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ORIGINAL PAPER

A Preliminary Psychometric Analysis of the Difficulties with Emotion Regulation Scale (DERS) Among Autistic Adolescents and Adults: Factor Structure, Reliability, and Validity

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Abstract

Emotion dysregulation is common among autistic people, yet few measures have received psychometric evaluation in this population. We examined the factor structure, reliability, and validity of a commonly-used measure of emotion dysregulation, the *Difficulties with Emotion Regulation Scale* (*DERS*), in a sample of 156 autistic adolescents and adults. Data were drawn from the NIH National Database for Autism Research (NDAR) and an author's existing dataset. Results demonstrated that the factor structure generally conformed to the original 6-factor model, with modifications. Reliability analyses revealed good-to-excellent internal consistencies. Validity analyses indicated that the *DERS* was positively associated with measures of anxiety, depression, and alexithymia. Our findings provide preliminary evidence for the utility of the *DERS* in a small autistic sample, with minor modifications.

Keywords Autism · Emotion regulation · Psychometrics

Introduction

Autistic adolescents and adults are at a significant risk for co-occurring mental health conditions. In particular, ADHD, anxiety, and depression are common in this population (Hollocks et al., 2019; Mattila et al., 2010; van Steensel, Bögels, & Perrin, 2011). Emotion regulation—how people influence their emotional experience, including when and how they experience affect (Gross, 1998), or more specifically, "the extrinsic and intrinsic processes responsible for monitoring, evaluating, and modifying emotional reactions, especially their intensive and temporal features, to accomplish one's goals" (Thompson, 1994, pp. 27–28)—may be an important transdiagnostic factor common to these co-occurring mental health conditions (e.g., White et al., 2014a, b). In fact, autistic people frequently demonstrate difficulties with emotion regulation (Mazefsky et al., 2013), yet few measures have been developed for autistic people or tested in an autistic sample. This is true of one widely used measure of emotion regulation, the *Difficulties with Emotion Regulation Scale* (*DERS*), which has yet to be examined in autism. Here, what is known about emotion regulation in autism is briefly reviewed, with a particular focus on tools used to measure this construct, followed by a summary of psychometric evaluations of the *DERS*. This information is presented in light of the present study, in which we evaluated the psychometric properties of the *DERS* in a sample of autistic adolescents and adults. A recent set of recommendations for removing ableist language from autism research (Bottema-Beutel et al., 2020) informed our terminology use throughout this paper.

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Emotion Regulation in Autism

Difficulties with emotion regulation are nearly ubiquitous among autistic youth and adults (Mazefsky et al., 2013). Recent literature suggests that there are shared mechanisms between emotion regulation processes and autism, namely: physiological arousal, affect intensity, and neural functions (amygdala and prefrontal cortex) (Mazefsky et al., 2013). Elucidating emotion regulation processes among autistic people may aid in the field's understanding of co-occurring mental health conditions in autism, such as anxiety (White et al., 2014a, b). A recent review identified that autistic people tend to have more difficulties with emotion regulation, are less effective at employing emotion regulation strategies, and use less healthy strategies for emotion regulation (Cai et al., 2018). Noted limitations in this body of literature include the use of measures not designed to capture emotion regulation (i.e., tools for assessing coping used as a proxy for emotion regulation; Cai et al., 2018) and those that have not been validated for use with autistic people (Beck et al., 2020; Weiss, Thomson, & Chan, 2014). Given the emerging body of research highlighting differences in measurement of related constructs (e.g., anxiety) among autistic people (Glod et al., 2017; Jitlina et al., 2017; Magiati et al., 2017; Schiltz et al., 2021; White et al., 2014a, b), concern regarding the lack of psychometric evidence for tools capturing emotion regulation is warranted.

Assessing Emotion Regulation in Autism

In one recent study, Keefer et al. (2019) examined psychometric properties of the caregiver-reported *CBCL Dysregulation Profile* (*CBCL DP*; which is comprised of three *CBCL* syndrome scales; Althoff et al., 2010) in a sample of more than 700 autistic youth with a focus on the factor structure. The authors tested a unidimensional, a three-factor, a second-order, and a bifactor model, and findings revealed that a bifactor model fit best. Dysregulation emerged as a broad underlying factor that explained covariation among item responses beyond what was accounted for by Anxiety, Attention, and Aggression factors. The authors concluded that the *CBCL DP* can be used in research and clinical settings as a measure of emotion dysregulation in autism, recommending that both the subdomain (Anxiety, Attention, and Aggression) and dysregulation scores be reported. They also recommended further study of the instrument; specifically, they called for parsing out items not associated with dysregulation, identifying whether common symptoms in autism contribute to dysregulation, and conducting validity studies to examine general versus emotional dysregulation in autism. This study is exciting in its examination of a widely-used measure with a large autistic sample. As the only psychometric evaluation of an existing measure of emotion regulation in autism, it also highlights the importance of continued work in this area.

One recently created caregiver-report measure, the *Emotion Dysregulation Inventory* (Mazefsky et al., 2018a; Mazefsky et al., 2018b), was developed specifically for autistic youth and young adults. Psychometric evaluation of the measure demonstrated a two-factor structure (*Reactivity* and *Dysphoria*). The *Reactivity* scale includes items related to intensely negative affective responses, such as anger and irritability, whereas the *Dysphoria* scale includes items pertaining to low motivation, sadness, and anhedonia (Mazefsky et al., 2020a; Mazefsky, Yu, & Pilkonis, 2020b). The *EDI* was designed to measure behaviors associated with emotion dysregulation that are observable by caregivers. Furthermore, the development of the *EDI* accounted for behaviors associated with emotion dysregulation that could be confounded with social interest or verbal ability (e.g., requesting help when distressed). The measure has shown no differential item functioning based on gender, age, IQ, or verbal ability (Mazefsky et al., 2018a, b), and has demonstrated sensitivity in measuring response to mindfulness-based treatment among autistic youth (Conner et al., 2019; Shaffer et al., 2019).

It remains important to determine the utility of measures of emotion regulation developed for the general population among autistic people, given the widespread use of such tools for research and clinical practice. Additionally, the use of multiple informants for the assessment of emotion regulation has been recently recommended (Beck et al., 2020). Therefore, evaluation of self-report measures is merited. The *DERS* is one such measure, and researchers have recently used it in studies with autistic samples to assess intervention outcome and explore links with alexithymia—difficulties recognizing and distinguishing between various emotions and physical sensations (Nemiah, 1976; Sifneos, 1973), victimization, and mental health (Conner & White, 2018; Maddox, Trubanova, & White, 2017; Morie et al., 2019; Swain et al., 2015; Weiss & Fardella, 2018).

Psychometric Properties of the DERS

Gratz and Roemer (2004) originally developed the *DERS* to examine multiple theoretically-driven facets of emotion regulation in adults. The *DERS* contains 36 items, which are rated on a 5-point Likert scale ranging from 1 (almost never) to 5 (almost always). Based on previous emotion regulation theories highlighting monitoring and control of emotional expression and experience, and emotion regulation strategies, Gratz and Roemer (2004) conceptualized emotion regulation as involving the following four areas: (1) awareness and understanding of emotions, (2) acceptance of emotions, (3) ability to control impulsive behavior and complete goal-directed behavior in emotional contexts, and (4) ability to flexibly use emotion regulation strategies in emotional contexts to meet goals and situational demands. Using an exploratory factor analysis (EFA) in a sample of 357 college-age adults, six factors were supported which were labeled as: (1) nonacceptance of emotional responses (*Nonacceptance*), (2) difficulties engaging in goal-directed behavior (*Goals*), (3) impulse control difficulties (*Impulse*), (4) lack of emotional awareness (*Awareness*), (5) limited access to emotion regulation strategies (*Strategies*), and (6) lack of emotional clarity (*Clarity*) (Gratz & Roemer, 2004). It is noteworthy that the authors used a cut-off of 0.40 for standardized factor loadings, and that multiple items demonstrated sizable cross-loadings using the standard 0.30 cut-off—these included two items from the *Clarity* subscale on the *Awareness* subscale and two items from the *Strategies* subscale on *Nonacceptance* and *Awareness* subscales. Additionally, there was high inter-item correlation based on Cronbach's α across the measure ($\alpha = 0.93$) and within each subscale (all α's > 0.80). Construct validity was supported by correlations of the *DERS* with measures of negative mood regulation and experiential avoidance. Additionally, specific subscales from the *DERS* (i.e., *Awareness*, *Strategies*, *Clarity*) were linked with emotional expressivity. Further, in a subsample of this study, the *DERS* demonstrated good test–retest reliability across a timespan of 4 to 8 weeks. Altogether, the findings suggested appropriate psychometric properties for the *DERS* in a predominantly White, female, college-age adult sample. Subsequent studies have explored the *DERS* factor structure in adult samples, with some inconsistencies. For example, among a sample of patients with chronic illness from Hungary, the original 6-factor structure fit poorly (Kökönyei et al., 2014). After modifications, including removing items with low factor-loadings or substantial cross-loadings, fit of the 6-factor structure was acceptable.

