Journal of Affective Disorders 216 (2017) 17–29

Contents lists available at ScienceDirect

Journal of Affective Disorders

journal homepage: www.elsevier.com/locate/jad

Research paper

Latent variable analysis of positive and negative valence processing focused on symptom and behavioral units of analysis in mood and anxiety disorders

Martin P. Paulus[a,c,*,1], Murray B. Stein[a], Michelle G. Craske[b], Susan Bookheimer[b], Charles T. Taylor[a], Alan N. Simmons[a], Natasha Sidhu[a], Katherine S. Young[b], Boyang Fan[b]

[a] Department of Psychiatry, University of California San Diego, La Jolla, CA, USA
[b] Department of Psychology, Psychiatry and Biobehavioral Sciences, University of California Los Angeles, USA
[c] Laureate Institute for Brain Research, Tulsa, Oklahoma, USA

ARTICLE INFO

Keywords:
Research domain criteria
Positive valence processing
Negative valence processing
Mood disorders
Anxiety disorders
Principal components analysis

ABSTRACT

Background: Mood and anxiety disorders are highly heterogeneous and their underlying pathology is complex. The Research Domain Criteria (RDoC) approach seeks to establish dimensionally and neuroscience-based descriptions of psychopathology that may inform better classification and treatment approaches. The current investigation sought to determine the latent variables underlying positive and negative valence processing in terms of symptoms and behavioral units of analysis.

Method: As part of an ongoing study, individuals with mood and anxiety problems were recruited largely from primary care clinics at UCLA (n=62) and UCSD (n=58). These participants underwent a comprehensive symptomatic and behavioral assessment. An implicit approach avoidance task and a modified dot probe detection task were used to measure positive and negative valence processing.

Results: Principal components analysis with varimax rotation identified four symptom components, three behavioral components for the dot probe task, and two behavioral components for the implicit approach avoidance task. These components yielded two meta-components consisting of: negative valence symptoms, negative approach bias, and high sustained, selective attention; and positive valence symptoms, positive approach bias, and slow selective or sustained attention. The components did not differ between males and females, nor by age or medication status.

Limitations: The limitations are: (1) relatively small sample, (2) exploratory analysis strategy, (3) no test/re-test data, (4) no neural circuit analysis, and (5) limited reliability of behavioral data.

Conclusions: These preliminary data show that positive and negative valence processing domains load on independent dimensions. Taken together, multi-level assessment approaches combined with advanced statistical analyses may help to identify distinct positive and negative valence processes within a clinical population that cut across traditional diagnostic categories.

1. Introduction

1.1. Mood and anxiety disorders

Mood (Moussavi et al., 2007) and anxiety (Kessler et al., 2010) disorders will account for approximately $16 trillion lost productivity or 25% of global GDP over the next 20 years (Whiteford et al., 2013) and are among the most common and devastating mental health conditions worldwide. Recent epidemiological data estimate the life-time prevalence of Major Depressive Disorder (MDD) at about 18% and the 12-month prevalence at 7% (Kessler et al., 2012). MDD is phenotypically and etiologically heterogeneous, which has posed a significant challenge to elucidation of the biological mechanisms, creation of objective, non-symptom-based nosological categories that cut across current diagnostic boundaries, and development of novel therapeutics. Recent analyses suggest that current interventions have limited efficacy and help to restore functioning in only a subgroup of individuals (Linde et al., 2015a, 2015b). Anxiety disorders are the most common mental health problem (Kessler et al., 1994) with a lifetime prevalence of approximately 33% (Kessler et al., 2012). Anxiety disorders are the sixth leading cause of disability world-wide and show no signs of reduced burden over recent years (Baxter et al., 2014). As

* Correspondence to: Scientific Director and President, Laureate Institute for Brain Research, 6655 S Yale Ave Tulsa, OK 74136-3326, USA.
E-mail address: mpaulus@laureateinstitute.org (M.P. Paulus).
[1] http://www.laureateinstitute.org

http://dx.doi.org/10.1016/j.jad.2016.12.046
Received 6 April 2016; Received in revised form 24 December 2016; Accepted 30 December 2016
Available online 11 January 2017
0165-0327/

with MDD, extant treatments are only partially effective (e.g., (Loerinc et al., 2015)). Both MDD and anxiety disorders are associated with significant medical comorbidities (Roy-Byrne et al., 2008), which further exacerbate the cost and suffering associated with these disorders. The heterogeneity of mood and anxiety disorders and the limited effectiveness of interventions have provided an impetus to utilize dimensional approaches to help delineate distinct syndromes of mood and anxiety that better reflect the underlying neurobiology.

1.2. Research domain criteria issues

Biological psychiatry is in a crisis (Insel and Cuthbert, 2015) and the fundamental insights into basic neuroscience have not translated into practical and clinical tools or treatment in psychiatry. The development of new therapeutics based on neuroscience approaches to understand the pathophysiology of these illnesses has stalled (Insel, 2012). Despite the development of a newly revised diagnostic classification for mental disorders (APA, 2013), neuroscience has had virtually no impact on the delineation and definition of the disorder categories. There are no clinical tools for prognosis, diagnosis, or treatment monitoring that derive from neuroscience (Prata et al., 2014). The National Institute of Mental Health began the Research Domain Criteria (RDoC) project in 2009 to develop a research classification system for mental disorders based upon neurobiology and observable behavior (Cuthbert and Insel, 2013). The RDoC initiative highlights the need to (1) determine the relationship between different units of analyses, that is, between genes, molecules, cells, circuits, physiology, behavior, self-report, and paradigms and (2) transcend traditional diagnostic groups to adequately capture the variation of domains in clinical populations that can be mapped across units of analyses.

