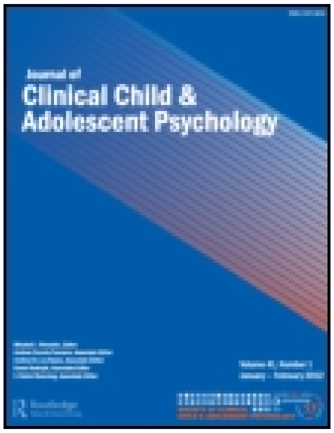

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Commentary: A Practical Guide for Translating Basic Research on Affective Science to Implementing Physiology in Clinical Child and Adolescent Assessments

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Commentary: A Practical Guide for Translating Basic Research on Affective Science to Implementing Physiology in Clinical Child and Adolescent Assessments

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The National Institute of Mental Health recently launched the Research Domain Criteria (RDoC). RDoC is a framework that facilitates the dimensional assessment and classification of processes relevant to mental health (e.g., affect, regulation, cognition, social affiliation), as reflected in measurements across multiple units of analysis (e.g., physiology, circuitry, genes, self-reports). A key focus of RDoC involves opening new lines of research examining patients' responses on biological measures, with the key goal of developing new therapeutic techniques that effectively target mechanisms of mental disorders. Yet applied researchers and practitioners rarely use biological measures within mental health assessments, which may present challenges in translating RDoC-guided research into improvements in patient care. Thus, if RDoC is to result in research that yields clinical tools that reduce the burden of mental illness and improve public health, we ought to develop strategies for effectively implementing biological measures in the context of clinical assessments. In this special issue, we sought to provide an initial step in this direction by assembling a collection of articles from leading research teams carrying out pioneering work on implementing multimodal assessments (biological, subjective, behavioral) of affective processes in applied settings. In this commentary, we expand upon the work presented in this special issue by making a series of suggestions for how to most parsimoniously conduct multimodal assessments of affective processes in applied research and clinical settings. We hope that this approach will facilitate translations of the RDoC framework into applied research and clinic settings.

To address the elevated rates of comorbidity among psychiatric disorders and improve understanding of the etiology and maintenance of mental health concerns, the National Institute of Mental Health (NIMH) recently launched the Research Domain Criteria (RDoC; Insel et al., 2010). A key goal of RDoC involves identifying the biological mechanisms that are associated with mental health concerns (Sanislow et al., 2010). It is important to note that the RDoC framework entails the dimensional assessment and classification of processes relevant to mental health (e.g., affect, cognition, social affiliation) across multiple units of analysis (e.g., physiology, circuitry, subjective reports, behavior). The hope is that research guided by RDoC will result in the development of therapeutic techniques that can effectively target biological factors linked to mental health concerns. Yet applied researchers and practitioners rarely incorporate biological measures within mental health assessments, which may present challenges in translating RDoC-guided research into improvements in patient care. Thus, if RDoC is to result in research that yields clinical tools that reduce the burden of mental illness and improve public health, we must develop strategies for effectively implementing biological measures in the context of

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clinical assessments. In addition, as we describe next, a key component of these strategies will likely involve understanding how to interpret biological assessments in conjunction with assessments based on other modalities (i.e., subjective reports, behavior). That is, what improvements in clinical decision making might biological assessments contribute to in addition to existing clinical tools (see also De Los Reyes & Aldao, 2015; Thomas, Aldao, & De Los Reyes, 2012)?

In this special issue, we sought to provide an initial step in this direction by assembling a collection of articles from leading research teams carrying out pioneering work on implementing multimodal assessments (biological, subjective, and behavioral) of affective processes in applied settings. These articles primarily focused on multimodal assessments of affect for two reasons. First, difficulties regulating one's emotions have been consistently utilized as a framework to identify patterns of dysfunction within psychopathology (e.g., Aldao, Nolen-Hoeksema, & Schweizer, 2010; Jazaieri, Urry, & Gross, 2013; Kring & Sloan, 2009). Second, the study of emotions has traditionally entailed the systematic assessment of multiple units of analysis (i.e., emotional domains, e.g., subjective, physiological, behavioral; Bradley & Lang, 2000; Ekman, 1992; Levenson, 1994). Thus, the work on affective science provides a roadmap for how the RDoC framework could be translated to applied research and clinic settings.