The utility of the *DERS* has since been extended to adolescent samples. Weinberg and Klonsky (2009) were the first to examine the psychometric properties of the *DERS* in a community sample of high school adolescents. Although the EFA supported six *DERS* factors, consistent with the original findings (Gratz & Roemer, 2004), there were deviations from the original model such that six items that did not uniquely load onto their parent factor (i.e., subscale recommended by the original 2004 *DERS* paper by Gratz and Roemer). Of these six items, four were those that demonstrated sizable cross-loadings in the original 2004 study and two items did not load onto any scale. Of note, the *Clarity* and *Awareness* subscales had the lowest inter-item correlations (Weinberg & Klonsky, 2009). Using a confirmatory factor analysis (CFA) in a sample of youth 11–17 years of age, Neumann et al. (2010) found support for the original *DERS* six factors (Gratz & Roemer, 2004). These studies of adolescent samples have identified good-to-excellent internal consistencies across the measure ($\alpha = 0.93$; Weinberg & Klonsky, 2009; $\alpha = 0.81$; Neumann et al., 2010), and acceptable-to-excellent ranges for internal consistencies within the *DERS* subscales (α range 0.76–0.89; Weinberg & Klonsky, 2009; α range 0.72–0.87; Neumann et al., 2010).

In addition to the correlated factor models described above, researchers have posited that a general "dysregulation" factor exists and can be measured using the *DERS* (Bardeen, Fergus, & Orcutt, 2012, 2016; Osborne et al., 2017). In order to test this possibility, studies have explored second-order and bifactor structures of the *DERS* that allow for a higher-order general "dysregulation" factor in addition to specific factors (Bardeen et al., 2012, 2016; Benfer et al., 2019; Hallion et al., 2018; Nordgren et al., 2020; Osborne et al., 2017). Multiple studies have shown support for bifactor models. Bardeen, Fergus and Orcutt (2012) were the first to find support for a bifactor model with five subfactors, excluding the *Awareness* items, in an all-female undergraduate sample. This factor structure has been replicated in a general adult sample and with treatment-seeking adults (Benfer et al., 2019; Hallion et al., 2018). Modified bifactor models that allow for correlations between the *Awareness* and *Clarity* specific factors have also been supported (Bardeen et al., 2016; Nordgren et al., 2020; Osborne et al., 2017). Although there has been some evidence for bifactor models, in a sample of adults admitted to a psychiatric hospital, all higher-order models on the *DERS* demonstrated poor fit (Fowler et al., 2014). Altogether, although the support for bifactor models is inconsistent in existing literature, there is precedent for exploring higher-order models of the *DERS* in an autistic sample.

Emotion regulation has broadly been linked to various affective states, including anxiety and depression, and is theorized to contribute in a transdiagnostic manner to the emergence and maintenance of many psychological disorders (Dennis, 2007; Sloan et al., 2017). Thus, the *DERS* has frequently been examined with measures of anxiety, depression, and alexithymia to establish construct validity. In a diverse high school adolescent sample, researchers found evidence of construct validity between all subscales of the *DERS*, except *Awareness*, and measures of depression, suicidal ideation, and anxiety (Weinberg & Klonsky, 2009). This pattern of findings has been replicated in a large adolescent sample with measures of anxiety and depression (Neumann et al., 2010). Similarly, in general and clinical adult samples, the *DERS* has been found to predict anxiety and depression scores, and these relationships have been found to be stronger when excluding *Awareness* (Bardeen et al., 2012; Hallion et al., 2018). Further, one study in adults with chronic pain found evidence for construct validity based on significant positive associations between modified *DERS* subscales and measures of depression and alexithymia (Kökönyei et al., 2014). Recent work has continued to support links between the *DERS* and alexithymia (Elmas, Cesur, & Oral, 2017; Greene et al., 2020), though only one recent study has examined associations between the *DERS* subscales with measures of alexithymia (Greene et al., 2020). Altogether, the relations between the *DERS* and measures of anxiety, depression, and alexithymia, have been demonstrated in both adolescent and adult samples, however, these associations have not yet been explored in autistic samples.

Considering the literature on the psychometric performance of the *DERS* overall, while multiple studies have demonstrated acceptable reliability and validity across adolescent and adult samples, support for the factor structure of the *DERS* has been highly variable across studies. This work has yet to be extended to autistic samples, which have been frequently found to have co-occurring mental health disorders and emotion regulation difficulties.

Summary and Aims of the Current Study

There are few validated measures of emotion regulation for use with autistic adolescents and adults, despite the high prevalence in this population and links with co-occurring mental health conditions. As the *DERS* is a commonly-used measure for assessing and targeting specific emotion regulation difficulties among adolescents and adults, it is important to examine the psychometric properties of the *DERS* in autistic samples. Thus, in this study, we examined the preliminary psychometric properties of the *DERS* in a sample of autistic adolescents and adults ($n = 156$). We aimed to determine the (1) factor structure, (2) reliability, and (3) construct validity of the *DERS* in this sample. Because a psychometric analysis of the *DERS* in an autistic sample has not previously been conducted, the factor analysis and reliability portions of our study were exploratory. In terms of construct validity, we hypothesized that the *DERS* would be significantly positively related to measures of anxiety, depression, and alexithymia, as has been demonstrated in the general population (i.e., Kökönyei et al., 2014).

Method

Participants

We drew our data from the National Database for Autism Research (NDAR), an NIH-funded data repository, and from existing data of one of the authors (MC). We used data from three NDAR studies (including Rabany et al., 2019; White et al., 2019) in the current analyses (Table 1). The Institutional Review Board (IRB) at Marquette University waived approval due to the deidentified and archival nature of the NDAR data. The IRB at Virginia Polytechnic Institute and State University provided approval for the study (# 17-327). Parents and adolescents in the Virginia Tech study provided both verbal and written consent and assent, respectively. Because the *DERS* has been validated among adolescents and adults in the general population (Gratz & Roemer, 2004; Neumann et al., 2010; Weinberg & Klonsky, 2009), for sufficient power to conduct our analyses, we combined data from autistic adolescents and adults. In total, data from 156 autistic adolescents and adults were pooled across four studies. Table 1 presents detailed information regarding each study's respective goals, recruitment, diagnostic characterization, and inclusion/exclusion criteria. Inclusion criteria for the current study were (1) having item-level data on the *DERS* and (2) being classified as autistic in their respective studies. In the overall sample, 83.33% of autistic adolescents and adults had *Autism Diagnostic Observation Schedule, Generic* or *Second Edition* (*ADOS*; Lord et al., 2002, 2012) scores available. For those with available *ADOS* data, only autistic adolescents and adults meeting criteria for autism (≥ 7) on the *ADOS* were included in the analyses. Data from autistic adolescents and adults without *ADOS* data (16.67%) were maintained for sample size and power; these adolescents and adults without *ADOS* data had a primary classification of "Autism" in their Individualized Education Plan (White et al., 2019). Our final sample had a mean age of 20.41 ($sd = 4.32$, range = 12.08–32.42), and 21.2% reported their gender as female. An estimated full-scale IQ score (based on the *WASI-II*) was available for 50.64% of the sample and indicated a mean in the average range 104.99 ($sd = 14.35$, range = 79–140). Of the 104 autistic adolescents and adults with data regarding their race and ethnicity, 85.58% identified as White. Data from structured clinical interviews indicated that the prevalence of co-occurring anxiety and mood disorders is comparable to estimates from other autistic samples (Hollocks et al., 2019). Specific data on socioeconomic status and educational attainment levels were not available in either dataset. Community members were not involved in the study. See Table 2 for full details on available demographic data.

