Chapter

Cognitive Behavioral Treatment of Anxiety in Children and Adolescents with ASD

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Abstract

Children and adolescents with a neurodevelopmental disorder experience vulnerabilities and coping deficits that contribute to the likelihood of developing co-occurring anxiety disorders. The development of anxiety disorders, including social anxiety disorder, is very often reported in children and adolescents with autism spectrum disorder (ASD). Cognitive behavior therapy (CBT) has strong evidentiary support both in combination with medication and as a stand-alone treatment for anxiety disorders in general and more specifically for phobic-type anxiety in children, adolescents, and adults. Moreover, specific manualized CBT is an evidentiarily sound method for treating anxiety in children and adolescents with ASD.

Keywords: ASD, autism, autism spectrum disorder, anxiety, social anxiety, cognitive behavior therapy, computer facilitated CBT, CBT, cCBT

1. Introduction

Individuals with autism spectrum disorders (ASD) have increased vulnerability to the development of other co-occurring neuropsychiatric disorders, including both neurodevelopmental disorders such as attention deficit disorder (ADD), intellectual disability, developmental coordination disorder, and learning disability, as well as other neuropsychiatric and medical disorders such as Gilles de la Tourette's disorder, epilepsy, depressive disorders, and anxiety disorders. We use the term co-occurring instead of comorbid, where the latter term suggests some common etiological relationship with ASD. Such potential for comorbidity does seem probable for some of the disorders that do co-occur such as Tourette's syndrome or ADD, presumably due to abnormalities of systems used in the regulation of dopamine, but to date, all that is really known remains hypothetical about such relationships. It is also reasonable to conclude that when a child begins to develop ASD, for which there is overwhelming evidence of neuropathologic, neuropathophysiologic, and substantial genetic influence on etiology, the evident symptoms used to diagnose the disorder are well preceded by the atypical development of the brain. It is also reasonable to conclude that such differences in brain development lead to secondary consequences on various

brain functions early in development involving attention, perception, the ability to construct social-communication schemes, and the exercise of effective executive control for goal-oriented behavior. The dysfunction of these secondary consequences then leads to vulnerability in basic learning, the development and ability to engage in reciprocal social relationships, the cognitive flexibility to develop effective adaptations to internal and external stress, increased conflict with the environment, and more unsuccessful efforts to receive positive rewards. Additive vulnerabilities increase the potential for a substantial degree of anxiety in children and adolescents with ASD [1–4]. Specifically, it has been reported that nearly 40% of children and adolescents with a diagnosis of ASD meet clinical criteria for at least one co-morbid anxiety disorder [5], and those with high-functioning ASD experience more anxiety than those with ASD and accompanying intellectual impairment [6, 7].

While it is beyond the scope of this chapter to review the various vulnerabilities or relationship among vulnerabilities of persons with ASD to the potential development of anxiety disorders, there is recent evidence that different patterns of functional connectivity may be associated with persons who have ASD with and without co-occurring anxiety [8]. In a resting state functional magnetic resonance study comparing matched samples of persons with ASD with and without anxiety to non-ASD controls, they reported different patterns of functional connectivity in brain regions previously identified in persons with anxiety disorders [9, 10]. Findings suggest comorbid anxiety in ASD may be associated with disrupted emotion monitoring processes supported by amygdala-dorsal anterior cingulate cortex/medial prefrontal cortical pathways [8] Such findings would be favorable to the idea of a comorbid versus co-occurring relationship between the association of ASD and anxiety. Notwithstanding such evidence of comorbidity, a finding that could eventually lead to interventions related to core etiology, this chapter will focus on current evidence-based behavioral interventions for children and particularly children with ASD.

However, it is also worth discussing the nature of anxiety vis-à-vis the development of anxiety disorders. Anxiety disorders are defined in various ways, but generally through consensus opinion involving experts. These experts agree on various symptoms necessary to meet the criteria for some specific anxiety disorder (e.g., social anxiety disorder, generalized anxiety disorder, separation anxiety disorder, etc.) and once some consensus is reached by a professional association those symptoms along with some other considerations such as the duration of symptoms becomes the diagnosis, at least for some period of time until a new revision is made. Alternative methods employ such criteria in developing questionnaires which, when developed properly, generally have better reliability and validity than the original symptom-based classification. Thus, different types of anxiety can be assessed using psychometric measurements. This is generally required if one was to conduct research about anxiety or assess and measure anxiety in some formal way over time.

However, anxiety can also be considered a dimensional symptom that cuts across many types of psychological conditions that lead to human suffering. People experience anxiety to situational stress, threat, trauma, and uncertainty. Anxiety can be triggered by various medications, substances, medical conditions, and even the onset of other psychiatric symptoms such as hallucinations or delusions. So, the unwanted conditions that lead to anxiety are experienced by most humans from time to time throughout their lifespan. However, it is clear that we evolved as a species to have the potential to experience anxiety not as an evolutionary goal to increase our vulnerability to anxiety disorders but to enhance the potential that we could survive long enough to get our genes in the gene pool. Most psychologists and psychiatrists would, in fact, argue that

some anxiety is not only beneficial for survival but that in the right doses can improve motivation and serve as a signal or discriminant stimulus to evoke an adaptive coping response when a person is under such stress or threat. Consequently, our goal in the behavioral treatment of anxiety disorders is to help the individual normalize and better tolerate their response to anxiety, and in particular, to learn more effective coping strategies that lessen the overreliance on avoidant coping and increase the potential for more problem-solving coping and interpersonal problem-solving coping.

2. Prevalence of childhood anxiety disorders

The Centers for Disease Control reports the prevalence of anxiety disorders among children and adolescents to be 9.4% (https://www.cdc.gov/childrensmentalhealth/data.html). Mohatt et al. [11] reported that children and adolescents are often diagnosed with separation, generalized, and social anxiety disorders. The chapter sections will detail: (a) anxiety disorders in youth, (b) co-occurring anxiety in youth with ASD, (c) treatment for anxiety in youth populations, (d) CBT for youth with ASD, (e) CBT for youth with ASD and co-occurring anxiety, (f) computerized CBT for the treatment of anxiety, (g) computer-assisted models of treatment for youth, and (h) computer-assisted CBT for the treatment of anxiety in youth with ASD and co-occurring anxiety. The final section of the literature review will be the summary and conclusion.

3. Anxiety disorders in youth

The Diagnostic and Statistical manual of Mental Disorders (5th ed.; DSM-5; American Psychiatric Associated [12]) stated that pathological anxiety, across ages, may be described by persistent or extensive degrees of anxiety and avoidance associated with subjective distress or impairment. However, when it comes to children, normal and pathological anxiety can sometimes be hard to distinguish [13]. Oddly, the high rates of symptoms of anxiety disorders in children and adolescents may itself be responsible for this diagnostic difficulty. Because of its commonality within the community, with some portion of anxiety during childhood and adolescence deemed developmentally appropriate, clinicians may pay less attention to the issue and overlook clinically significant symptoms of the disorder [13]. Usually, children manifest various types of fears and anxieties in their normal course of development and these fears and anxieties are difficult to immediately characterize as pathological [14–16]. This makes distress an unreliable and inadequate criterion for establishing that children are experiencing pathological anxiety. This problem forms unique dilemmas when one attempts to distinguish among normal, subclinical, and pathological anxiety states in children. Beesdo et al. [17] claimed that children at younger ages might face problems with communicating cognition, emotions, and avoidance, as well as the associated distress and impairments to their parents, doctors, and diagnostic clinicians. This creates a new host of problems for detecting childhood anxiety disorders.