1.3. Positive and negative valence domains

1.3.1. Positive and negative valence

Affect, or experience of emotion, can be divided into two domains (James, 1988). Positive affect involves emotions such as happiness, excitement, elation, and enthusiasm. Negative affect involves emotions such as anger, resentment, sadness, anxiety, and fear. Positive and negative affect systems are dimensions of psychopathology identified by the RDoC work groups (Health, 2011a, b). High negative affect is common to anxiety and depression (Brown et al., 1998; Chorpita, 2002; Prenoveau et al., 2010) and comorbid anxiety and depression is associated with more negative affect than each disorder alone (Weinstock and Whisman, 2006). Low positive affect is relatively specific to depression although it does extend to social anxiety and generalized anxiety disorder (Clark and Watson, 1991; Craske et al., 2009; Kashdan, 2007). In addition, psychophysiological and neurobiological data indicate that the negative affect system is closely tied to threat sensitivity whereas the positive affect system is closely tied to reward sensitivity, as described below.

1.3.2. Positive valence system

A central construct representing the positive valence system is approach motivation, which can be defined as processes that regulate the direction and maintenance of approach behavior, albeit moderated by pre-existing tendencies, learning, memory, stimulus characteristics, and deprivation states. Some have differentiated two separable components of reward-related processing; phasic prediction error signaling and reward sensitivity (Huys et al., 2013). Others have proposed that the construct of reward seeking and reward sensitivity is are components of approach motivation (Shankman et al., 2007). Reward sensitivity refers to the anticipation and receipt of positive stimuli as well as learning about the probabilities of receiving a reward (Romer Thomsen et al., 2015). Dysregulation of reward sensitivity has been observed in depression (Chen et al., 2015; Day et al., 2015). The neural mechanisms of reward sensitivity involve the ventral striatum (VS) and orbitofrontal cortex (OFC). These structures are involved in the processing of primary rewards, such as pleasant tastes (O'Doherty et al., 2002), smells (O'Doherty et al., 2000) or visual stimuli (O'Doherty et al., 2001), as well as secondary (monetary) rewards (Delgado et al., 2005; O'Doherty et al., 2001; Zink et al., 2004). Moreover, there is evidence that reduced reward sensitivity in depression is related to EEG OFC gamma activity (Webb et al., 2016).

1.3.3. Negative valence system

Responses to acute threat (fear) and potential harm (anxiety) were considered by the RDoC workshop committee to be central constructs within the negative valence system. These responses can be examined with respect to information processing (i.e. biases of attention) or incentive motivational actions (i.e. approach or avoidance behaviors). Attention bias can be quantified using response latency within a modified probe detection task (Rudaizky et al., 2014). Specifically, allocation of attention to the spatial location of affective stimuli (with positive or negative valence) can be determined from response latencies to probes (Mogg et al., 1995). In comparison, implicit approach/avoidance action tendencies are measured by the approach-avoidance task (AAT) (Strack and Deutsch, 2004). The basic premise underlying the AAT is that stimuli from the environment elicit automatic evaluations that activate affectively congruent behavioral schemas of approach and avoidance. These behavioral schemas can be assessed indirectly in terms of arm flexion (approach – i.e., pulling toward oneself) versus extension (avoidance – i.e., pushing away from oneself) through use of a joystick: Positively valenced stimuli are reliably associated with faster arm flexion than arm extension, whereas negatively valenced stimuli are associated with faster arm extension (e.g (Heuer et al., 2007)). By dictating behavioral movements in response to a feature of the task unrelated to the contents of the presented stimuli (e.g., instructing individuals to generate approach vs. avoidance actions according to different colored borders surrounding the target stimuli (Najmi et al., 2010; Taylor and Amir, 2012)), response latency differences in pulling versus pushing a given stimulus category (e.g., positively valenced stimuli) can be interpreted as relatively implicit action-tendencies driven by automatic evaluation of the stimulus contents.

1.4. Units of analyses

The ultimate goal for RDoC is to derive constructs (i.e., negative valence vs positive valence) that are observable in multiple units of analysis, i.e. that can be observed on a symptom, behavioral, physiological, circuit, molecular, or genetic level. Thus, the RDoC initiative underscores the need to (1) identify measures of multiple units of analysis (e.g., self-report, behavior, physiology) that reliably capture the variation of a given construct, and (2) establish the relationship among different units of analyses, with an emphasis upon linking underlying brain function (e.g., neural circuits) to behavior. Here, we used well-established self-report and behavioral measures as the units of analysis to (1) examine latent constructs of positive and negative valence construct and (2) examine the relationships among those units of analysis. Our choice of measures was guided by empirical data for specific measures heuristically aimed at quantifying each construct, and evidence suggesting that those measures relate to neural circuits governing positive and negative valence system functioning. For example, attentional biases for emotional information are considered a hallmark of anxiety and depression (Bar-Haim et al., 2007; Taylor and Amir, 2010). Attentional bias for threat-relevant stimuli is reliably associated with negative affective states (e.g., anxiety (Bar-Haim et al., 2007)) and has been linked to greater activation in the AMYG during emotion processing (El Khoury-Malhame et al., 2011). In contrast, attentional bias for positive stimuli is associated with positive affective states (Tamir and Robinson, 2007) and neural activity reflecting