


# Comorbid Internalizing and Externalizing Disorders Predict Lability of Negative Emotions Among Children With ADHD

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## Abstract

**Objective:** A subset of children with ADHD experience more frequent, sudden, and intense shifts toward negative emotions. The current study utilized ecological momentary assessment (EMA) to provide a valid assessment of the impact of comorbid internalizing and externalizing disorders on negative emotional lability (EL) among children with ADHD. **Method:** Parents of 58, 8- to 12-year-old children with ADHD were administered a diagnostic interview to assess for ADHD and for the presence of comorbid disorders. Parents completed EMA-based ratings of their child's negative emotions three times daily for a total of 28 days. **Results:** Children with a comorbid internalizing disorder or children with comorbid oppositional defiant disorder (ODD) experienced significantly greater EMA-derived negative EL than children without comorbid disorders over time. Children with multiple comorbidities experienced greater EL than children with single comorbidities. **Conclusion:** Overall, this study suggested that both comorbid ODD and comorbid internalizing disorders contribute to *negative* EL among children with ADHD. (*J. of Att. Dis.* XXXX; XX(X) XX-XX)

## Keywords

ADHD, emotional lability, comorbidity, emotional dysregulation, experience sampling methodology

An accumulation of evidence suggests that emotional lability (EL) is an impairing difficulty that affects children with ADHD at disproportionate rates (Anastopoulos et al., 2011; Sobanski et al., 2010). EL is a well-established, multidimensional construct defined by frequent, rapid, and intense shifts in emotions. EL is not attributed to any specific cause or stimulus, but involves a *pattern* of emotional reactivity and variability. In addition, EL involves difficulties regulating this intense and variable pattern of emotional responding (Marwaha et al., 2014). Many children with ADHD experience deficits in emotion regulation more broadly. Emotion regulation is a process whereby individuals modify their emotional responses to adapt to internal and external environmental demands (Thompson, 1991). Children with ADHD with emotion dysregulation experience emotions more intensely, are more emotionally reactive, and experience greater rates of negative emotionality (Martel & Nigg, 2006; Jensen & Rosén, 2004). Emotion dysregulation is present in approximately 25% to 45% of children with ADHD (Shaw, Stringaris, Nigg, & Leibenluft, 2014). Children with ADHD and comorbid deficits in emotion regulation experience greater dysregulation of both positive and negative emotions (Okado, Mueller, & Nakamura, 2016). However, research suggests that children with ADHD are most susceptible to react maladaptively to

negative events and display negative emotions (Jensen & Rosén, 2004). In particular, children with ADHD exhibit a lower frustration tolerance, quicker anger escalation, greater levels of impatience, and greater reactivity to negative events (Jensen & Rosén, 2004; Surman et al., 2010). In addition, studies suggest that children with ADHD likely experience negative emotions more variably (i.e., EL).

Numerous studies have indicated that children with ADHD experience elevated rates of EL (Anastopoulos et al., 2011; Stringaris & Goodman, 2009). EL emerges in individuals with ADHD as early as preschool years (Overgaard et al., 2015). As many as 25% of preschoolers with ADHD experience EL (Overgaard et al., 2015). Rates of EL among typically developing children usually decline throughout child development (Maciejewski, Lier, Van Branje, & Koot, 2015). However, rates of EL among children with ADHD actually become more apparent throughout child development, suggesting children with ADHD do

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not experience a normative decline in EL. Indeed, one study indicated that 46% of children aged 5 to 12 years with ADHD experienced high rates of EL (Anastopoulos et al., 2011). Research has revealed a positive correlation between EL and ADHD symptoms. More severe EL has been associated with more severe core ADHD symptoms (i.e., inattention, hyperactivity, impulsivity; Sobanski et al., 2010) and greater impairment among children with ADHD (Anastopoulos et al., 2011).

According to the *Diagnostic and Statistical Manual of Mental Disorders* (5th ed.; *DSM-5*; American Psychiatric Association [APA], 2013), the diagnosis of ADHD requires evidence that ADHD symptoms contribute to significant impairment across one or more domains of functioning (e.g., academic, social, occupational). EL may partially account for high rates of functional impairment observed among children with ADHD. Children with ADHD and EL experience greater functional impairment in social skills, daily living, and adaptive skills (Anastopoulos et al., 2011). In addition, EL has also been associated with greater emotional and behavioral difficulties among children with ADHD (Rosen & Factor, 2015). Some researchers have suggested that EL be considered a core diagnostic component of ADHD given it is an impairing difficulty occurring at elevated rates in individuals with ADHD (Skirrow, McLoughlin, Kuntsi, & Asherson, 2009). In fact, EL was a component of disorders preceding ADHD in earlier editions of the *DSM* (i.e., hyperkinetic disorder, minimal brain dysfunction; Carlson, 1998). Research examining variables that may account for higher rates of EL among children with ADHD suggests that comorbid internalizing and externalizing disorders may contribute to a greater risk of significant EL (Stringaris & Goodman, 2009; Sobanski et al., 2010).

