Repetitive behaviors in Autism Spectrum Disorder: Associations with depression and anxiety symptoms

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A B S T R A C T

Youth with Autism Spectrum Disorder (ASD) experience depression and anxiety at higher rates than typically developing (TD) youth. The current study examined how restricted and repetitive behaviors or interests (RRBs) may be related to symptoms of depression and anxiety. Participants included 35 children with ASD (29 male, 6 female) between 3 and 14 years. Youth who met clinical cut-off for depression and anxiety demonstrated increased self-injurious behavior compared to peers with ASD who did not meet clinical cut-off. These findings might suggest that self-injurious behaviors may serve as behavioral indicators of heightened negative affect. This could have important implications for assessment of symptoms of anxiety and depression in this population, which is especially critical given that children with ASD often experience language delays and difficulties.

1. Introduction

Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder characterized by marked deficits in the domains of social communication and social interaction and the presence of restricted and repetitive behaviors or interests [RRBs; American Psychiatric Association (2013)]. ASD affects an estimated 1 in 59 children in the United States (Baio et al., 2018). While youth with ASD demonstrate an elevated risk for the development of co-occurring internalizing problems including anxiety and depression (Gotham, Brunwasser, & Lord, 2015), there is a dearth of research available regarding the relationship between these co-occurring disorders and how they might be related to core ASD impairments.

Anxiety has been linked to the presence of increased RRBs in ASD (Lidstone et al., 2014; Stratis & Lecavalier, 2013; Wigham, Rodgers, South, McConachie, & Freeston, 2015). RRBs are listed in the DSM-5 as core symptoms of ASD, and they include behaviors such as stereotyped or repetitive motor movements, use of objects, or speech; insistence on sameness; inflexible adherence to routines or ritualized patterns of verbal or nonverbal behavior; highly restricted, fixated interests that are abnormal in intensity or focus; and hyper- or hypo-reactivity to sensory input or unusual interest in sensory aspects of the environment (American Psychiatric Association, 2013). Researchers have demonstrated that insistence on sameness, a behavior that falls within the RRB category, is associated with increased anxiety in children with ASD (Factor, Condy, Farley, & Scarpa, 2016; Gotham et al., 2013; Lidstone et al., 2014). Furthermore, Factor et al. (2016) found that the relationship between RRBs and anxiety was mediated by social withdrawal, which is often a defining feature of internalizing problems observed among youth with ASD. These findings suggest that increased RRBs (specifically sameness behaviors), lead to social withdrawal, which in turn leads to heightened anxiety. This indicates that if

sameness behaviors are present, clinicians may wish to also pay special attention to assessing for social withdrawal and subsequent anxiety or depression symptoms. Another recent study revealed that anxiety mediated the relationship between sensory differences and increased repetitive motor and insistence on sameness behaviors in children with ASD (Wigham et al., 2015). Thus, sensory differences may lead to increased anxiety (e.g., worry/fear that an aversive sensory experience may be encountered) which in turn may lead higher levels of repetitive motor movements and insistence on sameness. Although the proposed causal pathway is different, with anxiety as a suggested outcome in Factor et al. (2016) and as the mediator in Wigham et al. (2015), both articles suggest a strong association between anxiety and a more observable symptom in the form of RRBs. This suggests RRBs may be an observable indicator of anxiety in children with ASD.

There is less literature on the possible relationship between RRBs and depression in ASD. Research by Ghaziuddin, Ghaziuddin, and Greden (2002) has stated that depression is the most frequent comorbid psychopathology with ASD; however, there are clear inconsistencies in prevalence estimates of depression among youth on the autism spectrum. Estimates for major depressive episodes among youth with ASD range from 1.5% to 10% (Leyfer et al., 2006; Simonoff et al., 2008). Diagnosis is further complicated by the degree of phenotypic overlap between the two conditions, by which symptoms related to ASD might complicate the recognition of depressive symptoms (Magnuson & Constantino, 2011). For example, abnormalities in emotion regulation/emotion dysregulation, which often characterize youth with ASD, can lead to intense affective responses consistent with depressive symptoms (Hill, Berthoz, & Frith, 2004). Further, youth with ASD are often subjected to increased loneliness and negative peer relationships, which can trigger or exacerbate depressive symptomatology (Mazurek & Kanne, 2010). In fact, children with ASD who have greater theory of mind and insight into their social impairments are often acutely aware of their social difficulties, thus resulting in heightened depressive symptoms (Capps, Sigman, & Yirmiya, 1995; Vickerstaff, Heriot, Wong, Lopes, & Dossetor, 2007). As such, depression is more commonly researched among more verbal youth with ASD (Vickerstaff et al., 2007).

