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Acceptance and Commitment Therapy for Autism Spectrum Disorder

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ACCEPTANCE AND COMMITMENT THERAPY FOR AUTISM SPECTRUM DISORDER

Evaluation of feasibility, effectiveness, and validity of a novel contextual behavioral treatment

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ACCEPTANCE AND COMMITMENT THERAPY FOR AUTISM SPECTRUM DISORDER

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THESIS FOR DOCTORAL DEGREE (Ph.D.)

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Dedication

I dedicate this doctoral thesis to my beloved wife, Anna, my companion on the path of life, and our precious son, Alexander, who is the light guiding our way.

I am different. Not less.

Dr. Temple Grandin

Popular science summary

Autism spectrum disorder (ASD) is characterized by challenges in social interplay, adapting to new situations, and over- and under-sensitivity to sensory impressions. Autistic individuals are often stressed, depressed or anxious and have poor sleep, making every day a struggle and reducing life quality. However, mental health treatments suited for autistic individuals are few. Acceptance and commitment therapy (ACT) is a psychotherapy helpful for chronic or complex problems but is not evaluated for autism. Questionnaires assessing ACT, such as Action and Acceptance Questionnaire (AAQ) and Cognitive Fusion Questionnaire (CFQ), measuring flexibility and the ability to handle disturbing thoughts, are not assessed in autism. Therefore, this thesis evaluated ACT, AAQ, and CFQ in autistic individuals.

In Study I, 28 autistic students (13-21 years) received group-based ACT adapted to autism (NeuroACT) or teaching as usual. The NeuroACT program worked well in a school environment and improved stress, anger, depression, prosocial behavior, and hyperactivity/inattention compared to teaching as usual. However, the program did not improve conduct problems, peer relationship problems, or anxiety.

In Study II, ten autistic adults (25-65 years) with mental health problems received 12 NeuroACT group sessions. The program seemed logical and reasonable to the participants, and 90 % completed it. The participants experienced improved stress, life quality, depression, social ability, flexibility, and ability to handle disturbing thoughts directly after or after three months compared to before the program. However, anxiety or work and family-related disability did not improve.

In Study III, 39 autistic adults (25-65 years) with mental health problems received 14 NeuroACT group sessions or standard care. NeuroACT seemed logical and reasonable to the participants, and 85 % completed the program. NeuroACT participants perceived improved stress, life quality, sleep quality, and depression directly after or after six months compared to the standard care participants. Also, they were more flexible, could handle disturbing thoughts better, did not avoid stressful situations as much, and were more motivated to participate in social events compared to before the program. Participants in both NeuroACT and standard care were less anxious. No group difference was found in awakening difficulties, daytime tiredness, breathing problems, awareness of others, communication, or everyday functioning.

In Study IV, 54 autistic adults (21-72 years) with mental health problems completed AAQ and CFQ questionnaires. The questionnaires were related to psychological distress, quality of life, and autism, and adequately measured flexibility and the ability to handle disturbing thoughts in autistic adults.

In conclusion, ACT adapted to autism is appropriate and appears to improve stress and mental health in autistic adolescents and adults. Also, it may help overcome aspects of autistic core challenges. However, more research is needed to further evaluate ACT in autistic individuals.

Abstract

Background: Autism spectrum disorder (ASD) is neurodevelopmental condition, characterized by challenges in reciprocal social behavior, restricted and repetitive behaviors and interests, and sensory hyper- and hyposensitivity. ASD is associated with executive dysfunction, perceived stress, and psychiatric symptoms, reducing quality of life and adaptive functioning. Acceptance and commitment therapy (ACT) has been proven effective for complex and chronic conditions, although not evaluated in ASD. ACT-consistent instruments, such as Action and Acceptance Questionnaire (AAQ) and Cognitive Fusion Questionnaire (CFQ), measuring psychological inflexibility and cognitive fusion, have not been assessed in autistic individuals. Hence, evaluating ACT and the psychometric properties of AAQ and CFQ in autistic individuals is paramount.

Aims: The overarching aim was to evaluate the feasibility, preliminary effectiveness, and validity of ACT adapted to ASD. Specifically, the aims were to evaluate (1) the feasibility and preliminary effectiveness of group-delivered ACT for autistic adolescents and young adults in a special school setting (Study I), (2) the feasibility and preliminary effectiveness of group-delivered ACT for autistic adults in a psychiatric outpatient setting (Study II and III), and (3) the psychometric properties of AAQ and CFQ in autistic adults (Study IV).

Methods: An adapted ACT protocol (NeuroACT) was evaluated in a quasi-experimental randomized trial (Study I), an open pilot trial (Study II), and a randomized controlled trial (Study III).

Study I included 28 ASD adolescents and young adults (13-21 years) utilizing wait-list controls having school classes as usual. Assessments were done at pre, post, and two months follow-up, evaluating self- and teacher-rated stress, self-perceived depression, anxiety, anger, hyperactivity/inattention, prosociality, and conduct and peer problems, analyzed using rmANOVA.

Study II included 10 ASD adults (25-65 years), assessing treatment credibility, self-perceived stress and quality of life (primary outcomes), symptoms of depression and anxiety, disability (social; vocational; family), psychological inflexibility, and cognitive fusion at pre, post, and three months follow-up. Data were analyzed using paired *t*-tests.

Study III included 39 ASD adults (21-72 years) randomized to NeuroACT or treatment as usual (TAU), evaluating treatment credibility, self-perceived stress and quality of life (primary outcomes), symptoms of depression and anxiety, sleep problems, disability (social; vocational; family), cognitive and behavioral avoidance, psychological inflexibility, cognitive fusion, autistic core challenges, and executive dysfunction, at pre, post, and six months follow-up, compared to TAU. Data were analyzed using rmANOVA and clinically significant change.

Study IV evaluated the construct (convergent and divergent) validity and reliability of AAQ and CFQ in 54 autistic adults (21-72 years) in a psychiatric outpatient setting, using explorative factor analysis and Pearson's correlation coefficient.

Results: In Study I, all participants completed NeuroACT, and treatment satisfaction was high. Overall (pre-post-2-month) statistically significant improvements were found in self- and teacher-rated stress, overall psychiatric symptoms, anger, prosocial behavior, and hyperactivity/inattention (d = 0.70-0.81, 95% CI), and a statistical trend for depression (d = 0.67, 95% CI), in NeuroACT compared to wait-list. No statistically significant interaction effect or statistical trend was found in conduct problems, peer relation problems, or anxiety symptoms.

In Study II, 90 % completed NeuroACT, and treatment credibility was high (M=7.7/10, SD = .8). Statistically significant improvements or statistical trends were found (pre-post or pre-3-month) in perceived stress and quality of life (primary outcomes), depressive symptoms, social disability, psychological inflexibility, and cognitive fusion (d = 0.27-0.92, 95% CI). Anxiety or work and family-related disability were not statistically significantly improved.

In Study III, 85 % completed NeuroACT and treatment credibility was high (M=7.3/10, SD = 2.5). Overall (pre-post-6-month follow-up) statistically significant improvements or statistical trends were observed in perceived stress and quality of life (primary outcomes), depressive symptoms, sleep quality, cognitive and behavioral avoidance, psychological inflexibility, cognitive fusion, and autistic core challenges related to autistic mannerism (i.e., cognitive and behavioral inflexibility) and social motivation (d = 0.57-1.24, 95% CI) in NeuroACT compared to TAU. Between group clinically significant changes were in favor of NeuroACT. No statistically between group significant change or statistical trends were found in breathing problems, fatigue during daytime, awakening difficulties, social, work, or family-related disability, social awareness, social cognition, communication, or executive dysfunction. Dropout rates were higher in NeuroACT compared to TAU.

In study IV, parallel analysis indicated a one-factor solution for AAQ and CFQ. Both instruments showed one-factor solution, explaining 64% of AAQ variance (α = .92) and 67% of CFQ variance (α = .93). Statistically significant positive correlations were found between AAQ and CFQ, and measures of psychiatric symptoms and autistic traits, except social awareness, supporting convergent validity. Statistically significant negative correlations were observed between the AAQ and the CFQ, and quality of life, supporting divergent validity.

Conclusion: ACT adapted to autism is feasible in autistic adolescents and adults and appears to improve stress and mental health. Also, it may help overcome aspects of autistic core challenges. Common instruments to assess ACT are preliminarily valid and reliable for autistic adults. However, more extensive research is needed to further evaluate ACT in ASD. This thesis adds to the growing awareness and empirical support of contextual behavioral models for autistic individuals.

List of Scientific Papers

I. Pahnke, J, Lundgren, T, Hursti T, Hirvikoski, T. Outcomes of an acceptance and commitment therapy-based skills training group for students with high-functioning autism spectrum disorder: A quasi-experimental pilot study. Autism: the International Journal of Research and Practice. 2014; 18, Issue 8: 953-964.

II. Pahnke, J, Hirvikoski, T, Bjureberg J, Bölte, J, Jokinen, J, Bohman, B, Lundgren, T. Acceptance and commitment therapy for autistic adults: An open pilot study in a psychiatric outpatient context. Journal of Contextual Behavioral Science. 2019; 13: 34-41.

III. Pahnke, J, Jansson-Fröjmark, M, Andersson G, Bjureberg, J, Jokinen, J, Bohman, B, Lundgren, T. Acceptance and commitment therapy for autistic adults: A randomized controlled pilot study in a psychiatric outpatient setting (manuscript submitted for publication in Autism: the International Journal of Research and Practice).

IV. Pahnke, J, Jansson-Fröjmark, M, Andersson G, Bohman, B, Lundgren, T. An initial psychometric evaluation of Acceptance and Action Questionnaire (AAQ) and Cognitive Fusion Questionnaire (CFQ) in autistic adults (manuscript submitted for publication in Journal of Autism and Developmental Disorders).

Contents

Abbreviations

Abbreviation	Term
AARR	Arbitrarily applicable relational responding
ACC	Anterior cingulate cortex
ACT	Acceptance and commitment therapy
ADHD	Attention-deficit/hyperactivity disorder
ASC	Autism spectrum conditions
ASD	Autism spectrum disorder
CBS	Contextual behavioral science
CBT	Cognitive-behavior therapy
DSM	Diagnostic and statistical manual of mental disorders
HPA	Hypothalamic-pituitary-adrenal axis
ED	Executive dysfunction
MBSR	Mindfulness-based stress reduction
MCC	Middle cingulate cortex
MRI	Magnetic resonance imaging
OFC	Orbito-frontal cortex
PCC	Posterior cingulate cortex
PET	Positron emission tomography
PFC	Prefrontal cortex
RCT	Randomized controlled trial
RFT	Relational frame theory
RRB	Restricted repetitive behavior
RSB	Reciprocal social behavior
TAU	Treatment as usual

Terminology

Terminology	Explanation
Acceptance	Being in contact with thoughts, emotions, and body sensations without avoiding them
Antecedent	Something occurring before a behavior
Behavior-goal	Doing something important to oneself
Cognitive defusion	Helpful distance to thoughts not letting them be in the way for doing things that are important to oneself
Contextual	Analyzing what in the surrounding impacts a behavior (e.g., what occurs before and after a behavior)
Contingencies	Reinforcing consequences occurring after a behavior
Covert behavior	Things one does that cannot be observed (e.g., thoughts, emotions, and body sensations)
Experiential avoidance	Trying to avoid thoughts, emotions, and body sensations (opposite to acceptance)
Exteroception	Perceiving something outside of the body
Functional	Evaluated by its reinforcing consequences
Interoception	Perceiving something inside the body
Overt behavior	Things one does that can be observed
Pragmatic	Goal-oriented
Private events	Thoughts, emotions, and body sensations
Psychological flexibility	Behave in line with personal values while coping with thoughts, emotions, and body sensations
Reinforcing	Something occurring after a behavior increasing the likelihood that the behavior will happen again
Rule-governed behavior	Doing something following a verbal rule
Self-as context	A form of cognitive defusion including self-identity
Transformation of function	Changing the reinforcing context of a behavior
Truth criterion	What defines a successful outcome
Value	What is important to oneself

Foreword

After more than 20 years of experience in the 'autism field', I am still as fascinated, curious, and thankful as when I once started. My professional journey began as a school assistant using the ABA methodology of Örjan Swahn. I later continued as a CBT and ABA supervisor inspired by Olle Wadström, Gunilla Gerland, Tony Attwood, and Temple Grandin, to name a few. Finally, I have become a clinical neuropsychologist, seeing patients with neurodevelopmental conditions. I am happy to have the opportunity to take part in the many personal and professional experiences related to autism.

A neurodevelopmental condition such as autism has several facets, both strengths and difficulties. Also, whether it manifests as a strength or a difficulty may depend on what an autistic individual sees him or herself as part of - the mainstream society, the autistic community, or both. Moreover, it depends on whether society perceives autistic individuals as assets or liabilities.

The common ground shared by autistic individuals is the experience to deviate from how the majority of society's members perceive things and relate to the world around them; what captures one's interest, how sounds present, the tactile experience of objects, how people smell, the reflection of light on a surface, memories from one's childhood, self-biographical perspectives of the future, food's texture and taste, how things are organized into categories, perception of time, space and order, the registration of one's body signals, other people's facial expressions, voice tone, and gestures, what people mean by what they say, which events are stressful, and what activities are vital.

Finally, helping develop coping skills, alongside creating a more autism-friendly society to meet autism-specific challenges, can be essential to improving mental health and everyday life in autistic individuals.

Stockholm, April 2022

Chapter 1

Introduction

This doctoral thesis's overarching aim was to evaluate the feasibility and preliminary effectiveness of a contextual behavioral therapy, acceptance and commitment therapy (ACT) in improving stress and mental health and overcoming autistic core challenges in adolescents and adults with autism spectrum disorder (ASD). Notably, the overall objective was not to obtain changes in autistic presentation *per se* (i.e., objective observation of reduced core symptoms). Furthermore, aiming to change autistic core symptoms is not desired from an ethical perspective. Instead, we hypothesized that ACT would facilitate disengagement from (and willingness to experience) obstructive thoughts, emotions, sensory experiences, and body sensations. We anticipated that this would create a more psychologically flexible behavior repertoire and improve stress and quality of life.

In line with these hypotheses, we evaluated if ACT would be feasible and positively affect stress and mental health in autistic adolescents and young adults in a school setting and autistic adults in a psychiatric outpatient clinic. Moreover, we evaluated if ACT would help overcome autistic core challenges in these individuals. Finally, to validate the evaluation of key ACT constructs, we assessed standard instruments measuring psychological inflexibility and cognitive fusion in autistic adults.

Before presenting and discussing the details of the specific studies, I will give a background to ASD, its clinical features, epidemiology, consequences and treatment challenges, and the conceptual, clinical, and empirical underpinnings of interventions for autistic individuals in general and ACT for ASD in particular.

Chapter 2

Background

Perspectives and definitions of what are 'disabilities' have shifted along the historical and cultural horizon. From the 1st to the 8th century CE, the Moche people were one of the pre-Columbian's most prosperous civilizations that flourished in the Peruvian Andes until defeated by the Spanish conquistadors. In the Moche culture, persons born with disabilities were believed to have been touched by the hands of the Gods and blessed with special powers (Julien, 2009). In Ancient Greece, people with physical or mental disabilities (the ἀδύνατοι) were considered inferior and excluded from military, political, and religious roles (Penrose, 2015). Among the Chagga in East Africa, physically disabled children and adults are traditionally perceived as pacifiers of evil spirits (Amoak, 1975), while 16th century Calvinism viewed persons with disabilities as possessed by evil spirits (Barker, 1953).

In Western history, the Enlightenment marked the first positive shift in attitudes and treatment towards individuals with neurodevelopmental disabilities, as proponents advocated for removing inhumane institutional conditions (Shoychet, 2021). In 1911 the first concept of autism was coined by the German psychiatrist Eugen Bleuler to describe a symptom of the most severe cases of schizophrenia (Evans, 2013). Some decades later, the Austrian born psychiatrist Leo Kanner (infamous for his notion of 'refrigerator mothers') was one of the first to more objectively classify 'autism', using the word 'autistic' (also labeled Kanner's Syndrome) to describe a subgroup of children appearing not to be engaged with their external environment (Kanner, 1943). However, from being associated with schizophrenia in adults and psychoanalytic styles of reasoning, in the 1960s and 1970s (Rutter, 1968) 'autism' began to be used as a clinical category to reconceptualize psychological development in infants and children along with epidemiological studies and the development of the Diagnostic and Statistical Manual, DSM (Grob, 1991). The extensive work of Austrian pediatrician and medical professor Hans Asperger was in the 1980s taken further by the English psychiatrist and researcher Lorna Wing, who coined the term Asperger Syndrome.

2.1 AUTISM – CLINICAL FEATURES AND EPIDEMIOLOGY

In contemporary psychiatry, ASD is an early-emerging neurodevelopmental condition characterized by reciprocal social interaction impairment alongside restricted, repetitive behaviors and interests, and sensory hyper- and hyposensitivity (APA, 2013; Lai & Baron-Cohen, 2015; Lord, Elsabbagh, Baird, & Veenstra-Vanderweele, 2018) (for diagnostic criteria, see Table 1). The prevalence of ASD in children is about 1.5 % (Christensen et al., 2016) and in adults, at least 1.7 % (Brugha et al., 2016; Idring et al., 2015) with a male-to-female ratio of 3:1 (Loomes, Hull, & Mandy, 2017). Historically, the heterogeneity in the categorizing of autism spectrum disorders has comprised several distinct disorders, such as autistic disorder, Asperger's disorder; pervasive developmental disorder not otherwise specified, childhood disintegrative disorder, and Rett's disorder) (Lord & Jones, 2012). However, with the development of DSM-5, these previous diagnoses were merged into a single condition, Autism Spectrum Disorder (*note:* the Swedish version of DSM-5 uses the term Autism), categorizing the level of functioning into three classes (APA, 2013). Furthermore, the term Autism Spectrum Conditions (ASC) is sometimes used to reduce stigma and signal the diagnosis' heterogenetic character, as discussed in Oberman and Kaufmann (2020).

ASD has a strong genetic etiology (Robinson et al., 2016), shaped by gene-environment inter-play (Mandy & Lai, 2016), causing functional impairments in a large number of life areas, such as social relationships, vocational areas, and independent living (Howlin & Magiati, 2017; Howlin, Moss, Savage, & Rutter, 2013; Steinhausen, Mohr Jensen, & Lauritsen, 2016). In the general population, characteristics associated with autism range on a spectrum from clinical autism to dimensional autistic traits, both influenced by polygenetic and *de novo* variation (Weiner et al., 2017). ASD is associated with a specific cognitive style (e.g., attention to detail, preference for sameness) (Demetriou et al., 2018), alongside prefrontal deficits and executive dysfunction. Executive dysfunction implies difficulties with, for example, cognitive flexibility, organization and planning, metacognition, working memory, and inhibition, impairing the ability to cope with daily hassles and reach long-term goals (Bednarz, Trapani, & Kana, 2020; Zhang, Peng, & Zhang, 2020). Moreover, ASD is associated with neuropsychiatric and psychiatric comorbidities (e.g., ADHD; anxiety; depression; sleep disorders) (Lai et al., 2019; Lord et al., 2018) and somatic health issues (Croen et al., 2015; Davignon, Qian, Massolo, & Croen, 2018). More than 70 % percent of individuals with ASD have concurrent conditions, with depression and anxiety being the most frequent (Hollocks, Lerh, Magiati, Meiser-Stedman, & Brugha, 2019).

Table 1. Diagnostic criteria of ASD*

A. Persistent deficits in social communication and social interaction across multiple contexts, as manifested by the following, currently or by history.	**B. Restricted, repetitive patterns of behavior, interests, or activities, as manifested by at least two of the following, currently or by history.**
1. **Deficits in social-emotional reciprocity**, ranging, for example, from abnormal social approach and failure of normal back-and-forth conversation; to reduced sharing of interests, emotions, or affect; to failure to initiate or respond to social interactions.	1. **Stereotyped or repetitive motor movements, use of objects, or speech** (e.g., simple motor stereotypes, lining up toys or flipping objects, echolalia, idiosyncratic phrases).
2. **Deficits in nonverbal communicative behaviors used for social interaction**, ranging, for example, from poorly integrated verbal and nonverbal communication; to abnormalities in eye contact and body language or deficits in understanding and use of gestures; to a total lack of facial expressions and nonverbal communication.	2. **Insistence on sameness, inflexible adherence to routines, or ritualized patterns of verbal or nonverbal behavior** (e.g., extreme distress at small changes, difficulties with transitions, rigid thinking patterns, greeting rituals, need to take same route or eat same food every day).
3. **Deficits in developing, maintaining, and understand relationships**, ranging, for example, from difficulties adjusting behavior to suit various social contexts; to difficulties in sharing imaginative play or in making friends; to absence of interest in peers.	3. **Highly restricted, fixated interests that are abnormal in intensity or focus** (e.g., strong attachment to or preoccupation with unusual objects, excessively circumscribed or perseverative interests).
• Categorized in three levels depending on severity and level of functioning.	4. **Hyper- or hyporeactivity to sensory input or unusual interest in sensory aspects of the environment** (e.g., apparent indifference to pain/temperature, adverse response to specific sounds or textures, excessive smelling or touching of objects, visual fascination with lights or movement).

2.1.1 Adolescents and young adults

As noted above, autistic adults are at risk of comorbid mental health concerns. Regarding adolescents with ASD, the transition from childhood to adulthood is challenging for young people in general and autistic adolescents and young adults in particular (Fayette & Bond, 2018; Hendricks & Wehman, 2009; Rydzewska, 2012). There are high rates of bullying and victimization (Cappadocia, Weiss, & Pepler, 2012; Fisher & Taylor, 2016) alongside a low percentage of employment and secondary education (Anderson, Butt, & Sarsony, 2021; Crabtree & Demchick, 2017; Shattuck et al., 2012). Furthermore, quality of life is lower, and comorbid psychiatric symptoms and other health concerns are more frequent in young autistic individuals than in non-autistic people (e.g., physical health; psychological well-being; social support; peers) (Biggs & Carter, 2016; Gotham et al., 2015).

In sum, interventions that address mental health concerns in adolescents and adults with an ASD diagnosis are paramount (Crane, Adams, Harper, Welch, & Pellicano, 2019; Lewis & van Schalkwyk, 2020).

2.2 CLINICAL GUIDELINES

2.2.1 Theoretical perspectives

The complexity of ASD necessitates a range of interventions on different levels, including educational and societal services, adapted treatment programs, and medical services (Green & Garg, 2018). Moreover, autism (as a general term and not necessarily a disorder) can be viewed as a medical condition that gives rise to disability and an example of human variation characterized by neurological and cognitive differences (Sameroff & Mackenzie, 2003). On the one hand, autism is a condition that requires treatment or intervention (the medical view). On the other hand, autism is part of human variation, with strengths, weaknesses, differences, and disabilities that might fit more or less comfortably with a particular environment (the neurodiversity view). However, the duality of autism may not be viewed as opposing perspectives (i.e., a disorder to be treated or a variant of human nature to be cherished). Polarizing the medical and neurodiversity views may hold back progress both scientifically and clinically, given the complexity of having autism (Pellicano, Dinsmore, & Charman, 2014). When both identity *and* disability are recognized, enhancing adaptation and well-being is the ultimate goal for any support and intervention (Frazier et al., 2018).

2.2.2 Practical recommendations

According to general clinical guidelines and recommendations of children and adults with ASD, developed by governmental or professional organizations and based on reviews and expert panel discussions, service providers should (1) receive training in autism awareness and management, (2) ensure access to adapted educational, behavioral, and psychosocial interventions (for children and adolescents) or vocational support (for adults), (3) ensure access to behavioral, psychosocial and pharmacological treatment options for co-occurring challenges such as anxiety, depression, ADHD or sleep disturbances, (4) facilitate the person-to-environment fit to meet individual needs (5) support families and caregivers and maintain an active role in long-term support, including life transition issues, (6) involve autistic individuals and families in the planning and organization of their support and treatment programs (Crowe & Salt, 2015; Pilling, Baron-Cohen, Megnin-Viggars, Lee, & Taylor, 2012).

According to clinical guidelines and professional recommendations for targeted behavioral and psychosocial treatment programs for coexisting psychiatric disorders, these interventions should (1) use a concrete and structured approach with greater use of written and visual information (e.g., worksheets, thought bubbles, and images) adapted to individual needs, (2) place greater emphasis on changing behavior, (3) contain psychoeducational components, and (4) use a group-delivered format which is supportive (NICE, 2012).

The overall goal of evidence-based interventions and support for autistic individuals is: (1) *maximizing potential*, (2) *minimizing obstacles*, and (3) *increasing the person-environment fit* (Lai, Anagnostou, Wiznitzer, Allison, & Baron-Cohen, 2020).

2.2.3 Maximizing potential

Maximizing the autistic individual's potential implies selecting interventions appropriate to the age, developmental level, and social-ecological context to facilitate development and build skills (Odom, Hume, Boyd, & Stabel, 2012; Wong et al., 2015). Naturalistic early interventions (e.g., JASPER, ESDM, EIBI) (Kasari, Freeman, & Paparella, 2006) performed with an active caregiver, alongside targeted interventions (e.g., social skills training, PEERS, psychoeducation), can play a crucial role in the autistic child's development (Reichow et al., 2014; Spain & Blainey, 2015; Wolstencroft et al., 2018).

2.2.4 Minimizing obstacles

Minimizing obstacles implies identifying and counteracting barriers that impede development and adaptation (Lord, 2020). Critical of many early interventions is to enhance verbal and non-verbal communication. Communication programs, such as the Picture Exchange Communication System (PECS), which trains using specific pictures to facilitate functional communication, are essential (Al-Batayneh, Nazer, Khader, & Owais, 2020; Brignell et al., 2018). Further, interventions targeting sensory hypersensitivity (Mazurek et al., 2013; Uljarević et al., 2017; Weitlauf, Sathe, McPheeters, & Warren, 2017) and repetitive behaviors (Boyd, McDonough, & Bodfish, 2012; Harrop, 2015; Kose, Fox, & Storch, 2018), alongside pharmacological interventions for comorbid psychiatric symptoms (e.g., depression; anxiety; sleep disorders) (Croen et al., 2015; Howes et al., 2018; Muskens, Velders, & Staal, 2017), may facilitate everyday functioning in ASD.

2.2.5 Optimizing person-environment fit

Optimizing the person-environment fit (Lai & Szatmari, 2019) implies addressing socio-ecological factors, which enhance adaptation and resilience in ASD. Support should be collaborative with autistic individuals, their families, and service providers taking a shared decision-making approach to optimize the person-environment fit (Elwyn et al., 2012). Designing autism-friendly contexts, including classrooms, work environments, and public spaces (Schopler, Mesibov, & Hearsey; Spain et al., 2021; Tola, Talu, Congiu, Bain, & Lindert, 2021) might enhance adaptive functioning and minimize barriers in individuals with ASD.

2.3 LEVELS OF ANALYSIS

Autistic core and comorbid challenges, including interventions related to those challenges, require multiple layers of comprehension (De Rubeis & Buxbaum, 2015). As shown in Figure 1, ASD can be categorized into three levels of analysis, each contributing to the complexity of ASD: 1) *the neurobiological level*, 2) *the neuropsychological level*, and 3) *the psychosocial level* (Lai et al., 2020). The biological underpinnings such as etiology and brain structure and function are analyzed at the neurobiological level. The psychological basis, such as executive function and autistic core symptoms, are studied at the neuropsychological level. Finally, the effects of biological and neuropsychological core challenges concerning social and vocational demands are analyzed at the psychosocial level.

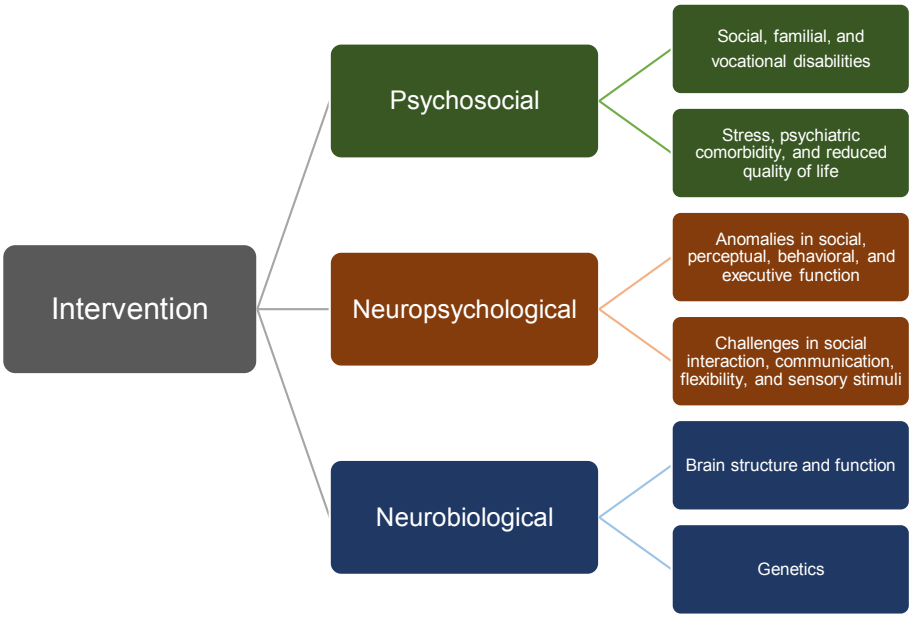

Figure 1. Levels of analysis in autism.

2.4 NEUROBIOLOGICAL LEVEL

2.4.1 Genetics

Twin studies have shown high heritability (> 80 %) in autism, although occurring in the context of environmental risks and gene-environment interplay (Ku et al., 2013; Ronald & Hoekstra, 2011). Some of the autistic phenotypes can be attributed to distinct etiological factors, such as Mendelian single-gene and de novo mutations (so-called syndromic autism, with a prevalence of about 5 % of all individuals with autism) (Iossifov et al., 2014; Krumm et al., 2015; Rao & Nelson, 2018).

The genetic architecture of autism has proven to be complex and heterogeneous, as shown by studies of cytogenetics, genetic linkage, association, whole-genome linkage or association, and, more recently, whole-genome or exome sequencing (known as next-gene sequencing) (Chan et al., 2021; Li et al., 2021). Further, autistic genetic variants have a high degree of pleiotropy (i.e., one gene affects more than one phenotype), explaining overlapping phenotypes, such as schizophrenia, ADHD, or bipolar disease (Murdoch & State, 2013; State & Levitt, 2011). Interestingly, genetic biomarkers, such as rare number copy variation, have been associated with intervention outcomes, such as in social skills group training (Tammimies et al., 2019).

2.4.2 Structural and functional neuroimaging

Over the last decade, in-vivo magnetic resonance imaging (MRI) and positron emission tomography (PET) studies have provided essential findings on the neural substrates underlying ASD, associated with neurodevelopmental variations in brain anatomy, functioning, and connectivity (Ecker, Bookheimer, & Murphy, 2015). However, some research indicates low neural connectivity (Just, Keller, Malavea, Kana, & Varma, 2012; Koshino et al., 2007; Müller et al., 2011), while other reports higher connectivity in ASD (Belmonte et al., 2004; Keown et al., 2013; Wass, 2011).

There is no complete comprehension of the exact way in which autistic connectivity deviates from the normal population. Hypotheses vary from decreased fronto-posterior and enhanced parietal-occipital connectivity, reduced long-range and increased short-range connectivity, to temporal binding deficits (Brock, Brown, Boucher, & Rippon, 2002; Just et al., 2012; Minshew & Keller, 2010). Further, the neurobiological development in ASD differs across the lifespan, implying different cortical abnormalities in autistic children compared to autistic adolescents and adults (Courchesne, Campbell, & Solso, 2011). As an example, toddlers with ASD (age 2–4 years) have, on average, a larger brain volume than typically developing children (Courchesne, 2002). However, this increased brain volume seems to

disappear around 6–8 years (Courchesne et al., 2001). Moreover, the altered neurodevelopmental trajectory of the autistic brain appears to vary across different brain regions, with the frontal and temporal lobes being affected more than the parietal and occipital lobes (Cai, Wang, Yang, Chen, & Huang, 2021; Carper & Courchesne, 2005; He et al., 2020). Cortical thickness and surface area are suggested to be determined by different types of progenitor cells, which divide in the ventricular zone to produce glial cells and neurons, affecting neural maturation and connectivity (Pontious, Kowalczyk, Englund, & Hevner, 2007). For example, atypical development of cortical grey matter in ASD is linked to abnormal maturation of cortical white matter (Casanova, 2004). Neural regions associated with ASD incorporate the frontotemporal and frontoparietal areas, amygdala, hippocampus, cerebellum, basal ganglia, and anterior and posterior cingulate (Amaral, Schumann, & Nordahl, 2008; Qi et al., 2020; Yang, Beam, Pelphrey, Abdullahi, & Jou, 2016).

Particular brain regions have been suggested to mediate specific clinical symptoms. For example, abnormalities in (1) medial prefrontal cortex, superior temporal sulcus, temporoparietal junction, amygdala, and fusiform gyrus are linked to social motivation and preference for social stimuli (Dichter, 2012; Philip et al., 2012); (2) Broca's area and Wernicke's area are associated with social communication and language deficits (Nielsen et al., 2014; Redcay & Courchesne, 2008; Zensho, Ishida, Nagai, Tsukahara, & Shimada, 2018); (3) frontotemporal regions and the amygdala are related to abnormal socio-emotional processing (Hirata et al., 2018; Kayarian, Jannati, Rotenberg, & Santarnecchi, 2020; L. Li et al., 2021); and (4) the orbitofrontal cortex and the caudate nucleus are linked to repetitive and stereotyped behaviors (Eisenberg, Wallace, Kenworthy, Gotts, & Martin, 2015; Wee, Wang, Shi, Yap, & Shen, 2014; Wolff et al., 2017).

2.4.3 Neuroendocrinology

Abnormal patterns regarding the immune-system and hypothalamic-pituitary-adrenal axis (HPA-axis) are observed in individuals with ASD and associated with comorbid stress, symptoms of depression and anxiety, and sleep disturbances (Hollocks, Howlin, Papadopoulos, Khondoker, & Simonoff, 2014; Masi et al., 2015; Sharpley, Bitsika, Andronicos, & Agnew, 2016). Research suggests that individuals with ASD are more vulnerable to stress due to challenges in coping with change, sensory aversions, and unpleasant events (Corbett, Muscatello, & Baldinger, 2019; Ogawa, Lee, Yamaguchi, Shibata, & Goto, 2016). Additionally, current evidence suggests that non-diagnostic features of ASD, such as circadian neuroendocrine dysregulation and increased inflammatory levels of cytokines, are associated with disturbed sleep-wake patterns and oxidative stress. Oxidative stress can be defined as a

disturbance in the balance between the production of reactive oxygen species and antioxidant defenses (Geoffray, Nicolas, Speranza, & Georgieff, 2016; Pangrazzi, Balasco, & Bozzi, 2020; Yavuz-Kodat et al., 2020). Studies examining the responsiveness of cortisol in ASD suggest both HPA axis *hypo*-responsiveness and *hyper*-responsiveness. Hypo-responsiveness typically occurs when the individual faces stressors that involve social threat. Instead, hyper-responsiveness primarily happens with stressors that involve unpleasant stimuli or relatively benign social situations (Bitsika, Sharpley, McMillan, & Agnew, 2018; Hadwin, Lee, Kumsta, Cortese, & Kovshoff, 2019; Taylor & Corbett, 2014).

Moreover, growing evidence shows that cortisol and arousal responsiveness are linked to depression and anxiety in ASD (Frankiensztajn, Elliott, & Koren, 2020; Muscatello, Andujar, Taylor, & Corbett, 2021; Panju, Brian, Dupuis, Anagnostou, & Kushki, 2015). In addition, heightened or varied cortisol levels and other endocrine dysregulation, such as alpha-amylase responses to stress, are associated with cognitive and behavioral inflexibility and uncertainty of novel situations in autistic individuals (Lydon et al., 2015).

2.5 NEUROPSYCHOLOGICAL LEVEL

2.5.1 Autistic traits

As described above, how autistic features manifest is significantly determined by gene-environment interplay, making 1-2 % of the population receive a clinical ASD diagnosis. However, autistic traits are normally distributed in the general population, indicating that autism should also be viewed as a natural part of the human genome (Frazier et al., 2014; Polimanti & Gelernter, 2017; Sikela & Searles Quick, 2018). In addition, research links autistic traits to lower openness, conscientiousness, extraversion, agreeableness, and emotional stability (Lodi-Smith, Rodgers, Cunningham, Lopata, & Thomeer, 2018).

From an evolutionary viewpoint, autistic traits may have been genetically selected due to the potential benefits of, for example, an extraordinary ability of systematization (Baron-Cohen, 2012; Baron-Cohen, Ashwin, Ashwin, Tavassoli, & Chakrabarti, 2011). A universal feature of the 'autistic brain' is exceptional attention to detail (Baron-Cohen, 2009; O'Riordan, Plaisted, Driver, & Baron-Cohen, 2001). This feature may represent the capacity to systemize the world around us, a highly adaptive human ability (Baron-Cohen, 2008). Individuals with such a capacity may have historically successfully traded products or services, thus increasing their reproductive fitness. Additionally, so-called 'savantism', defined as having skills significantly superior to others, may have been an essential advantage in particular areas (Paola, Laura, Giusy, & Michela, 2021).

2.5.2 Core challenges

ASD shows atypical development regarding social cognition, social perception, executive dysfunction, and abnormal bottom-up and top-down processing (Frith, 2012). Core features of social development include behavioral expressions and developmental precursors of mentalizing, such as joint attention, pretend play, eye contact, emotion perception, action–perception mirroring, social orienting, biological motion processing, and face processing (Boucher, 2012; Pelphrey, Shultz, Hudac, & Vander Wyk, 2011).

Many autistic individuals with normal intellectual capacity (i.e., IQ > 70) achieve some degree of explicit mentalizing. However, the implicit and intuitive components are still impaired, even in adulthood (Ronald, Viding, Happé, & Plomin, 2006; Senju, 2012; Yu Sun, Bareh, & Strube, 2014). In addition, mentalizing is closely linked to executive control, language, and self-referential cognition, thus associated with general executive functioning and self-awareness and not only social cognition (Apperly, 2012; Lombardo & Baron-Cohen, 2010; Lombardo et al., 2010).

As noted above, individuals with ASD typically have a preference for (and superiority in) processing of local rather than global sensory-perceptual features (i.e., local versus central coherence) (Happé & Frith, 2006). In addition, local coherence and top-down information processing in ASD are associated with attention to detail, enhanced sensory-perceptual processing and discrimination, idiosyncratic sensory responsivity (i.e., hyper- or hypo-sensitivity sensory stimuli or unusual interest in sensory features of the environment), and a preference for rule-based systems and behaviors (Baron-Cohen, 2009; Booth & Happé, 2018; Overskeid, 2016).

2.5.3 Executive dysfunction

Although inconsistent, empirical findings suggest executive dysfunction underlying repetitive, stereotyped behaviors and social communication deficits in ASD (Demetriou et al., 2018; White, 2013). In addition, executive dysfunction in ASD is linked to a broad range of higher-order neuropsychological domains, including goal-directed behavior, abstract reasoning, decision making, cognitive flexibility, and social regulation (Gardiner & Iarocci, 2018; Johnston, Murray, Spain, Walker, & Russell, 2019; Jones et al., 2018).

Research suggests that the underpinnings of executive dysfunction and core challenges in ASD may be related to an impaired ability of prediction (Cannon, O'Brien, Bungert, & Sinha, 2021; Sinha et al., 2014), deficits in emotional regulation and recognition (Barrett, 2016; Conner, White, Scahill, & Mazefsky, 2020; Griffiths et al., 2019), and context blindness (i.e., insensitivity to contextual cues) (Vermeulen, 2015; Westby, 2017). Furthermore, executive

dysfunction has been linked to difficulties to cope with daily hassles, thus provoking depression and anxiety and leading to reduced quality of life (de Vries & Geurts, 2015; Sáez-Suanes & Álvarez-Couto, 2021). Finally, research shows a relationship between specific types of ED, for example, cognitive inflexibility (i.e., set-shifting), and symptoms of anxiety and emotional distress (Brady et al., 2017; South et al., 2015; Wallace et al., 2016).

2.6 PSYCHOSOCIAL LEVEL

2.6.1 The function of abnormality

For something to be abnormal, it has to deviate from what is defined as normality (Millon, 1991). However, what is normal is a somewhat arbitrary and relative concept defined in relation to a particular context (Gildberg, Bradley, Fristed, & Hounsgaard, 2012). Although debated, the most common definitions of normality in clinical psychology and medicine are based on the central limit theorem and take a mechanistic stand (Sirignano & Spiliopoulos, 2020). However, some researchers argue that a mechanistic model of autism is limited since it disregards how autism relates to ideas about what kind of behavior is abnormal (Verhoeff, 2013). According to post-structural and discourse analytic perspectives, 'autistic identity' is continuously negotiated as a counterpart of mainstream society and sometimes expressed as 'neurodiverse' in contrast to 'neurotypical' (Edwards & Potter, 1993; Lester & Paulus, 2012; Ochs, Kremer-Sadlik, Sirota, & Solomon, 2004).

Moreover, from a contextual viewpoint, autistic core features are embedded in a social and cultural context (Broome & Bortolotti, 2010; Chapman, 2019). Hence, defining autism depends on historically and culturally variable ideas about deficiency, abnormality, and dysfunction (Verhoeff & Glas, 2010). Seeing autism as 'different' rather than 'abnormal' may facilitate optimizing the person-environment fit, including adapted home environments, schools, and workplaces (Altenmüller-Lewis, 2017; Nagib & Williams, 2017; Pfeiffer, Brusilovskiy, Davidson, & Persch, 2018).

2.6.2 Psychosocial stress

According to minority stress theories (Hendricks & Testa, 2012; Meyer, 2003), being perceived (or to perceive oneself) as abnormal or inferior gives rise to increased subjective stress and more release of stress hormones, such as cortisol (Denmark et al., 2010; Sapolsky, 1989, 2005). According to this perspective, mental health problems result from *external events,* such as workplace harassment, discrimination, or physical violence), and *internal events,* such as

negative beliefs about oneself or feeling wrong or less valuable. These kinds of stressors are experienced disproportionately by minority groups (Hendricks & Testa, 2012; Meyer, 2003).

Moreover, minority stress may help explain autistic coping and resilience strategies, such as connecting with other autistic individuals who share similar experiences, often resulting in a strong within-group identity (Cooper, Smith, & Russell, 2017). Some research suggests a more individualized stance on autism, potentially giving rise to a view of autistic individuals as different rather than abnormal (Anderson-Chavarria, 2021). Nevertheless, psychosocial stress is a significant concern in autistic individuals, associated with psychological challenges and increased emotional distress (Mazefsky, 2015; McGillivray & Evert, 2014; Rosen, Mazefsky, Vasa, & Lerner, 2018).

2.6.3 Health concerns

As noted above, inherited core challenges and being different from most people increase the risk of comorbid health problems in autistic individuals. More than 70 % of individuals with ASD have co-occurring medical, developmental, or psychiatric conditions (Lai et al., 2019). Some childhood comorbid conditions appear to persist into adolescence, while others debut in adolescence or adulthood, such as epilepsy or depression (Joshi et al., 2013; Kohane et al., 2012; Simonoff et al., 2013). However, what causes comorbid health issues in ASD is not thoroughly studied. Health problems in ASD may result from shared pathophysiology, secondary effects of growing up with autism, shared symptom domains, or over-lapping diagnostic criteria (Lai, Lombardo, & Baron-Cohen, 2014). What is known is that autistic individuals have a 2-8 times higher mortality risk and that this effect is associated with physical and mental comorbidity (Hirvikoski et al., 2020; Hirvikoski et al., 2016).

Moreover, evidence suggests stress and traumatic events as risk factors for comorbidity and worsening ASD core symptoms (Berg, Shiu, Acharya, Stolbach, & Msall, 2016; Taylor & Gotham, 2016). Evidence supports physiological effects, such as hyperarousal, in response to stressors, such as social interaction or unexpected experiences (Muscatello & Corbett, 2018; Spratt et al., 2012; Taylor & Corbett, 2014).