This special issue included two commentaries. Youngstrom and De Los Reyes address the methodological aspects of determining the extent to which biological measures might provide incremental diagnostic information beyond traditionally used assessment tools, such as self-reports and behavioral observations. In this commentary, we focus on providing concrete recommendations for how to parsimoniously conduct multimodal assessments of affective processes in applied research and clinical settings. We hope our recommendations inform the development and implementation of approaches that translate basic research and theory in affective science for use within mental health assessments. More broadly, it is our expectation the approach we adopted in this special issue will facilitate use and interpretation of physiology in clinical work and research, and that this will lead to a greater utilization of multimodal assessments of processes that may be disrupted in psychopathology (e.g., attention, memory, and cognition).

AFFECTIVE SCIENCE AND CLINICAL ASSESSMENTS

A prevailing theme in the introduction to this special issue dealt with the idea that child and adolescent mental health assessments incorporate multiple measurement methodologies (e.g., informants' survey reports, behavioral observations) that commonly evidence low levels of correspondence (De Los Reyes & Aldao, this issue). Similarly, a consistent finding in the work on affective science is that activity across emotional modalities (e.g., thoughts, behavioral tendencies, physiological activity) tends to evidence low coherence. For example, when getting ready to give a speech in class, an adolescent might entertain anxious thoughts (e.g., "I will do a terrible job and people will think I am a lousy speaker") and a strong behavioral tendency to avoid the presentation altogether, and yet he might experience a relatively diminished physiological arousal (e.g., low heart rate). Such low coherence among emotional modalities can be manifested both in circumstances in which people actively try to regulate their emotional states (e.g., Butler, Gross, & Barnard, in press; Dan-Glauser & Gross, 2013; Shiota & Levenson, 2009) and make no such attempts at regulation (e.g., Barrett, 2009; Bradley & Lang, 2000; Ekman, 1992; Hsieh et al., 2011; Levenson, 1994; Mauss, Levenson, McCarter, Wilhelm, & Gross, 2005; Mauss et al., 2011; Russell, Rosenberg, & Lewis, 2011; Smith, Hubbard, & Laurenceau, 2011; Sze, Gyurak, Yuan, & Levenson, 2010). In addition, the degree of emotional coherence might vary as a function of whether it is measured during relatively nonemotional periods or in response to emotion eliciting stimuli or situations. Consequently, to fully understand patterns of coherence it becomes essential to assess them as emotions unfold over time.

It is important to note that, as with low correspondence in child and adolescent mental health assessments (De Los Reyes, Thomas, Goodman, & Kundey, 2013), a growing number of laboratory studies suggest that low emotional coherence may not necessarily be a source of noise. Rather, there is growing consensus that low coherence reflects meaningful variation that might aid in identifying patterns of affective dysfunction in mental disorders (e.g., Burkhardt, Wilhelm, Meuret, Blechert, & Roth, 2010; Hastings et al., 2009; Lanteigne, Flynn, Eastabrook, & Hollenstein, 2014; Marx et al., 2012; Moscovitch, Suvak, & Hofmann, 2010; Waugh, Muhtadie, Thompson, Joormann, & Gotlib, 2012). For example, Lanteigne and colleagues instructed adolescent girls to participate in a social stressor task (spontaneous speech), and they measured activity in the subjective (self-reports of nervousness, embarrassment, and shame), behavioral (verbal and nonverbal cues indicative of self-consciousness), and physiological (heart rate) modalities. Using cluster analyses, the authors identified two groups of girls: (a) those who had elevated activity in the subjective and behavioral but not the physiological modalities (experience-expression group), and (b) those who had elevated activity in the physiological but not the subjective or behavioral modalities (arousal group).

Of importance, girls in each group differed in terms of their habitual patterns of emotion regulation and their experience of depression symptoms. Girls in the experience-expression group reported significantly more difficulties regulating emotions, a greater use of suppression, and a lower use of reappraisal than the girls in the arousal group. Similarly, girls in the experience-expression group reported marginally greater depression symptoms. Thus, this study shows that examining coherence (or lack thereof) among subjective, behavioral, and physiological modalities can allow researchers to understand meaningful variation in expressions of clinical phenomena among adolescents. Yet, despite the growing enthusiasm for modeling coherence among emotional modalities, a closer look at current clinical practices reveals that its incorporation into assessments has been relatively nonexistent. This is problematic for two reasons.

First, current clinical assessments have much room for improvement in terms of their ability to enhance clinical decision making and track patient outcomes (for a review, see Hunsley & Mash, 2007). Consequently, current procedures may greatly benefit from recent advances in affective science. For instance, as mentioned previously, child and adolescent mental health assessments rely primarily on subjective reports completed by patients or their significant others (e.g., adult authority figures), and to a lesser extent on behavioral observations made by clinicians or other trained judges (e.g., Weisz, Jensen-Doss, & Hawley, 2005). Thus, the assessment of psychophysiological activity in clinical and applied research contexts has been minimal (e.g., Davis & Ollendick, 2005; Thomas et al., 2012).