Despite the high prevalence of internalizing problems among youth with ASD and the amount of research examining the connection between anxiety and RRBs, less research has examined how depression might be associated with RRBs and research that has been conducted is mixed. Within the context of RRBs serving as a coping mechanism (Joyce, Honey, Leekam, Barrett, & Rodgers, 2017), it would be expected that RRBs would increase during intense emotional experiences such as a depressive episode. Among less verbal individuals with ASD, depression might result in an increase in stereotypic behaviors (e.g., hand flapping; Ghaziuddin et al., 2002). Another article found that ritualized behavior and insistence on sameness was positively related to depression while restricted interests were negative predictors (Stratis & Lecavalier, 2013). These mixed findings suggest that more research is needed on the relationship of RRBs to depressive symptomatology.

While some symptoms of internalizing conditions are readily observable by third parties (i.e., sleep problems), other symptoms can only be reported by subjective, internal experience (i.e., depressed or anxious mood). For this reason, many parent- or other-report measures only ask questions about the frequency and intensity of observable behaviors related to subjective internal symptoms of anxiety and depression. For example, the Child Behavior Checklist (CBCL; Achenbach, 1991; Achenbach, Dumenci, & Rescorla, 2003), a parent-report measure for children ages 1.5–18, is divided into several subscales intended to screen for varying kinds and degrees of childhood psychopathology. One of the depression screening scales, the Affective Problems subscale, does include some non-observable items such as "enjoys little," but also includes many items based on observable behaviors such as "doesn't eat well," "sleep problems," and "cries." The Anxiety Problems subscale includes a similar combination of items based on observable behaviors and internal states, such as being "nervous, high-strung, or tense," "too fearful or anxious," and "worries" (Achenbach & Rescorla, 2013).

Assessment using observable items may be particularly helpful to the screening of children with ASD for anxiety or depression. One such reason is that children with ASD often experience language difficulties. Specifically, up to 30% never acquire any language (Patten, Ausderau, Watson, & Baranek, 2013). For non-verbal ASD populations, youth are unable to report on their subjective internal experiences and thus assessment relies on caregiver reported symptoms and behaviors. Secondly, some studies suggest that up to 65% of children with ASD, including those who do have language, experience alexithymia (Berthoz & Hill, 2005; Hill et al., 2004; Milosavljevic et al., 2016), which is the inability to recognize and label one's own emotions (Milosavljevic et al., 2016). Thus, even children who do have language may not be able to appropriately report on their own internal states.

The aims of this exploratory study were two-fold: 1) to replicate previous research on the relationship of anxiety to RRBs and 2) to examine RRBs as potential behavioral markers of depression in ASD by extending extant research on anxiety and RRBs to depression. Additionally, where previous studies have often examined RRBs as a unitary construct, we sought to examine the different categories of RRBs (i.e., sameness behavior, stereotyped behaviors) as they relate to symptoms of anxiety and depression. Based on the literature suggesting RRBs may serve as a coping mechanism for children with ASD, we examined the relationship between RRBs and symptoms of clinical levels of anxiety and depression in children and adolescents with a clinically confirmed ASD diagnosis. Consistent with previous research, we predicted greater levels of RRBs in youth with versus without clinically significant anxiety or depressive symptoms.

