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

Johan Pahnke

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Cover image: *Pals* by Wil C. Kerner (at age 12), published in Drawing Autism (2014). The key in understanding *Pals* (by his grandmother) is the brown-rimmed, off-white donkey ear. Four facial expressions depict the bad boys turning into donkeys in the movie *Pinocchio*: purple-faced Pinocchio is stunned by his new ear and considering what to do; it’s too late for the horrified yellow face; the green trapezoid is oblivious to his pending fate; the blue head is looking away, hoping he’s not included. 
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ACCEPTANCE AND COMMITMENT THERAPY FOR AUTISM SPECTRUM DISORDER

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

THESIS FOR DOCTORAL DEGREE (Ph.D.)

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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
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 a 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 ($\alpha = .92$) and 67% of CFQ variance ($\alpha = .93$). 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


## Abbreviations

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

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

<table>
<thead>
<tr>
<th>A. Persistent deficits in social communication and social interaction across multiple contexts, as manifested by the following, currently or by history.</th>
<th>B. Restricted, repetitive patterns of behavior, interests, or activities, as manifested by at least two of the following, currently or by history.</th>
</tr>
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<tbody>
<tr>
<td>1. <strong>Deficits in social-emotional reciprocity</strong>, 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.</td>
<td>1. <strong>Stereotyped or repetitive motor movements, use of objects, or speech</strong> (e.g., simple motor stereotypes, lining up toys or flipping objects, echolalia, idiosyncratic phrases).</td>
</tr>
<tr>
<td>2. <strong>Deficits in nonverbal communicative behaviors used for social interaction</strong>, 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.</td>
<td>2. <strong>Insistence on sameness, inflexible adherence to routines, or ritualized patterns of verbal or nonverbal behavior</strong> (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).</td>
</tr>
<tr>
<td>3. <strong>Deficits in developing, maintaining, and understand relationships</strong>, 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.</td>
<td>3. <strong>Highly restricted, fixated interests that are abnormal in intensity or focus</strong> (e.g., strong attachment to or preoccupation with unusual objects, excessively circumscribed or perseverative interests).</td>
</tr>
<tr>
<td>- Categorized in three levels depending on severity and level of functioning.</td>
<td>4. <strong>Hyper- or hyporeactivity to sensory input or unusual interest in sensory aspects of the environment</strong> (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).</td>
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#### 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, McSheeters, & 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, & Santarneccchi, 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
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 overlapping 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-contextual approach regarding (1) truth criterion, (2) identity, (3) treatment objective, and (4) treatment focus (Hayes, Villatte, Levin, & Hildebrandt, 2011).

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

*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.
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 stimuli's 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.

<table>
<thead>
<tr>
<th>NeuroACT</th>
<th>Autism</th>
</tr>
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<tbody>
<tr>
<td>Values to motivate behavior change and self-determination</td>
<td>Preference for sameness, perseveration in problem solving, and prediction deficit</td>
</tr>
<tr>
<td>Explicit behavior-goals</td>
<td>Rituals and cognitive inflexibility</td>
</tr>
<tr>
<td>Adaptive and long-term contingencies</td>
<td>Rule-governed behaviors and pragmatic deficits</td>
</tr>
<tr>
<td>Psychoeduction of biological predisposition, stress, emotions, exteroception, and interoception</td>
<td>Exteroceptive hypersensitivity and reduced comprehension of self-regulation</td>
</tr>
<tr>
<td>Non-evaluative and non-judging approach to experiences</td>
<td>Emotional distress, physical reactivity, and perceived stress</td>
</tr>
<tr>
<td>Experiential openness to sensory input, emotions, thoughts, and physical sensations</td>
<td>Aversion to uncertainty and changes</td>
</tr>
<tr>
<td>Being present, contact with direct contingencies, consciousness as a process, and body awareness</td>
<td>Interoceptive hypo-sensitivity, reduced body-awareness, and alexithymia</td>
</tr>
<tr>
<td>Perspective taking on thoughts, emotions, body sensations, and self-awareness</td>
<td>Deficits in awareness of self and others, literality, intellectualization, and contextual blindness</td>
</tr>
<tr>
<td>Cognitive defusion and transformation of stimulus function of private events</td>
<td>Cognitive fusion and unhelpful self-perception</td>
</tr>
</tbody>
</table>

**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, Mehlng, & 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 outweigh 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, Schaeer, & 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.

