

Practitioner Review: Emotional dysregulation in attention-deficit/hyperactivity disorder – implications for clinical recognition and intervention

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Background: Because emotional symptoms are common in attention-deficit/hyperactivity disorder (ADHD) patients and associate with much morbidity, some consider it to be a core feature rather than an associated trait. Others argue that emotional symptoms are too nonspecific for use as diagnostic criteria. This debate has been difficult to resolve due, in part, to the many terms used to describe emotional symptoms in ADHD and to concerns about overlap with mood disorders. **Methods:** We sought to clarify the nature of emotional symptoms in ADHD by reviewing conceptual and measurement issues and by examining the evidence base regarding specificity of such symptoms for ADHD. We reviewed the various terms used to define emotional symptoms in ADHD, clarify how these symptoms are demarcated from mood disorders, and assess the possibility that symptoms of emotional impulsivity and deficient emotional self-regulation should be considered as core symptoms. We addressed psychiatric comorbidities, the effects of ADHD treatments on associated emotional dysregulation, and the utility of current rating scales to assess emotional symptoms associated with ADHD. **Results:** Emotional symptoms are common and persistent in youth and adults with ADHD. Although emotional symptoms are common in other psychiatric disorders, emotional impulsivity (EI), and deficient emotional self-regulation (DESR) may be sufficiently specific for ADHD to function as diagnostic criteria. **Conclusions:** Emotional symptoms in ADHD cause clinically significant impairments. Although there is a solid theoretical rationale for considering EI and DESR to be core symptoms of ADHD, there is no consensus about how to define these constructs in a manner that would be specific to the disorder. An instrument to measure EI and DESR which demarcates them from irritability and other emotional symptoms could improve the accuracy of diagnostic criteria for ADHD. **Keywords:** Attention-deficit/hyperactivity disorder; emotional dysregulation; deficient emotional self-regulation; emotional impulsivity; comorbidity; rating scale; irritability.

Introduction

Attention-deficit/hyperactivity disorder (ADHD) is a common neurodevelopmental disorder diagnosed by symptoms of age-inappropriate inattention, hyperactivity, and impulsivity that cause impairment in two or more domains of daily life (Faraone et al., 2015). Many iterations of the DSM since DSM-III view emotional symptoms as an *associated feature supporting the diagnosis* of ADHD. In contrast, in descriptions of the disorder prior to DSM-III, emotional symptoms had a prominent role in characterizing ADHD youth (Barkley, 2015) and such symptoms were core criteria of the Wender Utah Criteria for adults (Ward, Wender, & Reimherr, 1993).

Despite recognition that intense, emotionally charged behavior was common in ADHD, DSM-III's framing the disorder in terms of inattention and under inhibited behavior de-emphasized affective

disturbances and excluded them from diagnostic criteria. Since then, however, research has only strengthened the association between ADHD and emotion-related problems. Forty to 50% of children with ADHD have significant impairments that stem from rages, irritability, or other manifestations of susceptibility to anger and low tolerance for distress (Anastopoulos et al., 2011; Barkley, 2015; Barkley & Fischer, 2010; Biederman et al., 2012; Karalunas et al., 2014; Liu et al., 2016; Shaw, Stringaris, Nigg, & Leibenluft, 2014; Skirrow & Asherson, 2013; Sobanski et al., 2010; Spencer et al., 2011). We will refer to these collectively as 'emotional symptoms'. These symptoms are more prevalent in the combined subtype (now called 'presentation' in DSM-5) of ADHD compared with other subtypes and their severity increases with the severity of other ADHD symptoms (Sobanski et al., 2010; Vidal et al., 2014). Emotional symptoms are also common among adults with ADHD (Barkley & Fischer, 2010; Skirrow & Asherson, 2013; Surman et al., 2011, 2013).

Due to the high prevalence of emotional symptoms among patients with ADHD along with prevailing

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models of ADHD that emphasize the inadequacy of self-regulatory functions, some consider emotional symptoms integral to ADHD, rather than an associated trait (Barkley, 2015; Barkley et al., 2000; Nigg & Casey, 2005; Sagvolden, Johansen, Aase, & Russell, 2005). On the other hand, emotional symptoms are not specific to ADHD and are present variably among patients with the disorder (Copeland, Brotman, & Costello, 2015; Stringaris, Cohen, Pine, & Leibenluft, 2009), casting uncertainty on the merits of including them as a ‘core feature’ of ADHD.

Although there is substantial debate about the nature of emotional symptoms in ADHD and whether they should someday be incorporated into the diagnostic nomenclature, there is little question about their importance. Many studies have shown that such symptoms have a serious impact on patients with the disorder. In a study of 358 children aged 5–12 years with ADHD, emotional symptoms correlated with impaired social, daily living, and adaptive skills and were associated with increased rates of treatment service utilization (Anastopoulos et al., 2011). Children with ADHD and higher levels of emotional symptoms were rated as less likeable by unfamiliar peers in playgroups (Lee et al., 2017). Higher levels of emotional excitability/impatience, lack of behavioral control with strong emotions and inflexibility/slow return to baseline associate with parent and self-rated social impairment in adolescents. (Bunford, Evans, & Langberg, 2018). Children with ADHD and emotional symptoms are more likely to have hyperactive/impulsive symptoms continuing into early adulthood as well as a lower likelihood that fully syndromic ADHD will remit (Biederman et al., 2012). People with ADHD and emotional symptoms have significantly lower quality of life, significantly worse social adjustment and reduced marital status compared to those with ADHD and no emotional symptoms (Surman et al., 2013). Among people with ADHD, emotional symptoms associate with unemployment, poor work performance and peer relations, and being fired or quitting work out of boredom. Emotional symptoms associate with fewer years of schooling, decreases in the likelihood of graduation from high school and college, and higher rates of suspensions and expulsions from school. Patients with ADHD and emotional symptoms are more likely to have had driver license suspensions, traffic tickets and financial problems than those without emotional dysregulation (Surman et al., 2013).

Given the serious impact of emotional symptoms on people with ADHD, the present review sought to clarify the nature of these symptoms in ADHD. We first review conceptual and measurement issues and examine the evidence base regarding specificity of such symptoms for ADHD. We then evaluate implications for both medical and psychological treatments.

Conceptual issues

One challenge to understanding the role of emotional symptoms in ADHD is the abundance of terms used to describe them: emotional lability (EL), emotional reactivity, emotional impulsivity (EI), emotional instability, emotional dysregulation, deficient emotional self-regulation, distress tolerance, frustration discomfort and irritability. Approaching this issue by considering the time course, or ‘affective chronometry’ (Davidson, 1998; Thompson, 1994), of these difficulties may better specify how people with ADHD show emotion-related impairments that differ from others with other conditions who show emotional symptoms.