2. Method

2.1. Participants

For the current study, participants were part of an ongoing assessment database of children and adolescents with and without ASD receiving evaluations at a university clinic and research center that serves the local community. The sample included 35 participants ranging from 3 to 14 years ($M = 7.6$, $SD = 2.98$). The sample was 82.9% male ($n = 29$). Regarding race, 85.7% of participants were

White (*n* = 30), 8.6% Black (*n* = 3), 2.9% Asian (*n* = 1), and 2.9% identified as Other (*n* = 1). Intellectual functioning quotient (IQ) ranged from 45 to 125 (*M* = 93.83; *SD* = 16.36). Inclusion criteria for the study included a diagnosis of ASD confirmed by measures (described below) administered at the MASKED FOR REVIEW, as well as a completed CBCL.

2.2. Procedure

The study was approved by the institutional review board for human subject research. Participating families were largely from small cities and rural areas in a southeastern state who were informed of the possibility of receiving an assessment via email announcements, phone calls, flyers, or word-of-mouth. Prior to making an appointment for an evaluation, each participant was asked to complete consent documents and behavioral questionnaires (described in further detail below). Once all documents were returned, an in-person assessment was conducted, consisting of clinical interviews (e.g., Autism Diagnostic Interview-Revised), behavioral assessments (e.g., Autism Diagnostic Observation Schedule, Second Edition), and cognitive assessments (Mullen Scales of Early Learning, etc.) to inform a diagnosis of ASD and provide additional information regarding cognitive and language abilities. Diagnosis was based on these instruments and determined by expert clinical judgment by the assessment team and a licensed clinical psychologist based on DSM-5 criteria. After each evaluation, the assessment team reviewed all collected data and compiled a diagnostic summary report. As described below, participants were divided into those with and without clinically significant depressive scores and anxiety scores based on the CBCL. Groups were then compared on subscales of the Repetitive Behavior Scale-Revised (RBS-R; described in further detail below).

2.3. Measures

2.3.1. Demographic variables

Demographic information such as child age, sex, race, and family status (i.e., parents married, single parent, etc.) were collected from parent-report.

2.3.2. Cognitive measures

Depending on the age of the participant, cognitive ability was measured by The Mullen Scales of Early Learning (MSEL; Mullen, 1995), Wechsler Preschool and Primary Scales of Intelligence, Fourth Edition (WPPSI-IV; Wechsler, 2012), Wechsler Abbreviated Scales of Intelligence, Second Edition (WASI-II; Wechsler & Hsiao-pin, 2011), and the Wechsler Intelligence Scale for Children, Fifth Edition (WISC-V; Wechsler, 2014). These assessments measure verbal and nonverbal intelligence and have been found to have appropriate reliability and validity. Standard scores were used for each measure: the Early Learning Composite standard score on the MSEL and the Full Scale IQ (FSIQ) standard score on the WPPSI-IV, WASI-II, and WISC-V. In the current study, these cognitive scores were compared in the four groups to determine if differences in IQ needed to be statistically controlled.

2.3.3. Child behavior checklist (CBCL; Achenbach, 1991; Achenbach et al., 2003)

The CBCL is a standardized, parent-report measure, which assesses the behavioral and emotional functioning of children ages 1.5 to 18-years-old. Using a 3-point scale, parents rated their agreement with 113 items concerning their child's behavior (ranging from 0 = *not true* to 2 = *very true or often true*). Depressive symptomology was measured from parent report on the Affective Problems subscale, and anxiety symptomology was measured from parent report on the Anxious Problems subscale. Raw scale scores are transformed to *t*-scores (*M* = 50; *SD* = 10) to allow for comparison with children of the same age and gender. *T*-scores were used in place of raw scores to be consistent with previous research, to standardize the different forms used across ages (Berkovits, Eisenhower, & Blacher, 2017; Duncan, Tamm, Birnschein, & Becker, 2019; Factor, Ryan, Farley, Ollendick, & Scarpa, 2017) and to control for the different numbers of subscale items in different versions of the CBCL (i.e., preschool vs. school-aged). Higher *t*-scores indicate greater impairment. Scores less than 65 (i.e., less than 1.5 SD above the mean) are considered to be within the normal range, scores between 65 and 69 (i.e., between 1.5 to 2 SD above the mean) are considered borderline, and scores of 70 and above (i.e., 2 or more SD above the mean) are considered to be clinically significant (Achenbach & Rescorla, 2001). Previous research on the CBCL has demonstrated reliability (Cronbach's alpha) of α = .72 for the Anxiety Problems subscale and α = .82 for the Affective Problems subscale (Achenbach & Rescorla, 2001).