According to Beesdo et al. [17], it is during childhood and adolescence when anxiety symptoms and syndromes usually first materialize. In fact, childhood and adolescence are considered the core risk phases for individuals to develop anxiety-related illnesses, ranging from mild symptoms to significantly interfering anxiety disorders.

The nature of clinically-significant anxiety disorders as a whole almost guarantees that the individual, regardless of age, will have significant and negative impacts on

their social and personal development, causing marked impairment of family life, academic achievement, and relationships with peers [18–20]. Because of poor social functioning, anxious youth tend to have fewer friends and less social support during childhood and adolescence, and experience victimization in many arenas [19]. Anxiety disorders in childhood and adolescence are not only extremely common but the resultant distress of living with both the symptoms and the functional consequences of the disorder are associated with lifelong psychiatric disturbance [21].

Prevalence of childhood anxiety disorders has been reported between 2.6 and 41.2% [22]. Children and adolescents are most commonly diagnosed with separation anxiety disorder (SAD), generalized anxiety disorder (GAD), and social phobia (SoP) [11]. Childhood anxiety disorders usually persist into adulthood, making children at risk of having psychiatric disorders in the future [17]. Anxiety disorders among children are linked to considerable developmental, psychosocial, and psychopathological complications.

4. Co-occurring anxiety in youth with ASD

ASD is a neurodevelopmental disorder that is multifaceted. Individuals with ASD evidence persistent deficits in social communication and social interaction across multiple contexts and restricted, repetitive patterns of behavior, interests, or activities [12]. In addition to the core deficits, individuals with ASD also struggle with many co-occurring features. Among children with ASD, it is estimated from 57.5% to 96.4% meet the criteria for at least one co-occurring psychiatric disorder [3, 23, 24]. The most recent United States Centers for Disease Control (CDC) report on prevalence rates of ASD suggested approximately one per 44 children (of 8-year-olds when the diagnosis can be reliably assessed, https://www.cdc.gov/ncbddd/autism/addm.html). This is an increase from an estimate of one per 68 children receiving an ASD classification by the CDC I 2014 [25].

5. Prevalence of co-occurring anxiety in youth with ASD

Children with ASD have been found to have higher rates of internalizing disorders compared to typically developing children or children with other primary diagnosis such as attention deficit hyperactivity disorder (ADHD) or conduct disorder [24, 26, 27]. Internalizing disorders are comprised of behaviors and emotions that are directed inwards and include mood disorders and anxiety disorders. Leo Kanner [28] first described infantile autism and noted common features among his cases were anxiety-related features. For example, Kanner [28] reported the insistence of sameness or repetitive behaviors were observed across cases. He wrote:

> *The child's behavior is governed by an anxiously obsessive desire for the maintenance of sameness that nobody but the child himself may disrupt... Changes of routine, of furniture arrangement, of a pattern, of the order in which every day acts are carried out, can drive him to despair. (p. 245)*

Current literature on anxiety in youth with ASD primarily focuses on individuals with HFA and AS [2, 4, 24, 29]. It has been estimated that nearly 40% of children and adolescents with a diagnosis of ASD meet clinical criteria for at least one co-occurring anxiety disorder [5]. Systematic reviews of the literature investigating the

prevalence of anxiety in children and adolescents with ASD have been conducted [5–7, 30]. White et al. [6, 7] reviewed 40 publications. Of the 40 identified, 11 studies specifically examined the prevalence and reported rates of anxiety ranging between 11% and 84% in a population age range of 2–20 year-olds. In the review, only two studies were identified as reporting the prevalence of anxiety symptoms that met diagnostic criteria [1, 31], versus reports of clinical impairment or anxiety symptoms. MacNeil et al. [30] reviewed 13 studies with an age range of 2–19 years old. The mean prevalence rating of anxiety was neither scored nor reported due to the small number of identified studies and variation in outcome variables. It was concluded, however, across studies the findings were comparable in that youth with ASD experience increased levels of anxious symptomology that varied across types of anxiety [30]. van Steensel et al. [5] used a meta-analytic technique to review 31 studies. The review aimed to examine which of the primary anxiety diagnosis identified in the Diagnostic Statistical Manual (4th ed., text rev.; DSM-IV-TR; American Psychiatric Association [32]), occurs most in the ASD youth population. The researchers identified 10 additional studies that had been published since White et al. [6, 7] and MacNeil et al. [30]. Van Steensel et al. [5] reported across studies, a mean of 39.6% of children and adolescents with ASD meet the criteria for at least one co-occurring anxiety disorder according to DSM-IV diagnostic criteria. The meta-analysis of each specific anxiety disorder revealed the most frequently observed anxiety disorder in the ASD population less than 18 years of age, was specific phobia (SP) (29.8%). Furthermore, commonly occurring anxiety disorders also included obsessive-compulsive disorder (OCD) (17.4%) and SoP (16.6%) [5]. The prevalence rates of specific co-occurring disorders have differed by study. Researchers have also reported prevalence rates as follows: SP (8.5–44.3%), OCD (6.4–37%), SoP (7.4–29.2%), agoraphobia (6.4–7.9%), SAD (0.5–12%), GAD (2.4–13.4%), and panic disorder (1.1–10.1%) [1, 3, 31].

5.1. Models of anxiety in youth with ASD

Anxiety in children with ASD differs from anxiety in neuro-typical children due to behavioral manifestations and routine rigidity [33, 34]. Thus, the severity and typology of maladaptive behaviors exhibited by individuals with ASD in response to phobias and fears compound the difficulty of treating individuals with ASD compared to other groups [35]. Making diagnosis even more difficult is the fact that the presentation of anxiety is often atypical for youth with ASD relative to the DSM diagnostic criteria of said disorders [36]. As noted by Lecavalier et al. [37], the difficulty in diagnosing anxiety disorders in children and adolescents with ASD may stem from the fact that some maladaptive behaviors intrinsic to the diagnosis of ASD can make it unclear if such behaviors are the result of anxiety or are simply ASD related. For example, social avoidance is a factor in the diagnosis of children with social anxiety although it is intrinsic to the ASD diagnosis. Children with ASD are also likely to protest separation from caretakers, a behavior that, in a neuro-typical child might lead to a diagnosis of separation anxiety. Other common behaviors observed in youth with ASD relate to key features of anxiety disorders, such as the diagnostic criteria for sleep disturbance and simple phobia [37].

It is apparent that multiple factors impact the co-occurring nature of anxiety in youth with ASD. Common factors represented in the literature include: level of cognitive functioning or ability, age, and as previously stated, level of functioning on the autism spectrum as related to subgroups, and specific deficits or the presence of highly interfering behaviors [15, 16, 38–41].