In sum, findings indicate that individuals with ASD experience greater perceived and interviewer-observed stress associated with social functioning in ASD. Accordingly, treatments addressing stress and coping in ASD have been requested (Bishop-Fitzpatrick, Mazefsky, Minshew, & Eack, 2015).

2.7 ASSESSMENT AND METHODOLOGY

2.7.1 Participatory research

In autism research, as far as possible, is recommended a *participatory* research methodology incorporating the views of autistic people and their allies about what research is done, how it is done, and how it is implemented (Cornwall & Jewkes, 1995; Fletcher-Watson et al., 2019). This approach implies recognizing and undermining the traditional power imbalance between researcher and participant (Helen, 1996). Examples of participatory research may include autistic researcher leadership, professional partnership with autistic individuals, and engagement with the autistic community, for example, via social media or contact with community organizations. Another critical feature is adapting the research environment, methodology, and dissemination to facilitate accessibility and motivation for research participation (Long, Panese, Ferguson, Hamill, & Miller, 2017). The use of a *community involvement statement*, stating the degree of involvement from the autism community, has more and more become a gold standard in autism research (Pellicano et al., 2014).

2.7.2 Measurements

A general problem in autism research is that interventional studies are limited in quantity and quality (Bishop-Fitzpatrick, Minshew, & Eack, 2013; Howlin & Moss, 2012). For example, a systematic review by Bishop-Fitzpatrick et al. (2013) showed that, out of 1217 studies, only 13 met inclusion criteria which were (1) single case studies, non-controlled trials, non-randomized controlled trials, or RCT designs reporting pre-test and post-test data, (2) studies using quantitative data, and (3) participants with ASD that were 18 years or older.

Regarding assessing comorbid health aspects in ASD, some challenges are to consider. According to a systematic review by Brugha, Doos, Tempier, Einfeld, and Howlin (2015), there is a lack of sensitive, valid, and reliable outcome measures in autism. The authors report problems such as measures are (1) unrelated to the primary treatment focus, (2) non-ASD specific and (3) not adapted to the level of functioning or IQ, and (4) not validated for the ASD population.

Moreover, many features of autism, such as social withdrawal or sleep problems, overlap with symptoms of depression and anxiety, making it sometimes difficult for autistic individuals to identify that they are experiencing these conditions (Kerns et al., 2015; Quek, Sofronoff, Sheffield, White, & Kelly, 2012; Stewart, Barnard, Pearson, Hasan, & O'Brien, 2006). Further, characteristics associated with ASD may affect the way psychiatric comorbidity presents itself in autistic individuals (Stewart et al., 2006). For example, about 50 % of autistic individuals

have alexithymia, defined as a difficulty in describing and identifying feelings and emotions, which may impact how symptoms of depression and anxiety are perceived, reported, and measured in autistic people (Bagby, Parker, & Taylor, 1994; Berthoz, Lalanne, Crane, & Hill, 2013; Hill, Berthoz, & Frith, 2004). Therefore, using valid, reliable, and sensitive measures in autism research is essential.

2.7.3 Autism adapted terminology

When communicating research findings, it is essential to use autism-friendly language and terminology respectful to autistic people, their families, and caregivers (Autism, 2021). Although autistic individuals do not always agree on the preferred language, research shows that many prefer identity-first language (e.g., 'autistic person') to person-first language (e.g., 'person with autism') (Bury, Jellett, Spoor, & Hedley, 2020; Kenny et al., 2016). Moreover, instead of using vague terminologies, such as 'low-functioning' or 'severe autism', authors are warranted to use precise clinical characteristics to describe samples – for example, referring to cognitive or verbal abilities, support needs, or specifying intellectual disability where relevant (Alvares et al., 2020). Finally, while diagnostic labels, such as 'autism spectrum disorder', may sometimes be necessary, terminology with negative connotations, such as 'at risk of autism' or describing autism as a disease or illness, should be avoided (Fletcher-Watson et al., 2017).

In sum, there is a need for validated, adapted, and treatment-specific self-report measures and objective data collection, for example, using significant others and clinical interviews. Furthermore, it is essential to use autism-friendly language and well-controlled participatory trials in ASD.

2.8 COGNITIVE BEHAVIOR THERAPY

Cognitive behavior therapy (CBT) is a psychotherapy approach primarily based on learning principles and cognitive theories that has a solid evidence base and is the treatment of choice for many psychiatric disorders in the non-autistic population (Clark, 2011; Hofmann, Asnaani, Vonk, Sawyer, & Fang, 2012). In ASD, adapted individualized and group-based CBT protocols show reduced symptoms of anxiety and depression and increased quality of life, and the group delivered interventions are generally well-suited, supportive, and cost-efficient (Hesselmark, Plenty, & Bejerot, 2014; Lai et al., 2020; Spain, Sin, Chalder, Murphy, & Happé, 2015). Additionally, research indicates that CBT may improve autistic core challenges, such as social skills (Wood et al., 2009), emotion regulation (Scarpa & Reyes, 2011), independent living (Drahota, Wood, Sze, & Van Dyke, 2011), and executive function (Kenworthy et al., 2014).

Furthermore, clinical conceptualizations of CBT for autistic individuals have provided essential information on how to address autistic challenges in psychotherapy (Gaus, 2007, 2011).

Although promising, some obstacles in applying CBT to autistic adults have been observed, such as difficulties in grasping cognitive restructuring, such as disputing irrational thoughts, generalizing techniques to everyday life, and limited long-term effects (Burke, Waitz-Kudla, Rabideau, Taylor, & Hodapp, 2019; Cardaciotto & Herbert, 2004; Weiss & Lunsky, 2010). Moreover, for example, Burke et al. (2019) highlight the need for a flexible, trial-and-error stance, alongside listening to the needs of autistic youths and their parents when conducting intervention studies.

In general, research indicates that a range of adaptations is needed to the structure and process of CBT in ASD. The modifications of CBT for autistic adolescents and adults, described in Spain and Happé (2020), can be summarized as (1) *additions* to standard practice (e.g., allowing to do things that make patients feel comfortable such as not making eye contact or fiddling with objects), (2) *omitting* from standard practice (e.g., managing core beliefs), and (3) *modifications* of standard practice (e.g., using pictures to facilitate communication).

To summarize, research on CBT for autistic individuals suggests that adapted CBT may have beneficial effects on comorbid mental health problems, such as anxiety and depression, and autistic core challenges, such as executive dysfunction and difficulties in social interaction, and enhance the resilience of psychological distress in ASD.

2.9 MINDFULNESS-BASED THERAPIES

The concept of *mindfulness* can be traced into two separate traditions and definitions. Eastern philosophies traditionally conceptualize mindfulness as non-judgmental and non-reactive attention to experiences occurring in the present moment (Kabat-Zinn, 1982). In contrast, Western concepts define mindfulness as heightened attention to variability and openness to novelty, compared to *mindlessness,* defined as an inflexible use of information. A 'mindless' individual is thus not fully aware of information's potentially novel and helpful aspects (Langer & Piper, 1987). Meta-analyses of mindfulness-based therapies for individuals with ASD indicate overall improvements in anxiety, depression, and rumination (Cachia, Anderson, & Moore, 2016; Sizoo & Kuiper, 2017). Moreover, there are personal experiences of beneficial mindfulness practice within the autistic community (Wilson, 2015).

Research indicates that mindfulness practice may address the cognitive and behavioral inflexibility observed in ASD (Poquérusse, Pagnini, & Langer, 2021). In addition, the

beneficial effects of mindfulness in ASD might be related to three core cognitive theories of ASD: (1) *Theory of mind* (Baron-Cohen, Leslie, & Frith, 1985), (2) *Weak central coherence* (Happé & Frith, 2006), and (3) *Executive function* (Demetriou et al., 2018).

Regarding theory of mind, mindfulness practice may facilitate *tuning in* to others' contextual cues and perspectives. This process focuses on eye and facial expressions, story details, and vocalization characteristics representing shifts in emotions and mental states. Concerning weak central coherence, practicing mindfulness may help shift perspectives and broaden attention, rather than automatically paying excessive attention to detail. Finally, with regards to executive function, mindfulness is suggested to enhance flexible attention shifting (i.e., promote multiple perspectives and shift attentional foci), which are associated with executive function and cognitive performance in ASD, particularly in individuals with a comorbid attention deficit (Adams & Jarrold, 2012; Stevens, Peng, & Barnard-Brak, 2016).

Regarding mindfulness-based clinical interventions, an MBSR-protocol adapted to autistic adults has been shown to improve depression, negative affect, and rumination in autistic adults (Spek, van Ham, & Nyklíček, 2013). Another MBSR-study reported reduced anxiety, depression, somatization, inadequacy in thinking and eating, sleeping problems, distrust and interpersonal sensitivity, rumination, and increased general physical and psychological wellbeing in adults with ASD (Kiep, Spek, & Hoeben, 2015). Furthermore, Conner and White (2018) found increased emotion regulation abilities and impulse control in autistic adults practicing mindfulness.

In sum, research indicates that mindfulness-based interventions may improve mental health and emotion regulation in autistic individuals and that there is some understanding of the processes behind these improvements.

2.10 ACCEPTANCE AND COMMITMENT THERAPY

2.10.1 Contextual behavioral science

Scientific disciplines and clinical approaches evolve and develop in various ways, including empirical research, conceptual analyses, dissemination, and practice (Vidal-Rosset, 2019). Acceptance and commitment therapy (ACT) is a transdiagnostic contextual–behavioral approach, combining a functional analytical behavioral model with relational frame theory (RFT), which is a theory of language and cognition (Hayes, Barnes-Holmes, & Wilson, 2012).

Several meta-analyses of ACT have been published; for a list, see Hayes (2021a). ACT has demonstrated efficacy across a range of clinical concerns (A-Tjak et al., 2015; Powers,

Zum Vörde Sive Vörding, & Emmelkamp, 2009), with solid research support for chronic pain and modest research support for depression, mixed anxiety disorders, obsessive-compulsive disorder, psychosis, and psychological distress in parents of autistic children (APA, 2016; Prevedini et al., 2020).

The scientific and theoretical assumptions underlying acceptance and commitment therapy (ACT) are congruent with those expressed in contextual behavioral science (CBS) (Hayes, 2021b). CBS' overall scientific truth criterion and philosophical underpinnings are based on pragmatism (Long, 2013; Wilson, Whiteman, & Bordieri, 2013) and functional contextualism (Hayes & Fryling, 2019). From a functional contextual perspective, the basic unit of analysis is the behavior of whole organisms interacting in and with a current and historical context so that act and context cannot wholly be separated (Hayes, Long, Levin, & Follette, 2013). Notably, functional contextualism may thus provide a coherent scientific epistemology to ensure that theory and methodology cohere across contextual dimensions, such as time and location (Hayes et al., 2012). Furthermore, ACT's continuously evolving theoretical underpinnings are centered around the psychological flexibility model (McCracken & Morley, 2014). This model is a process-oriented approach to treatment development, integrating behavioral and cognitive principles, with the potential to generate general applications to a diverse range of psychological problems.

2.10.2 Functional contextual aspects of intervention

As shown in Figure 2, a functional contextual treatment approach may differ from a non-functional contextual approach regarding (1) truth criterion, (2) identity, (3) treatment objective, and (4) treatment focus (Hayes, Villatte, Levin, & Hildebrandt, 2011).

Approach	Truth criterion	Identity	Objective	Focus
Non-functional contextual	**Norm-based** (social skills training)	**Identity as a clinical feature** (diagnosis)	**Symptom reduction** (depression)	**Direct** (working memory training)
Functional contextual	**Pragmatic** (personal value-based behavior goals)	**Identity as an event** (defuse an unhelpful perception of self)	**Disrupt functional relation between symptoms and mind** (acceptance of anxiety)	**Indirect** (handling thoughts, emotions, and body sensations)

Figure 2. Theoretical aspects of intervention, comparing a contextual behavioral and a non-contextual behavioral perspective. Examples are presented in parenthesis.

Regarding treatment options for complex conditions, such as ASD, these conceptual differences may impact the optimal treatment approach in a given context. For example, in many interventions, a successful treatment outcome is the withdrawal of symptoms (e.g., anxiety) (Huda, 2021). In contrast, according to a functional contextual model, the withdrawal of symptoms *per se* is not the primary treatment objective. Instead, the treatment target is to behave in a particular way (a so-called *behavioral goal)*, which may or may not reduce symptoms. However, if the behavior is helpful, it generally increases long-term quality of life and adaptive functioning. An example is a woman who decides to go to a social event (behavioral goal), which, by experience, sometimes includes anxiety and sometimes doesn't (symptom). Nevertheless, although she is anxious during the event, it feels meaningful and valuable to be there (quality of life).

In functional contextual terms, the so-called *functional relationship* (Assaz, Roche, Kanter, & Oshiro, 2018) between going to a social event and having anxiety is disrupted. Consequently, anxiety is no longer an *obstacle* to go the social event. It is possible to have anxiety and, *at the same time,* carry out the behavioral goal. Another example is an autistic man who decides to go by bus (behavioral goal) since it facilitates keeping in contact with a friend (value). On the bus, he is disturbed by noises (symptom). He also has distressing thoughts ('I can't stand these noises'), emotions (fear, irritation), and body sensations (heart palpitation, dizziness). However, if he would cope with what distresses him, going by bus may increase long-term independent living (adaptive functioning).

In the second example, what guides intervention is the individual's own pragmatic and purposeful behavior (going by bus). It is not getting rid of the distressing symptoms (noises, thoughts, emotions, or body sensations). Such an intervention uses a so-called *pragmatic truth criterion* in functional contextual terms. A successful outcome is thus measured by how much the individual behaves in line with personally chosen behavior goals (Wilson et al., 2013). In contrast, norm-based interventions (e.g., social skills training or early intensive behavioral intervention) (Choque Olsson et al., 2017; Frazier et al., 2021) aim at developing behaviors related to a specific social and societal context. For example, training the behavior ('keeping eye contact during a conversation') assumes that keeping eye contact during a conversation is appreciated in that particular context. Further, it may be unrelated to the individual's personally chosen behavioral goal. For example, if the behavioral goal is to 'listen carefully to what the person says'. Instead, for an autistic individual, keeping eye contact may be incompatible with listening carefully.

Moreover, some interventions treat *identity* (e.g., ASD) as a clinical feature (e.g., psychoeducational programs for a specific diagnosis). In contrast, functional contextual interventions treat identity as a *thought*, which the individual can choose to disregard (if so desired and if it is unhelpful). For example, an autistic individual may have the thought, 'I have autism, so I can't see other people'. This thought may then be an obstacle to pursuing a personally chosen goal if that goal is to see other people.

Finally, the treatment focus is generally *indirect in a functional contextual approach,* referring to acquiring skills (a) to obtain value-based behavioral goals (b). For example, developing the skill to manage unhelpful thoughts (a), such as 'I have autism, so I can't see other people' (so-called cognitive defusion in ACT), may help to see other people (b) (value-based goal). Hence, acquiring the skill has in itself no value. In contrast, *direct* interventions use skills (a) that are the same as the behavioral goals (a). For example, this might be the case in working memory training where the skill (a) and the behavior goal (a), in both cases, are acquiring working memory capacity (Wagle et al., 2021; Wang et al., 2017).

2.10.3 Relational frame theory (RFT)

Operant learning theory (Skinner, 1963) is not enough to explain complex human behavior. For example, how come an autistic individual can immediately change his or her behavior based on a particular verbal rule (Tarbox, Zuckerman, Bishop, Olive, & O'Hora, 2011), such as 'I have my blue jacket on, so then I can see a friend'? In an ACT treatment, relational frame theory (RFT) is a theory of language and cognition that complements operant learning theory in explaining and influencing behavior (Barnes-Holmes, Barnes-Holmes, & Cullinan, 2000). Notably, RFT explains how contingencies that are abstract and have never occurred can impact behavior. For example, someone telling you don't go into that alley, you might get robbed' may make most of us less likely to go into the alley, even if we have not experienced being robbed in an alley. According to RFT, behaviors not under the control of direct contingencies can instead be controlled by so-called *relational framing.* The relevance of relational framing for ACT in general and ACT for autism, in particular, is explained below.

Relational framing is an ability humans appear to be predisposed to develop early in life through social reinforcement. As shown in Figure 3, this ability, which is absent in non-human species, can be categorized into three principles: (1) *Mutual entailment*, (2) *combinatorial mutual entailment*, and (3) *transformation of stimulus functions*.

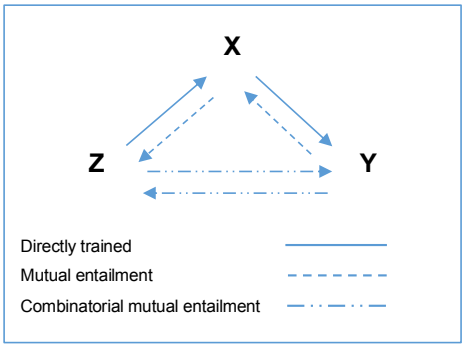

Figure 3. Direct training, mutual entailment, and combinatorial mutual entailment. Stimuli can be related in a vast number of ways; by coordination (e.g., X is the same as Y and Z), Comparison (e.g., X is more than Y, and Y is more than Z); and temporality (e.g., X precede Y, and Y precede Z). Only two relations need to be directly learned, while the others are derived.

2.10.4 Mutual entailment

Mutual entailment refers to the ability to mutually derive the relationship between *arbitrary* stimuli (i.e., arbitrarily applicable relational responding, AARR), in contrast to deriving the relationship between stimuli based on their physical appearance (e.g., short-long). For example, if a banana (stimulus X) is equal to an apple (stimulus Y), then we can conclude that the apple (Y) is also equal to the banana (X). Clinically, mutual entailment becomes problematic when we change the banana for a catastrophic thought, for example, 'I will never make it' and the apple for anxiety. Then the thought 'I will never make it' will not only be followed by anxiety. The anxiety will automatically elicit the thought 'I will never make it', which brings out more anxiety, eliciting more catastrophic thoughts, etcetera.

2.10.4.1 Combinatorial mutual entailment

AARR between three or more stimuli uses combinatorial mutual entailment. For example, suppose a banana (Y) is bigger than an apple (X), and a kiwi (Z) is bigger than the banana (Y). We can derive that the kiwi (Z) is bigger than the apple (X). Notably, when relational responding is established, we do not need to train the relationship between the stimuli directly. Instead, we can derive this information based on the relationship between stimuli. Clinically, if we are told that seeing a friend (Y) is worse than staying at home (X). And going to a party (Z) is worse than seeing a friend (Y). Then we can conclude that going to a party (Z) is worse than staying at home (X).

2.10.4.2 Transformation of stimulus functions

AARR allows *stimulus functions* of events (i.e., the event's reinforcing consequence) to be transformed by other events based on the derived relation between them without direct training (Dymond & Rehfeldt, 2000). For example, say that stimuli X, Y, and Z represent lions with the stimulus function of eliciting fear, and the relationship is X < Y < Z. Then lion Z will provoke the most fear, lion Y will cause less fear than lion Z, and lion X will elicit the slightest fear. Clinically, if we are told that staying at home (X) will give us anxiety (stimulus function). And that seeing a friend (Y) is worse than staying at home (X), and going to a party (Z) is worse than seeing a friend (Y). Then going to a party (Z) will elicit the most anxiety, seeing a friend (Y) will elicit less anxiety, and staying at home (X) will provoke the least anxiety. The point here is that thoughts, previously perceived as neutral, can take on aversive functions via transformation of stimulus function (i.e., provoking distress).

In sum, relational framing explains how arbitrary stimuli (e.g., thoughts) can take on functions (e.g., be distressing) without any direct experience of those thoughts provoking distress. Hence, making thoughts less distressing is an important treatment goal in ACT, which we will further explore below. But first, I will go through a specific type of relational framing, namely *rule-governed behavior*.

2.10.5 Rule-governed behavior

Using the RFT concept of rule-governed behavior may explain how thoughts can impact our behaviors. According to RFT, rule-governed behavior is a learned behavior controlled by the correspondence between relations specified in a particular verbal rule and the behavior carried out by a person (Hughes, 2016). In simple terms, behavior is reinforced by doing what is right according to the rule. For example, one can respond effectively to the rule 'If you drink petrol, you will die' without ever having to directly contact the contingencies (i.e., without ever engaging in the behavior of drinking petrol or experiencing dying). A clinical example of RGB would be an autistic person's verbal rule: 'I have Asperger, so I can't see other people', probably having the function of maintaining social avoidance.

There are different types of verbal rules, each having a specific function. For example, coordination (i.e., sameness; equivalence), opposition (i.e., contrast), comparison (i.e., comparing), temporal (i.e., time continuum), conditionality (i.e., conditioning), and deictic (perspective-taking). Behavioral analytically, verbal rules can be defined as stimuli that alter other stimulis' operant and respondent properties, which is consistent with the RFT conceptualization of RGB (Barnes-Holmes et al., 2000; Skinner, 1957). The antecedent stimulus (1) 'I have Asperger' participates in an equivalence relation (or frame of coordination)

with the (a) physical experience of being sensitive to external stimuli (e.g., sounds; smells), (b) aversive emotions (e.g., shame; sadness), and (c) challenging thoughts (e.g., 'I'm odd'; 'I can't stand these noises'). The stimulus (2) 'see other people' participates in equivalence relation with the actual behavior of seeing other people. Stimuli (1) and (2) are relationally framed as *conditionally oppositional* contextual cues (if/then), implying that they cannot exist simultaneously. Hence, as long as stimulus (1), alongside its associated frames (a), (b), and (c), is present, the verbal rule 'I have Asperger, so I can't see other people' functions as an operant which negatively reinforces social avoidance. Put another way: 'Since I have Asperger, as long as I avoid other people, I don't have to experience distressing thoughts, feelings, and body sensations'.

It should be noted that the *topography* (i.e., the *content* of thought) of the contextual cue (if/then) is irrelevant as long as the *stimulus function* (i.e., the *reinforcing consequent* of thought) is the same (e.g., the contextual cue has discriminative control over behavioral contingencies). Using the if/then contextual cue in other examples could illustrate the stance that different topography can have the same stimulus function (in these cases, the function of reinforcing avoidance): 'If I have anxiety, then I can't go out' or 'If I have autism, then I can't have friends'.

2.10.6 Experiential avoidance

As indicated above, RFT may help explain how cognitive and verbal processes can lead to dysfunctional behaviors. Due to the transformation of stimulus functions, harmless words and thoughts can suddenly be aversive. Consequently, thoughts (and also emotions and body sensations) that are related to painful or distressing events are avoided as if equivalent to the event itself, a process known as *experiential avoidance* (EA) (Hayes, 2015). Hence, since thoughts, emotions, and body sensations are present in practically every life situation, EA can be viewed as a particular *functional class* that inhibits broadening an adaptive behavioral repertoire and reduces quality of life (Boulanger, Hayes, & Pistorello, 2010).

EA is described as consisting of two related parts: (a) the unwillingness to remain in contact with aversive so-called *private events*, such as cognition (e.g., thoughts; memories; mental images), emotions (e.g., fear; sadness; anger), and body sensations (e.g., pain; heart palpitation; muscle tension), and (b) the action taken to alter the aversive experiences or the events that elicit them (Villatte et al., 2016). Further, EA is essential for developing and maintaining psychopathologies, such as depression and anxiety, in the normal population (Cookson, Luzon, Newland, & Kingston, 2020; Kirk, Meyer, Whisman, Deacon, & Arch, 2019).

2.10.7 Psychological flexibility

In contrast to experiential avoidance, the overall treatment goal in ACT is enhancing psychological flexibility, defined as non-judgmentally experiencing thoughts, emotions, and body sensations and acting effectively upon situational demands according to personally chosen goals and values (Hayes et al., 2011). Psychological flexibility is facilitated mainly through (1) behavioral change techniques using *values* and behavioral goals, and (2) *cognitive defusion* and *acceptance* to manage thoughts, emotions, and body sensations.

Values are essential to facilitating psychological flexibility in ACT, referring to motivating augmental verbal rules (i.e., altering the value of reinforcing contingencies) that include personally chosen behavioral goals, providing meaning, and reinforcing adaptive behavior (Paliliunas, 2021). In contrast to obtainable goals, values serve as behavioral guidance and direction (Barrett, O'Connor, & McHugh, 2019), such as valuing physical health or contacting a friend or family member.

Acceptance is an active and aware embrace of thoughts, feelings, and body sensations without unnecessary attempts to change their frequency or form (Hayes, Luoma, Bond, Masuda, & Lillis, 2006).

Cognitive defusion refers to observing thoughts without necessarily believing their content or letting them guide one's actions (Gillanders et al., 2013).

Chapter 3

ACT and Autism

This doctoral thesis started its journey in 2007-2008 as part of a clinical psychology master thesis. As a supervisor at a school for children with ASD, I recognized the need for stress-reducing approaches for the students. At the time, my sparse knowledge of mindfulness and ACT was primarily anecdotal. However, my intriguing curiosity to explore the eventual merge of, on the one hand, a functional contextual perspective and, on the other, a cognitive neuroscientific one kept me going.

So, when summarizing the acquired experience of adapting and evaluating ACT for autistic individuals, conceptualizing ACT into ASD may imply a crossroads between two opposite perspectives: (1) one may view ACT as something diametrically opposite to ASD and thus *dissuade* from further exploration and evaluation of such an approach, or (2) one may view ACT as something diametrically opposite to ASD, and thus *recommend* it for further exploration and evaluation of such an approach.

Arguably, the first perspective views psychological treatment as a means to an end, while the second views it as simultaneously a means *and* an end. The logical consequence of the first perspective is to create a treatment that is *congruent* with the actual clinical diagnosis (e.g., intuitively comprehensible; diagnosis-specific; focus on symptom reduction per se). However, the second perspective represents a treatment *incongruent* with the actual diagnosis (e.g., not automatically intuitively comprehensible; not diagnosis-specific; focus on skills acquisition) (Atzil-Slonim et al., 2015; Grafanaki & McLeod, 2002). Furthermore, the second perspective implies the acquisition of skills that might be opposite to the diagnosis-specific challenges (e.g., acceptance vs. social avoidance; value-based action vs. rule-governed behavior). Consequently, in this view, diagnosis-specific challenges are not obstacles to a successful treatment that need to be considered but why the treatment is relevant and can make a

difference. Practicing what is perceived as challenging and essential to dysfunction may help the individual improve long-term mental health.

As shown in Figure 4, the conceptualization of ACT can be viewed in the framework of the biosocial model for resilience to adversity in ASD (Scarpa, Swain, Factor, Dahiya, & Bertollo, 2021). In this model, psychological flexibility (e.g., emotion regulation, social reciprocity, or behavioral flexibility) along with physiological flexibility (e.g., arousal regulation, cardiac vagal control, or functional executive regulation) act as modulators between biosocial vulnerability (e.g., core challenges, executive dysfunction, or deviant neurobiology and neuroendocrinology) and resilience in individuals with ASD. Enhancing flexibility in response to stressful events can thus, directly and indirectly, increase resilience, such as quality of life; well-being, adaptive functioning, and reduced psychopathology.

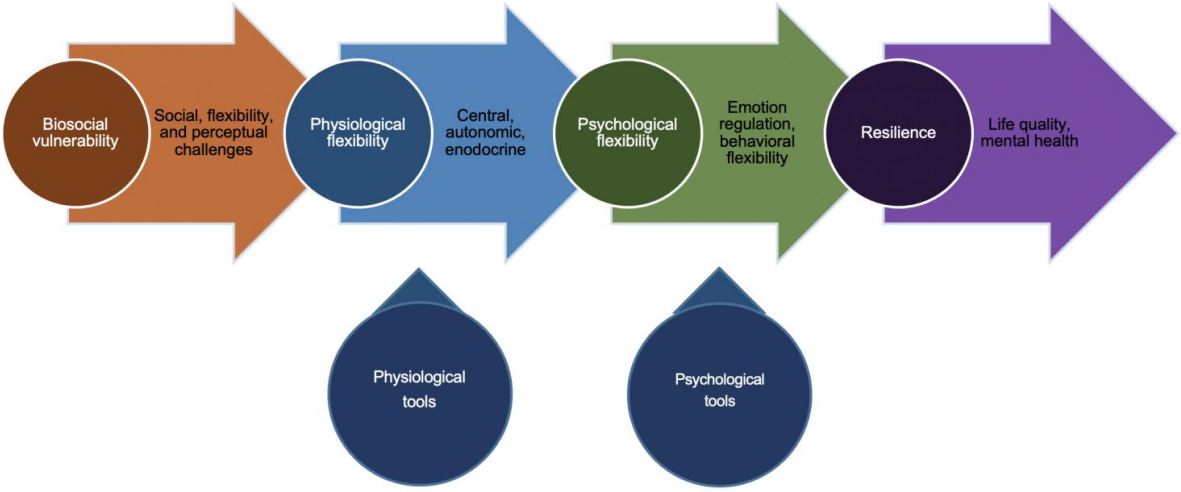

Figure 4. The biosocial model for resilience to adversity in ASD (Scarpa et al., 2021). When faced with biosocial vulnerability, the path to maladjustment can be broken. Resilience in autistic individuals can be enhanced through flexibility tools that change underlying physiological and psychological processes. Physical exercise, relaxation, and potentially biofeedback and brain stimulation techniques can reduce autonomic hyperarousal and increase cardiac vagal control having downstream effects on executive functions, emotion regulation, and social behavior. Cognitive-behavioral and mindfulness-based tools related to problem-solving and reappraisal of biased thoughts can improve physiological processes and attention, memory, impulsive responding, and negative affect. Social tools can improve reciprocity. Enhancing flexibility in response to stressful events can thus increase resilience in autistic individuals as indexed by reduced psychopathology or behavior problems and improved life satisfaction, well-being, adaptive functioning, and quality of life.

3.1 A FUNCTIONAL CONTEXTUAL FRAMEWORK ON AUTISM

From a functional contextual perspective, autistic core challenges, such as difficulties with social reciprocity, cognitive inflexibility, and sensory hypersensitivity, are not object to change *per se*. Instead, they are relationally framed with the functional contingencies of thoughts, emotions, and body sensations (i.e., private events) (Hayes et al., 2011) and thus indirectly manipulable.

Key (1) to behavioral change and transformation of stimulus function of these core challenges is thus to modify the functional connection between private events and autistic difficulties, making them less an obstacle to reaching value-based and long-term behavior goals. In other words, the overall treatment objective is to help the individual be less hindered by private events and *indirectly* decrease the negative effect that autistic functioning may have in everyday life.

Key (2) to behavioral change is not only the transformation of stimulus function of private events related to ASD challenges but the acquisition (or increase) of behaviors and skills correlating with adaptive functioning and value-based behavior goals, such as cognitive defusion, acceptance, self-awareness, and direct-contingent behavior.

ASD is associated with reduced behavioral and cognitive regulation abilities, such as heightened cognitive fusion and decreased self-awareness (Huang et al., 2017; Maisel, Stephenson, Cox, & South, 2019; Williams, 2010). Hence, enhancing cognitive defusion and self-awareness may improve autistic functioning (Bednarz et al., 2020).

3.2 NEUROACT CONCEPTUALIZATION OF AUTISM

As noted above, indirect and direct treatment pathways may be associated with beneficial effects on autistic functioning. Autistic core and comorbid challenges, alongside hindering thoughts, emotions, and body sensations related to these challenges, can be conceptualized as *psychological inflexibility* (Pahnke et al., 2019; Pellicano, 2012). In contrast, the overall treatment goal in ACT is creating *psychological flexibility*, referring to the ability to behave in line with what's important to oneself and cope with obstacles that usually stop oneself from carrying out those behaviors (Hayes & Wilson, 1994).

As presented in Figure 5, the NeuroACT treatment model is conceptualized as meeting ASD challenges within three domain pairs using a modified version of the Open-Aware-Active ACT model (Hayes et al., 2011; Strosahl, Robinson, & Gustavsson, 2015; Villatte et al., 2016): 1) *Motivation-Perseverance*, 2) *Acceptance-Avoidance* and 3) *Perspective-Mindlessness*. In short, the Open-Aware-Active model conceptualizes the six ACT processes (i.e., Acceptance,

Being present, Cognitive defusion, Self-as-context, Values, and Committed action) into three processes (i.e., Open, Aware, and Active). To adapt this model into ASD, the concepts of Motivation, Acceptance, and Perspective are used instead.

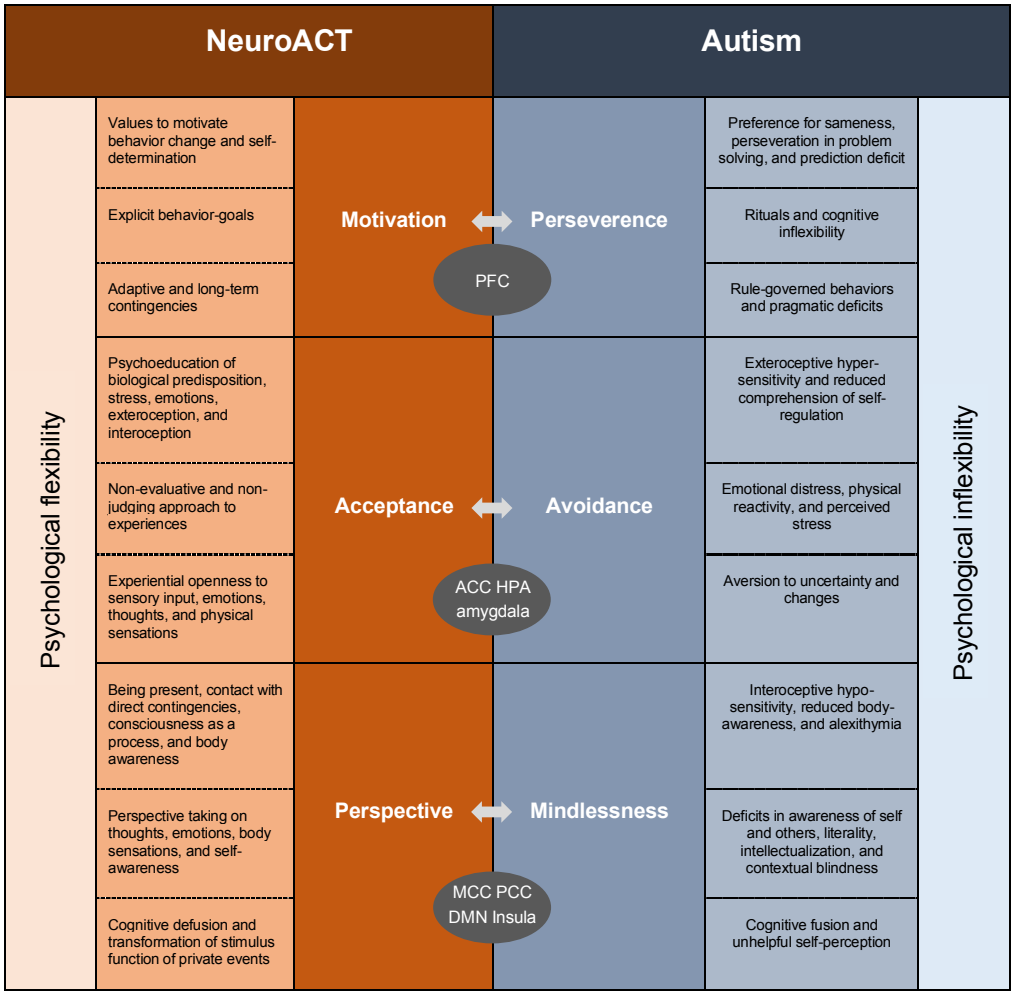

Figure 5. NeuroACT conceptualization of autistic challenges. Psychological flexibility is represented by the MAP acronym: Motivation – Acceptance – Perspective. Psychological inflexibility is represented by the inverted MAP acronym (iMAP): Perseverance – Avoidance – Mindlessness. Higher-order motivational processes are linked to prefrontal cortex (PFC) networks. Emotion regulation is associated with the anterior cingulate cortex (ACC), HPA-axis, and amygdala. Perspective-taking and body awareness are related to the middle cingulate cortex (MCC), posterior cingulate cortex (PCC), default mode network (DMN), and insula.

3.2.1 Motivation-Perseverance

In the *Motivation-Perseverance* domain pair, motivational cues, such as value-based and explicit behavior-goals and contact with adaptive long-term behavioral contingencies, are hypothesized to mediate or counteract autistic perseverative behaviors and cognitive inflexibility and increase social and behavioral motivation (Chevallier, Kohls, Troiani, Brodkin, & Schultz, 2012; Dubey, Ropar, & Hamilton, 2018; Kapp, Goldknopf, Brooks, Kofner, & Hossain, 2019). The cognitive inflexibility of ASD is related to restricted and repetitive behaviors, such as preference for sameness, pragmatic deficits, and rule-governed behaviors (Kissine, 2019; Turner, 1999; Twohig, 2012). Moreover, cognitive inflexibility is associated with anxiety in autistic individuals (Craig et al., 2016; Hollocks, Jones, et al., 2014; Hollocks et al., 2019).

A clinical example could be a patient whose social behavior repertoire is dictated by the rule 'I have autism, so I cannot see other people'), associated with behavioral avoidance of social gatherings or other social events. By making the patient's rule less dictating (e.g., seeing the rule as just another thought) and connecting values to behavior goals (e.g., 'It's important to me have contact with other people, so I decide to text a friend once a month'), behavioral motivation, along with the ability to cope with psychological obstacles (e.g., private events), is increased.

3.2.2 Acceptance-Avoidance

In the *Acceptance-Avoidance* domain pair, acceptance and willingness skills acquisition (Hayes et al., 2006), alongside psychoeducation (Davis, Kennedy, Dallavecchia, Skolasky, & Gordon, 2019) are thought to mediate or counteract the avoidance domain in ASD, such as exteroceptive hyper-sensitivity, reduced self-regulation, and emotional and physical reactivity (Jahromi, Bryce, & Swanson, 2013; Northrup et al., 2020). In addition, a biological predisposition of subjective and oxidative stress, such as a deviant HPA-axis, is associated with an increased risk for avoidant behavior in ASD (Pfaff & Barbas, 2019; Proff, Williams, Quadt, & Garfinkel, 2021).

In ASD, avoidance is observed as overt behavior, such as avoiding social gatherings or noisy elevators, and covert behavior, such as the unwillingness of experiencing specific thoughts ('I'm a failure'), emotions (fear, sadness), or body sensations (heart palpitation). Intolerance of uncertainty is associated with anxiety symptoms (Boulter, Freeston, South, & Rodgers, 2014) and behavioral inflexibility in ASD (Joyce, Honey, Leekam, Barrett, & Rodgers, 2017; Wigham, Rodgers, South, McConachie, & Freeston, 2015). Furthermore, intolerance of uncertainty along with experiential avoidance has been associated with general

anxiety disorder (GAD) (Buhr & Dugas, 2012), a common co-occurring condition in individuals with ASD (Rodgers, Glod, Connolly, & McConachie, 2012).

An example could be patient who scores high in alexithymia (Bagby et al., 1994), is hyper-sensitive to sounds, and avoids public transport due to distressing thoughts ('I can't stand these noises'), emotions (fear, anger), and body sensations (sweating, muscle tension). By increasing the patient's coping abilities using acceptance techniques and teaching about emotions, such as basic emotions and emotions' evolutionary functions, the patient's avoidance may decrease along with an extended behavior repertoire.

3.2.3 Perspective-Mindlessness

Regarding the *Perspective-Mindlessness* domain pair, perspective-taking abilities and cognitive defusion are thought to mediate or counteract the mindlessness domain in ASD, such as interoceptive hypo-sensitivity, reduced awareness of oneself and others, and literality (Hobson, 2012; Huggins, Donnan, Cameron, & Williams, 2020; Masuda, Hayes, Sackett, & Twohig, 2004). Anecdotally, the challenges in perspective-taking may be best described by a patient's reflecting commentary: 'I didn't know that I had thoughts'.

Perspective-taking abilities, such as theory of mind, are generally reduced in ASD and linked to so-called deictic shifting (I-you, Here-There, Now-Then) (Barnes-Holmes, McHugh, & Barnes-Holmes, 2004; Mizuno et al., 2011; Montoya-Rodríguez, Molina, & McHugh, 2017). There is some debate whether autistic perspective-taking should be labeled as 'different' or even part of autistic strengths, rather than a 'deficit' (Atherton, Lummis, Day, & Cross, 2019). Elevated cognitive fusion and a problematic perception of self, including autistic identity, have been observed in individuals with ASD (Huang et al., 2017; MacLeod, Lewis, & Robertson, 2013; Maisel et al., 2019), which implies a disability to (1) take perspective on one's thoughts and ideas about oneself ('I'm worthless') including undermining believability of thoughts and mental images, and (2) not automatically letting thoughts and unhelpful ideas about oneself, including mental rules ('I have Asperger, I don't have the right to live'), guide one's actions and thus transform stimulus function of thoughts, and (3) cope with one's cognitive inflexibility and reduced self- and bodily awareness (alexithymia) in a way that minimizes the risk of internalizing (anxiety, depression) and externalizing problems (aggression, outburst behaviors, or irritability) (Buhr & Dugas, 2009; Conner et al., 2020; Ozsivadjian et al., 2021).

Alexithymia refers to difficulties recognizing, labeling, and processing one's own emotions, differentiating emotions from bodily sensations, and focusing on inner experiences (Kinnaird, Stewart, & Tchanturia, 2019). There is some controversy about whether alexithymia should be viewed as a core challenge or represent a subgroup of ASD individuals, affecting

about 50 % of adults with ASD compared to about 10 % of the general population (Hill et al., 2004; Mazefsky et al., 2013; Trevisan, Mehling, & McPartland, 2021). Research indicates that alexithymia predicts difficulties in emotion recognition (Allen, Davis, & Hill, 2013; Cook, Brewer, Shah, & Bird, 2013; Heaton et al., 2012) and is associated with neurological structure and function related to empathy and interoception, such as insula ACC, or GABA, thus brain regions and functions critical in enabling conscious representation of feelings and body (Bird et al., 2010; Ernst et al., 2014; Simmons et al., 2013).

Clinically, practicing perspective-taking techniques, such as viewing thoughts, feelings, and body sensations as a process, not letting thoughts guides one's actions, shifting between different sensory modalities, or being aware of body parts, might increase the patient's ability to cope with distressing thoughts, emotions functionally, and body-sensations, enhancing the patient's value-based behavior goals and awareness of body signals, such as hunger, thirst, and fatigue.

In sum, 'autistic' behaviors and functioning are not a problem per se but depend on the *relationship* between autistic behaviors and the individual's mind, thus transforming stimulus function of behavior and associated thoughts, emotions, and body sensations (Assaz et al., 2018; Boland et al., 2021; Fletcher & Hayes, 2005). From a functional contextual perspective, the autistic individual needs to be in contact with personally chosen behavioral goals that fully motivate a behavior change to occur. The positive contingencies of these chosen behaviors thus need to overweigh the negative contingencies of perseverative and inflexible behaviors, which otherwise increases the risk for behavioral and experiential avoidance (Dearden, Emerson, Lewis, & Papp, 2017; Pfaff & Barbas, 2019; Shtayermman, 2016).

3.3 EMPIRICAL SUPPORT OF THE NEUROACT MODEL

3.3.1 Motivation-Perseverance

Atypical lateral frontoparietal and midcingulate-insular network activation is associated with cognitive and behavioral inflexibility in individuals with ASD (Lau, Leung, & Zhang, 2020; Uddin, 2021; Uddin et al., 2015). Social and behavioral motivation in ASD (Chevallier et al., 2012; Dubey et al., 2018; Kissine, 2019) is linked to a specific neural network, including the medial prefrontal cortex, superior temporal sulcus, temporoparietal junction, amygdala, and fusiform gyrus (Ciaramidaro et al., 2018; Patriquin, DeRamus, Libero, Laird, & Kana, 2016; Sumiya et al., 2020). These brains regions are associated with preference for social stimuli, mentalizing, and intentional movement (i.e., attribution of mental states evoked by kinetic stimulus properties) and goal-directed behavior, and not only primary dysfunction in

individuals with ASD (Castelli, Happé, Frith, & Frith, 2000; Dichter, 2012; Philip et al., 2012). As an example, an experimental condition comparing two biological movement conditions; a dancing figure (human body movement) and a grasping hand simulating the act of reaching out for a glass and bringing it to the mouth (goal-directed action), showed increased left medial prefrontal activity related to goal-directed behavior (Bonda, Petrides, Ostry, & Evans, 1996). In addition, higher-order executive function regulation is linked to the prefrontal cortex (PFC) and anterior cingulate cortex (ACC), regulating emotionally conflicting stimuli. These brain regions, alongside the amygdala and orbitofrontal cortex (OFC), are involved in goal-directed behavior and appear to be positively affected using mindfulness techniques in autistic individuals and the general population (Guerithault, 2021; Taren et al., 2017; Zelazo & Lyons, 2012).

