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Association between anger rumination and autism symptom severity, depression symptoms, aggression, and general dysregulation in adolescents with autism spectrum disorder

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Abstract

Rumination has a large direct effect on psychopathology but has received relatively little attention in autism spectrum disorder despite the propensity to perseverate in this population. This study provided initial evidence that adolescents with autism spectrum disorder self-report more anger-focused rumination than typically developing controls, though there was substantial within-group variability. Anger rumination was positively correlated with autism symptom severity with both groups combined. Future studies that include measures of perseveration on special interests are needed to understand whether anger rumination is a manifestation of a perseverative type of repetitive behavior or a distinct trait. Even when controlling for autism symptom severity, however, anger-focused rumination was associated with poorer functioning, including more depression symptoms and overall emotional and behavioral dysregulation. Therefore, further inquiry regarding anger rumination in autism spectrum disorder is clinically important, and the potential impact of rumination-focused interventions should be explored.

Keywords

adolescents; aggression; anger rumination; autism spectrum disorder; depression; dysregulation; emotion regulation

Rumination

Rumination involves perseverative thoughts that revolve around a negative emotion or situation. As an unintended and involuntary process, rumination is often long lasting and can consume cognitive resources (Nolen-Hoeksema, 2000). It has received extensive attention as a maladaptive process related to the development and maintenance of psychiatric symptoms and disorders. A meta-analysis of 114 studies found that rumination has a large direct effect on overall psychopathology across disorders (Aldao et al., 2010). In fact, this meta-analysis included the six most commonly studied emotion regulation strategies and found that the

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association between rumination and psychopathology was stronger than any other process assessed, such as problem-solving or trying to suppress emotions (Aldao et al., 2010).

Rumination has been most strongly tied to the vulnerability for and maintenance of depression (Siegle et al., 2004). Multiple studies support a prospective association between rumination and later onset of a depressive disorder (Aldao et al., 2010). Increased vulnerability to depression based on rumination has been demonstrated in children, adolescents, and adults (see Nolen-Hoeksema et al., 2008 for review). Studies have also shown that even with changes in levels of depression, individuals have stable tendencies to ruminate (Bagby et al., 2004).

Although most studies have focused on the correlation between rumination and sadness, rumination has also been linked to hostile, aggressive behavior, and anger (e.g. Bushman et al., 2005). The measures used to assess rumination are typically tied to a specific emotion. For example, the *Response Styles Questionnaire* is the most commonly used rumination assessment, and it specifically asks about thoughts and behaviors "when you feel down, sad, or depressed" (Nolen-Hoeksema, 1991). Not surprisingly, this measure is most often used in studies of depression, whereas anger-focused rumination questionnaires are usually considered in relation to outcomes such as anger intensity and aggression (e.g. Pugliese et al., 2015; Sukhodolsky et al., 2000). However, anger rumination is also correlated with depression (Peled and Moretti, 2007) and serves as a mediator between anger and depression (Besharat et al., 2013). A study that administered 16 different rumination questionnaires in three different samples concluded that they all indexed a central construct but also found specific effects on various aspects of psychiatric symptom presentation (Siegle et al., 2004).

Rumination in autism spectrum disorder

Many individuals with autism spectrum disorder (ASD) have a tendency to focus intently and excessively on one thing, a trait known as perseveration (Liss et al., 2001). In addition, accumulating evidence, including a recent meta-analysis, indicates that individuals with ASD have difficulty with inhibitory control (Geurts et al., 2014). This is noteworthy in light of experimental studies in typically developing (TD) and depressed samples demonstrating that poor inhibitory control contributes to increased rumination (e.g. Joormann and Gotlib, 2010). Thus, given both the propensity for perseveration in ASD and problems with inhibitory control, one might expect to find a greater tendency to ruminate about negative emotional experiences in this population (Mazefsky et al., 2012).