5.2 Assessment of anxiety disorders in ASD population

The variability in prevalence rates of anxiety in youth with ASD can be attributed to a number of factors. Specifically, variations in assessment procedures and tools can produce differing prevalence estimates [42–44]. Also, core features of ASD overlap with diagnostic markers of anxiety that make it difficult for clinicians to determine if the anxiety symptoms are functioning independently of an ASD diagnosis [45]. Overall, psychometric assessment of measures used to identify co-occurring or comorbid disorders in ASD youth is lacking and greatly needed [46]. For these reasons it is important that a multimodal approach be used when assessing anxiety disorders in ASD youth [44].

Grondhuis and Aman [47] conducted a comprehensive review of the recent literature (2000–2011) specifically focusing on the assessment of anxiety in children and adolescents with ASD. The authors identified the most commonly used assessment tools and provided information on each of their strengths and weaknesses (see [47]). Ultimately, a total of 10 scales were identified as being the most commonly used tools to assess anxiety in ASD youth; Autism Comorbidity Interview—Present and Lifetime Version (ACI-PL), Anxiety Disorders Interview Schedule —Child and Parent reports ADIS-C/P, Autism Spectrum Disorders—Comorbid for Children (ASD-CC), Baby and Infant Scale for Children with Autistic Traits (BUSCUIT), Behavioral Assessment System for Children-2 (BASC-D), Child Behavior Checklist (CBCL), Child Symptom Inventory (CSI), Multidimensional Anxiety Scale for Children—child and parent report (MASC-C/P), Social Anxiety Scale for Children—Revised (SASC-R), and Spence Child Anxiety Scale—child and parent report (SCAS-C/P). Of the 10 instruments, only four (ACI-PL, ADIS, MASC, and SCAS) capture four or more dimensions of anxiety, whereas the remaining are limited in their ability to obtain a broader range of anxiety symptoms [47].

Given the complexities in assessing an internalizing disorder such as anxiety in youth with ASD, when selecting assessment measures, particularly a self-report measure, the individual's developmental level should be a key consideration [48]. When monitoring progress over time, the utility of multiple methods is necessary as children with ASD may have difficulty recognizing the change in their own behavior and typically report inconsistently with informant reports [48].

5.3 Impact of co-occurring anxiety on youth with ASD

The presence of anxiety in youth with HFA often exacerbates the deficits in social interactions and contributes to secondary behavioral difficulties [44]. A study by Eussen et al. [49] showed that lower quality social relations and lowered symptoms in children with high-functioning ASD led to higher levels of anxiety. The participants in the study were 134 school-aged children with ASD with and without a diagnosed anxiety disorder. The researchers discovered a positive relationship between low quality social relations, HFA, and high anxiety levels. The researchers reported that intelligence had no impact on the severity of anxiety symptoms. The authors ultimately suggested that future therapeutic interventions include the improvement of social relations as a goal in order to reduce levels or severity of anxiety in high-functioning children with ASD who demonstrate low social relation skills [49].

Individuals with ASD have difficulty in the area of social interaction, and often have difficulty engaging with others in a meaningful and developmentally appropriate manner. Their significant impairment in reciprocal social communication skills and high levels of anxiety with avoidant symptoms and atypical behaviors add an

additional barrier to successful social functioning. Consequently, those with ASD may experience even more isolation from their neuro-typically developing peers [49–51].

In their study, Chang et al. [50] examined the link between anxiety and the degree of social functioning impairment in children with ASD. A total of 53 participants presented with a diagnosis of ASD and at least one anxiety disorder. SoP was the most prevalent disorder among the participants and according to the authors, the most problematic. If left untreated, SoP could extend through adolescence and into adulthood, impairing the development and maintenance of close relationships [50]. Although high-functioning children with ASD often have average cognitive abilities, their social impairment impedes their ability to interact with others. The study participants ranged in age from 7- to 11 years old and took a research evaluation to determine their levels of anxiety as well as depression and other disorders. They showed that SoP might have a greater negative functional impact than other types of anxiety on children with ASD. The researchers suggested CBT for children with ASD who are high functioning, noting that children without comorbid intellectual disabilities would make more progress through direct instruction [50].

6. Treatment for Anxiety in youth populations

The field of child psychology is faced with the critical issue of how to effectively treat and remediate the cognitive, behavioral, and emotional difficulties that are causing distress and psychopathology in childhood [52]. Before research being explicitly conducted with child participants, much of the framework for treating anxiety disorders in youth was derived from research with adult populations [53]. Currently, the most empirically supported modality of intervention for treating child anxiety disorders is CBT [54, 55]. CBT is an educational model that has been widely used to treat depressive and anxiety disorders [56]. The six central components of CBT include: (1) psychoeducation, (2) somatic management, (3) cognitive restructuring, (4) problem solving, (5) exposure, and (6) relapse prevention [57].

A primary goal of CBT for anxiety is to help the individual learn to recognize arousal and to use these signs as cues to implement anxiety-management strategies [58]. Psychoeducation provides information about common symptoms or problems associated with the individual's chief complaint [59]. Somatic management assists with further developing awareness and control over physiological and muscular reactions to anxiety. Typically, the individual is taught relaxation strategies such as deep breathing or progressive muscle relaxation. The exercises are intended to be utilized throughout the treatment protocol, initially requiring facilitation by a therapist, and eventually are performed independently by the individual. Cognitive restructuring teaches the individual to identify and modify any anxious self-talk in their internal dialog [60]. Problem-solving skills are taught to improve the client's ability to address concerns related to their condition. Problem-solving techniques are used to cope with anxiety symptoms. The individual learns that after recognizing and identifying the problem, they can then utilize learned techniques to manage their anxiety, weigh the consequences of each alternative, and ultimately choose and follow through with a plan [60]. Exposure provides systematic and controlled exposure to stimuli that have provoked anxiety in the past. Exposure tasks can be facilitated in session with the individual and therapist and can also be completed independently and documented as part of homework assignments. Exposure tasks allow the individual to practice skills, strategies, and problem-solving techniques in relevant contexts [60]. Relapse

prevention is the final component to CBT and can be taught in a variety of ways. For children, it is often most beneficial to teach relapse prevention strategies with reinforcement and self-evaluation [61]. For example, a therapist might teach a child to judge the effectiveness of his/her efforts and reward him/herself accordingly. Relapse prevention strategies are taught to increase the repertoire of appropriate behaviors and responses of the individual [58]. By judging the effectiveness of their efforts, a child can learn to identify the favorable aspects of how he/she handled a situation as well as those things they may want to do differently [61].

6.1. Effectiveness of CBT in treating childhood anxiety

Currently, the first-line intervention for treating anxiety disorders in youth is CBT. Both group and individual CBT are considered efficacious interventions [62, 63]. Stuhlmiller and Tolchard [64] considered CBT to be the most effective nonpharmacological treatment for anxiety disorders. These and other positive results of CBT for treating childhood anxiety and other childhood disorders have led to an increase in demand for CBT interventions in this age group [62]. Kendall et al. [65] noted that approximately 60–65% of youth with anxiety disorders treated with CBT show an immediate and meaningful reduction in anxiety symptoms following treatment. Additionally, Donovan and March [66] note that 65–85% of children and youth no longer meet the criteria for diagnosis of their primary anxiety disorder after completing CBT.