Measures

Difficulties with Emotion Regulation Scale (DERS)

The *DERS* (Gratz & Roemer, 2004) is a self-report questionnaire consisting of 36 items that measures emotion dysregulation. Items are scored on a 5-point scale ranging from 1 (almost never) to 5 (almost always). Eleven items are reverse scored (items 1, 2, 6, 7, 8, 10, 17, 20, 22, 24, and 34). Subscales scores are obtained by summing the corresponding items. The six subscales include: *Nonacceptance of Negative*

Table 1 Study details

Collection title	Source	NDAR collection ID	Collection investigator	Collection description	Recruitment details	Autism diagnostic characterization details	Inclusion/exclusion criteria
STEPS: Stepped Transition in Education Program for Students with ASD	NDAR	2122	Susan W. White	"The goal of this project is to develop a comprehensive program to promote successful transition of students with ASD from high school to post-secondary education"	"largely from small cities and rural areas in a southeastern state. Participating families were recruited through community advertisements, autism-specific e-mail listservs and newsletters, university-affiliated clinics, and area schools and universities"	"If a participant did not have a primary classification of "Autism" on his or her Individualized Education Plan (STEP 1 participants), diagnosis was confirmed by the Autism Diagnostic Observation Schedule-Second Edition (Lord et al., 2012), completed by a research-reliable clinician"	Inclusion: "To be eligible, participants had to have a diagnosis of ASD…Participants also had at least average range cognitive ability (i.e., Full Scale IQ $\geq$ 85)" Exclusion: "(a) unmanaged psychopathology that warranted immediate clinical care (including clear suicidal intent, psychosis, or severe aggression), as determined by clinical interview, and (b) student or family currently in therapy or receiving services considered redundant with STEPS (e.g., therapy for difficulties with emotion regulation, cognitive behavioral therapy)"

Table 1 (continued)

Collection title	Source	NDAR collection ID	Collection investigator	Collection description	Recruitment details	Autism diagnostic characterization details	Inclusion/exclusion criteria
Development of a Novel Neurotechnology to Promote Emotion Recognition in Autism	NDAR	2572	Susan W. White	"The goal of this project is to develop an assistive technology to promote facial emotion recognition in ASD"	"Participants were recruited from various local resources including the university-affiliated autism clinic, a college-based support program for students with ASD, social media advertising, and posted flyers in the community"*	"Diagnosis of ASD confirmed by either the ADOS-2 or ADI-R"*	Inclusion: "1) Male, 2) Between ages 16 and 30 years, inclusive, 3) IQ equal to or above 80, 4) No MRI contraindications (e.g., metal in body), 5) No known genetic, medical, or neurological conditions including intellectual disability, aside from an ASD, 6) Ambulatory and no known, uncorrected sensory deficits (e.g., blindness), 7) Free of severe psychopathology (e.g., suicidal intent) that would prohibit likely success of the FER Assistant, or that would require a different treatment immediately, 8) Not in a treatment that directly targets facial emotion recognition, 9) No consistent and current drug use, 10) No changes to medication (psychotropic) for past 4 weeks, and no planned changes in immediate future"*

Table 1 (continued)

Collection title	Source	NDAR collection ID	Collection investigator	Collection description	Recruitment details	Autism diagnostic characterization details	Inclusion/exclusion criteria
The Social Brain in Schizophrenia and Autism Spectrum Disorders	NDAR	2022	Michal Assaf	"The aim of the current study is to investigate the neural correlates of 3 social cognitive processes, Theory of Mind (ToM), social judgment, and empathy, using a multimodal approach incorporating functional MRI (fMRI) and event related potential (ERP) data, in relation to the nosological diagnoses of ASD and SZ and their clinical and functional symptoms"	"Participants were recruited via Olin Neuropsychiatry Research Center (ONRC) and Yale University School of Medicine"	"Clinical diagnoses were ascertained using the Autism Diagnostic Observation Schedule (ADOS; [1]) module 4 for ASD"	Exclusion: "intellectual disability (estimated full-scale IQ < 80), current substance use/abuse, assessed by detailed clinical interview and urine drug screen prior to MRI scan, clinical instability and MRI contraindications (e.g. in-body metal)"
Common and Distinct Mechanisms of Social Anxiety in ASD	Author's personal dataset	N/A	Marika Coffman	The goal of this project is to understand how adolescents with ASD + Social Anxiety Disorder, Social Anxiety Disorder alone, or controls learn and modify fear on a neural level	Participants were recruited through mailing lists, flyers, and recruitment databases maintained through the department	ASD diagnoses were determined by using the Autism Diagnostic Observation Schedule (ADOS; [1]) modules 3 or 4, based on developmental level from research-reliable clinician	Inclusion: "autistic adolescents with co-occurring social anxiety symptoms (measured by the Anxiety Disorders Interview Schedule) and an IQ at or above 85 were specifically recruited"

Information in quotations is pulled directly from NDAR website or publications resulting from the studies where indicated (Rabany et al., 2019; White et al., 2019) *S. White (personal communication, February 15 and 28, 2021)

Table 2 Demographic characteristics

$n=156$		
Variable	M (sd)	Range
Age	20.41 (4.32)	12.08–32.42
Gender		
% Male	78.8	
% Female	21.2	
Race ($n=104$)		
% White	85.58	
% Black	6.73	
% Multi-racial	1.92	
% Asian	4.81	
% Latinx/Hispanic	0.96	
IQ Estimate ($n=79$)	104.99 (14.35)	79–140
Co-occurring Conditions ($n=115$)		
% MDD	20.9	
% Panic Disorder	1.7	
% Agoraphobia	2.6	
% Social Phobia ($n=130$)	39.2	
% GAD	25.2	
% Specific Phobia	13.9	
% PTSD	2.6	
% OCD	7.8	

IQ was measured with the *Wechsler Abbreviated Scale of Intelligence, 2nd Edition* (*WASI-II*). Available data on co-occurring conditions were assessed with the Anxiety Disorders Interview Schedule for DSM-5 (ADIS-5; $n=64$) or the Structured Clinical Interview for DSM-IV (SCID-I; $n=51$)

MDD Major Depressive Disorder, *GAD* Generalized Anxiety Disorder, *PTSD* Post Traumatic Stress Disorder, *OCD* Obsessive Compulsive Disorder

Emotional Responses ("*Nonacceptance*;" 6 items), *Lack of Emotional Awareness* ("*Awareness*;" 6 items), *Lack of Emotional Clarity* ("*Clarity*;" 5 items), *Difficulties Controlling Impulsive Behaviors When Distressed* ("*Impulse*;" 6 items), *Difficulties Engaging in Goal-directed Behavior When Distressed* ("*Goal*;" 5 items), and *Limited Access to Effective Emotion Regulation Strategies* ("*Strategies*;" 8 items). Higher scores indicate greater emotion dysregulation. Details on the existing psychometric properties of the *DERS* and descriptions of the subscales can be found in the Introduction of this paper.

Beck Anxiety Inventory (BAI)

The *BAI* (Beck et al., 1988a; Beck, Steer, & Carbin, 1988b) is a self-report questionnaire that consists of 21 items measuring anxiety symptoms. Items are scored ranging from 0 (not at all) to 3 (severe), with higher total scores indicating more severe anxiety symptoms. The *BAI* has been shown to possess high inter-item correlations (α's = 0.92–0.94), good 1-week retest reliabilities of 0.67 to 0.75, and moderate concurrent validity when compared to other self-report anxiety measures, with correlations ranging from 0.47 to 0.58 (Beck et al., 1988a, b; Fydrich, Dowdall, & Chambless, 1992). The *BAI* was available on a subset of autistic adolescents and adults in this study ($n=49$). Inter-item correlation was high ($\alpha=0.92$).

Beck Depression Inventory, Second Edition (BDI-II)

The *BDI-II* (Beck, Steer, & Brown, 1996) is self-report questionnaire that consists of 21 items measuring depressive symptoms. Items are scored ranging from 0 (not at all) to 3 (severe), with higher total scores indicating more severe depression symptoms. The original and revised *BDI* have demonstrated good test–retest correlations ranging from 0.60 to 0.86, high inter-item correlation, good discriminant validity, and moderately-high convergent validity with psychiatric ratings of depression (Beck & Steer, 1984; Beck et al., 1988a, b). A recent study of the measure demonstrated good reliability and validity in a large autistic adult sample (Williams, Everaert, & Gotham, 2020). The *BDI-II* was available on a subset of autistic adolescents and adults ($n=46$) in the present study, and the inter-item correlation was high ($\alpha=0.94$).