ASD + Anxiety (*n* = 20) and ASD-Anxiety (*n* = 15) groups were formed based on the Anxiety Problems subscale. Children who had a *t*-score of 65 and above were classified as ASD + Anxiety (i.e., with borderline and clinically significant anxiety symptoms) and those with a *t*-score of < 65 were classified as ASD-Anxiety (i.e., without clinically significant anxiety symptoms). ASD + Depression (*n* = 22) and ASD-Depression (*n* = 13) groups were formed based on the Affective Problems subscale. Children who had a *t*-score of 65 and above were classified as ASD + Depression (i.e., with borderline and clinically significant depressive symptoms) and those with a *t*-score of < 65 were classified as ASD-Depression (i.e., without clinically significant depressive symptoms).

2.3.4. Repetitive behavior scale-revised (RBS-R; Bodfish, Symons, & Lewis, 1999; Bodfish, Symons, Parker, & Lewis, 2000)

The RBS-R is an empirically derived clinical rating scale for measuring the presence and severity of restricted, repetitive behaviors among youth with ASD. The RBS-R is a 44-item questionnaire which provides a quantitative, continuous measure of the full spectrum of repetitive behaviors. Behaviors are rated on a 4-point Likert scale: 0 = Behavior does not occur, 1 = Behavior occurs and is a mild problem, 2 = Behavior occurs and is a moderate problem, 3 = Behavior occurs and is a severe problem. Scores are calculated by summing the ratings in each category to obtain a severity score. In addition to a total score, the RBS-R consists of six subscales

Table 1
Variable Means, Standard Deviations, and Range by Group – Anxiety.

	Total (N = 35)			ASD + Anxiety (N = 20)			ASD-Anxiety (N = 15)						
	M	*SD*	*Range*	*M*	*SD*	*Range*	*M*	*SD*	*Range*	*F*	*df*	*p*	*η2*
RBS-R													
Stereotyped Behavior	4.97	3.38	0-11	5.75	3.42	0-11	3.93	3.15	0-10	2.59	1	.117	.073
Self-injurious Behavior	3.91	3.86	0-14	5.50	3.85	0-14	1.80	2.78	0-9	9.94**	1	.003	.232
Compulsive Behavior	5.71	4.36	0-14	6.60	4.08	0-14	4.53	4.58	0-13	1.98	1	.169	.057
Sameness Behavior	10.86	7.69	0-29	13.05	7.86	0-29	7.93	6.62	2-20	4.14	1	.050	.112
Restricted Behavior	4.71	3.14	1-12	5.35	3.13	1-12	3.87	2.77	1-9	1.97	1	.170	.056
Ritualistic Behavior	7.09	4.99	0-18	8.30	5.27	0-18	5.47	4.24	0-15	2.91	1	.097	.081
Total Score	37.26	21.44	5-81	44.55	21.33	5-81	27.53	17.95	8-55	6.23*	1	.018	.159
CBCL													
Anxiety Problems	63.57	9.43	50-81	70.70	4.32	65-81	54.00	4.47	50-62	124.39***	1	< .001	.79
Affective Problems	66.03	8.54	50-84	69.10	8.02	51-84	61.94	7.64	50-79	7.13*	1	.012	.178

Note. RBS-R = Repetitive Behavior Scale-Revised; CBCL = Child Behavior Checklist; *p < .05, **p < .01, ***p < .001.

(Stereotyped Behavior, Self-injurious Behavior, Compulsive Behavior, Routine Behavior, Sameness Behavior, and Restricted Behavior) that do not have any overlap in item content. This permits differential identification and scoring of discrete varieties of RRBs. Reliability was α = .91for the Sameness Behavior subscale, α = .84 for the Self-Injurious Behavior Subscale, α = .85 for the Stereotyped Behavior subscale, α = .79 for the Compulsive Behavior subscale, and α = .78 for the Restricted Behavior subscale (Lam & Aman, 2007).