Kendall [67] conducted the first RCT to investigate the effectiveness of CBT for children diagnosed with an anxiety disorder. Kendall [67] randomized 47 children aged 9–13 years with anxiety disorders (SAD, GAD, and SoP) to either an active treatment CBT group (n = 27) or a wait-list control group (n = 20). Diagnoses were determined using the ADIS-C/P [68]. For the treatment condition, the Coping Cat Workbook [67] was utilized for treatment procedures and the children utilized The Coping Cat Notebook to complete homework tasks. The individual therapy sessions occurred once a week for approximately 17 weeks and included education and facilitation of behavioral strategies to assist the child in (a) recognizing anxious feelings and somatic reactions to anxiety, (b) clarifying cognition in anxiety-provoking situations, (c) developing a plan to help cope with the situation, and (d) evaluating performance and administering self-reinforcement as appropriate.

For treatment outcomes, Kendall [67] utilized a 2 × 2 mixed factorial analysis of variance and the results revealed positive treatment outcomes for the active treatment of CBT condition. Children in the treatment condition demonstrated significant improvement from pre- to post-treatment on measures of self- and parent-reported distress and coping abilities, observation of anxious child behaviors, and overall diagnostic classification. Post-treatment 64% of participants in the treatment condition no longer qualified for an anxiety disorder diagnosis whereas only 5% of the participants in the wait-list condition did not qualify for an anxiety disorder diagnosis at the end of the waitlist period. These findings support the use of the Coping Cat protocol for the treatment of children with anxiety disorders [67]. Since the initial publication of evidence for the effectiveness of The Coping Cat treatment protocol in treating anxiety in youth, researchers have replicated results [67] with a variety of children with regards to ethnicity, gender [69] and cultures [70, 71]. Furthermore, long-term treatment gains have been demonstrated after 2 years post-completion of treatment [61].

Glenn et al.'s [72] study of CBT sought to determine the impact of treatment frequency and intensity and the extent of patient engagement on outcomes of CBT used in the treatment of anxiety disorders. The study sample consisted of 439 patients who

voluntarily chose CBT as a treatment modality. The researchers compared high and low treatment dosage and high and low patient engagement and compared it to predictors of 12 and 18-month outcomes for patients who took part in a randomized controlled trial of the coordinated anxiety learning and management intervention and received CBT treatment for anxiety with and without medication in primary care settings. Data collected by the authors during and after treatment, determined that high attendance and completion of homework assignments predicted better outcomes across measures at both 12 and 18 months, and high commitment to CBT predicted high outcomes for all measures at the 18-month mark. Thus, the study suggested that high treatment dosage and high engagement in CBT for anxiety disorders could predict more considerable reductions in the symptoms of anxiety and depression. The study implied that the more engaged the client is in the intervention, and the more CBT they receive, the bigger the reductions of anxiety and depression symptomology.

Because anxiety disorders in childhood are among the most prevalent, financially burdensome, and psychologically distressing of childhood psychiatric disorders, the need for efficacious treatment protocols is a societal imperative [73]. In the results of Erford et al.'s [73] meta-analysis, the authors determined that by themselves, face-to-face counseling, medication, and psychotherapy have only a small to medium effect on the treatment of anxiety in children. However, after the thorough analysis of 80 clinical trials of CBT used with children and adolescents, they determined that both individual and group CBT was the most efficacious in the treatment of anxiety disorders in this population. The study researchers also found that long-term counseling/psychotherapy treatment had long-lasting positive effects beyond the treatment for anxiety and SP but acknowledged the need for research to fill the gap regarding the long-term effects of such therapeutic interventions. The use of CBT as an effective treatment for child and adolescent anxiety disorders within the typically developing population has become the first-line intervention for its effectiveness and overall positive impact on reducing symptom severity and improving global functioning [74].

7. The application of CBT for youth with ASD

The use of behavioral modification techniques is not new to the treatment of autism spectrum disorder, as theoretically-related applied behavioral analysis interventions have been successfully helping to reduce the maladaptive behaviors associated with the disorder [75]. There is now a body of literature that suggests CBT can be an effective intervention for youth and adults with ASD, but with considerations that still need to be resolved such as small to medium effect sizes, effect sizes that vary by measures used to assess the outcome, outcome measures assessed by self-report that may be biased toward small or non-significant effect sizes, and relatively small sample trials [76]. Moreover, CBT has been applied to persons with high-functioning autism (HFA) and Asperger syndrome (AS) who have sufficiently developed language and cognitive skills which, are heavily relied upon to successfully engage in CBT. Specifically, the ability to identify and understand emotions and cognitions in oneself and others, referred to as the theory of mind [77], are necessary to utilize tasks and strategies taught in CBT. These abilities are often core challenges for children with ASD [77] however, children with HFA and AS have been found to be similar in their abilities to perform theory of mind tasks when compared to typically developing children [78].

Hare [79] published the first study employing CBT methods to treat co-occurring symptoms in ASD. In a single case study, Hare [79] utilized CBT to treat depression and self-harm in a 26-year-old man with AS. Subject "B," had previously been diagnosed with schizophrenia, but at the time of the referral for treatment, he exhibited no psychotic symptoms nor was he taking anti-psychotic medication. B was diagnosed with AS in primary school, however, no practical help or interventions were received. B's intellectual abilities were reported in the low normal range at the ninth percentile level. B's speech was limited as was his nonverbal communication. His verbal comprehension, short-term, as long-term memory were reported as well developed and assessed by observation and psychometric assessment. Furthermore, B was reported to have adequate literacy skills. B was administered the Beck Depression Inventory (BDI) and obtained a score of 29, indicative of severe depression. At the time of referral, chief complaints and behaviors causing the most concern were self-harm in the form of cutting his forearms with broken glass and excessive drinking while alone. A clinical interview revealed B's self-harm behaviors were often preceded by negative thoughts and verbalized dysfunctional assumptions such as 'life says you should have a girlfriend' and that he had 'been dealt a bad hand' [79].

A treatment plan was individualized and consisted of 10 weekly, 30–60 minute sessions followed by five biweekly sessions. Therapy goals were elicited at the beginning of the intervention session and included the client being able to "make up his mind, to express his feelings, and not to be nervous with women and in social situations in general" ([79], p. 221). B completed a BDI before each session and the material for each session was based on his pattern of responding to the inventory [79]. B kept a diary during treatment and his retrospective entries were also built into the framework of each session's materials. B's diary entries were written in a naturalistic manner. Adaptations were made from the usual CBT protocol to individualize treatment for B. For example, the intervention method was chosen due to B's difficulty with face-to-face communication and sustained dialog and his interest in using numbers to describe his emotional state [79]. Additionally, B's key care worker was present throughout all of the sessions, and was encouraged to take on a co-therapists role.

Therapy consisted of drawing connections between B's actions and thoughts and the negative emotional states that preceded them. Dysfunctional assumptions were identified and challenged. B was instructed to state evidence for a particular belief and identified alternative ways to construct an event or situation. Through this approach, B was able to find accurate and appropriate sources of information upon which to base his emotional state. Lastly, B was introduced to alternative and non-injurious behaviors to cope with emotional discomforts such as anger and frustration. Journaling thoughts, exercise, distraction, and relaxation techniques were used as coping skills and alternatives to self-injurious behaviors [79].