![Case study diagram](image)

**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).](image)

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.
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 $\alpha = .81–.87$) (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 $\alpha = .70–.76$), except for behavior problems (Cronbach's $\alpha = .52–.54$) (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 ($\eta^2$) 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).

<table>
<thead>
<tr>
<th>Occupation</th>
<th>n</th>
<th>Relationship</th>
<th>n</th>
<th>Housing</th>
<th>n</th>
<th>Social network</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sick leave</td>
<td>5</td>
<td>Single</td>
<td>7</td>
<td>Single household</td>
<td>6</td>
<td>Friends &gt; 1/t/month</td>
<td>6</td>
</tr>
<tr>
<td>Daily activities</td>
<td>2</td>
<td>Divorced</td>
<td>3</td>
<td>With children</td>
<td>2</td>
<td>Friends &gt; 1/t/week</td>
<td>2</td>
</tr>
<tr>
<td>Full time work</td>
<td>1</td>
<td>Children</td>
<td>3</td>
<td>With parents</td>
<td>1</td>
<td>No friends</td>
<td>2</td>
</tr>
<tr>
<td>Part time</td>
<td>1</td>
<td></td>
<td></td>
<td>Special accommodation</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Full time pension</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: t = number of occasions.
Table 4. Clinical characteristics of the participants (n = 10).

<table>
<thead>
<tr>
<th>Comorbidity Lifetime</th>
<th>n</th>
<th>On-going</th>
<th>n</th>
<th>NDD</th>
<th>n</th>
<th>On-going pharmacotherapy</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depression</td>
<td>1</td>
<td>Dysthymia</td>
<td>1</td>
<td>ADH D Tourette's syndrome</td>
<td>5</td>
<td>SSRIs</td>
<td>3</td>
</tr>
<tr>
<td>GAD</td>
<td>2</td>
<td>GAD</td>
<td>1</td>
<td>OCD</td>
<td>1</td>
<td>Methylphenidates</td>
<td>3</td>
</tr>
<tr>
<td>OCD</td>
<td>1</td>
<td>OCD</td>
<td>1</td>
<td>Epilepsy</td>
<td>1</td>
<td>Sleep medication</td>
<td>1</td>
</tr>
<tr>
<td>Social phobia</td>
<td>1</td>
<td>Social phobia</td>
<td>1</td>
<td>PD-NOS</td>
<td>1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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 $\alpha = .84$ (Eklund, Bäckström, & Tuveson, 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 $\alpha = .88$) 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 $\alpha = .89$) are observed in a Swedish sample (Lahlou-Laforêt, Ledru, Niarra, & Consoli, 2015). The BDI demonstrates good internal consistency (Cronbach's $\alpha = .89$) 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 $\alpha = .91$) 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 $\alpha = .89$) (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 $\alpha = .85$) 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 $\alpha = .93$) (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.
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.
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 $\alpha = .91$), and good test-retest-reliability ($r = .84$) have been reported (Vázquez-Morejón et al., 2014). The current sample showed satisfactory internal consistency (Cronbach's $\alpha = .95$).

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 $\alpha = .91$).

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 $\alpha = .79$).

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 $\alpha = .85$) and test-retest reliability ($r = .80$). The current sample showed satisfactory internal consistency (Cronbach's $\alpha = .92$).

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 $\alpha = .93$) (Ruiz et al., 2017) and in the present sample (Cronbach's $\alpha = .93$).