Phases of emotional expression: emotion generation and regulation

While people with ADHD are prone to rapid, unusually intense, and disproportionate emotional reactions, the point at which *emotional regulation* processes begin is a matter of some debate (Gross & Barrett, 2011). It seems intuitive that to regulate something it must already exist. By extension, emotion regulation would refer to the management of one’s current emotional state after it emerges (Barkley, 2015; Etkin, Büchel, & Gross, 2015; Shaw et al., 2014). However, the emergence of emotional states also involves regulating processes (e.g., sensory gating, thresholds for stimuli to activate emotion, anticipatory appraisal and valuation). Therefore, factors that regulate the onset of emotion could well include those intended to prevent unwanted emotional activation in the first place or to raise the likelihood of experiencing desired ones (e.g., selection or modification of situations, anticipatory self-preparation, external constraints and facilitators) (Gross & Barrett, 2011). From that standpoint, “...regulatory processes are developmentally incorporated into emotion itself—both neurobiologically and behaviorally—leading some to conclude that ‘unregulated emotion’ in any pure sense does not exist, especially when an appropriately-inclusive conceptualization of emotion regulation is used” (Thompson, 2011, p. 53).

We can reconcile different connotations of ‘regulation’ by distinguishing a narrow from a broad meaning. Current research on emotional states frequently differentiates emotion *generation* (or activation) from *regulation* in which the emotional state itself becomes the focus of controlling processes (Costa et al., 2014; Esslen, Pascual-Marqui, Hell, Kochi, & Lehmann, 2004; Gross & Barrett, 2011; Lindquist, Wager, Kober, Bliss-Moreau, & Barrett, 2012; Ochsner et al., 2009; Öner, 2018; Waugh, Shing, & Avery, 2015). To the extent that emotion generation is itself a regulated process, a broad meaning of ‘regulation’ encompasses the array of factors through which problematic emotional states

arise and are managed. The narrow meaning emphasizes this latter, management aspect. To avoid confusion with other usage, we will use the term emotion regulation to refer to the regulatory processes that occur after the generation of emotion.

A temporal model for emotional symptoms associated with ADHD

Barkley points out that those with ADHD are prone to difficulties both with emotion generation that is highly impulsive and with the self-regulatory functions that effectively manage emotional experience to rein in behavior from accelerating to problematic degrees (Barkley, 2015). He refers to the former as EI and the latter as deficient emotional self-regulation (DESR). Mirroring the broader literature on emotion, these processes are distinguishable. In this framework, due to weak self-regulatory processes, emotionally reactive behavior can reach high levels and be abnormally prolonged even if one's initial emotion is not pathologically intense. For example, the degree of anger experienced by an ADHD driver faced with a traffic incident may be the same as that for a non-ADHD driver. But while the non-ADHD driver can soothe herself with self-regulatory mechanisms, the ADHD driver cannot. Although emotional symptoms in ADHD often have a negative valence (e.g., irritability, anger), both EI and DESR are valence-free terms. Consider, for example, the ADHD child that cannot stop himself from giggling in the classroom. His age-typical mates may experience the same emotion, but their self-regulation skills lead to a covert smile rather than an explosive giggle.

Figure 1 shows our conceptual model of emotional processing impairments in relation to ADHD. We use two terms defined by Barkley (Barkley, 2015) as an organizing principle. EI is shown as fast-rising (i.e., rapid onset), with unusually high reactivity in emotionally evocative situations, which leads to quicker-than-typical emotional responses to provoking stimuli (e.g., Barkley, 2015). EI is abrupt and situationally provoked, not spontaneous. DESR, in contrast, occurs after emotion generation. DESR leads to a slower than typical return of activated emotions to baseline. Theoretically, EI and DESR could be caused by deficits in the biological networks regulating emotions and the cognitive-behavioral skills needed to cope with such emotions, but the presumptive specific underlying mechanisms may be distinct.

Our model also addresses the fairly well-established dyssynchrony between subjective emotional experience and observed behavior, which may have particular significance for ADHD. There is an understandable tendency to attribute greater anger to the individual who is more belligerent or pleasurable to one who laughs more loudly. At the same time, it seems inappropriate to say that the stoic, unexpressive mourner is necessarily less grief-stricken than

the sobbing one. In fact, the covariation among the response systems that jointly constitute emotions – subjective/cognitive, behavioral, and physiological – varies greatly across individuals. Findings of weak concordance between response systems for several emotional states has been demonstrated in adults (Lanteigne, Flynn, Eastabrook, & Hollenstein, 2014; Mauss, Levenson, McCarter, Wilhelm, & Gross, 2005; Mauss & Robinson, 2009), and similar results are seen for children and adolescents (Benoit, Allen, Austin, Waldron, & Ollendick, 2015; Smith, Hubbard, & Laurenceau, 2011).

Discordance between behavior and subjectively experienced emotion suggests that unusually intense behaviors in the form of rage outbursts, aggression, or other conspicuous upsets do not necessarily signify a commensurate rise in felt emotion. In ADHD, more extreme forms of behavioral expression may in part reflect the behavioral disinhibition inherent to the disorder. EI can be viewed as a special instance of a broader construct of impulsive behavioral in which a stimulus sparks disinhibited emotionally expressive behavior.

Each of the four infographics in Figure 1 show the time course of emotional intensity after an emotionally activating stimulus. These infographics separate emotional intensity into subjective experience (the red line) and behavior (the blue line). Trajectories reflect individual differences in processes that (a) generate an emotional state, and (b) regulate it after it emerges. Diagrams A through D illustrate how they might produce both typical and certain ADHD presentations that the next sections describe. These trajectories are presented as prototypes from which individuals will vary as one would expect from the heterogeneous nature of emotional symptoms in ADHD. Figure 1A presents trajectories for the typical, non-ADHD person. The generation of emotions in response to provoking stimuli is moderate and does not reach impairing levels. Self-regulatory skills are sufficient to bring emotions back to baseline quickly, and emotional and behavioral trajectories are in synch with one another.

Figure 1B portrays an ADHD prototype with high EI and high DESR. In this case, high EI leads to a fast rise time for the intensity of subjective states and behavior that, prior to the activating stimulus, was unremarkable. It contrasts with Figure 1A's depiction of a typical age mate whose reactions to the same stimulus are developmentally appropriate: less extreme, slower to gather steam, and overall better regulated. For high EI and high DESR patients, we hypothesize that behavioral responses are excessive for the level of emotion and rise more rapidly than emotional responses during episodes of EI. We hypothesize that the Figure 1B prototype would be associated with predominantly hyperactive-impulsive and combined-type ADHD presentations.

