Treatment of anxiety in autism spectrum disorders using cognitive behaviour therapy: A systematic review

Russell Lang, April Register, Stacy Lauderdale, Kristen Ashbaugh, & Anna Haring

Abstract
Objective: To review studies involving the treatment of anxiety in people with autism spectrum disorders (ASD) using Cognitive Behaviour Therapy (CBT) with the intent to inform practice and to identify areas for future research. *Methods:* Systematic searches of electronic databases, reference lists and journals identified nine studies. Each identified study that met pre-determined inclusion criteria was analysed and summarized in terms of: (a) participants, (b) intervention procedures, (c) dependent variables, (d) results of intervention and (e) certainty of evidence. To assess the certainty of evidence, each study's design and related methodological details were critically appraised.
Results: Positive outcomes were ubiquitous, suggesting CBT is an effective treatment for anxiety in individuals with Asperger's. However, data involving other ASD diagnostic sub-types is limited.
Conclusions: CBT has been modified for individuals with ASD by adding intervention components typically associated with applied behaviour analysis (e.g. systematic prompting and differential reinforcement). Future research involving a component analysis could potentially elucidate the mechanisms by which CBT reduces anxiety in individuals with ASD, ultimately leading to more efficient or effective interventions.

Keywords: *Cognitive behaviour therapy, Asperger's syndrome, autism, anxiety, systematic review, applied behaviour analysis*

Resumen
Objetivo: Revisar aquellos estudios que impliquen el tratamiento de la ansiedad en pacientes con trastornos del espectro autista (ASD) utilizando la terapia cognitiva conductual (CBT) con la intenci6n de informar la practica e identificar areas para futuras investigaciones.
Metodos: Se identificaron 9. estudios, mediante una busqueda sistematica en base de datos electr6nica, lista de referencias y publicaciones. Cada estudio identificado que cumplia con los criterios de inclusion predeterminados fue analizado y resumido en tcrminos de: (a) los participantes, (b) los procedimientos de intervenci6n, (c} las variables dependientes, (d) los resultados de la intervenci6n, y (e) la certeza de las pruebas. Para valorar la certeza de la evidencia, se evalu6 criticamente el disefto de cada estudio, y los detalles metodol6gicos relacionados.
Resultados: Se encontraron resultados positivos de manera general, lo que sugiere que la CBT es un tratamiento efectivo para la ansiedad enindividuos con sindrome de Asperger. **Sin** embargo, la informaci6n respecto a otros subtipos de **ASD** es aun limitada.
Conclusiones: La CBT se ha modificado para individuos con ASD agregando componentes de intervenci6n que normalmente se asocian al analisis de! comportamiento aplicado (por ejemplo, instigaci6n sistematica y reforzamiento diferencial). A travcs de futuros estudios qu involucren analisis de componentes, potencialmente se podria demostrar los mecanismos por cuales .la CBT disminuye la ansiedad en individuos con ASD, llevando finalmente a la aplicaci6n de intervenciones mas efectivas y eficientes.

Palabras clave: *Terapia cognitiva conductual, sindrome de Asperger, autismo, ansiedad, revision sistematica, analisis de comportamiento aplicado.*

Introduction

The term autism spectrum disorder **(ASD)** refers to a range of neurodevelopmental disorders that includes diagnoses of autism, Asperger's syndrome and pervasive developmental disorder not otherwise specified (PDD-NOS) [1,2). The defining features of ASD include impairments in social interaction, communication, imagination and an excess of repetitive body movements. These symptoms range in severity from mild to debilitating and usually persist throughout the lifespan (3).

Anxiety disorders are characterized by a disproportionate fear reaction to relatively benign environmental stimuli [1,4,5). Symptoms and behaviours related to anxiety are often thought to exacerbate the symptoms of ASD and have been shown to be positively correlated with increased behaviour problems and other life interferences [6]. The types of anxiety disorders experienced by individuals with ASD vary from common fears [7] to clinically significant anxiety disorders [8].

The prevalence of anxiety disorders within the ASD population has been examined in several studies. White et al. [8] reviewed 11 such studies and found the reported prevalence of anxiety disorders within the ASD population to range from 11-84%. The large range in prevalence data may be due to differences in definitions of anxiety, methods used to measure anxiety and in diagnostic sub-types (e.g. children with autism or children with Asperger's syndrome). For example, Weisbrot et al. [9] evaluated a total sample of 809 children and found that severity of anxiety symptoms varied by diagnostic sub-type, with more severe anxiety occurring in children with Asperger's syndrome, followed by **PDD-NOS** and then autism.

Several studies have compared prevalence of anxiety within the ASD population to prevalence within other populations. For example, the occurrence of anxiety within groups of children with autism has been found to be higher than groups of typical developing children [10,11]. Even when compared to other at risk groups (i.e. children with conduct disorders and learning disabilities), children with ASD were significantly more likely to be diagnosed with an anxiety disorder and/or to have more intense anxiety symptoms (12,13].

Despite high prevalence . and negative impact on quality-of-life, very few intervention strategies to treat anxiety within the ASD population have been evaluated (4,8). Cognitive Behaviour Therapy (CBT) is a form of psychotherapy originally developed for treatment of depression in the general population (14). The defining feature ofCBT is that the mechanism of action for clinical improvement is a change in· cognition (e.g. thoughts, beliefs, schemas) in which dysfunctional cognitive structures are corrected [15,16].