2.4. Statistical analyses

For each set of analyses, participants were divided into two groups: ASD + Depression or ASD-Depression and/or ASD + Anxiety or ASD-Anxiety. Means and standard deviations were calculated separately for both groups for each of the RBS-R subscales as well as the Affective Problems and Anxiety Problems subscales of the CBCL (see Tables 1 and 2). Bivariate correlations were conducted to characterize the sample between the descriptive variables of sex, IQ, age, and the variables of interest; anxiety symptoms, depressive symptoms, and RRB severity (Table 3). T-tests and chi-squared tests were conducted to examine group differences in age and gender (Table 4).

A MANOVA was conducted to examine group differences on the RBS-R between the ASD + Depression and ASD-Depression Groups, as well as between the ASD + Anxiety and ASD-Anxiety groups. In addition to conducting a MANOVA to examine group differences on the RBS-R, regressions were conducted to examine anxiety and depression as continuous variables, and to examine which RBS-R subscales may account for the most variance in these domains. Two stepwise multiple regressions were conducted to determine which subscales of the RBS-R accounted for the largest portion of variance in the CBCL Anxiety Problems, and affective problems subscales, respectively. Neither age nor IQ were significantly related to any of the variables of interest and thus were not controlled for in the regression analyses.

Table 2
Variable Means, Standard Deviations, and Range by Group – Depression.

	Total (N = 35)			ASD + Depression (N = 22)			ASD-Depression (N = 13)						
	M	*SD*	*Range*	*M*	*SD*	*Range*	*M*	*SD*	*Range*	*F*	*df*	*p*	*η2*
RBS-R													
Stereotyped Behavior	4.97	3.38	0-11	5.68	3.71	0-11	3.77	2.42	1-8	2.75	1	.107	.077
Self-injurious Behavior	3.91	3.86	0-14	5.23	4.07	0-14	1.69	2.18	0-5	8.33**	1	.007	.202
Compulsive Behavior	5.71	4.36	0-14	6.91	4.42	0-14	3.69	3.57	0-12	4.96*	1	.033	.131
Sameness Behavior	10.86	7.69	0-29	12.73	7.17	0-29	7.69	7.77	2-25	3.79	1	.060	.103
Restricted Behavior	4.71	3.14	1-12	5.14	3.18	1-12	4.00	3.06	1-11	1.07	1	.308	.031
Ritualistic Behavior	7.09	4.99	0-18	7.91	4.88	0-17	5.69	5.07	0-18	1.64	1	.209	.047
Total Score	37.26	21.44	5-81	43.59	20.53	5-81	26.54	19.17	8-68	5.91*	1	.021	.152
CBCL													
Anxiety Problems	63.57	9.43	50-81	67.59	8.30	65-84	56.69	7.11	50-68	15.59***	1	< .001	.752
Affective Problems	66.03	8.54	50-84	71.23	5.31	50-81	57.23	4.89	50-63	60.16***	1	< .001	.321

Note. RBS-R = Repetitive Behavior Scale-Revised; CBCL = Child Behavior Checklist; *p < .05, **p < .01, ***p < .001.

Table 3

2-Tailed Correlations Between Descriptive Variables, Anxiety, Depression, and RRBs.

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.
1. Age	1											
2. Sex	−.24	1										
3. IQ	.11	−.21	1									
4. Depression	−.10	−.15	−.12	1								
5. Anxiety	.01	−.15	−.01	.63**	1							
6. Stereotyped Behavior	−.23	.25	−.15	.24	.33	1						
7. Self-Injurious Behavior	−.03	.23	−.11	.44**	.53**	.26	1					
8. Compulsive Behavior	−.07	.20	−.23	.37*	.37*	.62**	.61**	1				
9. Ritualistic Behavior	.02	.12	.14	.28	.45**	.45**	.37*	.60**	1			
10. Sameness Behavior	.11	−.13	.14	.41*	.52**	.42*	.34*	.58**	.75**	1		
11. Restricted Behavior	−.04	.20	−.05	.27	.33	.52**	.37*	.47**	.73**	.53**	1	
12. RBS-R Total	−.02	.13	−.01	.45**	.56**	.66**	.61**	.83**	.87**	.86**	.75**	1

*Note: *$p < .05$, **$p < .01$, ***$p < .001$.*

Table 4

Descriptive Statistics by Group.