The outcome of treatment for B was assessed in the following ways: BDI score, observation of self-harm behavior, and attainment of therapeutic goals [79]. Outcomes were assessed pre-treatment, throughout the course of treatment, and post-treatment. B's BDI scores evidenced significant stable reduction following the initial 6 weeks of the intervention. B's initial score of 29 on the BDI decreased to 13 at the end of the treatment stage. At 6 months post-treatment, B's BDI scores had slightly increased to 19, and at 8 months post-treatment, he scored 20 on the measure of depression. B's outcome results suggested his depression had improved at the final stage of treatment, then worsened following the end of the intervention phase, however, not to its pre-treatment level [79]. With regard to B's therapy goals, he had achieved two of his three stated therapy goals: being able to make up his mind

(e.g., was able to make decisions related to looking for adult education classes) and being able to express his feelings (e.g., began to use writing to express his feelings and communicate with others). B did not meet his therapy goal of reducing social anxiety with females, as he was not able to generalize skills learned and practiced in the therapy session to real-life situations. In Hare [79], results suggested that the use of a CBT approach with the AS population could be useful. The findings paved the way for additional research examining the utility of CBT methods with the ASD population.

Since the publication of Hare [79], the use of CBT principles as effective interventions for youth with ASD has continued to be extensively examined. An intervention titled Program for the Education and Enrichment of Relationship Skills (PEERS) is an evidenced-based social skills program that utilizes the teaching methods of traditional CBT to teach social skills to adolescents with ASD and other social challenges [80]. The CBT treatment program has been examined through multiple clinical trials and reported to be effective in improving the social outcomes in youth with ASD [81–83].

The use of CBT, often with modifications, helps to make the modality more effective for use with this population [84]. The majority of studies employing CBT methods with the ASD population have been conducted with modifications [48]. Wood et al. [85] suggested using hands-on activities or visual aids to assist with facilitating concrete discussions and clarifying the lesson. Cardaciotto and Herbert [86] modified a CBT protocol to treat SoP by adding a social skills training component to the treatment. The modification Were done in the single case design to target the client's impairments in verbal, non-verbal, and paralinguistic communications. Assessment of SoP on outcome measures administered throughout treatment revealed a steady decline in SoP severity. Cardaciotto and Herbert [86] concluded that at the end of treatment the client no longer met diagnostic criteria for symptoms related to SoP.

Ames and Weiss [87] focused their study on the modifications necessary to treat anxiety in a child with ASD, aggression, and mild intellectual impairment with traditional CBT. CBT is the primary treatment for typically developing children and high-functioning children with ASD with anxiety and mood disorders. The study was qualitative and used one participant in a case-study format. The modifications necessary related to the participant's diagnosis of ASD, and included the use of visual aids, decreased verbal commands, role-play, the inclusion of special interests, visual social stories, direct parental participation, and physical play activities. The researchers determined that the use of modifications was useful in the treatment of ASD children, but acknowledged the lack of quantitative support for the modifications as the gains noted were anecdotal in nature. Although largely identified as an effective treatment for youth with ASD and co-occurring psychiatric or behavioral issues, researchers suggest that continued research is necessary to further strengthen the support that CBT is an efficacious modality for the population [88, 89].

8. CBT for youth with ASD and co-occurring anxiety

In the past decade, CBT has steadily emerged in the literature as an efficacious treatment modality for youth with ASD and co-occurring anxiety [85, 88, 90–92]. Across the current literature, positive outcomes are consistently reported, providing mounting evidence for CBT as an effective treatment modality for anxiety in individuals with ASD [85, 88, 90, 93–100].

Sofronoff et al. [90] published the first account of utilizing an RCT of a CBT intervention for anxiety in youth with AS. The study aimed to answer two primary questions,

"whether a brief CBT intervention for anxiety would effectively reduce symptomology in children diagnosed with AS" ([90], p. 1157) and "whether there would be a positive effect of parent involvement on children's use of the strategies and therefore an increase in effectiveness." ([90], p. 1157). The study consisted of 71 child participants with AS aged 10–12 years. The presence of anxiety symptomology was established via parent report and the SCAS-P was used to obtain baseline anxiety level. Participants were randomized to one of three intervention groups: CBT intervention 1 (child only), CBT intervention 2 (child + parent), or waitlist control. Within each intervention group, participants were matched on age, sex, baseline anxiety level, IQ, baseline level of depression measured by the Children's Depression Inventory (CDI), and baseline level of AS symptomology measured by the Childhood Asperger Syndrome Test (CAST).

There were eight CBT intervention 1 groups and nine CBT intervention 2 groups that were each comprised of three participants and two therapists. Parents from the CBT intervention 2 groups formed two parent groups and were trained by a therapist to work as co-therapists in all components of the intervention. The waitlist group completed CBT intervention 2 following their final waitlist assessment. Graduate student therapists provided the CBT intervention for all groups and they received ongoing supervision [90]. The intervention took place in a clinic setting and consisted of six weekly two-hour-long sessions. The first session included discussing happiness and relaxation, with activities to compare emotions in specific situations. Session two discussed the effects of anxiety and introduced the concept of a "tool box" to teach children various strategies to "fix" their negative emotions and anxiety. Session three focused on social and thinking tools, including cognitive restructuring techniques and how to get help from other people when feeling negative emotions or anxiety. In the fourth session, a "fear thermometer" was introduced to offer the children a visual aid in rating the level of anxiety in certain situations. Session five utilized social stories to teach emotion management strategies. Lastly, session six consisted of participants working together to create self-management plans.

Outcomes were measured by the SCAS-P, the Social Worries Questionnaire (SWQ), and a standardized observational measure of coping strategies generated by children called James and the Math Test. Assessment measures were completed at three time periods: Time 1 pre-treatment (baseline), Time 2 post-treatment, and Time 3 follow-up (6 weeks post-treatment). Scoring was completed by intervention-blind raters and yielded high inter-rater reliability (99%) [90].

The researchers used a series of repeated measures analyses of variance to compare parents' reports of child anxiety across time and between groups. Results from Sofronoff et al. [90] revealed significant reductions in parent-rated symptoms from Time 1 to Time 3 on both the total score and on all sub-scales of the SCAS-P and SWQ. Furthermore, James and the Math Test showed a significant increase in the number of adaptive coping strategies generated by each child to deal with anxiety-producing situations. There were also significant differences between the two CBT intervention groups, as measured by the SCAS-P, at Time 3 with the CBT intervention 2 group showing greater improvement, suggesting parent involvement in the program produced greater Outcome for the participants [90].

Overall, the results of this study demonstrated that CBT was effective in reducing symptoms in a child with AS [90]. The researchers reported that the CBT intervention was well accepted by the children and their parents. Some identified limitations of the study were focused on the nature of data collection. Outcome measures consisted of two parent report measures. As only parent report was utilized, parents may have expected their children to improve because of their participation in the program. The

authors suggested that future research collect data from multiple informant measures and that behavioral change be assessed as well [90].

McNally Keehn et al. [93] conducted the first study to examine the effectiveness of the Coping Cat program in reducing anxiety in children with ASD. The researchers conducted a randomized control trial including 22 children ages 8–14 years old. The participants included in the study achieved an IQ ≥ 70 and met diagnostic criteria for one or more principal anxiety disorders (GAD, SoP, SAD). Twelve participants were randomized to the CBT condition and 10 were randomized to the waitlist/control (WL) condition. The study utilized the ADIS-P [68] as the primary outcome measure and the SCAS-C/P [101] and MASC-C/P [102] as secondary outcome measures to assess for clinically significant anxiety.

