Psychiatry Research 218 (2014) 113–117

Contents lists available at ScienceDirect

Psychiatry Research

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

The role of executive attention in deliberate self-harm

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ARTICLE INFO

Article history:
Received 30 April 2013
Received in revised form
2 February 2014
Accepted 29 March 2014
Available online 4 April 2014

Keywords:
Executive control
Attention
Deliberate self-harm
Non-suicidal self-injury

ABSTRACT

Although a wealth of literature has examined the role of emotion-related factors in deliberate self-harm (DSH), less is known about neurocognitive factors and DSH. In particular, despite theoretical literature suggesting that deficits in executive attention may contribute to engagement in DSH, studies have not yet examined the functioning of this attentional network among individuals with DSH. The present study sought to address this gap in the literature by examining the functioning of the alerting, orienting, and executive attentional networks among participants with a recent history of DSH ($n=15$), a past history of DSH ($n=18$), and no history of DSH ($n=21$). Controlling for borderline personality pathology and depression symptoms, participants with a recent history of DSH exhibited deficits in executive attention functioning relative to participants without any history of DSH. No differences were found in terms of performance on the alerting or orienting attentional networks. These results provide preliminary support for the association between executive attention deficits and DSH.
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1. Introduction

The past decade has heralded an increase in research examining the factors contributing to deliberate self-harm (DSH; also referred to as non-suicidal self-injury), defined here as the deliberate, direct destruction of body tissue without conscious suicidal intent (see Gratz, 2001; Klonsky et al., 2003). Although historically studied in the context of psychopathology (e.g., borderline personality disorder [BPD]; American Psychiatric Association, 2000), growing evidence indicates high rates of DSH in nonclinical populations as well (e.g., 15–44%; Ross and Heath, 2002; Gratz, 2006; Gratz et al., 2010; Toprak et al., 2011; Cerutti et al., 2012). Indeed, similar to findings obtained within clinical samples, DSH has been found to be associated with a wide range of negative outcomes among nonclinical populations, including (a) emotional distress and poor coping abilities (Hasking et al., 2008); (b) relationship dissatisfaction and substance use (Toprak et al., 2011); and (c) heightened risk for suicide attempts (Nock et al., 2006). Despite the clinical relevance and public health significance of DSH within nonclinical populations, limited research has examined the mechanisms underlying DSH within this population. Moreover, the limited studies that have been conducted in this area have focused almost exclusively on emotion-related factors (e.g., emotion dysregulation, Paivio and McCulloch, 2004; Gratz and Roemer, 2008; Gratz et al., 2010) to the neglect of other potentially relevant mechanisms, such as neurocognitive factors. One set of factors that may be particularly important to examine in this regard is attentional network functioning, which is considered essential to psychological well-being and theorized to be the gatekeeper of emotion regulation (Bardeen and Read, 2010; Gross and Thompson, 2011). Specifically, due to its role in guiding attentional engagement and disengagement from emotionally-salient stimuli, attentional network functioning can be seen as a crucial first step in emotion modulation.

According to Fan et al., 2002, the attention system comprises three distinct attentional networks. The *alerting attentional network* involves the ability to sustain an alert state. The *orienting attentional network* involves the ability to identify and select visual stimuli. Finally, the *executive attentional network* serves to oversee and resolve conflict between other attentional networks, involving the facilitation and inhibition of activation in other networks (Botwinick et al., 2001). Theoretical and empirical literature suggest that engagement in DSH may be associated with deficits in executive attention functioning in particular (e.g., Linehan, 1993; Posner et al., 2002). The executive attentional network is thought to underlie self-regulatory efforts (see Rothbart et al., 2007), and researchers have theorized that dysfunction in attentional regulation may play an important role in the emotion dysregulation evident among individuals with borderline personality disorder (BPD) and recurrent DSH (Linehan, 1993). Specifically, when individuals who engage in DSH come into contact with aversive emotional experiences or other cues for DSH, deficits in executive attention may lead to difficulties in disengaging

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http://dx.doi.org/10.1016/j.psychres.2014.03.035
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attention from such cues, as well as difficulties attending to alternative stimuli. Consequently, with continued exposure to these cues, emotional arousal may increase, resulting in heightened emotion dysregulation and greater difficulties inhibiting maladaptive behaviors, such as DSH (see also Abdullaev et al. (2010), who describe a similar process with regard to substance abuse).