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 $\alpha = .95$) in psychiatric samples (Barajas, Garra, & Ros, 2017). In addition, the current sample showed good internal consistency (Cronbach's $\alpha = .89$).

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 α = .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 α = .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 α = .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 ≤ 0.05 for statistical significance and at p ≤ 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 α = .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 $\alpha = .87$) 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 $\alpha = .95$) in psychiatric samples (Barajas et al., 2017; Ottenbreit & Dobson, 2004). In addition, the CBAS showed satisfying internal consistency in the current sample (Cronbach's $\alpha = .91$).

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 $\alpha = .84$) in a Swedish sample with stress-related disorders (Eklund et al., 2014) and in the current sample (Cronbach's $\alpha = .84$).

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 $\alpha = .89$) in a Swedish sample (Kjærgaard et al., 2014) and satisfying internal consistency in the current sample (Cronbach's $\alpha = .93$).

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 $\alpha = .91$) in a clinical sample ($r = .84$) (Vázquez-Morejón et al., 2014), and satisfying internal consistency in the current sample (Cronbach's $\alpha = .95$).

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 $\alpha = .88$) in a Swedish sample (Hultell & Gustavsson, 2008) and in the current sample (Cronbach's $\alpha = .80$).

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.
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).

<table>
<thead>
<tr>
<th>NeuroACT Treatment Component and Adaptation</th>
<th>NeuroACT Treatment Component and Adaptation</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Acceptance of thoughts, feelings, and body sensations using acceptance exercises.</td>
<td>- Illustration of the avoidance trap.</td>
</tr>
<tr>
<td>- Self as context, using mindfulness exercises (i.e., developing the ability to take different perspectives on one’s thoughts, emotions, and body sensations).</td>
<td>- 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).</td>
</tr>
<tr>
<td>- Worksheets connecting values to behavior goals.</td>
<td>- Application of behavior strategies and mindfulness and acceptance techniques in stressful situations.</td>
</tr>
<tr>
<td>- Identification of obstacles to carry out value-based behaviors.</td>
<td>- Small groups (4–6 participants).</td>
</tr>
<tr>
<td>- Examination of the participant’s solutions and alternative strategies to carry out value-based behaviors.</td>
<td>- Shorter individual mindfulness and acceptance exercises (6–12 minutes of in-school practice).</td>
</tr>
</tbody>
</table>

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).

<table>
<thead>
<tr>
<th>Module 1. Stress and avoidance (Session 1-2)</th>
<th>Module 2. Perspective taking (Session 3-4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Psychoeducation on stress from an ACT perspective.</td>
<td>• Introduction to mindfulness and cognitive defusion.</td>
</tr>
<tr>
<td>• Recording of stressful situations.</td>
<td>• Being present.</td>
</tr>
<tr>
<td>• Avoidance trap.</td>
<td>• Perspective taking skills.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module 3. Values and committed action (Session 5-6)</th>
<th>Module 4. Acceptance and compassion (Session 7-8)</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Values- and motivation work.</td>
<td>• Acceptance and compassion skills.</td>
</tr>
<tr>
<td>• Purpose and meaning.</td>
<td>• Acceptance of emotions and body sensations.</td>
</tr>
<tr>
<td>• Behavior goals and committed action.</td>
<td>• Acceptance of sensory input.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module 5. Integration of ACT (Session 9-10)</th>
<th>Module 6. Consolidation of ACT (Session 13-14)</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Using presence, defusion, and acceptance.</td>
<td>• Action plan.</td>
</tr>
<tr>
<td>• Managing stress in social situations.</td>
<td>• Review of group experiences.</td>
</tr>
<tr>
<td>• Restorative actions.</td>
<td>• Planning for the future.</td>
</tr>
</tbody>
</table>

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).