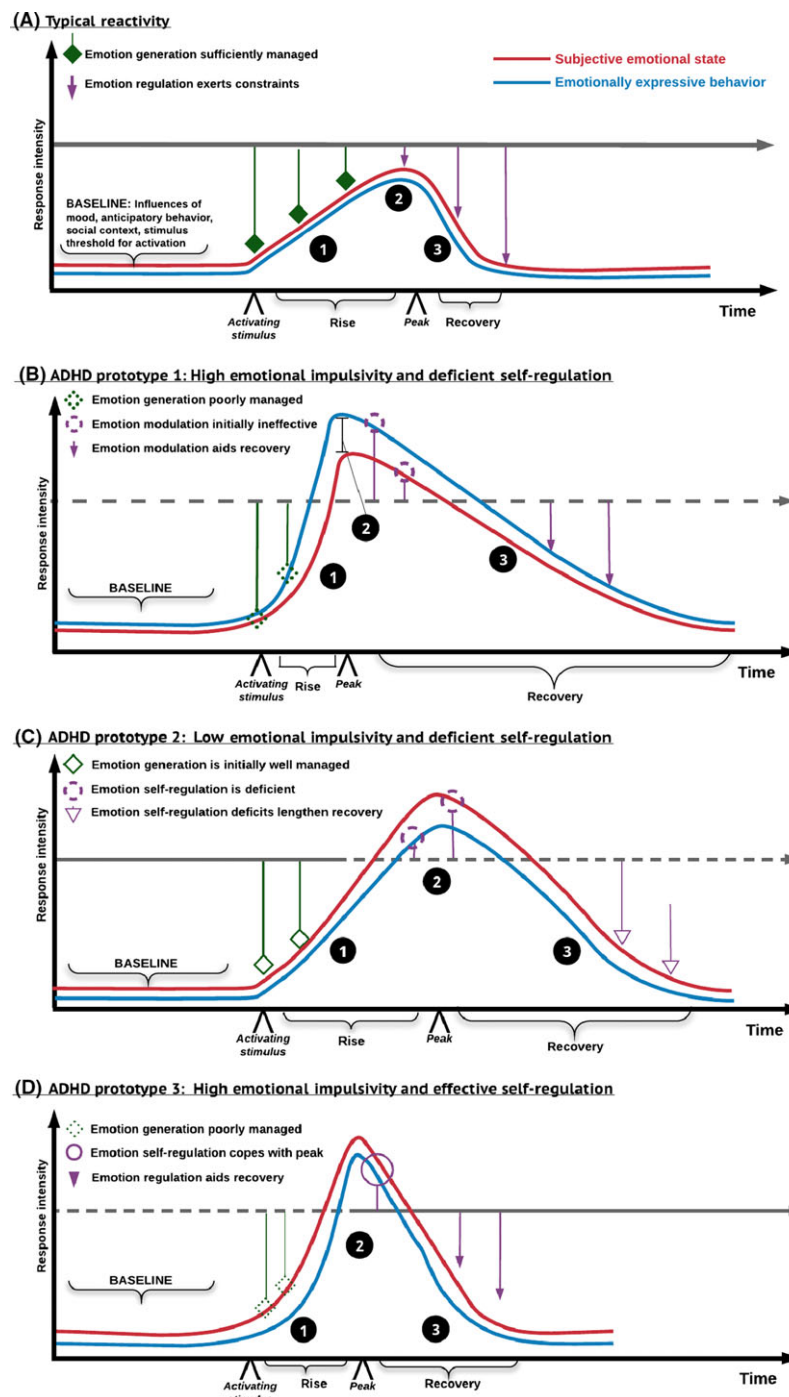


Figure 1 Deficient Emotional Processing in ADHD. For all Panels, the horizontal line is the threshold for maladaptive emotional experiences. Each graph exhibits three phases: (1) baseline and generation of emotions, (2) peak levels of emotions, and (3) return of emotions back to baseline. Panel A: Typical Reactivity. Phase 1: An activating event leads to an emotional phase in which both subjective state (red line) and emotionally expressive behavior (blue line) change gradually during the rise phase. Phase 2: Behavior and affect change in tandem. Phase 3: Emotional self-regulation skills return subjective emotionality and expressive behaviors to baseline. Panel B: ADHD Prototype 1 – High Emotional Impulsivity and Deficient Self-Regulation. Phase 1: High emotional impulsivity causes emotion generation at lower thresholds, shorter rise times, and intense emotional responses. Phase 2: Due to poor self-regulation skills the intensity of behavioral expression is excessive for the level of emotional response. Phase 3: Poor self-regulation skills and high levels of emotion generation lead to slower recovery times and prolonged episodes of behavioral disturbance. Panel C: ADHD Prototype 2 – No Emotional Impulsivity and Deficient Self-Regulation. Phase 1: Emotion generation is gradual but reaches high levels. Phase 2: With no emotional impulsivity, behavioral indicators of negative emotion lag behind subjective experience. Phase 3: Poor self-regulation prolongs emotions and their adverse impact. Counterproductive thoughts and behaviors such as rumination and avoidance sustain and intensify maladaptive emotions. Panel D: ADHD Prototype 3 – High Emotional Impulsivity and Effective Self-Regulation (e.g., Emotional Lability). Phase 1: High emotional impulsivity causes emotion generation at lower thresholds, shorter rise times and intense emotional responses. Phase 2: There is a closer relationship between subjective emotional intensity and its behavioral expression. Effective self-regulation of emotions shortens the peak. Phase 3: Emotional self-regulation skills return subjective emotionality and expressive behaviors to baseline but high emotional impulsivity puts person at risk for another episode of extreme emotion

Figure 1C shows the case for patients with no EI combined with DESR. This pattern leads to a slower generation of emotions to an impairing level of intensity from which recovery is difficult. We hypothesize that the Figure 1C prototype would be associated with primarily inattentive ADHD presentations.

Figure 1D shows a prototype of EI in ADHD. We use the term emotional lability to refer to rapid changes in emotional states (Graziano & Garcia, 2016; Hulvershorn et al., 2014; Posner et al., 2013; Skirrow & Asherson, 2013). In our model, EI occurs because onset of emotions is quick and impairing (due to high EI), but return to baseline is quick (due to sufficient self-regulatory processes). We hypothesize that the Figure 1D prototype would be associated with primarily hyperactive-impulsive and combined-type ADHD presentations.

Other approaches to the emotion-regulatory processes disrupted in ADHD

Different frameworks for the specific processes involved in emotion regulation tend to converge on a list of impairments that resembles those found in ADHD (D'Agostino, Covanti, Monti, & Starcevic, 2017; Ebner-Priemer et al., 2015; Etkin et al., 2015; Lindquist et al., 2012; Thompson, 2011). In broad terms, inadequate self-control and weak behavioral inhibition are frequently cited sources of emotional dysregulation. One might therefore expect that poorly controlled emotionally driven behavior would be another casualty of the wide-ranging self-regulatory deficits to which ADHD patients are prone (Nigg & Casey, 2005; Sagvolden et al., 2005; Barkley, 2015). Such frameworks are consistent with our conceptual model. Several more specific processes that are prominent in the literature on emotion regulation also warrant comment in relation to ADHD.

Some definitions of emotion regulation emphasize processes that are under effortful self-control (e.g., Shaw et al., 2014). These are self-regulatory skills required to regulate emotions and which are impaired by DESR. Other definitions incorporate explicit processes such as reappraisal, diverting one's attention or distracting oneself, and suppression of outward signs of reactivity (Gyurak, Gross, & Etkin, 2011; Phillips, Ladouceur, & Drevets, 2008). These are metacognitive activities in which people with ADHD show demonstrable impairments (i.e., DESR). Gyurak et al. (Gyurak et al., 2011) examined adults' success at employing these strategies as a function of performance on measures of executive function. They found that verbal fluency was associated with explicit emotion regulation. Adults with ADHD seem to be impaired on this task as well as on set-shifting, which is also necessary to exert cognitive control over emotional state (Marije Boonstra, Oosterlaan, Sergeant, & Buitelaar, 2005).

Several models include *self-monitoring* as a regulatory function, which is fundamental because early detection of looming emotional upset is a prerequisite to timely deployment of an effortful strategy. ADHD often involves deficits in self-monitoring skills, resulting in low awareness of, among other things, performance errors and emergent affective arousal (Olvet & Hajcak, 2008; Shiels & Hawk, 2010). Our model views self-monitoring as a skill set that can be applied to either EI or DESR.