## EL and Comorbidity

EL is independently associated with both internalizing disorders and externalizing disorders, although research has indicated a greater relationship between externalizing disorders and EL (Stringaris & Goodman, 2009). This may be accounted for by the high correlation between EL and externalizing problems such as hyperactivity/impulsivity and the irritable/reactive subset of oppositionality (Fantuzzo, Bulotsky-Shearer, Fusco, & McWayne, 2005; Stringaris & Goodman, 2009). However, numerous studies suggest that comorbidity of mixed internalizing and externalizing disorders contributes to the highest rates of EL; Stringaris & Goodman, 2009). In a large, national, cross-sectional study, 64% of children with comorbid internalizing and externalizing disorders also had EL (Stringaris & Goodman, 2009). The odds of displaying EL were 2.5 times higher for individuals with comorbid internalizing and externalizing disorders compared to children with either internalizing-only

diagnoses or externalizing-only diagnoses (Stringaris & Goodman, 2009). Research specifically examining the relationship between comorbidity and EL among children with ADHD suggests that children with ADHD and a comorbid internalizing or externalizing disorder experience significantly greater rates of EL than children with ADHD-only (Factor, Reyes, & Rosen, 2014). These findings suggest that a relation exists between comorbidity and EL. Children with ADHD exhibit high rates of comorbid internalizing and externalizing disorders (Larson, Russ, Kahn, & Halfon, 2011), which may account for high rates of EL observed in this population. However, it is also plausible that high rates of EL place children with ADHD at greater risk of developing comorbidity. There has been less research examining EL as a risk factor of comorbidity among children (Larson et al., 2011; Sobanski et al., 2010).

Emerging research suggests that among children with ADHD, both comorbid internalizing and externalizing disorders contribute to EL (Sobanski et al., 2010). Specifically, children and adolescents with ADHD and comorbid oppositional defiant disorder (ODD), affective disorders, and substance use disorders also display high rates of EL (Sobanski et al., 2010). Research examining which specific comorbid disorders contribute to EL among children with ADHD indicates that comorbid externalizing disorders may explain more variance in EL than comorbid internalizing disorders. Research suggests that children with ADHD are not only behaviorally impulsive but also emotionally impulsive. Emotional impulsivity defined as impatience, lower frustration tolerance, anger escalation, and emotional excitability (Barkley & Fischer, 2010), likely contributes to EL among children with ADHD and may be correlated with higher rates of comorbid externalizing disorders. For instance, in a study examining the impact of comorbid internalizing and externalizing problems on the severity of EL among children with ADHD, conduct problems explained 25% of the variance in EL and oppositional problems explained 15% of the variance in EL (Sobanski et al., 2010). These results suggest that comorbid externalizing difficulties may differentiate children with ADHD and high levels of EL from children with ADHD with lower levels of EL. This study was one of the first studies to examine which specific comorbid disorders predicted EL among children with ADHD. However, this study relied on a retrospective report measure to assess for the presence of EL. In addition, the authors created EL groups (i.e., low, medium, severe) rather than examining EL continuously. The construct EL is defined by variability in emotions over time. Studies measuring EL among children with ADHD and comorbid disorders more ecologically, prospectively, and continuously are needed to provide a more valid assessment of EL in this population.

Comorbid externalizing difficulties, such as conduct problems and oppositionality, may be the greatest predictors

of EL among children with ADHD (Sobanski et al., 2010). ODD, an externalizing disorder of childhood, is characterized by irritability, argumentativeness, and vindictiveness (APA, 2013). Children with ODD also display high levels of negative emotionality, a trait defined as intense emotional responding to negative emotional stimuli (Martel & Nigg, 2006). Research has indicated that ODD occurs in approximately 50% to 60% of children with ADHD (Bauermeister, Shrout, Ramirez, & Bravo, 2007); thus, ODD may be the most prevalent comorbid disorder among children with ADHD. Because ODD is associated with impairments in emotional functioning (i.e., negative emotionality) and EL is observed at high rates among children with ADHD, research has examined the overlap between symptoms of ODD and EL among child ADHD populations. Interestingly, this research suggests that ODD is related to but distinct from EL. A study utilizing confirmatory and exploratory factor analysis provided support for ODD and EL as distinct, independent constructs (Liu et al., 2016). These findings indicated that ODD is best conceptualized as including two dimensions: negativity and oppositional/provocative dimensions, while EL is best defined according to symptoms of mood variability (i.e., poor frustration tolerance, rapid and intense mood changes, unpredictability of emotional tantrums; Liu et al., 2016). Although some children with ADHD exhibit both comorbid ODD and EL, other children exhibit ODD or EL difficulties exclusively (Liu et al., 2016). However, given these difficulties are often comorbid and contribute to significant impairment, research further examining EL longitudinally, among children with ADHD and comorbid ODD is warranted.

There has been a paucity of research examining EL among children with ADHD and comorbid internalizing disorders, although some research suggests that anxious/shy problems explain some variance in EL among children with ADHD (Sobanski et al., 2010). For instance, in the study detailed above (Sobanski et al., 2010) examining the impact of comorbid internalizing and externalizing problems on the severity of EL among children with ADHD, results revealed that emotional problems as indexed by the Strengths and Difficulties Questionnaire (Goodman, 2001) contributed to 9% of the variance in EL while anxious/shy behavior contributed to 8% of the variance in EL (Sobanski et al., 2010). Both ADHD and internalizing disorders are independently associated with emotional impairments. Children with ADHD are susceptible to experiencing greater negative emotions (i.e., lower frustration tolerance, anger) and greater reactivity to negative events (Jensen & Rosén, 2004; Okado et al., 2016), while children with internalizing disorders exhibit greater overall negative affect (Joiner, Catanzaro, & Laurent, 1996). It is possible that the interaction of negative affectivity inherent in internalizing disorders and excessive emotional reactivity to negative events characteristic of ADHD may produce greater lability

of negative emotions. High rates of negative affect paired with a reactive style of coping likely contribute to a poorly inhibited, negative, and variable pattern of emotional responding. However, this relationship has yet to be explored in this population. Research has indicated that approximately 30% of children with ADHD have a comorbid internalizing disorder (Larson et al., 2011). Therefore, additional research examining whether children with ADHD and comorbid internalizing disorders also experience negative emotions more variably (i.e., EL) is warranted.