<table>
<thead>
<tr>
<th>Module 1. Stress and avoidance (Session 1-2)</th>
<th>Module 2. Perspective taking (Session 3-4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Psychoeducation on stress from an ACT perspective.</td>
<td>- Introduction to mindfulness and cognitive defusion.</td>
</tr>
<tr>
<td>- Recording of stressful situations.</td>
<td>- Being present.</td>
</tr>
<tr>
<td>- Avoidance trap.</td>
<td>- Perspective taking skills.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module 3. Values and committed action (Session 5-6)</th>
<th>Module 4. Acceptance and compassion (Session 7-8)</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Values- and motivation work.</td>
<td>- Acceptance and compassion skills.</td>
</tr>
<tr>
<td>- Purpose and meaning.</td>
<td>- Acceptance of emotions and body sensations.</td>
</tr>
<tr>
<td>- Behavior goals and committed action.</td>
<td>- Acceptance of sensory input.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module 5. Integration of ACT (Session 9-10)</th>
<th>Module 6. Support of executive function (Session 11-12)</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Using presence, defusion, and acceptance.</td>
<td>- Problem solving.</td>
</tr>
<tr>
<td>- Managing stress in social situations.</td>
<td>- Structure management.</td>
</tr>
<tr>
<td>- Restorative actions.</td>
<td>- Application of ACT techniques.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module 7. Consolidation of ACT (Session 13-14)</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Action plan.</td>
</tr>
<tr>
<td>- Review of group experiences.</td>
</tr>
<tr>
<td>- Planning for the future.</td>
</tr>
</tbody>
</table>

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.
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.

<table>
<thead>
<tr>
<th></th>
<th>Pre-skills training</th>
<th>Post-skills training</th>
<th>2-month follow-up</th>
<th>Effect of time</th>
<th>Between-group effect</th>
<th>Group-by-time interaction effect</th>
<th>Correlation with teacher-rating at baseline</th>
</tr>
</thead>
<tbody>
<tr>
<td>The SDQ total score</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ACT</td>
<td>14.09 (5.75)</td>
<td>12.29 (6.46)</td>
<td>11.13 (4.97)</td>
<td>$F_{(1, 35)} = 1.39; p = .258; \eta^2_g = .05$</td>
<td>NS</td>
<td>$F_{(1, 35)} = 1.95; p = .152; \eta^2_g = .07$</td>
<td>r = .23</td>
</tr>
<tr>
<td>C</td>
<td>11.92 (5.98)</td>
<td>10.92 (5.17)</td>
<td>11.92 (6.79)</td>
<td></td>
<td></td>
<td></td>
<td>p = .248</td>
</tr>
<tr>
<td>The SDQ subscales</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emotional symptoms</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ACT</td>
<td>3.87 (2.97)</td>
<td>3.27 (2.31)</td>
<td>2.93 (2.60)</td>
<td>$F_{(1, 35)} = 2.77; p = .116; \eta^2_g = .08$</td>
<td>NS</td>
<td>$F_{(1, 35)} = 2.13; p = .13; \eta^2_g = .06$</td>
<td>r = .23</td>
</tr>
<tr>
<td>C</td>
<td>3.38 (2.59)</td>
<td>2.62 (1.85)</td>
<td>2.85 (2.51)</td>
<td></td>
<td></td>
<td></td>
<td>p = .027</td>
</tr>
<tr>
<td>Hyperactivity/inattention</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ACT</td>
<td>4.07 (2.03)</td>
<td>4.73 (2.19)</td>
<td>3.20 (1.61)</td>
<td>$F_{(1, 35)} = 2.54; p = .099; \eta^2_g = .09$</td>
<td>NS</td>
<td>$F_{(1, 35)} = 3.36; p = .026; \eta^2_g = .13$</td>
<td>r = .13</td>
</tr>
<tr>
<td>C</td>
<td>4.54 (2.37)</td>
<td>3.22 (2.48)</td>
<td>3.62 (2.63)</td>
<td></td>
<td></td>
<td></td>
<td>p = .366</td>
</tr>
<tr>
<td>Conduct problems</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ACT</td>
<td>2.33 (1.80)</td>
<td>2.07 (1.79)</td>
<td>2.07 (2.12)</td>
<td>$F_{(1, 35)} = 5.11; p = .029; \eta^2_g = .01$</td>
<td>NS</td>
<td>$F_{(1, 35)} = 3.91; p = .01; \eta^2_g = .05$</td>
<td>r = .25</td>
</tr>
<tr>
<td>C</td>
<td>1.85 (1.33)</td>
<td>2.08 (1.89)</td>
<td>2.23 (1.88)</td>
<td></td>
<td></td>
<td></td>
<td>p = .001</td>
</tr>
<tr>
<td>Peer relation problems</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ACT</td>
<td>3.73 (1.91)</td>
<td>3.13 (1.44)</td>
<td>2.93 (1.67)</td>
<td>$F_{(1, 35)} = .33; p = .001; \eta^2_g = .03$</td>
<td>NS</td>
<td>$F_{(1, 35)} = 1.27; p = .289; \eta^2_g = .05$</td>
<td>r = .30</td>
</tr>
<tr>
<td>C</td>
<td>3.15 (1.99)</td>
<td>3.00 (1.35)</td>
<td>3.31 (2.21)</td>
<td></td>
<td></td>
<td></td>
<td>p = .007</td>
</tr>
<tr>
<td>Prosocial behaviour*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ACT</td>
<td>7.37 (1.93)</td>
<td>7.23 (2.02)</td>
<td>7.53 (1.77)</td>
<td>$F_{(1, 35)} = 1.54; p = .224; \eta^2_g = .06$</td>
<td>NS</td>
<td>$F_{(1, 35)} = 1.61; p = .234; \eta^2_g = .02$</td>
<td>r = .362</td>
</tr>
<tr>
<td>C</td>
<td>7.38 (1.39)</td>
<td>6.49 (2.18)</td>
<td>6.15 (2.20)</td>
<td></td>
<td></td>
<td></td>
<td>p = .058</td>
</tr>
</tbody>
</table>