Results of the data analysis showed that ratings for principal anxiety disorders in the CBT group dropped below the clinical cutoff (<4) at post-treatment as measured by the primary outcome measure [93]. Specifically, 58% of children in the CBT condition no longer met the criteria for their primary anxiety diagnosis at post-treatment assessment while 100% of children in the WL condition continued to meet the criteria for the principal anxiety diagnosis at post-WL assessment. Furthermore, 36% of the CBT condition participants remained free from meeting diagnostic criteria for their primary anxiety diagnosis at the two-month follow-up suggesting that treatment gains from the modified Coping Cat program were maintained. Given the positive findings from the research study, the authors suggest that a modified version of the Coping Cat program could be a possible first line of treatment for children with ASD and co-occurring anxiety [93].

In another 12-week trial comparing CBT to treatment as usual (TAU) in 45 children, ages 7–11, Storch et al. [103] reported significant improvement in anxiety symptoms. After randomization, children in the CBT group were given 16 sessions of manualized CBT that included psychoeducation, cognitive components, exposure, homework, and parent meetings employing the Behavior Interventions for Anxiety with Autism [104]. Eighteen of 24 children in the CBT group improved relative to 3 of 21 children in the TAU group. Gains were was maintained for most of the CBT group at 3 months. A total of 38% (9/24) of children in the CBT group achieved clinical remission at post-treatment versus 5% (1/21) of those in the TAU arm ($p < .01$).

This same team also reported positive results in an older cohort of children and adolescents ages 11–16 [105]. In a similar randomized trial comparing sixteen weekly, CBT sessions, 11 of 16 in the CBT group showed significant improvement compared to 4 of 15 in the TAU group based on blind ratings of symptoms taken at prescreening, posttreatment, and a 1-month follow-up. Moreover, gains were generally maintained at follow-up.

Wood et al. [104] examined the efficacy of CBT for use with youth diagnosed with ASD and comorbid anxiety. They used a modified version of a modular CBT program originally designed for preteens with ASD, called Behavioral Interventions for Anxiety in Children with Autism (BIACA) to treat early adolescents with ASD co-occurring anxiety. The study participants included 33 adolescents between the ages of 11 and 15, whom the researchers randomly assigned to attend 16 CBT sessions or to be placed in the waiting list control group. The CBT group experienced 79% symptom improvement at the end of the study as measured by the Clinical Global Impressions-Improvement scale, as compared with 28% of the waitlist group. Their findings provided additional support that CBT was an effective treatment for ASD youth who have clinically significant levels of co-occurring anxiety.

Wise et al. [99] completed a small open trial of a manualized CBT program on seven 16–20 year-olds with ASD to treat anxiety. Over their 16-week trials that

included psychoeducation, cognitive therapy, and exposure, significant improvement in anxiety was found on clinician-rated measures.

9. Computerized CBT for the treatment of anxiety.

Computerized CBT is a modern version of CBT developed to meet the needs of those who are diagnosed with or experience the symptoms of anxiety disorders and who, for a variety of reasons, do not use a therapist-guided CBT program. Barriers to treatment for anxiety include but are not limited to the accessibility of services, financial issues, lack of knowledge of appropriate services, and long waiting periods [106–108].

Andrews et al. [18] found that though treatment for anxiety has largely proved efficacious, low numbers of adults suffering from depression and anxiety actually seek therapeutic interventions. The researchers looked at the efficacy of the use of computer-based therapy for individuals with depression and anxiety. For their quantitative, retrospective cross-sectional study, the authors gathered 2670 abstracts on the subject of computer-based psychological treatment of depression, and anxiety disorders, calculated the effect size and determined the difference between the two conditions. Ultimately 22 studies were used in their analysis, and it was determined that even though the individuals had limited contact with a clinician, computerized CBT was a viable treatment for the disorders. When compared to face-to-face treatment, it offered the clients increased access to treatment, and had similar approval rates. Effect sizes obtained in the reviewed studies were substantial and the results indicated short-term and long-term benefits. The researchers concluded that computerized CBT is an efficacious and acceptable treatment [18].

A study by Amir and Taylor [109] noted that though GAD is a common and often debilitating disorder, many individuals who suffer from it do not seek or receive the most effective treatment. The quantitative research study included 21 participants who were seeking treatment for GAD and were willing to utilize a 6-week computerized home-based treatment program. The program contained two elements, an attention modification program (AMP) and a brief computer-delivered CBT module (cCBT). Of the 21 participants, 14 individuals, or 67% of participants, completed the program, and the treatment resulted in a clinically significant reduction in symptoms for program completers. The researchers reported considerably lower clinician and self-rated symptoms of GAD and 79% of the 14 study participants no longer met the DSM IV's criteria for GAD at the end of the program, with 36% classified as in remission.

Additionally, in their qualitative study, Barazzone et al. [110] found that computerized CBT programs build on certain features of the therapeutic alliance, such as the idea of empowerment, which helps to establish the therapeutic relationship and contribute to the achievement of positive mental health outcomes. Barazzone et al.'s [110] study used three online computerized CBT programs for depression to determine how well the therapeutic alliance was established and maintained electronically. The researchers analyzed data from the three computerized CBT programs using a deductive qualitative approach based on a matrix-based analytic method called framework analysis. The researchers looked for features within the three programs that could establish, develop, and maintain a therapeutic alliance. The study researchers determined that there was considerable evidence showing that the computerized therapy programs contained features associated with the establishment, development, and maintenance of the therapeutic alliance.

More recently, Bowler et al. [111] tested the prediction that computerized CBT and cognitive bias modification for interpretation (CBM-I) would reduce anxiety better than for a wait-list control group. The study participants were 63 mostly Caucasian adults who reported high levels of anxiety. Researchers randomly assigned participants to one of the three groups and obtained self-reported levels of anxiety, depression, attentional control, and threat-related interpretive bias at four time periods.

All participants, except those in the control group, reported clinically significant reductions in social and trait anxiety and depression levels.

Thus, combined studies reveal that computerized CBT is an efficacious and potentially cost-effective treatment for anxiety and depression when access to therapist-led, face-to-face cognitive behavioral therapy is limited [108, 110] (Lewis et al., 2012).

10. Computer-assisted models of treatment for youth

Multiple studies detailing the efficacy of using computerized CBT as a treatment for anxiety and depression in adults exist [18, 109–111]. There is also now a growing body of research focused on the efficacy of computerized CBT for use with youth ([66, 112–117].

Craske et al. [112] describe a computer-assisted CBT program designed to provide evidence-based treatment for the four types of anxiety disorders usually observed in primary care settings. These anxiety disorders are panic disorder, posttraumatic stress disorder, GAD, as well as SoP. The researchers described the structure and format of this CBT program and showed evidence of the program's effectiveness. They gathered 13 clinicians utilizing this program and interviewed them about their perceptions of the program. The researchers found that the clinicians using the program all had positive views and see it as very helpful to the youth with these disorders. The patients showed great commitment to attendance and homework compliance with this program. The patients also understood the program material better and even acquired CBT skills.