## Current Study

The current study examined the impact of comorbid internalizing and externalizing disorders among children with ADHD on lability of negative emotions (*negative EL*) over time. Previous research suggests that both comorbid internalizing and externalizing difficulties are related to retrospective report of EL among children with ADHD (Sobanski et al., 2010). This study will examine how diagnoses of comorbid internalizing *disorders* and/or comorbid externalizing *disorders* (i.e., ODD) contribute to prospective negative EL of children with ADHD. Previous studies have examined EL more broadly and have not examined lability of emotions more specifically (i.e., lability of negative emotions). Numerous studies suggest that children with ADHD experience negative emotions more intensely (Jensen & Rosén, 2004; Maedgen & Carlson, 2000; Sobanski et al., 2010). Thus, this study will focus on the experience of negative emotions in this population.

In addition, this study will utilize ecological momentary assessment (EMA) to examine negative EL prospectively over the course of a 28-day period, given the methodological limitations of previous studies relying on retrospective report of EL. The majority of studies examining EL in child ADHD populations have relied on retrospective report (Anastopoulos et al., 2011; Banaschewski et al., 2012; Sobanski et al., 2010). In one of the few studies assessing EL in a childhood ADHD population utilizing EMA, comorbidity broadly (i.e., presence of a comorbid diagnosis without examining internalizing versus externalizing diagnoses specifically) was found to contribute to greater EL, generally (Factor et al., 2014). To the author's knowledge, no studies have examined how specific comorbidities (i.e., internalizing versus externalizing disorders) contribute to *negative EL* in a child ADHD population. Studies examining negative EL in children have been conducted mostly in internalizing disorder populations (Silk et al., 2011; Tan et al., 2012). Given there have been few studies utilizing EMA to assess negative EL in a childhood ADHD population, further study is warranted. EMA allows for the collection of real-time data in an ecological environment. In addition, EMA permits for the collection of data at several

periods of the day over time, which is crucial when examining variability of emotions (Rosen, Epstein, & Van Orden, 2013).

The following hypotheses were posited:

**Hypothesis 1:** Given ODD is associated with greater negative emotionality (Martel & Nigg, 2006), and EL (Liu et al., 2016; Sobanski et al., 2010), it is hypothesized that children with ADHD and comorbid ODD will experience significantly greater negative EL compared to children with ADHD without a comorbid externalizing disorder.

**Hypothesis 2:** In addition, because both ADHD and internalizing disorders are associated with negative emotions and negative affect, it is hypothesized that children with ADHD and a comorbid internalizing disorder will also experience significantly greater negative EL than children with ADHD without a comorbid internalizing disorder.

**Hypothesis 3:** Given previous research indicating multiple comorbidities confer increased risk for EL, the authors hypothesize children with both a comorbid internalizing and externalizing disorder will experience significantly greater EL than children with a single comorbidity (i.e., either ADHD and a comorbid internalizing disorder or ADHD and comorbid ODD).

## Method

### Participants

Sixty-two children aged 8 to 12 years ( $M = 9.56$ ;  $SD = 1.20$ ) with ADHD and their families were recruited for the current study. All families in the current study were recruited through advertisements distributed through local schools in a midsized Midwestern metropolitan area. Children were only eligible for participation in the study if they were a resident of a single home (i.e., two-parent or single-parent family) full-time over the course of the study to ensure consistency across the EMA protocol. In addition, children with an IQ of less than 70 and children with an Autism Spectrum Diagnosis (based on parent report) were excluded from the study. The Diagnostic Structured Interview for Children (DISC-P; Shaffer, Fisher, Lucas, Dulcan, & Schwab-Stone, 2000) was used to assess for ADHD status and comorbid disorder status according to parent report of symptoms and associated impairment. All children met full criteria for ADHD-Combined Presentation or ADHD-Predominantly Inattentive Presentation with significant but subthreshold hyperactive/impulsive symptomatology (three or more symptoms of hyperactivity/impulsivity). Four children demonstrating minimal hyperactive/impulsive symptoms (less than three symptoms) were characterized as exhibiting an ADHD-Predominantly Inattentive Presentation without subthreshold hyperactive/impulsive symptoms.

**Table 1.** DSM-IV-TR Comorbid Diagnoses.

DSM diagnosis	n (%)
Social phobia	3 (5.2)
Separation anxiety	13 (22.4)
Generalized anxiety	5 (8.6)
OCD	7 (12.1)
Major depressive	4 (6.9)
ODD	31 (53.4)

Note. DSM-IV-TR = *Diagnostic and Statistical Manual of Mental Disorders* (4th ed.; text rev.); OCD = obsessive compulsive disorder; ODD = oppositional defiant disorder.

Research suggests that significant EL is less likely to be present in children with ADHD who do not demonstrate any hyperactive/impulsive symptomatology (i.e., fewer than three symptoms; Barkley, 2010); therefore, these four children were excluded from further analyses.

