Exploring the Association of Deliberate Self-Harm With Emotional Relief Using a Novel Implicit Association Test

Kim L. Gratz,

University of Mississippi Medical Center

Alexander L. Chapman,

Simon Fraser University

Katherine L. Dixon-Gordon, and

University of Massachusetts

Matthew T. Tull

University of Mississippi Medical Center

Abstract

Despite the growing consensus that negative reinforcement in the form of emotional relief plays a key role in the maintenance of deliberate self-harm (DSH), most of the research in this area has relied exclusively on self-report measures of the perceived motives for and emotional consequences of DSH. Thus, the primary aim of this study was to extend extant research on the role of emotional relief in DSH by examining the strength of the association of DSH with emotional relief using a novel version of the Implicit Association Test (IAT). The strength of the DSH-relief association among both participants with (vs. without) DSH and self-harming participants with (vs. without) BPD, as well as its associations with relevant clinical constructs (including DSH characteristics, self-reported motives for DSH, BPD pathology, and emotion dysregulation and avoidance) were examined in a community sample of young adults (113 with recent recurrent DSH; 135 without DSH). As hypothesized, results revealed stronger associations between DSH and relief among participants with versus without DSH, as well as among DSH participants with versus without BPD. Moreover, the strength of the DSH-relief association was positively associated with DSH frequency and versatility (both lifetime and at 6-month follow-up), BPD pathology, emotion dysregulation, experiential avoidance, and self-reported emotion relief motives for DSH. Findings provide support for theories emphasizing the role of emotional relief in DSH (particularly among individuals with BPD), as well as the construct validity, predictive utility, and incremental validity (relative to self-reported emotion relief motives) of this IAT.

Correspondence concerning this article should be addressed to Kim L. Gratz, Department of Psychiatry and Human Behavior, University of Mississippi Medical Center, 2500 North State Street, Jackson, MS 39216. klgratz@aol.com.
Kim L. Gratz, Department of Psychiatry and Human Behavior, University of Mississippi Medical Center; Alexander L. Chapman, Department of Psychology, Simon Fraser University; Katherine L. Dixon-Gordon, Department of Psychological and Brain Sciences, University of Massachusetts; Matthew T. Tull, Department of Psychiatry and Human Behavior, University of Mississippi Medical Center.

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Keywords

nonsuicidal self-injury; emotion regulation; borderline personality disorder; cognitive task

Deliberate self-harm (DSH; also referred to as nonsuicidal self-injury), defined as the deliberate, direct, self-inflicted destruction of body tissue without suicidal intent and for purposes not socially sanctioned (Chapman, Gratz, & Brown, 2006; Gratz, 2001), is a clinically important behavior commonly associated with border-line personality disorder (BPD; Linehan, 1993). Although once studied primarily in the context of this disorder (Shearer, 1994; Soloff, Lis, Kelly, Cornelius, & Ulrich, 1994), growing research demonstrates that DSH is not unique to BPD (Andover, Pepper, Ryabchenko, Orrico, & Gibb, 2005; Gratz, Breetz, & Tull, 2010; Nock, Joiner, Gordon, Lloyd-Richardson, & Prinstein, 2006) and provides evidence for high rates of DSH in both nonclinical (e.g., Cerutti, Presaghi, Manca, & Gratz, 2012; Gratz, 2006; Gratz et al., 2010; Ross & Heath, 2002; Toprak, Cetin, Guven, Can, & Demircan, 2011) and non-BPD clinical (e.g., Gratz & Tull, 2012; Paul, Schroeter, Dahme, & Nutzinger, 2002) populations as well. Furthermore, DSH is associated with a variety of negative consequences and functional impairment (Klonsky, May, & Glenn, 2013; Klonsky & Olino, 2008; Turner, Chapman, & Layden, 2012), and has been implicated in the high levels of health care utilization among individuals with BPD (Zanarini, 2009).