This lack of physiological indices in mental health assessments may often prevent practitioners and researchers from understanding whether patients experience positive outcomes on important therapeutic domains. For example, without assessing physiological responses to anxiety provoking social situations, a clinician might not be able to determine whether a socially anxious patient experiences physiological habituation as a result of exposure treatment (Davis, May, & Whiting, 2011). Further, subjective and putatively "objective" methods of monitoring physiology within assessments for social anxiety may yield discrepant outcomes: Adolescent social anxiety patients may subjectively perceive stable and high levels of physiological arousal within social situations, whereas heart rate monitor readings reveal physiological habituation to such situations (e.g., Anderson & Hope, 2009). Thus, use of both modalities in combination may improve case conceptualizations for patients, in that they may allow for the identification of targets of treatment that cannot be detected with use of either modality alone (e.g., training adolescents to identify physiological habituation within exposures to anxiety-provoking social situations; for a review, see Thomas et al., 2012).

Second, it is widely acknowledged that research in affective science has an enormous potential for both helping us *diagnose* (e.g., Aldao et al., 2010; Chaplin & Cole, 2005; Cicchetti, Ackerman, & Izard, 1995; Jazaieri et al., 2013; Kring & Sloan, 2009; Mulin & Hinshaw, 2007; Southam-Gerow & Kendall, 2002; Suveg & Zeman, 2004) and *treat* mental disorders (e.g., Barlow, Allen, & Choate, 2004; Bilek & Ehrenreich-May, 2012; Hayes, Strosahl, & Wilson, 1999; Linehan, 1993; Mennin & Fresco, in press; Roemer, Orsillo, & Salters-Pedneault, 2008). However, the realization of such potential is contingent upon the systematic application of this basic research to improving clinical assessment procedures (Sloan & Kring, 2007). In other words, basic research can help us identify patterns of emotion regulation that may improve methods for classifying and diagnosing mental health conditions as well as evaluating treatment outcomes (see Reese, Rosenfield, & Wilhelm, 2013). However, without proper assessments of affective processes in the clinic, how can we identify what processes need to be targeted and for whom? And how can we evaluate whether patients are engaging in more effective patterns of emotion regulation following treatment? Mental health research and practice would benefit enormously from empirical work seeking to enhance our current capacities for implementing multimodal measurement of affective processes within mental health assessments.

OVERVIEW OF SPECIAL ISSUE ARTICLES AND PHYSIOLOGICAL MODALITIES

Collectively, the studies in this special issue focused on use and interpretation of multimodal assessments of affective processes that included a variety of strategies for assessing physiological states. Some studies measured activity in the sympathetic and/or parasympathetic branches of the autonomic nervous system, such as heart rate, heart rate variability (HRV)/respiratory sinus arrhythmia (RSA), skin conductance, and blood pressure (e.g., Cohen, Masyn, Mastergeorge, & Hessl, 2015; De Los Reyes et al., 2015; Franklin, Glenn, Jamieson, & Nock, 2015; Gatzke-Kopp, Greenberg, & Bierman, 2015; Leitzke, Hilt, & Pollack, 2015; McLaughlin, Rith-Najarian, Dirks, & Sheridan, 2015). Two studies measured cortical brain response modalities, such as resting electroencephalography asymmetry, error related negativity, and feedback negativity (Bress, Meyer, & Hajcak, 2015; Moser, Durbin, Patrick, & Schmidt, 2015). One study (Moser et al., 2015) assessed fear-potentiated startle, which varies with muscle activity (orbicularis oculi), brain stem activity (e.g., *nucleus reticularis pontis* *caudalis*), limbic activity (e.g., amygdala, bed nucleus of the stria terminalis, and many more), and cortical activity (e.g., frontal lobes).