The final sample of children included 58 children (37 males and 21 females) ages 8 to 12 years ( $M = 9.53$ ;  $SD = 1.17$ ) and their families. All children in the current study met full criteria for ADHD, whereas 34 children (58.6%) also met criteria for at least one comorbid disorder. Twenty-four children were classified as ADHD-only (41.4%). Three children exclusively met criteria for a comorbid internalizing disorder (8.8%), 16 children exclusively met criteria for comorbid ODD (47.1%), and 15 children (44.1%) met criteria for both a comorbid internalizing and externalizing disorder. The breakdown by disorder is depicted in Table 1. Thirty of the 58 children (51.7%) were receiving stimulant or nonstimulant medication for the treatment of ADHD while participating in the study. Medication status and dose remained consistent throughout the study for all participants. The demographic breakdown of participants was 34 Caucasian (58.6%), 18 African American (31.0%), four Latino/Hispanic (6.9%), and two Biracial (3.4%), which is reflective of the area from which the population was drawn (U.S. Census Bureau, 2010).

### Procedures

**Baseline session.** Parents of children provided informed consent during the baseline session of the study. The DISC-P was administered to parents to assess child ADHD and comorbid disorder status. Parents then received training in completion of the EMA protocol. Parents received compensation for completing the baseline session (i.e., US\$15 gift cards).

**EMA protocol.** Parents completed EMA-based ratings of their child's negative emotions three times daily for a period of 28 days (84 total time points). This 28-day assessment period was selected over shorter (i.e., 1 week) periods



utilized in previous EMA studies (i.e., Suveg, Kendall, Comer, & Robin, 2006; Whalen et al., 2009) to ensure assessments captured the full temporal range of EL. Child report of negative emotions was not used, as previous studies have indicated that children were less likely to complete EMA ratings during intervals where their parents rated them as upset, thus rendering their ratings invalid (Rosen et al., 2013; Rosen & Factor, 2015). Therefore, only parent ratings were utilized in this analysis. All ratings were completed using Palm® Tungsten E2 Personalized Data Assistants (PDA) that had been programmed using Purdue Momentary Assessment Tool (PMAT) software (Weiss, Beal, Lucy, & MacDermid, 2004). The PDA was programmed according to time intervals compatible with the family schedule. The PDA set off alerts at three specific predetermined intervals (i.e., before school, after school, and evening). Parents were instructed to complete ratings at all time periods.

One parent was designated as the parent responsible for completing all EMA ratings to allow for assessment of within-informant variability. This was the same parent that completed the DISC-P during the baseline session. Parents indicated their identity (i.e., mother, father, guardian) prior to completing each EMA rating. Parents were instructed to only complete ratings if their child was present. Parents were given a 2-hr time window to complete ratings. The rating was unavailable after the 2-hr time period elapsed. In addition, before completing ratings, parents were prompted with a question asking whether the child was currently present. For parents that indicated “no” on this question, the ratings for the specific time point were not analyzed. At each time point, parents were asked to complete the Positive and Negative Affect Scale–Short Form (PANAS-Short Form; Thompson, 2007) regarding their perception of their child’s negative affect (NA) at the specific assessment interval. The 10-item short form was used instead of the long form to reduce the disruption to participants’ daily lives and enhance adherence to the EMA protocol over the 28-day period. Only the NA subscale was utilized in the current study to assess child lability of negative emotions. In addition, parents were provided with compensation that was commensurate with their completion of EMA ratings to further enhance adherence to the EMA protocol. Specifically, each week, parents could earn up to US\$10 (total of up to US\$40 over the 4-week assessment period) based on the percentage of completed rating intervals. All procedures within this study were approved by the local Institutional Review Board.

## Measures

**The DISC-P.** The DISC-P (Shaffer et al., 2000), a fully structured diagnostic clinical interview, was administered during the baseline session. This interview assesses for the presence of child psychiatric diagnoses according to *Diagnostic*

*and Statistical Manual of Mental Disorders* (4th ed.; *DSM-IV*; APA, 1994) criteria. The DISC-P was used to determine child ADHD diagnostic status according to parent report of diagnostic symptoms and degree of impairment from symptoms. Although the DISC-P only assesses for ADHD diagnostic status using one informant, the DISC-P assesses for ADHD symptoms across multiple settings (i.e., home, school, other). In addition, the DISC-P was also used to assess for the presence of internalizing and externalizing diagnoses, specifically, social phobia, separation anxiety disorder, generalized anxiety disorder, obsessive compulsive disorder, major depressive disorder, and ODD. The conduct disorder scale was not administered for the current study. A preliminary study examining a similar community sample of children with ADHD indicated a very low base rate of conduct disorder (Rosen & Factor, 2015). In addition, results of a large, epidemiological study indicated that the prevalence rate of conduct disorder in a community sample of children ages 8 to 12 was less than 2% (Maughan, Rowe, Messer, Goodman, & Meltzer, 2004). Finally, the majority of children in the epidemiological sample that met criteria for conduct disorder also met criteria for ODD. Thus, the small minority of children that may meet criteria for conduct disorder are captured by assessing for ODD. Research supports the validity and reliability of the DISC-P across numerous settings (Shaffer et al., 2000).