Prominent theories of DSH emphasize the central role of negative reinforcement in the form of emotional relief in the maintenance of this behavior (see Chapman et al., 2006; Haines et al., 1995; Linehan, 1993). Providing support for these theories, a growing body of research highlights the emotion-relieving consequences of DSH (Gratz, 2003), demonstrating that: (a) one of the most commonly reported motives for DSH in both BPD and non-BPD populations is to obtain relief from aversive or unwanted emotions (Briere & Gil, 1998; Brown, Comtois, & Linehan, 2002; Kleindienst et al., 2008; Rodham, Hawton, & Evans, 2004); and (b) most people report feeling better after DSH (Chapman & Dixon-Gordon, 2007; Kemperman, Russ, & Shearin, 1997; Paul et al., 2002), with relief being the most commonly endorsed emotional consequence of this behavior (Briere & Gil, 1998; Kleindienst et al., 2008; Kumar, Pepe, & Steer, 2004). Furthermore, some evidence suggests that the emotion-relieving consequences of DSH may be particularly salient in BPD. For example, Chapman and Dixon-Gordon (2007) found that self-harming participants with versus without BPD were significantly more likely to report relief following DSH. Further, the specific emotional consequence of relief tends to be reported at higher rates among self-harming BPD versus non-BPD or general psychiatric samples (Briere & Gil, 1998; Coid, 1993; Jones, Congiu, Stevenson, Strauss, & Frei, 1979; Kleindienst et al., 2008; Kumar et al., 2004).

Notably, despite providing support for the importance of emotional relief to DSH, most of the research in this area has relied exclusively on self-report measures of the perceived motives for and emotional consequences of DSH. However, such measures are vulnerable to retrospective recall biases, motivations toward impression management, and limits in people's understanding of what maintains or motivates their behavior. Thus, research is

needed to examine the role of emotional relief in DSH in ways other than self-report. Procedures that capture associations between DSH and relief at an implicit level hold particular promise in this regard, providing an innovative way to assess learned emotional associations of DSH. Indeed, although explicit expectancies of relief may play a major role in the initiation of DSH, they may become less relevant to the maintenance of DSH over time. Specifically, as people who self-harm repeatedly experience emotional relief following engagement in this behavior, this behavior may come to be driven largely by cognitive processes focused on anticipated consequences that are automatic and activated with limited awareness (see Beck & Clark, 1997, for a description of this model as it applies to anxiety). This could be one explanation why self-harming individuals remain at risk for the maintenance or reinitiation of this behavior, even following treatment (Hawton et al., 1998). Consequently, implicit measures of the strength of learned associations hold promise in refining our understanding of factors maintaining DSH over time, particularly among those with an extensive history of DSH.

Thus, the primary aim of this study was to extend extant research on the role of emotional relief in DSH by examining the strength of the association of DSH with emotional relief using a novel version of the Implicit Association Test (IAT). We hypothesized that the DSH-relief association would be stronger among participants with recent recurrent DSH (compared with those without DSH), as well as among self-harming participants with BPD (compared with those without BPD). We also hypothesized that the strength of the DSH-relief association would be positively associated with lifetime and future DSH frequency and severity (as indexed by DSH versatility, i.e., the use of multiple methods of DSH; Dixon-Gordon, Tull, & Gratz, 2014; Turner, Layden, Butler, & Chapman, 2013), severity of BPD pathology, and emotion dysregulation and avoidance. As for relations among self-harming participants in particular, we hypothesized that the strength of the DSH-relief association on this IAT would be positively associated with DSH frequency and versatility (both lifetime history and prospectively over a 6-month period) and self-reported emotion relief motives for DSH, both for the DSH group as a whole and for the subset of self-harming participants with BPD in particular. Finally, we hypothesized that the strength of the DSH-relief association on the IAT would demonstrate incremental validity through unique associations with DSH frequency and versatility above and beyond self-reported, explicit emotion relief motives for DSH (among both self-harming participants in general and those with BPD in particular).

Method

Participants

Participants were part of a large multisite prospective study of emotion dysregulation and DSH among young adults in the community. Participants were recruited through advertisements posted online and throughout the community (including coffee shops, churches, stores, hospitals, colleges, and clinics) at two sites in Western Canada and the Southern United States. Inclusion criteria included (a) being 18–35 years of age (given the elevated risk for DSH within this age group; Welch, 2001); and (b) either reporting a history of recent (i.e., past-year), recurrent (i.e., ≥ 10 lifetime episodes) DSH (DSH group), or

reporting no history of DSH (non-DSH group). Exclusion criteria for both groups focused on the presence of psychopathology that could influence performance on the IAT (e.g., by interfering with comprehension, concentration, or reaction times [RTs]), including current (past 2 weeks) manic, hypomanic, or depressive mood episodes (but not lifetime history of mood disorders), current (past month) substance dependence, and/or primary psychosis.

The final sample of participants ($N = 248$; 77% female) included 113 with recent, recurrent DSH and 135 without DSH. Participants ranged in age from 18 to 35 years of age ($M = 23.62$, $SD = 4.74$) and were ethnically diverse (44% White; 23% Black/ African American/ Canadian; 18% Asian/Asian American/Canadian; 12% other racial/ethnic background). Most participants (89%) were single, and 47% reported an annual household income of less than \$30,000. With regard to their highest educational attainment, 17% had completed high school or received a GED, 52% had attended some college or technical school, and 26% had completed a college degree. Despite being a community sample, 50% of participants reported a history of psychiatric treatment.