Although no studies to date have examined the association between DSH and attentional network functioning in general or executive attention in particular, preliminary research provides some support for the relevance of deficits in other indices of executive functioning to DSH. For example, results of a recent study revealed information processing deficits among university students with a history of repeated DSH, relative to individuals with no history of DSH and low emotion dysregulation (Franklin et al., 2010). Likewise, in a study comparing adolescents with DSH to healthy controls, those with a history of severe DSH were found to evidence working memory deficits, whereas those with a history of less severe DSH were found to evidence deficits in inhibitory control (Fikke et al., 2011). Finally, deficits in the executive attentional network have been found among patients with psychiatric disorders that commonly co-occur with DSH, including BPD (Haw et al., 2001) and posttraumatic stress disorder (PTSD; Zlotnick et al., 1999). For instance, research has provided evidence of executive attention deficits among both patients with PTSD (compared to controls with and without trauma-exposure; Leskin and White, 2007) and individuals with BPD (compared to non-personality disorder controls with low negative affect; Posner et al., 2002). Moreover, deficits in the functioning of the orienting and executive attentional networks have been found to predict BPD pathology (Fertuck et al., 2005). Together, the results of these studies suggest that deficits in the functioning of the executive attentional network may be associated with engagement in repeated DSH and highlight the need for research examining the role of executive attention in DSH.

To this end, the current study used a laboratory-based measure of attentional functioning (i.e., the Attention Network Task; Fan et al., 2002) to examine differences in three dimensions of attentional functioning (i.e., the alerting, orienting, and executive attentional networks) among individuals with (a) current (i.e., past six months) repeated DSH; (b) past repeated DSH; and (c) no history of DSH. In particular, the unique association between attentional network functioning and DSH, above and beyond their shared association with relevant psychopathology (e.g., BPD), was examined. It was hypothesized that, relative to participants without a history of DSH, participants with current DSH would demonstrate worse executive attentional functioning. Given the lack of research on differences between individuals with current versus past DSH, as well as the relative paucity of literature on the emotional and cognitive functioning of individuals with only past DSH, no *a priori* hypotheses were made with regard to the attentional network functioning of individuals with past DSH only.

2. Methods

2.1. Participants

Participants were recruited through advertisements posted online and throughout the greater Washington DC area. Participants were eligible for this study if they were between 18 and 55 years of age (to reduce the influence of age on cognitive performance; see Ronnlund et al., 2005). Inclusion criteria for the current DSH group included a history of repeated DSH (i.e., >1 episode) and at least one episode in the past six months; inclusion criteria for the past DSH group included a history of repeated DSH and no DSH in the past six months; and inclusion criteria for the non-DSH group included no history of DSH and no more than three criteria for BPD. Exclusion criteria for all three groups focused on the presence of Axis I pathology that could influence responding to the cognitive task, including current (past two weeks) manic, hypomanic, or depressive mood episodes (but not lifetime history of mood disorders), current (past-month) substance dependence, and primary psychosis.

The final sample included 15 individuals with current DSH (67% female), 18 individuals with past DSH (61% female), and 21 individuals in the no-DSH control group (52% female). Participants were ethnically diverse (52% White; 17% Black/African-American; 9% Asian-American; 8% Latino/a; 14% other race/ethnicity), predominantly single (93%), and had a *mean* age of 23 (S.D. = 9.07). Most participants (86%) reported an annual income of less than $20,000. With regard to their educational attainment, 9% had completed high school or received a GED and 80% had attended some college or technical school.