3.3.2 Acceptance-Avoidance

The notion that ASD is characterized by irregular resting-state physiology dates back to Ounsted, Lee, Hutt, and Hutt (1964). They suggested that those with ASD have a 'chronically high state of arousal' (Ounsted et al., 1964). This idea is supported by multiple lines of evidence suggesting that ASD is characterized by altered levels of basal and reactive arousal associated with amygdala hyperactivity, especially related to social stimuli (Kliemann, Dziobek, Hatri, Baudewig, & Heekeren, 2012; Levine et al., 2012; Riby, Whittle, & Doherty-Sneddon, 2012). In addition, research shows hyper- and hyporesponsiveness alterations in cortisol and the HPA axis, associated with emotional dysregulation and self-injury in ASD (Bitsika, Sharpley, Sweeney, & McFarlane, 2014; Courtemanche, Black, & Meyer, 2021; Hadwin et al., 2019).

Moreover, a hyperactive anterior insula, correlating with hypoactivity of ACC and PFC, is associated with intolerance of uncertainty in ASD (Dong, 2019; Gorka, Nelson, Phan, & Shankman, 2016; Moon, Tkachenko, Garcia-Gorbea, Shane Tubbs, & Moisi, 2018). Studies indicate that ACC, middle cingulate cortex (MCC), insula, and prefrontal cortices are involved in emotion regulation in ASD, including acceptance strategies (Messina, Grecucci, & Viviani, 2021; Richey et al., 2015). Intolerance of uncertainty has been indicated to mediate the relationships between emotion regulation and symptoms of anxiety and depression in ASD (Cai, Richdale, Dissanayake, & Uljarević, 2018). Meta-analyses have shown that ACC, insula, and prefrontal cortical areas are involved in emotion regulatory processes using mindfulness and acceptance strategies in the general population (Falcone & Jerram, 2018; Guendelman, 2021). Further, there is some evidence for improved executive functioning in the general population due to group-based mindfulness practice (Millett, D'Amico, Amestoy, Gryspeerdt, & Fiocco, 2021).

3.3.3 Perspective-Mindlessness

Atypical structural and functional activity, such as hypoactivation and inflammatory cytokines in MCC, is observed in individuals with ASD when making self-decisions in a social context (Chiu et al., 2008; Vargas, Nascimbene, Krishnan, Zimmerman, & Pardo, 2005). Self-awareness, alongside self-referential cognition and language, appears to be associated with social cognition and mentalizing (Apperly, 2012; Lombardo & Baron-Cohen, 2010; Lombardo et al., 2010). The neurobiological mechanisms behind self-awareness, and the ability to predict and monitor outcomes of social decisions, have been linked to MCC (Apps, Lockwood, & Balsters, 2013). Abnormalities in the posterior cingulate cortex (PCC) and medial prefrontal cortex (mPFC), associated with the default mode network (DMN), are linked to deficit self-referential processing and mentalizing in ASD (Padmanabhan, Lynch, Schaer, & Menon, 2017). Mindfulness practice, such as MBSR, has been associated with activity in the right MCC (rMCC) and resting-state functional connectivity in higher-order brain regions, such as mPFC, in individuals with ASD, associated with self-reflection and self-directed thought along with executive function and attentional control (Guerithault, 2021; Lombardo & Baron-Cohen, 2010; Lombardo et al., 2010). Moreover, mindfulness practice appears to increase connectivity between rMCC and pre and postcentral gyrus. This increased connectivity appears to facilitate primary sensorimotor input reaching higher-order cognitive brain regions and thus potentially reducing depressive symptoms in individuals with ASD (Pagni et al., 2020).

Interoceptive processing, which is how the nervous system anticipates, senses, and integrates signals originating from the body, is associated with a wide range of cognitive and emotional functions (Hatfield, Brown, Giummarra, & Lenggenhager, 2019). ASD is associated with interoceptive hyporeactivity, which is difficulties detecting and attending to internal bodily sensations such as hunger, thirst, respiration, and temperature (DuBois, Ameis, Lai, Casanova, & Desarkar, 2016; Noel, Lytle, Cascio, & Wallace, 2018; Schauder, Mash, Bryant, & Cascio, 2015). Notably, interoceptive hyporeactivity was already noted in early descriptions of ASD (Bettelheim, 1967; Kanner, 1943). The interoceptive sensory system is maintained by a homeostatic afferent pathway that originates within the small-diameter sensory afferent fibers that innervate all tissues and organs and terminates in the posterior insula (Craig, 2011). The continuous nature of interoceptive processing is implicated in the neurobiological construction of the sense of self (Quigley, Kanoski, Grill, Barrett, & Tsakiris, 2021). Mindfulness practice has been shown to modify the structure and function of the left-hemisphere posterior insula (Mooneyham et al., 2017), suggesting neural plasticity in the insula region.

To summarize, value-based behavioral goals in ASD are associated with higher-order (top-down) neural networks related to executive function, such as the mPFC, modulating

lower-order neural networks connected to emotional processing, such as the amygdala. Limbic and default mode networks, such as the ACC, MCC, PCC, and insula, are linked to homeostatic and emotional regulation, such as the HPA axis and oversensitivity to uncertainty, perspective-taking, such as self-awareness and mentalizing, and extero- and interoceptive processing in autistic individuals (Lian & Northoff, 2021; Martínez et al., 2020; Robertson & Baron-Cohen, 2017). Emotion regulation techniques, such as mindfulness and acceptance, are associated with increased functional connectivity and neural activity related to cortical and subcortical structures of importance for adaptive functioning, such as the PFC, OFC, ACC, rMCC, and insula, in ASD.

3.4 CASE STUDIES

3.4.1 Case study I (Man on the bus)

In the example below (Figure 6), an ASD patient's case study illustrates how psychological flexibility and an ACT conceptualization address ASD core and comorbid challenges and psychological inflexibility.

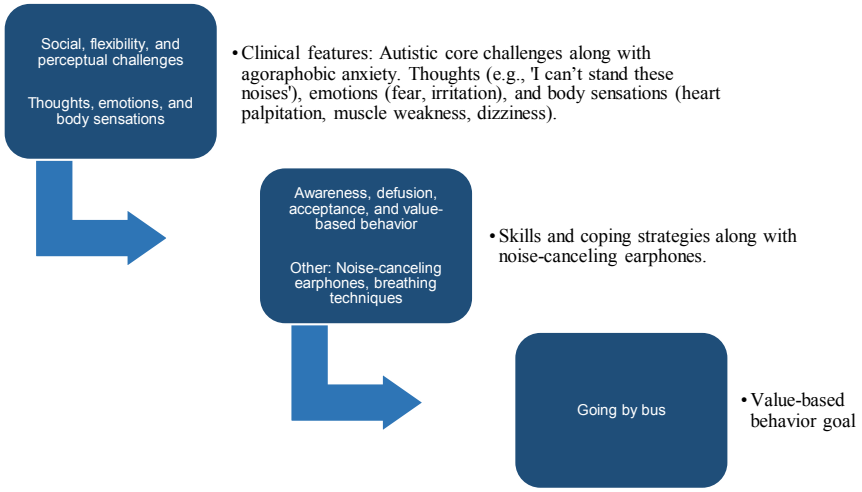

Figure 6. Case study (Man on the bus).

The patient is a man, 40 years of age, diagnosed with ASD, who reports problems using public transport due to over-sensitivity to sounds. The conceptual framework's starting point is the formulation of pragmatic and value-based goals. In this case, the patient's primary treatment objective was to manage to go by public bus without prematurely aborting the journey. The

patient's clinical features included core challenges such as cognitive inflexibility (e.g., difficulties adapting to new situations), social impairments (e.g., social anxiety due to problems interpreting social behaviors), and perceptual over-sensitivity (e.g., sensitive to sounds). Moreover, the patient experienced agoraphobic anxiety when using public transport. In addition to core and comorbid challenges, the patient usually experienced disturbing thoughts (e.g., 'I can't stand these noises'), emotions (e.g., fear, irritation), and body sensations (e.g., heart palpitation, muscle weakness, dizziness) when going by bus. The patient was taught ACT skills such as awareness and cognitive defusion (to handle thoughts), acceptance (to manage emotions and body sensations), and pragmatic and value-based behavior goals (to pinpoint the patient's desired behaviors and help him find the motivation to carry them out). He was also informed that he could use practical tools (e.g., noise-canceling earphones) or other coping strategies (e.g., breathing techniques) as long as these were in line with his value-based goals (i.e., going by bus).

3.4.2 Case study II (Girl avoiding school)

A second example concerns an autistic 13-year-old girl with three months of school avoidance (Figure 7).

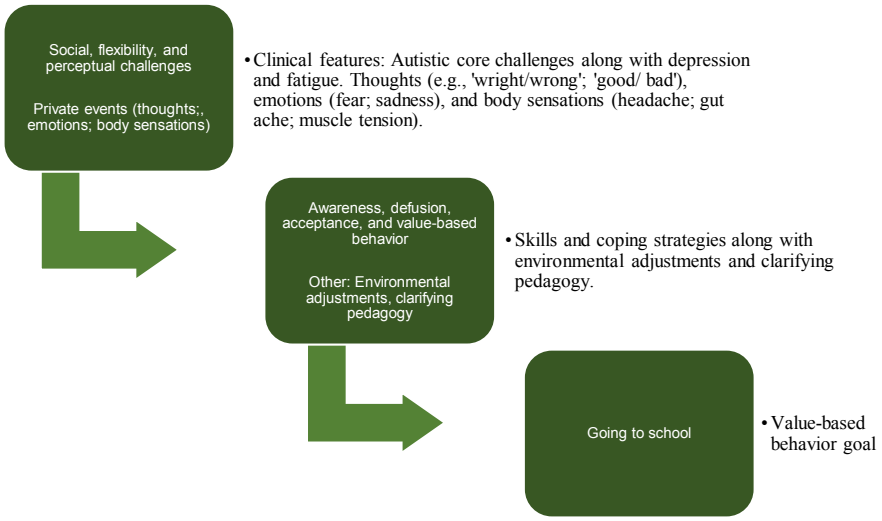

Figure 7. Case study (Girl avoiding school).

The clinical features included core challenges, such as social impairments (e.g., difficulties with social reciprocity or misinterpretation of social cues), cognitive inflexibility (e.g., 'right/wrong' or 'good/bad'), and perceptual over-sensitivity (e.g., light, smell, and touch).

Comorbid depressive symptoms and stress-related symptoms of fatigue were also present. The patient was taught ACT skills such as awareness and cognitive defusion (to handle thoughts), acceptance (to manage emotions and body sensations), and pragmatic and value-based behavior goals (to pinpoint the patient's desired behaviors and help her find the motivation to carry them out). Moreover, there were classroom environmental adjustments (e.g., dimmed light, separate room to avoid smell, or no physical touch from teachers or assistants) and clarifying pedagogy (e.g., short written instructions, picture-based schedule, and preparing for expected and unexpected change) to reduce unnecessary stressors. She was also informed that she could use practical tools (e.g., a stress ball) or other coping strategies (e.g., listening to music) as long as these were in line with her value-based goals (i.e., going to school).

3.5 SUMMARY

ASD is a complex neurodevelopmental condition associated with comorbid psychiatric symptoms (e.g., depression, anxiety, and sleep difficulties), perceived stress, reduced quality of life, and premature mortality. The complexity of having ASD may be conceptualized using neurobiological, neuropsychological, and psychosocial perspectives. Interventions in ASD are directed to maximizing potential, minimizing obstacles, or optimizing the person-environment fit. CBT or mindfulness-based therapies are the most evaluated adapted interventions that address core challenges or comorbid symptoms. ACT is a contextual behavioral therapy that combines CBT and mindfulness procedures, proven effective for complex and chronic conditions, such as long-term pain, diabetes, and psychosis, although not evaluated in ASD. However, ACT consistent instruments (i.e., AAQ and CFQ) measuring clinically relevant psychological constructs in ASD, such as psychological inflexibility and cognitive fusion, have not yet been psychometrically assessed in autistic individuals. Hence, the current doctoral thesis evaluates ACT adapted to autistic adolescents and adults and assesses the validity and reliability of AAQ and CFQ in autistic adults.

Chapter 4

Research aims

The general aims of this thesis were to evaluate the feasibility, and preliminary efficacy of ACT adapted to individuals with ASD and assess the psychometric properties of two standard psychological instruments used in treatment evaluation, although not analyzed in autistic individuals. Specifically, the aims were to evaluate (1) The feasibility and preliminary efficacy of group-delivered ACT for adolescents and young adults diagnosed with ASD in a special school setting (Study I) and (2) The feasibility and preliminary efficacy of group-delivered ACT for adults with an ASD diagnosis in a psychiatric outpatient setting (Study II and III), and (3) the psychometric properties of AAQ and CFQ in adults with ASD (Study IV). These aims are presented in relation to the individual studies below.

4.1 STUDY I

In Study I, we aimed at (1) developing an ACT group protocol adapted to ASD specific challenges (NeuroACT) and (2) evaluating the feasibility and preliminary efficacy of the protocol for adolescents and young adults diagnosed with ASD in a special school setting, regarding self- and teacher-rated stress, hyperactivity, prosociality, and psychiatric symptoms.

4.2 STUDY II

In Study II, we aimed at (1) adapting the NeuroACT protocol to adults with an ASD diagnosis and (2) evaluating the feasibility and preliminary efficacy of the protocol for ASD adults in a psychiatric outpatient setting regarding treatment credibility, session completion, homework compliance, self-perceived stress and quality of life (primary outcomes), symptoms of depression and anxiety, functional impairment (social, vocational, family), psychological inflexibility, and cognitive fusion (secondary outcomes).

4.3 STUDY III

In Study III, we aimed at (1) modifying the NeuroACT treatment protocol based on the clinical experiences from Study II and (2) evaluating the feasibility and preliminary efficacy of the modified protocol for ASD adults in a psychiatric outpatient setting regarding treatment credibility, self-perceived stress and quality of life (primary outcomes), symptoms of depression and anxiety, sleep problems, functional impairment (social, vocational, and family), cognitive and behavioral avoidance, psychological inflexibility, cognitive fusion, autistic core challenges, and executive dysfunction (secondary outcomes).

4.4 STUDY IV

In Study IV, we aimed at evaluating the (1) construct (convergent and divergent) validity and (2) the reliability of AAQ and CFQ in 54 adults with ASD in a psychiatric outpatient setting.

Chapter 5

Empirical Studies

Karolinska Institutet performed all studies. Study I was conducted in cooperation with Uppsala University and a special school for students with an ASD diagnosis. Study II and Study III were conducted at the Neuropsychiatric Unit Karolinska, Psychiatry Northwest.

5.1 STUDY I

5.1.1 Design, participants and procedure

Study I (Pahnke, Lundgren, Hursti, & Hirvikoski, 2014) was a quasi-experimental repeated measure two-group trial. Participants pertaining to school classes were randomized to either NeuroACT or waitlist, where the waitlist condition underwent teaching as usual. Thirty-nine students were screened for the study, and 11 were not found to be eligible.

As shown in Table 2, the remaining participants were 28 students (13-21 years old) with ASD (corresponding to DSM-5 ASD, level 1:1) (APA, 2013), which had written informed consent and normal intellectual capacity and not selective mutism (with or without comorbid ADHD and dyslexia), distributed in six school classes (three junior high school classes and three high school classes). Initially, school staff, parents, and students received oral and written practical and theoretical information about the study. Before entering the skills training group, participants were informed about study procedures and intervention content and that they could stop the intervention without further explanation. Measurements and the intervention were carried out within the school setting, and study procedures were performed following the Declaration of Helsinki (AMA, 2013). The waiting list group received the intervention after the study completion. The first author J. P. carried out the intervention.

Table 2. Participant characteristics.

Characteristics	Total (N = 28)	ACT (n = 15)		Waiting list (n = 13)		χ^2 test
	n	n	%	n	%	
Male	21	9	60	12	92	p = .049
Current medication use	8	5	33	3	23	NS
Psychiatric co-morbidity						
ADHD	7	3	20	4	31	NS
OCD	3	2	13	1	8	NS
Dyslexia	3	1	7	2	15	NS
Specific phobias	4	2	13	2	15	NS
	M (SD)	M (SD)		M (SD)		Student's t-test
Age (years)	16.5 (2.0)	16.2 (1.4)		16.8 (2.5)		NS

ACT: acceptance and commitment therapy; ADHD: attention-deficit hyperactivity disorder; OCD: obsessive–compulsive disorder; SD: standard deviation.

5.1.2 Ethical considerations

The study was approved by the regional ethical review board of Stockholm, Sweden (2013-046) and followed the Declaration of Helsinki (AMA, 2013). If younger than 18 years, participants' parents or caregivers provided written informed consent. If 18 years or older, the participants provided written informed consent themselves. Many students with ASD have difficulty changing their environment; therefore, the intervention was conducted within their regular school classes. Hence, no individual randomization was performed. Before the study, school staff, parents, and students were informed orally and written about study procedures and the intervention's content. The participants were told that they could stop the intervention without further explanation. Measurements and the intervention were carried out within the school setting. The waiting list group received the intervention once the study was completed.

5.1.3 Measures and assessments

The study included measures of participant characteristics and outcome measures. Assessments were performed one week before entering the intervention (pretreatment/T1), one week after the intervention was completed (post-treatment/T2), and two months after completion of the intervention (2-month follow-up/T3).

Self- and teacher-rated stress was measured using the Stress Survey Schedule for Autism and Other Developmental Disorders (Groden et al., 2001). The Stress Survey Schedule consists of 49 items scored on a 5-point Likert scale providing a total score. Based on exploratory and confirmatory factor analyses, the items are categorized into eight subscales representing situations that children with ASD and other developmental disabilities usually perceive as stressful: changes, anticipation, social interaction, pleasant events, sensory stimuli, unpleasant

events, food situations, and rituals. The internal consistency of the subscales is generally good (Cronbach's α = .81– .87) (Groden et al., 2001).

Self- and teacher-rated behavioral problems were measured using the Strengths and Difficulties Questionnaires, SDQ (Goodman, Ford, Simmons, Gatward, & Meltzer, 2000). The SDQ is a brief behavioral screening instrument developed for 3- to 16-year-old children, consisting of 25 items. Each item is scored 0–2, where 0 is not true, one is somewhat true, and two is certainly true. The scale has five subscales representing emotional symptoms, behavior problems, hyperactivity/ inattention, peer relationship problems, and prosocial behavior. The first four subscales summarize into a total score, with higher scores indicating more problems, while higher scores on the prosocial behavior scale indicate fewer problems. The instrument's internal consistency is generally good (Cronbach's α = .70– .76), except for behavior problems (Cronbach's α = .52–.54) (Goodman et al., 2000), and there is empirical support for the five-factor structure model in Scandinavian adolescents (Bøe, Hysing, Skogen, & Breivik, 2016).

Self-rated psychiatric symptoms were measured using the Beck Youth Inventories, BYIs (Beck, 2001). The BYIs are a self-rating questionnaire consisting of five subscales used in this study: anxiety, depression, and anger (when summarized into a total score representing overall psychological distress). Each scale consists of 20 items scored as never, sometimes, often, or always. The internal consistency ranges between .89 and .94 (Beck, 2001) in clinical samples of children and adolescents with autism, ADHD, and Tourette's syndrome.

5.1.4 Analytical approach

Feasibility was evaluated in terms of completion of the intervention (a drop-out was defined as attending fewer than six sessions); the number of sessions attended; the number of mindfulness practicing occasions at school between sessions, and by using an evaluation questionnaire covering treatment satisfaction on a 5-point Likert scale, from very low to very high satisfaction. After controlling for normal distribution and potential outliers, demographic data and background variables were analyzed using Student's t-test (Winter, 2013) for continuous variables and the chi-square test for categorical variables. Outcome measures were analyzed using two-tailed mixed-design repeated-measures analyses of variance (rmANOVA) (Keselman, Algina, & Kowalchuk, 2001). Effect sizes were expressed as partial eta-square (ηp2) for efficacy measures and were interpreted according to Cohen (1988): 0.01 = small effect size, 0.06 = moderate effect size and 0.14 = large effect size. The correlation between teacher ratings and Student's self-ratings were analyzed using Pearson product-moment correlation (Fowler, 1987). The alpha levels were set at $p \leq 0.05$ for significance and, for p

values, $p \leq 0.10$ for a trend. Statistical trends were not reported to avoid Type I error due to a small sample size (Thomas & Rao, 1987).

5.2 STUDY II

5.2.1 Design, participants, and procedure

Study II (Pahnke et al., 2019) was an open trial pilot study evaluating the feasibility and preliminary outcomes of the NeuroACT program adapted to adults with ASD in a psychiatric outpatient context. A total of 10 adults diagnosed with ASD (with or without ADHD; 5 men; 5 women; 25-65 years) with normal intelligence (i.e., IQ > 70) were included and assessed using self-ratings at pre- and post-assessment and 3-month follow-up.

Inclusion criteria were: (a) a DSM-IV (APA, 2000) diagnosis of Asperger syndrome (corresponds to a diagnosis of ASD without specified intellectual disability and language impairment in the fifth edition of the DSM (APA, 2013) as the primary neurodevelopmental diagnosis; (b) 18 years or older, and (c) if on any psychoactive drug treatment (for ADHD or other diagnoses), the treatment should have been stable for at least three months.

Exclusion criteria were: (a) ongoing substance abuse (during the last three months); (b) diagnosed intellectual disability (intelligence quotient, IQ < 70); (c) organic brain injury; (d) suicidality; and (e) all clinically unstable psychosocial circumstances or comorbid psychiatric disorders that were of such a severity that participation was deemed impossible, such as being homeless, or having severe depression, psychosis, or bipolar disorder not under stable pharmacological treatment. The diagnostic assessment included a clinical interview by a psychiatrist and neuropsychological testing with WAIS-R (Wechsler, 1981) or WAIS-III (Wechsler, 1997), Conner's Continuous Performance Test (CPT-II) (Conners, 2000), and/or Delis-Kaplan Executive Function System (D-KEFS) (Delis, 2001) by a psychologist.

Demographic and clinical characteristics are shown in Tables 3 and 4.

Table 3. Demographic characteristics of the participants (n = 10).

Occupation	*n*	Relationship	*n*	Housing	*n*	Social network	*n*
Sick leave	5	Single	7	Single household	6	Friends > 1 t/month	6
Daily activities	2	Divorced	3	With children	2	Friends > 1 t/week	2
Full time work	1	Children	3	With parents	1	No friends	2
Part time	1			Special accommodation	1		
Full time pension	1						

Note. t = number of occasions.

Table 4. Clinical characteristics of the participants (n = 10).

Comorbidity Lifetime	*n*	On-going	*n*	NDD	*n*	On-going pharmacotherapy	*n*
Dysthymia	1	Dysthymia	1	ADHD	5	SSRIs	3
Depression	1	Depression	4	Tourette's syndrome	1	Anti-epileptics	2
Panic disorder	2	GAD	2			Methylphenidates	3
GAD	1	OCD	1			Sleep medication	1
OCD	1						
Social phobia	1						
Epilepsy	1						
PD-NOS	1						

Note. GAD: generalized anxiety disorder; OCD: obsessive-compulsive disorder; PD-NOS: personality disorder not otherwise specified; NDD: neurodevelopmental disorder; ADHD: attention deficit/hyperactivity disorder; SSRIs: selective serotonin reuptake inhibitors.

5.2.2 Ethical considerations

The study was approved by the regional ethical review board of Stockholm, Sweden (2010-1122-31) and followed the Declaration of Helsinki (AMA, 2013). All participants provided written informed consent. Before the study, the participants received written information about study procedures and the treatment's content. Further, they were interviewed to explore any concerns about the participation and what the group leaders should be aware of during the treatment. The participants were informed that they could abort the treatment without further explanation. The assessments were facilitated by assisting the participants in completing self-rating instruments.

5.2.3 Measures and assessments

Treatment credibility was assessed using an ASD-adapted version of the Treatment Credibility Scale (TCS) (Borkovec & Nau, 1972). The TCS consists of five items scored on a scale from 1 to 10, with a higher score indicating more credibility of the current treatment. The TCS demonstrates high internal consistency in a Swedish sample with Cronbach's alpha (α) = .83 (Alfonsson, Olsson, & Hursti, 2016).

Comorbid psychiatric disorders were assessed using the Mini International Neuropsychiatric Interview (MINI) (Sheehan et al., 1998). The MINI shows moderate agreement with clinical mood and anxiety disorders (Verhoeven et al., 2017). For mood disorders, the AUC (i.e., area under the ROC curve) has shown a range between .55 and .81

(median .73), and for anxiety disorders, the AUC has been ranged between .78 and .88 (median .83) (Verhoeven et al., 2017)

Self-perceived stress was assessed using the Perceived Stress Scale 14 items (PSS-14) (Cohen, Kamarck, & Mermelstein, 1983). The items are rated on a five-point Likert-type scale (0 = never to 4 = very often). A total score is calculated where a higher score indicates greater stress. The PSS shows good construct validity with anxiety (r = .68), depression (r = .57), mental or physical exhaustion (r = .71), and demonstrates good internal consistency in a Swedish sample with Cronbach's α = .84 (Eklund, Bäckström, & Tuvesson, 2014; Nordin & Nordin, 2013).

Self-perceived quality of life was assessed using the Satisfaction with Life Scale (SWLS) (Diener, 1985). The scale consists of five items rated on a Likert-type scale 1–7, with a higher score indicating a higher quality of life. Satisfactory convergent validity with social support is observed (r = .39) for SWLS and Oslo Social Support Scale (Glaesmer, Grande, Braehler, & Roth, 2011). Furthermore, internal consistency of the SWLS is reported as good (Cronbach's α = .88) in a Swedish sample (Hultell & Gustavsson, 2008).

Depressive symptoms were assessed using the Beck Depression Inventory-II (BDI-II) (Beck, Steer, & Brown, 1996), a 21-item self-report questionnaire designed for adolescents and adults to measure depressive symptoms on a 0–3 scale with a scale higher score indicating more depressive symptoms. Good convergent validity (r = .72) and good internal consistency (Cronbach's α = .89) are observed in a Swedish sample (Lahlou-Laforêt, Ledru, Niarra, & Consoli, 2015). The BDI demonstrates good internal consistency (Cronbach's α = .89) in a Swedish sample (Kjærgaard, Arfwedson Wang, Waterloo, & Jorde, 2014).

Anxiety symptoms were assessed using the Beck Anxiety Inventory (BAI) (Beck, Epstein, Brown, & Steer, 1988), a 21-item self-report questionnaire measuring anxiety symptoms on a 0–3 scale. A higher score indicates more anxiety symptoms. Satisfactory AUC statistics are reported (78.5%) for the BAI (Phan et al., 2016). Internal consistency is reported as satisfactory (Cronbach's α = .91) and test-retest-reliability is good (r = .84) (Vázquez-Morejón, Zanin, & Bellido, 2014).

Self-perceived functional impairment (social, vocational, and familial) was assessed using the Sheehan Disability Scale (SDS) (Sheehan, Harnett-Sheehan, & Raj, 1996), a three-item scale ranging from 0 (not at all) to 10 (extremely), with higher scores indicating more functional impairment. The scale shows satisfactory AUC statistics (81.4%) (Luciano et al., 2010) and internal consistency (Cronbach's α = .89 (Leon et al., 1997).

Psychological inflexibility was assessed using the Acceptance and Action Questionnaire (AAQ-7) (Bond et al., 2011), a 7-item Likert scale (1 to 7), with higher scores indicating more

psychological inflexibility. The AAQ is evaluated in a Swedish sample (Lundgren & Parling, 2017) showing good concurrent and convergent validity, and satisfying internal consistency (Cronbach's α = .85) and test-retest reliability (r = .80).

Cognitive fusion was assessed using the Cognitive Fusion Questionnaire (CFQ-7) (Gillanders et al., 2013), a 7-item Likert scale (1 to 7), with higher scores reflecting more cognitive fusion. Discriminative validity of the CFQ against psychological acceptance has been observed as satisfactory (r = -.78) in a clinical sample (McCracken, DaSilva, Skillicorn, & Doherty, 2014). The scale demonstrates satisfactory internal consistency (Cronbach's α = .93) (Ruiz, Suarez-Falcon, Riano-Hernandez, & Gillanders, 2017).

5.2.4 Analytical approach

Analyses were on an intention-to-treat basis, including the total sample of 10 patients who attended at least one treatment session. When post-treatment data were missing, data were carried forward from the last assessment completed (Pedersen et al., 2017). All but one participant completed post- and follow-up assessments. After controlling for normality distribution, paired-samples t-tests were performed to examine potential changes in measures from pre-to post-treatment and from pre-treatment to 3-month follow-up. Effect sizes were calculated using Cohen's d (Cohen, 1988) interpreted as 0.2 (small), 0.5 (medium), and 0.8 (large).

5.3 STUDY III

5.3.1 Design, participants and procedure

Study III was a randomized two-group (intervention/TAU) controlled pilot study with repeated measures investigating the feasibility and preliminary efficacy of NeuroACT for adults with ASD in a psychiatric outpatient setting.

As shown in Figure 8, a total of 39 out of 52 adults (21 men; 18 women; 21-72 years) diagnosed with ASD (with or without ADHD) with normal intelligence (i.e., IQ > 70) were included and assessed using self-ratings at pre- and post-assessment and 6-month follow-up.

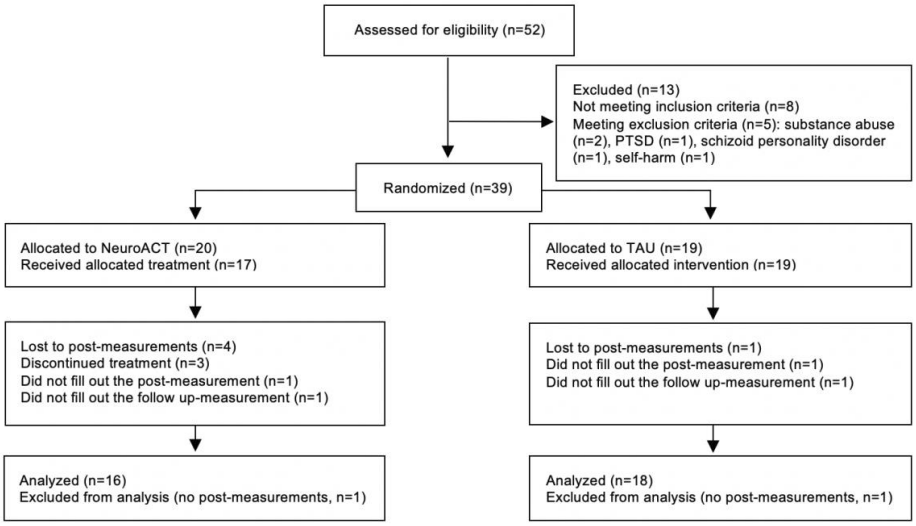

Figure 8. Flowchart of procedure and participants.

Inclusion criteria were: (a) a diagnosis of DSM-IV (APA, 2000) Asperger syndrome (corresponds to a diagnosis of ASD without specified intellectual disability and language impairment in the fifth edition of the DSM (APA, 2013) as the primary neurodevelopmental diagnosis; (b) 18 years of age or older; (c) if on any psychoactive drug treatment (for ADHD or other diagnoses), the treatment should have been stable for at least three months; and (d) scoring more than one standard deviation (QOLI < 1.84) under the population mean on Quality of life Inventory (QOLI) (Frisch, 1994) or more than one standard deviation (PSS > 24) over the population mean on Perceived Stress Scale (PSS) (Cohen et al., 1983).

Exclusion criteria were the same as in Study II. The diagnostic assessment followed local clinical guidelines and included a clinical interview by a psychiatrist and neuropsychological testing with WAIS-R (Wechsler, 1981) or WAIS-III (Wechsler, 1997), Conner's Continuous Performance Test (CPT-II) (Conners, 2000), and/or Delis-Kaplan Executive Function System (D-KEFS) (Delis, 2001), and interview with a significant other when available, by a psychologist. Blocked individual randomization was performed twice (2011 and 2012). Waiting list groups received treatment as usual (TAU) (e.g., communication training; autism psychoeducational programs; psychotherapy) within ordinary habilitation service or psychiatric care.

The participant characteristics are shown in more detail in Table 5.

Table 5. Participant characteristics.

Characteristics	NeuroACT (n = 20)	TAU (n = 19)	Total (N = 39)
	n	*n*	*n*
Gender, male	10	11	21
Age (years)	*M* (*SD*)	*M* (*SD*)	*M* (*SD*)
	38.4 (10.0)	39.8 (14.4)	39.1 (12.2)
Psychiatric comorbidity			
ADHD/ADD	9	6	15
Depression, depressive episode NOS, dysthymia	4	5	9
Anxiety disorders	5	0	5
Other comorbidities (e.g., dyslexia; bipolarity)	5	3	8
Any psychiatric comorbidity	11	11	22
Medication			
Antihistamines	2	7	9
Sleep medication	4	5	9
Antidepressants	5	8	13
Methylphenidate	5	7	12
Other medication	6	11	17
Any medication	13	16	29
Education			
University/higher education	7	3	10
High school	9	12	21
Elementary school	3	3	6
Other	1	1	2
Occupation			
Company owner/employee/student/parental leave	7	5	12
Part-time employee/temporary position	2	3	5
Pensioner	0	1	1
Unemployed	2	4	6
Temporary disability pension/early retirement benefit	5	3	8
Other	4	3	7

ACT = acceptance and commitment therapy; TAU = treatment as usual; ADHD = attention-deficit hyperactivity disorder; ADD = attention-deficit disorder; NOS = not otherwise specified

5.3.2 Ethical considerations

The study was approved by the regional ethical review board in Stockholm, Sweden (2015-1005-31) and followed the Declaration of Helsinki (AMA, 2013). All participants were informed about the study procedures, and participants who wanted to participate provided written informed consent. Before the treatment, the participants were interviewed to explore eventual participation concerns. In addition, they were asked if there were anything that the group leaders should be aware of during the treatment.

Further, the participants were informed that they could abort the treatment without further explanation. During assessments, the participants were assisted in completing self-rating instruments. The TAU group received the NeuroACT treatment after the study was conducted.

5.3.3 Measures and assessments

Treatment credibility was assessed using an ASD-adapted version of the Treatment Credibility Scale (TCS) (Borkovec & Nau, 1972). The TCS consists of five items scored on a scale from 1 to 10 (a higher score indicates more credibility). It has demonstrated high internal consistency in a Swedish sample with Cronbach's alpha (α) = .83 (Alfonsson et al., 2016).

Intellectual ability (IQ) was assessed using the WAIS-R (Wechsler, 1981) or the WAIS-III (Wechsler, 1997). The WAIS consists of verbal and performance subtests where a verbal IQ, a performance IQ, and a full-scale IQ are obtained. The WAIS' test-retest-reliability ranges between .70 and .90, inter-scorer coefficients are high (.90), and the WAIS' full-scale IQ correlates highly with the Stanford-Binet IV test (.88) (Wechsler, 1981).

Comorbid psychiatric disorders were assessed with the Mini-International Neuropsychiatric Interview (MINI) (Sheehan et al., 1998). The MINI shows moderate concurrent validity with mood and anxiety disorders (Verhoeven et al., 2017), with AUC (i.e., area under the receiver operating characteristic curve) ranging between .55 and .81 (median .73) for mood disorders and between .78 and .88 (median .83) for anxiety disorders (Verhoeven et al., 2017).

Self-perceived stress was assessed using the Perceived Stress Scale (PSS-14) (Cohen et al., 1983), a 14-item five-point Likert scale (0 = never to 4 = very often), with higher scores indicating greater stress. The PSS shows good criterion validity with anxiety (r = .68), depression (r = .57) and mental or physical exhaustion (r = .71), and good internal consistency with Cronbach's α = .84 in a Swedish sample (Eklund et al., 2014). The current sample showed satisfactory internal consistency (Cronbach's α = .77).

Self-perceived quality of life was assessed using the Satisfaction with Life Scale (SWLS) (Diener, 1985) and The Quality of Life Inventory (QOLI) (Frisch, Cornell, Villanueva, & Retzlaff, 1992). The SWLS consists of five items rated on a Likert scale of 1-7, with a higher score indicating a higher quality of life. Satisfactory convergent validity (r = .39) (Glaesmer et al., 2011) and good internal consistency (Cronbach's α = .88) in a Swedish sample, have been observed (Hultell & Gustavsson, 2008). The QOLI assesses 16 life areas, presenting a weighted score that considers each domain's importance and satisfaction. The scale shows satisfying internal consistency (Cronbach's α = .77–.89) and good test-retest reliability (Cronbach's α = .80–.91) (Frisch et al., 1992; M. B. Frisch, 2014). The current sample showed satisfactory internal consistency of the SWLS (Cronbach's α = .74) and good internal consistency of the QOLI (Cronbach's α = .88).

Self-perceived depressive symptoms were assessed using the Beck Depression Inventory-II (BDI-II) (Beck et al., 1996), a 21-item self-report four-point Likert scale, with higher scores indicating more depressive symptoms. The BDI shows good convergent validity (r = .72) (Lahlou-Laforêt et al., 2015) and satisfactory internal consistency in the current sample (Cronbach's α = .93).

Self-perceived anxiety symptoms were assessed using the Beck Anxiety Inventory (BAI) (Beck et al., 1988), a 21-item self-report four-point Likert scale, with a higher score indicating

more anxiety symptoms. Satisfactory AUC statistics (78.5%) (Phan et al., 2016) and internal consistency (Cronbach's α = .91), and good test-retest-reliability (r = .84) have been reported (Vázquez-Morejón et al., 2014). The current sample showed satisfactory internal consistency (Cronbach's α = .95).

Subjective sleep problems were assessed using the Karolinska Sleep Questionnaire (KSQ) (Kecklund & Åkerstedt, 1992), a six-point Likert scale, with higher scores indicating more difficulties. The instrument shows good criterion validity, internal consistency, and satisfactory construct validity in Swedish samples (Nordin & Nordin, 2013; Westerlund, Brandt, Harlid, Åkerstedt, & Trolle Lagerros, 2014). In addition, the current sample showed satisfactory internal consistency (Cronbach's α = .91).

Subjective functional impairment (social, vocational, and familial) was assessed using the Sheehan Disability Scale (SDS) (Sheehan et al., 1996), a three-item scale ranging from 0 (not at all) to 10 (extremely), with higher scores indicating more functional impairment. The SDS shows satisfactory AUC statistics in a clinical sample (81.4 %) (Luciano et al., 2010) and satisfactory internal consistency in the present sample (Cronbach's α = .79).

Self-perceived psychological inflexibility was assessed using the Acceptance and Action Questionnaire (AAQ-7) (Bond et al., 2011), a 7-item Likert scale (1 to 7), with higher scores indicating more psychological inflexibility. The AAQ is evaluated in a Swedish sample (Lundgren & Parling, 2017) showing good concurrent and convergent validity, and good internal consistency (Cronbach's α = .85) and test-retest reliability (r = .80). The current sample showed satisfactory internal consistency (Cronbach's α = .92).

Self-perceived cognitive fusion was assessed using the Cognitive Fusion Questionnaire (CFQ-7) (Gillanders et al., 2013), a 7-item Likert scale (1 to 7), with higher scores reflecting more cognitive fusion. The discriminative validity (r = -.78) of the CFQ against psychological acceptance has been observed as satisfactory in a clinical sample (McCracken et al., 2014). In addition, the scale demonstrates satisfactory internal consistency in a clinical sample (Cronbach's α = .93) (Ruiz et al., 2017) and in the present sample (Cronbach's α = .93).

Subjective cognitive and behavioral avoidance was assessed using the Cognitive-Behavioral Avoidance Scale (CBAS) (Ottenbreit & Dobson, 2004), a 31-item 5-point Likert scale. The scale demonstrates good convergent and discriminative validity, test-retest reliability, and satisfactory internal consistency (Cronbach's α = .95) in psychiatric samples (Barajas, Garra, & Ros, 2017). In addition, the current sample showed good internal consistency (Cronbach's α = .89).

Self-perceived autistic core symptoms were assessed using the Social Responsiveness Scale (SRS) (Constantino & Todd, 2005), a 65-item four-point Likert scale, resulting in a total

score and five subscale scores (Social motivation; Social cognition; Social awareness; Social communication; Autistic mannerism. The SRS adult version has been evaluated in different ASD populations showing good concurrent, predictive, convergent, and discriminative validity (Bolte, 2012; Chan, Smith, Hong, Greenberg, & Mailick, 2017; Frazier et al., 2014), with a sensitivity of .85 and a specificity of .83 for ASD, and a Cronbach's alpha of .89. In addition, the current sample showed satisfactory internal consistency (Cronbach's $\alpha = .91$).

Subjective executive dysfunction was assessed using the Dysexecutive Questionnaire (DEX-S), a 20-item 5-point Likert scale, with higher scores indicating executive dysfunction (Wilson, Alderman, Burgess, Emslie, & Evans, 1996). The scale shows satisfactory internal consistency (Cronbach's $\alpha = .91$) for brain-injured and neurologically impaired patients (Bennett, Ong, & Ponsford, 2005; Shaw, Oei, & Sawang, 2015). The present sample showed good internal consistency (Cronbach's $\alpha = .84$).

5.3.4 Analytical approach

Demographic data and background variables were analyzed using independent samples t-tests (Kim, 2019) or continuous variables and chi-square tests for categorical variables. After controlling for normality and potential outliers, outcome measures were analyzed using a series of two-tailed mixed-design repeated-measures analyses of variance (rmANOVA) (Keselman et al., 2001), with group (NeuroACT/TAU) as a between-subjects factor and pre-intervention score (T1), the post-intervention score, and the six-month follow-up score (T3) as a within-subjects repeated measure factor. Post hoc contrast analyses were performed to detect patterns of change from pre-intervention to post-intervention and from post-intervention to six-month follow-up. Kruskal-Wallis and Wilcoxon Signed-rank tests analyzed non-normal distributed samples (Mircioiu & Atkinson, 2017). Effect sizes were measured using Cohen's *d*, interpreted as 0.2 = small effect size, 0.5 = moderate effect size, and 0.8 = large effect size (Cohen, 1988). The alpha levels were set at $p \leq 0.05$ for statistical significance and at $p \leq 0.10$ for a statistical trend.

Clinically significant changes (C. Evans, Margison, & Barkham, 1998; Jacobson & Truax, 1991) of the primary outcome measures were calculated using normal population data of the PSS (M = 24.8, SD = 11.1) (Eklund et al., 2014) and the SWLS (M = 24.1, SD = 6.9) (Pavot & Diener, 2008), and clinical data from the present sample. A cut-off score of PSS below 31.36 for the NeuroACT group and below 30.35 for the TAU group was interpreted as a clinically significant recovery. A change score below two standard deviations (NeuroACT = 15.0; TAU = 15.4) of the group mean (NeuroACT = 35.8; TAU = 34.2) was interpreted as a clinically significant improvement. Within two standard deviations from the group mean was

interpreted as unimproved. A cut-off score of SWLS above 18.5 for the NeuroACT group and above 18.4 for the TAU group was interpreted as a clinically significant recovery. A change score exceeding two standard deviations (NeuroACT = 10.2; TAU = 9.8) of the group mean (NeuroACT = 14.3; TAU = 14.4) was interpreted as a clinically significant improvement. Within two standard deviations from the group was interpreted as unimproved.

5.4 STUDY IV

5.4.1 Design, participants and procedure

Study IV was a cross-sectional evaluation of the initial psychometrical properties of the Acceptance and Action Questionnaire (AAQ) and the Cognitive Fusion Questionnaire (CFQ) in 54 adults with ASD (21-72 years; 28 men and 26 women) in a psychiatric outpatient setting. The participants were recruited as part of Study II and Study III (for a detailed description of the inclusion and exclusion criteria, see Study II and III).

5.4.2 Ethical considerations

The analysis was performed using data from Study II and Study III, approved by the ethical review board of Stockholm, Sweden (2010-1122-31 and 2015-1005-31) and followed the Declaration of Helsinki (AMA, 2013).

