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Correspondence between physiological and self-report measures of emotion dysregulation: A longitudinal investigation of youth with and without psychopathology

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Background: Several theoretical perspectives suggest that emotion dysregulation is a predisposing risk factor for many psychiatric disorders. Yet despite a rapidly evolving literature, difficulties with emotion regulation (ER) are often measured inconsistently across studies, with little regard to whether different approaches capture the same construct. In this study, we evaluate the correspondence between two widely used measures of emotion dysregulation that cut across self-report and physiological levels of analysis. Our objectives were to (1) evaluate whether youth self-reports of ER difficulties correspond with physiological measures of emotion dysregulation collected at baseline and during sad emotion induction, and (2) validate the Difficulties in Emotion Regulation Scale (DERS) in a youth sample. **Method:** We measured emotion dysregulation among a sample of youth with depression, conduct problems, comorbid depression/conduct problems, or no psychiatric condition. Youth were assessed initially at ages 8–12 (Year 1) and followed up at Years 2 and 3. Respiratory sinus arrhythmia (RSA), a widely used physiological index of emotion regulation, was measured across all three years during sad emotion induction. At Year 3, the DERS was also administered. **Results:** Multilevel modeling analyses indicated that slopes in RSA collected across the three assessments were associated with later self-reported ER abilities at the transition into adolescence. These findings were replicated across contexts (baseline and emotional challenge), suggesting that adolescents whose physiological responding to emotional challenge improves also experience fewer difficulties with emotion regulation as they mature. **Keywords:** Emotion dysregulation, psychopathology, respiratory sinus arrhythmia, Difficulties in Emotion Regulation Scale. **Abbreviations:** RSA, Respiratory sinus arrhythmia; DERS, Difficulties in Emotion Regulation Scale; HLM®, Hierarchical Linear Modeling; ER, emotion regulation.

Over the past two decades, there has been increasing interest in the constructs of emotion regulation (ER) and dysregulation in developmental psychopathology research. Indeed, understanding ER abilities is central to the developmental psychopathology perspective, since most forms of psychopathology are characterized by negative emotional experiences that are either too intense or too protracted to be adaptive (Beauchaine, 2001). Accordingly, there is growing consensus that successful navigation of emotionally challenging developmental tasks, and acquisition of healthy ER strategies, are cornerstones of emergent socio-emotional competencies (Zeman, Cassano, Perry-Parrish, & Stegall, 2006). Conversely, several authors have proposed that emotion dysregulation is a core predisposing vulnerability to psychiatric disorders spanning both the internalizing and externalizing spectra (see Beauchaine, 2001 for a review).

Among children and adolescents, psychiatric comorbidity, including concurrent internalizing and externalizing disorders (heterotypic comorbidity), is the rule rather than the exception (e.g., Marmorstein & Iacono, 2003). Heterotypic comorbidity confers risk for a number of adverse outcomes during the transition to adolescence such as persistence of psychopathology, including personality disorders (Beauchaine, Klein, Crowell, Derbidge, & Gatzke-Kopp, 2009), initiation of substance use, and risk for self-injurious behaviors (Shipman, Schneider, & Brown, 2004). Consistent with models that emphasize emotion dysregulation as a vulnerability to psychopathology (Beauchaine, 2001), there is increasing evidence that internalizing, externalizing, and comorbid psychopathologies are characterized by underlying deficits in ER, which likely contribute to many problematic behaviors in adolescence (Marmorstein & Iacono, 2003).

Though it is now clear that emotion dysregulation is common to many psychiatric disorders, the best methods for assessing the construct among youth remain unclear. Psychophysiological measures have become accepted objective indicators of emotional processes in children, and they are

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advantageous because they require little in the way of cognitive abilities or insight. However, physiological data also have limitations, including the costs of collection, and the possibility that certain patterns of physiological responding suggest different processes for different people. Furthermore, despite compelling reasons to use multiple methods to assess emotion dysregulation (see Cole, Martin, & Dennis, 2004), few studies have responded to this call.

