Lost emotion: Disrupted brain-based tracking of dynamic affective episodes in anxiety and depression

Joshua M. Carlson\textsuperscript{a,}\textsuperscript{*}, Denis Rubin\textsuperscript{b}, Lilianne R. Mujica-Parodi\textsuperscript{b,c}

\textsuperscript{a} Department of Psychology, 1401 Presque Isle Avenue Northern Michigan University, Marquette, MI, USA
\textsuperscript{b} Department of Biomedical Engineering, State University of New York at Stony Brook, Stony Brook, NY, USA
\textsuperscript{c} Department of Radiology, A. A. Martinos Center for Biomedical Imaging, Massachusetts General Hospital, Charlestown, MA, USA

\textbf{A R T I C L E   I N F O}

Keywords:
- Generalized anxiety disorder
- Major depressive disorder
- Natural vision
- Amygdala
- Default mode network

\textbf{A B S T R A C T}

In our day-to-day lives we are confronted with dynamic sensory inputs that elicit a continuously evolving emotional response. Insight into the brain basis of the dynamic nature of emotional reactivity may be critical for understanding chronic symptoms of anxiety and depression. Here, individuals with generalized anxiety disorder, major depressive disorder, and healthy controls watched a video with dynamic affective content while fMRI activity was recorded. Across all participants there was a large-scale tracking of affective content in emotion processing regions and the default mode network. Anxious and depressed individuals displayed less brain-based coupling within these regions and the extent of this uncoupling correlated with variability in emotional numbing. Thus, abnormal neural tracking of affective information during dynamic emotional episodes appears to represent a disconnection between affective cues in the environment and an individual’s response to these cues—providing a putative neural basis for context insensitive affective reactivity and emotional numbing.

1. Introduction

Imagine your response to hearing a loud and unexpected door slam. When you notice that the person entering the door is a dear friend or relative, your emotional response quickly changes from one of startle and worry, to one of joy. On the other hand, if the person entering the room is unknown to you, perhaps holding a weapon, you are likely to maintain your response of startle and worry. This is just one example of how the human emotional response is a complex phenomenon that continuously evolves as we interact with our environment. Yet, research into the brain basis of emotional processing has primarily measured responses to “emotional” and “neutral” stimuli in a binary “on vs. off” fashion (Phan et al., 2002). This research has been invaluable in establishing a core network of emotion processing regions including, among others, the amygdala, anterior cingulate cortex (ACC), and insula. Although emotional stimuli are typically presented in a static binary fashion, the neural response to these stimuli is not “on or off”, but rather varies in relation to the relative intensity of the stimulus (Anders et al., 2004; Canli et al., 2002; Carlson et al., 2011; Engell et al., 2007; Taylor et al., 2003; Waugh et al., 2010). Yet, little is known about how the brain responds to dynamic emotional content. Given that our day-to-day emotional responses are driven by dynamic interactions with the environment, it is important to establish a line of cognitive neuroscience research into the neural correlates of dynamic emotional reactivity in more naturalistic settings (Zaki and Ochsner, 2009).

This is particularly true for disorders such as anxiety and depression, which are characterized by abnormal dynamics in emotion processing such as prolonged and unexplainable feelings of worry, hopelessness, despair, and anhedonic numbing (DSM-IV, 2000; DSM-V, 2013). According to the emotion context insensitivity view of depression, depressed individuals are insensitive to both emotionally positive and negative environmental stimuli, which results in a broadly blunted affective response (Bylsma et al., 2008; Rottenberg et al., 2005). Behavioral research has found that depressed individuals show a blunted affective response to both positive and negative emotional movies (Rottenberg et al., 2005, 2002). Researchers have also assessed emotional reactivity in depression using functional neuroimaging. The “default mode network” (DMN) consisting of the posterior cingulate (PCC), precuneus, inferior parietal lobule (IPL), & medial prefrontal cortex (mPFC) is more active during non-task states and less active during experimental tasks (Raichle et al., 2001). Patients with depression show hyperactive default mode network activity (Greicius et al., 2007) and in particular have shown hyperactive DMN activity during...
emotional image viewing (Grimm et al., 2009). Activation of the DMN during emotional tasks—when it should be less active—is in line with an insensitivity to environmental cues in depression. Depression has also been associated with hyperactive amygdala reactivity to threatening stimuli (Canli et al., 2004; Sheline et al., 2001; Siegle et al., 2007). Thus, depression is associated with both blunted and exaggerated, context insensitive, affective responses. Exaggerated, context insensitive, responses are also characteristic of anxiety (Etkin et al., 2004, 2009; Monk et al., 2008; Nitschke et al., 2009). For example, anxiety is characterized by unexplainable excessive worry and neuroimaging studies aimed at measuring states of worry or anxious anticipation have found that anxiety is associated with an increased response in the amygdala, ACC, and insula both in anticipation of aversive (Carlson et al., 2011; Simmons et al., 2006; Stein et al., 2007), but also neutral stimuli (Nitschke et al., 2009). Further evidence suggests that the ventromedial prefrontal cortex, which usually displays a graded response from threat to safety (Greenberg et al., 2013a), is flat-lined in individuals with generalized anxiety disorder and those comorbid with anxiety and depression (Greenberg et al., 2013b), which may result from multiple underlying structural abnormalities within the fear circuit (Cha et al., 2014b). A similar flat-lining has been observed in the ventral tegmental area for anxious individuals with and without comorbidity for depression (Cha et al., 2014a). Additionally, anxious individuals who are comorbid with depression show a blunted startle response similar to that observed in pure depression (Taylor-Clift et al., 2011). Thus, anxiety and depression are highly comorbid, due in part to overlapping symptoms. However, the symptoms of anhedonia and anxious arousal characterize “pure” cases of MDD and GAD, respectively (Watson et al., 1995). Both disorders appear to be associated with abnormal sensitivity to emotional cues within the environment.