**PANAS-PR.** The PANAS-PR (Phillips, Lonigan, Driscoll, & Hooe, 2002) assesses the presence and intensity of positive and negative affect. Several studies have used repeated administrations of the PANAS-PR at multiple time points to assess EL (Anestis et al., 2010; Cohn, Zeichner, & Seibert, 2008; Rosen, Walerius, Fogleman, & Factor, 2015; Silk et al., 2011). For the current study, the PANAS-PR was administered three times per day for a 28-day period in conjunction with EMA protocol to assess changes in negative emotions in children. A 10-item PANAS-PR short version was created for this study to minimize the inconvenience and time commitment of the EMA protocol. This 10-item scale was created by adapting items from Thompson’s (2007) 10-item adult self-report PANAS-Short Form using analog items from the 20-item PANAS-PR. The adult self-report PANAS-Short Form is psychometrically equivalent to the full, 20-item version (Thompson, 2007). Previous studies have also demonstrated the utility of the 10-item PANAS-PR for assessing EL within an EMA methodology in children (Walerius, Reyes, Rosen, & Factor, 2014). In a study utilizing item response theory to examine the psychometric properties of the 10-item PANAS-PR in a child sample, Ebesutani and colleagues (2012) concluded that the 10-item PANAS-PR (composed of five-item negative affect and five-item positive affect subscales) could be used to more efficiently assess negative and positive affect in children. Cronbach’s alpha coefficients for the reduced five-item positive affect

**Table 2.** Mean NA and Sum of Squared Difference by Diagnostic Group.

Diagnostic group	NA M (SD)	NA MSSD M (SD)	n
ADHD-only	5.66 (0.69)	3.09 (2.76)	24
ADHD + ODD	5.81 (0.50)	5.04 (4.82)	16
ADHD + internalizing	5.65 (0.18)	5.20 (2.45)	3
ADHD + internalizing + ODD	6.31 (0.76)	8.06 (3.51)	15

Note. NA = negative affect; ODD = oppositional defiant disorder.

scale and reduced five-item negative affect scale were .85 and .83, respectively. For a more detailed overview of psychometrics of the 10-item shortened PANAS-PR, see Tan et al. (2012).

### Analytic Plan

On the PANAS-PR, parents rated the degree to which their child demonstrated listed negative emotions at specific time points on a 5-point Likert-type scale ranging from 1 (*not at all*) to 5 (*extremely*). Mean negative affect scores were created by averaging scores from the PANAS-PR across each time point, which represented the child's average negative affective intensity across all time points. Mean squared successive difference (MSSD) scores were created to assess within-day variability by adhering to the procedures recommended by Solhan, Trull, Jahng, and Wood (2009). MSSD Negative Affect scores were calculated by taking the difference of each successive within-day rating point (i.e., morning-afternoon and afternoon-evening), squaring each within-day difference score, and averaging the within-day MSSD's across all days in which the participant completed EMA ratings. Through this process, a single MSSD Negative Affect Score (i.e., PANAS-NA) is created for each participant, which accounts for the frequency and amplitude of within-day variability over the 28-day measurement period. Previous research has demonstrated the reliability and validity of the MSSD score method to assess variability within EMA data (Jahng, Wood, & Trull, 2008). In an article outlining several methods of analyzing EMA data to assess EL, Jahng et al. (2008) concluded that the MSSD method is the most valid method for capturing EL because it provides a measure of within-day temporal variability and dependency of emotions. Numerous articles have utilized the MSSD method to assess EL (Anestis et al., 2010; Factor et al., 2014; Rosen et al., 2015; Thompson et al., 2012).

For the purpose of the current study, the authors were interested in examining the unique contribution of internalizing versus externalizing disorders on negative EL over a 28-day period. In addition, the authors were also interested in examining differences among children with ADHD-only, ADHD and a single comorbidity, and ADHD and multiple comorbidities. Thus, the authors conducted a two-way ANCOVA to examine the overall impact of internalizing

versus externalizing disorders on negative EL (on the PANAS-PR) over a 28-day period while controlling for age, gender, and ADHD medication status. In addition, a one-way ANCOVA and post hoc analyses were conducted to examine differences between ADHD diagnostic groups (i.e., 0 = no comorbidity, 1 = comorbid internalizing disorder, 2 = comorbid ODD, 3 = comorbid internalizing disorder + ODD; see Table 2). Although most children with a comorbid internalizing disorder also met criteria for comorbid ODD (i.e., only three children met criteria purely for a comorbid internalizing disorder), Levene's test emerged as nonsignificant, indicating the assumption of equal variances was not violated for any of the analyses.

## Results

### EMA Protocol Adherence

On average, participants completed the EMA ratings at 80.81% of the rating periods. A one-way ANOVA was conducted to determine differences between independent variables (i.e., comorbid internalizing disorder, comorbid externalizing disorder) on EMA adherence. Results were not statistically significant, all  $ps > .05$ .

### Univariate Analysis

PANAS ratings were compiled across all time points to create an overall negative affect (NA) MSSD using the procedures described in the "Method" section. Mean NA and NA MSSD by diagnostic group is displayed in Table 2. First, a two-way ANCOVA was conducted to examine the unique contribution of internalizing disorders versus ODD on negative EL (i.e., negative affect lability as indicated by EMA-derived PANAS negative affect MSSD) among children with ADHD. Then, a one-way ANCOVA and post hoc comparisons were conducted to examine differences between single comorbidity and multiple comorbidity groups. Age, gender, and medication status were entered as covariates in both analyses.