Rumination has been explored in two small ASD studies. Both adolescents (Gotham et al., 2014) and adults (Crane et al., 2013) with ASD report engaging in more frequent thoughts about their own depressive symptoms (i.e. depressive rumination) than TD controls. Similar to non-ASD populations, these studies found a moderate to high positive correlation between depressive rumination and depression symptom severity (Crane et al., 2013; Gotham et al., 2014), but neither examined whether this relationship remains after controlling for ASD symptomatology. However, a study of college students found that higher symptomatology of ASD in a non-clinical sample was associated with increased anger rumination, which in turn was associated with hostility and aggression (Pugliese et al.,

2015). Pugliese et al. were the first to examine the role of anger rumination related to symptoms of ASD, but these findings have not been replicated in a clinically diagnosed sample of individuals with ASD.

Clarifying whether there is a susceptibility to rumination in ASD may help to explain the high rates of psychiatric comorbidity. There is a growing consensus across studies that most individuals with ASD meet criteria for at least one comorbid psychiatric disorder (e.g. Leyfer et al., 2006; Simonoff et al., 2008). Although reported prevalence rates widely vary, there has been increasing attention on depression in ASD (see Magnuson and Constantino, 2011 for review). Depression may confer substantial added impairment as well as particularly high suicidal ideation rates among individuals with ASD (Cassidy et al., 2014). This finding highlights the need to identify mechanisms that underlie the co-occurrence.

In addition to comorbidities, a recent statement on the best practices for the assessment and treatment of ASD noted that individuals with ASD commonly present with a complex constellation of emotional and behavioral concerns (Volkmar et al., 2014). There is a growing body of work arguing that individuals with ASD may have underlying difficulty with self-regulation of emotions and behaviors (Mazefsky et al., 2013; Weiss, 2014). Thus, it may be important to consider the possibility that rumination is associated with more broadly defined increases in dysregulation across domains in ASD in addition to consideration of the specific presentations indicated by the TD literature, such as depression and aggression.

This study

This study compared verbal adolescents with ASD without intellectual disability and matched controls on anger rumination measures and explored their association with various indices of poor adjustment, including depression symptoms, aggressive behavior, and overall dysregulation. We focused on adolescents because adolescence is a developmental period characterized by a high degree of emotional turmoil and the development of psychiatric problems (Dahl, 2004), with some suggesting that it may be a particularly high-risk period for decline in functioning in ASD (Picci and Scherf, 2015). Furthermore, there is evidence that rumination in midadolescence mediates the relationship between negative emotionality and depression, even when controlling for the presence of depression symptoms earlier in development (Mezulis et al., 2011). Thus, although rumination is considered a stable trait (Smith and Alloy, 2009), adolescence may be a particularly sensitive period to examine the effects of rumination.

The over-arching goal of this study was to investigate the occurrence of anger rumination in ASD and its association with ASD symptoms, depression, aggression, and general emotional and behavioral dysregulation. First, we addressed whether adolescents with ASD engage in more rumination than adolescents without ASD. Given the tendency to perseverate in ASD (Mazefsky et al., 2012), reports of higher depressive rumination in ASD (Crane et al., 2013; Gotham et al., 2014), problems with inhibitory control (Geurts et al., 2014), and the link between inhibition and rumination (Joormann and Gotlib, 2010), we expected adolescents with ASD to ruminate more than the controls. As an alternative to considering individuals with ASD at increased risk of rumination, it could be argued that rumination is simply

reflective of core ASD characteristics (e.g. perseveration). Thus, we also explored the degree to which anger rumination was associated with ASD severity and whether anger rumination accounts for additional emotional and behavioral impairment above and beyond ASD symptoms. Specifically, we explored whether anger rumination was related to depression symptoms, aggression, and general dysregulation when controlling for ASD symptom severity. We included depression given the strong association between rumination and depression in the TD literature, and we included aggression based on research supporting a link between anger-focused rumination and hostile and aggressive behaviors (Pugliese et al., 2015). Given the possibility that individuals with ASD may be prone to poor self-regulation above and beyond an association with specific comorbidities (Mazefsky et al., 2013), we also explored whether rumination was associated with a composite measure of dysregulation. We expected to support an association with anger rumination across all of these domains.