*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.

ANOVA: analysis of variance; ACT = acceptance and commitment therapy-based skills training group; C = control group; SDQ = Strengths and Difficulties Questionnaire.

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](image.png)

**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.

<table>
<thead>
<tr>
<th>Measure</th>
<th>Pre-treatment</th>
<th>Post treatment</th>
<th>3-month follow-up</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M (SD)</td>
<td>M (SD)</td>
<td>M (SD)</td>
</tr>
<tr>
<td>PSS</td>
<td>35.1 (5.4)</td>
<td>29.6 (7.7)</td>
<td>31.5 (8.3)</td>
</tr>
<tr>
<td>SWLS</td>
<td>13.2 (5.1)</td>
<td>15.5 (5.7)</td>
<td>17.0 (4.8)</td>
</tr>
<tr>
<td>BDI-II</td>
<td>21.6 (14.3)</td>
<td>15.3 (10.7)</td>
<td>14.4 (11.6)</td>
</tr>
<tr>
<td>BAI</td>
<td>24.2 (16.4)</td>
<td>14.5 (9.5)</td>
<td>18.4 (13.0)</td>
</tr>
<tr>
<td>SDS (work)</td>
<td>6.7 (2.8)</td>
<td>7.1 (1.7)</td>
<td>6.2 (2.5)</td>
</tr>
<tr>
<td>SDS (social)</td>
<td>7.6 (3.0)</td>
<td>6.2 (3.2)</td>
<td>6.8 (2.9)</td>
</tr>
<tr>
<td>SDS (family)</td>
<td>6.6 (2.0)</td>
<td>5.9 (2.6)</td>
<td>6.3 (2.1)</td>
</tr>
<tr>
<td>AAQ-7</td>
<td>31.7 (8.1)</td>
<td>26.3 (4.2)</td>
<td>27.7 (6.0)</td>
</tr>
<tr>
<td>CFQ-7</td>
<td>33.0 (6.1)</td>
<td>28.4 (7.4)</td>
<td>29.9 (5.3)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>t</td>
<td></td>
<td>-1.54</td>
<td>-2.79*</td>
</tr>
<tr>
<td>Cohen's d</td>
<td></td>
<td>0.92</td>
<td>0.43</td>
</tr>
</tbody>
</table>

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.