5.4.3 Measures and assessments

The instruments used in Study IV had previously been psychometrically evaluated in the general population and clinical samples in English and some in Swedish. The rating scales were back-translated into English and reviewed by an independent researcher to ensure the integrity of the Swedish translations. The measures were selected to capture convergent and divergent aspects of construct validity.

The Acceptance and Action Questionnaire (AAQ) (Bond et al., 2011) is a 7-item Likert scale (1 to 7) assessing psychological inflexibility, with higher scores indicating more psychological inflexibility. The AAQ has been evaluated in a Swedish normal population showing good concurrent and convergent validity, internal consistency (Cronbach's $\alpha = .85$), and test-retest reliability ($r = .80$) (Lundgren & Parling, 2017). Confirmatory factor analyses have suggested that the AAQ involves a single factor (Bond et al., 2011).

The Cognitive Fusion Questionnaire (CFQ) (Gillanders et al., 2013) is a 7-item Likert scale (1 to 7) assessing cognitive fusion, with higher scores indicating more cognitive fusion. The CFQ has shown satisfying convergent and divergent validity with measures of mental

health, social functioning, vitality, psychological acceptance, and good internal consistency (Cronbach's α = .87) in a clinical sample (McCracken et al., 2014).

The Cognitive-Behavioral Avoidance Scale (CBAS) (Ottenbreit & Dobson, 2004) is a 31-item 5-point Likert scale assessing cognitive and behavioral avoidance, with higher scores indicating more avoidance. The CBAS has demonstrated good convergent and divergent validity, test-retest reliability, and satisfying internal consistency (Cronbach's α = .95) in psychiatric samples (Barajas et al., 2017; Ottenbreit & Dobson, 2004). In addition, the CBAS showed satisfying internal consistency in the current sample (Cronbach's α = .91).

The Perceived Stress Scale 14 items (PSS) (Cohen et al., 1983) is a 14-item five-point Likert scale measuring self-perceived stress, with higher scores indicating more stress. A total score is calculated after reversing positive item scores. The PSS has shown good construct validity with anxiety (r = .68), depression (r = .57), and mental or physical exhaustion (r = .71) in a Swedish sample (Nordin & Nordin, 2013). Further, the PSS has demonstrated good internal consistency (Cronbach's α = .84) in a Swedish sample with stress-related disorders (Eklund et al., 2014) and in the current sample (Cronbach's α = .84).

The Beck Depression Inventory-II (BDI-II) (Beck et al., 1996) is a 21-item four-point Likert scale assessing subjective depressive symptoms, with higher scores indicating more depression. The BDI has shown good convergent validity with the Montgomery Asberg Depression Rating Scale (MADRS) (r = .72) (Lahlou-Laforêt et al., 2015). In addition, the BDI demonstrated good internal consistency (Cronbach's α = .89) in a Swedish sample (Kjærgaard et al., 2014) and satisfying internal consistency in the current sample (Cronbach's α = .93).

The Beck Anxiety Inventory (BAI) (Beck et al., 1988) is a 21-item four-point Likert scale assessing subjective anxiety symptoms, with higher scores indicating more anxiety. The BAI has shown good test-retest-reliability and satisfying internal consistency (Cronbach's α = .91) in a clinical sample (r = .84) (Vázquez-Morejón et al., 2014), and satisfying internal consistency in the current sample (Cronbach's α = .95).

The Satisfaction With Life Scale (SWLS) (Diener, 1985) is a five-item seven-point Likert scale assessing perceived quality of life, with higher scores indicating more quality of life. Satisfying convergent validity with social support has been observed (r = .39) for the SWLS and the Oslo Social Support Scale (Glaesmer et al., 2011). Further, the SWLS has demonstrated good internal consistency (Cronbach's α = .88) in a Swedish sample (Hultell & Gustavsson, 2008) and in the current sample (Cronbach's α = .80).

The Social Responsiveness Scale (SRS) (Constantino, 2002) is a 65-item four-point Likert measuring autistic core challenges, with higher scores indicating more autistic symptoms. The scale results in a total score and five subscale scores (Social motivation; Social

cognition; Social awareness; Social communication; Autistic mannerism). The SRS has shown good concurrent, predictive, convergent, and discriminative validity with a sensitivity of .85 and a specificity of .83 for ASD (Bolte, 2012; Chan et al., 2017). In addition, the current sample showed satisfying internal consistency (Cronbach's $\alpha = .93$).

5.4.4 Analytical approach

Data were initially screened for missing values and outliers, and normality was assessed in skewness and kurtosis. Mean value imputation was used to deal with missing items. Exploratory factor analysis, using maximum likelihood as the factor extraction method and parallel analysis to decide upon the number of factors for each scale, were performed to analyze the component structure of the AAQ and the CFQ. Cronbach's alpha was used to assess internal consistency. The interpretations of Cronbach's alpha were $\alpha \geq .70$ = satisfying, $\alpha \geq .80$ = good, and $\alpha \geq .90$ = satisfying, where a too low or high alpha value may indicate insufficient reliability (Taber, 2018). Pearson's correlation coefficient was used to investigate the instruments' construct validity (convergent and divergent). In the case of non-normal distributions, Spearman's correlation coefficient was performed. The CFQ and AAQ consist of 7 items, making the total N of 54 low but an adequate number of participants for psychometric evaluations (Costello & Osborne, 2005; Mundfrom, Shaw, & Ke, 2005). According to Costello and Osborne (2005), a small sample can be acceptable if an instrument shows robust data (i.e., uniformly high communalities without cross-loadings and one-factor solution). The construct validity of the AAQ and the CFQ was evaluated by correlating the scales with one another and with other measures, that is, the PSS (Cohen et al., 1983), the BDI (Beck, Ward, Mendelson, Mock, & Erbaugh, 1961), the BAI (Beck et al., 1988), the SWLS (Diener, 1985), the CBAS (Ottenbreit & Dobson, 2004), and the SRS (Constantino, 2002).

5.5 TREATMENT DESCRIPTION

5.5.1 The NeuroACT treatment program

The manualized treatment NeuroACT – stress management for flexibility and health consists of training in ACT processes combined with psychoeducation on stress, emotions, and perception and the support of executive difficulties. As shown in Figure 9, the primary treatment objectives are to (1) Facilitate participants' motivation to behavior change and (2) train participants' skills to cope with daily hassles and stressful situations to reduce behavioral avoidance and increase flexibility.

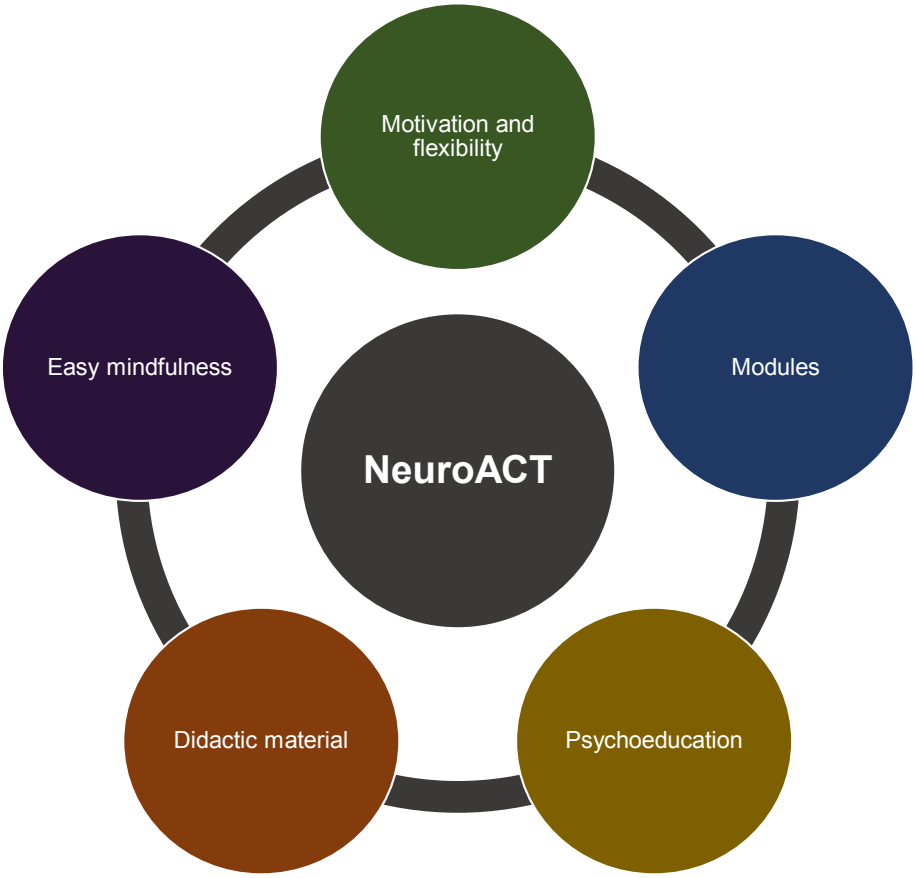

Figure 9. NeuroACT program overview.

The program includes components typically included in an ACT intervention: (1) *value-based action* (i.e., do what is essential to oneself), representing Motivation in the NeuroACT model, (2) *acceptance and willingness* (i.e., allowing thoughts, emotions, and body sensations come and go without judgment), representing Acceptance in the NeuroACT model, and (3) *being present, cognitive defusion, and self-as context* (i.e., strategies for reducing the tendency to make thoughts, images, and emotions concrete and thus being obstacles for value-based action), representing Perspective in the NeuroACT model.

The program consists of 12-14 (6-7 modules) weekly 150 minutes group sessions including a break (depending on the functional level of the participants), with 8-10 participants, usually led by two group leaders (or one depending on the number of participants). Each session

has a similar format with a short mindfulness or acceptance exercise, followed by a review of homework assignments, an introduction of the theme of the particular session, and finally, a review of new homework assignments and session evaluation.

The treatment is adapted to ASD challenges by using short mindfulness and acceptance exercises (5-12 minutes) and simplified language. Before each audio exercise, a rationale for why to practice mindfulness or acceptance are provided. Central components and processes of each treatment session are explained using didactic presentations. In-session activities and homework assignments consist of pencil-and-paper exercises using adapted worksheets (i.e., recording stressful situations and avoidance behaviors, values and actions work, cognitive defusion exercises, and visualized metaphors). In addition, psychoeducational information sheets are provided, such as about stress, emotions, or perception. Further, value-based in-session behaviors are encouraged, using each group session as a potential training occasion.

The program has been modified to meet ASD challenges and treatment settings in three steps: (1) the original program used for adolescents and young adults with ASD in a special school setting (Study I), (2) a modified version of the original program for adults with ASD in a psychiatric outpatient setting (Study II), and (3) a modification of the adult version of the program for adults with ASD in a psychiatric outpatient setting (Study III), based on the experiences from Study II.

5.5.2 Study I

In Study I, the NeuroACT program (described above) was delivered for six weeks. It consisted of two 40-min group sessions per week and 6- to 12-minutes of daily mindfulness and acceptance classroom training, assisted by the students' primary teacher or assistant. The students used a CD containing instructions and the exercises developed for this study and adjusted for adolescents with ASD (e.g., short format; straightforward language; rationale explained at the beginning of each exercise). Shorter and less abstract exercises were presented earlier in the program, while more extended exercises were presented later. Students participated in an initial introductory session. Each subsequent session followed a similar format with a short opening mindfulness exercise, followed by a review of homework assignments, an introduction of the theme of the particular session, and finally, the practice of the following individual mindfulness exercise and a review of new assignments. Homework assignments consisted of pencil-and-paper exercises (i.e., analysis of behavior, values, and behavior goals and recording of stressful situations), mindfulness and acceptance training using the same CD as in classroom sessions, and behavior change procedures. The program was modified to ASD challenges using shorter mindfulness and acceptance exercises (e.g.,

compared to MBRS), simplified language, images, visualized metaphors, and treatment material portfolios to support executive dysfunction. Furthermore, the students' overall needs concerning routine persistence, clarity, and planning were respected.

The central treatment components and adaptations are described in Table 6.

Table 6. NeuroACT treatment components and adaptations (adolescent version Study I).

- Acceptance of thoughts, feelings, and body sensations using acceptance exercises.
- Self as context, using mindfulness exercises (i.e., developing the ability to take different perspectives on one's thoughts, emotions, and body sensations).
- Worksheets connecting values to behavior goals.
- Identification of obstacles to carry out value-based behaviors.
- Examination of the participant's solutions and alternative strategies to carry out value-based behaviors.
- Illustration of the avoidance trap.
- Seeing thoughts as thoughts and not as true obstacles to a valued life (e.g., cognitive defusion, i.e., decreasing the literal meaning of thoughts).
- Application of behavior strategies and mindfulness and acceptance techniques in stressful situations.
- Small groups (4–6 participants).
- Shorter individual mindfulness and acceptance exercises (6–12 minutes of in-school practice).

5.5.3 Study II

In Study II, the adapted NeuroACT version for adults with ASD in a psychiatric setting consisted of 12 weekly 150 minutes group sessions. The protocol was identical to the one presented for Study I but modified to meet the needs of autistic adults in a psychiatric outpatient setting. The modifications of the protocol made from Study I were: (1) adaptation of examples to be recognizable to adults, (2) clarification of homework assignments and individual support voluntarily from the group leaders for 30 min after each treatment session, (3) extended psychoeducational material to help the participants obtain knowledge of the treatment themes, and (4) color-coded worksheets to facilitate and provide more structure for the participants.

The central treatment components and aims are described in more detail in Table 7.

Table 7. NeuroACT treatment modules and sessions (adult version Study II).

Module 1. Stress and avoidance (Session 1-2) • Psychoeducation on stress from an ACT perspective. • Recording of stressful situations. • Avoidance trap.	**Module 2. Perspective taking (Session 3-4)** • Introduction to mindfulness and cognitive defusion. • Being present. • Perspective taking skills.
Module 3. Values and committed action (Session 5-6) • Values- and motivation work. • Purpose and meaning. • Behavior goals and committed action.	**Module 4. Acceptance and compassion (Session 7-8)** • Acceptance and compassion skills. • Acceptance of emotions and body sensations. • Acceptance of sensory input.
Module 5. Integration of ACT (Session 9-10) • Using presence, defusion, and acceptance. • Managing stress in social situations. • Restorative actions.	**Module 6. Consolidation of ACT (Session 13-14)** • Action plan. • Review of group experiences. • Planning for the future.

ACT = acceptance and commitment therapy

5.5.4 Study III

In study III, the protocol was primarily identical to the one presented for Study II, but some modifications were made based on the experience from Study II. The treatment consisted of 14 weekly 150 minutes group sessions with 8-10 adults with ASD in a psychiatric outpatient setting. Hence the program contained two additional sessions to enhance problem-solving and everyday-structure skills.

The central treatment components and aims are described in more detail in Table 8.

Table 8. NeuroACT treatment modules and sessions (adult version Study III).

Module 1. Stress and avoidance (Session 1-2) • Psychoeducation on stress from an ACT perspective. • Recording of stressful situations. • Avoidance trap.	**Module 2. Perspective taking (Session 3-4)** • Introduction to mindfulness and cognitive defusion. • Being present. • Perspective taking skills.
Module 3. Values and committed action (Session 5-6) • Values- and motivation work. • Purpose and meaning. • Behavior goals and committed action.	**Module 4. Acceptance and compassion (Session 7-8)** • Acceptance and compassion skills. • Acceptance of emotions and body sensations. • Acceptance of sensory input.
Module 5. Integration of ACT (Session 9-10) • Using presence, defusion, and acceptance. • Managing stress in social situations. • Restorative actions.	**Module 6. Support of executive function (Session 11-12)** • Problem solving. • Structure management. • Application of ACT techniques.
Module 7. Consolidation of ACT (Session 13-14) • Action plan. • Review of group experiences. • Planning for the future.	

ACT = acceptance and commitment therapy

5.6 ETHICAL CONSIDERATIONS

The Ethical Review Board in Stockholm approved all studies and all participants gave their written informed consent to participate in the studies.

Chapter 6

Results

The results section summarizes the essential findings in each of the studies.

5.7 STUDY I

5.7.1 Feasibility

All NeuroACT group participants completed the treatment, 50 % attended all sessions, and the majority, 93 %, had six sessions or more. Training occasions had a mean score of 2.5 (SD = 1.5) per week (53 % practiced = > 3 days a week). Overall, treatment satisfaction was rated as high, and no adverse events were reported. The majority (93 %) reported high or very high satisfaction with the treatment content and the group-session format. The majority reported mindfulness and acceptance audio exercises to be easy or very easy (64 %).

5.7.2 Treatment outcome

As shown in Figure 10, self- and teacher-rated overall stress (SSS total score) was significantly reduced in the NeuroACT group compared to controls. However, the total stress score self-ratings did not correlate with teacher-ratings total stress score at any measuring time points.

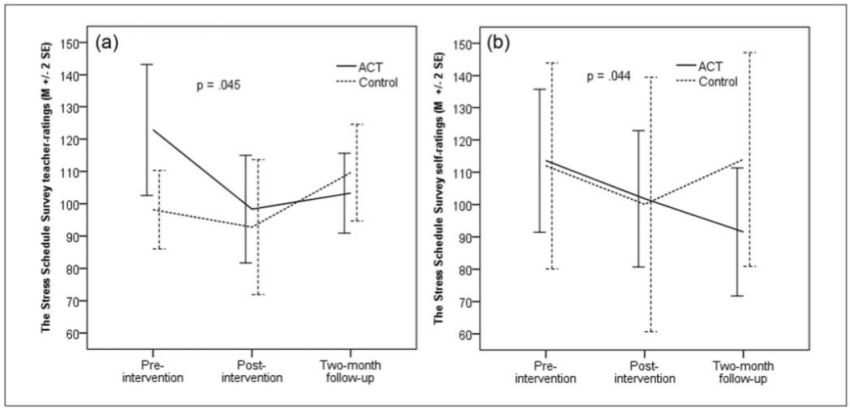

Figure 10. The analyses of the Stress Survey Schedule total scores showed a significant group-by-time interaction effect in (a) teacher-ratings and (b) self-ratings from pre-intervention (T1) to the 2-month follow-up (T3).

ACT: acceptance and commitment therapy; SE: standard error.

As shown in Table 9, overall self-rated hyperactivity (SDQ-Hyperactivity/inattention subscale) was statistically significantly reduced, and prosocial behavior (SDQ-Prosocial behavior subscale) increased in the NeuroACT group compared to the control group. Self- and teacher ratings correlated significantly in SDQ-Emotional symptoms, Conduct problems, and Peer relation problems. No statistically significant interaction effect was found in conduct problems or peer relation problems.

Table 9. Means and standard deviation (SD), and statistics from rmANOVA on self-ratings of the SDQ.

		Pre-skills training	Post-skills training	2- month follow-up	Effect of time	Between-group effect	Group-by-time interaction effect	Correlation with teacher-rating at baseline
The SDQ total score	ACT	14.00 (5.75)	13.20 (6.46)	11.13 (4.97)	$F_{(2, 52)} = 1.39$; $p = .258$; $\eta_p^2 = .05$	NS	$F_{(2, 52)} = 1.95$; $p = .152$; $\eta_p^2 = .07$	$r = .23$
	C	11.92 (5.98)	10.92 (5.17)	11.92 (6.78)				$p = .248$
The SDQ subscales								
Emotional symptoms	ACT	3.87 (2.97)	3.27 (3.31)	2.93 (2.60)	$F_{(2, 52)} = .27$; $p = .768$; $\eta_p^2 = .01$	NS	$F_{(2, 52)} = 2.13$; $p = .13$; $\eta_p^2 = .08$	$r = .42$
	C	2.38 (2.50)	2.62 (1.85)	2.85 (2.51)				**$p = .027$**
Hyperactivity/inattention	ACT	4.07 (2.05)	4.73 (2.19)	3.20 (1.61)	$F_{(2, 52)} = 2.54$; $p = .089$; $\eta_p^2 = .09$	NS	$F_{(2, 52)} = 3.90$; **$p = .026$**; $\eta_p^2 = .13$	$r = .18$
	C	4.54 (2.57)	3.23 (2.68)	3.62 (2.63)				$p = .366$
Conduct problems	ACT	2.33 (1.80)	2.07 (1.79)	2.07 (2.12)	$F_{(2, 52)} = .51$; $p = .951$; $\eta_p^2 = .00$	NS	$F_{(2, 52)} = .91$; $p = .410$; $\eta_p^2 = .03$	$r = .54$
	C	1.85 (1.35)	2.08 (1.89)	2.23 (1.83)				**$p = .003$**
Peer relation problems	ACT	3.73 (1.91)	3.13 (1.41)	2.93 (1.67)	$F_{(2, 52)} = .93$; $p = .402$; $\eta_p^2 = .03$	NS	$F_{(2, 52)} = 1.27$; $p = .289$; $\eta_p^2 = .05$	$r = .50$
	C	3.15 (1.99)	3.00 (1.35)	3.31 (2.21)				**$p = .007$**
Prosocial behaviour[a]	ACT	7.27 (1.91)	7.33 (2.02)	7.53 (1.77)	$F_{(2, 52)} = 1.54$; $p = .224$; $\eta_p^2 = .06$	NS	$F_{(2, 52)} = 3.61$; **$p = .034$**; $\eta_p^2 = .12$	$r = .362$
	C	7.38 (1.39)	6.69 (2.18)	6.15 (2.30)				$p = .058$

ANOVA: analysis of variance; ACT = acceptance and commitment therapy-based skills training group; C = control group; SDQ: Strengths and Difficulties Questionnaire.
[a]The SDQ subscale prosocial behaviour is not included in the SDQ total score. In contrast to other SDQ subscales, higher scores in the SDQ prosocial behaviour indicate better adjustment.
Bold values = statistically significant *p*-values.

As shown in Figure 11, overall psychological distress (BYI total score) and anger (BYI-Anger subscale) were significantly reduced in the NeuroACT group compared to the control group. At the same time, a statistical trend was observed for overall reduced depressive symptoms (BYI-Depression subscale). No statistically significant interaction effect was found in anxiety.

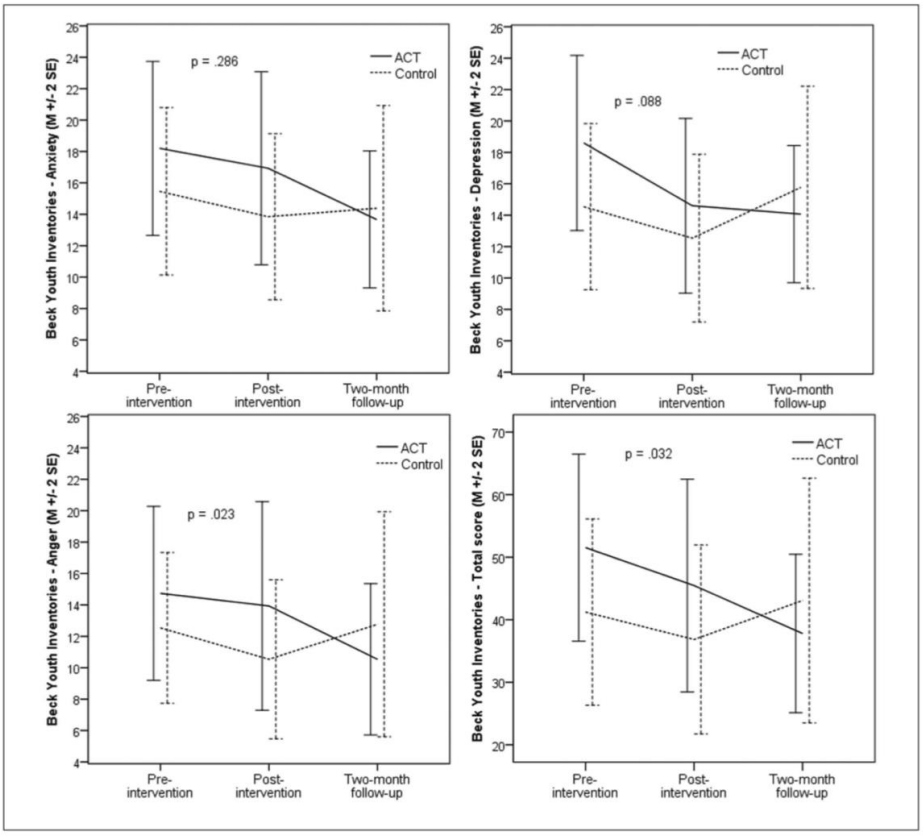

Figure 11. The analyses of the self-rated BYIs showed significant group-by-time interaction effects in anger and the BYIs total score, as well as a statistical trend in depression.

ACT: acceptance and commitment therapy; SE: standard error; BYIs: Beck Youth Inventories.

5.8 STUDY II

5.8.1 Feasibility

In Study II, nine of the ten participants completed treatment (one participant dropped out after two sessions), and mean attendance was 11 of 12 sessions (SD = 3, range 9–12). Self-rated treatment credibility total score (max = 10) (TCS) (Borkovec & Nau, 1972) was high (M = 7.7,

SD = 0.8). The mean score on item 1 (how apprehensible the treatment seemed to the participants) was 8.3 (SD = 1.6); item 2 (how confident they felt that the group would reduce their ASD related problems) was 6.9 (SD = 1.6); item 3 (how confident they would be in recommending this kind of group to a friend with ASD) was 8.3 (SD = 1.2); item 4 (how successful the participants thought that the treatment would be for other diagnoses) was 8.0 (SD = 0.7); and item 5 (how much improved they expected to become with this treatment) was 6.7 (SD = 2.5). Overall, the participants successfully completed homework assignments and carried out mindfulness and acceptance exercises at home. Participant experiences and comments from Study II are presented in Figure 12.

Figure 12. Participants' comments after NeuroACT.

5.8.2 Treatment outcome

The results of Study II showed statistically significant change in several measures at post-assessment as compared to pre-assessment, as shown in Table 10. Self-perceived stress (PSS), social impairment (SDS), psychological inflexibility (AAQ), and cognitive fusion (CFQ) were significantly reduced from pre- to post-treatment. At the 3-month follow-up, there was a significant increase in quality of life and a significant reduction in depressive symptoms (BDI) compared to pre-treatment. However, social impairment and cognitive fusion measures were still significantly reduced at 3-month follow-up compared to pre-treatment. The results did not show any significant changes in anxiety symptoms (BAI) or work- and family-related impairments (SDS work and family subscales).

Table 10. Means and standard deviations on study measures at pre, post, and follow-up (n = 10). Paired samples t-tests based on intention to treat evaluating differences between assessments points; effect sizes as Cohen's d.

Measure	Pre treatment	Post treatment	3-month follow-up				
	M (SD)	M (SD)	M (SD)	t		Cohen's d	
				Pre-post	Pre-follow-up	Pre-post	Pre-follow-up
PSS	35.1 (5.4)	29.0 (7.7)	31.5 (8.3)	2.73*	1.20	0.92	0.51
SWLS	13.2 (5.1)	15.5 (5.7)	17.0 (4.8)	−1.54	−2.79*	0.43	0.77
BDI-II	21.6 (14.3)	15.3 (10.7)	14.4 (11.6)	2.00	2.45*	0.50	0.55
BAI	24.2 (16.4)	14.5 (9.5)	18.4 (11.0)	1.56	1.14	0.72	0.42
SDS (work)	6.7 (2.8)	7.1 (1.7)	6.2 (2.5)	-.51	.75	0.17	0.19
SDS (social)	7.6 (3.0)	6.2 (3.2)	6.8 (2.9)	2.69*	2.45*	0.45	0.27
SDS (family)	6.6 (2.0)	5.9 (2.0)	6.3 (2.1)	.96	.64	0.35	0.15
AAQ-7	31.7 (8.1)	26.3 (4.2)	27.7 (6.0)	2.68*	1.50	0.84	0.56
CFQ-7	33.0 (6.1)	28.4 (7.4)	29.9 (5.3)	3.82**	3.09*	0.68	0.54

Note. PSS = Perceived Stress Scale; SWLS = Satisfaction with Life Scale; BDI-II = Beck Depression Inventory-II; BAI = Beck Anxiety Inventory; SDS = Sheehan Disability Scale; AAQ-7 = Acceptance and Action Questionnaire – 7 items; CFQ-7 = Cognitive Fusion Questionnaire – 7 items.
*$p < .05$.
**$p < .01$.

5.9 STUDY III

In study III, normal distribution was found for all measures except the Beck Depression Inventory, the Beck Anxiety Inventory, the Karolinska Sleep Questionnaire - Breathing Index, and the Karolinska Sleep Questionnaire – Fatigue Index. There was a slight majority of male participants (54 %). In addition, several participants had comorbid disorders (56 %), mainly ADHD/ADD, depression, and dysthymia, and had undergone some type of pharmacological treatment (72 %), mainly antihistamines, sleep medication, antidepressants, and methylphenidate. The mean total IQ score was 108.5 (SD = 13.5). The mean total IQ score was 107.0 (SD = 13.8) for the treatment group and 109.6 (SD = 13.9) for the control group.

5.9.1 Feasibility

Thirty-nine out of 52 assessed participants (75 %) were considered candidates to participate in the study, and 17 out of 20 participants (85 %) completed the treatment. The treatment credibility total score (max = 10) was rated as high (M = 7.3, SD = 2.5) using the TCS (Borkovec & Nau, 1972). The mean score was 7.6 (SD = 2.5) on item 1 (how apprehensible the treatment seemed to the participants); 6.3 (SD = 3.2) on item 2 (how confident they felt that the group would reduce their ASD related problems; 7.9 (SD = 3.2) on item 3 (how confident they would be in recommending this kind of group to a friend with ASD); 8.0 (SD = 2.7) on item 4 (how successful the participants thought that the treatment would be for other diagnoses); and 6.4 (SD = 3.1) on item 5 (how much improved they expected to become with this treatment). No adverse events were reported.

5.9.2 Treatment outcome

As presented in Table 11, a statistically significant difference was found in measures of self-perceived stress (PSS) and quality of life (SWLS) (primary measures), with a moderate effect size, in the NeuroACT group, compared to the TAU group. However, no statistically significant between-group improvement was found in the second quality of life instrument (QOLI). Sleep quality (KSQ-S) was statistically significantly improved from T1 to T2, with a moderate effect size. A statistical trend was found for improved overall sleep quality in the treatment group compared to the TAU group. Kruskal-Wallis tests showed a group-by-time statistical trend for reduced depressive symptoms (BDI) from T1 to T2 in the treatment group compared to the TAU group ($\chi 2_{(1, N = 32)} = 3.61$, $p = .057$). No statistically significant change or statistical trend was observed between the two groups in anxiety (BAI), breathing problems (KSQ-Breathing Index), fatigue during daytime (KSQ-Fatigue Index), or awakening difficulties (KSQ-A). A statistical trend for reduced anxiety was found from T1 to T2, in both the treatment group ($Z_{(1, N = 16)} = -1.82$, $p = .068$) and the TAU group ($Z_{(1, N = 16)} = -1.79$, $p = .073$). The results showed no statistically significant interaction effect or statistical trend in the functional impairment measure (SDS).

Table 11. Means, standard deviations, statistical significance, and effect sizes between groups for stress, quality of life, sleep problems, and functional impairment at pre, post, and 6-month follow-up.

	n	Pre	Post	6-mo	Group-by-time interaction effect (within-subjects)		Pre-post	Post-6-mo
Measure	NeuroACT = 16 TAU = 18	M (SD)	M (SD)	M (SD)	*ANOVA*	*d*	*d*	*d*
PSS	NeuroACT	35.8 (7.5)	24.9 (8.4)	22.6 (8.1)	F (2, 64) = 4.60	.76*	*1.02***	.40
	TAU	34.2 (7.7)	32.3 (8.6)	28.8 (8.1)				
SWLS	NeuroACT	14.3 (5.1)	18.7 (5.9)	20.3 (5.6)	F (2, 64) = 3.85	.77*	.69†	.71†
	TAU	14.4 (4.9)	15.4 (6.2)	16.4 (5.7)				
QOLI	NeuroACT	.70 (1.6)	1.67 (1.4)	1.41 (1.7)	F (2, 64) = 1.35	.41	.50	.26
	TAU	-.21 (1.5)	.12 (1.9)	.44 (1.7)				
KSQ-S	NeuroACT	10.8 (6.6)	7.7 (6.6)	6.9 (5.1)	F (2, 64) = 3.12	.63†	.78*	.11
	TAU	9.2 (6.5)	9.8 (5.5)	7.5 (5.0)				
KSQ-A	NeuroACT	7.8 (4.4)	7.4 (4.5)	5.7 (5.1)	F (2, 64) = .57	.26	.19	.37
	TAU	7.3 (4.6)	7.8 (4.5)	6.7 (3.8)				
SDS	NeuroACT	17.6 (6.1)	14.6 (4.9)	15.1 (7.3)	F (2, 64) = 1.47	.43	.59	.09
	TAU	19.4 (6.5)	19.7 (5.4)	19.1 (5.9)				

Note. PSS = Perceived Stress Scale; SWLS = Satisfaction with Life Scale; QOLI = Quality of Life Inventory; BDI-II = Beck Depression Inventory-II; KSQ-S = Karolinska Sleep Questionnaire – Sleep quality Index; KSQ-A = Karolinska Sleep Questionnaire – Awakening Index; SDS = Sheehan Disability Scale. Effect size measured by Cohen's *d* (0.2 = small; 0.5 = moderate; 0.8 = large).

* $p < .05$. ** $p < .01$. † non-significant trend

As shown in Table 12, statistically significant interaction effects were found in measures of psychological inflexibility (AAQ), cognitive fusion (CFQ), and cognitive and behavioral avoidance (CBAS), with moderate to large effect sizes in the NeuroACT group compared the TAU group.

Table 12. Means, standard deviations, statistical significance, and effect sizes between groups for ACT-related measures at pre, post, and 6-month follow-up.

	n	Pre	Post	6-mo	Group-by-time interaction effect (within-subjects)		Pre-post	Post-6-mo
Measure	NeuroACT = 16 TAU = 18	M (SD)	M (SD)	M (SD)	*ANOVA*	*d*	*d*	*d*
AAQ	NeuroACT	30.4 (11.0)	23.9 (9.4)	21.6 (9.1)	F (2, 64) = 3.91	.70*	.79*	.61†
	TAU	30.4 (9.5)	29.8 (9.9)	28.7 (8.5)				
CFQ	NeuroACT	33.5 (11.4)	25.0 (9.4)	24.3 (8.0)	F (2, 64) = 5.32	.82**	1.07**	.35
	TAU	31.0 (9.2)	31.6 (9.9)	28.7 (8.8)				
CBAS	NeuroACT	82.1 (21.1)	67.0 (19.6)	65.3 (22.1)	F (2, 64) = 6.44	.90**	1.24**	.41
	TAU	80.7 (15.4)	86.5 (18.0)	80.7 (16.0)				

Note. AAQ = Acceptance and Action Questionnaire – 7 items; CFQ = Cognitive Fusion Questionnaire – 7 items; CBAS = The Cognitive-Behavioral Avoidance Scale. Effect size measured by Cohen's *d* (0.2 = small; 0.5 = moderate; 0.8 = large).

* $p < .05$. ** $p < .01$. † non-significant trend

As shown in Table 13, statistically significant interaction effects or trends were found in measures of overall autistic core challenges (SRS total score), autistic mannerism (SRS-AM), and social motivation (SRS-M) at post-assessments (T2, T3) compared to T1, with moderate effect sizes, in the NeuroACT group compared to the TAU group. However, no statistically significant interaction effects or statistical trends were found for social awareness (SRS-A), social cognition (SRS-SC), communication (SRS-C), or executive difficulties (DEX).

Table 13. Means, standard deviations, statistical significance, and effect sizes between groups for autistic core challenges and executive difficulties at pre, post, and 6-month follow-up.

	n	Pre	Post	6-mo	Group-by-time interaction effect (within-subjects)		Pre-post	Post-6-mo
Measure	NeuroACT = 16 TAU = 18	M (SD)	M (SD)	M (SD)	*ANOVA*	*d*	*d*	*d*
SRS	NeuroACT	89.5 (28.1)	80.4 (22.7)	70.0 (28.7)	F (2, 64) = 2.55	.57†	.43	.62†
	TAU	88.6 (20.0)	86.1 (15.7)	83.5 (16.7)				
SRS-AM	NeuroACT	15.8 (7.4)	12.1 (5.7)	10.6 (6.0)	F (2, 64) = 3.93	.70*	.64†	.75*
	TAU	15.6 (6.2)	14.8 (6.0)	15.1 (5.2)				
SRS-M	NeuroACT	17.9 (6.0)	14.8 (4.7)	12.5 (6.6)	F (2, 64) = 2.92	.61†	.61†	.60†
	TAU	17.8 (5.4)	17.5 (4.3)	16.4 (3.8)				
SRS-A	NeuroACT	10.1 (3.9)	9.9 (3.2)	8.9 (3.0)	F (2, 64) = .14	.13	.01	.16
	TAU	9.6 (3.0)	9.2 (3.0)	8.8 (3.0)				
SRS-SC	NeuroACT	16.6 (4.6)	16.5 (6.9)	14.7 (6.5)	F (2, 64) = .94	.35	.00	.46
	TAU	15.9 (4.2)	15.7 (3.6)	15.7 (4.5)				
SRS-C	NeuroACT	29.1 (10.2)	27.1 (7.8)	23.3 (11.4)	F (2, 64) = 1.27	.40	.19	.49
	TAU	29.7 (7.0)	28.8 (6.4)	27.6 (6.6)				
DEX	NeuroACT	37.8 (11.5)	31.6 (11.7)	28.2 (8.6)	F (2, 64) = 2.04	.51	.41	.43
	TAU	37.3 (9.9)	36.8 (11.4)	34.1 (8.4)				

Note. SRS = Social Responsiveness Scale – total score; SRS-AM = Social Responsiveness Scale – Autistic mannerism; SRS-M = Social Responsiveness Scale – Motivation; SRS-A = Social responsiveness Scale – Social Awareness; SRS-SC = Social Responsiveness Scale – Social Cognition; SRS-C = Social Responsiveness Scale – Communication; DEX = Dysexecutive Questionnaire - Self report. Effect size measured by Cohen's *d* (0.2 = small; 0.5 = moderate; 0.8 = large).

* $p < .05$. ** $p < .01$. † non-significant trend

As shown in Table 14, clinically significant change scores differed between the NeuroACT and the TAU group. The NeuroACT group showed about twice as many participants recovering from stress (PSS) and about three times more that had a clinically significant improvement compared to the TAU group. Regarding quality of life (SWLS), nearly three times as many participants showed recovery. At the same time, a clinically significant improvement was observed with a 4/0-ratio in the NeuroACT group compared to the TAU group. More participants showed no clinically significant improvement in the TAU group compared to the NeuroACT group.

Table 14. Clinically significant change of the PSS and the SWLS (primary outcomes) against NeuroACT versus TAU from T1 to T3.

Classification	**PSS**		**SWLS**	
	NeuroACT (*n* = 16)	TAU (*n* = 18)	NeuroACT (*n* = 16)	TAU (*n* = 18)
	n (%)	*n* (%)	*n* (%)	*n* (%)
Recovered	8 (50 %)	5 (28 %)	6 (38 %)	2 (11 %)
Improved	6 (38 %)	2 (11 %)	4 (25 %)	0 (0 %)
Unimproved	2 (13 %)	7 (39 %)	7 (44 %)	13 (72 %)

Note. Recovered = Clinically significant change - below or above cut-off score; Improved = Clinically significant change - 2 standard deviations below or above the group mean; Unimproved = Failed to change 2 standard deviations from group mean.

5.10 STUDY IV

Study IV found skewness and kurtosis of AAQs and CFQs items and total scores, and all other instruments' total scores, to be acceptable (skewness = +-0.01-1.26; kurtosis = +-0.01-1.64) (Field, 2009). Parallel analysis indicated a one-factor solution for AAQ and CFQ, respectively. As shown in Table 15, the one-factor solution of the AAQ explained 64 % of the total variance, and Cronbach's alpha was .92, with a mean of 29.26 (*SD* = 11.09). Factor loadings based on maximum likelihood varied from .68 to .88 for the AAQ.

Table 15. Factor loadings of the AAQ from maximum likelihood extraction, total scale mean, standard deviation, and Cronbach's alpha (n = 54).

AAQ Items	Factor Loadings
1. My painful experiences and memories make it difficult for me to live a life that I would value.	.77
2. I'm afraid of my feelings.	.86
3. I worry about not being able to control my worries and feelings.	.87
4. My painful memories prevent me from having a fulfilling life.	.79
5. Emotions cause problems in my life.	.72
6. It seems like most people are handling their lives better than I am.	.68
7. Worries get in the way of my success	.88
Percent explained variance	64
Scale mean	29.26
Scale SD	11.09
Cronbach's α for scale	.92

Note. AAQ = Acceptance and Action Questionnaire – 7 items

As presented in Table 16, the one-factor solution of the CFQ explained 67 % of the total variance, and Cronbach's alpha was .93, with a mean of 31.00 (SD = 10.34). Factor loadings based on maximum likelihood varied from .74 to .87 for the CFQ.

Table 16. Factor loadings of the CFQ from maximum likelihood extraction, mean, standard deviation, and Cronbach's alpha (n = 54).

CFQ Items	Factor Loadings
1. My thoughts cause me distress or emotional pain	.86
2. I get so caught up in my thoughts that I am unable to do the things that I most want to do	.74
3. I over-analyze situations to the point where it's unhelpful to me	.75
4. I struggle with my thoughts	.86
5. I get upset with myself for having certain thoughts	.82
6. I tend to get very entangled in my thoughts	.87
7. It's such a struggle to let go of upsetting thoughts even when I know that letting go would be helpful	.84
Percent explained variance	67
Scale mean	31.00
Scale SD	10.34
Cronbach's α for scale	.93

CFQ = CF Questionnaire – 7 items

As shown in Table 17, statistically significant positive correlations between the AAQ and the CFQ, and most other measures, were found. As expected, the AAQ and the CFQ correlated positively with perceived stress (PSS), depression (BDI), anxiety (BAI), and overall autistic challenges (SRS), providing support for convergent validity. A statistically significant negative

correlation was observed between the AAQ and the CFQ, and the Satisfaction With Life Scale (SWLS), supporting divergent validity. Correlations between the AAQ and the CFQ and the Social Responsiveness Scale – Social Awareness subscale (SRS-A) were non-significant, indicating no relationship between PI and CF and social awareness.

Table 17. Correlations between AAQ and CFQ, and other measures.

Measure	*N*	AAQ	CFQ
AAQ	54		.63**
CFQ	54	.63**	
PSS	54	.59**	.60**
BDI	54	.73**	.54**
BAI	54	.59**	.47**
SWLS	54	-.63**	-.54**
CBAS	45	.62**	.38**
SRS	45	.60**	.54**
SRS-AM	45	.63**	.61**
SRS-M	45	.69**	.54**
SRS-A	45	.04	.09
SRS-SC	45	.66**	.62**
SRS-C	45	.57**	.53**

Note. AAQ = Acceptance and Action Questionnaire – 7 items; CFQ = CF Questionnaire – 7 items; PSS = Perceived Stress Scale; BDI = Beck Depression Inventory-II; BAI = Beck Anxiety Inventory-II; CBAS = The Cognitive-Behavioral Avoidance Scale; SWLS = Satisfaction With Life Scale; SRS = Social Responsiveness Scale – total score; SRS-AM = Social Responsiveness Scale – Autistic mannerism; SRS-M = Social Responsiveness Scale – Motivation; SRS-A = Social responsiveness Scale – Social Awareness; SRS-SC = Social Responsiveness Scale – Social Cognition; SRS-C = Social Responsiveness Scale – Communication.
* $p < .05$. ** $p < .01$.

Chapter 7

Discussion

7.1 ACT FOR ADOLESCENTS AND YOUNG ADULTS

The first aim of this doctoral thesis was to evaluate ACT in autistic adolescents and young adults. The results indicated good feasibility of the NeuroACT program in a school setting. Moreover, statistically significant improvements or statistical trends were observed in stress and mental health (primarily anger and depression), and hyperactivity/inattention, prosocial behavior, and emotional symptoms, with medium to large effect sizes, in NeuroACT compared to wait-list. However, no statistically significant interaction effect or statistical trend was found in conduct problems, peer relation problems, or anxiety symptoms.