For the two-way ANCOVA, there was no significant effect of any of the covariates on EMA-derived PANAS-NA MSSD (all  $ps > .05$ ) There was a significant main effect of comorbid internalizing disorder on EMA-derived PANAS-NA MSSD,

**Table 3.** Analysis of Covariance of Diagnostic Group Differences in Negative Emotional Lability.

Variable	Sum of squares	df	F	Partial $\eta^2$
<b>Covariates</b>				
Gender	3.45	1	0.25	.01
Age	0.44	1	>0.01	>.01
ADHD meds	0.14	1	0.01	>.01
<b>Independent variables</b>				
Internalizing Dx	66.09	1	4.81*	.09
Externalizing Dx	57.82	1	4.21*	.08

Note.  $N = 58$ .

\* $p < .05$ .

$F(1, 51) = 4.81, p = .03, \eta^2 = .09$ . Participants with ADHD and a comorbid internalizing disorder displayed significantly greater negative EL over time than children with ADHD without a comorbid internalizing disorder. There was also a significant main effect of comorbid ODD on EMA-derived PANAS-NA MSSD,  $F(1, 51) = 4.21, p = .04, \eta^2 = .08$ . Participants with ADHD and comorbid ODD displayed significantly greater negative EL over time than children with ADHD without comorbid ODD. There was no significant interaction of comorbid internalizing disorder and comorbid ODD on negative EL ( $p = .57$ ). Results are displayed in Table 3.

A comorbid diagnostic status variable was created to examine differences between diagnostic groups. Children were classified as either (a) ADHD-only (ADHD-only), (b) ADHD comorbid internalizing disorder (ADHD-Int), (c) ADHD comorbid ODD (ADHD-ODD), or (d) ADHD comorbid internalizing disorder and ODD (ADHD-Int/ODD; see Table 2). A one-way ANCOVA was conducted to examine differences in EMA-derived negative EL across the four diagnostic levels detailed above while controlling for age, gender, and ADHD medication status. There was no significant effect of any of the covariates on EMA-derived PANAS-NA MSSD (all  $ps > .05$ ). Results of the one-way ANCOVA, revealed a significant effect of comorbid diagnostic status on EMA-derived PANAS-NA MSSD,  $F(3, 51) = 6.99, p < .001, \eta^2 = .29$ . Post hoc analyses (i.e., Least Significant Difference test) were conducted to determine differences across diagnostic groups. No significant differences emerged between the ADHD-only and ADHD-Int ( $p > .05$ ) groups or between the ADHD-Int and ADHD-ODD groups ( $p > .05$ ). A trend emerged in which the ADHD-ODD group displayed greater EMA-derived negative EL than the ADHD-only group ( $M$  difference = 1.97;  $p = .11$ ). Results revealed a significant difference between the ADHD-only and ADHD-Int/ODD group ( $M$  difference = 5.64,  $p < .001$ ), such that children in the ADHD-Int/ODD group displayed significantly greater EMA-derived negative EL than those in the ADHD-only group. In addition, a

significant difference emerged between the ADHD-ODD group and ADHD-Int/ODD group ( $M$  difference = 3.67,  $p = .008$ ), such that children in the ADHD-Int/ODD group displayed significantly greater EMA-derived EL than children in the ADHD-ODD group. Although not significant, a trend emerged in which children in the ADHD-Int/ODD group displayed greater EMA-derived EL than children in the ADHD-Int group ( $M$  difference = 3.49,  $p = .15$ ).

## Discussion

The findings of the current study suggest that children with ADHD and either a comorbid internalizing or externalizing disorder experience greater negative EL than children with ADHD without comorbid disorders over the course of a 28-day period. As hypothesized, children with ADHD and comorbid ODD experienced greater negative EL in comparison to those without comorbid ODD. Interestingly, children with ADHD and a comorbid internalizing disorder also experienced significantly greater rates of negative EL. These results would suggest that both comorbid externalizing disorders and comorbid internalizing disorders independently contribute to greater negative EL over time among children with ADHD. Previous research suggests that externalizing problems (i.e., conduct problems and oppositionality) may be the greatest predictors of EL among children with ADHD (Sobanski et al., 2010). The results of this study provide some support for this finding, as children with comorbid ODD experienced greater EL than children without a comorbid externalizing disorder. More specifically, this study provides new evidence that comorbid ODD contributes to *negative* EL over time among children with ADHD. However, this study found that comorbid internalizing disorders equally contributed to negative EL over time among children with ADHD. In addition, the EMA methodology utilized in this study to examine EL provides evidence of variability in negative emotions among children with comorbid disorders *over time* (i.e., 28 days) in an ecological setting.

Although there was a limited sample of children with internalizing-only comorbidity, and thus limited power to detect a significant effect among children in the ADHD-Int group, results of analyses suggest children with mixed internalizing/externalizing disorders (i.e., ADHD-Int/ODD group) experienced greater negative EL than children with a single comorbid disorder (i.e., ADHD-Int or ADHD-ODD groups). These findings support prior research suggesting multiple comorbidities confer increased risk for higher EL (Stringaris & Goodman, 2009). Greater negative EL in children experiencing multiple comorbidities may also be explained by the general factor “p,” a general psychopathology dimension. Studies suggest that high “p” scores are associated with greater overall comorbidity and impairment (Caspi et al., 2014). Research examining network models



have concluded that over half of the *DSM* symptoms are connected, accounting for high comorbidity rates (Borsboom, Cramer, Schmittmann, Epskamp, & Waldorp, 2011). EL may in fact be a component of “p,” and may help explain high rates of negative EL among children with comorbidity in the current study. Overall, the current study presents new evidence that children with ADHD and multiple comorbidities experience the greatest lability of negative emotions.