Methods

Participants

Participants included 25 adolescents with ASD and 24 controls. The participants were volunteers recruited through newsletters, postings on ASD-related websites, and presentations to parents and professionals. The study also included neuroimaging (not reported here), so contradictions for neuroimaging such as history of head trauma, metal in the body, claustrophobia, and neurological disorders were exclusionary criteria. Subjects were 12–19 years of age (mean age of 15) and had an intelligence quotient (IQ) of 80 or above based on the *Wechsler Abbreviated Scale of Intelligence* (Wechsler, 1999). There were no significant differences between groups in age or IQ (see Table 1), $p > 0.05$. Participants with ASD had a *Diagnostic and Statistical Manual of Mental Disorders* (4th ed.; DSM-IV)-defined ASD diagnosis, which was verified by the Autism Diagnostic Observation Schedule (ADOS; Lord et al., 2000), the Autism Diagnostic Interview–Revised (ADI-R; Rutter et al., 2003), and expert clinical opinion from a licensed psychologist (last author (C.A.M.)). The control participants were free of any psychiatric disorders according to *Adolescent Symptom Inventory-4* (Gadow and Sprafkin, 1998) at the initial screening and had a negative family history of ASD in first- and second-degree relatives, normal Social Responsiveness Scale (SRS) scores (Constantino, 2005), and no signs of early developmental delays per parent report.

Two participants were excluded from final analyses (one ASD and one control) who did not complete the questionnaire battery. These two participants did not differ from the retained participants in age or IQ, $p > 0.05$.

Given the high rates of psychiatric comorbidity in ASD (Leyfer et al., 2006; Simonoff et al., 2008) and the association between rumination and psychopathology (Aldao et al., 2010), the psychiatric comorbidity status of the ASD participants was determined in order to better characterize the sample. Parents of participants with ASD were interviewed with the Autism Comorbidity Interview (ACI; Lainhart et al., 2003; Leyfer et al., 2006) by C.A.M. to determine the presence of both lifetime and current diagnoses based on the *Diagnostic and Statistical Manual of Mental Disorders* (4th ed., text rev.; DSM–IV–TR) (American

Psychiatric Association (APA), 2000). Only mood disorders, anxiety disorders, and attention-deficit/hyperactivity disorder were assessed. Participant's current and past diagnoses based on the ACI are listed in Supplemental Table 1.

Procedure

This study was completed in one or two visits, depending on whether eligibility assessments needed to be administered. The ADOS and IQ assessments were not completed if performed within the past 3 years by a research reliable staff member. Additionally, if a research reliable administrator ever completed the ADI-R, it was not repeated. The adolescents completed a battery of self-report questionnaires on iPads via a secure online system for data collection. A research assistant went through each questionnaire with the participant to ensure understanding and was available throughout for questions. Item responses were transferred to an Access database automatically, which was also programmed to produce applicable scores. Hand-scored data were double entered and verified to reduce errors. The study was institutional review board (IRB) approved.

Measure/materials

The Anger Rumination Scale (ARS) is a 19-item self-report questionnaire assessing cognitive processes related to feelings of anger (Sukhodolsky et al., 2001). The ARS has four subscales: anger afterthoughts, thoughts of revenge, angry memories, and understanding of causes. The first two subscales correspond to the notion that anger rumination involves thinking about recent episodes of anger or becoming angry while recalling a distant episode. The last two subscales correspond with recognizing the causes of anger and how that relates to the process of understanding an anger episode. With author permission, the first question on the scale was adjusted from "I ruminate about my past anger experiences" to "I think about my past anger experiences a lot" in order to make the question easier to understand. High scores indicate a greater tendency toward anger rumination. High internal reliability within the control group (Cronbach's alpha = 0.888) and the ASD group (Cronbach's alpha = 0.950) was observed.

