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BRIEF REPORT

Emotion Dysregulation and the Core Features of Autism Spectrum Disorder

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Abstract The aim of this study was to examine the relationship between emotion dysregulation and the core features of Autism Spectrum Disorder (ASD), which include social/communication deficits, restricted/repetitive behaviors, and sensory abnormalities. An 18-item Emotion Dysregulation Index was developed on the basis of expert ratings of the Child Behavior Checklist. Compared to typically developing controls, children and adolescents with ASD showed more emotion dysregulation and had significantly greater symptom severity on all scales. Within ASD participants, emotion dysregulation was related to all core features of the disorder, but the strongest association was with repetitive behaviors. These findings may facilitate the development of more effective therapeutic strategies targeting emotion dysregulation in order to optimize long-term outcomes for individuals with ASD.

Keywords Autism Spectrum Disorder · Core features · Emotion regulation · Restricted/repetitive behaviors · Social/communication deficits · Sensory abnormalities

Introduction

Autism Spectrum Disorder (ASD) is a pervasive neurodevelopmental disorder that is characterized by difficulties with social and communicative functioning, restricted interests, repetitive behavior, and sensory deficits (APA 2000; Kientz and Dunn 1997, Tomchek and Dunn 2007). Recent prevalence data indicate that as many as 1 in 88 children are diagnosed with ASD (CDC 2012). ASD is a life-long disorder and poses significant challenges to the affected individuals and their families, and to the educational and social support systems. While a better understanding of core deficits is essential to provide the necessary assistance, one particular challenge posed by ASD is the associated feature of emotion dysregulation.

Emotion dysregulation—broadly defined as the failure to regulate emotions appropriately and effectively—is not considered a core deficit in ASD; however, both parents and clinicians have long emphasized the important role played by maladaptive emotional responses in ASD which might be a result of dysregulated emotions (Geller 2005). These responses take the form of irritability, poor anger control, temper tantrums, self-injurious behavior, aggression, and mood dysregulation (Lecavalier et al. 2006; Prizant and Laurent 2011; Quek et al. 2012). In addition, there is an increasing recognition of the impact of severe emotion disturbances in ASD (Laurent and Rubin 2004; Mazefsky et al. 2012; Samson et al. 2012), and initial empirical findings suggests that maladaptive emotional responses may contribute to impaired functioning (Jahromi et al. 2013) and could consequently affect long-term outcome.

Despite the clinical significance of emotion dysregulation in ASD, only a handful of empirical studies have addressed this topic. Maladaptive or idiosyncratic strategies (see Laurent and Rubin 2004), such as avoidance, venting, or crying, are used more frequently by children with ASD (Konstantareas and Stewart 2006; Jahromi et al. 2012). Recently, one study suggested that children and adolescents with ASD made less frequent and less effective use of adaptive emotion regulation strategies such as goal-

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directed behaviors or social support seeking compared to typically developing youth (Jahromi et al. 2012). This decreased use of adaptive and increased use of maladaptive emotion regulation strategies has also been shown in adults, where individuals with ASD were found to use less cognitive reappraisal, but more often expressive suppression than matched non-ASD participants (Samson et al. 2012). What is not known, however, is how core features of ASD are related to emotion dysregulation.

The aim of the present study is to examine the association between emotion dysregulation and the core features of ASD including deficits in social and communication functioning, restricted and repetitive behavior, and sensory sensitivities. An emotion dysregulation index (EDI) was calculated on the basis of items from the Child Behavior Checklist (CBCL, Achenbach 1991) which best represent emotion dysregulation based on expert judgments. We hypothesized that 1) children and adolescents with ASD would show more emotion regulation difficulties than typically developing (TD) controls, and 2) within ASD participants, emotion dysregulation would be associated with the core features, even when controlling for cognitive and adaptive functioning. We also wanted to explore which of the core features would be the most predictive of emotion dysregulation.

Methods

Participants

Fifty-six individuals with ASD (47 males, 9 females) and 38 TD (26 males, 12 females) participants between the ages of 6 and 16 years were included in the study. ASD ($M = 10.11$, $SD = 2.68$) and TD participants ($M = 10.00$, $SD = 2.85$) did not differ by age ($t(92) = .19$, $p = .85$) or gender ($\chi^2(1) = 3.14$, $p = .08$). The sample consisted of 59.6 % Caucasian, 17 % Asian, 5.3 % Hispanic, 5.3 % were biracial, and 4.3 % indicated others ethnicities (8.5 % declined to answer or information was missing). No group differences was observed when comparing Caucasians to all other ethnicities ($\chi^2(1) = .50$, $p = .48$).