Moreover, the clinicians who used the program reported that improvements were seen across the four types of principal anxiety disorders. Patients diagnosed with these different disorders showed improvements to the same degree as one another when it came to their self-ratings of self-ratings of anxiety, depression, and expectations for improvement. The researchers concluded that computer-assisted CBT programs could enable an effective practice-based system for spreading evidence-based mental health treatment across primary care settings while making sure that there would be treatment fidelity even in the hands of novice clinicians [118].

Holmes et al. [119] also discussed the effectiveness of using computer-based interventions as possible alternatives to treating children dealing with anxiety disorders. The researchers designed the study after identifying the gap in the literature exploring the feasibility and efficacy of computer-delivered treatment of anxiety in child patients as opposed to the frequently-studied adult populations. The researchers found that the internet might be an effective way of delivering CBT targeting children suffering from anxiety disorders since it has reportedly been effective for adults [119]. Computerized CBT programs can be effective either as a stand-alone internet treatment or a combined clinic and internet program. The researchers, however, questioned whether a computerized program is better than a clinic-based treatment program, especially for children. The researchers claimed that as of now, firm conclusions on this cannot yet be drawn, although it seems that internet approaches may be acceptable and beneficial for a significant proportion of children dealing with anxiety disorders, with their parents being satisfied with the process and outcomes [119].

In 2008 Kendell and Khanna introduced CCAL: The Coping Cat CD Rom [120, 121]. Khanna and Kendall [122] evaluated the feasibility and acceptable effects of CCAL, a computer-assisted CBT intervention for anxiety in youth based on the Coping Cat program framework. The researchers randomly assigned 49 children, 33 of whom are males from ages 7 to 13 and of different ethnicities, to CCAL, individual CBT (ICBT), and a computer-assisted education, support, and attention (CESA) condition. All therapists came from the community or were Psy.D. or Ph.D. trainees, some of whom were trained, others untrained, in practicing CBT for child anxiety. The researchers conducted independent diagnostic interviews and self-report measures at pre- and post-treatment and 3-month follow-up. At post-treatment, the researchers found that children who went through the ICBT or CCAL showed greater improvement than the children who underwent CESA. In addition, these improvements were sustained at follow-up, with no significant differences between the children who underwent ICBT and children who underwent CCAL [122]. At the 3-month post-treatment follow-up, 70% of those treated with CCAL, 81% of those who used the ICBT program, and 19% of those using the CESA program no longer met the criteria for their anxiety disorder. The parents of the children all provided satisfactory ratings for the treatments. However, the CCAL and ICBT children provided higher satisfaction ratings than the CESA children. Khanna and Kendall [122] concluded that CCAL is feasible, acceptable, and beneficial for children dealing with anxiety. This research provided further support for the effectiveness of computer-assisted modalities in delivering empirically supported treatments.

Spence et al. [123] compared online versus clinical delivery of CBT to treat anxiety disorders in adolescents. This comparison has been the question of most researchers in computer-assisted CBT treatment. Even though the safety and benefits of computer-assisted CBT treatments for children have been established by several researchers, they could not draw a firm conclusion as to whether computer-assisted treatments are better than clinical treatments. Spence et al. [123] tried to close this research gap. To determine this, they gathered 115 clinically anxious adolescents aged 12–18 years and their parent(s). Adolescents were randomly assigned to online delivery of CBT, clinic-based delivery of CBT, or WL control conditions. Those in the treatment groups were given equivalent CBT content. The researchers conducted clinical diagnostic interviews and questionnaire assessments 12 weeks after baseline and at 6- and 12-month follow-ups. They found that both online delivery and clinic-based delivery of CBT treatments are beneficial. Children in these two delivery modes of CBT experienced greater reductions in anxiety diagnoses and anxiety symptoms compared with the WL control. These improvements were maintained or further enhanced for both conditions, with minimal differences between them, at 6- and 12-month follow-ups. Therefore, the researchers cannot say online delivery is better than clinic-based delivery. In particular, 78% of those who underwent the online delivery program no longer met the principal anxiety diagnosis criteria at the 12-month follow-up. Around 80.6% of the patients in the clinic-based delivery group experienced the same. This shows that the two types of CBT treatments offer no relatively different outcomes and that both are effective. Ratings of treatment credibility from both parents and adolescents were high for both types of programs. Satisfaction ratings by adolescents were equivalent for the two types of CBT treatments [123]. However, parents of children in the clinic-based delivery of CBT treatments are a bit more satisfied than those whose children underwent the online delivery model. Still, the researchers concluded that online delivery of CBT, even if children experienced minimal therapist support, is equally efficacious as clinic-based, face-to-face therapy in treating anxiety disorders among adolescents [123]. The online-based

treatment is also far more accessible [123]. This approach is an effective alternative for those who do not engage in face-to-face clinical treatment.

Blocher et al. [124] recognized that anxiety disorders are prevalent among children suffering from epilepsy and designed a study that would determine the efficacy, adaptability, and feasibility of a manual-based, computer-based CBT intervention for anxiety disorders in children with epilepsy. They gathered 15 children (aged 8–13 years) with epilepsy and dealing with anxiety disorder and asked them to complete 12 weeks of a manualized computer-assisted CBT. The children and their parents were interviewed at baseline with semi-structured questions. They were also asked to complete surveys before, during, and after treatment to determine their symptoms of anxiety, depression, and behavior problems. The researchers found that there were apparent reductions in symptoms experienced by the children in relation to anxiety and depression at the completion of the intervention and the 3-month follow-up. Aside from the children, the parents asserted that they observed fewer anxiety symptoms and a reduction in behavior problems. No adverse events were reported for any of the participants. The researchers, therefore, were able to conclude that computer-assisted CBT intervention for children with epilepsy and anxiety disorders is safe, effective, and feasible. They asked that this treatment form be included in future intervention studies dealing with children suffering from anxiety disorders.

A study by Donovan and March [66] determined the efficacy of a computerized CBT program for preschoolers with anxiety disorders. The computerized CBT program was parent-focused and therapist-assisted. The study authors required parents to complete a series of diagnostic interviews and parent-report questionnaires to determine the severity of anxiety symptoms of their combined 52 children ranging in age from 3 to 6-year-old. The researchers randomly placed the children into either the program group or informed them that they were on the waiting list, a group that then served as the control group. The parents participated in diagnostic interviews and filled out parent-report symptom severity questionnaires at the program's start and again after 6 months. Post-treatment assessments revealed that 39% of participants versus 25% of the control group showed significantly reduced symptoms at the end of the program. At the 6-month review, 70% of the preschoolers who had participated in the program group no longer had their initial anxiety disorder diagnosis. The results indicate that computerized CBT is efficacious for preschoolers with anxiety disorders.

Donovan et al. [106] detail how technology can decrease the barriers to treatment for children and adolescents, and study the benefits and weaknesses of using various computerized CBT programs to treat anxiety. Mentioned briefly was the efficacy of using a computer-based program for the treatment of adolescents with ASD. The study authors detailed a program called "BRAVE ONLINE," a computer-based CBT program for treating anxiety in children and adolescents. The program treats children aged 7–17 and has shown efficacy for both age groups. Although there is also a parent-based program for use with younger children, the results currently remain unpublished.