The SRS is a 65-item parent questionnaire designed to describe and measure the severity of symptoms associated with ASD in social settings (Constantino, 2005). The total score was used as a metric of ASD severity. The items on the questionnaire are rated using a 4-point Likert scale ranging from "not true" (1) to "almost always true" (4). Higher total scores on the SRS indicate a greater severity of autistic traits.

The Mood and Feelings Questionnaire (SMFQ)—Short Form is a 13-item screening questionnaire for depression symptomatology over the past week (Angold et al., 1995). There is evidence for its discriminant validity in ASD (White et al., 2012). The internal consistency of the SMFQ self-report was 0.85 in the ASD group and 0.87 in the control group.

The Early Adolescent Temperament Questionnaire– Revised (EATQ-R; Ellis and Rothbart, 2001) is a measure of temperament traits in adolescents that includes an 11-item aggression scale. Higher scores on the aggression scale reflect a greater tendency to engage in hostile and aggressive actions, including person- and object-directed physical violence, direct and

indirect verbal aggression, and hostile reactivity. The internal consistency of the aggression scale was 0.78 in the ASD group and 0.81 in the control group.

The Youth Self-Report (YSR) form is an empirically derived measure of a broad range of manifestations of psychopathology (Achenbach, 1991). A pattern of elevations on the Anxious/Depressed, Aggression, and Attention Problem scales has been termed the "Dysregulation Profile" (Althoff et al., 2010b). The Dysregulation Profile in childhood has been prospectively associated with a range of negative outcomes, including attention-deficit/hyperactivity disorder, mood and substance use disorders, suicidality, and poorer overall functioning in young adulthood (Holtmann et al., 2011). However, accumulating evidence suggests that while children with high scores on the Dysregulation Profile may have psychiatric disorders, it is distinct from specific disorders, generally stable, and should be conceptualized as a measure of broad deficits in self-regulation (Althoff et al., 2010a), which is how we are applying it in this study. Although most often utilized as a categorical metric (above a certain threshold), it has been applied as a continuous measure that is sensitive to the degree of overall dysregulation (e.g. Ayer et al., 2009), which we opted to do to maximize power. High internal consistency was observed for the 39 items in the Dysregulation Profile for both the ASD group (0.89) and the control group (0.93).

Data analysis

All statistical analyses were conducted using SPSS v21 (IBM, 2012). Cronbach's alpha was computed for all measures, separately by group, to determine internal consistency reliability. Because the ARS data were determined to be non-normally distributed with both groups combined ($W(49) = 0.89$, $p = 0.000$), independent-samples Mann–Whitney U tests, with the exact method of determining the p value, were utilized to compare the ARS total and subscale scores between groups. Effect size r was calculated from z-scores (Rosenthal, 1991); as a guideline, effect sizes of 0.10, 0.30, and 0.50 were interpreted as small, medium, and large effects, respectively. Kendall's tau-b correlations were utilized to investigate the association between ARS and SRS scores. Utilizing log-transformed data, hierarchical linear regression analyses were performed to assess the association between anger rumination, depression symptoms, aggression, and dysregulation in the ASD group when controlling for SRS scores. Semi-partial correlations were included in the reporting of regression results to provide information on the degree of association between anger rumination scores and the behavioral variables while accounting for the effects of autism symptom severity. Finally, given the small sample size, individual ASD participant data on key characteristics (age, IQ, ASD symptom severity, and current and past psychiatric disorders) and study variables were included in a supplementary table to enable visual inspection of the data.

Results

Group differences in rumination scores

Mean and median rumination scores are summarized in Table 2 by group. Results of independent-samples Mann–Whitney U tests revealed that the ASD group reported significantly more overall anger rumination, thoughts of revenge, and angry memories

scores. The effect size *r*s for these comparisons varied from 0.42 to 0.47, which can be interpreted as between medium and large effects.

Associations between rumination and behavioral indices

ARS scores were not significantly correlated with SRS scores in the ASD group ($\tau(24) = 0.13$, $p = 0.386$) or control group ($\tau(23) = 0.23$, $p = 0.123$). Given the possibility that a restricted range of SRS scores within each group led to the negative findings, an additional correlation was conducted with both groups combined. With the groups combined, there was a small, positive correlation between ARS and SRS scores ($\tau(49) = 0.29$, $p = 0.004$).