CBT can include a variety of treatment components [17]. The most common CBT treatment package involves some form and sequence of the following components. (a) The patient is told the aetiology of their specific anxiety disorder in order to externalize symptoms·(i.e. understand that behaviours associated with the anxiety disorder are not their fault). (b) The therapist and client establish a need for behaviour change by creating an awareness of interferences that the behaviours associated with anxiety may be causing (e.g. time spent engaging in compulsions resulting from Obsessive Compulsive Disorder may interfere with day-to-day functioning) (18]. (c) A hierarchical list of anxiety-producing situations is created in which scenarios are rated from most to least anxiety producing. (d) Clients are gradually exposed to these scenarios starting with the least anxiety producing and progressing up the hierarchy while simultaneously being taught to manage anxiety (i.e. graduated exposure or systematic desensitization [4]. (e) Finally, the client is taught additional coping behaviours (e.g. relaxation methods and how to think logically regarding realistic outcomes of anxiety-producing scenarios). The above strategies have been demonstrated to be successful in reducing anxiety in the general population [19].

The symptoms and characteristics often associated with ASD would seem to complicate implementation of the CBT procedures described above. For example, individuals with **ASD** often suffer from a reduced ability to recognize thoughts and feelings both in themselves and others [20,21]. This would seem likely to obstruct the introspection often required by CBT. Additionally, language and social skill deficits associated with· ASD could impede the formation of therapeutic relationships and the communication of complex or abstract concepts. Combined, these deficits would seem likely to hinder CBT's effectiveness.

In order to enhance potential for CBT to benefit individuals with ASD several researchers have suggested modifications and additions to CBT protocol. For example, Attwood [22] describes several intervention components that can be added to CBT. Examples of Attwood's suggestions include: (a) increasing the use of visual aides, (b) using social stories [23] to explain complex scenarios and expectations, (c) associating emotions with tangible objects (e.g. making a scrapbook of relevant pictures, creating drawings of feelings and thoughts), (d) increased emphasis on coping strategies that do not require the use of abstract language (e.g. relaxation strategies), (e) use of alternative communication modes (e.g. internet chat), (f) embedding perseverative interest topics into CBT sessions and (g) increasing the focus on teaching social skills. Other researchers have made similar suggestions for modifying CBT for individuals with ASD (for additional examples see [24,25)). These suggested modifications and additions have been evaluated in a number of anxiety intervention studies involving participants with ASD.

At least three previous reviews address anxiety within the ASD population [4,8,24]. These reviews are either (a) narrative in nature and were not intended to be exhaustive or systematic (24],

(b) split focus between etiology, prevalence and treatments other than CBT (e.g. medications) (8] or (c) focus on one CBT treatment component (i.e. graduated exposure with reinforcement) [4]. A systematic review focusing on the modifications and adaptations made to CBT when treating anxiety in individuals with ASD remains warranted.

To facilitate evidence-based practice in this important area, this review provides a systematic review of studies using CBT to ameliorate symptoms of anxiety in individuals with ASD. This review describes characteristics of the included studies, evaluates intervention results and appraises the certainty of evidence for the existing corpus of research. A review of this type has two aims. First, to· inform evidence-based practice in the implementation of CBT for individuals with ASD. Second, to stimulate future research regarding the use of CBT with individuals with ASD. Ultimately, we aim to contribute to ongoing efforts to more efficiently and effectively treat the debilitating anxiety frequently experienced by people with ASD.

Method

Each identified study that met pre-determined inclusion criteria was analysed and summarized in terms of: (a) participants, (b) intervention procedures, (c) dependent variables, (d) results of intervention and (e) certainty of evidence. To assess the certainty of evidence, each study's design and related methodological details (e.g. measures of treatment integrity and reliability of data) were critically appraised.

Search procedures

Systematic searches were conducted in three electronic databases: PsychJNFO, Education Resources Information Center (ERIC) and Medline. Publication year was not restricted, but the search was limited to English-language peer reviewed journals. On all three databases, the terms 'Asperger', 'autism' or 'developmental disability' plus 'anxiety' or 'CBT' were searched for in pairs (e.g. Asperger plus anxiety). Terms were inserted as free text in the keywords field. The abstracts of the resulting 164 studies were reviewed for possible inclusion (see inclusion and exclusion criteria below). The reference lists for studies meeting inclusion criteria were also reviewed to identify additional articles for possible inclusion. Hand searches, covering January-July 2009, were then completed for the journals containing the published studies. Finally, using an author search, the three databases were searched again for additional related work by authors of the studies that met inclusion criteria. The search of the databases, journals and reference lists occurred during June and July 2009. From this combination of search procedures, 11 articles were identified for possible inclusion in this systematic review.

Inclusion and exclusion criteria

To be included in this review, the article had to describe a research study that included the provision of CBT with the aim of reducing anxiety symptoms to at least one person with an **ASD** diagnosis (i.e. autism, Asperger's syndrome or **PDD-NOS).** Of the original 11 studies identified for possible inclusion, after reading the studies, two were excluded from the review. Scolnick [26] was excluded because the intervention to reduce anxiety was electroencephalogram biofeedback and did not contain any CBT components. Hare [27] was excluded because CBT was used to treat depression and self-injury, but 'anxiety' was not specifically mentioned.

Data extraction

Each identified study was first assessed for inclusion/exclusion by the first author. After this, each included study was summarized in terms of the following features: (a) participant characteristics, (b) intervention procedures, (c) dependent variables, (d) main findings and (e) certainty of evidence. Various procedural aspects were also noted, including experimental design, inter-observer agreement, treatment integrity, duration, type of anxiety disorder and the implementer of the intervention. Main findings were summarized in terms of the extent to which participants were reported to have shown reductions in symptoms of anxiety. This involved reporting statistical results for group designs and percentage of non-overlapping data *(PND)* for single-subject designs [28]. Certainty of evidence was evaluated by considering main findings in light of the research design and other methodological details. The ability of a study to provide certainty of evidence was rated as either 'suggestive', 'preponderant' or 'conclusive' [29-31]. This classification system was utilized in this review in · an effort to provide an overview of the quality of evidence across the corpus of reviewed studies [32].