The results from Study I are in line with empirical support for ACT as a feasible and effective approach not only for adults but also for children and adolescents (Coyne, McHugh, & Martinez, 2011; Fang & Ding, 2020; Halliburton & Cooper, 2015). Interestingly, hyperactivity/inattention was improved, indicating that mindfulness may benefit self-regulation and attention in ASD. This finding is consistent with research on individuals with ADHD (i.e., a neurodevelopmental condition with attention deficits) showing improved attention capacity due to mindfulness training (Hirvikoski et al., 2011). The treatment aimed at elaborating skills to cope with uncomfortable mental events and sensory inputs and thus use goal-directed behaviors instead of relying on restricted behaviors and avoidance. As noted previously, practicing mindfulness, cognitive defusion, acceptance, and value skills may increase psychological flexibility and self-awareness (Coyne et al., 2011). Hence, the improved stress and psychiatric symptoms, and prosocial behaviors, may thus indicate improved emotional regulation alongside increased perspective-taking. However, the analysis of active treatment components goes beyond the scope of this study, and the effect that ACT processes have on autistic core challenges, such as perspective-taking and cognitive inflexibility, requires further attention.

7.2 ACT FOR ADULTS

The second aim of this doctoral thesis was to evaluate ACT in autistic adults. The results indicated that NeuroACT was feasible in adults with ASD in a psychiatric outpatient setting. Statistically significant improvements or statistical trends were observed in several mental health outcomes and ACT related measures of psychological inflexibility, cognitive fusion, and behavioral avoidance, with moderate to large effect sizes in NeuroACT compared to TAU. In addition, both groups improved in anxiety. Further, improvements were found in autistic core challenges related to autistic mannerism and social motivation, but not social awareness, social cognition, functional impairment, communication, or executive dysfunction in NeuroACT compared to TAU.

The improvements in several measures are consistent with research indicating that autistic adults can benefit from CBT and mindfulness practice for autistic adults, suggesting that psychological treatments could positively influence mental health and increase quality of life (Beck et al., 2020; Kiep et al., 2015; Weston, Hodgekins, & Langdon, 2016). ACT for autistic individuals is mainly based on mindfulness training from a functional analytic perspective, which means using mindfulness skills to overcome obstacles and pursue personally chosen values and goals. Short-term reinforced behaviors, cognitive inflexibility, and social avoidance are common problems in autistic individuals, making improved psychological flexibility valuable (Bishop-Fitzpatrick, Minshew, Mazefsky, & Eack, 2017). Furthermore, symptoms of stress, such as high arousal and unpleasant affect, increase the risk of emotional and behavioral avoidance in ASD (Sheynin et al., 2017). Hence, enhancing psychological flexibility may be especially important in autistic individuals since insufficient emotion regulation skills and maladaptive behavioral avoidance affect mental health negatively (Mazefsky, 2015). The reduced self-perceived stress and cognitive and behavioral avoidance, alongside the increased quality of life observed in this thesis, may suggest a broadening of the participants' behavioral repertoire, enhancing a sense of meaning in everyday life. Furthermore, the observed improved mental health and quality of life are coherent with empirically supported models of adversity and resilience in individuals with ASD (Scarpa et al., 2021). In this perspective, enhancing psychological flexibility through emotional regulation skills in response to stressful events can increase quality of life and reduce psychopathology in ASD.

NeuroACT uses techniques and treatment content such as motivation, acceptance, cognitive defusion, and psychoeducation to create psychological flexibility (Hayes, 2021b). Hence, from an ACT perspective, when individuals learn to relate to symptoms of stress more flexibly, the risk of avoidance decreases (Hayes et al., 2006). Moreover, long-term social disability and quality of life improvements found in Study II are coherent with ACT studies

suggesting an 'incubation effect,' whereby improvement is maintained or increased after finishing an ACT treatment (Clarke, Kingston, James, Bolderston, & Remington, 2014; Hayes et al., 2004; Lundgren, Dahl, Melin, & Kies, 2006).

The overall significant interaction effect of one quality of life measure (SWLS) but not the other (QOLI) observed in Study III may be associated with the more persistent sub-areas of the QOLI, such as economic status, neighborhood well-being, and family-related concerns. The SWLS measures subjective quality of life and overall well-being, potentially reflecting a more general sense of meaning and purpose than the QOLI. Replication studies and prolonged follow-up are warranted to further assess the eventual effects in these measures for autistic individuals.

Furthermore, the improved sleep quality in autistic adults suggests that ACT may have regulatory effects on sleep. Reduced sleep quality is expected in both autistic children and adults and is linked to mental health problems and even the severity of autistic core challenges (Carmassi et al., 2019; Díaz-Román, Zhang, Delorme, Beggiato, & Cortese, 2018; Morgan, Nageye, Masi, & Cortese, 2020). Therefore, improving sleep in autistic individuals may thus be a valuable feature of ACT. However, the improved sleep quality, but not other aspects of sleep, found in Study III may reflect the general problem with multiple testing, increasing the risk of Type 1-error. Hence, further evaluation of the potential benefits of ACT in autistic individuals is crucial.

Although beyond the scope of this thesis, research indicates that well-being may result from the regulation of self-perception, such as self-awareness and autistic identity (Anderson-Chavarria, 2021; MacLeod et al., 2013; Tan, 2018). This view may be coherent with the NeuroACT treatments' contextualizing of 'self' using cognitive defusion techniques. Furthermore, the group-based format may facilitate validation and normalization in autistic individuals not having to camouflage natural autistic functioning (Corbett et al., 2021; Jorgenson, Lewis, Rose, & Kanne, 2020; Lai et al., 2017).

While no significant changes were observed in social cognition, social awareness, or communication, improvements were found in autistic mannerism and social motivation, suggesting that ACT may regulate behavioral flexibility in autistic adults. Moreover, this result may align with ACT's overarching goal of making social difficulties less of an obstacle to being active in social relationships without training the social skills *per se*. Social skills training is often essential in developing specific social behaviors (Choque Olsson et al., 2017). However, data from this thesis suggest that training skills to handle intrusive thoughts and fears of social situations may also be helpful.

7.3 VALID AND RELIABLE EVALUATIONS

The third aim of this doctoral thesis was to evaluate the psychometric properties of two instruments measuring psychological inflexibility (AAQ) and cognitive fusion (CFQ) in autistic adults. The results indicated that the instruments' internal consistency was satisfactory and parallel analysis suggested a one-factor solution for both scales. Factor analyses showed acceptable factor loadings in all items. The results supported convergent validity concerning measures of psychiatric symptoms and autistic challenges and divergent validity with quality of life.

The data presented in study IV preliminarily suggest that the original versions of psychological inflexibility and cognitive fusion are valid and reliable in autistic adults. However, the construct validity of the AAQ has been questioned. For example, it is not clear whether this instrument discriminates between process and outcome and if it measures psychological inflexibility or overall negative affect (Chawla & Ostafin, 2007; Wolgast, 2014).

Furthermore, contextual insensitivity (i.e., impaired ability to use contextual cues in sense-making) is a well-documented feature of ASD (Vermeulen, 2015; Westby, 2017). Hence, there might be advantages of using context-specific measures (i.e., adapted to a specific problem or population) in autistic individuals, such as sensitivity to population-specific difficulties, measurement specificity, and better prediction of treatment outcomes, as suggested by Ong, Lee, Levin, and Twohig (2019). Thus, adopting the AAQ and the CFQ measures into ASD-specific areas of concern may improve the scales' psychometric properties in autistic individuals.

The non-significant correlation between psychological inflexibility and cognitive fusion and social awareness may suggest that social awareness does not merely reflect the ability to defuse one's thoughts (as in cognitive defusion) or act in line with one's values (as in psychological flexibility). To the best of the author's knowledge, no previous studies have explored how social awareness is linked to psychological inflexibility and cognitive fusion. Nevertheless, the results of Study IV are consistent with Study III showing no effect on social awareness due to training psychological flexibility and cognitive defusion skills.

7.4 METHODOLOGICAL CONSIDERATIONS

7.4.1 Limitations

Although promising, the studies in this doctoral thesis have limitations. First, the studies' small sample size and low statistical power may increase the risk of Type-II error, limiting potential modulation analyses. In addition, there might be a risk of type 1-error regarding the significant

efficacy measures, primarily since a vast number of measurements were included. However, several improvements are in line with previous research, making it less likely that the results depend on chance. Finally, Study I and Study II used open trial or quasi-experimental design, heightening the risk of systematic biases.

Moreover, no treatment integrity, adherence, and competence assessment were performed. Hence, specific ACT procedures and modifications were not measured, and thus, the degree to which the procedures were implemented as described cannot be determined. However, the treatments were performed with the first author and manual writer J. P., making it unlikely that the treatments deviated from protocol.

Nevertheless, a limitation of the current studies is that J. P. and a co-writer of the present manuscripts participated as therapists in Study II and III data collection. This representation may thus increase the risk of non-objectivity and information bias in the data collection and reporting of study results. Therefore, for future studies, non-dependent data collection, therapist representation, and reporting of study results are warranted.

Outcome measures mainly relied on self-report, and no independent or objective criteria were used, increasing the risk of over- or underestimating individual progress. In addition, the study participants had average to above-average intellectual capacity; hence, the results cannot generalize to autistic individuals with lower intellectual capacity. Further, the evaluated treatment manual was ACT adapted to autism, so generalization to other ACT protocols is limited.

Study IV's limitations include a small sample size, increasing the risk of erroneous findings, and requiring more caution when interpreting the results. However, as Costello and Osborne (2005) have suggested, a study's subject to item ratio should be about 8:1, and thus study IV falls within an appropriate range. Furthermore, all scale items of both scales were normally distributed and highly correlated to each scale's construct. Another general limitation is self-report assessment, which always implicates a risk of information bias, mainly since there are no previous evaluations of the AAQ and the CFQ in autistic individuals.

Furthermore, to ensure the integrity of the results, sensitivity analyses (i.e., how changes in methods, models, or values affect the results) would provide more detailed information on the robustness of the factor analysis used in the present study.

Finally, future research using a larger sample size, confirmatory factor analysis, item response analysis, and ASD adapted versions may potentially further enhance the validity and reliability of the AAQ and the CFQ in autistic adults.

7.4.2 Strengths

An essential overall aim of the current doctoral research project was to include a representative sample of the ASD population concerning autistic adolescents and young adults in a school setting and autistic adults in a psychiatric outpatient clinic, thus increasing ecological validity. Therefore, a strength is the naturalistic character of the environments in which the studies are performed. Further, the results and experiences of the current studies suggest that it is feasible to conduct studies on autistic individuals in these settings.

As noted above, there are limits to the generalizability of the current results. However, they may be considered valid for representing autistic individuals with average range intellectual capacity and comorbid ADHD, stress, reduced quality of life, and psychiatric symptoms, such as poor sleep quality, depression, and anxiety. Moreover, although underpowered, the RCT design of Study III and the quasi-experimental design of Study I may indicate that the results from these studies are reasonably reliable. Another strength is the development of a specific ACT treatment manual adapted to autistic individuals. Finally, the feasibility evaluation of the three studies suggests that the participants perceive the NeuroACT treatment as credible and logical.

7.5 GENERAL ETHICAL CONSIDERATIONS

7.5.1 Research

As noted above, conducting pragmatic and clinic-oriented research increases ecological validity. Ecological validity means that it is optimized to meet the needs of specific patients in a particular clinical setting, such as a psychiatric outpatient clinic, a school for autistic students, or some other care institution. Also, it usually assures that an intervention is provided by the right competence, such as clinicians typically providing care to these patients.

There are apparent advantages of this approach. First, the target intervention is likely suitable and adapted to the participants. Second, measurement completion is done in a familiar environment. Third, treatment outcomes normally reflect clinically relevant targets. However, there are some challenges to this approach. For example, it may be unethical to let patients wait for a treatment of choice. However, it would be similarly unethical to let patients receive an intervention that is not evaluated, thus being potentially infeasible, ineffective, or harmful.

Another essential consideration in clinic-oriented research is not to take resources from ordinary care that goes beyond a clinic's or another setting's mission. However, many clinics' mission includes scientifically assessing an intervention before implementing it. Further, many

ordinary care options are not adapted to autism and may thus not work as expected or be harmful. Hence, the benefits of research-based clinic-oriented research may, in many cases, outweigh the risks.

An alternative to pragmatic research is university-based studies. In university-based studies, participants are often recruited by public announcements instead of within the clinic. The advantages of that approach are that (1) interventions can be experimentally tested before implementing them in the clinic, and (2) interventions do not burden the clinic financially or take resources from standard care patients. However, the first is true even for pragmatic research, where clinics usually perform local evaluations to see how the intervention works in their specific setting before fully implementing it in the organization. Further, university-based assessments are not always suitable or effective for actual patients in a particular clinical setting. Hence, the ecological validity of university-based studies can sometimes be questioned.

Implementing a treatment in a specific context comes with a balance between alternatives. Quality assuring psychological interventions may include training future therapists within a particular treatment method. The demand for a particular treatment manual may create financial incentives for the educational institution that provides training, increasing the risk of bias. Accordingly, since this thesis' author has been involved in all the present studies, including developing the treatment manual, delivering the treatments, and teaching the treatment manual to professionals (involving financial gain), there is a risk that this involvement may have affected evaluation and reporting of the study results. However, co-authorship and peer-reviewing processes may have counteracted this potential bias.

7.5.2 Clinical work

Delivering ACT for autistic individuals comes with a balance between creating a predictable and safe atmosphere to meet autistic core challenges and training ACT skills. The latter implies some unpredictability due to, for example, handling thoughts, emotions, and body sensations and opening up oneself in a group setting. Therefore, ACT can be said to 'go against ASD', meaning that what ACT trains is also what an autistic individual struggles with. Clinically, ACT thus includes some discomfort for the participants. However, increasing skills that the participants lack or have too little of is a crucial treatment objective in ACT. Therefore, challenging a participant's default functioning is probably part of why ACT may be effective for autistic individuals.

To conclude, the benefits of ACT for autistic individuals appear to be greater than the effort invested by the participants.

Chapter 8

Points of perspective

8.1 FUTURE RESEARCH

The present doctoral thesis evaluated a novel contextual behavioral treatment's feasibility, effectiveness, and validity in autistic adolescents and adults. Given the limited scope of this thesis, there are several essential aspects to take into concern in future studies.

First, in line with the autistic community's values, participatory research inviting autistic individuals to participate in outlining research project designs is warranted. Second, more extensive and robust studies with blinded assessment and RCT design, alongside assessing treatment integrity, adherence, and competence, are warranted to evaluate ACT in autistic individuals further. Third, assessment using objective data complementing self-report (e.g., independent measures) and analysis of mediators and moderators of change (e.g., sex; cognitive abilities; behavioral avoidance; adherence to homework) would provide valuable data. Forth, the current doctoral project evaluated a group-based ACT intervention. However, future studies may explore the potential benefit of ACT as an individual-based treatment in autistic individuals. Fifth, therapist and independent clinic evaluations are needed.

Further, sixth, it is warranted to adopt ACT in other settings (e.g., habilitation service; child and adolescent psychiatry) and populations (e.g., autistic individuals with IQ < 70) to increase the generalizability of the results. In addition, it would be interesting to study, for example, via qualitative methods, how autistic individuals are helped in everyday life by using the psychological skills trained using ACT. Seventh, it is warranted to analyze the potential effects of specific ACT processes, such as cognitive defusion and acceptance, using, for example, single-case design or mediation analyses. Eighth, concerning developing skills to improve social functioning in autistic individuals, future studies may further evaluate social skills training, training skills to handle thoughts and emotions to enhance social functioning, or a combination of both. Ninth, regarding psychometric evaluations, more extensive studies using confirmatory factor analysis are needed to evaluate the AAQ and the CFQ in autistic

adults. To ensure the integrity of the results, sensitivity analyses (i.e., how changes in methods, models, or values affect the results) would provide more detailed information on the robustness of the factor analysis used in the present study. Finally, future research using a larger sample size, confirmatory factor analysis, item response analysis, and ASD adapted versions may potentially further enhance the validity and reliability of the AAQ and the CFQ in autistic adults.

8.2 CLINICAL IMPLICATIONS

The primary research aim of the present doctoral thesis has been to evaluate a novel treatment approach in a specific population. A secondary objective is to disseminate and implement the treatment in the clinic.

Based on the results of the present studies, the NeuroACT program appears feasible and preliminarily effective, and valid in autistic adolescents and adults with comorbid mental health problems. Accordingly, the results support the implementation of the intervention in mental health care institutions, such as adult psychiatric clinics, child and adolescent psychiatry, habilitation services, or other settings providing care or mental support for these individuals. However, local adaptations and evaluations may be recommended to further assess the feasibility and effectiveness of the program in each setting.

Finally, quality assurance of the method is enabled through training and clinical supervision of therapists.

8.3 TOWARDS A CONTEXTUAL NEUROSCIENTIFIC PARADIGM?

ACT's philosophical roots are based on American pragmatism and functional contextual behaviorism, which are continuously under development within the Contextual Behavior Science community (Hayes et al., 2021). In the present thesis, the focus has been on developing and evaluating an ACT program adapted to meet the need of autistic individuals. The NeuroACT program incorporates knowledge about the inherited essential biological and nomothetic foundation of the human condition and the contextual and historical cues that shape and dictate how this natural foundation presents. Epistemologically, the NeuroACT model may thus be conceptualized as operating within a contextual neuroscientific framework, merging cognitive neuroscience and evolutionary biology with contextual behavioral science (as shown in Figure 8) (Hayes & Long, 2013; Sarkar et al., 2018).

Contextual neuroscience may be described as studying real-life behavioral and neural processes set in environments relevant to daily life and involving naturally occurring stimuli, increasing the ecological validity of cognitive neuroscience (Shamay-Tsoory & Mendelsohn, 2019). Notably, contextual cues may facilitate understanding complex human behavior, acknowledging inherited pervasive behavioral patterns, such as in autism, alongside overt (e.g., historical and societal) and covert (e.g., cognitions; emotions; body sensations). The intersectional topography between these opposite perspectives is essentially an empirical question.

Using only a cognitive neuroscientific perspective implies the risk of missing out on operant behavioral contingencies as explanatory and mediating factors of autistic functioning. In contrast, using respondent and operant conditioning-based models to understand and moderate outcomes of autistic functioning may neglect core challenges associated with autism. For example, viewing socially dysfunctional behaviors as an essential and deterministic part of autism may underestimate the efficacy of behavioral skills training and the effect that managing thoughts, emotions, and body sensations has on autistic functioning. On the contrary, viewing dysfunctional social behaviors as merely the result of respondent and operant conditioning may underestimate the effect of core challenges, such as social cognition deficits (e.g., coding gestures, voice tone, or facial expression) and over-sensitivity to external stimuli (e.g., sounds, smells, or touching), have on social functioning.

Hence, taking cognitive neuroscience *and* contextual behavioral science into account may benefit the overall comprehension of autism and facilitate the development of feasible and effective methods to improve mental health and everyday life in autistic individuals.

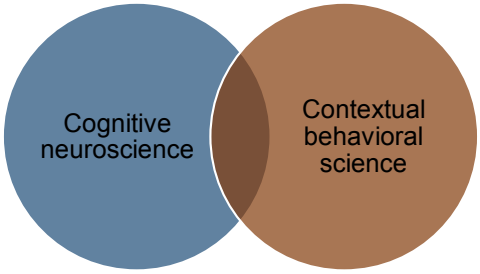

Figure 8. Intersection between cognitive neuroscience and contextual behavioral science. The overlapping area represents a contextual neuroscientific framework.

8.4 MAIN CONCLUSIONS

The results of the present doctoral thesis suggest that ACT adapted to autism is feasible in autistic adolescents and adults and appears to improve stress and several mental health outcomes. Moreover, the treatment may help overcome some aspects of autistic core challenges, such as prosocial behavior and hyperactivity/inattention in adolescents and young adults, alongside autistic mannerism (i.e., cognitive and behavioral inflexibility) and social motivation in autistic adults. Preliminarily, ACT does not effectively reduce conduct problems or peer relationship problems in autistic adolescents and young adults or increase social awareness, social cognition, communication, functional ability, or executive function in autistic adults. However, the results indicate significant improvements in primary ACT-related treatment targets, such as psychological inflexibility, cognitive fusion, and behavioral avoidance in autistic adults. Furthermore, instruments measuring psychological inflexibility and cognitive fusion appear valid and reliable in autistic adults. More extensive research is needed to further evaluate ACT for ASD. This thesis adds to the growing awareness and empirical support of contextual behavioral models for autistic individuals.

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Outcomes of an acceptance and commitment therapy-based skills training group for students with high-functioning autism spectrum disorder: A quasi-experimental pilot study

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Abstract

Autism spectrum disorder is characterized by social impairments and behavioural inflexibility. In this pilot study, the feasibility and outcomes of a 6-week acceptance and commitment therapy-based skills training group were evaluated in a special school setting using a quasi-experimental design (acceptance and commitment therapy/school classes as usual). A total of 28 high-functioning students with autism spectrum disorder (aged 13–21 years) were assessed using self- and teacher-ratings at pre- and post-assessment and 2-month follow-up. All participants completed the skills training, and treatment satisfaction was high. Levels of stress, hyperactivity and emotional distress were reduced in the treatment group. The acceptance and commitment therapy group also reported increased prosocial behaviour. These changes were stable or further improved at the 2-month follow-up. Larger studies are needed to further evaluate the benefits of acceptance and commitment therapy for autism spectrum disorder.

Keywords

acceptance and commitment therapy, adolescents, autism spectrum disorder, cognitive behavioural therapy, high-functioning, mindfulness, skills training, treatment

Introduction

Autism spectrum disorder (ASD) is characterized by impairments in social interaction and communication, as well as restricted and repetitive behaviours and interests (American Psychiatric Association, 1994). Psychiatric comorbidity is common in individuals with ASD, including other neurodevelopmental disorders such as attention-deficit hyperactivity disorder (ADHD) and Tourette's syndrome, as well as anxiety and depression (Abdallah et al., 2011; Ghaziuddin et al., 2002; Hofvander et al., 2009; Vickerstaff et al., 2007). ASD is also associated with deficits in executive function (EF), which include difficulty with higher order cognitive skills such as planning, strategy use, cognitive flexibility, working memory and inhibition (Happe et al., 2006; Hill and Frith, 2003; Pennington and Ozonoff, 1996). Difficulties in executive functioning interfere with efficient attainment of cognitive or behavioural goals (Christ et al., 2007; Kenworthy et al., 2008). Individuals with ASD often show restricted behaviour patterns (such as rituals and routines) which can limit their ability to effectively adjust to situational demands and is often seen as psychological inflexibility (Esbensen et al., 2009). Despite average or above average intellectual capacity, autistic traits may complicate performance in many everyday situations, thus leading to stress. Furthermore, preliminary studies have found that autistic traits may be associated with both self-perceived stress/distress and restricted ability to cope with stressors (Hirvikoski and Blomqvist, 2013); for example, people with autism may not

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have the ability and/or willingness to seek social support which can often reduce stress in other populations.

There is no pharmacological treatment of the core symptoms of ASD. There are behavioural treatments available that have been determined to be best practice for skill building in people with autism, and these include social skills training (Reichow et al., 2012). Additionally, some cognitive behavioural therapy (CBT) interventions have been adapted to address common co-existing psychological problems, such as anxiety and subjective stress for people with ASD (Wood et al., 2009). One contextual behavioural treatment, dialectic behaviour therapy (DBT), has been shown to be effective for adults with ADHD, although it has not been tested in individuals with ASD (Hirvikoski et al., 2011). The literature on applied behaviour analysis–based treatments for people with high-functioning ASD is still limited and adapted treatment protocols are therefore of current interest for promoting health, facilitating self-management and reducing stress in ASD.

Acceptance and commitment therapy (ACT) is a contextual behaviour therapy, a group of interventions based on CBT that also includes additional techniques such as cognitive defusion, acceptance, mindfulness, values and commitment methods. ACT teaches people to notice and accept thoughts and feelings, even unpleasant ones. The goal of an ACT therapy is to increase psychological flexibility, which refers to the ability to non-judgementally experience thoughts, emotions and body sensations, to act effectively upon situational demands, and take action towards personally chosen values and goals. ACT has proven to be effective in a diverse range of clinical conditions such as anxiety disorders, stress and substance abuse (Bohlmeijer et al., 2011; Twohig et al., 2010). Moreover, ACT has been successfully evaluated in chronic and complex conditions such as pain, epilepsy and schizophrenia (Gaudiano and Herbert, 2006; Lundgren et al., 2006; Wicksell et al., 2011), as well as in psychiatric conditions frequently associated with ASD, such as anxiety and depression (Hayes et al., 2006).

In our clinical experience, a common problem in high-functioning ASD is experiential avoidance that may arise from the vulnerability to stress and experiences of negative life events. ACT suggests that experiential avoidance is one of the roots of psychopathology and refers to human beings' tendencies to avoid not only dangerous situations or events but also thoughts and feelings associated with these events. Individuals with ASD also exhibit inflexibility which may be associated with a propensity to perseveration in problem solving, aversion to uncertainty, intellectualization, rule-governed behaviours, literality, sensory over- and/or under-sensitivity, as well as deficits in the perception of self and others. Experiential avoidance may further increase psychological inflexibility in people with ASD and further narrow the individual's behaviour repertoire. In ACT, experiential avoidance is targeted by an attempt to increase psychological flexibility mainly through two sets of procedures: acceptance and mindfulness skills and behaviour change procedures. Acceptance and mindfulness skills are aimed at helping the individual cope with difficult thoughts, emotions and body sensations, thereby breaking experiential avoidance patterns. Behaviour change procedures, such as helping individuals identify values and teaching committed action skills to help reach their goals, are aimed at helping the individual to define important life directions and act according to them.

To the best of the authors' knowledge, no studies have evaluated the use of ACT in individuals with ASD. Modifying the ACT model in ways that make it feasible to use with people who have ASD may help reduce stress and emotional distress, and increase psychological flexibility in people with ASD. The aim of this pilot study was to evaluate the feasibility and outcomes of a modified ACT protocol for adolescents and young adults with high-functioning ASD.

Methods

The study is designed as a quasi-experimental two-group trial (intervention/waiting list) study with repeated measures. The feasibility and outcomes of an ACT-based skills training group were evaluated for adolescents and young adults with high-functioning ASD.

Study setting and recruitment process

Participants were recruited at a special school serving approximately 50 students with high-functioning ASD in Stockholm, Sweden. Six school classes were included in the study (3 junior high school classes and 3 high school classes), with 5–7 students in each class (13–21 years old). Two middle school classes were excluded (students > 13 years old).

School staff, parents and students received written initial practical and theoretical information about the study, adjusted to each recipient group. School staff and parents were also informed orally at a school staff meeting and a parent meeting, respectively. Written informed consent was given by parents for students younger than 18 years old and by the students themselves if they were 18 years old or older. Before entering the skills training group, the participating students were informed about study procedures and the content of the skills training and that they could stop the skills training at any time without further explanation. All measurements and the skills training were carried out within the school setting, and study procedures were performed in accordance with the Declaration of Helsinki (World Medical Association General Assembly, 2004). The waiting list group received skills training after the study was completed. The current project has previously been reviewed and accepted by the Department of Psychology, Uppsala University, and presented in a master's degree thesis by the first author (J.P.).

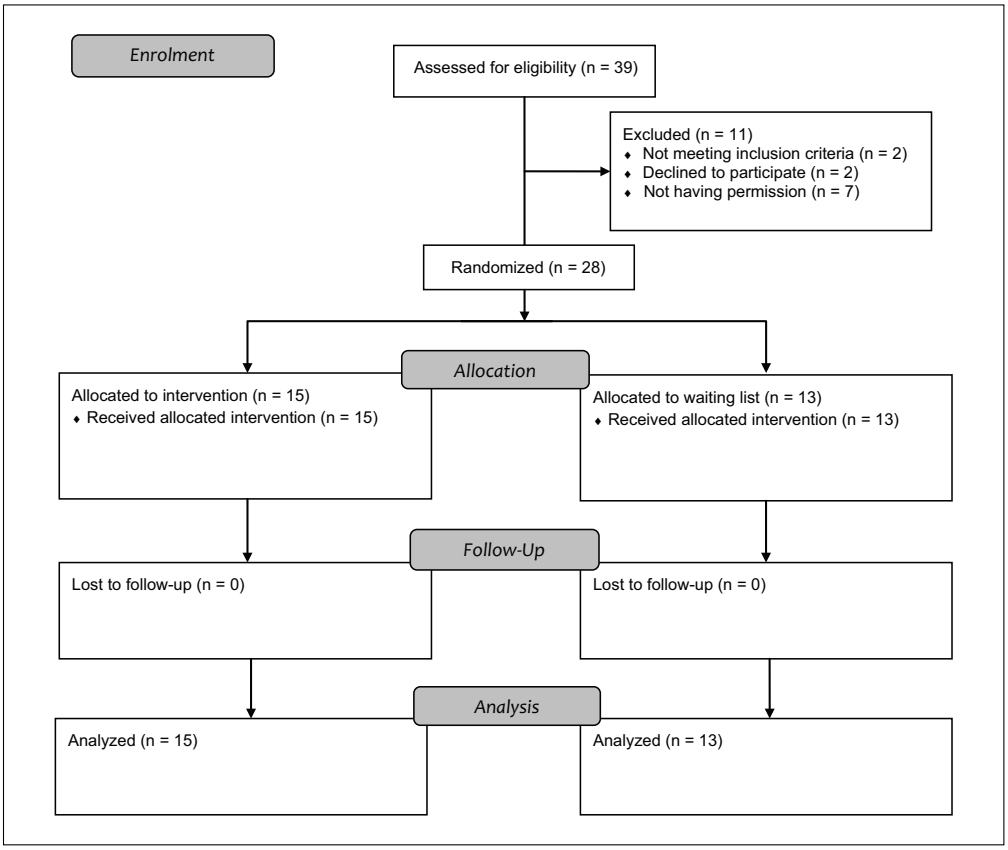

Figure 1. Flow chart.

The study groups (treatment vs control group)

Many students with ASD have difficulty with changes to their environment; therefore, skills training was conducted within the students' usual school class groups. No individual randomization was performed. The six participating school classes were randomized to either skills training or the waiting list. A simple class-wise randomization was performed using folded opaque cards placed in a container and mixed. The container was placed so that the cards could not be seen and the group leader then drew a card for each class group.

Participants

Students were eligible to participate if they were previously diagnosed with *Diagnostic and Statistical Manual of Mental Disorders* (4th ed.; *DSM-IV*) (high-functioning) ASD, 13 years old or older, had given their (or their parents) written informed consent and were able to attend the first session of the programme. Students with a differential diagnosis of mental retardation or selective mutism were excluded. Participants with other co-morbid disorders, such as ADHD and dyslexia, were included. A total of 39 students were screened for the study. In total, 11 of the students were not found to be eligible (Figure 1).

Measures

The study included measures of participant characteristics and outcome measures. Outcome measures were the Stress Survey Schedule (teacher- and self-ratings), the Strengths and Difficulties Questionnaires (SDQ; teacher- and self-ratings), and the Beck Youth Inventories (BYIs; self-ratings). These measures were administered 1 week before entering the intervention (pretreatment/T1), 1 week after the intervention was completed (post-treatment/T2) and 2 months after completion of the intervention (2-month follow-up/T3).

Feasibility

Feasibility was evaluated in terms of completion of the skills training programme (a drop-out was defined as attending fewer than six sessions); attendance at skills training sessions (number of sessions attended); number of mindfulness training occasions at school between the sessions (i.e. how many times the student actively participated at daily mindfulness classroom training under supervision of the students' teachers, see section 'ACT-based skills training group'); and by using an evaluation questionnaire covering aspects of treatment satisfaction on a 5-point Likert scale from *very low* to *very high* satisfaction. Items on the questionnaire asked participants about satisfaction with treatment contents both for the sessions and the between-session mindfulness training. Participants were specifically asked about satisfaction with the group format.

Outcome measures

The Stress Survey Schedule. Behaviours related to stress were assessed using the Stress Survey Schedule for Autism and Other Developmental Disorders (Groden et al., 2001). The original Stress Survey Schedule is an other-report scale. In this study, teachers completed the survey. In addition, the scale was also adjusted into a self-report instrument completed by the students. The Stress Survey Schedule consists of 49 items scored on a 5-point Likert scale. Based on exploratory and confirmatory factor analyses, the items are categorized into eight subscales representing categories of situations that children with ASD and other developmental disabilities normally perceive as stressful: changes, anticipation, social interaction, pleasant events (generally pleasant events that can be perceived as stressful by an individual with ASD, for example, birthday gifts or having a conversation), sensory stimuli, unpleasant events, food situations and rituals. The internal consistency of the subscales is generally good (Cronbach's alpha = .81–.87) (Groden et al., 2001). In the current study, only the Stress Survey Schedule total scores are reported.

The SDQ. The SDQ (Goodman, 1999) is a brief behavioural screening instrument developed for 3- to 16-year-old children, consisting of 25 items. In this study, teachers and students completed the questionnaire. Each item is scored 0–2, where 0 is *not true*, 1 is *somewhat true* and 2 is *certainly true*. The scale has five subscales representing emotional symptoms, behaviour problems, hyperactivity/inattention, peer relationship problems and prosocial behaviour. On the first four subscales, higher scores indicate more problems, while on the last subscale, higher scores indicate fewer problems. The first four subscales are summarized to give a total score. The instrument's internal consistency is generally good (Cronbach's alpha = .70–.76), except for behaviour problems (Cronbach's alpha = .52–.54) (Goodman, 1999).

The BYIs. The BYIs (Beck et al., 2001) are a self-rating questionnaire that consists of five subscales, three of which were used in this study: anxiety, depression and anger. The internal consistency generally ranges between .89 and .94 (Beck et al., 2001). Each scale consists of 20 items scored *never, sometimes, often* or *always*. In this study, the three subscales were also summarized into a total score representing psychological distress. The BYIs have been evaluated in clinical samples of children and adolescents with autism, ADHD and Tourette's syndrome. The Swedish version has been adapted to Swedish conditions and evaluated for 9- to 18-year-old individuals.

ACT-based skills training group. An ACT protocol (Hayes et al., 2003) was modified to meet the specific challenges of having ASD. Skills training was provided to develop the participants' ability to cope with daily hassles and stressful situations, to break behavioural avoidance patterns, and to develop a broader behavioural repertoire. The skills training programme included the behavioural components normally included in an ACT intervention including the general principles of setting values, self as context (understanding the self that is observing and experiencing without judgement), defusion (strategies for reducing the tendency to make thoughts, images, and emotions concrete), acceptance (allowing thoughts to come and go without judgement), contact with the present moment (openly experiencing the here and now) and committed action (setting goals according to values and carrying them out). These components were applied in order to promote psychological flexibility. The ACT goal is to teach acceptance and mindfulness skills as a way of dealing with difficult thoughts, emotions and body sensations so as to increase the likelihood that the individuals can develop in personally chosen important life areas according to the individuals' values. A specific example might be a female adolescent who wants to be in school but refuses to go due to thoughts about not understanding what is expected of her. She has previous experiences of not understanding and feeling stupid. When thinking about going to school, emotions related to the previous failures are evoked and, owing to the fear of failing again, the adolescent refuses to go. In an ACT approach, the adolescent is taught acceptance and mindfulness skills in order to be able to deal with the emotions and thoughts that have become barriers to doing what is important to her, that is, going to school and learning.

The 6-week ACT-based skills training programme consisted of two 40-min group sessions per week and 6- to 12-min of daily mindfulness exercises in the classroom (mindfulness training occasions). These mindfulness training occasions were facilitated by the classroom teacher and consisted of listening to a CD containing instructions and mindfulness and acceptance exercises that was developed for this study and adjusted for adolescents with ASD. In order to facilitate training, shorter and less abstract exercises were presented earlier in the programme, while the longer

ones were presented later. For the group sessions, the group leader was a graduate psychology student (J.P.), under the supervision of an experienced mindfulness instructor and ACT therapist (second author (T.L.)). Students participated in an initial introductory session. Each subsequent session followed a similar format with a short opening mindfulness exercise, followed by a review of homework assignments, introduction of the theme of the particular session and finally, practice of the next individual mindfulness exercise and a review of new assignments. Homework assignments consisted of pencil-and-paper exercises (i.e. analysis of behaviour, values and behaviour goals and recording of stressful situations), mindfulness training on a regular basis using a CD with short, adapted mindfulness exercises, as well as behaviour change (i.e. adopting new behaviour strategies). Homework assignments were performed partly at school under the supervision of the students' teachers (daily mindfulness occasions) and partly at home (independently by the students or supported by their parents). The original ACT protocol was modified using shorter mindfulness exercises and simplified language, pictures and diagrams to explain theoretical concepts and metaphors, and portfolios containing treatment material. Furthermore, the students' overall needs with regard to routine persistence, clarity and planning were respected.

The central aims and components of the skills training are described as follows:

1. Acceptance of thoughts, feelings and body sensations using acceptance exercises.
2. Self as context, using mindfulness exercises (i.e. developing the ability to take different perspectives on one's own thoughts, emotions and body sensations).
3. Worksheets connecting values to more direct behaviour goals.
4. Identification of obstacles in order to carry out goal-directed behaviour.
5. Examination of the participant's solutions and alternative strategies in order to carry out goal-directed behaviour.
6. Illustration of the avoidance trap.
7. Seeing thoughts as thoughts and not as true obstacles to a valued life (defusion, that is, decreasing the literal meaning of thoughts).
8. Application of learned behaviour strategies and mindfulness techniques in stressful situations.

In addition, the skills training was modified to meet the unique challenges of ASD, as described below:

1. Small groups (4–6 participants).
2. Shorter individual mindfulness exercises than used in comparable programmes for other diagnostic groups or typically developing individuals (6–12 min of in-school practice).
3. Additional mindfulness exercises focusing on coping with perception and sensory over- and under-sensitivity, since perceptual distortions are central symptoms in ASD.
4. Individualized classroom training with a CD containing verbal instructions and mindfulness exercises.
5. Modified worksheets on stress management and functional analysis of behaviours.
6. Metaphors were visualized and used to a limited extent.

Statistical analyses

Data were analysed using statistical software SPSS version 20.0. The demographic data and background variables were analysed using Student's *t*-test for continuous variables and the chi-square test for category variables. An exploratory analysis was initially performed to assess normal distribution and potential outliers, and the assumptions for variance analyses were met. The outcome measures were analysed using a series of two-tailed mixed-design repeated measures analyses of variance (rmANOVAs), with group (skills training/waiting list checking) as a between-subjects factor, and the pre-intervention score (T1) and the post-intervention score (T2), as well as the 2-month follow-up score (T3) of the outcome measures, as a within-subjects repeated measure factor. In order to avoid type I errors due to many analyses of a small sample, no post hoc contrast analyses were performed, but general patterns in the results were interpreted. The effect sizes were expressed as partial eta-square (η_p^2) for efficacy measures and were interpreted using the guidelines proposed by Cohen (1988): 0.01 = small effect size, 0.06 = moderate effect size and 0.14 = large effect size. The correlation between teacher-ratings and student's self-ratings was analysed using the Pearson product-moment correlation. The alpha levels were set at $p \leq 0.05$ for significance and, for p values, $p \leq 0.10$ for a trend. Statistical trends were reported in order to avoid beta errors due to small sample sizes.

Results

Participant characteristics

As shown in Table 1, there were more male than female participants. Several participants had co-morbid disorders and had undergone some type of pharmacological treatment (mainly antidepressants and central nervous system stimulants). The distribution of participant characteristics was equal between the skills training group and controls, except that the skills training group included more girls.

Feasibility

According to the cut-off for drop-outs (those attending fewer than six sessions), all of the 15 participants in the

Table 1. Sample characteristics.

Characteristics	Total (N = 28)	ACT (n = 15)		Waiting list (n = 13)		χ^2 test
	n	*n*	%	*n*	%	
Male	21	9	60	12	92	p = .049
Current medication use	8	5	33	3	23	NS
Psychiatric co-morbidity						
ADHD	7	3	20	4	31	NS
OCD	3	2	13	1	8	NS
Dyslexia	3	1	7	2	15	NS
Specific phobias	4	2	13	2	15	NS
	M (*SD*)	*M* (*SD*)		*M* (*SD*)		Student's *t*-test
Age (years)	16.5 (2.0)	16.2 (1.4)		16.8 (2.5)		NS

ACT: acceptance and commitment therapy; ADHD: attention-deficit hyperactivity disorder; OCD: obsessive–compulsive disorder; *SD*: standard deviation.

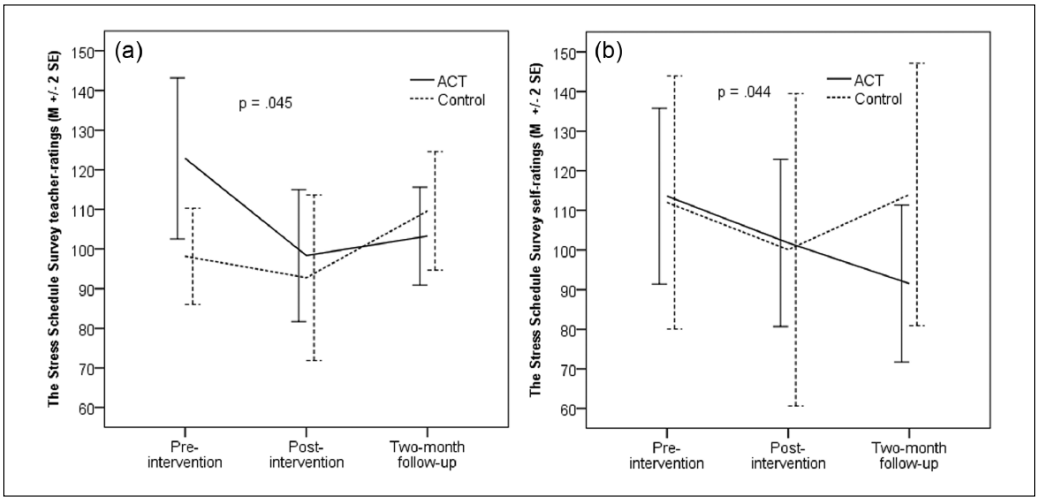

Figure 2. The analyses of the Stress Survey Schedule total scores showed a significant group-by-time interaction effect in both (a) teacher-ratings and (b) self-ratings from pre-intervention (T1) to the 2-month follow-up (T3).
ACT: acceptance and commitment therapy; SE: standard error.

skills training group completed the treatment, half of them attended all 12 sessions and the majority (93%), six sessions or more. Training occasions between sessions varied among participants with a total mean score of 2.5 (standard deviation (*SD*) = 1.5) per week, where the majority (53%) practised 3 days a week or more. The evaluation questionnaire showed high treatment satisfaction overall, and no adverse events were reported. The majority (93%) reported high or very high satisfaction with the treatment content and the group-session format. Exercises on CDs were reported to be easy or very easy by the majority (64%), while the other participants reported the exercises neither easy nor difficult.

Outcome measures

The Stress Survey Schedule. The mean values and standard errors of the Stress Survey Schedule teacher- and self-ratings are shown in Figure 2. The overall effect of time on stress was observed as a trend in the self-ratings ($F_{(2, 52)}$ = 2.78, p = .071, η_p^2 = .10), and as a significant effect in the teacher-ratings ($F_{(1.60, 41.52)}$ = 3.54, p = .048, η_p^2 = .12). However, there was also a significant interaction effect in both self-ratings ($F_{(2, 52)}$ = 3.31, p = .044, η_p^2 = .11) and teacher-ratings ($F_{(1.60, 41.52)}$ = 3.63, p = .045, η_p^2 = .12), indicating a difference in the Stress Survey Schedule scores of the two groups over time. In the ACT skills training group,

a decrease was observed from pre- to post-intervention, and this reduction in stress was stable or further reduced at the 2-month follow-up. Among controls, an increase in stress from post-intervention to the 2-month follow-up was observed in both teacher- and self-ratings (Figure 2). No general differences between the skills training group and controls were observed either in the self-ratings or in the teacher-ratings (between-group effects, both p values > .10). The total Stress Survey Schedule score in self-ratings did not correlate with the total stress score in teacher-ratings at any of the measuring time points (all p values > .10).