Three separate regressions were conducted in the ASD group only, with SRS scores entered in the first step, followed by ARS scores in the second step and utilizing self-reported depression (Mood and Feelings Questionnaire (MFQ)), aggression (EATQ-R), and dysregulation scores (YSR composite) as the DV. The model predicting depression was significant, $F(2, 20) = 5.98$, $p = 0.009$, and explained 37% of the variance in self-reported depression. The model predicting aggression approached significance, $F(2, 20) = 3.03$, $p = 0.069$. The model predicting dysregulation was significant, $F(2,22) = 7.62$, $p = 0.003$, and explained 41% of the variance in dysregulation. In each case, the only significant predictor in the final model was anger rumination. Based on semi-partial correlations, anger rumination accounted for 20%, 17%, and 27% of the variance in depression, aggression, and general dysregulation after controlling for the effect of autism symptom severity. Table 3 provides the additional regression results and includes the specific beta weights.

Individual ASD participant scores for each primary measure of interest are presented in Supplementary Table 1 in descending order of Anger Rumination Total scores (i.e. high to low scores). In addition, age, full-scale intelligence quotient (FSIQ), and current and past psychiatric comorbidities, as measured via the ACI, are included to allow visual inspection of patterns. Many participants met criteria for at least one comorbid psychiatric disorder. Seven participants met criteria for an anxiety disorder or obsessive–compulsive disorder (OCD); these participants had anger rumination scores across the range. Two met criteria for a current depressive disorder and seven met criteria for a past depressive disorder. With one exception, those with current or past depressive disorder diagnoses had anger rumination scores above the median score of 35. Although there was some variability, the average aggression score corresponds to a response of “almost always untrue of you.” Overall, the aggression scores were low in this sample. Finally, based on the guideline of scores above 180 as positive for emotion dysregulation on the dysregulation profile (Biederman et al., 2012), just under half of participants were elevated. While most (with one exception) of those with the lowest anger rumination scores also had the lowest dysregulation scores, those with elevated dysregulation were fairly evenly split above and below the anger rumination median.

Discussion

This preliminary study investigated the occurrence of anger rumination and its association with ASD symptoms and emotional and behavioral concerns in adolescents with ASD and controls. The measure of rumination specifically focused on feelings of anger and

frustration, providing the first investigation of this type of rumination in ASD. Consistent with expectations, adolescents with ASD reported engaging in anger rumination more than their non-ASD peers. This adds to reports of more depressive-focused rumination in ASD from two prior studies (Crane et al., 2013; Gotham et al., 2014). Taken together, these results provide initial support for Mazefsky et al.'s (2012) contention that the propensity to perseverate in ASD extends to repetitive and persistent thoughts about negative emotional experiences, including both anger/frustration and depression symptoms.

The small, but now growing, body of studies indicating more negatively valenced rumination in ASD raises questions about how this should be conceptualized. One possibility is that rumination is an extension of the tendency to perseverate, which is considered part of ASD's core symptomatology. A prior study of TD individuals found that having more ASD symptoms was associated with more anger rumination (Pugliese et al., 2015), and we also found a small, but significant, positive correlation between ASD symptoms and anger rumination when both the control and ASD groups were combined. These findings suggest that anger rumination and ASD characteristics are associated. However, it is important to emphasize that while the ASD group as a whole reported more rumination than the control group in our study, there was a high degree of within ASD variability in the propensity to ruminate, similar to the very wide range of sadness rumination scores reported by Crane et al. (2013). Future studies that include specific measures of perseveration on special interests and other forms of rumination on positive events may shed light on whether negatively valenced emotional rumination is part of a repetitive behavior profile characterized by perseveration.