	M (SD)/ N (%)	M (SD)/ N (%)	t/χ²	df	p	Cohen's d/φ
	ASD + Anxiety (N = 20)	ASD-Anxiety (N = 15)				
IQ	91.65 (19.23)	96.33 (11.49)	−.78	33	.441	.295
Age	7.80 (2.90)	7.33 (3.18)	.45	33	.654	.139
Gender (Male)	16 (80%)	13 (87%)	.27	1	.605	.088
	ASD + Depression (N = 22)	ASD-Depression (N = 13)				
IQ	93.64 (13.92)	94.15 (20.48)	−.09	33	.930	.029
Age	7.32 (3.05)	8.08 (2.93)	−.72	33	.475	.254
Sex (Male)	17 (77%)	12 (92%)	1.30	1	.254	.193

*Note. * $p < .05$.*

3. Results

3.1. Descriptive analyses

As expected, the various scales of the RBS-R were significantly inter-correlated with each other. It was found that neither age nor IQ were significantly correlated with any of the other variables. Depression and anxiety were significantly correlated with total RBS-R score and all subscales except for Stereotyped Behaviors. No significant differences were found in age or gender between any groups.

3.2. Hypothesis testing

3.2.1. Multivariate analysis of variance (MANOVA)

The first Multivariate Analyses of Variance (MANOVA) was conducted to examine group status, for the ASD + Anxiety and ASD-Anxiety groups, as the independent variable and the six RBS-R subscale total scores as the dependent variables. The multivariate result was significant for group status, Pillai's Trace = .35, $F_{(6,28)} = 2.53$, $p = .04$, $\eta_p^2 = .35$, indicating that the two groups did significantly differ in their RBS-R subscale scores. Using a Bonferroni corrected alpha value of $p < .007$, univariate F-tests indicated a significant difference between the groups only for Self-Injurious behaviors, $F_{(1,28)} = 9.94$, $p = .003$, $\eta_p^2 = .24$. The ASD + Anxiety group demonstrated higher rates of RRBs in this domain.

A second MANOVA was conducted to examine depression group status (i.e., ASD + Depression and ASD-Depression) as the independent variable and the six RBS-R subscale total scores as the dependent variables. The multivariate result was not significant for group status, Pillai's Trace = .26, $F_{(6,28)} = 1.69$, $p = .16$, $\eta_p^2 = .27$, indicating that the two groups did not significantly differ in their RBS-R subscale scores. Using a Bonferroni corrected alpha value of p < .007, univariate F-tests indicated no significant differences between the groups.

3.3. Exploratory analyses

3.3.1. Stepwise linear regression (anxiety)

In the first stepwise regression, step 1 of the analysis the Self-Injurious Behavior subscale was significantly predictive of the CBCL Anxiety Problems subscale, such that higher scores on the Self-Injurious Behaviors subscale were predictive of higher scores on the Anxiety Problems subscale, $F_{(1, 32)} = 12.86$, $p = .001$, $R^2 = .28$). Self-injurious behaviors accounted for 28% of the variance in Anxiety Problems. In step 2 of the model there was a significant change in the amount of variance predicted, $F_{(1,32)} = 10.98$, $p = .014$, $R^2 = .41$). Overall, the addition of the Sameness Behavior subscale to the model accounted for an additional 12.7% of the

Table 5

Regression of RRB Subscales on Anxiety.

	ΔR^2	R^2	β	p
Step 1	.28	.28**		
Self-Injurious Behavior			.53	.001
Stereotyped Behavior			.20	.188
Compulsive Behavior			.08	.671
Ritualistic Behavior			.29	.066
Sameness Behavior			.38	.014
Restricted Behavior			.16	.319
F-value	12.86			
Step 2	.13	.41*		
Self-Injurious Behavior			.40	.010
Sameness Behavior			.38	.014
Stereotyped Behavior			.08	.807
Compulsive Behavior			− .19	.477
Ritualistic Behavior			.037	.424
Restricted Behavior			− .02	.683
F-value	6.83			

Note. * $p < .05$, ** $p < .01$, *** $p < .001$.
$R^2 > .02 =$ small effect, $R^2 > .15 =$ medium effect, $R^2 > .35 =$ large effect.

variance in Anxiety Problems. No other subscales from the RBS-R were found to be significantly predictive of Anxiety Problems (Table 5).