One's *valuation* or appraisal of a stimulus relative to a desired state (is it 'good' or 'bad' for me) influences emotion generation; afterward, valuation of the emotional state itself influences motivation to suppress or amplify it (Etkin, Egner, Peraza, Kandel, & Hirsch, 2006; Gyurak et al., 2011; Ochsner & Gross, 2014). From this standpoint, high EI signifies that a person overvalues what he or she wants to attain or maintain, so that the negative affect observed is disproportionate to the context. Problems with down-regulating negative emotions would stem from a determination that the desired outcome is so valuable that it is worth the 'cost' of high distress plus the consequences of the behavior that results.

Reappraisal is an essential element of effectively managing emotionally evocative situations. Adults try to do this explicitly with young children by, for instance, telling them they will get to do the preferred activity later, that something else enjoyable is on the horizon, that sharing is highly valued by others (implying a social payoff), and so on. The cognitive flexibility and motivation to see alternate outcomes as beneficial depends on self-regulatory skills that are impaired by DESR among those with ADHD. Such deficits include those shown for reversal learning, perspective taking, and working memory. These deficits suggest that ADHD lowers one's capacity to re-evaluate goals and behavior. Those with ADHD may also attach anomalous valuations to certain events so that they amplify emotional upsets.

Other models view emotional symptoms in the context of distress tolerance (i.e., the ability to withstand aversive emotional states) (Leyro, Zvolensky, & Bernstein, 2010). In our model, distress tolerance is a trait that tempers EI to avoid excessive emotion generation. This is consistent with one study showing that distress tolerance separates out from factors of emotion regulation (Van Eck, Warren, & Flory, 2017). In their review, Leyro et al. (2010), following Trafton and Gifford (2011) describe distress tolerance as a process regulated by the reward system. In this view, distress tolerance is a 'propensity to respond to immediate (negative) reinforcement or reward, as opposed to pursuing alternative reinforcers that may become accessible when immediate negative reinforcement is inhibited or not pursued'. This is especially relevant to ADHD given its association with exaggerated delay discounting. It is possible that patients with ADHD prefer the immediate

reward of a quick emotional response (e.g., relief of distress) rather than the longer term rewards of self-regulation (e.g., not aggravating an already demanding situation).

Differentiating the emotional symptoms of ADHD from the irritability of other disorders

The role of irritability in diagnosing disorders has generated much debate. For a comprehensive review of this construct, see Brotman, Kircanski, and Leibenluft (2017). DSM-5 uses irritability as a symptom in several ways. Its mood criterion for a manic episode can be met by a distinct period of abnormal and persistent irritability if that period lasts for 1 week, is present most of the day, nearly every day and co-occurs with abnormal and persistent goal-directed activity or energy. The irritability seen in bipolar disorder represents a time limited episode and a distinct break from the child's usual mood. The mood criterion for a depressive episode can be met by being irritable most of the day, nearly every day for a 2-week period. When such episodes occur in an ADHD patient, they are symptoms of a mood disorder, not of ADHD. In contrast to the 'distinct periods' that characterize mood disorders, the relatively brief episodes of EI and DESR we attribute to ADHD are not diagnostic of these other disorders even if irritability occurs.

The DSM-5 category of disruptive mood dysregulation disorder (DMDD) describes those who have frequent fits of rage and a persistently angry or irritable mood 'most days, most of the time' (American Psychiatric Association, 2013). Although some ADHD youth also have DMDD, the episodic rages and persistent irritability of DMDD differ from the flashes of high emotional intensity followed by a return to a euthymic 'baseline' that most children with ADHD experience (e.g., Blader et al., 2016; Roy et al., 2013).

The diagnosis of DMDD requires four mood criteria: (A) severe, recurrent temper outbursts that are out of proportion to the situation or provocation; (B) the outbursts are inconsistent with developmental level; (C) the outbursts occur three or more times per week; and (D) the mood between outbursts is persistently angry or irritable most of the day, nearly every day and is observable by others. Although criteria A through C might be confused with the dysregulation associated with ADHD criterion D's requirement for a persistent angry or irritable mood clearly demarcates ADHD from DMDD. In principle, there may be distinct processes involved when a provocation quickly and profoundly alters one's emotional state (as in EI) versus when it intensifies an already negative mood (as in DMDD). In practice, distinguishing persistent negative mood states that 'smolder' from those that 'flare' for briefer periods can be difficult. DMDD's weak reliability in field trials may stem in part from

such uncertainties in parent reports (Regier et al., 2013). The high comorbidity of DMDD with ADHD adds to this complexity.

In DSM-5, irritability is also diagnostic for oppositional defiant disorder (ODD) and is associated with conduct problems, anxiety, autism spectrum disorders, personality disorders, and intermittent explosive disorder (Anastopoulos et al., 2011; Berkovitz, Eisenhower, & Blacher, 2017; Fettich, McCloskey, Look, & Coccaro, 2015; Sobanski et al., 2010). Table 1 describes clinical features that discriminate between emotional symptoms in ADHD and these potentially comorbid disorders. The cross-disorder nature of irritability is seen in a study of 500 subjects with ADHD (Ambrosini, Bennett, & Elia, 2013), which concluded that irritability in children with ADHD increased the likelihood of comorbidity with several disorders. Similarly, Mulraney et al. followed children with ADHD for 3 years, finding that significantly more parent-reported irritability in the adolescents was predicted by earlier externalizing problems (Mulraney, Zendarski, Mensah, Hiscock, & Sciberras, 2017). Persistent irritability was also associated with increased severity of ADHD symptoms and poorer functioning in multiple domains.

The above notwithstanding, it is important to note that irritability in ADHD is not simply a consequence of mood disorder or another comorbidity. Geller et al. (2002) reported that 71.6% of subjects with ADHD and no mood disorder displayed irritability. Mick, Spencer, Wozniak, and Biederman (2005) found that 76% of ADHD subjects endorsed at least one irritability item from the ODD module of the Kiddie Schedule for Affective Disorders and Schizophrenia. However, greater severity of irritability, defined as mad/cranky from the depression module and super-angry/grouchy, cranky from the mania module, was associated with a comorbid mood disorder.

There exists evidence of a relationship between anxiety disorders and irritability and between irritability and ADHD in clinical populations. For example, in a clinical study comparing Affective Reactivity Index scores between groups of youth with either no psychopathology, anxiety disorders, bipolar disorder, or severe mood dysregulation, Stoddard et al. (2014) found a clear relationship between irritability and anxiety disorders. However, the relationship between anxiety and irritability in ADHD youths is presently unclear and remains understudied. In a study investigating the genetic underpinnings of irritability using polygenic risk scores (PRS) in three separate cohorts with irritability data (one ADHD sample and two epidemiological samples), associations were found between ADHD PRS and early irritability traits. Associations with anxiety and mood disorders were not found, suggesting that childhood irritability in the population is associated more with ADHD than anxiety and mood disorders (Riglin et al., 2017).