Eligibility criteria were as described below. Participants with ASD were identified from a clinic specializing in ASD and developmental disabilities and a research registry. The autism diagnosis was established through expert clinical evaluation based on the DSM-IV-TR and confirmed with the Autism Diagnostic Interview-Revised (ADI-R) and Autism Diagnostic Observation Schedule (ADOS; Lord et al. 1994, 2000). The ADI-R is administered to the parent and consists of 88 items that are informed by the ICD-10 and DSM-IV-TR diagnostic criteria (APA 2000) for autistic disorder. The ADOS is a semi-structured instrument that allows assessment of children through behavioral observations during specific play, social, and language tasks (Lord et al. 2000). Children with secondary autism related to a specific genetic etiology (e.g., tuberous sclerosis, Fragile X) were excluded, as were potential subjects with evidence of metabolic or infectious disorders.

TD controls were recruited through advertisements in areas that are comparable to the socio-economic status of the ASD participants. Exclusion criteria for the TD controls were any evidence of any psychiatric disorder such as schizophrenia, bipolar disorder, depressive disorders, or anxiety disorders on the basis of screenings using face-to-face evaluations (Kiddie-Schedule for Affective Disorders and Schizophrenia for School-Aged Children, K-SADS PL, Kaufman et al. 1997), questionnaires, telephone interviews, medical and psychiatric history, and observation during psychometric tests. The K-SADS is a semi-structured diagnostic interview designed to assess current and past episodes of psychopathology in adolescents according to DSM-III-R and DSM-IV criteria.

Participants were included only if the CBCL data and if at least four of the following five measures described below were available. Methodology of the study was approved by the Institutional Review Board.

Measures

All participants were characterized using the following instruments and questionnaires to assess cognitive and adaptive functioning, as well as the core features of ASD.

The Stanford Binet, 5th Edition (SB5; Roid 2003) was administered to determine cognitive functioning. It provides an overall (Full Scale) IQ score (FSIQ). The Vineland Adaptive Behavior Scales, 2nd Edition (VABS-2, Sparrow et al. 2005) is a parent interview measuring adaptive behavioral functioning in the following domains: Socialization, Communication, Daily Living Skills, Motor Skills, and an overall Adaptive Behavior Composite score. The Social Responsiveness Scale (SRS, Constantino and Gruber 2005; Constantino and Todd 2003; Constantino et al. 2000, 2003) is a questionnaire developed to measure social and communication deficits in both clinical and non-clinical populations and assesses the following domains: Total score (which reflects severity of social and communication deficits), Social Cognition, Social Motivation, Social Awareness, Social Communication, and Autism Mannerisms. The Repetitive Behavior Scale-Revised (RBS-R, Lam and Aman 2007; Bodfish et al. 2000) is a questionnaire filled out by parents capturing six domains of restricted repetitive behaviors in ASD: Stereotyped Behavior, Self-Injurious Behavior, Compulsive Behavior, Ritualistic Behavior, Sameness Behavior and Restricted Behavior. The Short Sensory Profile (SSP, McIntosh et al.

1999) is a questionnaire that provides subscales to reflect atypical sensory processing in different domains (Tactile Sensitivity, Taste/Smell Sensitivity, Movement Sensitivity, Underresponsive/Seeks Sensation, Auditory Filtering, Low Energy/Weak, and Visual/Auditory Sensitivity) and provides a total score.

Emotion Dysregulation Index (EDI)

Items from the *Child Behavior Checklist* (CBCL, Achenbach 1991), a parent-report measure assessing problem behaviors (e.g., aggressive behavior), were used to derive an emotion dysregulation (EDI) index. Twenty-three clinicians and experts working in the field of child psychiatry and emotion regulation research and highly familiar with the CBCL examined each item of the CBCL. They assessed to what degree they thought each item related to emotional dysregulation (relevancy) from 1 = not at all, 2 = somewhat, to 3 = extremely, and how confident they were regarding their judgment (confidence) from 1 = no, 2 = somewhat, to 3 = extremely. No specific definition for emotion dysregulation was given in order to get unbiased judgments on emotion regulation issues.