3.3.2. Stepwise linear regression (depression)

In the second stepwise regression the affective problems subscale was examined as the dependent variable. It was found in step 1 of the model that the Self-Injurious Behavior subscale was significantly, positively predictive of affective problems, $F (1,33) = 7.9$, $p =.008$, $R^2 =.17$). Self-injurious behavior accounted for 16.9% of the variance in affective problems (Table 6). No other subscales from the RBS-R were found to be significantly predictive of affective problems.

4. Discussion

In light of the oft-noted emotion regulation difficulties in ASD as well as the higher rates of anxiety and depression, it is important to understand how anxiety and depression may relate to ASD core impairments, specifically RRBs. The decision to categorize participants into groups (i.e., ASD + Anxiety, ASD-Anxiety, ASD + Depression, ASD-Depression) was made to examine the differences between children who might be considered to meet diagnostic criteria for depression/anxiety versus those who would not in the community and to be consistent with previous research (Factor et al., 2017). It was determined that examining the variables in this way could have clinical utility. However, as anxiety and depression are naturally continuous variables, regression analyses were used to examine which subscales of the RBS-R might be most predictive of anxiety or depression in children with ASD.

Within the context of this preliminary study when we divided children into groups we found that children with ASD who met the clinical cut-off for anxiety on the CBCL Anxiety Problems scale had significantly more self-injurious behaviors than those who did not. Self-injurious behaviors include skin picking, deliberately hitting oneself, and deliberately hitting objects. Several of these specific behaviors have been related to anxiety in previous research (e.g., skin picking; Stargell, Kress, Paylo, & Zins, 2016). Results from the current study could suggest that, in combination with other measures, the presence of high self-injurious behaviors in a child with ASD may aid in the recognition of clinical anxiety, particularly if there is an intensification in self-injurious behavior compared to the

Table 6

Regression of RRB Subscales on Depression.

	ΔR^2	R^2	β	p
Step 1	.19	.19**		
Self-Injurious Behavior			.44	.008
Stereotyped Behavior			.14	.403
Compulsive Behavior			.16	.143
Ritualistic Behavior			.14	.425
Sameness Behavior			.30	.074
Restricted Behavior			.12	.486
F-value	7.92			

Note. * $p < .05$, ** $p < .01$, *** $p < .001$.
$R^2 > .02 =$ small effect, $R^2 > .15 =$ medium effect, $R^2 > .35 =$ large effect.

child's usual behavior. The second MANOVA found no clinical differences between the ASD + Depression and ASD-Depression groups, this is interesting given the results of stepwise regression, as well as the possibility of self-injurious behaviors relating to non-suicidal self-injury which will be discussed below.

With regard to the stepwise regression analyses, it was found that both the self-injurious behavior subscale and the sameness behavior subscale were significantly predictive of anxiety, such that higher scores on these subscales were predictive of higher anxiety despite no significant group differences between the ASD + Anxiety and ASD-Anxiety groups with regard to sameness behavior. However, this finding is consistent with previous research suggesting that the behaviors consistent with self-injurious behavior are related to increased anxiety (Stargell et al., 2016), as well as previous research suggesting that insistence on sameness is related increased anxiety (Factor et al., 2016; Lidstone et al., 2014). Although these two subscales of the RBS-R are predictive of anxiety, factors which explain why this difference does not hold for sameness when participants are divided into clinical categories merits additional consideration. This presents an interesting issue in the field at large, which is that of dichotomizing inherently continuous variables for the purpose of diagnosis (i.e., meeting criteria for an anxiety disorder versus not). Further, this could suggest that when high levels of sameness and self-injurious behavior are present, special attention should be paid when determining whether or not a child with ASD may meet diagnostic criteria for an anxiety disorder.