Table 1 Clinical features that discriminate between emotional dysregulation in ADHD and other childhood psychiatric disorders [adapted from Childress & Saltee, 2015]

Disorder	Clinical feature of emotional dysregulation				
	Irritability	Inappropriately positive emotions	Persistent anger most of the day	Argumentative/defiant behavior and or vindictiveness	Impulsive aggression
Attention-deficit/hyperactivity disorder	Episodic	Yes	No	No	No
Autism spectrum disorder	Chronic	Yes	No	No	No
Bipolar disorder	Episodic	Yes	No	No	No
Borderline personality disorder	Chronic	No	No	No	Yes
Oppositional defiant disorder	Chronic	No	No	Yes	Yes
Disruptive mood regulation disorder	Chronic	No	Yes	No	Yes
Intermittent explosive disorder	Chronic	No	Yes	No	No
Generalized anxiety disorder	Episodic	No	No	No	No
Depressive disorder	Chronic	No	No	No	No

Evidence suggests that the emotional symptoms of ADHD and the irritability of ODD are separate entities. Liu et al. (2016) studied 1,317 children and adolescents, 42.6% of whom had emotional lability and 39.4% of whom had ODD: 19.7% had emotional lability only, 16.6% had ODD only, and 22.9% expressed both conditions. They concluded that emotional lability is distinct from the ‘mood/affect sub-dimensions’ of ODD. It is also not clear that irritability can be explained by the same mechanisms across both disorders. One hypothesis is that irritability in ODD is influenced by vulnerability for emotional disorders (mood and anxiety) with attendant increase in exposure to stressful negative life events (Eyre et al., 2017), and that irritability in ADHD is influenced by deficits in response inhibition to frustration (i.e., low frustration tolerance) mediated by the pre-frontal cortex (Fischer, Barkley, Smallish, & Fletcher, 2005).

Because emotional symptoms are features of many psychiatric disorders that co-occur with ADHD, it is possible that the emotional symptoms of ADHD are simply epiphenomena of comorbidity. This issue has only been addressed by a handful of studies. Taken together, these studies indicate that, although psychiatric comorbidity accounts for some of the emotional symptoms associated with ADHD, there is an independent contribution from ADHD symptoms both in predicting emotional symptoms and functional impairments in multiple areas including occupation, education, legal, financial, family life, and social relations (Barkley & Fischer, 2010; Skirrow & Asherson, 2013; Surman et al., 2013).

The measurement of emotional symptoms

The different terms used to describe the emotional symptoms of ADHD are mirrored by a plethora of rating scales for emotional symptoms. Our review

found 20 such measures that could be used in either research or clinical practice (Table 2). We do not include behavioral tasks used to assess emotional responses in experimental settings. Currently, no one standard tool has been adopted by either the clinical or research community. Most of the scales adopt the concept of emotional self-regulation, whereas a few address-related constructs such as affective reactivity, emotional lability, and the expression of emotions. The degree to which these scales measure the same or different constructs is, essentially, unknown.

The scales in Table 2 can be differentiated in several ways. Four are intended for adults only, eight are for children only, and eight for both. Most have a self-report version; some can be administered by parents, teachers, or clinicians. Thirteen have been used in treatment trials, but none has been validated as a patient-reported outcome using current criteria for clinical trials (Patrick et al., 2011a, 2011b). Eleven have population norms; nine do not. The normed scales are good screening tools because they can gauge how the patient’s level of EI differs from that of an average person. Most of the scales are free; some require a fee. We know of no data to indicate that the free tools are better or worse than those that require a fee for use.

Most of the scales for emotion regulation were *not* developed specifically for people with ADHD. Exceptions are: Conners Global Index Emotional Lability Scale (CGIELS) (Conners, 1997), the Emotional Lability scale on Conners Rating Scales-Revised (CSR-R) (Conners, 2001), and the Wender-Reimherr Adult Attention Deficit Disorder Scale (Marchant, Reimherr, Robison, Robison, & Wender, 2013). The Conners scales focus on emotional lability, which overlaps with emotional dysregulation. The remaining scales are either measures of executive functioning, emotional dysregulation broadly defined, or a broader conceptualization of ADHD which includes

Table 2 Rating scales developed to measure emotional symptoms

Scale	Reporter ^a	Children, adults, or both	Trials	Norms	Availability
Affective Lability Scale – Short Form (ALS-18) (Weibel et al., 2017)	A	Adults	Yes	Yes	Free
Affective Reactivity Index (ARI) (Stringaris et al., 2012)	Y, P	Children	Yes	Not found	Free
Barkley Deficits in Executive Functioning Scale — Children and Adolescents (BDEFS-CA) (Barkley, 2012)	Y, P	Children	None found	Yes	\$
Behavior Rating Inventory of Executive Function (BRIEF or emotion control subscale) (Mahone et al., 2002)	Y, A, P, T	Both	Yes	Yes	\$
Brown ADD Rating Scales for Children, Adolescents and Adults (BADDs) (Brown, 1996)	Y, A	Both	Yes	Yes	\$
Conners Global Index (CGI) Emotional Lability Scale (Conners, 1997)	Y, A	Children	Yes	Yes	\$
Child Behavior Checklist – Dysregulation Profile (CBCL-DP) (Geeraerts et al., 2015)	Y, A	Children	No	Yes	\$
Difficulties in Emotion Regulation Scale (DERS) (Gratz & Roemer, 2004)	Y, A	Both	Yes	Not found	Free
Difficulties in Emotion Regulation Scale – Brief Version (DERS-16) (Kaufman et al., 2016)	Y, A	Both	None found	Not found	Free
Emotion Dysregulation Scale, short version (EDS-short) (Powers, Stevens, Fani, & Bradley, 2015)	Y, A	Both	None found	Not found	Free
Emotion Regulation Checklist (ERC) (Shields & Cicchetti, 1997)	P	Children	Yes	Not found	Free
Emotion Regulation Index for Adults and Children (ERICA) (MacDermott, Gullone, Allen, King, & Tonge, 2010)	Y, A	Both	Yes	Not found	Free
Emotion Regulation Questionnaire (ERQ) (Gross & John, 2003)	Y, A	Both	Yes	Yes	Free
Emotional Lability T-scores on Conners Rating Scales – Revised (CRS-R) (Conners, 2001)	Y, A, P, T	Children	Yes	Yes	Free
Expression and Emotion Scale for Children (EESC) (Penza-Clyve & Zeman, 2001)	Y, A, P, T	Children	Yes	Yes	Free
State Difficulties in Emotion Regulation Scale (S-DERS) (Lavender, Tull, DiLillo, Messman-4 Moore, & Gratz, 2017)	Y, A	Both	None found	Not found	Free
Strengths and Difficulties Questionnaire – Dysregulation Profile (SDQ-DP) (Holtmann, Becker, Banaschewski, Rothenberger, & Roessner, 2011)	P	Children	Yes	Yes	Free
Wender-Reimherr Adult Attention Deficit Disorder Scale (Marchant et al., 2013)	C	Adults	Yes	Yes	Free
Distress Tolerance Scale (Simons & Gaher, 2005)	A	Adults	None found	Not found	Free
Frustration Discomfort Scale (Harrington, 2005)	A	Adults	None found	Not found	Free

^aY, youth self-report; P, parent; T, teacher; A, adult self-report; C, clinician.

emotional dysregulation (Brown, 1996; Marchant et al., 2013).