Neuroimaging research has adopted the use of multimodal and dynamic naturalistic visual stimuli such as movies and virtual worlds (Bartels and Zeki, 2004a, 2004b; Hasson et al., 2004; Malinen et al., 2007). Initial research using such naturalistic stimuli has primarily focused on so-called “inter-subject correlations” of shared perceptual processing across individuals (Bartels and Zeki, 2004b; Hasson et al., 2004). A study by Nummenmaa and colleagues (2012) suggests that the widespread inter-subject synchronization of brain activity in visual, emotional, and default mode networks during natural vision is linked to emotion. Additional research by Zaki and colleagues (2009) has revealed that the ability to track others’ affective state during natural vision is associated with activity in the mPFC and IPL. Other research using naturalistic stimuli has also found that the DMN and emotion processing regions track positive and negative emotions (Goldin et al., 2005; Hutcherson et al., 2005). Although these studies provide initial evidence that naturalistic stimuli can be effective tools in the study of emotional processing and social cognition, the neural system(s) involved in tracking dynamic emotional content remains under studied. Of critical importance, it is unclear to what extent abnormal neural coupling with dynamic affective cues contributes to mood abnormalities in anxiety and depression.

Here, patients with generalized anxiety disorder, major depressive disorder, those comorbid for anxiety and depression, and a sample of healthy controls viewed the pilot episode of ABC’s TV-series Lost (42 min) while functional magnetic resonance imaging (fMRI) data were acquired. Immediately after viewing the episode, participants rated arousal and valence levels for each scene. We hypothesized that activity in sensory regions, emotion processing regions (e.g., amygdala, ACC, and insula), and the DMN would correlate with valence and arousal ratings. Further, we expected to see a greater correlation between the affective content of the episode and neural activity in healthy controls compared to anxious and depressed individuals; especially in emotion processing regions and the DMN.

2. Methods

2.1. Participants

Sixty consenting adult females recruited from a university community participated in the study (Mage = 22.52, SDage = 5.62). Our sample contained patients with generalized anxiety disorder (n = 17), major depressive disorder (n = 15), those comorbid for anxiety and depression (n = 15), and healthy controls (n = 13). Participants in this study represent a subsample of individuals with minimal motion (< 4 mm see Supplementary Table 1) from a larger age matched adult sample (N = 94). However, groups differed on mean frame displacement (F (3, 56) = 4.37, p < 0.05). The resulting subsample of participants also differed in age across groups with patients (GAD M_age = 23, MDD M_age = 26, COM M_age = 21) generally being slightly older than controls (M_age = 20, F (3, 56) = 3.28, p < 0.05). To help control for these differences, age and mean frame displacement were included as covariates (see the MRI acquisition and analysis section for more). G*Power 3.1.9.2 was used to determine whether the remaining subsample was sufficiently powered. Using a = 0.05, power = 0.80, and a large effect of d = 0.8, it was determined that an N = 54 would be needed. Thus, our subsample of N = 60 was sufficiently powered for effect sizes of d ≥ 0.8. Additional demographic data for participant groups can be found in Supplementary Table 2.

Given that anxiety and depression are more commonly diagnosed in females, we only recruited women to reduce gender-related heterogeneity in the sample. All participants were administered the Structured Clinical Interview for DSM-IV (Axis I Disorders—Patient Edition, Version 2) (DSM-IV, 2000) by trained clinical psychologists at Stony Brook University to confirm diagnoses of GAD, MDD, or comorbidity in the patient groups as well as the absence of Axis-I diagnoses in the healthy group. Participants were free from psychotropic medication for at least six months prior to the time of the experiment and with no history of substance abuse/dependence. The healthy control group had no diagnosable lifetime Axis I disorder and no history of neurological illness. Prior to scanning, participants were screened for metal and other MRI contraindications. The Stony Brook University Institutional Review Board approved the study.

2.2. Questionnaires

Participants completed questionnaires intended to measure specific symptoms of anxiety and depression including the Mood and Anxiety Symptoms Questionnaire (MASQ), which includes the following four subscales: General Distress Anxiety (11 items), General Distress Depression (12 items), Anxious Arousal (17 items), and Anhedonic Depression (22 items). The General Distress Anxiety and General Distress Depression subscales are thought to capture symptoms more common to both disorders, while the Anhedonic Depression and Anxious Arousal subscales capture symptoms specific to depression and anxiety, respectively. The disorder-specific subscales exhibit convergent and discriminant validity (Watson et al., 1995) and overall the MASQ has good internal consistency (α > 0.80). We also included the Penn State Worry Questionnaire (PSWQ) to assess symptoms of worry (16 items), which are characteristic of anxiety (Meyer et al., 1990). Summary Data from these questionnaires are presented in Supplementary Table 3.

2.3. Stimulus

Participants viewed the entire pilot episode of ABC’s TV-series Lost in a continuous uninterrupted scanning session lasting 42 min. Approximately, half of the participants reported previously watching
دریافت فوری

متن کامل مقاله

امکان دانلود نسخه تمام متن مقالات انگلیسی
امکان دانلود نسخه ترجمه شده مقالات
پذیرش سفارش ترجمه تخصصی
امکان جستجو در آرشیو جامعی از صدها موضوع و هزاران مقاله
امکان دانلود رایگان ۲ صفحه اول هر مقاله
امکان پرداخت اینترنتی با کلیه کارت های عضو شتاب
دانلود فوری مقاله پس از پرداخت آنلاین
پشتیبانی کامل خرید با بهره مندی از سیستم هوشمند رهگیری سفارشات