Toronto Alexithymia Scale (TAS-20)

The *TAS-20* (Bagby, Taylor, & Parker, 1994) is a 20-item self-report questionnaire intended to measure aspects of alexithymia. Items are answered on a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The *TAS-20* has three subscales: *Difficulty Describing Feelings*, *Difficulty Identifying Feelings*, and *Externally-oriented Thinking*. The total *TAS-20* score is comprised of sum responses to all 20 items. A total score > 61 indicates alexithymia, with scores between 52 and 60 indicating possible alexithymia. The *TAS-20* has been reported to have high inter-item correlation ($\alpha=0.81$) and test–retest reliability (0.77), and it has been found to be stable and replicable across clinical and nonclinical populations (Bagby et al., 1994). Here, inter-item correlation was high for the Total score ($\alpha=0.80$) and the *Difficulty Identifying Feelings* subscale ($\alpha=0.86$), moderate for the *Difficulty Describing Feelings* subscale ($\alpha=0.78$), and low for the *Externally-oriented Thinking* subscale ($\alpha=0.31$). The *Externally-oriented Thinking* subscale was excluded from further analyses.

Data Analytic Plan

Factor Structure

We conducted analyses exploring the factor structure of the *DERS* in *Mplus* version 8.1.6 (Muthén & Muthén, 1998–2017). Prior to factor analyses, we inspected items for sparseness (categories with endorsement less than five), and we recoded them as necessary (i.e., combining adjacent categories). We used the diagonally-adjusted weighted least squares estimator in *Mplus* due to the categorical nature of the items. We evaluated model fit using multiple goodness-of-fit statistics, including relative fit indices [comparative fit index (CFI) and Tucker–Lewis Index (TLI)] as well as absolute fit indices [root mean square error of approximation (RMSEA) and χ^2 tests]. Guidelines for levels of model fit were developed under normal-theory maximum likelihood with continuous indicators, unlike the indicators in the present study. For that reason, the entire collection of fit statistics was considered more leniently, with the general goal of obtaining RMSEA values less than 0.08 (Browne & Cudeck, 1993) and CFI and TLI values greater than 0.95 (Hu & Bentler, 1999). χ^2 Difference tests were used to compare nested models as described below.

First, we tested the original 6-factor structure using a CFA (Model 1); correlations among the six factors were estimated, based on prior literature (Gratz & Roemer, 2004) (see Fig. 1a for correlated factors model depiction). Then, we conducted a series of EFA models testing one to seven factors using geomin rotation in order to identify the number of factors and items with substantial cross-loadings (Models 2–8). We considered items with standardized factor loadings above 0.30 to load onto that respective factor, consistent with psychometric conventions (Brown, 2015). Once we determined the number of factors based on the EFA results, we tested a series of CFA models to evaluate whether cross-loading items could be constrained to load on a single factor. To test this, we estimated a CFA with all cross-loading items as indicated by the EFA (Model 9). Then, we removed items with standardized factor loadings below 0.30 (Model 10). In order to test whether constraining cross-loading items reduced model fit, we constrained one cross-loading item at a time to load onto a single factor (Models 11–13). We compared successive models using a χ^2 difference test for nested models, where a non-significant test supports the more parsimonious (i.e., highly constrained) model. In other words, a non-significant χ^2 difference would indicate that constraining an item to load onto a single factor, rather than two factors, did not significantly reduce model fit.

Lastly, we tested higher-order models that estimate a general factor. First, we tested a second-order (Fig. 1b) and bifactor model (Fig. 1c) based on the 6-factor literature standard (Models 14 and 15). A second-order model is hierarchical such that a second-order latent variable accounts for associations among the first-order factors; measured variables are only indirectly related to the second-order variable. That is, each first-order factor loads onto the second-order factor. A bifactor model is not hierarchical and instead the general factor accounts for common variance in the measured variables unexplained by the subdomain factors; that is, each item loads onto the general factor, as well as the specific factors (Chen, West, & Sousa, 2006). Then, we tested models that have been identified by prior literature including: (1) a bifactor model with five specific factors and excluding *Awareness* items completely (Model 16; Benfer et al., 2019; Hallion et al., 2018), (2) a "modified" bifactor model including five specific factors with the *Awareness* items excluded from the general factor and the correlation between *Awareness* and *Clarity* estimated (Model 17; Osborne et al., 2017), (3) a "modified" bifactor model including six specific factors in which the correlation between *Awareness* and *Clarity* was estimated (Model 18; Nordgren et al., 2020). It is important to note that the "modified" bifactor models are not true bifactor models, given that the specific factors are uncorrelated in a bifactor model (Reise, 2012).

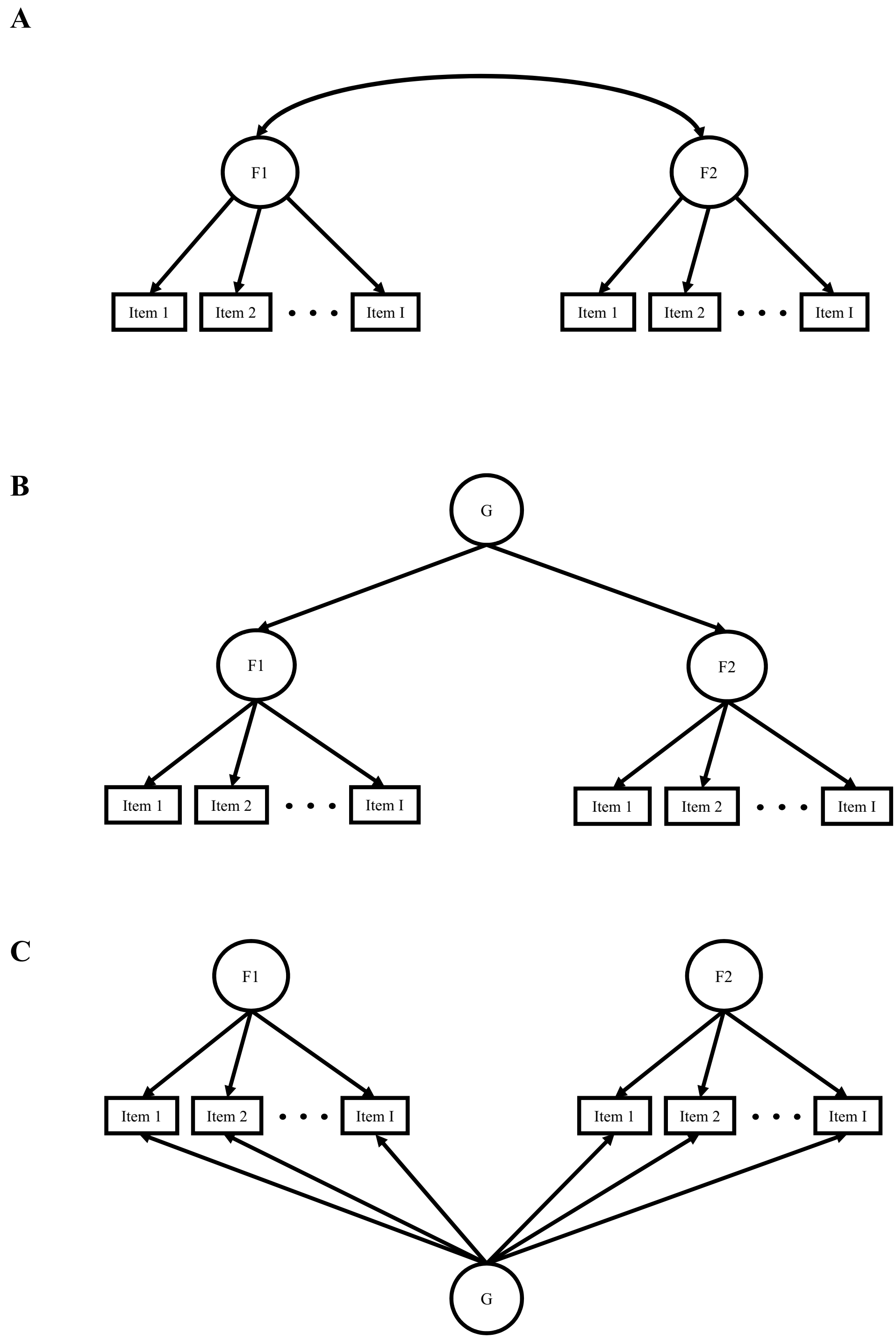
Reliability

We assessed inter-item correlation and internal consistency of each identified subscale using Cronbach's α and *Ω* (McNeish, 2018). We used SPSS version 26.0 (IBM Corp., 2019) to calculate Cronbach's α. For α, values above 0.90 are considered excellent, above 0.80 are good, 0.70 are acceptable, and 0.60 are questionable, while less than 0.50 are poor (DeVellis, 2016). While Cronbach's α is often used as a metric of reliability, the assumption of τ-equivalence is often violated (McNeish, 2018). In other words, α assumes that the covariance between each item with the true score is equivalent across all items (i.e., they have the same factor loadings). *Ω* Does not assume τ-equivalence and, therefore, is a recommended alternative. We used a spreadsheet with code provided by McNeish (2018) to calculate *Ω*.