The findings from these investigations underscore the notion that low correspondence among emotional modalities may not necessarily be indicative of measurement error. For instance, several articles provided evidence suggesting that physiological assessments can be used to improve diagnostic assessments, in particular by helping differentiate between commonly comorbid conditions (see also Franklin et al., 2015; Moser et al., 2015).[1] Bress and colleagues found that, whereas one set of brain responses (i.e., the error related negativity) to a task assessing sensitivity to error commissions (i.e., Flankers task) was associated with increased self-reported anxiety symptoms, another set of brain responses (i.e., the feedback negativity) to a task capturing sensitivity to receipt of rewarding stimuli (i.e., Doors Task) was associated with increased self-reported depression symptoms. However, self-reported anxiety symptoms did not significantly relate to sensitivity experienced within the Doors Task, and self-reported depression symptoms did not significantly relate to sensitivity experienced during the Flankers Task. Of importance, these findings reflect the idea that people who report anxiety symptoms tend to experience increased physiological sensitivity to making errors but no decreased sensitivity to receiving or experiencing rewards. Conversely, people who report depression symptoms tend to experience decreased physiological sensitivity to receiving or experiencing rewards but no increased sensitivity to making errors. Cohen and colleagues sought to differentiate autonomic physiological profiles in boys meeting diagnostic criteria for autism spectrum disorders, Fragile X syndrome, or both conditions, and healthy controls. The authors recorded sympathetic (FPS, skin conductance) and parasympathetic activity (HRV) in response to pictures that varied in valence (neutral and positive) and social context (social vs. nonsocial). They found that boys who met criteria for Fragile X syndrome had the highest sympathetic activity. In addition, boys who met criteria for autism and autism/Fragile X evidenced the lowest parasympathetic activity.

[1]We would like to emphasize that there is a inherent tautology in seeking to apply the dimensional RDoC framework to differentiate between existing *Diagnostic and Statistical Manual of Mental Disorders* (*DSM*)–based diagnostic categories. However, *DSM* is currently the prevailing system for classifying psychopathology, so it is sensible that it would serve as an anchor for RDoC-inspired work. Future iterations of RDoC-guided work may increasingly reveal an independence between the RDoC domains and *DSM* criteria. Alternatively, such work may result in identifiable links between *DSM*-defined symptom criteria (albeit not contained within a given DSM diagnostic category) and functioning within or across RDoC domains.

Other studies in this special issue showed that physiological assessments can provide useful information regarding treatment outcome and/or indicators of long-term functioning. Gatzke-Kopp et al. (2015) conducted a randomized controlled trial of a targeted school-based intervention for aggressive and oppositional behavior, using changes in psychophysiology as an outcome measure. They recruited aggressive children at the start of elementary school and randomly assigned them to one of two interventions: Promoting Alternative Thinking Strategies (PATHS), a teaching-administered prevention program, and PATHS+, an enhanced version of PATHS that also included social skills training sessions led by a trained facilitator. The authors assessed RSA in order to uncover treatment effects that have proven difficult to identify by relying on subjective or behavioral outcome measures alone (e.g., Beauchaine & Gatzke-Kopp, 2012). They found that RSA reactivity to a fear-inducing film clip moderated the effects of the intervention on kindergarteners' and first graders' externalizing problems. Specifically, low-reactive children in the PATHS+ condition showed greater increases in their ability to regulate their emotions and greater declines in externalizing symptoms than those in the PATHS condition. Leitzke and colleagues assessed blood pressure responses during a social stressor in a sample of children with and without a history of maltreatment. They found that children with a history of maltreatment experienced a blunted systolic blood pressure response to social stress, relative to those without such a history. McLaughlin and colleagues recruited a sample of adolescents and examined the relation between resting RSA, internalizing problems, and the previous experience of psychosocial stressors. They found that resting RSA moderated the relation between experiencing psychosocial stressors and having internalizing problems, such that adolescents with low resting RSA had a positive association between stressors and symptoms.

An important issue raised in this special issue is that the utility of physiological measures may extend to the point only where methods are available to facilitate administration, scoring, and interpretation of assessment outcomes in applied research and practice settings. Specifically, De Los Reyes and colleagues (2015) assessed heart rate responses to a social stressor task within a sample of adolescents who had been referred for a social anxiety evaluation. Using graphical depictions of adolescents' heart rates, undergraduate research assistants without a background in psychophysiology reliably and validly distinguished graphical depictions of patients' heart rate responses of age-matched normative healthy controls. Further, research assistants' judgments of adolescent heart rates could be distinguished by the contexts from which the recordings were taken (e.g., speech preparation vs. speech giving vs. baseline). Adolescent patients' self-reported anxiety also predicted research assistants' heart rate judgments, providing some evidence of the clinical validity of assistants' judgments.

The findings of De Los Reyes and colleagues point to the potential for developing user-friendly physiological assessments for use in screening and treatment response assessments. For example, assessments might focus on identifying adolescents who experience primarily anticipatory anxiety (i.e., elevated heart rates during speech preparation) performance anxiety (i.e., elevated heart rates during speech preparation), or both forms of anxiety within performance contexts. Identifying individual differences in screening assessment outcomes might result in strategies for individually tailoring treatment plans to meet the needs of patients who experience primarily anticipatory anxiety (e.g., emotion regulation training), performance anxiety (e.g., exposure-based treatment), or anxiety in both performance contexts (e.g., combined treatment protocol).