Under appropriate stimulus conditions, respiratory sinus arrhythmia (RSA), which indexes vagal tone and vagal reactivity, is a well-validated measure of emotion dysregulation in children (see Beauchaine, 2001; Beauchaine, Gatzke-Kopp, & Mead, 2007; El-Sheikh, 2005). Briefly, RSA captures the ebbing and flowing of heart rate across the respiratory cycle, with heart rate increases occurring during inhalation and heart rate decreases occurring during exhalation. RSA is typically measured by assessing heart rate variability, either via spectral analytic or peak-to-valley techniques. Such analyses of the R-wave time series are required to capture parasympathetic nervous system influences on heart rate, independent of sympathetic nervous system contributions (see Berntson et al., 1997). There are now a number of studies of children and adolescents linking reduced RSA to psychological disorders characterized by emotion dysregulation, including depression, anxiety, self-injury, and disruptive behavior, among others (Beauchaine et al., 2007; Shannon, Beauchaine, Brenner, & Neuhaus, 2007; Crowell et al., 2005; Silk, Steinberg, & Morris, 2003). However, consistent among these studies is the assumption that diagnosable psychopathology is suggestive of emotion dysregulation, with little attention to whether RSA is related specifically to ER difficulties.

In this study, we examine the correspondence between RSA and a recently introduced self-report measure of emotion dysregulation, the Difficulties in Emotion Regulation Scale (DERS; Gratz & Roemer, 2004). Our sample, which consists of youth with conduct problems (CPs), depression (DEP), comorbid CPs and DEP (comorbid), or neither condition (controls), includes individuals who likely possess a wide range of ER abilities and strategies. We hypothesize that, among these children, there will be a negative relation between RSA and the DERS, with lower parasympathetic regulation of cardiac functioning corresponding to greater difficulties in self-reported ER. In addition, we expect that this relationship will be significant longitudinally, and that RSA values that increase across middle childhood – suggesting improved ER across development – will correspond with fewer self-reported ER difficulties. Finally, we hypothesize that these results will be consistent across contexts, including at rest (baseline) and during emotional challenge (sadness induction).

Method

Participants

All study procedures were approved of by the University of Washington Institutional Review Board, with consent and assent obtained from the parent and child, respectively. Data were collected as part of a longitudinal study examining the development of depression and conduct problems in middle childhood. Readers are referred to other publications for additional information on study procedures and participating families (see Beauchaine, Hong, & Marsh, 2008; Kopp & Beauchaine, 2007; Shannon et al., 2007). Participants were recruited from urban Seattle neighborhoods through flyers posted at clinics and community centers, and through advertisements in local newspapers, radio spots, city busses, and school newsletters. Interested parents responded to advertisements by telephone and completed a 20–30 min structured interview to evaluate their child's eligibility for the study. The telephone interview included portions of the Child Symptom Inventory (CSI; Gadow & Sprafkin, 1997) and the Child Behavior Checklist (CBCL; Achenbach, 1991a), two frequently used measures of child psychopathology with adequate to excellent reliability. The CSI provides a dimensional score and diagnostic cutoffs for DSM-IV (APA, 2000) disorders. Each diagnostic criterion is rated on a 4-point scale (0 = *never*, 1 = *sometimes*, 2 = *often*, 3 = *very often*), with ratings of 2 or higher considered positive for a given criterion. The administered CSI scales included conduct disorder (CD), attention-deficit/hyperactivity disorder (ADHD), oppositional defiant disorder (ODD), major depressive disorder (MDD), and dysthymia (DYS). The CSI has adequate sensitivity and specificity (Gadow & Sprafkin, 1997). Parents also completed the aggression, attention problems, and anxious/depressed subscales of the CBCL. In total, 445 interviews were conducted to recruit 212 participating families. Based on results from the telephone interview, children were placed either in the control group or in one of three clinical groups (CPs, DEP, comorbid). Control participants did not meet criteria for any disorder on the CSI and did not exceed a *T*-score > 59 on any CBCL scale. Children placed into one of the three clinical groups were required to meet CSI criteria for their respective disorder(s), and to score at or above the 98th percentile ($T \geq 70$) on the appropriate CBCL scale(s). For the present study, participants across all four groups were pooled to evaluate the correspondence between physiological and self-report measures of ER. This conferred a number of statistical advantages, described below.

Upon meeting eligibility criteria for the study, participating families were assessed at three time points separated by approximately one year. Those enrolled during Year 1 included 212 children (139 male; 132 Caucasian, 25 African American, 3 Native American, 13 Asian American, 5 Pacific Islander, 21 Latino, and 12 mixed race/unspecified) between the ages of 8 and 12, and one biological parent (the mother in all but 4 cases). Most families (77%) had annual incomes below $70,000, which is well below the median family income for Seattle ($82,867; United States Census Bureau, 2006). Attrition rates were relatively low across the three waves of assessment, resulting in a total of 193

participants for whom complete data were available. At the time of the Year 3 assessment, participants were between the ages of 11 and 15. Families received a $175 incentive for their Year 1 assessment and $100 for subsequent assessments.