Construct Validity

We evaluated the construct validity of the *DERS* subscales in a subset of our sample using bivariate Pearson's correlations conducted in SPSS version 26.0 (IBM Corp., 2019). We ran correlations between the estimated factor scores of each identified *DERS* subscale with measures of anxiety (*BAI*), depression (*BDI-II*), and alexithymia (*TAS-20*). We selected these constructs based on prior literature demonstrating links between anxiety, depression, and alexithymia and emotion regulation in the general population (Kökönyei et al., 2014; Weinberg & Klonsky, 2009). While there is no cutoff value that defines construct validity, positive associations of a medium-to-strong magnitude suggest related, yet distinct, constructs (DeVellis, 2016).

Fig. 1 **a** Correlated factors model, **b** Second-order model, and **c** Bifactor model; *F* Factor, *G* General Factor, *I* up to number of items in the respective factor



Results

Only two items on the *DERS* (items 4 and 32) had low endorsement in the highest and lowest category, respectively; therefore, we combined these categories with the subsequent category.

Factor Structure

Model fit statistics for the CFAs and EFAs are depicted in Table 3. First, we conducted a CFA of the original 6-factor structure, which demonstrated poor fit (CFI 0.83; TLI 0.82; RMSEA 0.10; Model 1). Therefore, we conducted EFAs

Table 3 Exploratory and confirmatory factor analysis model fits

Model number	Model description	χ^2 (*df*)	*df*	CFI	TLI	RMSEA [90% CI]
1	6-Factor CFA (literature standard)	1408.35	579	0.84	0.82	0.10 [0.09, 0.10]
2	1-Factor EFA	2402.47	594	0.64	0.62	0.14 [0.13, 0.15]
3	2-Factor EFA	1591.56	559	0.80	0.77	0.11 [0.10, 0.12]
4	3-Factor EFA	1132.37	525	0.88	0.86	0.09 [0.08, 0.09]
5	4-Factor EFA	879.78	492	0.92	0.90	0.07 [0.06, 0.07]
6	5-Factor EFA	761.29	460	0.94	0.92	0.07 [0.06, 0.07]
7	6-factor EFA	633.67	429	0.96	0.94	0.06 [0.06, 0.05]
8	7-Factor EFA	571.74	399	0.97	0.95	0.05 [0.04, 0.06]
9	6-Factor CFA based on EFA (Model 6): 8 cross-loading items (Q11, Q17, Q20, Q23, Q24, Q30, Q33, Q36)	809.55	537	0.95	0.94	0.06 [0.05, 0.07]
10	6-Factor CFA based on EFA (Model 6): 4 cross loading items with low loading constrained to zero (Q11, Q17, Q24, Q33), 4 cross-loading items (Q20, Q23, Q30, Q36)	**834.54**	**541**	**0.94**	**0.94**	**0.06 [0.05, 0.07]**
11	6-Factor CFA based on EFA (Model 6) with 3 cross-loading items (Q23, Q30, Q36), Q20 constrained on *Goal*	876.94	542	0.93	0.93	0.06 [0.06, 0.07]
12	6-Factor CFA based on EFA (Model 6) with 3 cross-loading items (Q20, Q30, Q36), Q23 constrained on *Nonacceptance*	866.58	542	0.94	0.93	0.06 [0.05, 0.07]
13	6-Factor CFA based on EFA (Model 6) with 3 cross-loading items (Q20, Q23, Q36), Q30 constrained on *Strategies*	866.45	542	0.94	0.93	0.06 [0.05, 0.07]
14	6-Factor CFA based on EFA (Model 6) with 3 cross-loading items (Q20, Q23, Q30), Q36 constrained on *Impulse*	862.53	542	0.94	0.93	0.06 [0.05, 0.07]
15	Bifactor of literature standard 6-factor structure	1448.82	558	0.82	0.80	0.10 [0.10, 0.11]
16	Second-order of literature standard 6-factor structure	1472.39	589	0.83	0.81	0.10 [0.09, 0.10]
17	Bifactor of 5 factors (excluding *Awareness* completely) (Benfer et al., 2019; Hallion et al., 2018)	795.64	375	0.91	0.90	0.09 [0.08, 0.09]
18	Modified "bifactor" of 5 factors (excluding *Awareness* on general factor but correlated with *Clarity*) (Osborne et al., 2017)	954.18	563	0.92	0.91	0.07 [0.06, 0.07]
19	Modified "bifactor" of literature standard 6-factor structure (allowing *Awareness* and *Clarity* to correlate) (Nordgren et al., 2020)	1081.31	557	0.90	0.88	0.08 [0.07, 0.09]

Final model in bold

EFA exploratory factor analysis, *CFA* confirmatory factor analysis, *df* degrees of freedom, *CFI* comparative fit index, *TLI* Tucker–Lewis Index, *RMSEA* root mean-square error of approximation, *CI* confidence interval

examining the model fit for 1- through 7-factors (Models 2–8). Based on the collective goodness-of-fit indices, the 5-, 6-, and 7-factor models demonstrated adequate fit, and we inspected these further. The 5-factor structure (Model 6) had many items with substantial cross-loadings (42% of items), and the 7-factor structure (Model 8) had one factor with just three items, none of which loaded solely on that factor. Therefore, we selected the 6-factor EFA (Model 7) as the most representative and parsimonious model. Table 4 depicts the factor loadings for this 6-factor EFA.

Next, we conducted CFAs to further examine this 6-factor structure. These model fit statistics are also presented in Table 3 (Models 9–13). Results of the CFAs based on the 6-factor EFA structure allowed eight cross-loading items and revealed good fit (Model 9). Four of the cross-loading items (11, 17, 24, 36), however, had low factor loadings on one of the two factors. Therefore, we constrained these items to load only on the factor with the higher loading. The 6-factor model allowing only the four remaining cross-loading items continued to demonstrate good fit (Model 10). Model fit significantly declined when any of these cross-loading items were constrained to load onto a single factor (Models 11–14).

Lastly, we examined bifactor and second-order models based on the literature standard 6-factor solution, the results of which are also presented in Table 3. These demonstrated inadequate fit (Models 15–16). Additionally, modified bifactor models based on prior literature (Benfer et al., 2019; Hallion et al., 2018; Nordgren et al., 2020; Osborne et al., 2017) indicated good fit (Models 17–19). Compared to the results of the modified 6-factor solution (Model 10), however, none of the bifactor solutions demonstrated superior fit. Therefore, Model 10 was selected as the final factor structure.

Results of the final 6-factor CFA (Model 10) are displayed in Table 5. We observed that this structure was highly similar to the original 6-factor model, with some