For each item, mean scores for relevancy and confidence were formed. Considering all CBCL items, the average relevancy score was 1.79 ($SD = .42$) and an average confidence score of 2.18 ($SD = .18$). Eighteen items were selected to be relevant for emotional dysregulation on the basis of the following criteria: (a) average relevancy scores >2, (b) more than 10 clinicians/experts rated that particular item to be extremely relevant, and (c) at least 20 clinicians/experts rated the item extremely or somewhat relevant, and (d) the average confidence ratings were >2. The 18 items that were selected to form the EDI had an average relevancy score was 2.53 ($SD = .17$) and an average confidence score of 2.43 ($SD = .15$). Internal consistency, computed on the basis of the sample described in the present study, proved to be satisfactory (Cronbach's alpha = .90).

The 18 items selected were originally in different subscales of the CBCL (aggressive, social problems, anxious/depressed, withdrawn/depressed, and thoughts problems), and represent various problematic internalizing and externalizing behaviors (e.g., screaming, arguing, or crying a lot, destroying things, getting into fights, being nervous, highstrung, or tense, sudden mood changes).

Statistical Analyses

Group comparisons were completed by independent *t*-tests, or ANCOVAs when including covariates. The association between the EDI and the core features were tested by means of correlations with and without controlling for cognitive and adaptive functioning to assess whether these factors would explain differences in emotion dysregulation. Analyses were primarily completed on the total scores, and secondarily on the subscales when indicated. In addition, a multiple regression analysis was applied to determine which of the core features were most predictive of emotion dysregulation. The predictors, which are the total scores of the instruments and questionnaires, were tested beforehand for multi-collinearity, and the VIF was <5 for all variables. In addition, all the core features, as well as cognitive and adaptive functioning did not correlate higher than .59.

Table 1 Clinical features in participants with Autism Spectrum Disorder (ASD) and typically developing participants (TD)

	ASD M (SD)	TD M (SD)	Statistics
Emotion dysregulation	(N = 56) .52 (.37)	(N = 38) .13 (.14)	$t(92) = 6.33$***
Cognitive functioning (FSIQ)	(N = 53) 82.75 (23.61)	(N = 37) 112.35 (9.98)	$t(88) = -7.18$***
Adaptive functioning (VABS)	(N = 52) 76.52 (11.26)	(N = 33) 108.45 (12.41)	$t(83) = -12.25$***
Social Responsiveness Scale[a]	(N = 52) 96.64 (27.66)	(N = 37) 22.14 (12.51)	$t(88) = 15.30$***
Restricted and Repetitive Behavior Scale-Revised[a]	(N = 54) 28.31 (24.64)	(N = 36) 2.72 (4.43)	$t(88) = 6.16$***
Short Sensory Profile[a]	(N = 55) 138.49 (23.48)	(N = 38) 177.08 (12.95)	$t(91) = -9.20$***

Emotion dysregulation was measured with the Emotion Dysregulation Index; *FSIQ* full scale IQ, Standard Score of the Stanford Binet; *VABS* Vineland Adaptive Behavior Scales, Composite Standard Score

*** $p < .001$

[a] Total score

Results

Preliminary Analyses

The relationships between gender, age, and cognitive functioning with EDI in the full sample (ASD and TD) were first explored. Males ($M = .40$, $SD = .36$) scored slightly higher than females ($M = .24$, $SD = .27$) on the EDI, but differences did not reach statistical significance ($t(92) = 1.83$, $p = .07$). The EDI was not associated with age ($r(94) = .02$, $p = .85$) nor with FSIQ ($r(90) = -.19$, $p = .07$). Differences in clinical measures between the

Table 2 Correlations between emotion dysregulation and clinical features in participants with Autism Spectrum Disorder (ASD)

	Emotion dysregulation	Emotion dysregulation (controlled for cognitive and adaptive functioning)
Cognitive functioning (FSIQ)	$r(53) = .25, p = .08$	–
Adaptive behavior (VABS)	$r(52) = .02, p = .89$	–
Social Responsiveness Scale[a]	$r(53) = .52, p < .001$	$r(41) = .43, p = .004$
Restricted and Repetitive Behavior Scale-Revised[a]	$r(54) = .44, p = .001$	$r(41) = .47, p = .002$
Short Sensory Profile[a]	$r(55) = -.51, p < .001$	$r(41) = -.45, p = .002$

FSIQ Full scale IQ, Standard Score of the Stanford Binet; *VABS* Vineland Adaptive Behavior Scales, Composite Standard Score

[a] Total score

ASD group and controls were also examined. As expected, the two groups differed significantly on all total scores and subscales of the instruments and questionnaires as summarized in Table 1 (the comparisons remained significant, even with Bonferroni adjusted comparisons within each scale). The mean FSIQ of the ASD sample was in the average range despite including subjects with low cognitive abilities (ASD range 40–129, TD range 90–141).