Understanding the characteristics that contribute to an increased tendency to engage in anger rumination is clinically relevant given its role in emotional and behavioral functioning. We found that anger rumination accounted for a substantial amount of variance in emotional functioning, even when controlling for ASD symptom severity. Specifically, anger rumination was strongly correlated with depressive symptoms, even after controlling for the effects of ASD symptoms. In addition, those with current or past depression diagnoses tended to have more elevated anger rumination scores. Prior studies have suggested a link between sadness-focused rumination and depression in ASD (Crane et al., 2013; Gotham et al., 2014), and our study is the first to demonstrate a similar association with anger-focused rumination. This may be related to the fact that childhood depression often presents as irritability (APA, 2000). Furthermore, given that children with ASD have difficulty differentiating between emotions (Rieffe et al., 2007), it is possible that rumination on any negative emotion could be associated with depression in ASD.

However, anger rumination was not exclusively associated with depression. Anger rumination was most strongly associated with a composite measure of dysregulation that broadly tapped attentional problems, anxious and depression symptoms, and aggression. This supports arguments that a shared underlying emotion regulation mechanism, such as rumination, might underlie the complex constellation of dysregulated emotions and behaviors frequently observed in ASD (Mazefsky et al., 2013; Weiss, 2014).

The association between anger rumination and worse emotional and behavioral functioning is consistent with the emotional cascade model of behavioral dysregulation in non-ASD samples, which posits that rumination intensifies negative affect which subsequently can lead to dysregulated behaviors (Selby et al., 2008). It must be stressed, however, that while this mechanism is theoretically plausible and consistent with our findings, we cannot make causal conclusions given our cross-sectional design. Although the TD literature supports rumination as a prospective risk factor for the development of psychopathology (Aldao et al., 2010), this association is most likely bi-directional. For example, experiencing significant depression may cause one to focus more on feeling angry or sad, and having stronger emotions also may make it more difficult to stop thinking about them. Future longitudinal studies are needed to tease apart the direction of these effects in order to determine whether rumination precedes dysregulated emotions and behavior in ASD.

Contrary to prior work in TD samples (e.g. Pugliese et al., 2015; Sukhodolsky et al., 2001), the model testing the association between anger rumination and aggression failed to reach significance. This was likely due to a combination of low power and the fact that the ASD group as a whole had a rather restricted range of low aggression scores. An association potentially may be observed in a sample with a wider range of aggressive behavior.

Other aspects of the sample and study design should be considered when interpreting our findings. The sample size was small and power to detect small effects was low, so the results must be considered preliminary. The results can only be generalized to verbal adolescents without intellectual disability. In addition, the control group was also utilized in a neuroimaging study that sought a disorder-free sample, so they did not have any identified psychiatric or learning diagnoses at the initial screening, although two children were diagnosed with a DSM-IV-TR Axis I disorder subsequent to the study. Therefore, while this study provides useful information on how the ASD group is similar to and different from a primarily healthy non-ASD control sample, it would be fruitful to compare adolescents with ASD to other clinical samples in order to identify any potential differences in mechanisms. Furthermore, while we included the participant's comorbid diagnoses for descriptive purposes, the sample included a mixture of children with and without comorbidity. Designs that include large dually diagnosed samples would be more sensitive to determine whether there are differences in rumination related to psychiatric comorbidity status. Except for autism symptom severity, data were obtained through self-report, so self-presentation biases are possible. Shared variance is also a possible explanation, though visual inspection of the individual data suggests that participants appeared to rate themselves differently on measures of different constructs. Finally, assessing both anger rumination and sadness rumination in the same study would further clarify whether or how they have a differential impact on functioning and psychopathology development.

In conclusion, this study suggests that more attention on the role of anger rumination in ASD is warranted. We provided initial evidence that anger rumination is maladaptive and related to the presence of depression and general emotional and behavioral dysregulation in individuals with ASD as it is in other clinical populations (e.g. Aldao et al., 2010). Thus, therapeutic interventions to reduce rumination in ASD may be useful in improving a broad range of symptoms. For example, a mindfulness intervention led to reductions in both

rumination and mood symptoms in a pilot study of adults with ASD (Spek et al., 2013). If indicated, intervention targeting rumination may be particularly important given that those with a propensity to ruminate typically will continue to do so over time (Smith and Alloy, 2009). It may be useful to adapt interventions developed for non-ASD populations, given that our findings add to a body of studies supporting similar underlying mechanisms across populations (e.g. Gotham et al., 2014; Mazefsky et al., 2014).