The Distress Tolerance (Simons & Gaher, 2005) and Frustration Discomfort (Harrington, 2005) scales focus on the related construct of distress tolerance. When applied to emotions, distress tolerance refers to the ability to withstand aversive emotional states (Leyro et al., 2010).

Effects of ADHD treatments on emotional dysregulation

Medical treatment

Two recent meta-analyses of pharmacotherapy on emotional dysregulation in adults with ADHD demonstrate some improvement in emotional

dysregulation, but these effects were not as large as those demonstrated for core ADHD symptoms with medical treatment. A meta-analysis of nine studies which examined methylphenidate (MPH) or atomoxetine (ATX) in treating emotional dysregulation in adults found that the medications had a positive effect which was in the moderate range and lower than for ADHD symptoms (Moukhtarian, Cooper, Vassos, Moran, & Asherson, 2017). All medication effects were analyzed together, so the efficacy of MPH versus ATX for emotional dysregulation cannot be compared. In addition, the analyses did not address whether the effects of treatment were equivalent for the two medications or primarily carried by one or the other. A subsequent meta-analysis (Lenzi, Cortese, Harris, & Masi, 2018) included 21 studies; additions were

more recent studies, as well as data from unpublished studies by investigators and/or drug companies. The authors also analyzed the effects of several medications separately. The effect size (ES) for MPH and lisdexamfetamine (LDX) was small-to-medium (each $SMD = 0.34$), while the ES for ATX was small ($SMD = 0.24$). Again, these authors found weaker effects of the treatments on emotional dysregulation than on core ADHD symptoms. Although the results from the meta-analyses are encouraging, the effect sizes are low compared with the effects of the same medications on ADHD symptoms. This could be due to the inadequacies in measures of emotional regulation, to the existence of substantial heterogeneity among ADHD patients in the expression of these symptoms or to different dose requirements for the different components of the disorder.

Stimulant medications. Several studies of children, adolescents, and adults with ADHD and emotional dysregulation demonstrated that extended-release methylphenidate preparations significantly improved measures of emotional lability; these studies were summarized by Childress and Sallee (2015). Masi et al. (2016) demonstrated lower aggression and emotional dysregulation scores on the CBCL in 8–12-year-old children with Disruptive Behavior Disorders (DBD) and ADHD. Peyre, Speranza, Cortese, Wohl, and Purper-Ouakil (2015) noted in their sample that the Child Behavior Checklist – Dysregulation Profile was not associated with a poorer response of ADHD symptoms to MPH or to increased adverse effects. An additional clinical study of the effect of MPH on emotional dysregulation among 7–13-year-old children with ADHD + ODD or conduct disorder showed that treatment with MPH over 1 year was effective in improving emotional dysregulation symptoms significantly, independent of both the positive effects from a parent behavior management program and the degree of improvement in the children's ADHD symptoms (Kutlu, Akyol, & Ercan, 2017). The latter finding is consistent with the interpretation that emotional symptoms in ADHD are not solely attributable to the other core symptoms of the disorder.

Using data from two trials in which children with ADHD and severe aggressive behavior received carefully optimized stimulant monotherapy before randomization to adjunctive medications if aggression did not remit, Blader et al. (2016) reported that stimulant treatment alone led to remission of aggressive behavior in almost two thirds of patients. The likelihood of remission was not diminished by the presence of persistent negative mood symptoms, and these symptoms also improved significantly. Other work shows that stimulant monotherapy leads to high rates of remission of irritability among highly volatile, aggressive children with ADHD. This finding is consistent with the possibility that

improved impulse control mediates improvements in emotional regulation (Blader et al., 2013).

Rösler et al. (2010) conducted a 24-week, double-blind, randomized controlled trial (DBRCT) of extended-release MPH. This extended-release MPH was superior to placebo in reducing emotional symptoms associated with ADHD in adults. Reimherr, Marchant, Gift, Steans, and Wender (2015) assessed two distinct categories of adults with ADHD: those with a high Inattentive Factor, and those with a high Emotional Dysregulation Factor. Over two long-term clinical trials with extended-release MPH, emotional dysregulation was acutely responsive to MPH treatment, and symptoms continued to improve during 6-month open-label follow-up periods. Another study demonstrated that adults with ADHD in group cognitive psychotherapy or individual counseling plus MPH treatment had significantly better scores on measures of impulsivity and emotional lability after 24 and 52 weeks than those in psychotherapy/counseling plus placebo (Philipsen et al., 2015).

There have been fewer studies with amphetamine formulations. A post hoc analysis of an open-label, 7-week, dose optimization study of lisdexamfetamine dimesylate (LDX) in three hundred and sixteen 6–12-year-old children with ADHD found that 53% of the subjects met predetermined criteria for 'emotional control impairment' at baseline, but only 20.7% met these criteria after treatment with LDX (Katic et al., 2013). Additional analyses found that children treated with either extended-release MPH or LDX demonstrated significant decreases in overall functional impairment, including improvements in family and social activities, suggesting better emotional self-regulation (Banaschewski et al., 2013). A subsequent, post hoc analysis of a double-blind, placebo-controlled study of the effects of LDX on emotional dysregulation in children with ADHD found that there were significant improvements in emotional lability in children having the most severe emotional lability scores at baseline. However, in this stratified group of children with ADHD and severe emotional lability, there was a high percentage of patients who experienced irritability as a treatment-emergent adverse event (Childress et al., 2014). Interestingly, in the Multimodal Treatment Study of Children with ADHD (MTA), irritability measured as an adverse effect of ADHD treatment (primarily with stimulants) improved with treatment (Fernández de la Cruz et al., 2015).

There are a few studies of emotional dysregulation and ADHD treatment in adults, and the findings are generally consistent with studies in children. Moderate improvements have been found in the Emotional Control subscale of the Behavior Rating Inventory of Executive Function-Adult Version Self-Report (BRIEF-A) Behavioral Regulation Index after a 10-week trial of LDX (Adler et al.,

2013). Thus, amphetamines, although less well-studied than MPH for emotional dysregulation, do appear to be effective for the treatment of adults with ADHD and emotional dysregulation.

Table 3 summarizes the methodology, sample size, and results of these studies.

Nonstimulants. A meta-analysis of all pediatric ADHD studies (N: ATX = 2,449; placebo = 1,479) found small positive effects of ATX on child emotionality (Schwartz & Correll, 2014). In subgroup analyses, small improvements in ODD symptoms also were noted, although this finding has been

inconsistent across studies with ATX (Biederman, Wigal, Spencer, McGough, & Mays, 2006).