Group Differences in Emotion Dysregulation

As expected, the two groups differed significantly in the EDI ($t(92) = 6.33, p < .001$). Differences between the groups on the EDI remained significant even after controlling for gender, age, FSIQ and adaptive functioning ($F(5, 81) = 7.57, p < .001$), confirming our first hypothesis. 52 % of the children in the ASD group scored higher than 2 *SD* of the mean observed in the control group.

Emotion Dysregulation and Core Features in ASD Participants

Within the ASD group, the EDI was significantly correlated with the total scores of the core features as measured by the Social Responsiveness Scale, Repetitive Behavior Scale-Revised, and Short Sensory Profile. No association was observed between EDI and FSIQ and adaptive functioning as assessed by the SB5 and VABS-2, respectively. The relationship between the EDI and core features remained significant, even after controlling for adaptive and cognitive functioning (see Table 2).

Secondary analyses were completed to examine the relationship between the EDI and the subscales of the Social Responsiveness Scale, Repetitive Behavior Scale-Revised, and Short Sensory Profile with Bonferroni adjustments for multiple comparisons within each scale. The EDI was significantly correlated with the following subscales of the Social Responsiveness Scale: Social Cognition ($r(53) = .39, p < .05$), Social Communication ($r(53) = .51, p < .001$), and Autism Mannerisms ($r(53) = .61, p < .001$). Significant associations were found with the following subscales of the Repetitive Behavior Scale-Revised: Stereotyped Behavior ($r(54) = .36, p < .05$), Self-Injurious Behavior ($r(54) = .36, p < .05$), Ritualistic Behavior ($r(54) = .37, p < .05$), and Sameness Behavior ($r(54) = .36, p < .05$). Within the Short Sensory Profile, significant associations were found for Underresponsive/Seeks Sensation ($r(55) = -.57, p < .001$), and Auditory Filtering ($r(55) = -.43, p < .01$).

A multiple regression analysis was used to test which of the core features predicted emotion dysregulation best. We entered age, gender, FSIQ, and adaptive functioning (Composite Standard Score on the VABS-2) as predictors in order to partial out any variance associated with these factors. The results of the regression indicated that the entire model explained 42 % of the variance ($R^2 = .42$, $F(7,44) = 3.87, p < .01$). Interestingly, restricted and repetitive behaviors, as measured by the Repetitive Behavior Scale-Revised, was the only significant predictor for emotion dysregulation, when the other variables are held constant ($\beta = .36, p < .05$, see Table 3) and explains an additional 5 % of variance in emotion dysregulation above and beyond the other predictors ($\Delta R^2 = .05$, in comparison to a regression model that did not contain repetitive behavior)[1].

Discussion

Our findings are consistent with previous investigations reporting high rates of emotion dysregulation in individuals with ASD (Laurent and Rubin 2004; Samson et al. 2012). However, to our knowledge, this is the first study to provide preliminary evidence supporting a relationship between all the core features of autism and emotion dysregulation. Findings indicate that symptom severity in each of the core features of autism, including deficits in social and communication functioning, repetitive behaviors, and sensory abnormalities, is significantly related to emotion dysregulation. These observations, specifically the association between EDI and social and communication deficits, are consistent with previous reports of an association

[1] A regression analysis was also conducted within the TD controls, and no variable was found to be a predictor of emotion dysregulation.

Table 3 Predictors of emotion dysregulation in participants with Autism Spectrum Disorder (ASD)

	β	t ($df = 36$)
Gender	.20	1.29
Age	−.12	−.63
Cognitive functioning (FSIQ)	.18	.90
Adaptive functioning (VABS)	.11	.69
Social Responsiveness Scale[a]	.20	1.01
Restricted and Repetitive Behavior Scale-Revised[a]	.36*	2.10
Short Sensory Profile[a]	−.24	−1.32

Multiple regression analysis with emotion dysregulation as dependent variable and age, gender, cognitive and adaptive functioning, and the different core features as predictors

$R^2 = .42$, Adjusted $R^2 = .31$, $F(7, 44) = 3.87$, $p < .01$. Standardized coefficients are reported; * $p < .05$

FSIQ Full scale IQ, Standard Score of the Stanford Binet; *VABS* Vineland Adaptive Behavior Scales, Composite Standard Score

[a] Total score

between poor social abilities (i.e., Theory of Mind, perspective taking abilities) and emotion dysregulation (Samson et al. 2012) and studies that provided initial evidence for a link between emotion dysregulation and social competences (i.e., prosocial peer engagement, see Jahromi et al. 2013).