The lowest level of certainty is classified as suggestive evidence. Studies within this category might have utilized AB or intervention only designs, but did not involve a true experimental design (e.g. group design with random assignment and a control group, multiple-baseline or an ABAB design). The second level of certainty was classified

as preponderance of evidence. Studies within this level contained the following five qualities: (a) experimental designs, (b) when appropriate, adequate inter-observer agreement and treatment fidelity measures (i.e. 20% of sessions with 80% or better agreement), (c) operationally-defined dependent variables and (d) enough detail to enable replication. However, these studies also have limitation(s) regarding controls against alternative explanations for treatment outcomes (e.g. maturation). The final level of certainty was classified as conclusive. Within this level studies contain all of the qualities of the preponderance level, but also attempted to control for alternative explanations of treatment gains (e.g. a double-blind, placebo, randomized trial that controlled for concurrent interventions).

Inter-rater agreement

The first author made an initial determination as to whether each study from the pool of 164 potential studies met the inclusion criteria. After this the second author independently applied the inclusion/exclusion criteria. Agreement on the resulting list of included studies was obtained on nine of the nine studies.

The first author then extracted information to develop an initial summary of the included studies. The accuracy of these summaries was independently checked by one of the remaining co-authors using a checklist that included the first author's summary of the study and a number of questions regarding various details of the study (i.e. Is this an accurate description of the participants?, Is this an accurate description of the intervention?, Is this an accurate description of the dependent variables?, Is this an accurate summary of the results? and Is this an accurate summary of the certainty of evidence?). Co-authors were asked to read the study and the summary and then complete the checklist. In cases where the summary was not considered accurate, the co authors were asked to edit the summary to improve its accuracy. Disagreements were settled by discussion until all co-authors agreed the summary was accurate.

This approach was intended to ensure accuracy in the summary of studies, but it also provided a measure of inter-rater agreement on data extraction and analysis. There were 45 items on which there could be agreement or disagreement (i.e. nine studies times five questions per study). Agreement was obtained on 39 items (87%). In the six instances where aspects of the summaries were considered inaccurate, changes were made to more fully and accurately describe the study.

Results

From 164 potential studies, 155 studies were excluded (see above), leaving nine studies for summary and analysis. Table I summarizes participants, intervention procedures, dependent variable(s), results and certainty of evidence for each of the included studies. Studies are grouped within the table according to their certainty of evidence classifications and then listed alphabetically by first author's surname. The reason a particular study is classified within a given certainty of evidence level is summarized in the last column of the table.

Participants

Collectively, the nine studies provided intervention to 110 participants with ASD [18,33-40]. The sample size of individual studies ranged from 1-50. Most participants (i.e. $n = 66$, 60%) were male, 16 (15%) were female and the gender of the remaining 25% was not reported. The ages of participants varied from 9-23 years old ($M = 10$ years). Seventy-five (67%) were diagnosed with Aspergers syndrome, 20 (18%) with autism (nine described as 'high functioning autism') and 17 (15%) with **PDD-NOS. A** wide variety of anxiety disorders were treated including social phobia (SoP), obsessive compulsive disorder (OCD), separation anxiety disorder (SAD), general anxiety disorder (GAD), panic disorder (PD) and specific phobias (SpP). See Table I for participant characteristics for each study.

Intervention characteristics

The duration of CBT intervention ranged from 6-16 sessions ($M = 12.4$ sessions). Sessions were between 1-2 hours long ($M = 1.25$ hours). CBT interventions were completed within a time frame of 6 weeks to 6 months ($M = 4$ months). In every study, interventions were implemented by doctoral level psychologists, psychology doctoral students or highly trained therapists.

Treatment protocols were based on manuals or books containing specific implementation instructions and then adapting the intervention to be appropriate for children with ASD [25,41-43]. One study did not cite a treatment manual but described the intervention in detail within the paper [37] and another cited an unpublished treatment manual [36].

In every reviewed study, adaptations or extensions to traditional CBT procedures were made. These modifications were based on common characteristics of children with ASD and were intended to increase CBT's effectiveness with this population. Seven studies included components designed to directly

Table I. Summary of reviewed studies.