Reimherr et al. (2005) re-examined the data from two double-blind, randomized controlled trials (DBRCT) of ATX in adults with ADHD, looking specifically at the response of ‘emotional dysregulation’ symptoms to ATX versus placebo as measured by the Wender-Reimherr Adult Attention Deficit Disorder Scale (WRAADDS), defined as problems with ‘temper, affective lability and emotional over-reactivity’; emotional dysregulation symptoms improved significantly more in ADHD patients taking ATX than placebo. A 12-week DBRCT of ATX in

Table 3 Sample size and design in studies of central nervous system stimulants for ADHD and emotional dysregulation

References	Design	Sample size	Results
Masi et al. (2016)	Randomized	144	Additional pharmacotherapy significantly improved aggression and emotional dysregulation, but not callous emotional traits
Peyre et al. (2015)	Questionnaire	173	Variables independently associated with CBCL-DP were clinical severity, internalized disorders, high emotionality, and low self-directedness
Kutlu et al. (2017)	Open label	118	Emotional dysregulation is highly prevalent in disruptive behavioral disorders that are comorbid with ADHD, and methylphenidate is effective for emotional dysregulation independently from other clinical determinants
Blader et al. (2016)	Open label	156	Stimulant treatment markedly improved aggressive behavior in children with ADHD and severe aggression/DBD
Rösler et al. (2010)	Randomized	363	MPH was significantly statistically superior to placebo in reducing emotional symptoms with ADHD as assessed by the EDS and the ELS
Reimherr et al. (2015)	Randomized	136	Adult patients with ADHD and emotional dysregulation showed more childhood ADHD symptoms, adult symptoms of ODD, and evidence of personality disorder, with improvement of emotional domains during treatment with methylphenidate
Philipsen et al. (2015)	Randomized	419	In adults with ADHD, methylphenidate was significantly superior to placebo as assessed by change in the ADHD Index of the Conners Adult ADHD Rating Scale
Katic et al. (2013)	Open label	318	The proportion of children with behavioral impairments in executive function control of emotional response during treatment with lisdexamfetamine
Banaschewski et al. (2013)	Randomized	317	The benefits of short-term stimulant treatment in children and adolescents with ADHD extend beyond symptomatic relief and impact positively on health-related quality of life and daily functioning
Childress et al. (2014)	Open label	211	Symptoms of ADHD and emotional lability improved with lisdexamfetamine regardless of baseline emotional lability symptoms
Fernández de la Cruz et al. (2015)	Randomized	579	Irritability associated with ADHD improved after treatment with MPH
Adler et al. (2013)	Randomized	159	Among adults with ADHD and clinically significant executive function deficits, lisdexamfetamine was associated with significant improvements in self-reported executive function ratings

RMET, Reading the Mind in the Eyes Test; BFRT, Benton Facial Recognition Test; CBCL-DP, Child Behavior Checklist – Dysregulation Profile; EDS, Emotional Dysregulation Scale; ELS, Emotional Lability Scale; MPH, methylphenidate; ADHD, attention-deficit/hyperactivity disorder; ODD, oppositional defiant disorder.

young adults (18–30 years) with ADHD found overall improvements in the Behavioral Regulation Index of the BRIEF-A, and a numerical improvement in the Emotional Control subscale that did not reach significance (Adler, Clemow, Williams, & Durell, 2014). A retrospective analysis of subjects from three pooled studies of adults with ADHD assessed baseline status and changes in emotional control, as measured by the BRIEF-A (Asherson et al., 2015). Approximately 50% of adult ADHD subjects had elevated Emotional Control scores on the BRIEF-A; treatment with ATX for 10–12 weeks produced small but significant improvements in Emotional Control scores for subjects with very high Emotional Control scores at baseline.

Connor et al. reviewed the literature on guanfacine extended-release effects in children and adolescents (Connor, Arnsten, Pearson, & Greco, 2014), concluding that this medication was promising for problems of emotional dysregulation associated with ADHD. To date, double-blind, placebo-controlled trials of short- and long-acting formulations of α -2 adrenergic agonists for treating ADHD in children and adults have not specifically examined effects on emotional dysregulation. However, findings from a single-dose challenge study with guanfacine, showing decreased prefrontal-limbic connectivity during a face go-no go task and corresponding improvement in negative emotional bias on cognitive control, suggest a possible mechanism underlying the clinically observed effects of the α -2 adrenergic agonists on emotion regulation (Schulz, Clerkin, Newcorn, Halperin, & Fan, 2014).

Nonmedical treatment

Behavior management training for parents, children, and teachers. Parent Behavior Management Training (PBMT) programs teach positive parenting and helpful child behavior management strategies, initially using praise and incentives to influence the child's behavior, based on operant conditioning principles. One such program, the Incredible Years (IY), offers training about establishing predictable home routines, social coaching, and teaching emotion regulation and problem-solving strategies to children. Significant parent-reported improvements in the children's emotional regulation were noted at the end of the 16–20-week program (Trillingsgaard, Trillingsgaard, & Webster-Stratton, 2014). PBMT may be especially helpful for preschoolers with symptoms of both ADHD and ODD. (Forehand et al., 2016; Sanders & Mazzucchelli, 2013). Although there is strong evidence for the efficacy of PBMT programs for disruptive behaviors in general, few published reports assessed emotional dysregulation outcomes after PBMT in preschoolers with ADHD.

Graziano and Hart (2016) reported a study of preschoolers with externalizing behavior problems who were exposed to one of three interventions: an 8-

week School Readiness Parenting Package (SRPP), or the SRPP plus one of two intensive, pre-kindergarten (pre-K) summer treatment camp program modules. The first module offered a behavior modification system and a pre-K academic curriculum (STP-Pre-K); the second offered STP-Pre-K and a social-emotional and self-regulation training program (STP-Pre-K Enhanced). Children in the summer program with the social-emotional training module demonstrated better emotion knowledge, emotion regulation and overall executive functioning compared with children in the other two groups. Gains were sustained at 6 months.

Cognitive-behavioral and metacognitive therapies. Cognitive-behavioral therapies (CBT) differ from PBMT in drawing attention to the role that one's thoughts and feelings can have on behavior, helping individuals to become aware of these and to address distortions in thinking, feelings and expectations so that they do not adversely influence behavior. One promising new treatment for young children with ADHD and emotional dysregulation is directed play-based metacognitive executive function training, developed by Tamm and colleagues (Tamm, Nakonezny, & Hughes, 2014). In a small, proof-of-concept study, the parents of 3–7-year-old children with ADHD attended eight weekly instructional sessions, with concurrent sessions for the children; parents and their children were taught a set of games and activities designed to improve a variety of executive functions, such as attention, inhibition, and memory (Tamm & Nakonezny, 2015). Significant improvements in parent-rated children's behavior, including normalization of BRIEF Emotion Regulation ratings, were seen at the end of the intervention, compared to a waitlist control group of children with ADHD.

Sukhodolsky, Smith, McCauley, Ibrahim, and Piasecka (2016) recently reviewed CBT in children and adolescents, focusing particularly on those with irritability, anger problems and/or aggression, trans-diagnostically. They noted that children and adolescents with ADHD often have such problems, which may reflect ADHD with emotional dysregulation; thus, ADHD patients may benefit from CBT that focuses on emotion regulation and cognitive reappraisal. Because controlled trials are lacking, we cannot draw any conclusions about the efficacy of these CBT methods for emotional dysregulation issues in youth.