SDQ. The mean values and *SD*s, as well as the statistics of the SDQ self-ratings, are presented in Table 2, while the mean values and standard errors for the SDQ teacher-ratings are shown in Figure 3. In self-ratings, statistically significant group-by-time interaction effects were observed on the SDQ subscales hyperactivity (p = .026) and prosocial behaviour (p = .034), indicating a reduction in self-perceived hyperactivity and increased prosocial behaviour in the skills training group. In the self-ratings of the SDQ, no general differences between the skills training group and controls were observed (between-group effects, all p values > .10). In addition, no statistically significant overall effects of time were observed; however, a statistical trend was observed on the SDQ subscale hyperactivity (p = .089). The significant group-by-time interaction effects indicated differences over time in the two groups in the teacher-ratings SDQ total score, ($F_{(1.79, 46.50)} = 5.63, p = .008, \eta_p^2 = .18$), as well as the SDQ subscales emotional symptoms ($F_{(2, 52)} = 6.22, p = .004, \eta_p^2 = .19$) and hyperactivity ($F_{(1.60, 41.67)} = 5.67, p = .010, \eta_p^2 = .18$) (Figure 3). There was no statistically significant general difference between the intervention group and controls (between-group effects, all p values > .10). A statistically significant overall effect of time on the repeated measure was observed for the SDQ total score ($F_{(1.79, 46.50)} = 4.89, p = .014, \eta_p^2 = .16$), as well as for the SDQ subscales emotional symptoms ($F_{(2, 52)} = 6.52, p = .003, \eta_p^2 = .20$), peer relationship problems ($F_{(2, 52)} = 10.20, p = .000, \eta_p^2 = .28$) and prosocial behaviour ($F_{(2, 52)} = 3.36, p = .042, \eta_p^2 = .11$>). Taken together, these results indicated both general changes in symptoms and differences in how the two groups reacted over time. The symptom reduction appears to be larger in the skills training group than in controls, and treatment effects were maintained to the 2-month follow-up (Figure 3), while an increase in symptoms was observed in the control group from T2 to T3 regarding many of the measures.

Correlations between the self-rated SDQ subscales and corresponding teacher-ratings were significant on the SDQ subscales emotional symptoms, conduct and peer relationship problems and at a level of a statistical trend in prosocial behaviour. Thus, only the self-ratings of the subscale hyperactivity did not correlate significantly with teacher-ratings (Pearson's r and p values are presented in Table 2).

Table 2. Means and standard deviations (*SD*s) as well as statistics from the repeated measures ANOVAs on self-ratings of the SDQ.

		Pre-skills training	Post-skills training	2- month follow-up	Effect of time	Between-group effect	Group-by-time interaction effect	Correlation with teacher-rating at baseline
The SDQ total score	ACT	14.00 (5.75)	13.20 (6.46)	11.13 (4.97)	$F_{(2, 52)} = 1.39; p = .258; \eta_p^2 = .05$	NS	$F_{(2, 52)} = 1.95; p = .152; \eta_p^2 = .07$	$r = .23$
	C	11.92 (5.98)	10.92 (5.17)	11.92 (6.78)				$p = .248$
The SDQ subscales								
Emotional symptoms	ACT	3.87 (2.97)	3.27 (3.31)	2.93 (2.60)	$F_{(2, 52)} = .27; p = .768; \eta_p^2 = .01$	NS	$F_{(2, 52)} = 2.13; p = .13; \eta_p^2 = .08$	$r = .42$
	C	2.38 (2.50)	2.62 (1.85)	2.85 (2.51)				$\boldsymbol{p = .027}$
Hyperactivity/inattention	ACT	4.07 (2.05)	4.73 (2.19)	3.20 (1.61)	$F_{(2, 52)} = 2.54; p = .089; \eta_p^2 = .09$	NS	$F_{(2, 52)} = 3.90$; $\boldsymbol{p = .026}$; $\eta_p^2 = .13$	$r = .18$
	C	4.54 (2.57)	3.23 (2.68)	3.62 (2.63)				$p = .366$
Conduct problems	ACT	2.33 (1.80)	2.07 (1.79)	2.07 (2.12)	$F_{(2, 52)} = .51; p = .951; \eta_p^2 = .00$	NS	$F_{(2, 52)} = .91; p = .410; \eta_p^2 = .03$	$r = .54$
	C	1.85 (1.35)	2.08 (1.89)	2.23 (1.83)				$\boldsymbol{p = .003}$
Peer relation problems	ACT	3.73 (1.91)	3.13 (1.41)	2.93 (1.67)	$F_{(2, 52)} = .93; p = .402; \eta_p^2 = .03$	NS	$F_{(2, 52)} = 1.27; p = .289; \eta_p^2 = .05$	$r = .50$
	C	3.15 (1.99)	3.00 (1.35)	3.31 (2.21)				$\boldsymbol{p = .007}$
Prosocial behaviour[a]	ACT	7.27 (1.91)	7.33 (2.02)	7.53 (1.77)	$F_{(2, 52)} = 1.54; p = .224; \eta_p^2 = .06$	NS	$F_{(2, 52)} = 3.61$; $\boldsymbol{p = .034}$; $\eta_p^2 = .12$	$r = .362$
	C	7.38 (1.39)	6.69 (2.18)	6.15 (2.30)				$p = .058$

ANOVA: analysis of variance; ACT = acceptance and commitment therapy-based skills training group; C = control group; SDQ: Strengths and Difficulties Questionnaire.
[a]The SDQ subscale prosocial behaviour is not included in the SDQ total score. In contrast to other SDQ subscales, higher scores in the SDQ prosocial behaviour indicate better adjustment.
Bold values = statistically significant *p*-values.

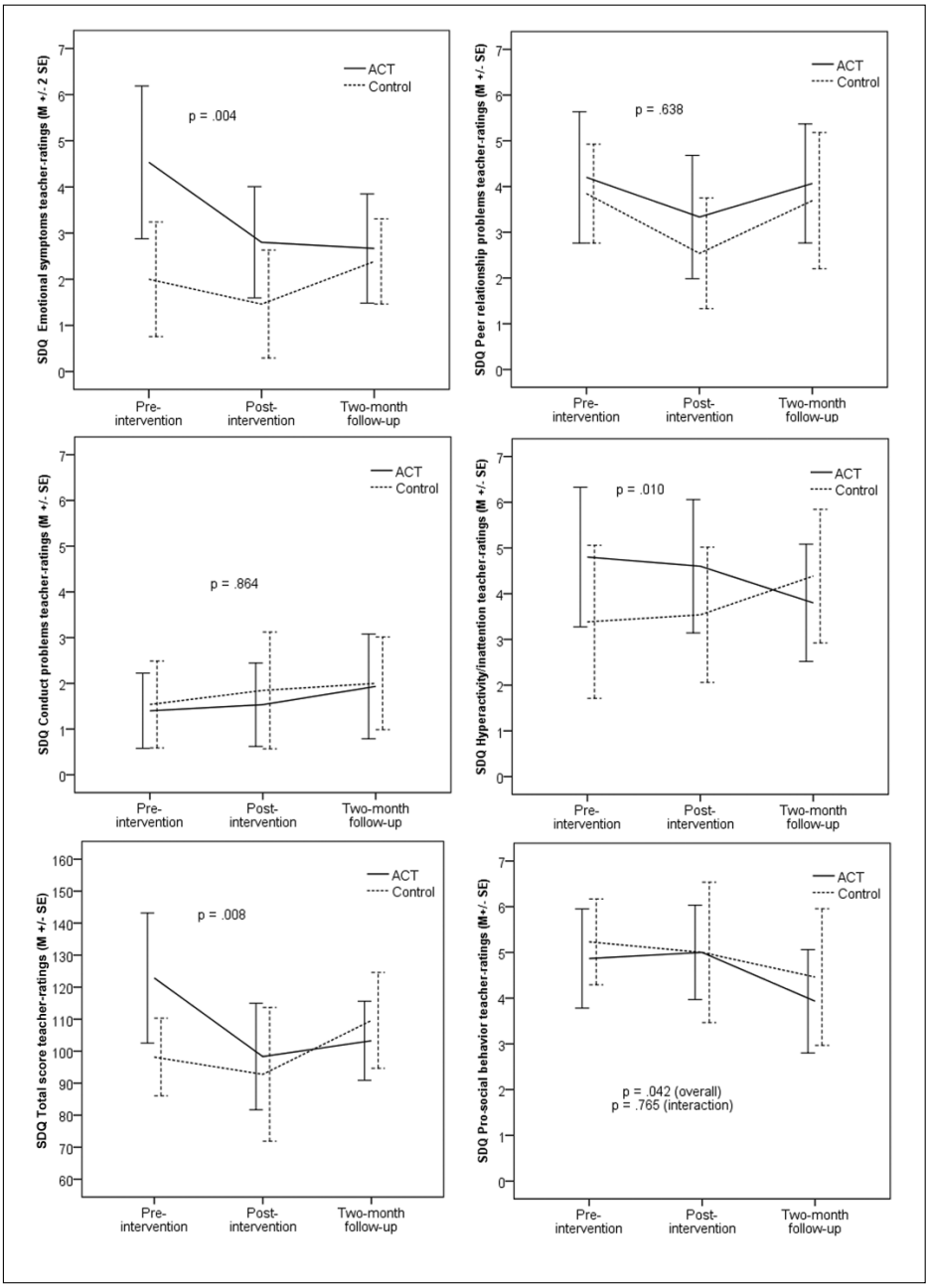

Figure 3. In the teacher-ratings of the SDQ, significant group-by-time interaction effects were observed on the emotional symptoms and hyperactivity/inattention subscales as well as in the SDQ total score, while on the prosocial behaviour subscale, an overall effect of time was observed. It should be noted that in contrast to other SDQ subscales, higher scores in the SDQ prosocial behaviour indicate better adjustment.

ACT: acceptance and commitment therapy; SE: standard error; SDQ: Strengths and Difficulties Questionnaire.

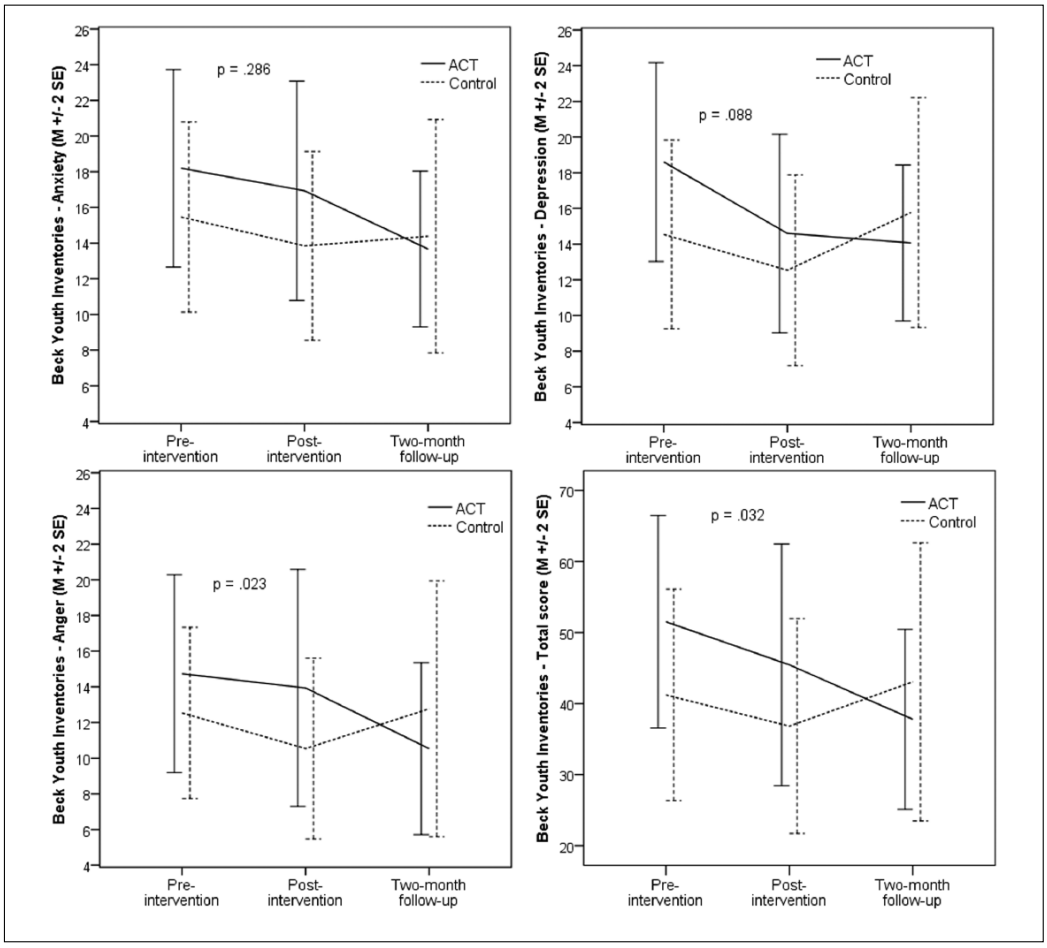

Figure 4. The analyses of the self-rated BYIs showed significant group-by-time interaction effects in anger and the BYIs total score, as well as a statistical trend in depression.
ACT: acceptance and commitment therapy; SE: standard error; BYIs: Beck Youth Inventories.

The BYIs. The BYIs' mean values and *SD*s are shown in Figure 4. In the BYIs total score, a group-by-time interaction effect was observed ($F_{(2, 52)} = 3.68$, $p = .032$, $\eta_p^2 = .12$) indicating that the two groups reacted differently over time. In the skills training group, psychological distress was reduced from pre- to post-treatment and was further reduced at the 2-month follow-up, while in the control group, psychological distress was increased from T2 to T3. There was also an interaction effect on the anger subscale ($F_{(2, 52)} = 4.07$, $p = .023$, $\eta_p^2 = .14$), and a statistical trend was observed in the interaction effect for the depression subscale ($F_{(1.56, 40.66)} = 2.82$, $p = .083$, $\eta_p^2 = .10$). The general pattern of the results was similar to those in the total score (Figure 4). On the BYIs subscale anxiety, there was no significant interaction effect. Overall, there were no statistically significant general differences between the skills training group and controls (between-group effects, all p values > .10). In addition, no statistically significant overall effects over time were observed; however, a statistical trend was observed for depression ($F_{(1.56, 40.66)} = 2.97$, $p = .074$, $\eta_p^2 = .10$).

Discussion

In this pilot study, comparing an ACT-based skills training group with controls (school classes as usual/waiting list) in

a special school setting, good treatment feasibility was observed together with positive outcomes in measures of stress, hyperactivity, prosocial behaviour and emotional symptoms.

An explicit goal was to adapt the skills training to adolescents and young adults with ASD with co-morbid mental health problems within a special school setting in order to increase the ecological validity. Moreover, additional goals were that the skills training would motivate the majority of participants to complete the programme (e.g. by being perceived as relevant and interesting by the students), and the programme would be perceived as acceptable by school staff. These goals were attained. In the skills training group, the overall treatment satisfaction was reported to be high and all participants completed a majority of the programme sessions. The adaptations of the ACT protocol made for students with ASD (such as visual-based worksheets, mindfulness training in the classroom and a small group setting) were seen as meaningful by the students. The daily mindfulness training was administered in school, optimizing the effectuation of the training as well as being consistent with the students' need of routines and familiarity. Altogether, the feasibility in the special school setting was good.

In the outcome measures, a decrease in self- and teacher-reported stress, hyperactivity and emotional symptoms was observed in the skills training group, while self-reported prosocial behaviour was increased. The effect sizes in the significant group-by-time interaction effects were generally large. A general pattern of the results indicated maintenance of the obtained effects up to the 2-month follow-up in the skills training group, while in the control group, symptoms were generally increased from T2 (post-treatment period) to T3 (2-month follow-up). All students underwent a series of school exams during this period, and the newly acquired skills might have had a protective effect on stress for the students in the intervention group. There were no general differences in the school situation between the intervention group and the control group.

To the best of the authors' knowledge, this is the first study to adjust an ACT protocol to adolescents and young adults with ASD. The promising results indicate that ACT might constitute a valuable approach for facilitating everyday life and alleviating symptoms of stress and psychological distress. The results are also in line with the emerging empirical support for ACT as a valuable approach not only for adults but also for children and adolescents (Coyne et al., 2011). Interestingly, reduced symptoms of hyperactivity were observed, as this has been found in a study on another contextual behavioural therapy, that is, DBT-based skills training in ADHD groups (Hirvikoski et al., 2011). Thus, acceptance and non-judgemental approaches might have beneficial effects on self-regulation in ASD.

The current treatment was aimed at supporting individuals with ASD in elaborating skills that will potentially generate a greater ability to cope with uncomfortable mental events and sensory inputs, and help them to use goal-directed behaviours instead of relying on restricted behaviour patterns. For example, in social settings, the individual might be able to have (accept) self-critical thoughts and at the same time (mindfully) stay in an appropriate conversation (behavioural goal). A central concept in ACT is psychological flexibility defined as the ability to non-judgementally experience thoughts, emotions and body sensations, to act effectively upon situational demands, and take action towards personally chosen values and goals. The opposite of psychological flexibility is psychological inflexibility, which correlates highly with psychological and psychiatric problems (Levin et al., 2012). According to the theories upon which ACT is based, a key component in the development of psychological flexibility is the ability to shift perspectives such as I/You, Here/There, Now/Then. It has been suggested that applying different perspectives is a problem for persons with autism spectrum disorders (ASD) (Rehfeldt et al., 2007), and ACT may be helpful in building this skill in this population.

Practising mindfulness, acceptance and values skills may increase the ability to understand the perspective of others and increase psychological flexibility. Thus, the increase in self-perceived prosocial behaviour in this study may be interpreted as an increased ability to understand the perspectives of others. However, the analysis of active components in the current treatment goes beyond the scope of this pilot study, and the effect that mindfulness, acceptance and values-based interventions have on basic perspective-taking skills and psychological flexibility requires further attention. Nevertheless, the study supports ACT as a means to manage stress and emotional symptoms in ASD.

In this pilot study, several methodological issues affect the interpretation of the results. To measure self-perceived stress, an other-report questionnaire (the Stress Survey Schedule) was modified into a self-report form. This format has not been validated. Interestingly, no correlation was observed between self- and teacher-reported stress, indicating that subjective stress may be a concept which differs from collateral information on stress. A possible explanation could be the students' difficulty in communicating stress that makes teachers' interpretations vague. Alternatively, it could be argued that individuals with AS may have general difficulties in interpreting their own affect (Lombardo et al., 2007), leading to over- or underestimation of the symptoms. However, in this study, we observed significant correlation with almost all subscales of another questionnaire, the SDQ, indicating a good inter-rater agreement between the students and the teachers.

With regard to the outcome measures, it should also be noted that the questionnaires used were selected on the basis of clinical experience and are not fully theory-consistent with contextual behaviour science (Hayes et al., 2011). Therefore, there may have been treatment effects that we did not measure, thus committing type II errors. Moreover,

performing several analyses on small samples increases the risk of type I errors (random significances). However, we only performed a priori planned statistical analyses, which should decrease the risk of type I error. Moreover, the general pattern in the outcome measures was consistent between the self- and teacher-ratings, as well as across different questionnaires.

A major limitation was the small sample size and low statistical power (increased risk of type II errors), which also limited the analyses of possible effects of background variables (such as IQ, gender, age and co-morbidity) on the treatment outcome. The large age range of the participating students due to recruitment at the special school setting may not have been optimal; for example, two of the measures used were out of the valid age range for the older participants. Furthermore, because of the quasi-experimental design, differences between the skills training group and controls may have influenced the result. For an appropriate evaluation of efficacy, an individualized randomization should be performed in future studies. The treatment group consisted of more girls than the control group, which may have also had an impact on the outcome. However, no general between-group differences in the skills training group and the controls were observed in the rmANOVAs. A further limitation was lack of systematic assessment of treatment fidelity (e.g. by rating tapes of treatment sessions or using therapist checklists). Therefore, the specific ACT procedures and modifications were not clearly measured, and thus, the degree to which the procedures were implemented as described cannot be determined.

Larger studies and replications of the skills training programme are needed to further evaluate ACT for adolescents and young adults with ASD in different settings. Moreover, theory-consistent measures should be applied in future studies, including component analyses of central concepts in ACT, such as psychological flexibility.

In summary, the current results suggest that the ACT-based skills training programme may be a promising treatment which is feasible in a special school setting and has the potential to be effective for reducing stress and psychiatric symptoms in adolescents and young adults with ASD.

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Acceptance and commitment therapy for autistic adults: An open pilot study in a psychiatric outpatient context

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1. Introduction

Autism spectrum disorder (ASD) is a neurodevelopmental condition characterized by persistent social interaction challenges, alongside restricted, repetitive behaviors and interests leading to functional impairment (APA, 2013). The prevalence in both children and adults is at least 1.7% (Baird et al., 2006; Bolte et al., 2019; Brugha et al., 2016; Idring et al., 2015). ASD is associated with challenges in executive function, such as planning, working memory, and inhibition, impairing the ability to cope with daily demands and reach long term goals (Christ, Holt, White, & Green, 2007; Kenworthy, Yerys, Anthony, & Wallace, 2008). Furthermore, ASD is associated with self-perceived stress (Bishop-Fitzpatrick, Minshew, Mazefsky, & Eack, 2017; DeLongis, Folkman, & Lazarus, 1988; Hirvikoski & Blomqvist, 2015), reduced quality of life (Jonsson et al., 2017; Tobin, Drager, & Richardson, 2014), co-occurring psychiatric symptoms, primarily anxiety and depression (Lugnegard, Hallerback, & Gillberg, 2011; Simonoff et al., 2008), and premature mortality (Hirvikoski et al., 2016). As many as 70% of autistic adults report at least one major depressive episode during their lifetime, while 50% report an anxiety disorder (Lugnegard et al., 2011). Hence, the continuous development of feasible and effective treatment options that address psychiatric symptoms, stress, and quality of life in adults diagnosed with ASD is of paramount importance.

There is no efficacious pharmacological treatment of the core symptoms in ASD (Cheng, Rho, & Masino, 2017; Jobski, Hofer, Hoffmann, & Bachmann, 2017). Many individuals diagnosed with ASD cannot tolerate or have limited effect from pharmacological treatments of co-occurring psychiatric symptoms, such as depression and anxiety (LeClerc & Easley, 2015; K. Williams, Brignell, Randall, Silove, & Hazell, 2013). The research base on feasible and effective psychological interventions in autistic adults that address stress and comorbid psychiatric symptoms is limited. The most evaluated psychological treatments for comorbid psychiatric symptoms are based on cognitive-behavioral therapy (CBT) (Spain, Sin, Chalder, Murphy, & Happe, 2015), and more recently mindfulness procedures, such as mindfulness-based stress reduction (MBSR) (Cachia, Anderson, & Moore, 2016; Sizoo & Kuiper, 2017). In contemporary psychology, mindfulness defines as non-judgmental and non-reactive attention to experiences occurring in the present moment, including bodily sensations, cognitions, emotions, and urges (Kabat-Zinn, 2005). In ASD, emotional reactions, such as anger or worries, are frequently observed in response to exposure to stressful situations and everyday hassles (Bishop-Fitzpatrick, Mazefsky, & Eack, 2017). Mindfulness is an emotion regulation technique that enhances the ability to cope with emotional responses (Guendelman, Medeiros, & Rampes, 2017). Reviews and meta-analyses support the efficacy of both CBT and mindfulness training in reducing symptoms of anxiety and depression in autistic adults (Sizoo & Kuiper, 2017). A study by Weiss and Lunsky (2010), found that a group-based CBT protocol reduced symptoms of anxiety and depression in adults diagnosed with ASD. The authors concluded that a group format could be a well-suited, supportive, and cost-efficient treatment option (Weiss & Lunsky, 2010). However, researchers report general limitations in the application of CBT in autistic adults, such as difficulties learning to dispute irrational and maladaptive thoughts (i.e., cognitive restructuring), generalization of training of cognitive behavioral techniques to everyday situations, and limited long-term effects (Cardaciotto & Herbert, 2004; Weiss & Lunsky, 2010). Regarding mindfulness-based interventions, an ASD adapted protocol of MBSR was shown to reduce symptoms of depression, negative affect, and rumination in autistic adults (Spek, van Ham, & Nyklicek, 2013). In another study, MBSR reduced symptoms of anxiety, depression, agoraphobia, somatization, inadequacy in thinking and eating, distrust and interpersonal sensitivity, sleeping problems, and rumination, as well as increased general

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psychological and physical well-being (Kiep, Spek, & Hoeben, 2015). However, these protocols (Kiep et al., 2015; Spek et al., 2013) include mindfulness training, but not direct behavioral change processes (Sizoo & Kuiper, 2017). According to the National Institute for Health and Care Excellence (NICE) treatment guidelines, interventions that address co-occurring psychiatric symptoms should use: a concrete and structured approach, include behavioral change components (i.e., to plan and execute goal-directed behaviors), and contain written and visual information (i.e., worksheets and images), to support skills development and facilitate the enhancement of emotional literacy (NICE, 2012). Hence, a treatment method that includes both mindfulness procedures, and behavioral change techniques, and is adjusted to ASD specific needs, would potentially be beneficial to autistic individuals who suffer from stress, psychiatric symptoms and reduced quality of life.

Acceptance and commitment therapy (ACT) is a contextual behavioral approach that combines behavioral change techniques and mindfulness procedures. The goal of ACT is to increase *psychological flexibility*, which refers to the ability to non-judgmentally experience obstructive thoughts, emotions, and body sensations and act effectively upon situational demands according to personally chosen goals and values (Hayes, 2016). ACT suggests that *experiential avoidance* (i.e., *psychological inflexibility*) is one of the roots to behavioral challenges and refers to human beings' tendencies to avoid not only dangerous situations or events but also thoughts and feelings associated with these events (Hayes & Wilson, 1994). In ACT, psychological flexibility increases mainly through two sets of procedures: mindfulness and acceptance skills training, and behavior change techniques. Mindfulness and acceptance skills aim at helping the individual to cope with stressful thoughts, feelings, and body sensations, thereby disrupting experiential avoidance patterns. Behavior change techniques aim at assisting the individual in defining important life directions and act according to them. ACT has proven effective for reducing psychological distress in complex and persistent conditions, such as chronic pain, epilepsy, and psychosis (Hughes, Clark, Colclough, Dale, & McMillan, 2017; Lundgren, Dahl, Yardi, & Melin, 2008; Shawyer et al., 2017). Moreover, ACT has shown to be useful for reducing co-occurring psychiatric symptoms, such as anxiety, depression, and stress, as well as increasing quality of life (A-Tjak et al., 2015).

In both autistic children and adults, psychological inflexibility is a common problem associated with reduced goal-directed action control, vulnerability to stress and sensory stimuli (e.g., sounds, smell or tactile stressors), and adverse life events (Alvares, Balleine, Whittle, & Guastella, 2016). Further, *cognitive fusion* (i.e., difficulties with self-perception and perspective taking on one's mind) is a significant concern, which may additionally narrow their behavior repertoire (Lombardo & Baron-Cohen, 2011; Williams, 2010; Williams & Happe, 2010). There is some support for ACT to have health benefits in adolescents with diagnosed ASD (Pahnke, Lundgren, Hursti, & Hirvikoski, 2014). A study in a special school setting evaluated ACT in 28 students diagnosed with ASD, using a quasi-experimental design (Pahnke et al., 2014). The results showed good feasibility, significantly reduced stress and co-occurring psychiatric symptoms, as well as increased pro-social behaviors. ACT may be a feasible and effective approach for reducing stress and psychiatric symptoms, as well as increasing psychological flexibility and quality of life, in autistic adults. However, to the best of the authors' knowledge, there are no studies evaluating ACT in adults diagnosed with ASD.

1.1. Study objectives

The current pilot study aimed to evaluate the preliminary feasibility and potential utility of an ACT group protocol for adults diagnosed with ASD, in a psychiatric outpatient setting. The research questions were: 1) Is an ACT protocol acceptable for adults diagnosed with ASD? 2) What are the preliminary effects on comorbid symptoms of stress and quality of life? 3) What are the preliminary effects on symptoms of depression and anxiety, and functional impairment? 4) What are the preliminary effects on ACT consistent processes such as psychological inflexibility and cognitive fusion?

2. Methods

2.1. Design

The design of the study was an open trial with assessments conducted at pre-treatment (T1), post-treatment (T2), and three months after treatment completion (T3).

2.2. Ethics

The regional ethical review board of Stockholm, Sweden approved the study (2012/158-31). The study was performed in accordance with the Declaration of Helsinki (General Assembly of the World Medical, 2014). All participants provided written informed consent.

2.3. Participants

This pilot study was conducted at the Neuropsychiatric Unit Karolinska, at the Psychiatry Northwest clinic, Stockholm City Council, Stockholm, Sweden; a unit specialized in the assessment and treatment of neurodevelopmental disorders in adults. Ten individuals that had undergone a diagnostic evaluation at the unit during the past ten years, and met the inclusion as well as did not meet the exclusion criteria, were eligible to participate in the study. If changes in the participants' pharmacological medication would occur, they could continue treatment but be excluded from statistical analyses. The responsibility for the participants' pharmacological treatment stayed with their attending psychiatrist. The included participants reported no changes in medication during the study period. The inclusion criteria were: (a) a DSM-IV (APA, 2000) diagnosis of Asperger syndrome (corresponds to a diagnosis of ASD without specified intellectual disability and language impairment in the fifth edition of the DSM; APA, 2013) as the primary neurodevelopmental diagnosis; (b) 18 years or older; and (c) if on any psychoactive drug treatment (for ADHD or other diagnoses), the treatment should have been stable for at least three months. The exclusion criteria were: (a) ongoing substance abuse (during the last 3 months); (b) diagnosed intellectual disability (intelligence quotient [IQ] < 70); (c) organic brain injury; (d) suicidality; and (e) all clinically unstable psychosocial circumstances or comorbid psychiatric disorders that were of such a severity that participation was deemed impossible, such as being homeless, or having severe depression, psychosis, or bipolar disorder not under stable pharmacological treatment. An explicit goal of the study was to include a representative selection of psychiatric patients with ASD. Hence, comorbid neurodevelopmental disorders, such as ADHD or Tourette's disorder, were not excluded.

Participants were five women and five men ranging in age from 25 to 65 years with a mean age of 49 years (SD = 12). The mean IQ measured with the Wechsler Adult Intelligence Scale-revised edition (WAIS-R) (Wechsler, 1981) or WAIS third edition (WAIS-III) (Wechsler, 1997) was 106 (SD = 16.14). Five participants had an educational level corresponding to college or university, two participants upper secondary, and three participants nine years of compulsory school or less. A description in detail of the sample shows in Tables 1 and 2.

2.4. Procedure

The diagnostic assessment of all study participants was performed at the Neuropsychiatric Unit Karolinska, at the Psychiatry Northwest clinic, Stockholm City Council, Stockholm, Sweden. The diagnostic evaluation followed local clinical guidelines (X) and was based on multiple sources of information. A clinical interview by a psychiatrist

Table 1
Demographic characteristics of the participants (n = 10).

Occupation	*n*	Relationship	*n*	Housing	*n*	Social network	*n*
Sick leave	5	Single	7	Single household	6	Friends > 1 t/month	6
Daily activities	2	Divorced	3	With children	2	Friends > 1 t/week	2
Full time work	1	Children	3	With parents	1	No friends	2
Part time	1			Special accommodation	1		
Full time pension	1						

Note. t = number of occasions.

Table 2
Clinical characteristics of the participants (n = 10).

Comorbidity Lifetime	*n*	On-going	*n*	NDD	*n*	On-going pharmacotherapy	*n*
Dysthymia	1	Dysthymia	1	ADHD	5	SSRIs	3
Depression	1	Depression	4	Tourette's syndrome	1	Anti-epileptics	2
Panic disorder	2	GAD	2			Methylphenidates	3
GAD	1	OCD	1			Sleep medication	1
OCD	1						
Social phobia	1						
Epilepsy	1						
PD-NOS	1						

Note. GAD: generalized anxiety disorder; OCD: obsessive-compulsive disorder; PD-NOS: personality disorder not otherwise specified; NDD: neurodevelopmental disorder; ADHD: attention deficit/hyperactivity disorder; SSRIs: selective serotonin reuptake inhibitors.

was included, as well as neuropsychological testing with WAIS-R (Wechsler, 1981) or WAIS-III (Wechsler, 1997), Conner's Continuous Performance Test (CPT-II) (Conners, 2000) and/or Delis-Kaplan Executive Function System (D-KEFS) (Delis, Kaplan, & Kramer, 2001) by a psychologist. The participants completed standardized self-rating questionnaires, such as the Adult Autism Spectrum Quotient (AQ) (Baron-Cohen, Wheelwright, Skinner, Martin, & Clubley, 2001) and Wender Utah Rating Scale (WURS) (Ward, Wender, & Reimherr, 1993), for the assessment of autistic symptoms and childhood ADHD-symptoms. Further information was gathered by interviewing the participants' family members or significant others to obtain a complete medical history of each participant. When available, additional information was obtained from records of child and adolescent psychiatry, school health services, and adult psychiatry. The demographic and clinical information was obtained from the participants' medical records and self-reports. The participants completed a questionnaire, covering demographic information and current stressors within different areas of life activities (Hirvikoski, Lindholm, Nordenstrom, Nordstrom, & Lajic, 2009). The two group leaders administered self-report questionnaires to examine the feasibility and outcomes of the stress management program. The group leaders were a clinical psychologist and Ph.D. candidate (J.P), with extensive experience of working with patients with ASD, and a graduate student in clinical psychology. During the completion of the self-report questionnaires, the participants were encouraged to ask the group leaders for help when necessary. When completed, the questionnaires were checked whether all items were filled in correctly to prevent any missing values.

2.5. Intervention

The manualized ACT group program named *NeuroACT – stress management for flexibility and health*, which was used in this study was a modified version of the ACT protocol previously evaluated in adolescents and young adults diagnosed with ASD (Pahnke et al., 2014). The NeuroACT treatment manual can be retrieved from the website http://www.brainproof.se or will be made available upon request by contacting the first author. The treatment program combines a functional contextual perspective with neuropsychology and support of executive functions. The intervention consisted of 12 weekly 150 min' group sessions. After each session, there were 30 min where the participants could ask questions or get help with homework assignments. Each session had a similar format with a short mindfulness or acceptance exercise, followed by a review of homework assignments, introduction of the theme of the particular session, and finally a review of new homework assignments and session evaluation. In-session activities and homework assignments consisted of pencil-and-paper exercises using adapted work-sheets (i.e., recording of stressful situations and avoidance behaviors, values and actions work, cognitive defusion exercises, visualized metaphors, and home-assignment sheets), alongside mindfulness training on a weekly basis using a compact disc (CD) with short adapted mindfulness and acceptance exercises. Auditive instructions and explanations were provided on the CD for how to perform the exercises, and the essentials of mindfulness and acceptance. Prior to each exercise, a rationale for why to practice mindfulness and acceptance was provided on the CD. The central components and processes of each treatment session were explained using PowerPoint images. Psychoeducative information sheets were given on stress, restoration, emotions, and perception. The modifications made from the protocol used for adolescents and young adults with ASD were: 1) adaptation of examples in order to be recognizable to adults, 2) clarification of homework assignments and individual support on a voluntary basis from the group leaders during 30 min after each treatment session, 3) extended psychoeducative material in order to help the participants obtain knowledge of the treatment themes, and 4) color-coded worksheets in order to

Table 3
NeuroACT treatment modules and sessions.

Module 1. Stress and avoidance (Session 1–2)
- Psychoeducation on stress from an ACT-perspective.
- Recording of stressful situations.
- Avoidance trap.

Module 2. Perspective taking (Session 3–4)
- Introduction to mindfulness and cognitive defusion.
- Being present.
- Perspective taking skills.

Module 3. Values and committed action (Session 5–6)
- Values- and motivation work.
- Purpose and meaning.
- Behavior goals and committed action.

Module 4. Acceptance and compassion (Session 7–8)
- Acceptance and compassion skills.
- Acceptance of emotions and body sensations.
- Acceptance of sensory input.

Module 5. Integration of ACT (Session 9–10)
- Using presence, defusion, and acceptance.
- Managing stress in social situations.
- Restorative actions.

Module 6. Consolidation of ACT (Session 11–12)
- Action plan.
- Review of group experiences.
- Planning for the future.

facilitate and provide more structure for the participants. The central treatment components and aims are described in more detail in Table 3.

2.6. Measures

2.6.1. Treatment credibility

Treatment credibility was assessed using an ASD-adapted version of the Treatment Credibility Scale (TSC) (Borkovec & Nau, 1972). The TSC consists of five items scored on a scale from 1 to 10 with a higher score indicating more credibility of the current treatment. The items were adjusted to be relevant for autistic individuals: 1) how apprehensible the treatment seemed to the participants; 2) how confident they felt that the group would reduce their ASD-related problems; 3) how confident they would be in recommending this kind of group to a friend with ASD; 4) how successful the participants thought that the treatment would be for other diagnoses; and 5) how much improved they expected to become with this treatment. The TCS total score is calculated as a mean of all items, and each item is calculated as a mean. The TCS has demonstrated high internal consistency in a Swedish sample with Cronbach's alpha (α) = 0.83 (Alfonsson, Olsson, & Hursti, 2016). The TCS was administered at the end of the treatment.

2.6.2. Intellectual ability

IQ was assessed with the WAIS-R (Wechsler, 1981) or the WAIS-III (Wechsler, 1997). The WAIS is the most frequently used instrument for assessment of intellectual ability in adults (16–89 years). WAIS-R (Wechsler, 1981) consists of six verbal and five performance subtests. The verbal tests are Information, Comprehension, Arithmetic, Digit Span, Similarities, and Vocabulary. The performance tests are Picture Arrangement, Picture Completion, Block Design, Object Assembly, and Digit Symbol. A verbal IQ, performance IQ, and full-scale IQ are obtained. WAIS-III (Wechsler, 1997) consists of fourteen subtests and 4 secondary indexes; Verbal Comprehension (Vocabulary, Similarities, Information, Comprehension), Perceptual Organization (Picture Completion, Block Design, Matrix Reasoning), Working Memory (Arithmetic, Digit Span, Letter-Number Sequencing), and Processing Speed (Digit Symbol-Coding, Symbol Search). The subtests of Picture Arrangement and Object Assembly are not included in the indexes. A full-scale IQ is obtained as well as an IQ for each index. The IQ and the index scores have a population mean of 100 and a standard deviation of 15, and subtest results have a mean of 10 and standard deviation of three. The WAIS has high consistency, and test-retest-reliability ranges between 0.70 and 0.90 (Wechsler, 1981). Inter-scorer coefficients have shown to be high (0.90) (Wechsler, 1981). The WAIS correlates highly with the Stanford-Binet IV test (0.88) (Wechsler, 1981).

2.6.3. Psychiatric comorbidity

Co-occurring psychiatric disorders were assessed with the Mini-International Neuropsychiatric Interview (MINI) (Sheehan et al., 1998). The MINI is a structured diagnostic interview for DSM and ICD psychiatric disorders. The MINI has shown moderate agreement with clinical mood and anxiety disorders (Verhoeven et al., 2017). For mood disorders, the AUC (i.e., area under the ROC curve) has shown a range between 0.55 and 0.81 (median 0.73), and for anxiety disorders, the AUC has been ranged between 0.78 and 0.88 (median 0.83) (Verhoeven et al., 2017).

2.6.4. Perceived stress

The participants' subjective stress, was assessed using the Perceived Stress Scale 14 items (PSS-14) (Cohen, Kamarck, & Mermelstein, 1983). The PSS is a widely used instrument for measuring the degree to which situations in one's life are appraised as stressful. The items are rated on a five-point Likert-type scale (0 = never to 4 = very often). A total score is calculated after reversing positive items' scores and then summing up all scores. A higher score indicates greater stress. The PSS has shown good construct validity with anxiety (r = 0.68), depression (r = 0.57), and mental or physical exhaustion (r = 0.71) in a Swedish sample (Nordin & Nordin, 2013). The PSS-14 has demonstrated high internal consistency in a Swedish sample with Cronbach's α = 0.84–0.90 (Eklund, Backstrom, & Tuvesson, 2014).

2.6.5. Quality of life

Self-perceived quality of life was assessed using the Satisfaction with Life Scale (SWLS) (Diener, Emmons, Larsen, & Griffin, 1985). The scale consists of five items rated on a Likert-type scale 1–7, with a higher score indicating a higher quality of life. The total score is calculated as the sum of the item scores. Satisfactory convergent validity with social support has been observed (r = 0.39) for SWLS and Oslo Social Support Scale (Glaesmer, Grande, Braehler, & Roth, 2011). Internal consistency of the SWLS has been reported as high (Cronbach's α = 0.88) in a Swedish sample (Hultell & Gustavsson, 2008), which is in accordance with previous findings from other countries (Arrindell, Heesink, & Feij, 1999; Diener et al., 1985; Navratil & Lewis, 2006).

2.6.6. Depression

Depressive symptoms were assessed using the Beck Depression Inventory-II (BDI-II) (Beck, Ward, Mendelson, Mock, & Erbaugh, 1961), a 21-item self-report questionnaire designed for adolescents and adults that measures depressive symptoms on a 0–3 scale, with a higher score indicating more depressive symptoms. The total score is calculated as the sum of the scores on each item. Good convergent validity has been observed (r = 0.72) for the BDI and Montgomery Asberg Depression Rating Scale (Lahlou-Laforet, Ledru, Niarra, Consoli, & Investigators, 2015). The BDI demonstrates high internal consistency (Cronbach's α = 0.89) in a Swedish sample (Kjaergaard, Arfwedson Wang, Waterloo, & Jorde, 2014).

2.6.7. Anxiety

Anxiety symptoms were assessed using the Beck Anxiety Inventory (BAI) (Beck, Epstein, Brown, & Steer, 1988), a 21-item self-report questionnaire measuring anxiety symptoms on a 0–3 scale, where a higher score indicates more anxiety symptoms. The total score is calculated as the sum of the scores on each item. Satisfactory AUC statistics have been reported (78.5%) for the BAI (Phan et al., 2016). Both internal consistency (Cronbach's α = 0.91) and test-retest-reliability (r = 0.84) of the BAI have been reported as high (Vazquez Morejon, Vazquez-Morejon Jimenez, & Zanin, 2014).

2.6.8. Functional impairment

The subjective appraisal of functional impairment as related to familial, social, and vocational aspects of life was assessed using the Sheehan Disability Scale (SDS) (Sheehan, Harnett-Sheehan, & Raj, 1996). The scale is a three-item, self-rated questionnaire designed to measure the extent to which a patient's disability due to an illness or health problem interferes with work/school, social life/leisure activities, and family life/home responsibilities, ranging from 0 (*not at all*) to 10 (*extremely*). Each subscale can be scored independently or combined into a single total score, representing a global impairment rating, ranging from 0 to 30, with higher scores indicative of significant functional impairment. Satisfactory AUC statistics have been reported (81.4%) for the SDS (Luciano et al., 2010). The scale demonstrates high internal consistency with Cronbach's α = 0.89 (Leon, Olfson, Portera, Farber, & Sheehan, 1997).

2.6.9. Psychological inflexibility

Psychological inflexibility defines as the inability to experience obstructive thoughts, emotions, and body sensations non-judgmentally, and act effectively upon situational demands according to personally chosen goals (Hayes, Luoma, Bond, Masuda, & Lillis, 2006a). Psychological inflexibility was assessed using the Acceptance and Action Questionnaire 7 items (AAQ-7) (Hayes, Luoma, Bond, Masuda, & Lillis, 2006b). The scale consists of 7 items, which are rated on a Likert-type

scale from 1 to 7. A higher score indicates more psychological inflexibility. The convergent validity (r = 0.63) and internal consistency (Cronbach's $\alpha = 0.89$) of the AAQ, have been reported as satisfactory (Bond et al., 2011), and was evaluated in a Swedish sample (Lundgren & Parling, 2017).

2.6.10. Cognitive fusion

Cognitive fusion refers to the inability to take perspective on one's thoughts without letting their content guide one's actions (Masuda, Hayes, Sackett, & Twohig, 2004). Cognitive fusion was assessed using the Cognitive Fusion Questionnaire 7 items (CFQ-7) (Gillanders et al., 2014). The CFQ-7 is a 7-item Likert-type scale from 1 to 7 that measures general cognitive fusion. Higher scores reflect more cognitive fusion. The discriminative validity (r = −0.78) of the CFQ, concerning psychological acceptance, has been observed as satisfactory in a clinical sample (McCracken, DaSilva, Skillicorn, & Doherty, 2014). The scale demonstrates high internal consistency with Cronbach's $\alpha = 0.93$ (Ruiz, Suarez-Falcon, Riano-Hernandez, & Gillanders, 2017).