Similarly, the second stepwise regression contradicted the initial results of the MANOVA analysis in demonstrating that self-injurious behavior was significantly predictive of depression. It is possible that some of the behaviors listed above may capture behaviors related to non-suicidal self-injury that is sometimes expressed in individuals with depression (e.g., deliberately hitting self). This is especially plausible given that case studies have suggested that self-injurious behaviors often coincide with the onset of depression among individuals with ASD (Stewart, Barnard, Pearson, Hasan, & O'Brien, 2006). An article by Maddox, Trubanova, and White (2017) calls attention to the possibly complicated relationship between self-injurious behavior (considered an RRB, therefore a core symptom ASD) and non-suicidal self-injury (not a core symptom of ASD, rather an indication of possible co-occurring difficulties) such as depression or anxiety. Their study found that in a sample of adults with ASD, 50% endorsed some history of non-suicidal self-injury. They list several additional core findings, including that non-suicidal self-injury is likely underreported in the research on individuals with ASD because it is likely frequently misconstrued as self-injurious behavior. In our study, behaviors that could be consistent with either self-injurious behavior, or non-suicidal self-injury were endorsed on the RBS-R, a measure meant to capture the core symptoms of ASD. However, the fact that these behaviors were positively predictive of depression suggests that further research should be conducted to determine specific symptoms which are captured on the self-injurious behavior subscale of the RBS-R and whether they may be more reflective of non-suicidal self-injury.

This lends further support that more research should be conducted on the distinction between self-injurious behaviors and non-suicidal self-injury as well as other possible relationships between RRBs and depression symptoms in children with ASD. This also suggests that clinicians may wish to be cautious when dichotomizing by number of symptoms, as this demonstrates that just because differences may not be present at the group level, two variables may not necessarily be unrelated. Clinicians and researchers may wish to dedicate further efforts to the possibility of utilizing the presence of high levels of self-injurious behavior as an indicator that depressive symptomatology may be present and thus warrant further evaluation.

5. Limitations and future directions

There are several limitations that should be addressed. This study spans a large age range and does not address the role that age and relative developmental stage may play in the presence of both internalizing psychopathology and RRBs, however, in our sample it is important to note that age was not significantly related to any of the dependent variables. Another limitation includes the lack of data available regarding the socioeconomic status (SES) of our sample. As such, future research should consider whether SES might influence the present findings. Further, as stated above, it is unclear from this study whether depression and anxiety lead to increases in RRBs or more severe ASD symptomology leads to increased anxiety and depression, as this study did not look at causal relationships. Future directions should further examine the specific nature of this relationship and how this can be incorporated into the development of assessment measures for anxiety and depression that are sensitive to this population's unique impairments. Finally, although not explored specifically in this article, there is always the question of differential diagnosis, and whether the questions used on screeners such as the CBCL are accurately capturing the symptoms of anxiety and depression or whether there may be some overlap with the core symptoms of ASD. For example, a question related to social withdrawal on a screener for depression may actually capture the social amotivation sometimes present in ASD. As such, future research may wish to examine the overlap in these symptoms.

6. Conclusion

In sum, while RRBs have been related to the presence of anxiety in individuals with ASD (Lidstone et al., 2014; Stratis & Lecavalier, 2013), fewer studies have examined the relationship between RRBs and the presence of depressive symptomology. Our results indicate that self-injurious behavior was significantly higher for individuals with ASD who met clinical cut-offs for anxiety than for those who did not. Additionally, self-injurious behavior significantly predicted increases in both anxiety and depression symptomology. This suggests that RRBs, particularly self-injurious behavior, may be a useful observation of general distress related to feelings of internalizing distress. Future research should explore what may be done to better differentiate the symptoms of anxiety and depression in the ASD population, as well as possible clinician applications of this knowledge. For example, future research may wish to examine whether these measures could be incorporated in the assessment of anxiety or depression in this population, or into

treatment protocols for these concerns. Future research may also wish to more closely examine the differences and relationships between self-injurious behavior, non-suicidal self-injury, and internalizing symptomology in children with ASD.

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