Reference	Participants	Intervention characteristics	Dependent variables	Results and threats to certainty of evidence
Studies capable of providing suggestive level of evidence				
Cardaciotto and Herbert (33)	1 male 23 years old AS & SoP	*Duration:* 14 weeks *Implementer:* Trained therapist *Intervention was based on:* manuals (41,67) *Modifications included:* Teaching social skills (i.e. introductions, maintaining conversations, eye contact, posture, rate of speech and voice volume)	SPAI, LSAS, EDI-II, SUDS, Likert Scale completed by data collectors watching videos of anxiety producing situations, and CGI	*Results:* SP AI *PND* = 66%, 11% LSAS-fear *PND* = 11%, LSAS-avoidance *PND=44%* and BDI-II= 100%., *M PND* across dependent variables== 55% *Certainty:* No experimental design
Greig and MacKay (35)	1 male 12 years old **AS** & unspecified anxiety disorder	*Duration:* 15 sessions *Implementer:* Doctoral level researcher-clinician *Intervention was based on:* manual [68] *Modifications included:* Humunculi (cognitive restructuring tool involving an imaginary friend that helps solve problems) social stories and video modelling	TSCC, Teacher report, andSWQ	*Results:* Anxiety score on the Briere Trauma Scales reduced from 19 to 5. Teacher anecdotal report suggested improvements at school *Certainty:* No experimental design
Reaven and Hepburn [18]	1 female 7 years old AS & OCD	*Duration:* 14 sessions over 5.5 months *Implementer:* Doctoral level researcher-clinician *Intervention was based on:* manual [42] *Modifications included:* Increased parent involvement, visual aides, use of correct technical names as opposed to symbolic names and social stories	CY-BOCS and Self report in the form of drawing the amount of OCD pre-treatment and post-treatment	*Results:* CY-BOCS score decreased 65% and self-report indicated improvements *Certainty:* No experimental design
Sze and Wood [38]	1 female 11 years old HFA, SAD, GAD, &OCD	*Duration:* 16 sessions 90 minutes each over 4 months *Implementer:* Doctoral level researcher-clinician *Intervention was based on:* manual (43) *Modifications included:* Embedding instruction into perseverative topics, visual aides, increased parent involvement, token economy system and social skills instruction via peer mediated intervention	ADIS	*Results:* No longer met criteria for SAD, GAD or OCD on the ADIS by child or parent report *Certainty:* No experimental design
Sze and Wood [39]	1 male 10 years old AS, GAD&SAD	*Duration:* Not reported *Implementer:* Not reported *Intervention was based on:* manual [43] *Modifications included:* teaching social skills (e.g. greetings, compliments, question asking), suppressing stereotypes and teaching self-help skills, visual aides, incorporation of perseverative interests and reinforcement of appropriate social skills.	ADIS, CGI, MASC, CBCL, SSRS and VABS	*Results:* No longer met criteria for Social phobia or GAD, on the ADIS by either child or parent, anxiety symptoms were 'very much improved' on CGI-I, clinically significant reduction of anxiety symptoms on the MASC, improved from borderline to normal on the academic sub-scale of the CBL, improvements found in both VABS and SSRS. *Certainty:* No experimental design

(continued)

Table I. Continued.

Reference	Participants	Intervention characteristics	Dependent variables	Results and threats to certainty of evidence
Studies capable of providing preponderance level of evidence				
Chalfant et al. [34]	28 Mage== 10.8 years 8 HFA, 20 AS & SAD, GAD, SoP, SpP, &/or PD	*Duration:* 9 weekly and 3 monthly 2 hour *Implementer:* Clinical psychologist *Intervention was based on:* manual [25] *Modifications included:* Visual aides, emphasis on relaxation techniques, less emphasis on abstract language, simplification of cognitive restructuring tasks (e.g. listing helpful and unhelpful thoughts)	ADIS, RCMAS, SCAS, CATS, and SDQ	*Results:* 71.4% of the children in CBT group no longer meet definition for diagnosis of an Anxiety disorder as compared to 0% of the control group *($p<0.05$).* Statistically significant improvements were found all dependent variables *Certainty:* Utilized an experimental design but .did not contain blinding
Reaven et al. [36]	7 male 3 female Mage= 11 years 3 AUT, 2 PDD-NOS, 5 AS either GAD, SAD, or SoP	*Duration:* 12 weekly sessions of 1.5 hours *Implementer:* Trained facilitators supervised by researchers *Intervention was based on:* unpu,blished manual. The authors created an original manual as opposed to modifying and existing protocol. *Modifications included:* Systematic reinforcement, visual aides, predictable routines, embedding instruction into perseverative topics, role play, video modelling and increased parent participation	SCARED	*Results:* Parent report on SCARED showed significant decrease in the severity of anxiety symptoms over time in treatment group and no significant decreases in the control group. Child report on the SCARED found no significant differences for reduction of anxiety in either group *Certainty:* Utilized an experimental design but did not contain random assignment
Sofronoff et al. [37]	44 males, 6 females *M* age == 10 years 44 AS & PD, OCD, SoP, SAD, &/or GAD 4drop outs	*Duration:* 6 group sessions of 2 hours *Implementer:* Post-graduate clinical psychology students receiving on-going feedback from researcher *Intervention description:* Session 1: discussed happiness and relaxation with activities to	James and the Math Test, SCAS and SWQ	*Residts:* Significant reduction in parent-rated symptoms from pre-intervention to 6 week follow-up on both the total score and on all sub-scales of the SCAS-P and SWQ. James and the Math Test showed a significant increase in the number of strategies to deal with anxiety-producing situations

		compare emotions in specific situations, Session 2: discussed effects of anxiety and the concept of a tool box to fix these problems was introduced, Session 3: focused on social tools (e.g. how to get help from other people when feeling anxious) and on thinking tools, Session 4: Concept of 'fear thermometer' introduced to rate the anxiety of certain situations and group meeting to share strategies, Session 5: social stories were used, Session 6: Participants worked together to create self-management plans		*Certainty:* Utilized an experimental design but did not contain blinding
Studies capable of providing conclusive level of evidence				
Wood et al. (40)	12 male, 5 female *M* age= 9 years 9 AUT, 6 **PDD-**NOS, 2 AS & SoP, SAD, OCD, &/or GAD	*Duration:* 16 weekly sessions of 1.5 hours *Implementer:* Psychology doctoral students supervised by psychologist-researchers *Intervention was based on:* manual (43) *Modifications included:* social skills instruction, adaptive skills instruction, embedding instruction into perseverative topics and reinforcement system for absence .of disruptive behaviour	ADIS, CGI and MASC	*Results:* 92.9% (13 out of 14) met CGI criteria for positive treatment response compared to 9.1% (2 out of 22) on waitlist; 9 of 14 no longer met criteria for any anxiety disorder vs. 2 of 22 on WL (x^2 (1) = 12.28, $p < 0.0001$), Parent MASC scores were significantly lower in the post treatment group, but not for the child-reported MASC scores *Certainty:* Utilized an experimental design, blinding, random assignment, control group, treatment fidelity, inter-observer agreement and controlled for potential interference from concurrent therapies.