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

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.

<table>
<thead>
<tr>
<th>Measure</th>
<th>Group</th>
<th>n</th>
<th>Pre</th>
<th>Post</th>
<th>6-mo</th>
<th>ANOVA</th>
<th>d</th>
<th>d</th>
<th>d</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>NeuroACT</td>
<td>16</td>
<td>M (SD)</td>
<td>M (SD)</td>
<td>M (SD)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AAQ</td>
<td>TAU</td>
<td>18</td>
<td>30.4</td>
<td>23.9</td>
<td>21.6</td>
<td>F (2, 64) = 3.91</td>
<td>.70*</td>
<td>.79*</td>
<td>.61*</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(11.0)</td>
<td>(9.4)</td>
<td>(9.1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CFQ</td>
<td>NeuroACT</td>
<td>33.5</td>
<td>25.0</td>
<td>24.3</td>
<td>F (2, 64) = 5.32</td>
<td>.82**</td>
<td>1.07**</td>
<td>.35</td>
<td></td>
</tr>
<tr>
<td></td>
<td>TAU</td>
<td>(11.4)</td>
<td>(9.4)</td>
<td>(8.0)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>31.0</td>
<td>31.6</td>
<td>28.7</td>
<td>F (2, 64) = 6.44</td>
<td>.90**</td>
<td>1.24**</td>
<td>.41</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(9.2)</td>
<td>(9.9)</td>
<td>(8.8)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CBAS</td>
<td>NeuroACT</td>
<td>82.1</td>
<td>67.0</td>
<td>65.3</td>
<td>F (2, 64) = 6.44</td>
<td>.90**</td>
<td>1.24**</td>
<td>.41</td>
<td></td>
</tr>
<tr>
<td></td>
<td>TAU</td>
<td>(21.1)</td>
<td>(19.6)</td>
<td>(22.1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>80.7</td>
<td>86.5</td>
<td>80.7</td>
<td>F (2, 64) = 6.44</td>
<td>.90**</td>
<td>1.24**</td>
<td>.41</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(15.4)</td>
<td>(18.0)</td>
<td>(16.0)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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.

<table>
<thead>
<tr>
<th>Measure</th>
<th>n</th>
<th>Pre</th>
<th>Post</th>
<th>6-mo</th>
<th>Group-by-time interaction effect (within-subjects)</th>
<th>Pre-post</th>
<th>Post-6-mo</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>M (SD)</td>
<td>M (SD)</td>
<td>M (SD)</td>
<td>ANOVA</td>
<td>d</td>
<td>d</td>
</tr>
</tbody>
</table>
| 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 | 37.5 (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.

<table>
<thead>
<tr>
<th>Classification</th>
<th>PSS</th>
<th></th>
<th></th>
<th>SWLS</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>NeuroACT (n = 16)</td>
<td>TAU (n = 18)</td>
<td>NeuroACT (n = 16)</td>
<td>TAU (n = 18)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>n (%)</td>
<td>n (%)</td>
<td>n (%)</td>
<td>n (%)</td>
<td></td>
</tr>
<tr>
<td>Recovered</td>
<td>8 (50 %)</td>
<td>5 (28 %)</td>
<td>6 (38 %)</td>
<td>2 (11 %)</td>
<td></td>
</tr>
<tr>
<td>Improved</td>
<td>6 (38 %)</td>
<td>2 (11 %)</td>
<td>4 (25 %)</td>
<td>0 (0 %)</td>
<td></td>
</tr>
<tr>
<td>Unimproved</td>
<td>2 (13 %)</td>
<td>7 (39 %)</td>
<td>7 (44 %)</td>
<td>13 (72 %)</td>
<td></td>
</tr>
</tbody>
</table>

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).