Lab visit

Psychophysiological task and assessment. Children were seated alone in a comfortable, sound-attenuated room equipped with audio/video monitoring equipment. RSA was measured during a 5 min resting baseline, followed by a 3 min video clip from the movie *The Champ*, in which a young child witnesses and reacts to the death of his father. This film clip has been demonstrated to evoke sadness (see Gross & Levenson, 1995), and to result in physiological reactivity – including changes in RSA – that are consistent with individual differences in ER abilities (Crowell et al., 2005). Physiological data were collected at each assessment (Years 1–3) with the same hardware, procedures, and settings. Electrodes were placed in a standardized spot configuration on the child's torso, and the ECG signal was sampled at 1 kHz. RSA was assessed using spectral analytic software developed by Richard Sloan and colleagues at Columbia University. Parasympathetic nervous system activity is confined to the high frequency band of the fast Fourier-transformed R-wave time series (≥ .15 Hz). The validity of RSA as a marker of parasympathetic-linked cardiac activity has been established using pharmacological blockade (see Berntson et al., 1997). Consistent with our past research, data were collected and scored in 30-s epochs. Though shorter than sometimes recommended, 30-s epochs allow for maximum temporal resolution. In this study, we averaged across epochs (see below), which is an acceptable means of increasing reliability when longer epochs are not available (Berntson et al., 1997). As is typical, RSA data were log transformed to correct for excessive skew.

Self-report of emotion regulation. The DERS (Gratz & Roemer, 2004) is a recently developed self-report index of difficulties in ER that is among the most widely used measures of the construct. The DERS has high internal consistency, good test–retest reliability, and adequate construct and predictive validity. However, the measure was developed with adult samples and has consequently been used primarily with non-child participants with borderline personality disorder, anxiety disorders, or those engaging in self-harm, among others (e.g., Gratz & Chapman, 2007; Tull, 2006; Gratz, Tull, Baruch, Bornovalova, & Lejuez, 2008). To our knowledge, the DERS has not been used with children. However, the measure is written at approximately a 7th grade reading level. The DERS was administered at the Year 3 visit when participant children were 11–15 years old (5th–10th grade). All questionnaires were completed independently by participants with an interviewer available to answer questions. Interviewer notes indicate that all children were able to complete the DERS without assistance. Assessments at Year 3 began in 2005, one year after the DERS became available. Although about half of the sample (n = 110) completed the DERS at Year 2 (2004), these data were insufficient to be analyzed using lag-sequential methods.[1]

In addition to a DERS total score, the measure consists of six subscales (Gratz & Roemer, 2004): (1) nonacceptance of emotional responses (NONACCEPTANCE), which includes a tendency to have negative secondary emotional responses to negative emotions or not accepting one's reactions to distress; (2) difficulties engaging in goal-directed behaviors (GOALS), such as difficulty concentrating or accomplishing tasks when upset; (3) impulse control difficulties (IMPULSE), including poor behavioral control when experiencing negative emotions; (4) lack of emotional awareness (AWARENESS), or the ability to attend to and acknowledge emotions; (5) limited access to ER strategies (STRATEGIES), for example, the belief that little can be done to regulate emotions effectively; and (6) lack of emotional clarity (CLARITY), which includes the ability to identify the emotions one is experiencing. Higher DERS scores always indicate greater difficulties with ER. Parents and children also completed measures of child psychopathology, including the CBCL, the CSI (parent report as described above; Achenbach, 1991; Gadow & Sprafkin, 1997), the Child Depression Inventory, self-report (CDI; Kovacs, 1992) and the Youth Self Report (YSR; Achenbach, 1991b).

Data analyses

Prior to performing statistical analyses, DERS data and psychopathology scores were examined to ensure conformity with assumptions of multiple linear regression. Both skew (≤ = .8) and kurtosis (≤ = .8) were within acceptable limits for all measures. Given this, we modeled continuous psychopathology scores rather than performing by-group analyses. This (a) provided greater statistical power (McCallum, Zhang, Preacher, & Rucker, 2002), (b) avoided issues associated with arbitrary diagnostic cutoffs and drifting in and out of psychiatric groups, and (c) reduced the number of statistical comparisons and the associated alpha error rate by about 75%. Reliability statistics on the DERS are reported below.