Interestingly, restricted and repetitive behaviors appeared to be the best predictors of emotion dysregulation, when other factors are held constant. This finding might indicate that individuals with ASD with severe repetitive and restricted symptoms are less able to regulate their emotions due to difficulties inhibiting ongoing behaviors. This observation is consistent with Mazefsky et al. (2012) who suggested that perseveration (an example of a repetitive behavior) can lead to the development and maintenance of emotion regulation difficulties. However, an alternative explanation is that emotion dysregulation in ASD triggers compensatory control mechanisms expressed by restricted and repetitive behaviors. Consequently, the clusters of symptoms that include preoccupation with stereotyped and restricted patterns of interest, inflexibility to changes in the environment, and stereotyped and repetitive motor mannerisms could be the manifestation of a deficient emotion regulation system subserved by frontal and subcortical networks (Goldin et al. 2008; Ochsner and Gross 2008). Although plausible, this hypothesis requires additional multimodal investigations to further examine these relationships in a longitudinal design.

Future research will also be needed to address the specificity of the relationships between emotion dysregulation and severity of core features. It is also essential to determine whether the severity of all core features predict emotion dysregulation or, as observed here, emotion dysregulation is mostly related to restricted and repetitive behaviors. Additionally, findings from this study raise the question of whether emotion dysregulation should be considered as part of the core features in ASD or as associated symptoms. Currently, symptoms of emotion dyregulation are not listed as part of the required criteria for ASD in the DSM-V. If further evidence becomes available from comprehensive multimethod investigation linking emotion dysregulation to the core features, it will pave the way for new approaches in understanding the pathology of ASD symptomatology.

This step is crucial in the development of effective treatment for emotion dysregulation that could also improve the core features of autism, especially restricted and repetitive behaviors. This strategy offers a unique opportunity to target these traditionally treatment-resistant behaviors with the development of training programs that aim at promoting emotion regulatory processes (Prizant et al. 2003; Sofronoff et al. 2007; Scarpa and Reyes 2011). Finally, the availability of such training programs might also decrease the use of pharmacological agents associated with severe side effects (e.g., antipsychotic medications), to reduce disruptive behaviors related to emotion dysregulation, such as irritability, temper tantrums, aggression, or self-injurious behavior (Owen et al. 2009).

Several limitations of this study bear noting. First, in this study, items from the CBCL were used to develop the EDI. However, some of these items could also be seen as indices of excessive emotional reactivity (e.g., "too fearful or anxious"). Since it is at times difficult to distinguish emotion experience and expression from its regulation (Cole et al. 2004), future studies should attempt to more clearly distinguish between problematic emotional reactivity and difficulties with emotion regulation. This will also help to refine our working definition of emotion regulation broadly defined as the failure to regulate emotions appropriately and effectively. A second notable limitation is that the sample size is relatively small. Given that multiple regression analysis was applied with seven predictors on 56 participants with ASD, the findings need to be confirmed with larger sample sizes. Future studies should include a higher number of participants to facilitate the ability to test our findings with more complex statistical models (structure equation modeling, for example). Third, our sample was characterized by a wide age range, enabling us to examine the existence of any age effect on different variables. However, future studies should include a narrower age range. Fourth, this investigation was cross-sectional and longitudinal designs should be considered in future studies to better examine the directionality of the associations observed in the present report. Finally, parent reports were used to assess symptom severity for both the core features of ASD and emotion dysregulation indices and no laboratory-based assessment was completed. Future

studies should include other methods to examine emotion dysregulation. Such investigations may, for example, focus on the use and effectiveness of specific adaptive and maladaptive emotion regulation strategies in relation to the core features of ASD. Experimental manipulation of emotion regulation skills might also help to understand the directionality of the association between core features and emotion dysregulation.

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Conflict of interest None. The work with human subjects complies with the guiding policies and principles for experimental procedures endorsed by the NIH.

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