<table>
<thead>
<tr>
<th>AAQ Items</th>
<th>Factor Loadings</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. My painful experiences and memories make it difficult for me to live a life that I would value.</td>
<td>.77</td>
</tr>
<tr>
<td>2. I'm afraid of my feelings.</td>
<td>.86</td>
</tr>
<tr>
<td>3. I worry about not being able to control my worries and feelings.</td>
<td>.87</td>
</tr>
<tr>
<td>4. My painful memories prevent me from having a fulfilling life.</td>
<td>.79</td>
</tr>
<tr>
<td>5. Emotions cause problems in my life.</td>
<td>.72</td>
</tr>
<tr>
<td>6. It seems like most people are handling their lives better than I am.</td>
<td>.68</td>
</tr>
<tr>
<td>7. Worries get in the way of my success</td>
<td>.88</td>
</tr>
</tbody>
</table>

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).

<table>
<thead>
<tr>
<th>CFQ Items</th>
<th>Factor Loadings</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. My thoughts cause me distress or emotional pain</td>
<td>.86</td>
</tr>
<tr>
<td>2. I get so caught up in my thoughts that I am unable to do the things that I most want to do</td>
<td>.74</td>
</tr>
<tr>
<td>3. I over-analyze situations to the point where it's unhelpful to me</td>
<td>.75</td>
</tr>
<tr>
<td>4. I struggle with my thoughts</td>
<td>.86</td>
</tr>
<tr>
<td>5. I get upset with myself for having certain thoughts</td>
<td>.82</td>
</tr>
<tr>
<td>6. I tend to get very entangled in my thoughts</td>
<td>.87</td>
</tr>
<tr>
<td>7. It's such a struggle to let go of upsetting thoughts even when I know that letting go would be helpful</td>
<td>.84</td>
</tr>
</tbody>
</table>

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.

<table>
<thead>
<tr>
<th>Measure</th>
<th>N</th>
<th>AAQ</th>
<th>CFQ</th>
</tr>
</thead>
<tbody>
<tr>
<td>AAQ</td>
<td>54</td>
<td></td>
<td>.63**</td>
</tr>
<tr>
<td>CFQ</td>
<td>54</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PSS</td>
<td>54</td>
<td>.59**</td>
<td>.60**</td>
</tr>
<tr>
<td>BDI</td>
<td>54</td>
<td>.73**</td>
<td>.54**</td>
</tr>
<tr>
<td>BAI</td>
<td>54</td>
<td>.59**</td>
<td>.47**</td>
</tr>
<tr>
<td>SWLS</td>
<td>54</td>
<td>-.63**</td>
<td>-.54**</td>
</tr>
<tr>
<td>CBAS</td>
<td>45</td>
<td>.62**</td>
<td>.38**</td>
</tr>
<tr>
<td>SRS</td>
<td>45</td>
<td>.60**</td>
<td>.54**</td>
</tr>
<tr>
<td>SRS-AM</td>
<td>45</td>
<td>.63**</td>
<td>.61**</td>
</tr>
<tr>
<td>SRS-M</td>
<td>45</td>
<td>.69**</td>
<td>.54**</td>
</tr>
<tr>
<td>SRS-A</td>
<td>45</td>
<td>.04</td>
<td>.09</td>
</tr>
<tr>
<td>SRS-SC</td>
<td>45</td>
<td>.66**</td>
<td>.62**</td>
</tr>
<tr>
<td>SRS-C</td>
<td>45</td>
<td>.57**</td>
<td>.53**</td>
</tr>
</tbody>
</table>

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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