Two sets of analyses were performed in order to evaluate the correspondence between RSA and self-reported ER difficulties on the DERS at both baseline and in response to emotion evocation. Baseline RSA was calculated by averaging across the final two 30-s epochs of the resting baseline (one min of data). To calculate RSA change scores (ΔRSA) during the Champ,

[1] One reviewer was concerned about the unavailability of DERS data at each time point, which precluded construction of cross-lag correlation models. In an effort to partially address this concern, we conducted a simultaneous multiple regression analysis with Year 2 mean RSA baseline scores and Year 2 DERS scores as predictor variables, and Year 3 DERS as the criterion for the subset of individuals who completed the DERS at Year 2 (n = 110). This yielded an overall R^2 of .44, $F(2, 108)$ = 42.3, p < .001. The unique contribution of Year 2 RSA to Year 3 DERS was significant, pr = .22, p = .02, over and above the effect of Year 2 DERS, pr = .63, p < .001. Thus, Year 2 RSA offered independent longitudinal prediction of DERS scores at Year 3, over and above the effects of Year 2 DERS scores on Year 3 DERS scores.

we subtracted the 30-s baseline epoch (immediately preceding the movie) from each of the six 30-s Champ epochs, resulting in six change scores for each assessment point. These scores were averaged to create a single data point for each year. As noted above, averaging across epochs increases reliability (see Berntson et al., 1997). Analyses of respiration rate suggested that breathing was within normal limits across baseline and task and was not correlated with RSA ($r = .062$, $p = .68$). Thus, we did not control statistically for respiration in subsequent analyses.

Data were analyzed by constructing multilevel models using Hierarchical Linear Modeling (HLM®). HLM is an analytic method that can be used to evaluate individual growth trajectories. One advantage of HLM is flexibility in the number and spacing of RSA observations, each set of which was nested within persons. In addition, multilevel modeling provides for simultaneous estimation of both within- and between- participant effects. Analyses were conducted using HLM 6.04 (Raudenbush, Bryk, & Congdon, 2000). Full maximum likelihood models followed the general form presented below:

$$\text{Level 1: baseline RSA} = \pi_{0j} + \pi_{1j}(\text{year}) + r_{ij}$$

$$\text{Level 2: } \pi_{0j} = \beta_{00} + u_0$$

$$\pi_{1j} = \beta_{10} + \beta_{11}(\text{DERS total}) + u_1$$

At Level 1, repeated observations for each participant were modeled as random effects. For example, in the equation above, baseline RSA represents the three repeated observations of RSA (one observation per annual assessment) for each person. Level 2 equations tested the significance of the intercept (π_{0j}) and slope (π_{1j}) at Level 1. Individual variation among participants on the DERS was modeled as a predictor of the slope of RSA across the three assessments. This analysis tested the hypothesis that DERS at Year 3 would account for changes in RSA over time. Since DERS scores were only available for a sufficient number of participants at Year 3 (see above), they were used as Level 2 predictors rather than time-varying covariates at Level 1. Because RSA data were collected at rest (baseline) and challenge (reactivity), separate two-level models were constructed for each condition. Given the sample size, we used robust standard errors for all analyses.

Results

Descriptive statistics

Descriptive statistics for participants are presented by group in Table 1. Not surprisingly, mean psychopathology scores were elevated among the clinical groups. Chronbach's alpha for the total DERS scale was identical to that in the adult validation sample (.93). Reliability statistics for each of the six subscales are presented in Table 2, and are also highly similar to those seen in the adult validation sample. We also evaluated the correspondence between the DERS and other measures of psychopathology completed by participants (Table 3) and their parent (Table 4). Our findings indicate that higher self-reported psychopathology – both internalizing and externalizing – correlated with self-reported difficulties in ER. Similarly, children's self-reported ER difficulties were related positively to parental reports of child psychopathology.

Correspondence between physiological and self-report measures

Baseline RSA. Overall DERS scores were associated significantly with the slope of RSA across the three waves of data collection ($\beta = -.12$, $p = .025$). Thus, increasing baseline RSA across Years 1 to 3 was related to fewer difficulties in ER at the final assessment. Follow-up analyses exploring each of the DERS subscales revealed a significant negative relation between RSA slope and the awareness of emotion subscale ($\beta = -.07$, $p = .022$).