Ebert et al. [113] also studied the possibility of using computerized CBT treatments to alleviate the symptoms of anxiety and depression in children and adolescents. The researchers used data from 13 randomized trials that used 796 children and adolescents as participants to determine the effectiveness of symptom reduction when using computerized CBT programs to treat the symptoms of anxiety and depression in that population. They ultimately discovered that computerized CBT is an effective treatment modality relative to face-to-face treatment services for lessening anxiety and depression symptoms in young people up to age 25.

Researchers such as Vigerland et al. [116] suggested that most clinicians continue to lack the knowledge of or experience with the use of computerized CBT, even though computerized CBT has proven effective for treating anxiety in children and adolescents. In fact, many researchers believe that it should be the primary treatment for anxiety disorders in this age group [116]. In their 2014 study, Vigerland et al. [116] surveyed 156 mental health clinicians on their attitudes toward using computerized CBT to treat anxiety in children and adolescents. Although many clinicians (73%) viewed computerized CBT as an effective preventative measure, and 75% of the clinicians studied acknowledged its usefulness in the treatment of mild to moderate anxiety, most reported that they did not want computerized CBT to be freely accessible online. The mental health practitioners were reportedly concerned with the severity of symptoms, the age of the client, and the lack of human support during treatment. Thus, most clinicians wanted to see computerized CBT administered within a mental

Name of program and website	Ages	Facilitated support
Camp Cope-A-Lot https://www.workbookpublishing.com/camp-cope-a-lot.html	11–13	Professional and/or parent
SMARTCAT https://apps.apple.com/us/app/smartcat-3-0/id1511786912	7–13	Professional
Treasure Hunt https://www.treasurehunt.uzh.ch/en.html	9–13	Professional
BRAVE https://www.taptap.io/app/65756	8–12 9–13	Professional
Mayo Clinic Anxiety Coach https://anxietycoach.mayoclinic.org/anxiety/	Child/adol.	Self-help
REACH Patwardhan et al. [125]	9–11	Not specified
DARE	8–12	Therapist
https://apps.apple.com/us/app/dare-panic-anxiety-relief/id1034311206		
Cool Little Kids https://coollittlekids.org.au/login	3–6	Not specified
Pesky gNATs Island https://peskygnats.com/peskygnats/	9–17	Professional
Think, Feel, Do Stallard et al. [63]	11–16	Professional
Cool Teens Program https://www.c4tbh.org/program-review/cool-teens/	14–17	Professional
MoodGYM https://moodgym.com.au/	Not specified	Teacher
Unnamed; Tillfors [126]	Not specified	Professional
Kids-accident Cox et al. [127]	Not specified	Parents

Adapted from Tozzi et al. [115].

Table 1.
Current evidence-based computer facilitated applications for treating anxiety in children.

health or primary care facility to ensure the involvement of face-to-face interaction in combination with the computerized CBT interventions [116].

Tozzi et al. [115] completed a meta-analysis of 197 articles with 19 meeting criteria for review of acceptable technology with treatment and prevention programs for anxiety in children and adolescents. Fourteen technology-based CBT treatments were identified as meeting efficacy standards. Seven were appropriate for children and seven for adolescents. The programs they identified can be seen in **Table 1**.

Despite questions of accessibility, the use of computerized CBT is now a growing trend in the treatment of anxiety disorders for children, adolescents, and adults alike [128–130], but the use of computerized CBT for children and adolescents with co-occurring ASD is not as prevalent. Thus, future research will likely include the efficacy of computerized CBT for use in youth populations with ASD [131].

11. Computer-Assisted CBT for the treatment of anxiety in youth with ASD and co-occurring anxiety

Children and adolescents with ASD have unique needs regarding the treatment of their disorder, and in most cases, behavioral analysis interventions were the preferred treatment [75]. The success of behavioral interventions combined for the treatment of ASD, and cognitive behavioral interventions for the treatment of co-occurring anxiety disorders are largely unknown and represent a significant gap in the research. Although it is known that CBT is an effective treatment for use with youth with co-occurring anxiety disorders and ASD, future research needs to determine the efficacy of computer-assisted CBT for the treatment of this population [117, 132–135]. Zabel recently completed a dissertation at Philadelphia College of Osteopathic Medicine, Department of Psychology, investigating the efficacy of CCAL CD Rom for treating anxiety symptoms in children with ASD. The single case study revealed inconsistent results on the overall reduction of anxiety symptoms in the participants diagnosed with ASD. The study utilized a small sample (n = 4) with no control group. According to Zabel [135] the 12-week CCAL intervention was "generally successful in decreasing some symptoms of anxiety for each of the participants" (p. 111). However, results on outcome measures yielded no statistically significant changes in symptom severity and were inconsistent across scales, subscales, and participants. The variability observed across outcome data was attributed to participant heterogeneity and a small sample size. Although quantitative data analysis did not reveal a statistically significant change in the participants' self and parent report outcomes measures, the researcher discussed valued qualitative information obtained during the study. For example, Zabel [135] discussed overall parent-reported satisfaction with the intervention and observed improvement in the participant's ability to approach their fears as they progressed through the intervention. Results from this first-known study on the efficacy of CCAL in treating anxiety in children with ASD offered valuable limitations identified that will benefit researchers wishing to continue examining the potential efficacy of CCAL, an empirically supported intervention program in youth with co-occurring ASD. To date, no known studies investigating the efficacy of CCAL have been conducted utilizing a larger sample size or RCT design.

Most recently, our group [95] reported the results of a crossover design showing the efficacy of a computer-assisted intervention program for youth with ASD who also experience co-occurring anxiety. The computer-assisted cognitive behavior program, CCAL was compared to control intervention, another computer-assisted

program, The Social Express (TSE), that does not employ CBT nor is targeted for the treatment of anxiety. TSE is designed to improve social skills in youth with ASD. Participants had a principal anxiety disorder and a current diagnosis of ASD. Participants received 12 sessions of CCAL or 12 sessions of TSE. Outcome measures were obtained at intake, upon completion of the first intervention of the trial, and upon completion of the second intervention of the trial. CCAL was efficacious for treating anxiety. Participants who completed CCAL demonstrated significant clinical reductions in anxiety when compared to participants who completed TSE. The study obtained an NNT = 2.17 which is comparable or superior to those reported by pharmacological research examining evidence-based approaches to treating pediatric anxiety [136]. While a multi-modal treatment approach has been found most effective in treating anxiety in youth [136], there remains the potential for adverse events with psychopharmacological interventions. A small dropout rate for CCAL, and the intervention required minimal financial support interventions, CCAL and TSE, also both showed some limited improvement in social skills.

12. Conclusions

Anxiety is a frequent co-occurring condition in persons with ASD and particularly children and adolescents with ASD. During the past decade, multiple clinical trials have demonstrated significant evidence that CBT employed to treat anxiety in children and adolescents with ASD was generally effective and clearly constituted an evidence-based intervention treatment modality. Effect sizes, while significant, ranged from small to large depending on the study and particularly on outcome measures. Virtually all of the trials reported in this chapter were relatively small with treatment samples of less than 30 participants receiving CBT. This suggests the need for larger randomized trials.

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