AS = Asperger Syndrome; *PND* = Percentage Non-Overlapping Data; *M* = Mean; HFA == High Functioning Autism; AUT== Autism.

teach social skills [33,34-40]. Specific social skills taught included social greetings, eye contact, appropriate rate of speech, compliment giving, maintaining conversations and controlling voice volume. These skills were taught using a variety of instructional procedures (i.e. peer mediated intervention, video modelling, social stories and role-play). Five studies specifically mentioned increasing the amount and quality of visual aides used to teach key concepts [18,34,36,38,39]. Examples of visual aides included worksheets, cardboard cut-outs of symbols representing different coping strategies and photographs of anxiety-producing stimuli. Four studies used the perseverative interests of participants to increase motivation to engage in CBT [36,38-40]. For example, one study described a participant whose favourite conversational topic was the fictional movie character Indian Jones©. In order to engage the participant in therapy and to better teach necessary concepts, examples were framed in terms of 'what Indiana Jones would do' [38]. Four studies used systematic reinforcement (e.g. token economy systems and differential reinforcement) procedures to increase the frequency of desirable behaviour [36,37,39,40]. Three studies involved the participants' parents in CBT sessions in meaningful ways [18,36,37]. See Table I for a list of adaptations per each study.

Dependent variables

A variety of measures were used across the corpus of studies. Seven of the nine studies contained more than one dependent variable (M=3; range= 1-6). All nine studies included at least one standardized questionnaire or rating scale with documented reliability and validity data. These assessments were completed by either the parent or child and included the Social Phobia and Anxiety Inventory (SPAI) [44], Social Anxiety Scale (LSAS) [45], Beck Depression Inventory-II (BDI-II) [46], Subjective Units of Discomfort Scale (SUDS) [47], Briere Trauma Scales (TSCC) [48], Social Worries Questionnaire (SWQ) [49], Children's Yale-Brown Obsessive Compulsive Scale (CY-BOCS) [50], Anxiety Disorders Interview Schedule (ADIS) [51], Multidimensional Anxiety Scale for Children (MASC) [52], Child Behavior Checklist (CBCL) [53], Social Skills Rating System (SSRS) [54], Vineland Adaptive Behavior Scales (VABS) [55], Revised Children's Manifest Anxiety Scale (RCMAS) [56], Spence Children's Anxiety Scale (SCAS) [57], Children's Automatic Thoughts Scale (CATS) [58], Strengths and Difficulties Questionnaire (SDQ) [59] and Screen for Child Anxiety and Related Emotional Disorders (SCARED) [60].

Sofronoff et al. [37) used an unpublished assessment entitled 'James and the Math Test'. This assessment asked the child to verbally explain strategies that could be used by a fictional character Games) to cope with anxiety in different situations. The different anxiety-producing scenarios were read aloud to each participant and the number of strategies was recorded by the therapist. The number of appropriate strategies the child was able to list in baseline was then compared to the number listed following CBT. Reaven and Hepburn [18] also used a novel dependent variable; in their study the child was asked to draw a picture of her anxiety pre- and post-treatment. The drawings were then compared via visual analysis to determine potential changes in anxiety. The clinical opinion of the therapist or clinician was measured in three studies using the Clinical Global Impressions Scale (CGI) [61]. The CGI is a 7-point Likert Scale that requires the clinician to assess current symptoms relative to pre-treatment. Finally, direct observation of behaviour was used as a dependent variable by Cardaciotto and Herbert [33]. In that study participants were videotaped role-playing three different anxiety-producing scenarios. Two independent data collectors then viewed the tapes and rated participants' social behaviours and anxiety levels on Likert scales.

Results

Within each reviewed study, at least one dependent variable suggested a reduction in anxiety following implementation of CBT. The majority of positive results were obtained from standardized questionnaires and rating scales completed by parents, teachers or therapists. In two studies, child-report measures failed to show significant improvements. Reaven et al. [36] found significant decreases on parent ratings of their child's anxiety, but no decrease in child's self-ratings using the SCARED. Wood et al. [40) used the MASC and found the same pattern (i.e. improvements were detected in parent report but not in child self-report). However, four studies did detect improvements in child report measures [18,33,34,38].

Sofronoff et al. [37] found a significant increase in the amount of strategies participants could list over time using 'James and the Math Test'. Reaven and Hepburn [18] determined the pre- and post-treatment drawings made by the participant to represent an improvement in levels of anxiety. Cardaciotto and Herbert [33] found no difference between baseline and post-treatment in the ratings of child behaviour

obtained from watching video of participants in role-playing anxiety-producing situations. Overall, the corpus of studies had predominately positive findings across multiple dependent measures.