2.2. Measures

The *Structured Clinical Interview for DSM-IV Axis I Disorders* (SCID; First et al., 1996) was used to assess for the exclusion criteria (current mood episodes, substance dependence, and primary psychosis). The *Diagnostic Interview for DSM-IV Personality Disorders* (DIPD-IV; Zanarini et al., 1996) was used to assess for the presence of BPD. Both the SCID and DIPD-IV have demonstrated adequate interrater and test–retest reliability (First et al., 1996; Zanarini et al., 2000). Interviews were conducted by bachelors- or masters-level clinical assessors trained to reliability with one of the investigators (KLG or MTT). All interviews were reviewed by a PhD-level psychologist (KLG or MTT), with diagnoses confirmed in consensus meetings. Diagnostic agreement for the SCID was 100%. For the DIPD-IV, diagnostic discrepancies were found in fewer than 10% of cases. In these instances, areas of disagreement were discussed as a group and a consensus was reached.

The *Deliberate Self-Harm Inventory* (DSHI; Gratz, 2001) is a 17-item self-report questionnaire that assesses lifetime history of various aspects of DSH (defined as the deliberate, direct destruction of body tissue without suicidal intent), including frequency, duration, and type of DSH behavior (e.g., cutting, burning, carving, biting). Specifically, participants are asked whether and how often they have engaged in a variety of DSH behaviors "intentionally (i.e., on purpose)," as well as the last time they engaged in each of the behaviors. The DSHI has demonstrated high internal consistency, adequate test–retest reliability, and adequate construct, discriminant, and convergent validity among undergraduate student, community adult, and patient samples (Gratz, 2001; Fliege et al., 2009; Gratz et al., 2011).

The *Attention Network Task* (ANT; Fan et al., 2002) is a computerized laboratory-based task that assesses three distinct networks of attention (orienting, alerting, and executive attention). This task has the benefit of assessing all three attentional networks in a relatively brief (<30 min) procedure. At the beginning of each trial, a fixation cross was presented (for 400–1600 ms) in the center of the screen. Next, one of four cue conditions lasting 400 ms was presented (1) no cue (where the fixation cross remained on the screen), (2) central cue (where the fixation cross was replaced by a star), (3) double cue (where stars were presented above and below the fixation cross), or (4) spatial cue (where a star was presented either above or below the fixation cross, indicating where subsequent stimuli would be presented). Following the initial cue presentation, a response target was presented either above or below the initial fixation cross. Each response target was a series of five arrows presented in a single line, which remained until participants provided a response. Specifically, participants were instructed to indicate (by pressing a key on the keyboard) the direction in which the middle arrow (the target stimulus) was pointing. Each target stimulus was flanked on either side by arrows facing in the same direction (congruent condition) or facing in the opposite direction (incongruent condition). This resulted in a total of 16 trial conditions in which one of 4 initial cue conditions was followed by a congruent or incongruent response target either above or below the fixation cross (a visual depiction of the ANT is presented in Fan et al. (2002)).

Participants first completed a 32-trial practice block, in which response accuracy feedback was provided. Next, participants completed four 64-trial blocks. Reaction times (RT) and errors were calculated for all cue conditions. Scores for each attentional network were calculated according to guidelines described by Fan et al. (2002). Alerting attention was calculated by subtracting mean RT for no cue trials from mean RT of double cue trials. Orienting attention was calculated by subtracting mean RT of central cue trials from mean RT of spatial cue trials. Executive attention was calculated by subtracting mean RT during congruent trials from mean RT during incongruent trials (across all cue types), and adjusted by dividing by the overall RT (per Posner et al., 2002). Higher scores (i.e., larger discrepancy in RT between cue conditions) indicate worse functioning of the alerting, orienting, and executive attentional networks.

The *Borderline Evaluation of Severity over Time* (BEST; Pfohl and Blum, 1997) is a 15-item self-report measure of BPD symptom severity over the past month. Research indicates that the BEST has adequate test–retest reliability as well as good convergent and discriminant validity (Pfohl et al., 2009). Specifically, scores on the BEST have been found to correlate with other measures of BPD symptoms and to distinguish patients with BPD from control participants (Pfohl et al., 2009). Internal consistency in the present sample was adequate ($\alpha = 0.72$). This measure was included as a potential covariate to establish the unique association between neurocognitive functioning and DSH, particularly in light of previous findings

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