ΔRSA during The Champ. Correlations between the DERS and baseline RSA at each time point were significant for Year 1 ($r = .33$, $p < .01$) and Year 2 ($r = .18$, $p < .05$). A positive slope in RSA across assessments was related to fewer self-reported ER difficulties at Year 3 ($\beta = -.23$, $p = .028$). This finding is represented in Figure 1. Those who self-reported fewer ER difficulties initially showed RSA withdrawal in response to sad mood induction at Year 1. By Year 3, these participants exhibited RSA increases in response to *The Champ*. In contrast, those who scored high on the DERS reacted similarly to the emotion induction across all three assessments. For graphing purposes only, a median split at a DERS score of 2.0 was performed to depict trajectories among those with lower vs. higher ER difficulties. Follow-up analyses with each of the six subscales indicated that the emotion regulation strategies ($\beta = -.17$, $p = .025$) and impulse control ($\beta = -.16$, $p = .041$) subscales were related to RSA reactivity across time. The DERS and RSA reactivity were correlated at Year 1 ($r = -.27$ $p < .01$) but not at the two subsequent assessments (rs < .1, ps > .24).

Discussion

Our findings indicate a negative relation between self-reports of ER difficulties as measured by the DERS, and longitudinally-collected physiological indices of emotion dysregulation, as indicated by slopes in baseline RSA and RSA reactivity. Increasing RSA across development was associated with fewer difficulties in ER abilities at Year 3. Subsequent analyses examining each of the DERS subscales suggested that awareness of emotions (i.e., the ability to attend to and acknowledge emotions) was related to baseline RSA. However, when experiencing negative emotions, accepting one's emotional response (e.g., by not having a negative secondary emotional response to the emotion of sadness), impulse control (e.g., the ability to control one's

Table 1 Descriptive statistics for participants by group

Variable	CTR (n = 69)	DEP (n = 28)	CP (n = 30)	CMB (n = 80)	Test statistic	p
Age at enrollment in study	9.8 (1.5)	10.0 (1.5)	9.6 (1.5)	10.0 (1.5)	$F(3, 198) = 0.6$	.59
CSI at enrollment in study						
Conduct disorder symptoms	0.7 (1.1)	1.9 (3.1)	7.0 (5.0)	7.2 (4.7)	$F(3, 203) = 23.8$	< .01
Oppositional defiant symptoms	4.1 (2.9)	7.6 (4.1)	16.2 (4.2)	16.8 (5.0)	$F(3, 203) = 147.4$	< .01
Major depression symptoms	0.7 (1.0)	6.7 (3.6)	3.0 (2.9)	10.1 (5.0)	$F(3, 203) = 44.1$	< .01
Dysthymia symptoms	1.0 (1.1)	7.1 (2.3)	3.2 (2.2)	9.6 (4.2)	$F(3, 203) = 67.9$	< .01
DERS at Year 3						
Total score	1.9 (.5)	2.1 (.4)	2.2 (.4)	2.3 (.7)	$F(3, 163) = 3.6$	< .01
Acceptance score	1.5 (.8)	1.5 (.5)	1.7 (.6)	1.7 (.8)	$F(3, 163) = 0.3$	.82
Goal-directed behavior score	2.5 (1.0)	2.6 (1.0)	2.8 (.7)	2.7 (1.0)	$F(3, 163) = 0.6$	.62
Impulse control score	1.6 (.7)	1.7 (.5)	2.1 (.8)	2.1 (.9)	$F(3, 163) = 4.9$	< .01
Awareness score	4.8 (.8)	2.9 (.9)	3.2 (.8)	3.1 (1.0)	$F(3, 163) = 5.0$	< .01
Use of strategies score	1.7 (.8)	1.9 (.8)	1.9 (.4)	1.9 (.9)	$F(3, 163) = 1.2$	.30
Emotional clarity score	1.8 (.5)	2.3 (.7)	2.0 (.7)	2.2 (.8)	$F(3, 163) = 3.4$	< .05

Notes: CSI = Child Symptom Inventory (Gadow & Sprafkin, 1997); DERS = Difficulty in Emotion Regulation Scales (Gratz & Roemer, 2004). Higher DERS scores indicate greater ER difficulties.