Waxmonsky et al. (2016) published the results of an 11-week RCT of an Integrative treatment for children with both ADHD and Severe Mood Dysregulation (SMD, a precursor of DSM-5's DMDD). All participants were treated with optimized doses of stimulant medication. The authors' experimental treatment combined techniques from CBT, social cognitive programs and PBMT that focused especially on identification of negative mood states,

emotion regulation, coping skills for managing anger, and problem-solving after modulating emotions. For integrative treatment, children met in group therapy while parents met together in simultaneous treatment sessions. The comparison group was assigned to community psychosocial care; 60% received some mental health services during the study. Parental satisfaction with the Integrative Treatment program was quite positive. The clinicians' mean ratings of mood severity improved for the integrative group among those who attended most sessions ($ES = 0.53$). Irritability ratings improved during treatment but worsened significantly in the 6-week post-treatment follow-up period. Despite face validity, it is not yet known whether ADHD patients with ED but without SMD would find this program more effective than the other combined (medical & nonmedical) treatments described above.

Manualized CBT group and individual therapy programs have been developed for adults with ADHD, most of whom are treated with ADHD medications but still have residual symptoms. However, few investigators have examined whether this treatment has benefit for emotional dysregulation. Two small studies have shown promise for treating emotional dysregulation with a combination of CBT and dialectical behavior therapy (DBT) (Cole et al., 2016; Nasri et al., 2017). Nasri et al. (2017) found significantly improved emotion regulation after a CBT/DBT program.

Mindfulness techniques. Mindfulness meditation is often regarded as a method of enhancing self-regulation and moderation of emotions and impulses. The current state of research in mindfulness-based approaches for individuals with ADHD was reviewed by Mitchell et al. (Mitchell, Zylowska, & Kollins, 2015). Schoenberg et al. (2014) postulated that changes in event-related potentials (ERPs) in adults with ADHD after a 12-week course of Mindfulness-Based Cognitive Therapy (MBCT) might reflect improvements in both 'top-down' and 'bottom-up' emotional regulation. A small pilot study of an 8-week mindfulness meditation group training for adults with ADHD (Mitchell et al., 2017) improved impulse control and access to emotion regulation strategies. Although these preliminary results suggest some promise for mindfulness-based treatments for adults with ADHD, large controlled studies are needed before one can draw firm conclusions.

Discussion

Our review of emotional symptoms in ADHD has examined conceptual and measurement issues along with the evidence base regarding specificity of such symptoms for ADHD. We also evaluated implications for both medical and psychological

treatments. Although ADHD has often been considered a disorder of cognitive and executive functions, emotional symptoms are highly prevalent. These symptoms are associated with higher levels of impairment in youth and adults with ADHD. They predict a more pernicious course and are only partially responsive to treatments for ADHD. Although emotional symptoms occur in other psychiatric disorders, the emotional symptoms of ADHD cannot be adequately accounted for by the presence of comorbidity in individuals with ADHD.

Emotional symptoms are currently considered to be associated features of ADHD – much like learning problems or executive dysfunction. They are not diagnostic for the disorder. Yet our conceptual model, which extends Barkley's, 2015 framework, supports the idea that symptoms of EI and DESR should be considered when diagnostic criteria are revised. From a theoretical perspective, it seems odd that impulsive and poorly regulated cognition and behaviors are criteria for ADHD, but impulsive and poorly regulated emotions are not. That said, the finding that emotional dysregulation is present in only a subset of individuals with ADHD, the recognition that emotional dysregulation also exists in individuals without ADHD, and the lack of a consensus on how to measure emotional dysregulation, are formidable challenges to be considered before changes in diagnostic criteria can be considered.

Re-evaluation of the current diagnostic criteria requires clarification of measurement issues and refinement of the measures themselves. Although EI and DESR have a big impact on the functional status and treatment outcomes in youth and adults with ADHD, current screening and measurement tools are based primarily on assessment instruments for ADHD and mood disorders. This is a significant problem, because there are several components of emotional symptoms and different terms used to describe them. Accordingly, there is a need for a new measurement tool/assessment instrument that captures the multidimensional nature of emotional symptoms. Creating such a measure would help identify emotional symptoms in the context of ADHD, delineate boundaries between ADHD and other disorders and improve the measurement of changes with treatment. Because emotional symptoms are also a prominent feature of other psychiatric disorders in children and adults, more accurate identification and description of EI and DESR would benefit the psychiatric field beyond ADHD.

When criteria for disorders are selected, specificity is one of many considerations. If a symptom commonly occurs in other disorders, its diagnostic utility for ADHD may be limited. Emotional symptoms, broadly defined, are clearly not specific for ADHD. For example, it would be a mistake for future

diagnostic criteria to include irritability as a criterion for ADHD. The more narrowly defined constructs of EI and DESR may be sufficiently specific (Surman et al., 2011), but more work is needed to better define and select such symptoms.

When considering whether emotional symptoms are part of the core disorder in ADHD, we must keep in mind that few symptoms in psychiatry are completely specific. The reliability and validity of diagnoses derives from the use of polythetic criteria, each of which may lack complete specificity (Cooper, Balsis, & Zimmerman, 2010). In fact, current trends emphasize transdiagnostic phenomena that arise from shared components of etiology (Cuthbert, 2015). New molecular genetic data are quite clear in confirming results from epidemiologic studies indicating substantial overlap among psychiatric disorders as regards causal genomic loci (Smoller et al., 2018). Likewise, others have suggested that shared mechanisms among disorders should be key treatment targets (Green, 2017; Marchette & Weisz, 2017).

The treatment data both support and augment the points made above. Both medical and nonmedical treatments show some efficacy for treating the emotional symptoms of ADHD. Yet the efficacy of these treatments is relatively weak compared with the efficacy of similar treatments for managing the symptoms of ADHD. The efficacy results could be due, in part, to the measurement issues discussed above. With other factors held constant, a measure with low reliability will show lower efficacy than one with higher reliability. Researchers and clinicians must also consider that there may be much heterogeneity in emotional symptoms among patients with ADHD. No study finds that all patients exhibit emotional symptoms. Thus, there is heterogeneity about whether emotional symptoms are present or not and, if present, heterogeneity about the nature of the symptoms. Such heterogeneity makes it difficult to offer diagnostic or treatment guidelines, especially given the measurement issues that remain to be resolved.

The capacity for emotion regulation transcends specific emotional states. However, there is some debate whether these regulatory processes influence the range of emotional states associated with emotional valence or specific disorders (Becerra, Preece, Campitelli, & Scott-Pillow, 2017; Lannoy et al., 2014; Lavender et al., 2017). The timing of emotion-related phenomena seems to vary for specific valences (Lindquist et al., 2012; Waugh et al., 2015). For instance, neural activation to stimuli eliciting disgust and fear occur faster than for anger and happiness, and sadness is slower still (Costa et al., 2014). However, among those with ADHD, inadequate management of emotional

experience and expression for both positive and negative emotions often poses difficulties, leading some to view their emotional symptoms as a global trait (e.g., Barkley, 2015). Further study of this issue may contribute to more precise delineation of the contributions of generalized emotional under-control versus more selective amplification of certain emotional states for subgroups of patients. It will also have crucial implications for the development of therapies aimed at teaching self-regulatory strategies.

We conclude by encouraging broader recognition of the importance of emotional symptoms in individuals with ADHD and recommend that EI and DESR be considered as important targets of assessment and treatment in persons with ADHD. We call for multidisciplinary efforts to better characterize the specific nature of EI/DESR in ADHD, the similarities and differences between EI/DESR in ADHD and other disorders, elucidation of the neurobiology underlying this construct, and investigation and/or development of treatments that specifically target these emotional symptoms.

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