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1

Sample characteristics.

	ASD (*n* = 25)	TD (*n* = 22)	*p*
	Mean (SD)	Mean (SD)	
Age	15.40 (2.24)	15.73 (2.90)	0.640
Socioeconomic status	49.15 (10.98)	49.36 (9.60)	0.238
WASI full-scale IQ	110.48 (13.59)	112.64 (13.08)	0.583
SRS total	78.08 (15.34)	39.77 (5.01)	0.000
Percent male	96.0% (*n* = 24)	95.5% (*n* = 21)	0.952

ASD: autism spectrum disorder; TD: typically developing; SD: standard deviation; WASI: Wechsler Abbreviated Scale of Intelligence; IQ: intelligence quotient; SRS: Social Responsiveness Scale.

Table 2

Group differences in rumination scores.

Scale	ASD (*n* = 25)			Control (*n* = 24)			Mann–Whitney *U* results			
	Mean	Median	SD	Mean	Median	SD	*U*	*z*	*p*	Effect size *r*
ARS total score	37.16	35.00	13.44	29.33	28.87	7.71	187.50	−2.25	0.024	0.42
Angry afterthoughts	11.20	10.00	4.85	9.00	8.50	2.83	227.00	−1.46	0.146	0.27
Thoughts of revenge	7.84	8.00	3.20	5.53	5.00	1.59	175.50	−2.55	0.010	0.47
Angry memories	10.40	10.00	4.02	8.04	7.50	2.18	`184.00	−2.35	0.018	0.44
Understanding causes	7.72	7.00	2.75	6.71	7.00	1.88	235.50	−1.31	0.193	0.24

ASD: autism spectrum disorder; SD: standard deviation; ARS: Anger Rumination Scale.

Table 3

Linear model of the role of anger rumination in depression, aggression, and dysregulation, controlling for autism symptom severity, in ASD participants.

DV: mood and feelings questionnaire short form (depression)	*b*	SE	β	*p*	Semi-partial *r*
Step 1: $R^2 = 0.22$ ($p = 0.024$)					
Constant	−1.33	0.82			
SRS	1.03	0.42	0.47	0.024	0.47
Step 2: $R^{2\Delta} = 0.16$ ($p = 0.038$)					
Constant	−2.23	0.86			
SRS	0.60	0.43	0.27	0.180	0.30
ARS	1.11	0.50	0.44	0.038	0.45
DV: EATQ-R aggression	*b*	SE β	β	*p*	Semi−partial *r*
Step 1: $R^2 = 0.06$ ($p = 0.231$)					
Constant	−0.04	0.31			
SRS	0.19	0.16	0.25	0.231	0.25
Step 2: $R^{2\Delta} = 0.15$ ($p = 0.049$)					
Constant	−0.47	0.35			
SRS	0.12	0.15	0.16	0.421	0.17
ARS	0.36	0.17	0.40	0.049	0.41
DV: YSR dysregulation profile	*b*	SE β	β	*p*	Semi−partial *r*
Step 1: $R^2 = 0.14$ ($p = 0.064$)					
Constant	2.04	0.10			
SRS	0.10	0.05	0.38	0.064	0.38
Step 2: $R^{2\Delta} = 0.27$ ($p = 0.005$)					
Constant	1.85	0.10			
SRS	0.07	0.04	0.26	0.139	0.25
ARS	0.16	0.05	0.53	0.005	0.52

SE: standard error; SRS: Social Responsiveness Scale; ARS: Anger Rumination Scale; EATQ-R: Early Adolescent Temperament Questionnaire–Revised; YSR: Youth Self-Report; DV: Dependent Variable.