Certainty of evidence

Five studies were classified as having the ability to provide a suggestive level of certainty [18,33,35, 38,39]. All of the studies in this category contained only one participant and utilized AB designs (i.e. intervention only). These studies also lacked treatment fidelity, inter-observer agreement and did not attempt to control for any alternative explanations for reductions in anxiety (e.g. maturation and concurrent interventions). Three studies were classified as able to provide a preponderance level of certainty [34,36,37]. Within this category experimental designs were utilized but studies either did not use blinding procedures, random assignment or did not attempt to control for alternative explanations for reductions in anxiety. One study was classified as capable of providing a conclusive level of certainty [40]. Wood et al. [40] utilized an experimental design with blinding and random assignment, collected treatment fidelity, inter-observer agreement data and controlled for potential alternative explanations. Specifically, participants either were not receiving medication or dosage and administration was held constant and participants did not receive any additional interventions outside of the study during the course of CBT (i.e. psychotherapy, social skills training and applied behaviour analysis).

Discussion

This review summarized and analysed nine studies involving 110 participaµts with ASD who received CBT for the treatment of anxiety. In regards to the effects of CBT, analysis across studies reveals that CBT is a potentially versatile and effective intervention approach for treatment of anxiety in individuals with Asperger's. Although previous research has suggested that anxiety may be more prevalent and intense in Asperger's than in autism and PDD-NOS [9], it can not be assumed that because CBT may work with individuals with Asperger's that it will also work for individuals with autism or PDD-NOS. One potential reason for this is that communication skills and intellectual functioning are central to differentiating diagnosis between ASD sub-types and these traits would seem likely to influence the effectiveness of CBT. Therefore, the limited numbers of participants with autism ($n = 20$) and PDD-NOS ($n = 17$) within the reviewed studies preclude statements . regarding the effects of CBT for these ASD sub-types. Future research towards understanding the influence of communication skills and intellectual functioning on CBT could be useful for predicting intervention outcomes for individuals with ASD. Additionally, such research could also suggest additional modifications to CBT designed to increase effectiveness with participants with a wider range of abilities.

CBT can be thought of as a treatment package containing multiple intervention components. When implementing CBT it is not uncommon to add or modify components in order to tailor CBT for specific individuals presenting with specific complaints [39,62]. Although it is not uncommon to adapt CBT, the adaptations made for the ASD population raise questions concerning CBT's mechanism of action. The fundamental mechanism by which CBT influences levels of anxiety is often assumed to involve correcting dysfunctional cognitions [15,16,19]. This cognitive-based paradigm is consistent with many core CBT components which rely heavily on introspection [24]. However, the adaptations made to CBT for individuals with ASD seem to de-emphasize introspection and increase emphasis on teaching practical skills (e.g. social or adaptive self-help skills). Further, the manner in which these skills have been taught during CBT has involved describing the desired behaviour in concrete terms and then systematically prompting and providing differential reinforcement. As such, the adaptations made to CBT when working with individuals with ASD seem to suggest a more behavioural, as opposed to cognitive, mechanism of action. Questions regarding the mechanism of action for clinical improvement are important for increasing the efficiency of interventions.

Individuals with ASD often lack social skills and the ability to recognize the thoughts and intentions of others. As a result, they may behave in unusual ways during social situations causing them to be victims of stigmatization, embarrassment, ridicule and even overt bullying or harassment. In fact, individuals with Asperger's have been shown to have an increased risk of both being the victim of bullying and of engaging in bullying or harassing behaviours [63-65]. Given that social situations may be contexts in which individuals with ASD are at an increased risk of harm, symptoms of anxiety during these seemingly innocuous situations may be reasonable and not the result of cognitive dysfunction. The most efficient treatment of this type of anxiety would likely be to teach the individual social skills and additional CBT components involving introspection and correcting dysfunctional cognition may not be as necessary.

It has been suggested that intervention research for individuals with ASD may be developing separately across 'sub-disciplines' (e.g. developmental psychology, psychiatry, special education and applied behaviour analysis) and that cross-fertilization between sub-disciplines would be heuristic and beneficial [66]. Future research could address questions regarding the mechanism of action for CBT when behavioural components are added. This research would likely require an integration of theoretical or conceptual frameworks and could facilitate an integration of facts from multiple sub-disciplines. Results of such research could increase understanding and elucidate the inherent complexity involved in the treatment of **ASD.**

Declaration of interest: The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