2.7. Data analysis

Analyses were on an intention-to-treat basis. Data analyses included the full sample of 10 patients who attended at least one treatment session. When post-treatment data were missing, data were carried forward from the last assessment completed. All but one participant completed post- and follow-up assessments. Analyses were conducted using the SPSS version 21.0 and, after controlling that the sample scores were normally distributed, paired samples *t*-tests were performed to examine whether there were any changes on the measures from pre-to post-treatment and from pre-treatment to 3-month follow-up. Effect sizes were calculated using Cohen's *d* (Cohen et al., 1983). Cohen's *d* effect sizes are commonly interpreted as 0.2 (small), 0.5 (medium), and 0.8 (large).

3. Results

3.1. Feasibility

Nine out of ten completed the treatment and among them mean attendance was 11 sessions (SD = 3, range 9–12). One of the participants dropped out after two sessions. The treatment credibility total score was rated as high (M = 7.7, SD = 0.8) using the TCS (Borkovec & Nau, 1972). The mean score was 8.3 (SD = 1.6) on item 1 (how apprehensible the treatment seemed to the participants); 6.9 (SD = 1.6) on item 2 (how confident they felt that the group would reduce their ASD related problems; 8.3 (SD = 1.2) on item 3 (how confident they would be in recommending this kind of group to a friend with ASD); 8.0 (SD = 0.7) on item 4 (how successful the participants thought that the treatment would be for other diagnoses); and 6.7 (SD = 2.5) on item 5 (how much improved they expected to become with this treatment). Overall, the participants were successful in completing homework assignments, as well as carrying out mindfulness and exercises at home.

3.2. Outcome measures

As shown in detail in Table 4, the results showed a statistically significant change in several measures at post-assessment as compared to pre-assessment. The sample data met the statistical assumptions for using paired samples t-test (Xu et al., 2017). Measures of perceived stress (Fig. 1), social impairment, psychological inflexibility, and cognitive fusion significantly reduced from pre- (T1) to post-treatment (T2). At the 3-month follow-up (T3) there was a significant increase in quality of life (Fig. 1) and a significant reduction in depressive symptoms, as compared to T1. Measures of social disability and cognitive fusion were still significantly reduced at T3 as compared to T1. The results did not show any significant changes in symptoms of anxiety, or work- and family-related impairments.

4. Discussion

The current pilot study aimed at examining the preliminary feasibility and efficacy of ACT for adults with ASD in a psychiatric outpatient setting. Outcome measures of stress, quality of life, comorbid symptoms such as anxiety and depression, level of functioning (social, family and vocational), as well as ACT consistent measures of psychological inflexibility and cognitive fusion, were evaluated. The participants perceived the NeuroACT program as credible, and session completion, homework compliance, and attendance were high. Overall, the results showed a statistically significant change in several measures. Improvements were observed for perceived stress and quality of life, as well as for depressive symptoms, social impairment, psychological inflexibility, and cognitive fusion. However, no significant improvements were found for symptoms of anxiety, or work- and family-related impairments. Where significant changes were found, effect sizes ranged from small to large. The largest effect size was found for perceived stress and psychological inflexibility at post-assessment, and the quality of life at the follow-up. Overall, the results indicated that the NeuroACT program is a promising treatment for adults with ASD and that further research, using a methodologically robust randomized controlled design, is warranted.

To our knowledge, this is the first study to indicate that adults diagnosed with ASD could benefit from ACT. The finding is consistent with previous studies on mindfulness training, which suggest that such practice improves wellbeing in adults diagnosed with ASD (Conner & White, 2017; Kiep et al., 2015; Spek et al., 2013). ACT for autistic individuals relies heavily on mindfulness training from a functional analytic perspective (i.e., using mindfulness skills to pursue personal goals and values). Moreover, the NeuroACT program is structured and adds other treatment modules of value-based work, cognitive defusion, acceptance skills, and psychoeducation, with the overarching goal of creating psychological flexibility (Villatte et al., 2016). Increasing psychological flexibility may be especially crucial in autistic individuals, since short-term reinforced behaviors and cognitive inflexibility, along with experiential and social avoidance, is a common problem (Bishop-Fitzpatrick, Mazefsky, Minshew, & Eack, 2015). In this study, while perceived stress significantly decreased immediately after treatment, this change was no longer significant at the follow-up. However, the opposite was found for quality of life, where significant improvement was found at the follow-up but not directly after treatment. This finding may indicate a broadening of the participants' behavioral repertoire and a decrease in social avoidance, giving rise to increased symptoms of stress *but at the same time* enhancing the participants' sense of meaning and purpose in everyday life. In ACT, behavioral problems are seen as how the individual *relates* to his or her symptoms, and not the symptoms in themselves (Gaudiano, Herbert, & Hayes, 2010). Symptoms of stress are associated with high arousal and unpleasant affect, which increases *the risk of* emotional and behavioral avoidance (Sheynin et al., 2017). From an ACT perspective, when patients learn to relate to symptoms of stress more flexibly, the risk of avoidance decreases (Hayes et al., 2006b).

Moreover, social functioning improved immediately after treatment and sustained at follow-up, suggesting a reduction in social avoidance and increased social functioning. These findings are consistent with studies on ACT suggesting an 'incubation effect,' whereby improvement is maintained or increased after ACT ceases (Clarke, Kingston, James, Bolderston, & Remington, 2014; Hayes et al., 2004; Lundgren, Dahl, Melin, & Kies, 2006). Although recent data challenge the psychometric validity of conventional measures of experiential avoidance (Rochefort,

Table 4
Means and standard deviations on study measures at pre, post and follow-up (n = 10). Paired samples t-tests based on intention to treat to evaluate differences between assessment points, and effect sizes as Cohen's d.

Measure	Pre treatment	Post treatment	3-month follow-up				
	M (SD)	M (SD)	M (SD)	t		Cohen's *d*	
				Pre-post	Pre-follow-up	Pre-post	Pre-follow-up
PSS	35.1 (5.4)	29.0 (7.7)	31.5 (8.3)	2.73*	1.20	0.92	0.51
SWLS	13.2 (5.1)	15.5 (5.7)	17.0 (4.8)	−1.54	−2.79*	0.43	0.77
BDI-II	21.6 (14.3)	15.3 (10.7)	14.4 (11.6)	2.00	2.45*	0.50	0.55
BAI	24.2 (16.4)	14.5 (9.5)	18.4 (11.0)	1.56	1.14	0.72	0.42
SDS (work)	6.7 (2.8)	7.1 (1.7)	6.2 (2.5)	-.51	.75	0.17	0.19
SDS (social)	7.6 (3.0)	6.2 (3.2)	6.8 (2.9)	2.69*	2.45*	0.45	0.27
SDS (family)	6.6 (2.0)	5.9 (2.0)	6.3 (2.1)	.96	.64	0.35	0.15
AAQ-7	31.7 (8.1)	26.3 (4.2)	27.7 (6.0)	2.68*	1.50	0.84	0.56
CFQ-7	33.0 (6.1)	28.4 (7.4)	29.9 (5.3)	3.82**	3.09*	0.68	0.54

Note. PSS = Perceived Stress Scale; SWLS = Satisfaction with Life Scale; BDI-II = Beck Depression Inventory-II; BAI = Beck Anxiety Inventory; SDS = Sheehan Disability Scale; AAQ-7 = Acceptance and Action Questionnaire – 7 items; CFQ-7 = Cognitive Fusion Questionnaire – 7 items.
*$p < .05$.
**$p < .01$.

Baldwin, & Chmielewski, 2018), improvements in the ACT consistent measures regarding psychological flexibility and cognitive fusion may further indicate that the participants' ability to cope with thoughts, emotions, and body sensations has increased. Alternatively, to paraphrase one of the participants: '*I didn't know I had thoughts*.' In summary, these findings may suggest that the participants have benefited from the NeuroACT program in line with the ACT model. However, further studies are needed to evaluate the potential benefits of ACT for autistic adults more fully.

Overall, the results of the current study indicate that adults diagnosed with ASD can benefit from a structured and modified ACT program. Although promising, due to the pilot open trial design the present study has several limitations regarding the efficacy evaluation. First, the results showed significantly reduced symptoms of depression but not anxiety, although anxiety symptoms reduced with a medium effect size from pre to post-assessment. With regards to symptoms of anxiety, as with the other non-significant results, there may be a risk of a type-2 error because of the small sample size. Moreover, there might be a risk of type-1 error regarding the statistically significant measures. However, since several results are pointing in the same direction, there is a minor probability of this. Second, as no control group was used, time or other confounding variables could explain the treatment effects. Third, the outcome measures relied on self-report of the participants and no independent and objective criteria were used, which could imply over- or underestimation of individual progress. Fourth, the participants included in the study all had normal to above average intellectual capacity, why generalization of the results to autistic adults with lower intellectual capacity cannot be made. Fifth, no measurements of autistic symptoms were performed; as such, no information was provided on whether the NeuroACT program could be beneficial on autistic core difficulties.

For future research, to increase the internal validity and generalizability of the results, studies with a randomized controlled design using blinded assessments and control of treatment adherence are needed to further explore the potential benefits of ACT in adults diagnosed with ASD. Evaluation of the effect of potential mediators and moderators of change is warranted, such as gender, cognitive abilities, adherence to homework, and ACT processes on treatment outcomes. Further, an evaluation of the potential effects of ACT on autistic core difficulties would be of interest. Finally, a possible speculative correlation between social and behavioral avoidance and quality of life and depression would need to be evaluated.

In summary, the results of the current pilot study suggest that the NeuroACT program may be a promising treatment, which is feasible and tolerable in a psychiatric outpatient setting, and has the potential to be effective for improving stress, quality of life, social functioning, cognitive fusion, psychological inflexibility, and symptoms of depression, in adults diagnosed with ASD.

Conflicts of interest

There are no conflicts of interest to disclose.

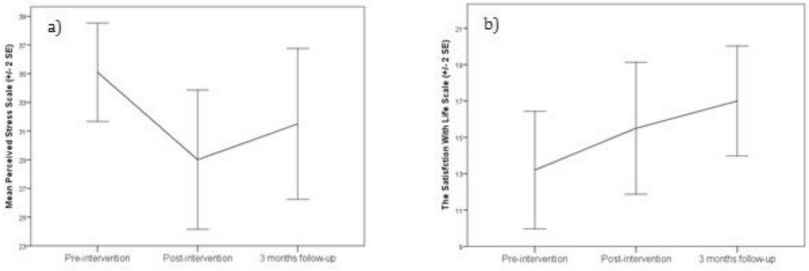

Fig. 1. The perceived stress scale (PSS) showed a significant reduction from pre to post intervention ($p = .023$) but not from pre to 3-month follow-up (a). The satisfaction with life scale (SWLS) showed a significant increase from pre to 3-month follow-up ($p = .021$) but not from pre to post (b). SE: standard error.

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III

Acceptance and commitment therapy for autistic adults: A randomized controlled pilot study in a psychiatric outpatient setting

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Abstract

Autistic adults are at risk of stress-related psychiatric disorders and reduced quality of life due to social, cognitive, and perceptual challenges. However, mental health interventions adapted to autistic adults are scarce. Acceptance and commitment therapy (ACT) has preliminarily indicated health benefits in autistic adults, although not robustly evaluated. Thirty-nine adults (21 males; 21-72 years) with autism spectrum disorder (ASD) and normal intellectual ability (IQ M = 108.5; SD = 13.5) were randomized to 14 weeks of adapted ACT group treatment (NeuroACT) or treatment as usual (TAU). Feasibility was satisfying. Perceived stress and quality of life (primary outcomes), sleep quality, cognitive and behavioral avoidance, psychological inflexibility, cognitive fusion, and autistic mannerism were statistically significantly improved in NeuroACT compared to TAU (d = 0.66-0.77). Depression, autistic core challenges, and social motivation showed statistical trends (d = 0.57-1.24). Clinically significant changes were in favor of NeuroACT. Between-group altered anxiety, sleep aspects, one quality of life measure, functional impairment, social awareness, social cognition, communication, and executive difficulties were statistically non-significant. Dropout was higher in NeuroACT. NeuroACT may be a promising treatment for autistic adults with co-existing mental health problems and reduced quality of life. However, more extensive studies are warranted to further evaluate NeuroACT.

Introduction

Autism spectrum disorder (ASD) is a neurodevelopmental condition characterized by challenges in social interaction, repetitive and restricted behavior and interest, and sensory hyper- and hyposensitivity (APA, 2013; Lai & Baron-Cohen, 2015; Lord, Elsabbagh, Baird, & Veenstra-Vanderweele, 2018). ASD is present in 1-2 % of the adult population (Idring et al., 2015). Executive difficulties (e.g., working memory, inhibition, or planning) often impairs the ability to cope with daily hassles and reach long-term goals (Bednarz, Trapani, & Kana, 2020; Uddin, 2021; Wallace et al., 2016) and affect important life areas, such as social relationships, work, and independent living (Bishop-Fitzpatrick, Minshew, Mazefsky, & Eack, 2017; Brugha et al., 2016; Lai, Anagnostou, Wiznitzer, Allison, & Baron-Cohen, 2020). Moreover, autistic adults have higher rates of perceived stress (Bishop-Fitzpatrick et al., 2017) and reduced quality of life (Park et al., 2019), alongside psychiatric symptoms (e.g., depression and anxiety) (Croen et al., 2015), problems with sleep (Morgan, Nageye, Masi, & Cortese, 2020), and even premature mortality (Smith DaWalt, Hong, Greenberg, & Mailick, 2019). As many as 70 % of autistic adults experience at least one lifetime depressive episode and 50 % meet the criteria for a lifetime anxiety disorder (Lugnegård, Hallerbäck, & Gillberg, 2011; Nah, Brewer, Young, & Flower, 2018). Accordingly, the continuous development of feasible and effective treatments that address stress, quality of life, and psychological distress in autistic adults is paramount.

Many autistic individuals cannot tolerate or have limited effects from pharmacological treatments intended to impact upon psychiatric symptoms (LeClerc & Easley, 2015; Williams et al., 2013). Moreover, research on feasible and effective psychological interventions that address health outcomes in autistic adults is limited (Benevides et al., 2020). Common psychological treatments adapted for ASD that address mental health problems are cognitive-behavior therapy (CBT) (Spain, Sin, Chalder, Murphy, & Happé, 2015) and mindfulness-based stress reduction (MBSR) (Cachia, Anderson, & Moore, 2016). Mindfulness is an emotion regulation technique defined as non-judgmental and non-reactive attention to momentarily experiences, including thoughts, emotions, and body sensations (Dryden & Still, 2006; Guendelman, Medeiros, & Rampes, 2017; Ludwig & Kabat-Zinn, 2008). The results are promising; CBT has indicated improved anxiety, depression, and quality of life, and group delivered interventions seem to be well-suited, supportive, and cost-efficient for an ASD population (Hesselmark, Plenty, & Bejerot, 2014; Spain et al., 2015; Weiss & Lunsky, 2010). MBSR adapted for ASD has shown health benefits in a range of areas, such as depression, anxiety, rumination, sleeping problems, and interpersonal sensitivity, and the effects seem to last at least nine weeks after treatment completion (Kiep, Spek, & Hoeben, 2015; Spek, van Ham, & Nyklíček, 2013). Furthermore, Conner and White (2018) have observed increased emotion regulation and impulse control in autistic adults as a result of mindfulness practice. Psychological treatments based on CBT and mindfulness principles thus appear to have the potential to benefit mental health in autistic adults. Furthermore, given the heterogeneity across the autism spectrum, such as cognitive profile, functional level, or comorbidity,

new treatment models are continuously warranted to cover different aspects of autism, increase mental health and optimize everyday life in autistic individuals.

Acceptance and commitment therapy (ACT) is a psychotherapy method that combines mindfulness procedures and behavioral change techniques (Villatte et al., 2016). ACT has proven effective for reducing psychological distress in complex and persistent conditions, such as chronic pain, epilepsy, and psychosis (Hayes, 2019; Hughes, Clark, Colclough, Dale, & McMillan, 2017; Shawyer et al., 2017). ACT may complement existing psychological treatments for mental health problems in autism by targeting purported underlying mechanisms somewhat differently than CBT and MBSR. In ACT, psychological inflexibility means that an individual avoids situations that are perceived as stressful or unpleasant, including thoughts, emotions, and body sensations related to those situations (Hayes & Wilson, 1994). Although sometimes helpful in the short run, repeated avoidance often implies missing out on important things in life, eventually leading to a sense of hopelessness and causing or worsening mental health problems. Since autistic individuals are more exposed to stressors, such as sounds, social events, or new situations, they run a higher risk of developing avoidant behaviors and maladaptive coping strategies, which might cause long-term mental health problems (Conner, White, Scahill, & Mazefsky, 2020; Pagni et al., 2020; Pfaff & Barbas, 2019). Increasing coping skills to handle stressful situations more flexibly could thus reduce avoidance and benefit mental health and quality of life in autistic adults.

In ACT, psychological flexibility is the ability to do what is important to oneself while handling mental obstacles that would otherwise be in the way (Hayes, Luoma, Bond, Masuda, & Lillis, 2006). Psychological flexibility is enhanced mainly through two procedures: (1) training mindfulness, cognitive defusion, and acceptance skills, and (2) using behavior change techniques. Cognitive defusion is the ability to observe thoughts without literally believing their content or letting them guide one's actions (Gillanders et al., 2013). Acceptance is the active and aware embracement of thoughts, emotions, and body sensations without attempts to avoid or counteract them, especially when doing so would cause psychological harm (Hayes, Villatte, Levin, & Hildebrandt, 2011). Mindfulness, cognitive defusion, and acceptance help the individual to cope with stressful thoughts (e.g., 'I'm worthless'), emotions (e.g., fear or sadness), and body sensations (e.g., heart palpitation), thereby preventing avoidance. Behavioral change techniques assist the individual in defining what is important to him or her (e.g., social contact) and acting according to this (e.g., texting a friend or using public transport), thereby reaching personally chosen behavior goals.

Interventions based on ACT have been evaluated for parents of autistic children (Hahs, Dixon, & Paliliunas, 2019; Prevedini et al., 2020; Whittingham et al., 2020), autistic adolescents (Pahnke, Lundgren, Hursti, & Hirvikoski, 2014), and autistic adults in a non-clinical setting (Hutchinson, Rehfeldt, Hertel, & Root, 2019). However, only a few studies have evaluated ACT-based interventions for autistic adults in a clinical context. Pahnke et al. (2019) found preliminary benefits of an ACT protocol adapted for autistic adults on perceived stress, quality of life, and depression, alongside reduced

psychological inflexibility and cognitive fusion. Moreover, Maisel, Stephenson, Cox, and South (2019) showed reduced psychological distress in autistic adults using a cognitive defusion intervention. However, to the best of our knowledge, there is no randomized controlled trial (RCT) of ACT for autistic adults. Therefore, studies using an RCT design to evaluate the feasibility and effectiveness of ACT adapted to autistic adults are of importance.

Study objectives

The current pilot RCT study evaluated the feasibility and preliminary effectiveness of an ACT group protocol (NeuroACT) adapted for autistic adults in a psychiatric outpatient setting compared to treatment as usual (TAU). The research questions were: (1) Is the study procedure and the NeuroACT protocol feasible (i.e., treatment completion, treatment credibility, data collection, and participant recruitment)? (2) What are the effects of NeuroACT on perceived stress and quality of life (primary outcomes) compared to TAU? (3) What are the effects of NeuroACT on psychiatric symptoms (i.e., depression, anxiety, and sleep problems) and functional impairment (secondary outcomes) compared to TAU? (4) What are the effects of NeuroACT on ACT-related variables (i.e., psychological inflexibility, cognitive fusion, and cognitive and behavioral avoidance) (secondary outcomes) compared to TAU? (5) How does NeuroACT affect autistic core challenges, such as social cognition, communication, autistic mannerism (i.e., repeated and restricted behaviors), and executive difficulties (secondary outcomes) compared to TAU?

Methods

Design

The study design was a randomized two-group controlled pilot trial with repeated measures evaluating the feasibility and preliminary effectiveness of NeuroACT compared to TAU for autistic adults. The pilot study design motivated the inclusion of several outcome measures to cover different aspects of potential treatment benefits and to follow a broad spectrum of symptoms, correlates, and consequences of autism. Assessments were conducted at pre-treatment (T1), post-treatment (T2), and six months after treatment completion (T3). Power calculation was based on an open trial pilot study on ACT for autistic adults (Pahnke et al., 2019) using the results of the Satisfaction with Life Scale (SWLS) (Diener, 1985) ($M = 13.2$, $SD = 5.1$ for pre-treatment and $M = 17.0$, $SD = 4.8$ for post-treatment, 0.05 significance level, and .8 statistical power). The calculation indicated the need for 30 participants in each treatment group (a total of 60 participants) to reduce the risk of Type 2-error. However, due to organizational changes within the psychiatric clinic, the study was prematurely aborted reaching a total of 39 participants.

Randomization was conducted block-wise (Schochet, Pashley, Miratrix, & Kautz, 2021) and performed 1:1 using folded pieces of paper reading either 'treatment' or 'control' placed in a container,

mixed, and drawn. Twenty participants were randomized in the first block (fall 2011) and 19 participants were randomized in the second block (fall 2012). Post-assessment (T2) was conducted within one week after treatment completion and follow-up assessment (T3) was performed six months after the post-assessment. As shown in Figure 1, fifty-two adults were screened for the study, 13 were not found eligible, and 39 (75 %) were included in the study.

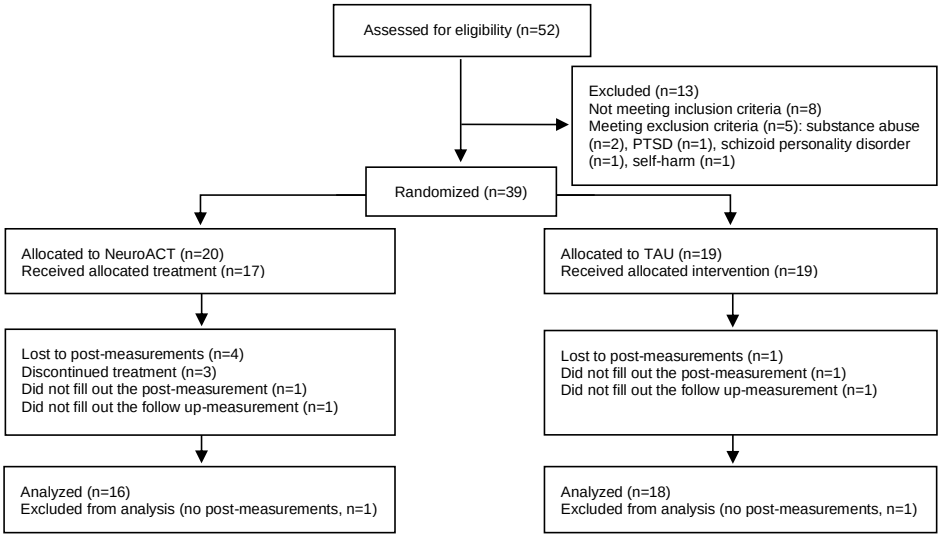

Figure 1. Flowchart of procedure and participants.

Ethics

The trial was approved by the regional ethics committee of Stockholm, Sweden (2015-1005-31) and followed the Declaration of Helsinki (AMA, 2013). All participants were given verbal and written information about the study procedures and that they could withdraw study participation at any time without further explanation.

Participants

Participants were recruited at the Neuropsychiatric Unit Karolinska, a clinic specialized in assessing and treating neurodevelopmental disorders in adults. Individuals that met the diagnostic criteria of ASD were invited to participate. Inclusion criteria were: (a) a diagnosis of DSM-IV Asperger syndrome (i.e., equivalent to ASD without specified intellectual disability or language impairment in the fifth edition of the DSM) (APA, 2013) as the primary neurodevelopmental diagnosis; (b) 18 years of age or older;

(c) if on any psychoactive drug treatment (for ADHD or other diagnoses), treatment should have been stable (at least for three months); and (d) scoring more than one standard deviation under the population mean on the Quality of Life Inventory (QOLI) (Frisch, 1994), that is, QOLI < 1.84) or more than one standard deviation over the population mean on the Perceived Stress Scale (PSS) (Cohen, Kamarck, & Mermelstein, 1983), that is, PSS > 24. Exclusion criteria were: (a) ongoing substance abuse (last three months); (b) diagnosed intellectual disability (intelligence quotient, IQ < 70); (c) organic brain injury; (d) suicidality; and (e) severe clinically unstable psychosocial circumstances or comorbid psychiatric disorders (e.g., being homeless or severe depression, psychosis, or bipolar disorder not under stable pharmacological treatment). An explicit study objective was to include a representative selection of psychiatric patients with ASD. Hence, comorbid neurodevelopmental disorders (e.g., ADHD or Tourette's disorder) were not excluded. Participants included were 21 men and 18 women (21-72 years) with a mean age of 39 years (SD = 12). The ACT group consisted of 20 participants (10 males), and the TAU group contained 19 participants (11 males).

Assessment

The diagnostic assessment followed local clinical guidelines and was based on multiple sources of information. First, a clinical interview was performed by a psychiatrist followed by neuropsychological testing by a psychologist (e.g., WAIS-R, or WAIS-III) (Wechsler, 1981, 1997), frequently complemented by Conners' Continuous Performance Test (CPT-II) (Conners, 2000) or Delis-Kaplan Executive Function System (D-KEFS) (Delis, 2001). Second, assessing autistic and ADHD symptoms included standardized self-rating questionnaires (e.g., Adult Autism Spectrum Quotient, AQ; Wender Utah Rating Scale, WURS (Baron-Cohen, Wheelwright, Skinner, Martin, & Clubley, 2001; Ward, Wender, & Reimherr, 1993). Third, family members or significant others were interviewed for a complete medical history, and information was obtained from child and adolescent psychiatry, school health services, and adult psychiatry. Fourth, demographic and clinical data were obtained from medical records and a self-report questionnaire covering different clinical aspects (Hirvikoski, Lindholm, Nordenström, Nordström, & Lajic, 2009). Finally, feasibility and outcome self-report questionnaires were administered by clinical psychologists to evaluate the treatment.

Treatment

The manualized treatment (NeuroACT – stress management for flexibility and health) was a modified version of the protocol evaluated in autistic adults within a psychiatric outpatient setting (Pahnke et al., 2019). The NeuroACT treatment manual can be retrieved by contacting the corresponding author. The treatment program consists of training in ACT processes combined with psychoeducation on stress, emotions, and perception as well as the support of executive difficulties. Primary treatment objectives were to (1) Facilitate participants' motivation to behavior change and (2) train participants' skills to cope

with daily hassles and stressful situations to reduce behavioral avoidance. The treatment consisted of 14 weekly 150 minutes group sessions with 8-10 participants, led by two clinical psychologists with experience of ACT and autism (the first and fourth authors of this article). After each session, 30 minutes were added for questions or assistance with homework assignments. Each session had a similar format with a short mindfulness or acceptance exercise, followed by a review of homework assignments, an introduction of the theme of the particular session, and finally, a review of new homework assignments and session evaluation. In-session activities and homework assignments consisted of pencil-and-paper exercises using adapted worksheets (i.e., recording stressful situations and avoidance behaviors, values and actions work, cognitive defusion exercises, and visualized metaphors). In addition, mindfulness and acceptance were practiced at home five times per week using prerecorded adapted audio exercises. Before each exercise, a rationale for why to practice mindfulness or acceptance was provided. Central components and processes of each treatment session were explained using didactic presentations. In addition, psychoeducational information sheets were provided, such as about stress, emotions, or perception. Compared to the protocol used in Pahnke et al. (2019), modifications consisted of two additional sessions to enhance problem-solving and everyday-structure skills. Central treatment components and aims are described in Table 1.

Table 1. NeuroACT treatment modules and sessions.

Module 1. Stress and avoidance (Session 1-2) • Psychoeducation on stress from an ACT perspective. • Recording of stressful situations. • Avoidance trap.	**Module 2. Perspective-taking (Session 3-4)** • Introduction to mindfulness and cognitive defusion. • Being present. • Perspective-taking skills.
Module 3. Values and committed action (Session 5-6) • Values- and motivation work. • Purpose and meaning. • Behavior goals and committed action.	**Module 4. Acceptance and compassion (Session 7-8)** • Acceptance and compassion skills. • Acceptance of emotions and body sensations. • Acceptance of sensory input.
Module 5. Integration of ACT (Session 9-10) • Using presence, defusion, and acceptance. • Managing stress in social situations. • Restorative actions.	**Module 6. Support of executive function (Session 11-12)** • Problem-solving. • Structure management. • Application of ACT techniques.
Module 7. Consolidation of ACT (Session 13-14) • Action plan. • Review of group experiences. • Planning for the future.	

ACT = acceptance and commitment therapy

The TAU group received ordinary care, such as communication training, psychoeducational programs, or psychotherapy, as part of their standard disability service or outpatient psychiatric care and obtained the NeuroACT treatment with a one-year delay.

Measures

Assessment measures

Intellectual ability

Intellectual ability (IQ) was assessed using the WAIS-R (Wechsler, 1981) or the WAIS-III (Wechsler, 1997). WAIS consists of verbal and performance subtests where a verbal IQ, a performance IQ, and a full-scale IQ are obtained. IQ and index scores' population mean is 100 with a standard deviation of 15. WAIS' test-retest-reliability ranges between .70 and .90, inter-scorer coefficients are high (r = .90), and WAIS' full-scale IQ correlates highly with the Stanford-Binet IV test (r = .88) (Wechsler, 1981).

Psychiatric diagnoses

Comorbid psychiatric disorders were assessed using the Mini-International Neuropsychiatric Interview (MINI) (Sheehan et al., 1998), a structured diagnostic interview for DSM and ICD psychiatric disorders. MINI has shown moderate concurrent validity with mood and anxiety disorders (Verhoeven et al., 2017) with AUC (i.e., area under the receiver operating characteristic curve) ranging between .55 and .81 (median .73) for mood disorders and between .78 and .88 (median .83) for anxiety disorders (Verhoeven et al., 2017).

Feasibility measures

Overall feasibility was calculated as a percentage of (1) Treatment completion (2) Measurement fulfillment at T1, T2, and T3; (3) Dropout rates between the NeuroACT group and the TAU group post randomization; (4) Treatment credibility; and (5) Any adverse events as reported in participants' medical records, according to the CONSORT statement for randomized trials of nonpharmacologic treatments (Boutron, Altman, Moher, Schulz, & Ravaud, 2017).

Treatment credibility was assessed using an ASD-adapted version of the Treatment Credibility Scale (TCS) (Borkovec & Nau, 1972). TCS consists of five items scored on a scale from 1 to 10, with a higher score indicating more credibility of the current treatment. In addition, items were adjusted to be relevant for autistic individuals: (1) how apprehensible the treatment seemed to the participants; (2) how confident they felt that the group would reduce their ASD-related problems; (3) how confident they would be in recommending this kind of group to a friend with ASD; (4) how successful the participants thought that the treatment would be for other diagnoses, and (5) how much improved they expected to

become with this treatment. The TCS total score is calculated as a mean of all items. The TCS has demonstrated good internal consistency in a X sample consisting of stress and anxiety patients (Cronbach's α = .83) (Alfonsson, Olsson, & Hursti, 2016) and satisfying internal consistency in the current sample (Cronbach's α = .92).

Primary outcome measures

Stress

Perceived stress was assessed using the Perceived Stress Scale 14 items (PSS-14) (Cohen et al., 1983), a 14-item five-point Likert scale (0 = never to 4 = very often), with higher scores indicating more stress. A total score is calculated after reversing positive items' scores and then summing up all scores. The PSS has shown good criterion validity with anxiety (r = .68), depression (r = .57) and mental or physical exhaustion (r = .71), and good internal consistency in a Swedish sample (Cronbach's α = .84) (Eklund, Bäckström, & Tuvesson, 2014; Nordin & Nordin, 2013). The PSS showed satisfying internal consistency in the present sample (Cronbach's α = .77).

Quality of life

Perceived quality of life was assessed using the Satisfaction with Life Scale (SWLS) (Diener, 1985) and the Quality of Life Inventory (QOLI) (Frisch, Cornell, Villanueva, & Retzlaff, 1992). The SWLS consists of five items rated on a Likert-type scale 1-7, with a higher score indicating higher quality of life. A total score is calculated as the sum of the item scores. Satisfactory convergent validity (r = .39) (Glaesmer, Grande, Braehler, & Roth, 2011) and good internal consistency (Cronbach's α = .88) of the SWLS in a Swedish clinical sample have been observed (Hultell & Gustavsson, 2008). The QOLI assesses 16 life areas, presenting a weighted score that considers each domain's importance and satisfaction. The QOLI has shown satisfying to good internal consistency (Cronbach's α = .77–.89) and test-retest reliability (Frisch et al., 1992). The SWLS showed satisfying internal consistency (Cronbach's α = .74) and the QOLI demonstrated good internal consistency in the current sample (Cronbach's α = .88).

Secondary outcome measures

Depression

Perceived depressive symptoms were assessed using the Beck Depression Inventory-II (BDI-II) (Beck, Ward, Mendelson, Mock, & Erbaugh, 1961), a 21-item self-report four-point Likert scale, with higher scores indicating more depressive symptoms. A total score is calculated as the sum of the scores on each item. Good convergent validity (r = .72) (Lahlou-Laforêt, Ledru, Niarra, & Consoli, 2015) and internal consistency (Cronbach's α = .89) was observed in a Swedish clinical sample (Kjærgaard, Arfwedson

Wang, Waterloo, & Jorde, 2014). The BDI showed satisfying internal consistency in the current sample (Cronbach's α = .93).

Anxiety

Perceived anxiety symptoms were assessed using the Beck Anxiety Inventory (BAI) (Beck, Epstein, Brown, & Steer, 1988), a 21-item self-report four-point Likert scale, with a higher score indicating more anxiety symptoms. A total score is calculated as the sum of the scores on each item. Satisfactory internal consistency (Cronbach's α = .91) and good test-retest-reliability (*r* = .84) have been reported (Vázquez-Morejón, Zanin, & Bellido, 2014). The BAI showed satisfying internal consistency in the current sample (Cronbach's α = .95).

Sleep problems

Perceived sleep problems were assessed using the Karolinska Sleep Questionnaire (KSQ) (Kecklund & Åkerstedt, 1992), a six-point Likert scale, with higher scores indicating more difficulties. KSQ covers four indices (i.e., sleep quality, awakening difficulties, breathing problems, and fatigue during daytime), which are recommended to use instead of the scale's total score (Nordin & Nordin, 2013). The instrument has shown good criterion validity, internal consistency, and satisfactory construct validity in Swedish samples (Nordin & Nordin, 2013; Westerlund, Brandt, Harlid, Åkerstedt, & Trolle Lagerros, 2014). In addition, the KSQ demonstrated satisfying internal consistency in the present sample (Cronbach's α = .91).

Functional impairment

Perceived functional impairment (familial, social, and vocational) was assessed using the Sheehan Disability Scale (SDS) (Sheehan, Harnett-Sheehan, & Raj, 1996), a three-item scale ranging from 0 to 10, with a higher score indicating more functional impairment. The SDS has shown satisfactory AUC statistics (.81) (Luciano et al., 2010) and good internal consistency (Cronbach's α = .89) (Leon et al., 1997). In addition, good internal consistency of the SDS was observed in the present sample (Cronbach's α = .79).

Psychological inflexibility

Perceived psychological inflexibility was assessed using the Acceptance and Action Questionnaire (AAQ-7) (Bond et al., 2011), a 7-item Likert scale (1 to 7), with a higher score indicating more psychological inflexibility. AAQ was evaluated in a Swedish sample showing good concurrent and convergent validity, and good internal consistency (Cronbach's α = .85) and test-retest reliability (*r* = .80) (Lundgren & Parling, 2017). In addition, the AAQ showed satisfying internal consistency in the present sample (Cronbach's α = .92).

Cognitive fusion

Perceived cognitive fusion was assessed using the Cognitive Fusion Questionnaire (CFQ-7) (Gillanders et al., 2013), a 7-item Likert scale (1 to 7), with a higher score reflecting more cognitive fusion. Discriminative validity of the CFQ against psychological acceptance has been observed as satisfactory (r = -.78) in a clinical sample (McCracken, DaSilva, Skillicorn, & Doherty, 2014). The CFQ demonstrated satisfying internal consistency in a clinical sample (Cronbach's α = .93) (Ruiz, Suarez-Falcon, Riano-Hernandez, & Gillanders, 2017) and in the current sample (Cronbach's α = .93).

Cognitive and behavioral avoidance

Perceived cognitive and behavioral avoidance was assessed using the Cognitive-Behavioral Avoidance Scale (CBAS) (Ottenbreit & Dobson, 2004), a 31-item 5-point Likert scale, with a higher score indicating more cognitive and behavioral avoidance. The CBAS has demonstrated satisfactory internal consistency (Cronbach's α = .95) and good convergent and discriminative validity, and 4-month test-retest reliability, in psychiatric samples (Barajas, Garra, & Ros, 2017; Ottenbreit & Dobson, 2004). In the present sample, the CBAS showed good internal consistency (Cronbach's α = .89).

Autistic core challenges

Perceived autistic core challenges were assessed using the Social Responsiveness Scale (SRS) (Constantino, 2002), a 65-item four-point Likert scale resulting in a total score and five subscale scores (Social motivation, Social cognition, Social awareness, Social communication, and Autistic mannerism). Social motivation assesses the degree of motivation to participate in social-interpersonal behavior. Social cognition measures the ability to understand social information, while social awareness implies noticing social cues. Social communication refers to the ability to demonstrate expressive social communication. Finally, autistic mannerism refers to cognitive and behavioral inflexibility (Booker & Starling, 2011). The SRS showed good concurrent, predictive, convergent, and discriminative validity with a sensitivity of .85 and a specificity of .83 for ASD, and a Cronbach's alpha of .89 in different ASD populations (Bolte, 2012; Chan, Smith, Hong, Greenberg, & Mailick, 2017; Frazier et al., 2014). The SRS showed satisfactory internal consistency in the current sample (Cronbach's α = .91).

Executive difficulties

Perceived executive difficulties were assessed using the Dysexecutive Questionnaire (DEX-S), a 20-item 5-point Likert scale, with a higher score indicating more executive difficulties (Wilson, Alderman, Burgess, Emslie, & Evans, 1996). The DEX-S showed satisfying internal consistency (Cronbach's α = .91) for neurologically impaired patients (Bennett, Ong, & Ponsford, 2005; Shaw, Oei, & Sawang, 2015) and good internal consistency in the current sample (Cronbach's α = .84).

Statistical analyses

Data were analyzed using the statistical software SPSS version 27.0. Demographic data and background variables were analyzed using independent *t*-tests for continuous variables and chi-square tests for categorical variables. An exploratory analysis was performed to assess the normal distribution and potential outliers, indicating normality for all measures except the BDI, the BAI, the KSQ - Breathing Index, and the KSQ – Fatigue Index. Outcome measures were analyzed using two-tailed mixed-design repeated-measures analyses of variance (rmANOVA). Group (NeuroACT/TAU) was the between-subjects factor and time (T1, T2, and T3) the within-subjects factor. Calculations of the outcome measures were performed on treatment completers. Contrast analyses were performed from pre (T1)- to post (T2)-intervention and from post- to six-month follow-up (T3). Kruskal-Wallis and Wilcoxon Signed-rank tests were used for non-normal distributed samples. The interpretations of Cronbach's alpha were $\alpha \geq .70$ = satisfying, $\alpha \geq .80$ = good, and $\alpha \geq .90$ = satisfying, where a too low or high alpha-value may indicate insufficient reliability (Taber, 2018). Effect sizes were calculated by converting R-squared effect size to Cohen's d, interpreted using the guidelines proposed by Cohen (1988): 0.2 = small effect size, 0.5 = moderate effect size, and 0.8 = large effect size. Alpha levels were set at $p \leq .05$ for statistical significance and $p \leq .10$ for a statistical trend. Statistical trends were included to reduce Type-2 error due to the small sample size.

Clinically significant changes (Evans, Margison, & Barkham, 1998; Jacobson & Truax, 1991) of the primary outcome measures were calculated using normal population data of the PSS (M = 24.8, SD = 11.1) (Eklund, Bäckström, & Tuvesson, 2014) and the SWLS (M = 24.1, SD = 6.9) (Pavot & Diener, 2008) along with clinical data from the present sample. In the PSS, a cut-off score below 31.36 for the NeuroACT group and below 30.35 for the TAU group was interpreted as a clinically significant recovery. A change score below two standard deviations (NeuroACT = 15.0; TAU = 15.4) of the group mean (NeuroACT = 35.8; TAU = 34.2) was interpreted as a clinically significant improvement, and within two standard deviations from the group mean was interpreted as unimproved. For the SWLS, a cut-off score above 18.5 for the NeuroACT group and above 18.4 for the TAU group was interpreted as a clinically significant recovery. A change score exceeding two standard deviations (NeuroACT = 10.2; TAU = 9.8) of the group mean (NeuroACT = 14.3; TAU = 14.4) was interpreted as a clinically significant improvement, and within two standard deviations from the group was interpreted as unimproved.

Results

Participant characteristics

A slight majority of participants were male (54 %). Most had comorbid disorders (56 %) (e.g., ADHD/ADD, depression, or dysthymia) and used pharmacological treatment (72 %) (e.g., antihistamines, sleep medication, antidepressants, or methylphenidate). The mean overall IQ score was 108.5 (SD = 13.5). The NeuroACT group had an IQ score of 107.0 (SD = 13.8), and the TAU group's IQ score was 109.6 (SD = 13.9). The distribution of participant characteristics (e.g., age, sex, IQ, psychiatric comorbidity, medication, and occupation) is shown in Table 2.

Table 2. Participant characteristics.

Characteristics	NeuroACT (*n* = 20)	TAU (*n* = 19)	Total (N = 39)
	n	*n*	*n*
Gender, male	10	11	21
Age (years)	*M* (*SD*)	*M* (*SD*)	*M* (*SD*)
	38.4 (10.0)	39.8 (14.4)	39.1 (12.2)
Psychiatric comorbidity			
ADHD/ADD	9	6	15
Depression, depressive episode NOS, dysthymia	4	5	9
Anxiety disorders	5	0	5
Other comorbidities (e.g., dyslexia; bipolarity)	5	3	8
Any psychiatric comorbidity	11	11	22
Medication			
Antihistamines	2	7	9
Sleep medication	4	5	9
Antidepressants	5	8	13
Methylphenidate	5	7	12
Other medication	6	11	17
Any medication	13	16	29
Education			
University/higher education	7	3	10
High school	9	12	21
Elementary school	3	3	6
Other	1	1	2
Occupation			
Company owner/employee/student/parental leave	7	5	12
Part-time employee/temporary position	2	3	5
Pensioner	0	1	1
Unemployed	2	4	6
Temporary disability pension/early retirement benefit	5	3	8
Other	4	3	7

ACT = acceptance and commitment therapy; TAU = treatment as usual; ADHD = attention-deficit hyperactivity disorder; ADD = attention-deficit disorder; NOS = not otherwise specified

Feasibility

Results showed good overall feasibility: 39 out of 52 assessed participants (75 %) were considered candidates and invited to participate in the study. All 39 invited participants chose to participate. Seventeen out of 20 participants (85 %) completed the treatment. Thirty-four out of 39 (87 %) completed all assessments at T1, T2, and T3. Dropout rates were slightly higher in the NeuroACT group (20 %) compared to the TAU group (5 %) post-randomization, and no adverse events were reported. Two participants were included that had a lower score (20 and 23, respectively) on the PSS than the inclusion cut-off (PSS > 24) but instead met inclusion criteria on QOLI. Five participants were included that had

a higher score (1.9-2.9) in the QOLI than the inclusion cut-off (QOLI < 1.84) but instead met inclusion criteria on PSS.