A related issue regarding the implementation of these paradigms in applied settings pertains to deciding which ones to use and what assessments to conduct. A sensible starting point might be to take a closer look at the effect sizes for each measure within each paradigm. In the accompanying commentary, Youngstrom and De Los Reyes (2015), calculated the largest effect size for three empirical studies in the special issue (the rest of the studies did not report sufficient data for calculating bivariate associations between physiological measures and clinical outcomes). They benchmarked these effect sizes against area under the curves (AUCs) from receiver operating characteristics (ROC) and found that two of the studies (Bress et al., 2015; Moser et al., 2015) had effect sizes with corresponding AUCs above .80, which placed them in the good-to-excellent range in terms of physiological measures in relation to clinical outcomes (Swets, Dawes, & Monahan, 2000). These effect sizes represented the association between Child Depression Inventory scores and feedback negativity (Bress et al., 2015) and Child Behavior Questionnaire total (parent report) and cortical asymmetry (Moser et al., 2015). The third effect size (Leiztke et al., 2015) corresponded to a good AUC (.61). These findings suggest that when utilizing these paradigms, practitioners and applied researchers might focus on these particular measures. As this area of work continues to develop, it will be essential to conduct calculations of effect sizes and AUCs across studies (i.e., meta-analytic work). In this respect, it will be extremely important to utilize standardized guidelines for reporting assessment data (e.g., the STAndardized Reporting of Diagnostic; Bossuyt et al., 2003).

TRANSPORTING AFFECTIVE SCIENCE PARADIGMS FROM THE LABORATORY TO APPLIED RESEARCH AND CLINIC SETTINGS

In sum, the work presented in this special issue represents an important step in moving the field of affective science closer toward a systematic integration of subjective, behavioral, and physiological modalities within mental health assessments. Nevertheless, much of this work required a level of conceptual and methodological complexity that might not be readily available for those investigators and practitioners carrying out assessments in applied research and practice settings. To address this issue, we provide suggestions for relatively straightforward ways of assessing emotional coherence in applied settings. We differentiate between tonic (i.e., baseline activity in the absence of stimuli) and phasic assessments (i.e., activity in reaction to emotion-eliciting stimuli), as they each provide different types of information and require varying levels of methodological complexity.

Tonic Assessments

Tonic assessments of emotional coherence provide information about functioning in the absence of emotion-eliciting stimuli or situations. These might also be referred to as *baseline* or *resting* assessments. Tonic assessments constitute a window into how each person approaches the world before that person is even faced with the need to regulate an emotion. Of particular importance, patterns of tonic coherence (or lack thereof) can provide useful clinical information that can be utilized to tailor interventions. For example, Patients 1 and 2 might both meet diagnostic criteria for generalized anxiety disorder. Let us imagine that Patient 1 experiences chronically elevated physiological arousal (e.g., elevated resting heart rate and blood pressure) and relatively low levels of subjective anxiety (e.g,. worrysome, self-critical thoughts). She will likely benefit from an intervention that emphasizes mindful awareness and/or relaxation exercises. Patient 2 also experiences elevated physiological arousal, but he also experiences intense subjective anxiety. He might benefit from a course of therapy that emphasizes both mindful awareness and critically examining and challenging distorted cognitions.

Recent data support the importance of modeling tonic coherence when seeking to understand the course and prevalence of mental disorders. For example, one of the articles in this special issue found that greater tonic RSA was associated with greater adaptive psychosocial outcomes (McLaughin et al., 2015).[2] In prior work, tonic

[2]A growing literature has identified elevated tonic HRV/RSA as a marker of affective flexibility and good mental health (e.g., Appelhans & Luecken, 2009; Thayer, Ahs, Fredrikson, Sollers, & Wager, 2012).

HRV has been shown to differentiate adolescents whose parents sought on their behalf a clinical evaluation for social anxiety from age- and gender-matched community control adolescents (De Los Reyes et al., 2012).