References

1. American Psychiatric Association (APA). Diagnostic and statistical manual of mental disorders-fourth edition, text revision. Washington, DC: American Psychiatric Association; 2000.
2. Sturmey P, Fitzer A. Autism spectrum disorders: Applied behavior analysis, evidence, and practice.. Austin, TX: Pro-Ed; 2007.
3. National Research Council. Educating children with autism. Washington, DC: National Academy Press; 2001.
4. Hagopian LP, Jennett HK. Behavioral assessment and treatment of anxiety in individuals with intellectual disabilities and autism. Journal of Developmental and Physical Disabilities 2008;20:467-483.
5. Reiss S, Peterson RA, Gursky DM, McNally RJ. Anxiety sensitivity, anxiety frequency and the prediction of fearfulness. Behaviour Research and Therapy 1986;24:l-8.
6. Farrugia S, Hudson J. Anxiety in adolescents with Asperger syndrome: Negative thoughts, behavioral problems, and life interference. Focus on Autism and Other Developmental Disabilities 2006;21:25-35.
7. Matson JL, Love SR. A comparison of parent-reported fear for autistic and nonhandicapped age-matched children and youth. Australia and New Zealand Journal of Developmental Disabilities l990;16:349-357.
8. White SW, Oswal D, Ollendick T, Scahill L. Anxiety in children and adolescents with autism spectrum disorders. Clinical Psychology Review 2009;29:216-229.
9. Weisbrot DM, Gadow KD, DeVincent CJ, Pomeroy J. The presentation of anxiety in children with pervasive developmental disorders. Journal of Child and Adolescent Psychopharmoacology 2005;15:477-496.
10. Gillot A, Furniss F, Walter A. Anxiety in high-functioning children with autism. Autism 2001;5:277-286.
11. Bellini S. Social skills deficits and anxiety in high-functioning adolescents with autism spectrum disorders. Focus on Autism and Other Developmental Disabilities 2004;19:78-86.
12. Burnette CP, Mundy PC, Meyer JA, Sutton SK, Vaughan AE, Charak D. Weak central coherence and its relation to theory of mind and anxiety in autism. Journal of Autism and Developmental Disorders 2005;35:63-73.
13. Green J, Gilchrist A, Burton D, Cox A. Social and psychiatric functioning in adolescents with Asperger syndrome compared with conduct disorder. Journal of Autism and Developmental Disorders 2000;30:279-293.
14. Beck AT, Rush AJ, Shaw BF, Emory G. Cognitive therapy of depression. New York: Guilford Press; 1979.
15. Beck AT. Cognitive therapy: Past, present, and future. Journal of Consulting and Clinical Psychology 1993;61: 194-198.
16. Forman EV, Herbert JD, Moitra E, Yeomans PD, Geller PA. A randomized controlled effectiveness trial of acceptance and commitment therapy and cognitive therapy for anxiety and depression. Behavior Modification 2007;31:772-779.
17. Otto **M,** Reilly-Harrington N. The impact of treatment on anxiety sensitivity. In: Taylor **S,** editor. Anxiety sensitivity: Theory, research, and treatment of the fear of anxiety. New Jersey: Lawerence Erlbaum Associates Publishers; 1999. pp 321-336.
18. *Reaven J, Hepburn S. Cognitive-behavioral treatment of obsessive-compulsive disorder in a child with Asperger syndrome: A case report. Autism 2003;7:145-164.
19. Smits JA, Berry AC, Tart CD, Powers MB. The efficacy of cognitive-behavioral interventions for reducing anxiety sensitivity: A meta-analytic review. Behavior Research and Therapy 2008;46:1047-1054.
20. Baron-Cohen S, Jolliffe T. Another advanced test of theory of mind: Evidence from very high functioning adults with autism or Asperger syndrome. Journal of Child Psychology and Psychiatry 1997;38:813-822.
21. Baron-Cohen S, O'Riordan **M,** Stone **V,** Jones R, Plaisted K. Recognition of faux pas by normally developing children and children with autism and Asperger syndrome or high-functioning autism. Journal of Autism and Developmental Disorders l999;29:407-418.
22. Attwood T. Cognitive behavior therapy for children and adults with Asperger's syndrome. Behaviour Change 2004;21:147-161.
23. Gray CA. Social stories and comic strip conversations with students with Asperger syndrome and high-functioning autism. In: Schopler E, Mesibov GB, Kunce LJ, editors. Asperger syndrome or high-functioning autism? New York: Plenum Press; 1998. pp 167-199.
24. Anderson S, Morris J. Cognitive behaviour therapy for people with Asperger syndrome. Behavioural and Cognitive Psychotherapy 2006;34:293-303.
25. Lyneham HJ, Abbott MJ, Wignall A, Rappe RM. The cool kids family program-Therapist manual. Sydney, Australia: Macquarie University; 2003.
26. Scolnick B. Effects of electroencephalogram biofeedback with Asperger's syndrome. International Journal of Rehabilitation Research 2005;28:159-163.
27. Hare DJ. The use of cognitive-behavioral therapy with people with Asperger syndrome: **A** case study. Autism 1997; 1:215-225.
28. Scruggs T, Mastropieri **M,** Casto G. The quantitative synthesis of single-subject research: Methodology and validation. Remedial & Special Education 1987;8:24--33.
29. Schlosser R. The role of evidence-based journals as evidence-based information sources. Applied Behavior Analysis International Annual Convention [Conference]. Phoenix; 25 May 2009.
30. Simeonsson R, Bailey D. Evaluating programme impact: Levels of certainty. In: Mitchell D, Brown R, editors. Early intervention studies for young children with special needs. New York: Chapman and Hall; 1991. pp 280-296.
31. Smith N. The certainty of evidence in health evaluations. Evaluation and Program Planning 1981;4:273-278.
32. Schlosser RW, Sigafoos J. Editorial: Moving evidence-based practice forward. Evidence-based Communication Assessment and Intervention 2007;1:1-3.