### Implications

**Theoretical implications.** These findings have significant implications for research investigating the role of comorbidity on the emotional functioning of children with ADHD. Previous research examining EL among children with ADHD suggests that externalizing problems contribute to more severe EL. The current study provides evidence that children with ADHD experience greater negative EL when they have a comorbid externalizing disorder (i.e., ODD). The core symptom dimensions of ODD, negativity, irritability, and oppositionality, may interact with deficits inherent in ADHD (i.e., disinhibition and impulsivity) to produce greater EL in this population. ADHD is theorized to involve a primary deficit in behavioral inhibition which may manifest as poor emotional self-control and emotional impulsivity (Barkley, 1997). It is likely that emotional impulsivity inherent in ADHD interacts with symptoms of negative emotionality inherent in ODD to produce a more intense, poorly inhibited, and variable pattern of negative emotional responding among children with comorbid ADHD and ODD.

This pattern of negative EL was also found among children with ADHD and comorbid internalizing disorders. Interestingly, studies suggest that children with internalizing disorders also experience greater rates of negative affect and emotional dysregulation (Tortella-Feliu, Balle, & Sesé, 2010; Watson, Clark, & Carey, 1988). However, children with ADHD and internalizing disorders may experience deficits in behavioral inhibition that are distinct from children with ADHD and comorbid externalizing disorders. Research suggests that children with ADHD and comorbid internalizing disorders experience a pattern of disinhibition characterized by anxious impulsivity (Newman & Wallace, 1993; Nigg, 2001). This pattern of anxious impulsivity likely differs from emotional impulsivity experienced by children with ADHD and comorbid externalizing disorders. However, the results of this study suggest that children with comorbid internalizing disorders exhibit a similar pattern of negative EL. Greater rates of negative affect among children with internalizing disorders likely interacts with disinhibition inherent in ADHD to produce negative EL in this population. There appears to be multiple pathways to negative EL among children with ADHD. The results of this

article suggests that negative EL is not unique to children with ADHD and comorbid ODD, but also exists in children with ADHD and comorbid internalizing disorders. In addition, the results of the current study suggest that multiple comorbidities among children with ADHD confer the greatest risk of negative EL. Children with ADHD and both comorbid internalizing and externalizing disorders experience heightened levels of negative affect. Among children with ADHD and multiple comorbidities, negative affect and a reactive coping style may be exacerbated by both emotional and anxious impulsivity. Studies have yet to explore negative EL among this population of children with ADHD. Further research on children with ADHD and multiple comorbidities would prove useful; given these children experience the most impairing rates of negative EL.

This study also has significant implications for the use of EMA as a method of assessing EL among children with ADHD. In a review on the assessment of EL, Marwaha et al. (2014) identified 24 measures of EL, primarily self-report measures, and most of which did not include test-retest, interrater reliability, or validity assessments. The current study provides evidence for the utility of EMA as a method of assessing the emotional functioning of children with ADHD, as differences in EL were observed among children with ADHD and comorbid disorders. In addition, this study provides evidence of ecological validity, as variability in emotions was observed in an ecologically valid (i.e., real-life, day-to-day) setting. In the Marwaha et al. review paper, the authors identified the need for valid measures that captured the “core elements” of EL (i.e., frequency of oscillations in affect, intensity of affective changes, regulation of affect). The EMA methodology in this study allowed for an assessment of within-day variability of the frequency and amplitude of negative emotions in an ecological setting. The current study takes an important step in establishing the utility of EMA in assessing the multidimensional construct of EL in a childhood ADHD sample.

**Clinical implications.** The current study also provides significant clinical implications for the assessment and treatment of children with ADHD. This study adds to a growing body of research suggesting children with ADHD and comorbid disorders experience greater impairments in emotional functioning than children without comorbidity. In the present study, children with ADHD and a comorbid disorder (i.e., internalizing or externalizing disorder) experienced significantly greater negative EL than children with ADHD-only. Comorbidity may in fact be one of the greatest predictors of EL and associated emotional and functional impairment among children with ADHD. Typical treatments for childhood ADHD involve targeting core ADHD symptoms (i.e., inattention, hyperactivity, impulsivity) utilizing medication management or behavioral parent training



(American Academy of Pediatrics [AAP], 2011). Although these treatments are useful in reducing the impact of ADHD symptoms on the behavioral functioning of children with ADHD, typical treatments do not address associated comorbidities that significantly contribute to emotional impairment observed in this population (Shaw et al., 2014; Waxmonsky et al., 2013).

These findings highlight the importance of thoroughly assessing for the presence of comorbid disorders when assessing for childhood ADHD. Thorough assessment of comorbidity should also involve an assessment for associated emotional impairments such as EL, given the current findings that comorbidity is related to significantly greater negative EL in this population. In addition, the results of this study reveal a critical need for ADHD treatments that target emotional impairments arising from the interaction of ADHD and comorbid internalizing and/or externalizing disorders. Treatments addressing emotional impairments would fill a significant gap in the ADHD treatment literature as current evidence-based treatments do not target these concerns. ADHD treatments should include an emotion regulation component to address the pattern of negative EL, overall negative affect, and greater reactivity to emotional stimuli that is more prevalent in this population. Cognitive behavioral treatments that include an emotion regulation component have demonstrated preliminary effectiveness in treating emotional impairments in children with internalizing disorders (Hannesdottir & Ollendick, 2007) and may prove useful for treating children with ADHD and comorbid disorders. These treatments should incorporate emotion recognition techniques, problem solving, cognitive restructuring, and relaxation training (Hannesdottir & Ollendick, 2007) in conjunction with the typical ADHD treatment regimen (i.e., medication management, behavioral parent training) to address both core ADHD symptoms and associated emotional impairments. In addition, parent training interventions such as the Incredible Years Program utilizing social and emotion-coaching techniques have demonstrated some efficacy in increasing children's emotion vocabulary and problem solving abilities (Webster-Stratton, Reid, & Beauchaine, 2011). Thus, child treatments that incorporate emotional-coaching parenting techniques may prove useful in addressing emotion regulation difficulties children with ADHD experience.