Tonic assessments are relatively straightforward to administer because they do not require establishing a particular stimulus or situation to elicit an emotional reaction. A practitioner would need the patient to sit still for a given amount of time and within a nonstressful environment (e.g., sitting 5 to 10 min in a comfortable chair in a nondescript room). Such instructions are easy to provide, one can use a stopwatch to keep track of time, and thus resting physiology assessments can be administered in locations outside of the laboratory (e.g., therapy room). If the assessment room contains a window, one might instruct patients to look away from the window so as to minimize the probability that nonrandom environmental factors might elicit emotions (e.g., passing cars, weather). As patients sit still, they would be connected to equipment to record their physiological activity. This equipment could be ambulatory, as is the case with exercise watches designed to track heart rate functioning, or stationary. Applied researchers and practitioners who work with patients in large hospitals and academic medical centers might be able to conduct these assessments in research laboratories housed in their institution (see Moser et al., 2015).

Phasic Assessments

In contrast to tonic assessments of emotional coherence, phasic assessments can help us identify how a person reacts to and recovers from encountering emotion eliciting stimuli and situations. Such assessments can also be extremely valuable in helping us tailor interventions. Let us turn to an example. Let us imagine that we are treating Patient 1, who suffers from a spider phobia. He finds a spider in his garden, and he suddenly experiences intense fear. His heart rate speeds up, his breathing gets shallow, and he starts to sweat profusely. Let us now also imagine that this patient is able to reappraise this situation in a less threatening way, for example, by telling himself that the spider is quite harmless and far away from him. If the patient successfully engages in this reappraisal, his subjective anxiety may go down, his heart rate may begin to slow down, his breathing may get slower and deeper, and his sweating may become less intense. In other words, he may experience a relatively fast *recovery* (i.e., physiological habituation to stimulus) from his initial *reactivity* (i.e., physiological response relative to baseline). Let us imagine now that another patient, Patient 2, is not able to utilize reappraisal in the presence of the spider, and thus he experiences a much slower recovery. If we were to assess the initial reactivity in both patients, we might find their patterns of affective functioning to be quite similar. However, by examining their reactivity in tandem with their recovery, we could draw important conclusions regarding the ability of these two patients to regulate their emotions (see Aldao, 2013). Similar to our previous example, a practitioner might use this information to develop different treatment plans. In particular, Patient 2 might benefit from learning how to implement and maintain reappraisal when experiencing intense fear. Conversely, because Patient 1 was able to benefit from his use of reappraisal while in the midst of a fearful reaction, his treatment plan might include learning how to implement reappraisals earlier on in the emotion generative process and therefore influence the course of his emotions more effectively (e.g., Sheppes, Scheibe, Suri, & Gross, 2011). In addition, by assessing the effects of reappraisal across emotional modalities, the practitioner could also gather important information about these patients. Perhaps Patient 2's difficulties utilizing reappraisal are the result of this strategy of reducing the intensity of subjective feelings without slowing down his heart rate or helping him take deeper breaths? In this case, it might be useful to teach him to focus his reappraisals on modifying his perceptions of his physical arousal (e.g., Jamieson, Nock, & Mendes, 2013).

One potential challenge to conducting phasic assessments in the clinic is that these entail a greater degree of sophistication than tonic assessments. This is because phasic assessments require the introduction of an emotion-eliciting stimulus or situation in order to produce an emotional response that will vary over time. Of importance, widely used therapy techniques, such as in vivo and imaginal exposures, already capture these affective temporal dynamics. Similarly, as some of the articles in this special issue highlight, it can be relatively straightforward to administer standardized tasks in the context of applied research and clinical practice that produce emotional reactions similar to those elicited by behavioral exposures (see also Gatzke-Kopp et al., 2015; Leitzke et al., 2015). We next discuss both of these techniques.

Exposure. During exposure treatment for anxiety disorders, patients are encouraged to come into gradual contact with the stimuli and/or situations that are the sources of their fear and anxiety (Barlow, 2002). By allowing themselves to experience that anxiety, patients' fear reactions become extinguished over time, and this leads to an amelioration of their symptoms (e.g., Craske et al., 2008). Practitioners assess activity in the behavioral modality by measuring the extent to which patients get close to that object and/or participate in that situation (i.e., via Behavioral Avoidance Tests; Vasey & Lonigan, 2000). In addition, practitioners track activity in the subjective modality by asking participants to rate their subjective units of distress (SUDs), scales of which tend to range between 0 (*no anxiety*) and 100 (*extreme anxiety*; e.g., Hope, Heimberg, & Turk, 2006). Patients provide SUDs ratings before, during, and after exposure. Thus practitioners and researchers utilizing exposure techniques for the treatment of anxiety disorders already have at their disposal a rich context through which to conduct multimodal phasic assessments of patients' physiology in reference to emotion-eliciting stimuli (for the utilization of ratings of arousal *and* valence in clinical settings, see Sloan & Kring, 2007).[3]