Table 2 Internal consistency analyses for DERS Subscales (N = 165)

Subscale	Number of items	Cronbach's alpha	Range of item-total correlations	Range of inter-item correlations	Mean inter-item correlation
Acceptance	6	.87	.71–.86	.42–.67	.54
Goals	5	.83	.59–.85	.27–.69	.50
Impulsivity	6	.87	.55–.89	.36–.85	.54
Awareness	6	.85	.64–.81	.36–.69	.49
Strategies	8	.87	.47–.81	.07–.67	.48
Clarity	5	.72	.62–.78	.07–.58	.34

Table 3 Bivariate correlations for DERS subscales and self reported problem behaviors at Year 3

Scale	DERS Total	DERS Acceptance	DERS Goals	DERS Impulsivity	DERS Awareness	DERS Strategies	DERS Clarity
YSR							
Externalizing	.51**	.46**	.43**	.48**	.07	.46**	.35**
Aggression	.47**	.52**	.37**	.47**	.04	.44**	.30**
Delinquency	.34**	.28**	.15	.31**	.18	.28**	.31**
Anxiety-Depression	.54**	.46**	.38**	.45**	.02	.64**	.35**
Withdrawn	.37**	.15	.21*	.20*	.23*	.38**	.41**
Attention	.60**	.57**	.51**	.48**	.02	.61**	.43**
Social Problems	.36**	.28**	.25**	.20*	.08	.35**	.41**
CDI							
Total Problems	.66**	.39**	.36**	.51**	.36**	.62**	.57**
Negative Mood	.66**	.45**	.41**	.53**	.23**	.67**	.53**
Interpersonal Problems	.40**	.31**	.20**	.33**	.17	.37**	.34**
Ineffectiveness	.52**	.31**	.37**	.38**	.31**	.40**	.48**
Anhedonia	.56**	.30**	.25**	.42**	.37**	.51**	.51**
Negative Self-Esteem	.47**	.20*	.23*	.35**	.31**	.49**	.38**

Notes: YSR = Youth Self Report (Achenbach, 1991b); CDI = Child Depression Inventory (Kovacs, 1992); DERS = Difficulty in Emotion Regulation Scales (Gratz & Roemer, 2004). The YSR Somatic Complaints Subscale was not collected. Consequently, the Internalizing Subscale could not be computed. Alpha was set at $p \leq .01$ to reduce p(Type I) error.
*p < .01; **p <.001.

behavior when experiencing negative emotions), and the ability to use ER strategies were most predictive of physiological responding during emotional distress. Our results are novel in that they validate the DERS against a widely used physiological measure of emotion dysregulation. Additionally, this study is the first to test whether RSA is related specifically to ER difficulties among youth, rather than serving as a proxy for another construct (e.g., diagnosable psychopathology or extreme behaviors such as self-inflicted injury).

Our study included a relatively large sample, a longitudinal design, multiple measures of emotion dysregulation, and multiple contexts in which ER

Table 4 Bivariate correlations for DERS subscales and parent reported problem behaviors at Year 3

Scale	DERS Total	DERS Acceptance	DERS Goals	DERS Impulsivity	DERS Awareness	DERS Strategies	DERS Clarity
CBCL							
Externalizing	.38**	.21*	.28*	.38**	.27*	.27*	.20
Aggression	.29**	.18	.16	.34**	.17	.22*	.15
Delinquency	.29**	.17	.16	.30**	.21*	.21*	.15
Internalizing	.31**	.11	.162	.27*	.30**	.21*	.25*
Anxiety-Depression	.30**	.16	.18	.31**	.17	.25*	.19
Somatic Complaints	.07	.05	.001	.03	.14	.04	.11
Withdrawn	.23*	.02	.10	.22*	.26*	.13	.23*
Attention	.31**	.21*	.19	.32**	.14	.24*	.22*
Social Problems	.24*	.13	.09	.25*	.16	.16	.24*
CSI							
ADHD	.28*	.21*	.16	.32*	.11	.24*	.15
Conduct Disorder	.20*	.17	.12	.20*	.15	.12	.10
Dysthymia	.24*	.06	.14	.22*	.22*	.19	.20*
Major Depression	.23*	.04	.10	.21*	.21*	.21*	.21*
Oppositional Defiant	.29**	.14	.17	.30*	.24*	.19	.16