Treatment credibility (max score = 10) was rated as high (M = 7.3, SD = 2.5) using the TCS (Borkovec & Nau, 1972). The mean score of the TCS was 7.6 (SD = 2.5) on item 1 (how apprehensible the treatment seemed to the participants); 6.3 (SD = 3.2) on item 2 (how confident they felt that the group would reduce their ASD related problems; 7.9 (SD = 3.2) on item 3 (how confident they would be in recommending this kind of group to a friend with ASD); 8.0 (SD = 2.7) on item 4 (how successful the participants thought that the treatment would be for other diagnoses); and 6.4 (SD = 3.1) on item 5 (how much improved they expected to become with this treatment).

Primary outcomes

Stress and quality of life. As presented in detail in Table 3, the results of the rmANOVA showed a statistically significant interaction effect in favor of the NeuroACT group compared to the TAU group on perceived stress (PSS), with a moderate effect size. Contrast analyses showed a statistically significant reduction in perceived stress from T1 to T2 but not from T2 to T3. The results showed a statistically significant interaction effect, with moderate effect size, in favor of the NeuroACT group compared to TAU on one quality of life measure (SWLS), but not the second quality of life instrument (QOLI). Contrast analyses showed a group-by-time statistical trend in improved quality of life (SWLS) from T1 to T2 and from T2 to T3 in the NeuroACT group compared to the TAU group. No group-by-time statistical trend was observed in the QOLI.

Secondary outcomes

Psychiatric symptoms and functional impairment. As shown in Table 3, sleep quality (KSQ-S) was statistically significantly improved from T1 to T2, with a moderate effect size, and a statistical trend was found for improved overall sleep quality in the treatment group compared to the TAU group. Kruskal-Wallis tests showed a group-by-time statistical trend for reduced depressive symptoms (BDI) from T1 to T2 in the treatment group compared to the TAU group ($\chi 2_{(1, N = 32)} = 3.61$, $p = .057$). No statistically significant change or statistical trend was observed between the two groups in anxiety (BAI), breathing problems (KSQ-Breathing Index), fatigue during daytime (KSQ-Fatigue Index), or awakening difficulties (KSQ-A). Wilcoxon Signed-rank tests analyzing the two groups, respectively, showed statistically significantly reduced depressive symptoms from T1 to T2, in the treatment group ($Z_{(1, N = 16)} = -2.82$, $p = .005$) but not the TAU group ($Z_{(1, N = 16)} = -1.31$, $p = .191$). No significant change was found in depressive symptoms from T2 to T3, in neither the treatment group ($Z_{(1, N = 16)} = -.53$, $p = .593$) nor the TAU group ($Z_{(1, N = 16)} = -1.05$, $p = .295$). A statistical trend for reduced anxiety was found from T1 to T2, in both the treatment group ($Z_{(1, N = 16)} = -1.82$, $p = .068$) and the TAU group ($Z_{(1, N = 16)} = -1.79$, $p = .073$). There was no significant change in anxiety symptoms from T2 to T3, in neither the

treatment group ($Z_{(1, N = 16)}$ = -.59, p = .556) nor the TAU group ($Z_{(1, N = 16)}$ = -.93, p = .355). The results showed no statistically significant interaction effect or statistical trend on the measure of functional impairment (SDS).

Table 3. Means, standard deviations, statistical significance, and effect sizes between groups for stress, quality of life, sleep problems, and functional impairment at pre, post, and 6-month follow-up.

	n	Pre	Post	6-mo	Group-by-time interaction effect (within-subjects)		Pre-post	Post-6-mo
Measure	NeuroACT = 16 TAU = 18	M (SD)	M (SD)	M (SD)	*ANOVA*	*d*	*d*	*d*
PSS	NeuroACT	35.8 (7.5)	24.9 (8.4)	22.6 (8.1)	F (2, 64) = 4.60	.76*	*1.02***	.40
	TAU	34.2 (7.7)	32.3 (8.6)	28.8 (8.1)				
SWLS	NeuroACT	14.3 (5.1)	18.7 (5.9)	20.3 (5.6)	F (2, 64) = 3.85	.77*	.69†	.71†
	TAU	14.4 (4.9)	15.4 (6.2)	16.4 (5.7)				
QOLI	NeuroACT	.70 (1.6)	1.67 (1.4)	1.41 (1.7)	F (2, 64) = 1.35	.41	.50	.26
	TAU	-.21 (1.5)	.12 (1.9)	.44 (1.7)				
KSQ-S	NeuroACT	10.8 (6.6)	7.7 (6.6)	6.9 (5.1)	F (2, 64) = 3.12	.63†	.78*	.11
	TAU	9.2 (6.5)	9.8 (5.5)	7.5 (5.0)				
KSQ-A	NeuroACT	7.8 (4.4)	7.4 (4.5)	5.7 (5.1)	F (2, 64) = .57	.26	.19	.37
	TAU	7.3 (4.6)	7.8 (4.5)	6.7 (3.8)				
SDS	NeuroACT	17.6 (6.1)	14.6 (4.9)	15.1 (7.3)	F (2, 64) = 1.47	.43	.59	.09
	TAU	19.4 (6.5)	19.7 (5.4)	19.1 (5.9)				

Note. PSS = Perceived Stress Scale; SWLS = Satisfaction with Life Scale; QOLI = Quality of Life Inventory; BDI-II = Beck Depression Inventory-II; KSQ-S = Karolinska Sleep Questionnaire – Sleep quality Index; KSQ-A = Karolinska Sleep Questionnaire – Awakening Index; SDS = Sheehan Disability Scale. Effect size measured by Cohen's *d* (0.2 = small; 0.5 = moderate; 0.8 = large).

* p < .05. ** p < .01. † non-significant trend

Psychological inflexibility, cognitive fusion, and cognitive and behavioral avoidance. As shown in Table 4, statistically significant interaction effects were found in measures of psychological inflexibility (AAQ), cognitive fusion (CFQ), and cognitive and behavioral avoidance (CBAS), with moderate to large effect sizes, in the NeuroACT group compared the TAU group. Contrast analyses showed that significant improvements occurred from T1 to T2 in all measures and that a statistical trend was observed for psychological inflexibility from T2 to T3.

Table 4. Means, standard deviations, statistical significance, and effect sizes between groups for ACT-related measures at pre, post, and 6-month follow-up.

	n	Pre	Post	6-mo	Group-by-time interaction effect (within-subjects)		Pre-post	Post-6-mo
Measure	NeuroACT = 16 TAU = 18	M (SD)	M (SD)	M (SD)	*ANOVA*	*d*	*d*	*d*
AAQ	NeuroACT	30.4 (11.0)	23.9 (9.4)	21.6 (9.1)	F (2, 64) = 3.91	.70*	.79*	.61†
	TAU	30.4 (9.5)	29.8 (9.9)	28.7 (8.5)				
CFQ	NeuroACT	33.5 (11.4)	25.0 (9.4)	24.3 (8.0)	F (2, 64) = 5.32	.82**	1.07**	.35
	TAU	31.0 (9.2)	31.6 (9.9)	28.7 (8.8)				
CBAS	NeuroACT	82.1 (21.1)	67.0 (19.6)	65.3 (22.1)	F (2, 64) = 6.44	.90**	1.24**	.41
	TAU	80.7 (15.4)	86.5 (18.0)	80.7 (16.0)				

Note. AAQ = Acceptance and Action Questionnaire – 7 items; CFQ = Cognitive Fusion Questionnaire – 7 items; CBAS = The Cognitive-Behavioral Avoidance Scale. Effect size measured by Cohen's *d* (0.2 = small; 0.5 = moderate; 0.8 = large).

* $p < .05$. ** $p < .01$. † non-significant trend

Autistic core challenges. As shown in Table 5, statistically significant interaction effects or trends were found in measures of overall autistic core challenges (SRS total score), autistic mannerism (SRS-AM), and social motivation (SRS-M) at post-assessments (T2, T3) compared to T1, with moderate effect sizes, in the NeuroACT group compared to the TAU group. However, no statistically significant interaction effects or statistical trends were found for social awareness (SRS-A), social cognition (SRS-SC), communication (SRS-C), or executive difficulties (DEX). Where statistically significant changes or statistical trends were found, contrast analyses showed the improvements to occur from T1 to T2, except in overall autistic core challenges (SRS total score) and autistic mannerism (SRS-AM) where changes occurred from T2 to T3 and social motivation (SRS-M) where changes were equally distributed between T1 and T2 compared to T2 and T3.

Table 5. Means, standard deviations, statistical significance, and effect sizes between groups for autistic core challenges and executive difficulties at pre, post, and 6-month follow-up.

	n	Pre	Post	6-mo	Group-by-time interaction effect (within-subjects)		Pre-post	Post-6-mo
Measure	NeuroACT = 16 TAU = 18	M (SD)	M (SD)	M (SD)	*ANOVA*	*d*	*d*	*d*
SRS	NeuroACT	89.5 (28.1)	80.4 (22.7)	70.0 (28.7)	F (2, 64) = 2.55	.57†	.43	.62†
	TAU	88.6 (20.0)	86.1 (15.7)	83.5 (16.7)				
SRS-AM	NeuroACT	15.8 (7.4)	12.1 (5.7)	10.6 (6.0)	F (2, 64) = 3.93	.70*	.64†	.75*
	TAU	15.6 (6.2)	14.8 (6.0)	15.1 (5.2)				
SRS-M	NeuroACT	17.9 (6.0)	14.8 (4.7)	12.5 (6.6)	F (2, 64) = 2.92	.61†	.61†	.60†
	TAU	17.8 (5.4)	17.5 (4.3)	16.4 (3.8)				
SRS-A	NeuroACT	10.1 (3.9)	9.9 (3.2)	8.9 (3.0)	F (2, 64) = .14	.13	.01	.16
	TAU	9.6 (3.0)	9.2 (3.0)	8.8 (3.0)				
SRS-SC	NeuroACT	16.6 (4.6)	16.5 (6.9)	14.7 (6.5)	F (2, 64) = .94	.35	.00	.46
	TAU	15.9 (4.2)	15.7 (3.6)	15.7 (4.5)				
SRS-C	NeuroACT	29.1 (10.2)	27.1 (7.8)	23.3 (11.4)	F (2, 64) = 1.27	.40	.19	.49
	TAU	29.7 (7.0)	28.8 (6.4)	27.6 (6.6)				
DEX	NeuroACT	37.8 (11.5)	31.6 (11.7)	28.2 (8.6)	F (2, 64) = 2.04	.51	.41	.43
	TAU	37.3 (9.9)	36.8 (11.4)	34.1 (8.4)				

Note. SRS = Social Responsiveness Scale – total score; SRS-AM = Social Responsiveness Scale – Autistic mannerism; SRS-M = Social Responsiveness Scale – Motivation; SRS-A = Social responsiveness Scale – Social Awareness; SRS-SC = Social Responsiveness Scale – Social Cognition; SRS-C = Social Responsiveness Scale – Communication; DEX = Dysexecutive Questionnaire - Self report. Effect size measured by Cohen's *d* (0.2 = small; 0.5 = moderate; 0.8 = large).

* $p < .05$. ** $p < .01$. † non-significant trend

Clinically significant change. As shown in Table 6, the clinically significant change scores differed between the NeuroACT and the TAU group. The NeuroACT group showed about twice as many participants recovering from stress (PSS) and about three times more that had a clinically significant improvement, compared to the TAU group. Regarding quality of life (SWLS), about three times as many participants showed recovery while a clinically significant improvement was observed with a 4/0-ratio, in the NeuroACT group compared to the TAU group. Reversely, more participants showed no clinically significant improvement in the TAU group compared to the NeuroACT group.

Table 6. Clinically significant change of the PSS and the SWLS (primary outcomes) against NeuroACT versus TAU from T1 to T3.

Classification	**PSS**		**SWLS**	
	NeuroACT (*n* = 16)	TAU (*n* = 18)	NeuroACT (*n* = 16)	TAU (*n* = 18)
	n (%)	*n* (%)	*n* (%)	*n* (%)
Recovered	8 (50 %)	5 (28 %)	6 (38 %)	2 (11 %)
Improved	6 (38 %)	2 (11 %)	4 (25 %)	0 (0 %)
Unimproved	2 (13 %)	7 (39 %)	7 (44 %)	13 (72 %)

Note. Recovered = Clinically significant change - below or above cut-off score; Improved = Clinically significant change - 2 standard deviations below or above the group mean; Unimproved = Failed to change 2 standard deviations from group mean.

Discussion

The current randomized controlled pilot study evaluated the feasibility and preliminary effectiveness of an adapted ACT group protocol (NeuroACT) for autistic adults in a psychiatric outpatient setting. Results indicated overall good treatment feasibility, where the vast majority of the participants completed the treatment alongside high treatment credibility ratings and satisfactory measurement fulfillment. Analyses of effects showed statistically significantly improved primary outcomes of perceived stress and quality of life, with moderate effect sizes, in the NeuroACT group compared to the TAU group. In the secondary outcomes, sleep quality, cognitive and behavioral avoidance, psychological inflexibility, cognitive fusion, and autistic mannerism were statistically significant, and statistical trends were found for depression, overall autistic core challenges, and social motivation, with moderate to large effect sizes, in the NeuroACT group compared to TAU. Reduced anxiety was observed in both groups. Moreover, clinically significant changes were observed in favor of the NeuroACT group compared to the TAU group. However, no statistically significant change or statistical trends were observed between the two groups in anxiety, breathing problems, fatigue during daytime, awakening difficulties, the second quality of life measure, functional impairment, social awareness, social cognition, communication, or executive difficulties. Further, dropout rates were slightly higher in the NeuroACT group compared to the TAU group. Where significant changes or statistical trends were found, effect sizes ranged from moderate to large. The largest effect sizes were noticed in perceived stress, cognitive and behavioral avoidance, and cognitive fusion (Cohen's d = 1.02-1.24). Improvements occurred from T1 to T2, except in overall autistic core challenges and autistic mannerism, where changes occurred from T2 to T3, alongside quality of life and social motivation where changes were equally distributed between T1 and T2 compared to T2 and T3. Overall, the results suggest that NeuroACT is a promising treatment for autistic adults and that further larger evaluations are warranted.

To our knowledge, this is the first RCT to stipulate that autistic adults with mental health problems and reduced quality of life could benefit from ACT. The improvements in several outcomes are in line with research on CBT and mindfulness practice for autistic adults, suggesting that psychological treatments could positively influence mental health and increase quality of life (Beck et al., 2020; Cachia et al., 2016; Weston, Hodgekins, & Langdon, 2016). ACT for autistic individuals is mainly based on mindfulness training from a functional analytic perspective (i.e., using mindfulness skills to overcome obstacles and pursue personally chosen values and goals). NeuroACT uses techniques and treatment content such as motivation, acceptance, cognitive defusion, and psychoeducation, with the overarching goal of creating psychological flexibility (Hayes, 2021). Enhancing psychological flexibility may be especially important in autistic individuals since insufficient emotion regulation skills alongside maladaptive behavioral avoidance are common problems that affect mental health negatively (Mazefsky, 2015). ACT skills help motivate participants to overcome obstructive thoughts, difficult emotions, and a lack of values clarity. In this study, the increased quality of life alongside reduced perceived stress, depression, and cognitive and behavioral avoidance, may thus indicate a broadening of the participants' behavior repertoire enhancing a sense of meaning in everyday life.

The overall significant interaction effect of the SWLS but not the QOLI, both measuring quality of life, may be associated with the more durable sub-areas of the QOLI, such as economic status, neighborhood well-being, and family-related concerns. The SWLS is a measure of subjective quality of life and sense of overall well-being, potentially reflecting a more general sense of meaning and purpose, compared to the QOLI. Replication studies and prolonged follow-up might further evaluate the eventual effects of using these instruments in autistic adults.

The improved sleep quality suggests that the NeuroACT treatment may have beneficial effects on sleep problems in autistic adults. Reduced sleep quality is common in both autistic children and adults and linked to mental health problems and even the severity of autistic core challenges (Carmassi et al., 2019; Díaz-Román, Zhang, Delorme, Beggiato, & Cortese, 2018; Morgan et al., 2020). The improved sleep quality found in the present study may reflect the general problem with multiple testing, increasing the risk of Type 1-error. However, the sleep questionnaires used in the present study represent different aspects of sleep problems, which may not be fully correlated and should therefore be analyzed separately. Furthermore, although not evaluated in autistic individuals, ACT has been indicated to improve sleep quality and insomnia in clinical samples (Salari et al., 2020). Sleep problems may exacerbate as an individual tries to control intrusive thoughts and negative emotions. In contrast, ACT teaches emotion regulation skills to let go of difficult thoughts and emotions thus decreasing unnecessary effort and tension. Moreover, ACT may increase motivation to improve sleep quality by attracting the individual to problematic thought patterns and unhelpful sleep environments (Zakiei et al., 2021).

While no significant changes were observed in social cognition, social awareness, or communication, improvements were found in autistic mannerism and social motivation. This result may

align with the NeuroACT program's overarching treatment goal of making social difficulties less of an obstacle for being active in social relationships, without training the social skills in themselves. Social skills training is often crucial in developing specific social behaviors (Choque Olsson et al., 2017). However, data from this study suggest that training skills to handle obstructive thoughts and fears of social situations may also be important. Therefore, future studies may further evaluate these two treatment approaches; social skills training, training skills to handle thoughts and emotions, or a combination of both.

Although promising, the current study has limitations. First, a small sample size reduces statistical power and increases the risk of type 2-error. Second, there might be a risk of type 1-error regarding the statistically significant efficacy measures, due to the vast number of measures included. However, several changes in the outcome measures align with previous research, suggesting that the results do not depend just on chance. Third, the outcome measures relied on participant self-report, and no objective or independent criteria were used, increasing the risk of over or underestimating individual progress. Forth, the study was conducted within a psychiatric outpatient clinic, so the generalizability outside of this setting may be limited. Fifth, the participants included in the study all had average or above-average intellectual capacity, so generalization of the results to autistic adults with lower intellectual capacity cannot be made.

Concluding remarks

Overall, the present study results indicate that the NeuroACT program may be a feasible and beneficial treatment option for autistic adults with comorbid perceived stress, depressive symptoms, poor sleep quality, and reduced quality of life. For future research, to increase the integrity of the results, large-scale studies with blinded assessments, control of treatment adherence and group aspects of the intervention, alongside qualitative feedback from participants are needed to further explore the potential benefits of NeuroACT in autistic adults. In addition, evaluation of the effect of potential mediators and moderators of change, such as sex, cognitive profile, psychological flexibility, behavioral avoidance, or adherence to homework assignments, is warranted.

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IV

An initial psychometric evaluation of Acceptance and Action Questionnaire (AAQ) and Cognitive Fusion Questionnaire (CFQ) in autistic adults

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Abstract

Psychological inflexibility and cognitive fusion are measured by Acceptance and Action Questionnaire (AAQ) and Cognitive Fusion Questionnaire (CFQ), although not psychometrically evaluated in autistic individuals. Construct validity and reliability were assessed in 54 adults (21-72 years) with autism spectrum disorder (ASD), using explorative factor analysis and Pearson's correlation coefficient. Both instruments showed one-factor solution, explaining 64% of AAQ variance (Cronbach's α = .92) and 67% of CFQ variance (Cronbach's α = .93). AAQ and CFQ correlated significantly with measures of psychiatric symptoms, quality of life, and autistic traits. AAQ and CFQ are preliminarily valid and reliable measures of psychological inflexibility and cognitive fusion in autistic adults. More extensive studies are needed to further evaluate these instruments in autistic adults.

Introduction

In contemporary psychology, psychological inflexibility (PI) and cognitive fusion (CF) are psychological constructs associated with suppressing thoughts and emotions hypothesized to maintain emotional distress and psychiatric symptoms, such as depression and anxiety (Faustino, Vasco, Farinha-Fernandes, & Delgado, 2021; Meyer et al., 2019; Peltz, Rogge, Bodenlos, Kingery, & Pigeon, 2020). These constructs are generally measured using the Action and Acceptance Questionnaire (AAQ) (Bond et al., 2011) and the Cognitive Fusion Questionnaire (CFQ) (Gillanders et al., 2013), which have shown good psychometric properties in the general population and clinical samples (Faulkner et al., 2021; Gillanders et al., 2013; Ong, Lee, Levin, & Twohig, 2019). Moreover, PI and CF appear to be more present in autistic adults than in the normal population, and accordingly, essential treatment evaluation targets using the AAQ and the CFQ (Maisel, Stephenson, Cox, & South, 2019; Pahnke et al., 2019). However, the scales' psychometric properties have not been evaluated in autistic individuals. Hence, the present study aimed to preliminarily assess the psychometric properties of the AAQ and the CFQ in autistic adults.

Autism spectrum disorder (ASD) is a neurodevelopmental condition present in at least 1.7% of adults (Idring et al., 2015). ASD is characterized by challenges in social interaction, repetitive and restricted behavior and interests, and sensory hyper- and hyposensitivity (APA, 2013; Lai, Lombardo, & Baron-Cohen, 2014). Executive dysfunction in ASD, such as attention shifting (i.e., cognitive inflexibility) and awareness of one's mind (i.e., meta-cognition), impairs the ability to cope with daily hassles and reach long-term goals (Uddin, 2021; Wallace et al., 2016). Moreover, ASD is associated with perceived stress (Bishop-Fitzpatrick, Minshew, Mazefsky, & Eack, 2017; Hirvikoski & Blomqvist, 2015), reduced quality of life (Bishop-Fitzpatrick, Mazefsky, & Eack, 2018; Park et al., 2019), and psychiatric comorbidity, with depression and anxiety being most common (Nah, Brewer, Young, & Flower, 2018). Psychological and pharmacological treatments enhance well-being and reduce distress in autistic individuals (Lai, Anagnostou, Wiznitzer, Allison, & Baron-Cohen, 2020). However, many rating scales used for treatment evaluation are not validated in autistic individuals (Howlin, 2021). Therefore, there is a need to develop and investigate rating scales' psychometric properties to draw valid conclusions regarding outcome effects and how those effects occur. In the present study, two standard instruments to assess treatment outcomes and psychological processes were thus evaluated psychometrically in autistic adults.

Common psychological treatments for comorbid psychiatric symptoms adapted for ASD are cognitive-behavior therapy (CBT) (Spain, Sin, Chalder, Murphy, & Happé, 2015), mindfulness-based stress reduction (MBSR) (Cachia, Anderson, & Moore, 2016), and acceptance and commitment therapy (ACT) (Pahnke et al., 2019; Pahnke, Lundgren, Hursti, & Hirvikoski, 2014). In these models, external and internal factors contribute to psychological distress (Assaz, Roche, Kanter, & Oshiro, 2018; Tarbox, Szabo, & Aclan, 2020). External factors refer to environmental cues, such as social expectations or

exteroceptive stressors (e.g., noise or smell) (Bishop-Fitzpatrick et al., 2017; Martínez et al., 2020; Proff, Williams, Quadt, & Garfinkel, 2021). Internal factors apply to cognitive and interoceptive elements, such as thoughts, memories, emotions, and body signals (Bednarz, Trapani, & Kana, 2020; DuBois, Ameis, Lai, Casanova, & Desarkar, 2016; Huggins, Donnan, Cameron, & Williams, 2020).

PI can be defined as avoiding events perceived as threatening or stressful, along with thoughts, emotions, and body sensations related to those events, hindering the individual from living a meaningful life (Hayes, Luoma, Bond, Masuda, & Lillis, 2006). Autistic individuals are more exposed to stressors due to social challenges, cognitive inflexibility, and sensory over-sensitivity, thus increasing the risk of avoidant behavior (Maisel et al., 2019; Noel, Lytle, Cascio, & Wallace, 2018; Pfaff & Barbas, 2019). In addition, avoidant behavior often serves the function of diminishing discomfort (Skinner, 1963). Paradoxically, however, avoiding may cause long-term distress and even worsen autistic core challenges (Ozsivadjian et al., 2021). Moreover, suppressing thoughts and emotions, or avoiding stressful situations, maybe more hindering for autistic individuals than the actual autistic core challenges (Cai, Richdale, Dissanayake, Trollor, & Uljarević, 2019).

CF constitutes an essential part of PI. Still, it adds the specific feature of *thought* suppression rather than trying to avoid emotions or body sensations (Villatte et al., 2016). A standard definition of CF is the inability to observe thoughts without necessarily believing their content or letting them guide one's actions (Gillanders et al., 2013). CF appears to be more extensive in ASD than in the general population (Maisel et al., 2019) and hypothetically related to the sparse self-awareness and theory of mind in ASD (Williams, 2010). Thoughts or mental rules (e.g., I'm odd' or 'I'm autistic, so I can't contact other people') are hypothesized to be associated with low self-confidence and behavioral avoidance in autistic individuals (Cooper, Smith, & Russell, 2017).

Furthermore, research indicates that practicing psychological flexibility and cognitive defusion (i.e., techniques opposed to PI and CF) may improve PI and CF in autistic adults (Maisel et al., 2019; Pahnke et al., 2019). It is thus paramount to investigate the construct validity and reliability of instruments measuring PI and CF in individuals with ASD. However, the questionnaires used to measure these processes, the AAQ and CFQ, have not been psychometrically evaluated in ASD. Hence, the current study aimed to assess the psychometric properties of the AAQ and CFQ in autistic adults.

Research aims and questions

The current study evaluated the psychometric properties of the AAQ and the CFQ in adults diagnosed with ASD. The evaluation targeted the instruments' component structure, internal consistency, and construct validity. The research questions were: (1) What is the component structure of the AAQ and the CFQ?, (2) What is the internal consistency of the AAQ and the CFQ?, and (3) What is the construct validity (convergent and divergent) of the AAQ and the CFQ?

Methods

Design

The current study was a cross-sectional evaluation of the psychometrical properties of AAQ and CFQ in adults with ASD.

Ethics

The analysis was performed using data from two other studies approved by the ethical review board of Stockholm, Sweden (2010-1122-31 and 2015-1005-31). The current and previous studies were performed following the Declaration of Helsinki (AMA, 2013).

Participants and study procedure

Fifty-four Swedish adults diagnosed with ASD were recruited in a psychiatric outpatient setting as part of two other studies (Pahnke et al., 2019; Pahnke et al., submitted manuscript). The two studies used a similar procedure. Data collection was conducted in 2010 (sample 1) and 2011-2012 (sample 2). The diagnostic evaluation followed local clinical guidelines and included a clinical interview by a psychiatrist and neuropsychological testing with WAIS-R (Wechsler, 1981) or WAIS-III (Wechsler, 1997), Conner's Continuous Performance Test (CPT-II) (Conners, 2000), and or Delis-Kaplan Executive Function System (D-KEFS) (Delis, 2001) by a psychologist. The participants completed standardized self-rating questionnaires, such as the Adult Autism Spectrum Quotient (AQ) (Baron-Cohen, Wheelwright, Skinner, Martin, & Clubley, 2001) and Wender Utah Rating Scale (WURS) (Ward, Wender, & Reimherr, 1993) to assess autistic symptoms and childhood ADHD-symptoms. Family members or significant others were interviewed to obtain a complete medical history. Information was obtained from child and adolescent psychiatry, school health services, or adult psychiatry when available. Demographic and clinical information was obtained from the participants' medical records, self-reports, and a questionnaire, covering demographic data (Hirvikoski, Lindholm, Nordenström, Nordström, & Lajic, 2009).

In the previous studies, participants were included if they fulfilled the inclusion and exclusion criteria. Inclusion criteria were: (a) a diagnosis of DSM-IV Asperger syndrome (i.e., equivalent to ASD without specified intellectual disability and language impairment in the fifth edition of the DSM) (APA, 2013); (b) 18 years of age or older; and (c) if on any psychoactive drug treatment (e.g., for ADHD), treatment should have been stable for at least three months. Exclusion criteria were: (a) substance abuse (during the last three months); (b) intellectual disability (intelligence quotient, IQ < 70); (c) organic brain injury; and (d) suicidality. Additionally, in the present study, participants were allegeable if they had completed all measurements. Participants included were 28 men and 26 women (21-72 years) with a mean age of 42 years (SD = 13). Demographic sample characteristics are presented in Table 1.

Table 1
Demographic and clinical characteristics of participants.

Characteristics	**Sample 1** (*n* = 9)	**Sample 2** (*n* = 45)	**Sample total** (*n* = 54)
	M (SD)	*M (SD)*	*M (SD)*
Age (years)	49 (13)	40 (12)	42 (13)
	n (%)	*n* (%)	*n* (%)
Gender, male	5 (57)	23 (51)	28 (52)
Education			
University/higher education	3 (33)	13 (29)	16 (30)
High school	5 (56)	24 (53)	29 (54)
Elementary school	1 (11)	6 (13)	7 (13)
Other	0 (0)	2 (4)	2 (<1)
Occupation			
Company owner/employee/student/parental leave	1 (11)	15 (33)	16 (30)
Part-time employee/temporary position	1 (11)	5 (11)	6 (11)
Pensioner	1 (11)	1 (2)	2 (<1)
Unemployed	0 (0)	7 (16)	7 (13)
Temporary disability pension/early retirement	4 (44)	9 (20)	13 (24)
Other	2 (22)	8 (18)	10 (19)
Psychiatric comorbidity			
ADHD/ADD	4 (44)	16 (36)	20 (37)
Depression, depressive episode NOS, dysthymia	5 (56)	10 (22)	15 (28)
Anxiety disorders	4 (44)	6 (13)	10 (19)
Other comorbidities (e.g., dyslexia; bipolarity)	3 (33)	12 (27)	15 (28)
Any psychiatric comorbidity	9 (100)	26 (58)	35 (65)
Medication			
Methylphenidate	4 (44)	13 (29)	17 (31)
Antidepressants	2 (22)	14 (31)	16 (30)
Sleep medication	1 (11)	10 (22)	11 (20)
Antihistamines	0 (0)	10 (22)	10 (19)
Other medication (e.g., anti-epileptics)	3 (33)	17 (38)	20 (37)
Any medication	7 (78)	32 (71)	39 (72)

Note. ADHD = attention-deficit hyperactivity disorder; ADD = attention-deficit disorder; NOS = not otherwise specified

Measures

The rating instruments used in the current study had previously been psychometrically evaluated in the general population and clinical samples, in English and some in Swedish. To ensure the integrity of the Swedish translations, the instruments were back-translated into English reviewed by an independent researcher. In addition, the measures were selected to capture convergent and divergent aspects of construct validity.

Psychological inflexibility

The Acceptance and Action Questionnaire (AAQ) (Bond et al., 2011) is a 7-item Likert scale (1 to 7) assessing PI, with higher scores indicating more PI. The AAQ has been evaluated in a Swedish normal population showing good concurrent and convergent validity, internal consistency (Cronbach's $\alpha = .85$), and test-retest reliability ($r = .80$) (Lundgren & Parling, 2017). Confirmatory factor analyses have suggested that the AAQ involves a single factor (Bond et al., 2011).

Cognitive fusion

The Cognitive Fusion Questionnaire (CFQ) (Gillanders et al., 2013) is a 7-item Likert scale (1 to 7) assessing CF, with higher scores indicating more CF. The CFQ has shown satisfying convergent and divergent validity with measures of mental health, social functioning, vitality, psychological acceptance, and good internal consistency (Cronbach's α = .87) in a clinical sample (McCracken, DaSilva, Skillicorn, & Doherty, 2014).

Cognitive and behavioral avoidance

The Cognitive-Behavioral Avoidance Scale (CBAS) (Ottenbreit & Dobson, 2004) is a 31-item 5-point Likert scale assessing cognitive and behavioral avoidance, with higher scores indicating more avoidance. The CBAS has demonstrated good convergent and divergent validity, test-retest reliability, and satisfying internal consistency (Cronbach's α = .95) in psychiatric samples (Barajas, Garra, & Ros, 2017; Ottenbreit & Dobson, 2004). In addition, the CBAS showed satisfying internal consistency in the current sample (Cronbach's α = .91).

Self-perceived stress

The Perceived Stress Scale 14 items (PSS) (Cohen, Kamarck, & Mermelstein, 1983) is a 14-item five-point Likert scale measuring self-perceived stress, with higher scores indicating more stress. A total score is calculated after reversing positive item scores. The PSS has shown good construct validity with anxiety (r = .68), depression (r = .57), and mental or physical exhaustion (r = .71) in a Swedish sample (Nordin & Nordin, 2013). Further, the PSS has demonstrated good internal consistency (Cronbach's α = .84) in a Swedish sample with stress-related disorders (Eklund, Bäckström, & Tuvesson, 2014) and in the current sample (Cronbach's α = .84).

Depressive symptoms

The Beck Depression Inventory-II (BDI-II) (Beck, Steer, & Brown, 1996) is a 21-item four-point Likert scale assessing subjective depressive symptoms, with higher scores indicating more depression. The BDI has shown good convergent validity with the Montgomery Asberg Depression Rating Scale (MADRS) (r = .72) (Lahlou-Laforêt, Ledru, Niarra, & Consoli, 2015). In addition, the BDI demonstrated good internal consistency (Cronbach's α = .89) in a Swedish sample (Kjærgaard, Arfwedson Wang, Waterloo, & Jorde, 2014) and satisfying internal consistency in the current sample (Cronbach's α = .93).

Anxiety symptoms

The Beck Anxiety Inventory (BAI) (Beck, Epstein, Brown, & Steer, 1988) is a 21-item four-point Likert scale assessing subjective anxiety symptoms, with higher scores indicating more anxiety. The BAI has shown good test-retest-reliability and satisfying internal consistency (Cronbach's α = .91) in a clinical

sample (r = .84) (Vázquez-Morejón, Zanin, & Bellido, 2014), and satisfying internal consistency in the current sample (Cronbach's α = .95).

Quality of life

The Satisfaction With Life Scale (SWLS) (Diener, 1985) is a five-item seven-point Likert scale assessing perceived quality of life, with higher scores indicating more quality of life. Satisfying convergent validity with social support has been observed (*r* = .39) for the SWLS and the Oslo Social Support Scale (Glaesmer, Grande, Braehler, & Roth, 2011). Further, the SWLS has demonstrated good internal consistency (Cronbach's α = .88) in a X sample (Hultell & Gustavsson, 2008) and in the current sample (Cronbach's α = .80).

Autistic core challenges

The Social Responsiveness Scale (SRS) (Constantino, 2002) is a 65-item four-point Likert measuring autistic core challenges, with higher scores indicating more autistic symptoms. The scale results in a total score and five subscale scores (Social motivation; Social cognition; Social awareness; Social communication; Autistic mannerism). The SRS has shown good concurrent, predictive, convergent, and discriminative validity with a sensitivity of .85 and a specificity of .83 for ASD (Bolte, 2012; Chan, Smith, Hong, Greenberg, & Mailick, 2017). In addition, the current sample showed satisfying internal consistency (Cronbach's α = .93).

Statistical analyses

Data analysis was performed using SPSS version 27.0. Data were initially screened for missing values and outliers, and normality was assessed in skewness and kurtosis. Mean value imputation was used to deal with missing items. Exploratory factor analysis, using maximum likelihood as the factor extraction method and parallel analysis to decide upon the number of factors for each scale, were performed to analyze the component structure of the AAQ and the CFQ. Cronbach's alpha was used to assess internal consistency. The interpretations of Cronbach's alpha were α ≥ .70 = satisfying, α ≥ .80 = good, and α ≥ .90 = satisfying, where a too low or high alpha value may indicate insufficient reliability (Taber, 2018). Pearson's correlation coefficient was used to investigate the instruments' construct validity, divided into convergent and divergent validity. In the case of non-normal distributions, Spearman's correlation coefficient was performed. The CFQ and AAQ consist of 7 items, making the total N of 54 low but an adequate number of participants for psychometric evaluations (Costello & Osborne, 2005; Mundfrom, Shaw, & Ke, 2005). According to Costello and Osborne (2005), a small sample can be acceptable if an instrument shows robust data (i.e., uniformly high communalities without cross-loadings and one-factor solution). The construct validity of the AAQ and the CFQ was evaluated by correlating the scales with one another and with other measures, that is, the PSS (Cohen et al., 1983), the BDI (Beck, Ward,

Mendelson, Mock, & Erbaugh, 1961), the BAI (Beck, Epstein, Brown, & Steer, 1988), the SWLS (Diener, 1985), the CBAS (Ottenbreit & Dobson, 2004), and the SRS (Constantino, 2002).

Results

As presented in Table 1, the overall homogeneity between the two samples was satisfactory. However, sample 1 showed a slightly higher age on average and more psychiatric comorbidity, whereas sample 2 had a higher education level. Skewness and kurtosis of AAQs and CFQs items and total scores, and all other instruments' total scores, were acceptable (skewness = +-0.01-1.26; kurtosis = +-0.01-1.64) (Field, 2009). Parallel analysis indicated a one-factor solution for AAQ and CFQ, respectively. As shown in Table 2, the one-factor solution of the AAQ explained 64 % of the total variance, and Cronbach's alpha was .92, with a mean of 29.26 (*SD* = 11.09). Factor loadings based on maximum likelihood varied from .68 to .88 for the AAQ.

Table 2
Factor loadings of the AAQ from maximum likelihood extraction, total scale mean, standard deviation, and Cronbach's alpha (*n* = 54).

AAQ Items	Factor Loadings
1. My painful experiences and memories make it difficult for me to live a life that I would value.	.77
2. I'm afraid of my feelings.	.86
3. I worry about not being able to control my worries and feelings.	.87
4. My painful memories prevent me from having a fulfilling life.	.79
5. Emotions cause problems in my life.	.72
6. It seems like most people are handling their lives better than I am.	.68
7. Worries get in the way of my success	.88
Percent explained variance	64
Scale mean	29.26
Scale SD	11.09
Cronbach's α for scale	.92

Note. AAQ = Acceptance and Action Questionnaire – 7 items

As presented in Table 3, the one-factor solution of the CFQ explained 67 % of the total variance, and Cronbach's alpha was .93, with a mean of 31.00 (*SD* = 10.34). Factor loadings based on maximum likelihood varied from .74 to .87 for the CFQ.

Table 3
Factor loadings of the CFQ from maximum likelihood extraction, mean, standard deviation, and Cronbach's alpha (n = 54).

CFQ Items	Factor Loadings
1. My thoughts cause me distress or emotional pain	.86
2. I get so caught up in my thoughts that I am unable to do the things that I most want to do	.74
3. I over-analyze situations to the point where it's unhelpful to me	.75
4. I struggle with my thoughts	.86
5. I get upset with myself for having certain thoughts	.82
6. I tend to get very entangled in my thoughts	.87
7. It's such a struggle to let go of upsetting thoughts even when I know that letting go would be helpful	.84
Percent explained variance	67
Scale mean	31.00
Scale *SD*	10.34
Cronbach's α for scale	.93

CFQ = CF Questionnaire – 7 items

As shown in Table 4, statistically significant and high positive correlations between the AAQ and the CFQ, and most other measures, were found. As expected, the AAQ and the CFQ correlated positively with perceived stress (PSS), depression (BDI), anxiety (BAI), and overall autistic challenges (SRS), providing support for convergent validity. Moreover, a statistically significant negative correlation was observed between the AAQ and the CFQ, respectively, and the Satisfaction With Life Scale (SWLS), indicating support for divergent validity. Correlations between the AAQ and the CFQ, respectively, and the Social Responsiveness Scale – Social Awareness subscale (SRS-A) were non-significant, indicating no relationship between PI and CF and social awareness.

Table 4
Correlations between AAQ and CFQ, and other measures.

Measure	*N*	AAQ	CFQ
AAQ	54		.63**
CFQ	54	.63**	
PSS	54	.59**	.60**
BDI	54	.73**	.54**
BAI	54	.59**	.47**
SWLS	54	-.63**	-.54**
CBAS	45	.62**	.38**
SRS	45	.60**	.54**
SRS-AM	45	.63**	.61**
SRS-M	45	.69**	.54**
SRS-A	45	.04	.09
SRS-SC	45	.66**	.62**
SRS-C	45	.57**	.53**

Note. AAQ = Acceptance and Action Questionnaire – 7 items; CFQ = CF Questionnaire – 7 items; PSS = Perceived Stress Scale; BDI = Beck Depression Inventory-II; BAI = Beck Anxiety Inventory-II; CBAS = The Cognitive-Behavioral Avoidance Scale; SWLS = Satisfaction With Life Scale; SRS = Social Responsiveness Scale – total score; SRS-AM = Social Responsiveness Scale – Autistic mannerism; SRS-M = Social Responsiveness Scale – Motivation; SRS-A = Social responsiveness Scale – Social Awareness; SRS-SC = Social Responsiveness Scale – Social Cognition; SRS-C = Social Responsiveness Scale – Communication.

* $p < .05$. ** $p < .01$.

Discussion

The present study evaluated the psychometric properties of two instruments measuring PI (AAQ) and CF (CFQ) in adults with ASD. The instruments' internal consistency was satisfactory, and parallel analysis indicated a one-factor solution for both scales. Subsequent factor analyses showed acceptable factor loadings for all items. In addition, support for convergent validity was provided in terms of a positive correlation between PI and CF and measures of psychiatric symptoms and overall autistic challenges. On the other hand, support for divergent validity was observed in a negative correlation between PI and CF and quality of life.

Based on the data presented in this study, our findings support the usage of the *original* measures of PI and CF in autistic adults, that is, the AAQ and the CFQ. The instruments appear to be psychometrically reliable *general* PI and CF measures in autistic adults. However, limitations in item sensitivity, divergent validity, and measurement invariance across samples have been noted (Ong, Pierce, Woods, Twohig, & Levin, 2018; Tyndall et al., 2019; Wolgast, 2014). A review by Ong, Lee, Levin, and Twohig (2019) proposes advantages of *context-specific* measures (i.e., adapted to a specific problem or population), such as sensitivity to population-specific difficulties, measurement specificity, and better prediction of treatment outcomes. Therefore, since contextual insensitivity (i.e., impaired ability to use contextual cues in sense-making) is reasonably well-documented (Vermeulen, 2015; Westby, 2017), it may be essential to adopt these measures to ASD-specific areas. Furthermore, a comparison analysis (e.g., using qualitative interviews alongside psychometrics evaluations) between general and context-specific versions of the AAQ and the CFQ in autistic individuals would potentially give different results. Adapting the scales into ASD-specific areas of concern may thus further improve the scales' psychometric properties.

The present study's results showed a strong association between PI and depression in autistic adults, suggesting that PI changes predict changes in depressive symptoms. However, it has been questioned if AAQ discriminates between process and outcome (Chawla & Ostafin, 2007; Wolgast, 2014) and whether it measures overall negative affect rather than PI (Allen, 2021; Rochefort, Baldwin, & Chmielewski, 2018). The weaker association between the CFQ and other measures may indicate that the CFQ imbricates to a lesser degree with overall negative affect than the AAQ.

The non-significant and sparse correlation between PI and CF and social awareness (Constantino, 2002) may suggest that social awareness does not merely reflect the ability to defuse one's thoughts (as in cognitive defusion) or act in line with one's values (as in psychological flexibility). No previous studies have explicitly related social awareness to PI and CF. However, the present study's results are consistent with our research on acceptance and commitment therapy for autistic adults, where training psychological flexibility and cognitive defusion skills did not improve social awareness but mental health and quality of life (Pahnke et al., submitted manuscript).

To the best of the authors' knowledge, this study is the first to evaluate the psychometric properties of the AAQ and the CFQ in autistic adults. Although promising, the study's limitations include a small sample size, increasing the risk of erroneous findings, and requiring more caution when interpreting the results. However, according to Costello and Osborne (2005), the current study's subject to item ratio of about 8:1 falls within an appropriate range. Furthermore, all scale items of both scales were normally distributed and highly correlated to each scale's construct. Another general limitation is self-report assessment, implicating a risk of information bias, primarily since there are no previous evaluations of the AAQ and the CFQ in autistic individuals. Furthermore, to ensure the integrity of the results, sensitivity analyses (i.e., how changes in methods, models, or values affect the results) would provide more detailed information on the robustness of the factor analysis used in the present study. Finally, more extensive studies using confirmatory factor analysis, item response analysis, and ASD adapted instruments may further enhance the validity and reliability of the AAQ and the CFQ in autistic adults.

Concluding remarks

This initial psychometric evaluation of the AAQ and the CFQ in adults with ASD found these scales to have a robust factor structure and internal consistency and an overall reasonably solid construct validity against relevant psychiatric, quality of life, and autism-related instruments. Therefore, the results from this study suggest that the AAQ and CFQ are valid and reliable to use when working with autistic adults.

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