Table 4 Factor loadings from the 6-factor EFA

Item	Factors					
	1	2	3	4	5	6
Q:11	**0.71**	0.02	−0.07	0.02	−0.08	0.30
Q:12	**0.76**	0.08	−0.06	0.04	0.01	−0.01
Q:21	**0.76**	−0.07	0.04	0.09	0.19	0.01
Q:23	**0.48**	0.16	0.07	−0.12	**0.44**	−0.04
Q:25	**0.79**	−0.01	0.05	0.01	0.01	0.17
Q:29	**0.68**	0.04	0.03	0.00	0.21	0.10
Q:13	0.05	**0.66**	0.03	0.14	0.16	−0.04
Q:18	0.03	**0.77**	−0.05	0.03	0.21	0.05
Q:20	−0.16	**0.60**	**0.34**	−0.02	−0.01	−0.02
Q:26	0.03	**0.74**	0.01	0.10	0.11	0.04
Q:33	0.04	**0.49**	−0.08	0.22	0.30	0.04
Q:3	0.19	−0.03	−0.13	**0.43**	0.01	0.29
Q:14	0.23	−0.02	−0.04	**0.85**	0.02	−0.02
Q:19	0.21	0.11	0.07	**0.67**	0.06	0.08
Q:24	−0.15	**0.31**	**0.42**	0.15	−0.02	0.02
Q:27	−0.04	0.13	0.03	**0.83**	−0.02	−0.02
Q:32	−0.06	0.05	0.07	**0.84**	−0.01	0.14
Q:2	0.10	−0.09	**0.83**	0.00	0.06	0.04
Q:6	−0.05	−0.20	**0.71**	0.06	0.21	−0.13
Q:8	0.10	−0.10	**0.79**	0.04	−0.03	−0.17
Q:10	0.08	−0.05	**0.67**	0.03	0.02	−0.03
Q:17	**0.34**	−0.02	**0.61**	−0.07	−0.22	0.00
Q:34	−0.14	−0.12	0.16	−0.04	0.21	−0.03
Q:15	−0.04	0.06	0.05	0.00	**0.72**	0.23
Q:16	0.12	−0.13	−0.05	0.06	**0.81**	0.07
Q:22	−0.08	0.18	**0.61**	0.09	−0.07	0.16
Q:28	−0.05	−0.03	0.06	0.01	**0.74**	0.16
Q:30	**0.43**	0.18	−0.06	0.00	**0.53**	−0.04
Q:31	−0.01	0.20	−0.03	−0.01	**0.66**	0.03
Q:35	0.06	0.11	0.01	0.17	**0.58**	−0.02
Q:36	0.24	0.22	0.00	**0.39**	0.30	−0.02
Q:1	−0.07	0.06	**0.73**	−0.18	−0.02	0.14
Q:5	0.05	0.10	0.14	−0.12	0.15	**0.69**
Q:7	0.04	0.11	**0.71**	−0.21	0.12	0.15
Q:9	0.31	−0.01	−0.04	0.10	−0.07	**0.77**
Q:4	−0.02	−0.30	0.03	0.04	0.22	**0.79**

Bold indicates significance at alpha of 0.05

EFA exploratory factor analysis, *Q* question

modifications. Twenty-seven out of 36 items loaded only onto their parent factor. Of the remaining nine items, four demonstrated substantial cross-loadings onto their parent factor and another factor. These included item 23 (loaded on both *Nonacceptance* [parent] and *Strategies*), item 20 (loaded on *Goal* [parent] and *Awareness*), and item 30 (loaded on *Strategies* [parent] and *Nonacceptance*), and item 36 (loaded on *Strategies* [parent] and *Impulse*). Four items loaded onto a different factor than in the original structure. In particular, items 1 and 7 (parent: *Clarity*) loaded onto *Awareness*. Items 22 (parent: *Strategies*) and 24 (parent: *Impulse*) loaded onto *Awareness*. Item 34 (parent: *Awareness*) did not load onto any factor.

We found that the *DERS* factors were generally moderately positively correlated. *Awareness*, however, was uncorrelated with most other factors, with the exception of a moderate correlation with *Clarity*. These correlations are depicted in Table 6.

Table 5 Final 6-factor CFA model: internal consistencies, standardized factor loadings, and thresholds

Item	Standardized factor loading	*SE*	Thresholds
Nonacceptance $\alpha=0.90$; $\Omega=0.88$			
Q11: When I'm upset, I become angry with myself for feeling that way	0.77	0.04	−0.54, 0.28, 0.65, 1.30
Q12: When I'm upset, I become embarrassed for feeling that way	0.76	0.05	−0.45, 0.24, 0.89, 1.57
Q21: When I'm upset, I feel ashamed with myself for feeling that way	0.87	0.03	−0.43, 0.43, 0.80, 1.20
Q23: When I'm upset, I feel like I am weak	0.39	0.07	−0.57, 0.25, 0.67, 1.13
Q25: When I'm upset, I feel guilty for feeling that way	0.83	0.03	−0.30, 0.43, 0.96, 1.26
Q29: When I'm upset, I become irritated with myself for feeling that way	0.88	0.03	−0.53, 0.18, 0.77, 1.260
Q30: When I'm upset, I start to feel very bad about myself	0.45	0.05	
Goal $\alpha=0.85$; $\Omega=0.88$			
Q13: When I'm upset, I have difficulty getting work done	0.81	0.03	−1.11, −0.54, 0.10, 0.8
Q18: When I'm upset, I have difficulty focusing on other things	0.90	0.02	−1.3, −0.56, −0.05, 0.85
Q20: When I'm upset, I can still get things done (R)	0.30	0.07	−1.17, −0.31, 0.45, 1.47
Q26: When I'm upset, I have difficulty concentrating	0.86	0.03	−1.38, −0.50, 0.14, 0.80
Q33: When I'm upset, I have difficulty thinking about anything else	0.88	0.03	−1.13, −0.36, 0.20, 0.80
Impulse $\alpha=0.88$; $\Omega=0.91$			
Q3: I experience my emotions as overwhelming and out of control	0.74	0.05	−0.80, 0.45, 0.94, 1.43
Q14: When I'm upset, I become out of control	0.90	0.23	0.00, 0.74, 1.20, 1.80
Q19: When I'm upset, I feel out of control	0.91	0.03	−0.21, 0.48, 1.05, 1.63
Q27: When I'm upset, I have difficulty controlling my behaviors	0.79	0.04	−0.44, 0.39, 1.07, 1.63
Q32: When I'm upset, I lose control over my behaviors	0.84	0.04	0.02, 0.91, 1.38
Q36: When I'm upset, my emotions feel overwhelming	0.52	0.07	−0.33, 0.60, 1.2
Awareness $\alpha=0.85$; $\Omega=0.88$			
Q1: I am clear about my feelings. (R)	0.73	0.04	−1.08, −0.16, 0.67, 1.43
Q2: I pay attention to how I feel. (R)	0.86	0.03	−0.76, 0.03, 0.70, 1.34
Q6: I am attentive to my feelings. (R)	0.70	0.04	−1.02, −0.19, 0.67, 1.42
Q7: I know exactly how I am feeling. (R)	0.78	0.04	−0.72, 0.06, 0.76, 1.43
Q8: I care about what I am feeling. (R)	0.70	0.05	−0.65, 0.10, 0.65, 1.34
Q10: When I'm upset, I acknowledge my emotions (R)	0.65	0.05	−0.80, −0.13, 0.43, 1.20
Q17: When I'm upset, I believe that my feelings are valid and important. (R)	0.51	0.06	−0.89, −0.16, 0.36, 1.11
Q20: When I'm upset, I can still get things done. (R)	0.33	0.06	
Q22: When I'm upset, I know that I can find a way to eventually feel better. (R)	0.68	0.05	−0.69, 0.01, 0.71, 1.26
Q24: When I'm upset, I feel like I can remain in control of my behaviors	0.049	0.07	−0.87, 0.11, 0.69, 1.42
Strategies $\alpha=0.89$; $\Omega=0.87$			
Q15: When I'm upset, I believe that I will remain that way for a long time	0.82	0.04	−0.45, 0.24, 0.92, 1.47
Q16: When I'm upset, I believe that I'll end up feeling very depressed	0.82	0.04	−0.36, 0.28, 0.60, 1.23
Q23: When I'm upset, I feel like I am weak	0.44	0.07	
Q28: When I'm upset, I believe that there is nothing I can do to make myself feel better	0.74	0.05	−0.26, 0.53, 1.16, 1.76
Q30: When I'm upset, I start to feel very bad about myself	0.52	0.06	−0.63, 0.09, 0.41, 1.13
Q31: When I'm upset, I believe that wallowing in it is all I can do	0.75	0.05	−0.14, 0.37, 0.89, 1.42
Q35: When I'm upset, it takes me a long time to feel better	0.77	0.04	−0.99, −0.01, 0.63, 1.26
Q36: When I'm upset, my emotions feel overwhelming	0.43	0.06	−1.02, −0.14, 0.37, 1.02
Clarity $\alpha=0.80$; $\Omega=0.84$			
Q4: I have no idea how I am feeling	0.68	0.06	
Q5: I have difficulty making sense out of my feelings	0.79	0.05	−0.69, 0.25, 0.94, 1.42
Q9: I am confused about how I feel	0.92	0.04	−0.64, 0.38, 0.89, 1.77

Items in italics load on a different factor than their parent factor or cross-load on multiple factors. *Q* question, *SE* standard error

Table 6 Validity analyses: correlations between DERS factors and the BAI, BDI-II, and TAS-20