Notes: CBCL = Child Behavior Checklist (Achenbach, 1991a); CSI = Child Symptom Inventory (Gadow Sprafkin, 1997); DERS = Difficulty in Emotion Regulation Scales (Gratz & Roemer, 2004). Alpha was set at $p \leq .01$ to reduce p(Type I) error.
*$p < .01$; **$p < .001$.

difficulties were assessed. These longitudinal findings offer evidence that adolescents who self-report fewer ER difficulties show improvements in physiological responding to distress over time. To our knowledge, this is the first study to validate the DERS in a sample of adolescents and pre-adolescents. Our findings indicate that youth have insight into their ER abilities, suggesting that the DERS is a concise and valid method of assessing ER in young samples.

Nevertheless, there are several limitations to our study. Our sample included youth who likely possess a wide range of ER difficulties, yet it does not represent the full range of disorders that are characterized by poor ER. Future studies could examine the correspondence between measures of ER among eating disordered, self-injuring, or anxious youth, among others. Furthermore, consistent with the demographics of Seattle, participants were predominantly Caucasian. Therefore, results require replication among more diverse samples. Because the DERS has not been validated previously among youth, future studies should use multiple indices of ER to determine whether the DERS is the most appropriate measure for children and adolescents.

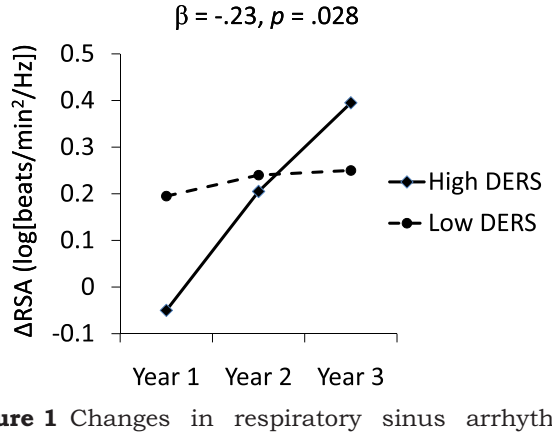

Figure 1 Changes in respiratory sinus arrhythmia reactivity across assessment points for those above and below the median Difficulties in Emotion Regulation Scale score at Year 3

We were only able to use the DERS at Year 3, so we could not examine cross-lagged correlations between growth in RSA, RSA reactivity, and self-reported ER. Thus, this and similar samples should be followed longitudinally to determine whether low DERS scores indicate risk prospectively. Finally, in spite of significant longitudinal findings, cross-sectional analyses indicated that the DERS was not related to RSA at Year 3. This suggests that adolescents who self-report fewer ER difficulties may be aware of improvements in their ER abilities over time. Based upon these trajectories, further improvements in ER among those with low DERS scores might be expected by late adolescence. Indeed, RSA increases across adolescent development are normative (see Spear, 2009 for a review), which suggests that a lack of RSA change may ultimately indicate heightened risk for ER difficulties.

Increasing evidence suggests that ER is an important predictor of healthy socio-emotional development. Similarly, emotion dysregulation appears to be a vulnerability for a wide range of negative outcomes, including behavioral problems and diagnosable psychopathology. In spite of growing interest in ER difficulties among youth, there are few studies that have used multiple measures of the construct and validated them against one another. The present study supports the use of a self-report measure of ER difficulties (the DERS) among youth ranging in age from pre-adolescence to adolescence. Furthermore, our findings suggest that the DERS is an adequate measure of ER as measured physiologically. These results have significant implications for both researchers and practicing mental health professionals, who often

cannot conduct physiological assessments. As the study of ER advances, RSA and the DERS should be compared with emerging measures of the construct, with the goal of predicting and ultimately preventing negative mental health outcomes among youth.

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Key points

- Preliminary research indicates that internalizing, externalizing, and comorbid psychopathology are all characterized by underlying deficits in emotion regulation ability.
- Youth reporting strong emotion regulation demonstrated increasing respiratory sinus arrhythmia reactivity over time, whereas youth reporting weak emotion regulations skills maintained constant respiratory sinus arrhythmia reactivity over time.
- Findings validate the Difficulties in Emotion Regulation Scales against physiological markers of emotion dysregulation and measures of psychopathology.
- The Difficulties in Emotion Regulation Scales may be a clinically useful tool for measuring emotion dysregulation in children and adolescents.

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