However, it is also noteworthy that physiological assessments are usually absent from exposure exercises. This is particularly problematic because phasic assessments might provide important information about the process of exposure (e.g., Alpers, Wilhelm, & Roth, 2005). For example, if a patient endorses high SUDs reactivity but evidences blunted heart rate reactivity, might this suggest that he is engaging in a "safety behavior" meant to diminish or reduce his anxious arousal (e.g., mental rehearsal or distraction; see Hedtke, Kendall, & Tiwari, 2009; Helbig-Lang & Petermann, 2010; Parrish, Radomsky, & Dugas, 2008; Rachman, Radomsky, & Shafran, 2008)? If another patient endorses low SUDs reactivity but she has a sharp increase in her heart rate reactivity and in her behavioral avoidance of the feared object or situation, this might be indicative of her underplaying her subjective experiences of anxiety. By systematically assessing emotional coherence—or lack thereof—in the context of exposure, applied researchers and practitioners can develop a much more nuanced understanding of patients' difficulties and, consequently, tailor treatment accordingly.

Computer-based and behavioral tasks. In addition to taking advantage of exposure techniques that are already embedded in psychosocial interventions, applied researchers and practitioners also have at their disposal a series of computer-based paradigms and short behavioral tasks. For example, Gatzke-Kopp and colleagues (2015) utilized film clips to elicit fear, sadness, anger, and happiness in their sample of children receiving a targeted intervention for aggression. Of importance, it was the RSA phasic reactivity to the film clips (rather than tonic RSA) that predicted future symptoms and emotion regulation. Leitzke and colleagues (2014) administered a performance-based social stressor, similar to behavioral exposures in therapy, except that the task was administered once in the context of a screening evaluation for childhood maltreatment. They found that children who had a history of stress exposure demonstrated blunted systolic blood pressure reactivity during this task (and no baseline differences).

Beyond the tasks described in this special issue, there are several paradigms that can be used to assess emotional functioning in applied research and clinical practice settings. The most popular ones entail the presentation of emotion eliciting media, such as pictures, film clips, and/or music (Ellard, Farchione, & Barlow, 2011), followed by instructions to implement various emotion regulation strategies. Investigators then measure the effectiveness with which each regulation strategy modifies affect across modalities (for a review, see Aldao, 2013). Additional tasks consist of those that measure implicit forms of emotion regulation, such as the emotional Stroop task (e.g., Etkin, Egner, & Kalisch, 2011), the emotion regulation implicit association tests (Mauss, Cook, & Gross, 2007), and the dot probe task (e.g., Amir et al., 2009; Gotlib & Joormann, 2010; Teachman, Joormann, Steinman, & Gotlib, 2012). All of these tasks are programmable on a laptop, and many of them are available for free from task developers.

PRACTICAL BARRIERS TO OVERCOME

Perhaps one of the greatest challenges to implementing multimodal assessments in the clinic pertains to the concerns that physiological data might be cumbersome to collect, clean, analyze, and interpret. In this section we discuss some of the current challenges facing the implementation of a multimodal assessment in applied research and clinical practice settings.

The first challenge for the utilization of multimodal assessments consists of the lack of normative comparisons. Let us turn to an example based on heart rate, for which available norms indicate that the average resting rate for healthy children and adolescents aged 12 to 16 years is 85 beats per minute (e.g., Siegfried & Henderson, 2002). If an adolescent 15 years of age evidences a heart rate of 120 during a tonic assessment, we can infer that his heart rate is elevated relative to the normative heart rate. However, what about heart rate functioning during a phasic assessment? Let us imagine two patients experiencing specific phobia concerns about snakes. Patient 1 experiences an increase relative to a tonic baseline of 30 beats per minute when confronted with a snake, whereas Patient 2 experiences a baseline-to-stimulus increase of 25 beats per minute. Are these values meaningfully

[3]Although exposure has been primarily utilized in the treatment of anxiety disorders, there has been a growing interest in applying this technique to treating other conditions, particularly depression (e.g., Kumar, Feldman, & Hayes, 2008) and eating disorders (e.g., Steinglass et al., 2011). Similarly, mindfulness- and acceptance- and emotion-based treatments entail the practice of coming in contact with emotion-eliciting material in order to reduce subsequent reactivity (e.g., Barlow et al., 2004; Bilek & Ehrenreich-May, 2011; Hayes et al., 1999; Linehan, 1993; Mennin & Fresco, in press; Roemer et al., 2008). Consequently, many applied researchers and practitioners currently use therapeutic techniques that provide prime opportunities for assessing the temporal dynamics of emotion (i.e., tonic and phasic assessment periods).