### Limitations and Future Directions

This study provides evidence that comorbidity of internalizing or externalizing disorders contributes to greater negative EL among children with ADHD, over time. However, several limitations of the current study should be addressed. Although significant effects were observed, the relatively small sample size ( $N = 58$ ) may have decreased statistical

power, thus limiting the ability to detect significant effects. Future research should replicate these findings in a larger, broader sample to determine whether these effects remain significant with a larger population of children. Specifically, the relatively small sample size limited the ability to distinguish and assess the effects of internalizing disorder with comorbid ODD among children with ADHD. Further research with a larger sample is needed to see whether differences in EL exist between children with ADHD with comorbid internalizing disorder only, children with ADHD and ODD only, and children with ADHD with comorbid internalizing disorder *and* ODD. In addition, this study used one primary informant to complete the DISC-P to determine diagnostic status and to complete the EMA ratings over the 28-day period. Although research supports the reliability and validity of the DISC-P (Shaffer et al., 2000), future studies would benefit from the use of multiple informants (e.g., two parents) to more reliably assess for diagnostic status and negative EL in the home environment.

The purpose of the current study was to determine how patterns of comorbidity predicted the negative EL of children with ADHD. Although significant effects emerged when comparing the ADHD-ODD group to the ADHD-only and ADHD-Int/ODD group, the small number of children only meeting criteria for a comorbid internalizing disorder ( $N = 3$ ) limited power to detect significant effects among contrasts for this group (ADHD-Int). In addition, the sample was not large enough to examine which specific internalizing disorders (i.e., separation anxiety disorder, generalized anxiety disorder, mood disorders, etc.) contributed to the greatest rates of negative EL among children with ADHD. Although many internalizing disorders share similar symptoms, it is likely that emotional impairments associated with each internalizing disorder may be distinct. For instance, some research suggests that anxiety disorders are associated with greater physiological emotional reactivity (Van Lang et al., 2007), while depressive disorders are associated with greater overall negative affect (Watson et al., 1988). Future research should specifically examine differences in negative EL between specific comorbid disorders as some disorders may contribute to greater negative EL than other comorbid disorders among children with ADHD. Understanding specific emotional impairments associated with each comorbid disorder may aid in treating this population.

The current study only assessed for *negative* EL among a sample of children with ADHD. Research examining lability of positive emotions among children with ADHD is scarce, despite findings that children with ADHD exhibit higher levels of positive affect as well as negative affect (Okado, Mueller, & Nakamura, 2016). Future studies examining positive EL among children with ADHD and comorbid disorders are warranted. In addition, research examining whether lability of positive emotions is associated with

emotional and functional impairment in this population is needed as most studies have focused on impairment arising from overall EL.

Although EMA allows for a valid assessment of negative EL in an ecological setting, limitations of EMA should be addressed. In the current study, ratings of child negative emotions were collected three times per day over a 28-day period, which permitted for the assessment of within-day variability in negative emotions. However, EMA only provides ratings of child emotions and does not provide the context in which the emotion occurred. EMA permits for the measurement of a *pattern* of negative EL, but does not assess for an underlying, specific cause of the emotional event. Thus, we cannot determine whether children experienced greater variability in negative emotions or whether they experienced more negative emotion provoking events. Future research examining the context in which negative emotions occur may clarify whether greater negative EL observed in children with ADHD and comorbid disorders is a result of greater variability in emotions or a consequence of experiencing more frequent negative events. In addition, the use of EMA permitted for the assessment of EL over a 28-day period. Thus, it was concluded that children with ADHD and comorbid disorders experienced greater EL *over time*. However, this study did not permit for an assessment of the directionality of this relationship. It is possible that comorbidity among children with ADHD predicts greater EL over time. However, it is also possible that greater EL places children with ADHD at a greater risk of developing comorbid disorders. Future research should examine the bidirectional relationship between EL and comorbid disorders among children with ADHD.

## Conclusion

The current study takes an important step in identifying the impact of comorbid disorders on the emotional functioning of children with ADHD. This study provides preliminary evidence that both comorbid internalizing and comorbid externalizing disorders equally and independently contribute to *negative EL over time* among children with ADHD. In addition, this study provides new evidence that multiple comorbidities among children with ADHD confer the greatest risk for negative EL. Deficits in behavioral inhibition inherent in ADHD experienced concurrently with symptoms of negative emotionality characteristic of internalizing and externalizing disorders likely contribute to a poorly inhibited, variable pattern of negative emotional responding in this population. These findings will aid in the recognition of children likely to experience negative EL. In addition, these findings further highlight the need for treatments tailored to address emotional impairments experienced by children with ADHD and comorbid disorders, given that these children experience greater lability of negative emotions in their

daily lives. Our hope is that by understanding the unique pattern of emotional responding occurring in children with ADHD and comorbid disorders, we can improve our ability to assess and treat the negative effects of EL on the daily functioning of children with ADHD.

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