33. *Cardaciotto L, Herbert JD. Cognitive behavior therapy for social anxiety disorder in the context of Asperger's syndrome: A single-subject report. Cognitive and Behavioral Practice 2004;11:75-81.
34. *Chalfant AM, Rapee R, Carroll L. Treating anxiety disorders in children with high functioning autism spectrum disorders: A controlled trial. Journal of Autism and Developmental Disorders 2007;37:1842-1857.
35. *Greig A, MacKay T. Asperger's syndrome and cognitive behaviour therapy: New applications for educational psychologists. Educational and Child Psychology 2005;22:4-15.
36. *Reaven JA, Blakeley-Smith A, Nichols S, Dasari M, Flanigan E, Hepburn S. Cognitive-behavioral group treatment for anxiety symptoms in children with high-functioning autism spectrum disorders: A pilot study. Focus on Autism and Other Developmental Disabilities 2009;24:27-37.
37. *Sofronoff K, Attwood T, Hinton S. A randomised controlled trial of a CBT intervention for anxiety in children with Asperger syndrome. Journal of Child Psychology and Psychiatry 2005;46:1152-1160.
38. *Sze KM, Wood JJ. Cognitive behavioral treatment of comorbid anxiety disorders and social difficulties in children with high-functioning autism: A case report. Journal of Contemporary Psychotherapy 2007;37:133-143.
39. *Sze KM, Wood JJ. Enhancing CBT for the treatment of autism spectrum disorders and concurrent anxiety. Behavioural and Cognitive Psychotherapy 2008;36:403-409.
40. *Wood JJ, Drahota A, Sze K, Har K, Chiu A, Langer DA. Cognitive behavioral therapy for anxiety in children with autism spectrum disorders: A randomized, controlled trial. Journal of Child Psychology and Psychiatry 2009;50: 224-234.
41. Heimberg RG, Becker RE. Cognitive-behavioral treatment for social phobia: Basic mechanisms and clinical strategies. New York: The Guilford Press; 2002.
42. March JS, Mulle K. OCD in children and adolescents: A cognitive behavioral treatment manual. New York: The Guilford Press; 1998.
43. Wood JJ, McLoed B. Child anxiety disorders: A treatment manual for practitioners. New York: Norton; 2008.
44. Turner SM, Beidel DC, Dancu CV, Stanley MA. An empirically derived inventory to measure social fears and anxiety: The Social Phobia Anxiety Inventory. Psychological Assessment 1989;1:35-40,
45. Liebowitz MR. Social phobia. Modem Problems in Pharmaco-Psychiatry l 987;22:141-173.
46. Beck AT, Steer RA, Brown GK. Manual for the revised Beck Depression Inventory. San Antonio, TX: Psychological Corporation; 1996.
47. Wolpe J, Lazarus AA. Behaviour therapy techniques. New York: Pergamon; 1966.
48. Briere J. Trauma scales for children and adolescents (TSCC). Lutz, FL: Psychological Assessment Resources (PAR); 1996.
. 49. Spence SH. The social worries questionnaire. Social skills training: Enhancing social competence with children and adolescents. Windsor, Canada: NFER-Nelson; 1995.
50. Goodman WK, Price LH, Rasmussen SA, Riddle MA, Rapoport }L. Children's Yale-Brown Obsessive-Compulsive Scale (CY-BOCS). National Institute of Mental Health (public domain); 1986.
51. Silverman WK, Albano AM. The Anxiety disorders interview schedule for DSM-IV: Child and Parent Versions. Clinical manual. San Antonio, TX: Graywind; 1996.
52. March JS. Multidimensional anxiety scale for children manual. North Tanawanda, NY: Multi-Health Systems; 1999.
53. Achenbach T. Manual for the child behavior checklist/4-18 and 1991 profile. Burlington, VT: University Medical Education Associates; 1991.
54. Gresham FM, Elliott SN. Social skills rating system. Circle Pines, MN: American Guidance Service; 1990.
55. Sparrow SS, Balla D, Ciccetti C. Vineland Adaptive Behavior Scales. Circles Pines. MN: American Guidance Services; 1984.
56. Reynolds CR, Richmond BO. What I think and feel: A revised measure of children's manifest anxiety. Journal of Abnormal Child Psychology 1978;6:271-280.
57. Spence SH. A measure of anxiety symptoms among children. Behaviour Research and Therapy 1998;36: 545-566.
58. Schniering CA, Rapee RM. Development and validation of a measure of children's automatic thoughts: The children's automatic thoughts scale. Behaviour Research and Therapy 2002;40:1091-1109.
59. Goodman R. The strengths and difficulties questionnaire: A research note. Journal of Child Psychology and Psychiatry 1997;38:581-586.
60. Birmaher B, Brent D, Chiapetta L, Bridge J, Monga S, Baugher M. Psychometric properties of the Screen for Child Anxiety Related Emotional Disorders (SCARED): A replication study. Journal of the American Academy of Child and Adolescent Psychiatry l999;38:1230-1236.
61. National Institute of Mental Health. CGI: Clinical Global Impression Sc.ile-NIMH. Psychopharmacology Bulletin 1985;21:839-844.
62. Tarrier N, Yusupoff I, Kinney C, McCarthy E, Gledhill A, Haddock G, Morris J. Randomized controlled trial of intensive cognitive behavior therapy for patients with chronic schizophrenia. British Medical Journal 1998;3l 7: 303-307.
63. Didden R, Scholte R, Moor J, Korzilius H, Vermeulen A, O'Reilly M, Lang R, Lancioni G. Cyberbullying among students with mild to borderline intellectual disability and/or developmental disorders who visit a special school. Developmental Neurorehabilitation . 2009;12: 146-151.
64. Dubin N. Asperger syndrome and bullying: Strategies and solutions. London: Jessica Kingsley; 2007.
65. Wainscot JJ, Naylor P, Sutcliffe P, Williams JV, Tantum D. Relationships with peers and use of the school environment of mainstream secondary school pupils with Asperger syndrome (high functioning autism): A case control-study. International Journal of Psychology and Psychological Therapy 2008;8:25-38.
66. McConnell **SR.** Interventions to facilitate social interaction for young children with autism: Review of available research and recommendations for educational intervention and future research. Journal of Autism and Developmental Disorders 2002;32:351-372.
67. Herbert JD, Rheingold AA, Goldstein SG. Brief cognitive behavioral group therapy for social anxiety disorder. Cognitive and Behavioral Practice 2002;9:l-8.
68. Attwood T. Cognitive behavior therapy (CBn. In:Holliday Willey L, editor. Asperger syndrome in adolescence: Living with the ups and downs and things in between. London: Jessica Kingsley; 2003. pp 38-68.

* Denotes studies included in the review.