different from one another? That is, do physiological data for Patient 1 indicate significantly greater impairments in emotional functioning relative physiological data for Patient 2? In addition, how many seconds—or minutes—should a normative recovery from the initial reaction to the phobic stimulus last? This issue becomes much more complex when we turn to examining physiology in tandem with subjective and behavioral activity (see also De Los Reyes et al., 2012; De Los Reyes et al., 2013). For instance, would one calibrate the meaning of the difference between Patient 1's reactivity and Patient 2's reactivity if the 5-point difference was accompanied by Patient 1 electing to stop the snake exposure, whereas Patient 2 continued through to the end of the exposure? Might calibration entail examining whether Patient 2's lower heart rate relative to Patient 1 was also accompanied by Patient 1 making greater negative self-statements (i.e., "I am so scared!") during the snake exposure, relative to Patient 2? The articles in this special issue present a starting point in collecting these data in laboratory settings, but clearly much more work remains to be done in this respect.

A second challenge pertains to identifying and isolating assessment periods of interest. In a previous section, we discussed tonic and phasic assessments of physiology. Yet we did not comment on the duration in time that should be allocated to each of these periods. What constitutes an adequate tonic assessment? Three minutes? Five minutes? Seven minutes? How long should the stimulus be present in order to elicit a clinically meaningful phasic assessment? A close look at the basic research on affective science shows that there is substantial heterogeneity in how researchers identify periods of interest both when designing studies and analyzing data (e.g., Aldao & Mennin, 2012, used a 5-min baseline; Hofmann, Heering, Sawyer, & Asnaani, 2009, used a 3-min baseline). A similar concern applies to the selection of psychophysiological measures. Given the wide range of available measures of central and peripheral nervous system activity (e.g., Dennis, O'Toole, & DeCicco, in press; Hajcak, MacNamara, & Olvet, 2010; Kreibig, 2010), which assessments should applied researchers and practitioners administer? In this case, the answer for clinical use may be similar to the answer for use in empirical work. That is, the most useful measures are those that (a) are cost-effective, (b) are straightforward to use, (c) have been extensively validated, and (d) yield incremental information relative to alternative clinical tools (see also Youngstrom & De Los Reyes, 2015).

A third barrier to being able to successfully incorporate multimodal assessments of affective processes in applied research and clinical settings is that some of the physiological assessments cannot be currently conducted using ambulatory methodologies. That is, brain imaging techniques, such as functional magnetic resonance imaging, may currently be cost-prohibitive for routine use in mental health assessments. Further, functional magnetic resonance imaging requires substantial infrastructure to operate for such assessments to be routinely implemented in mental health assessments. Substantially more compact methods, such as functional near-infrared spectroscopy, are versatile enough for portable use in clinic settings but are likely still cost-prohibitive and cannot assess responses from subcortical brain regions (e.g., amygdala and hippocampus; Bunce, Izzetoglu, Izzetoglu, Onaral, & Pourrezaei, 2006). That said, however, there are promising leads. For instance, a recent meta-analysis suggests that HRV might provide an index of the extent to which top-down appraisals influence brainstem activity and autonomic responses via cortical–subcortical pathways (Thayer et al., 2012). Stated another way, future work might involve calibrating data derived from relatively low-cost physiological tools (e.g., heart rate monitors) so that they may function as reliable indicators of brain responses that currently can only be directly assessed using expensive brain imaging tools.

Concluding Remarks

In this special issue, we took an initial step in bridging the gap between basic research and clinical assessments of affective dysfunction in clinical populations. We assembled a collection of articles from leading research teams carrying out pioneering work on implementing multimodal assessments of affective processes that included low-cost, noninvasive peripheral physiology. In this commentary, we provided a series of practical suggestions regarding how to translate this basic science work into assessments in applied research and clinical settings. We hope that the articles presented in this special issue—as well as this commentary—will inspire solid translational work that can improve how we conceptualize, assess, and treat affective dysfunction in mental disorders. Further, we hope the translation of techniques and procedures from the lab into the clinic will allow researchers to systematically collect data within applied and clinical settings and, in turn, inform basic research. More broadly, the implementation of this bidirectional translational work beyond affective science to examine multiple processes (e.g., attention, memory, and cognition) will be essential for the ultimate success of the RDoC initiative and the development of therapeutic techniques that reduce the burden of mental illness and improve public health.

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