Factor	1	2	3	4	5	6
1	*DERS Nonacceptance*	–				
2	*DERS Goal*	0.53**	–			
3	*DERS Impulse*	0.62**	0.73**	–		
4	*DERS Awareness*	−0.02	0.03	0.06	–	
5	*DERS Strategies*	0.66**	0.79**	0.66**	0.20*	–
6	*DERS Clarity*	0.65**	0.50**	0.57**	0.31**	0.61**	–
7	*BAI*	0.61**	0.58**	0.54**	−0.19	0.64**	0.62**
8	*BDI-II*	0.62**	0.63**	0.50**	−0.21	0.77**	0.59**
9	*TAS-20 Total*	0.05	0.13	0.15	0.47*	0.16	0.62**
10	*TAS-20 Difficulty Identifying*	0.26	0.29	0.33	0.40*	0.32	0.61**
11	*TAS-20 Difficulty Describing*	0.46*	0.22	0.39*	0.61**	0.33	0.73**

DERS Difficulties with Emotion Regulation Scale, *BAI* Beck Anxiety Inventory, *BDI-II* Beck Depression Inventory, 2nd Ed., *TAS-20* Toronto Alexithymia Scale, 20

*$p < 0.05$; **$p < 0.01$

Reliability

Results of reliability analyses revealed good-to-excellent inter-item correlations based on Cronbach's α. These results are shown in Table 5. Values ranged from 0.80 to 0.90, with *Nonacceptance* having the highest internal consistency and *Clarity* the lowest, although well within an acceptable range. Similarly, the subscales showed good reliability based on Ω, ranging from 0.84 to 0.91, with *Clarity* the lowest and *Impulse* the highest.

Construct Validity

Construct validity analyses indicated moderately-strong-to-strong positive associations between the measures of anxiety and depression with the factor scores of the following five *DERS* subscales: *Nonacceptance*, *Goals*, *Impulse*, *Strategies*, and *Clarity*. In contrast, the *Awareness* subscale was not correlated with either anxiety or depression. Results for alexithymia demonstrated moderate-to-strong positive associations between the *DERS Awareness* and *Clarity* subscales and the *TAS-20 Total, Difficulty Identifying, and Difficulty Describing* subscales. Additionally, the *DERS Nonacceptance* subscale was moderately positively associated with *TAS-20 Difficulty Describing*. These results are displayed in Table 6.

Discussion

While emotion dysregulation is a common concern for many autistic people, our ability to measure this construct, especially using self-report, is limited by a lack of measures validated among autistic people. In this study, we examined the psychometric properties of the *DERS*, a frequently used self-report measure of emotion regulation, among a sample of autistic adolescents and adults. Results from our evaluation of the factor structure, reliability, and construct validity of the scale are promising and generally support its utility for this population.

Factor Structure

Regarding the factor structure, our results support a 6-factor structure, similar to that found in the general population (Gratz & Roemer, 2004; Neumann et al., 2010). Given that our final factor structure is neither a unidimensional score nor a bifactor or second-order model, we do not recommend the use of the *DERS* Total Score with autistic adolescents or adults. Perhaps a dysregulation factor reflecting shared common variance does not emerge in the same manner among an autistic sample as some evidence has suggested in the general population (Bardeen et al., 2012, 2016; Benfer et al., 2019; Hallion et al., 2018; Nordgren et al., 2020; Osborne et al., 2017); the multidimensionality of emotion dysregulation may be more pronounced in autistic people. This idea is consistent with the multidimensionality of the caregiver-reported *EDI*, such that there are related, yet independent, dimensions of dysregulation in autistic people (Mazefsky et al., 2018a, b). The pattern of factor loadings that informed the modifications we made here are similar to those found in prior studies in the general population (Gratz & Roemer, 2004; Weinberg & Klonsky, 2009; Table 7). In prior studies, however, a factor loading cut-off of 0.40 was used, rather than the 0.30 convention. Therefore, these items were not necessarily flagged for cross-loadings or loadings on alternate factors. As such, the modifications indicated by our results may not be specific to autism, and may, instead, reflect the complexity of measuring emotion

Table 7 Item modifications in current analyses: comparisons with item performance in prior studies

	Item	Parent factor	Gratz and Remer (2004)	Weinberg and Klonsky (2009)	Current analyses
			Undergraduate students	High school students	Autistic adolescents and adults
1	I am clear about my feelings	Clarity	Clarity (0.42) and **Awareness (0.38)**	**Awareness (0.73)**	**Awareness (0.73)**
7	I know exactly how I am feeling	Clarity	Clarity (0.59) and **Awareness (0.32)**	**Awareness (0.71)**	**Awareness (0.71)**
20	When I'm upset, I can still get things done	Goals	Goals (0.64)	Goals (0.60) and **Awareness (0.34)**	Goals (0.60) and **Awareness (0.34)**
22	When I'm upset, I know that I can find a way to eventually feel better	Strategies	Strategies (0.49) and **Awareness (0.43)**	**Awareness (0.61)**	**Awareness (0.61)**
23	When I'm upset, I feel like I am weak	Nonacceptance	Nonacceptance (0.41)	**Strategies (0.37)**	Nonacceptance (0.48) and **Strategies (0.44)**
24	When I'm upset, I feel like I can remain in control of my behaviors	Impulse	Impulse (0.40)	**Awareness (0.37)**	**Awareness (0.42)**
30	When I'm upset, I start to feel very bad about myself	Strategies	Strategy (0.45) and **Nonacceptance (0.34)**	Strategies (0.63) and **Nonacceptance (0.44)**	Strategies (0.53) and **Nonacceptance (0.43)**
34	When I'm upset, I take time to figure out what I'm really feeling	Awareness	Awareness (0.57)	Awareness (0.51)	**None**
36	When I'm upset, my emotions feel overwhelming	Strategies	Strategies (0.45)	Strategies (0.36)	Strategies (0.30) and **Impulse (0.39)**

Standardized factor loadings are presented in parentheses. Bolded subscales are different from the parent factor

regulation broadly. In terms of the specific items (1, 7, 22, 24) that did not load on their parent factors in our analyses, prior work has similarly found that many of these items did not (or did not only) load on their parent factor in samples of adolescents (items 1, 7, 22, 24) (Weinberg & Klonsky, 2009) and general population of adults (items 1, 7, 22) (Gratz & Roemer, 2004). Four of these items (1, 7, 22, 24) loaded on our *Awareness* subscale. Given that *Awareness* was correlated with a measure of alexithymia, it is possible that symptoms of alexithymia underlie responses on these questions about internal experiences; this may be especially true given the high rates of alexithymia among autistic people (Poquérusse et al., 2018). We also noted that two of our cross-loading items (23 and 30) loaded on both the *Nonacceptance* and *Strategies* subscales, similar to findings of other studies (Gratz & Roemer, 2004; Weinberg & Klonsky, 2009). Items 34 and 36 seemed to function in a unique way specific to our sample. Item 34 (taking time to identify emotions) did not load on any factor in our analyses, and item 36 (emotions feeling overwhelming) loaded on the *Impulse* subscale as well as its parent subscale, *Strategies*. It is possible that the phrasing of these items is not ideal for autistic adolescents and adults.

Reliability

Our examination of inter-item correlation and internal consistency demonstrated good reliability using Cronbach's α and *Ω* (the latter of which is a more robust and psychometrically-sound assessment; McNeish, 2018). As such, we can conclude that the items in each subscale are generally measuring the same construct. Our α estimates are highly similar to those reported by studies of the *DERS* among adults and adolescents in the general population (Gratz & Roemer, 2004; Weinberg & Klonsky, 2009). These findings are consistent with the reliability of the *CBCL DP*, identified by Keefer et al. (2019), wherein the general dysregulation factor had an *Ω* of 0.96, while the subdomain factors had *Ω*s between 0.86 and 0.95.

Construct Validity

With regard to construct validity, our findings suggest positive relations between the *DERS* and anxiety and depression, demonstrating construct validity of the *DERS* among autistic adolescents and adults. The magnitude of these correlations suggests that, while emotion regulation as measured by the *DERS* subscales is strongly linked with anxiety and depression, it is indeed a separate and distinct construct. Interestingly, we observed that the *Awareness* subscale was not only unrelated to most of the other subscales (correlating only moderately with the *Clarity* subscale), but it also was not associated with measurements of anxiety and depression. In previous work, this subscale had the weakest relation with other subscales and constructs of interest, specifically depression, in a general population sample (Weinberg & Klonsky, 2009). In contrast, alexithymia was uniquely related to the *DERS Awareness* and *Clarity* subscales. Therefore, it may be that these two *DERS* subscales are capturing a construct more closely related to emotion identification, rather than emotion regulation. These findings are in line with previous research that has advocated for removing the *DERS Awareness* items from the *DERS* total score (Bardeen et al., 2012). Due to the low inter-item correlation we observed in this sample ($\alpha = 0.31$), we excluded the *Externally-oriented Thinking* subscale from our validity analyses, however, this finding merits discussion in its own right. Given this subscale's focus on concrete *versus* imaginal thinking, it could be that difficulties with theory of mind, common among autistic people (Baron-Cohen, 2000), influenced this result. One recent study examined the inter-item correlation of the *TAS-20* in a sample of autistic and non-autistic adults and found an α of 0.60 for this subscale (Ryan et al., 2020). They did not report αs by group; therefore, replication of this finding is needed in an autistic sample.

Clinical Implications

Our results demonstrate promise for the use of the *DERS* in clinical practice by informing the measurement of emotion regulation among autistic adolescents and adults. Clinically, our findings suggest that the *DERS*, modified in the manner described above, may help to identify and characterize emotion dysregulation among autistic people, prompting further assessment and/or treatment. Given the poor fit of the literature standard 6-factor model, using an unmodified version of the *DERS* with autistic people will likely result in inaccurate estimations of emotion dysregulation dimensions, and thus, is not recommended. Measuring emotion dysregulation as a transdiagnostic factor may make the *DERS* a more efficient tool for providers in some clinical settings than the use of multiple questionnaires for syndrome specific assessment. This is not to suggest that emotion regulation should be measured in lieu of specific psychiatric disorders, especially in diagnostic settings. Rather, clinicians without ample time to assess for a variety of psychiatric presentations, such as those in emergency departments or primary care clinics, could use the *DERS*, when a self-report measure is merited, to screen for more significant emotional concerns, informing the need for a higher level of care (as highlighted by Keefer et al. 2019 for the caregiver-reported *CBCL-DP*). The *DERS* is also commonly used to assess treatment response to *Dialectical Behavior Therapy* (*DBT*; e.g., Goodman et al., 2014), and our findings point to the potential utility of this tool for autistic adolescents and adults who may receive this treatment. One caveat to this, however, is the lack of established thresholds of emotion dysregulation severity for the *DERS*.

Because the *DERS* is a self-report questionnaire, unlike other measures of emotion regulation among autistic people (*EDI*, *CBCL DP*), its use may be warranted among adolescents and adults to supplement caregiver-report or when caregivers are not available to report on the patient's behavior. As such, the *DERS* is uniquely positioned as the only self-report measure with psychometric evidence in autistic samples.

Finally, clinicians should bear in mind that many of the items on the *DERS* inquire about cognitive states, which may be difficult for autistic people to report upon (Mazefsky, Kao, & Oswald, 2011); these individual differences could influence scores on the *DERS*. Future research is needed to examine whether and how items on the *DERS* are endorsed differently (e.g., Differential Item Functioning) by autistic people with varying levels of alexithymia and verbal and/or cognitive ability. Moreover, clinicians should be cognizant of the strengths and limitations of the existing emotion regulation measures with evidence for use among autistic adolescents and adults. The *CBCL DP* was developed from common psychiatric symptoms and problem behaviors and relies on caregiver-report. The *EDI* has demonstrated sensitivity in autistic samples and focuses on behavioral observations from caregivers related to emotional reactivity and dysphoria. The *DERS* is the only self-report measure with empirical psychometric support for use among autistic people, although it requires insight into one's own emotional states and coping strategies, therefore, it may be best used with autistic adolescents and adults without intellectual disability and with low levels of alexithymia.

Future Directions

In addition to the above recommendations, there are several directions for future research we would like to suggest. First, while the *DERS* has demonstrated good test–retest reliability in the general population (Gratz & Roemer, 2004), the stability of the *DERS* has yet to be tested in an autistic sample. Evaluating test–retest reliability in the absence of an intervention would be beneficial, particularly for researchers who wish to examine the *DERS* as a marker of response to treatment.

Second, we observed one item (34, taking time to identify emotions) did not load well onto any factor. Accordingly, researchers may wish to exclude this item from their analyses. It would be helpful for future research to replicate this finding to confirm that this item should be excluded from future analyses. Given the functioning of some items, including this one, it may be beneficial for future work to examine autistic adults' perceptions of the items on the *DERS* and adapt the measure accordingly, similar to recent work examining a measure of suicidal ideation (Cassidy et al., 2020).

Third, in order to better parse the heterogeneity of the relation between emotion dysregulation from related but distinct constructs, such as alexithymia, in autistic samples, future research should examine additional correlates with the *DERS*, including caregiver-report, clinical judgment, physiological markers, and neural mechanisms of emotion dysregulation. Additionally, examining the correlation of the *DERS* with another measure of emotion regulation in comparison to the magnitude of correlations with other related constructs would help to establish convergent validity (i.e., multitrait–multimethod; Campbell & Fiske, 1959); we would expect the association with a measure of emotion regulation to be stronger than those with anxiety and depression reported here. Beck et al. (2020) note that physiological measures of emotion dysregulation in autistic people, such as skin conductance and heart rate variability, are more objective markers of emotion dysregulation in this population, but that equipment may be expensive or difficult for researchers to obtain. Moreover, emerging research has revealed neural mechanisms of emotion dysregulation in autistic people, though these correlates have yet to be compared to self-report (Mazefsky et al., 2020a, b; Pitskel et al., 2014; Richey et al., 2015). Altogether, validation with other reports, physiological markers, and neural mechanisms may result in more precise and targeted measurement of emotion regulation.

Strengths and Limitations of the Present Study

We believe this study had notable strengths. Analytically, we used diagonally-adjusted weighted least-squares estimator to account for the categorical nature of the data, which does not rely upon assumptions of normal-theory-based methods (e.g., association between items and latent factor are linear). We also utilized Ω as a measure of reliability, in addition to Cronbach's α. Ω Does not assume τ-equivalence (i.e., same factor loadings across items), making it a more robust reliability metric (McNeish, 2018).

The study has several limitations that merit discussion. First, although data were drawn from a large repository and supplemented with another dataset, our final sample was small for psychometric analyses. This is especially pertinent when conducting both EFA and CFA—ideally, half of the sample would be used for each of these analyses and overlap in data across the analyses would be avoided. This small sample limits our ability to draw robust conclusions based on this data alone. Therefore, future studies should seek to replicate our CFA findings with a larger sample wherein EFA and CFA can each be conducted. Additionally, given our small sample size, we are unable to test for measurement invariance across the four combined samples. Second, we recognize that the sample, in part because it was drawn from a data repository, demonstrated homogeneity in terms of demographic characterization. In particular, our final sample was predominantly White and only 83.33% were administered a gold-standard autism assessment measure (the *ADOS*). Furthermore, studies varied in their collection and reporting of demographic data, limiting our ability to report these details to the recommended degree (Appelbaum et al., 2018). These results should also be considered within the context of the clinical sampling. The Virginia Tech dataset ($n = 15$) recruited adolescents whose parents reported high degrees of social anxiety symptoms, indicating potentially increased difficulties with emotion regulation compared to the general autistic sample. Similarly, one of the NDAR datasets is from a study entitled "Development of a novel neurotechnology to promote emotion recognition in autism," which may imply these adolescents and adults had greater difficulty recognizing emotions, one component of emotion dysregulation. A measure of ADHD was also not available for this sample; thus, we could not determine the relation between impulsivity and the *DERS* here.

In conclusion, our preliminary psychometric evaluation of the *DERS* in a sample of autistic adolescents and adults points to its potential utility to capture and characterize emotion dysregulation in clinical settings. For researchers wishing to use this tool in their studies, further examination, including independent replication of the CFA in a larger sample, establishing thresholds of severity, differential item functioning analyses based on alexithymia and verbal/cognitive ability, test–retest reliability, and a focus group with autistic self-advocates is merited. Overall, our preliminary evidence for the psychometric properties of the *DERS* in an autistic sample is promising.

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Declarations

Conflict of interest All authors declare they have no conflict of interest.

Ethical Approval All procedures performed in studies involving human participants were in accordance with the Ethical Standards of the Institutional Research Committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Informed Consent Informed consent was obtained from all individual participants included in the study.

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