Measures

Diagnostic interviews—The *Structured Clinical Interview for DSM–IV Axis I Disorders* (SCID; First, Spitzer, Gibbon, & Williams, 1996) was used to assess for the exclusion criteria (i.e., current mood episodes, substance dependence, and primary psychosis), as well as lifetime *DSM–IV* Axis I disorders. The *Diagnostic Interview for DSM–IV Personality Disorders* (DIPD–IV; Zanarini, Frankenburg, Sickel, & Yong, 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., 1996). Interviews were conducted by bachelors- or masters-level clinical assessors trained to reliability with study investigators (diagnostic agreement $> 88\%$) and cross-site reliability was good for the DIPD–BPD module ($\kappa = 0.64$; diagnostic agreement = 90%) and the SCID (all κ s > 0.64 , with a median of 0.84; diagnostic agreement = 87%), as a kappa coefficient of 0.61–0.80 is considered to represent “substantial” agreement in the good range (Landis & Koch, 1977; Zanarini et al., 2000).

Self-report measures—Characteristics of DSH were assessed with the *Deliberate Self-Harm Inventory* (DSHI; Gratz, 2001). This 17-item self-report questionnaire assesses various aspects of DSH (including frequency, duration, and type of DSH behavior) over specified time periods. 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 (Fliege et al., 2006; Gratz, 2001; Gratz, Tull, & Levy, 2014). Consistent with past research (Dixon-Gordon et al., 2014; Gratz, 2001; Gratz et al., 2010, 2014; Turner et al., 2013), continuous variables measuring DSH frequency over the specified time periods (e.g., lifetime, since the last assessment) were created by summing participants’ scores on the frequency questions for each item, continuous variables measuring DSH versatility over the specified time periods (e.g., lifetime, since the last assessment) were computed by summing the number of different types of DSH behaviors (e.g., cutting, burning, etc.; see Turner et al., 2013), and a dichotomous DSH variable assessing the presence versus absence of DSH during the follow-

up period was created by assigning a “1” to participants who reported having engaged in DSH, and a “0” to participants who denied any DSH during that period.

Motives for DSH were assessed with an English translation (Turner et al., 2012) of the *Questionnaire for Nonsuicidal Self-injury* (QNSSI; Kleindienst et al., 2008), supplemented with 13 items from the *Suicide Attempt Self-injury Interview* (SASII; Linehan, Comtois, Brown, Heard, & Wagner, 2006). Although there are other measures that broadly assess affect regulation functions of DSH (e.g., Klonsky & Glenn, 2009; Nock & Prinstein, 2004), the QNSSI (when supplemented with the SASII items as done here) is the only measure with a specific scale assessing emotion relief motives in particular. Specifically, past factor analytic work using these items has found that the 22 QNSSI and SASII items assessing motives for DSH yield five reliable subscales, including emotion relief, feeling generation, interpersonal communication, interpersonal influence, and self-punishment (Turner et al., 2012). Moreover, the QNSSI and SASII were developed specifically to assess DSH characteristics among recurrently self-harming individuals with BPD. Internal consistency was acceptable for all subscales (α s = 0.66–0.90).

BPD pathology was assessed using the *Personality Assessment Inventory-Borderline Features Scale* (PAI-BOR; Morey, 1991). This 24-item self-report questionnaire assesses four domains of BPD features (affective instability, identity problems, negative relationships, and self-harm) and yields both overall and subscale scores. The PAI-BOR is a widely used measure of BPD pathology (Trull, 2001) and has been found to demonstrate strong associations with SCID-II diagnoses of BPD (Jacobo, Blais, Baity, & Harley, 2007). Internal consistency in this sample was acceptable for the overall scale (α = .92) and all subscales (α s = 0.73–0.86).

Self-reported emotion dysregulation was assessed using the *Difficulties in Emotion Regulation Scale* (DERS; Gratz & Roemer, 2004), a 36-item self-report measure that assesses individuals' typical levels of emotion dysregulation across six domains: non-acceptance of negative emotions, difficulties engaging in goal-directed behaviors when distressed, difficulties controlling impulsive behaviors when distressed, limited access to emotion regulation strategies perceived as effective, lack of emotional awareness, and lack of emotional clarity. The DERS demonstrates good test–retest reliability and construct and predictive validity and is significantly associated with objective measures of emotion regulation (Gratz, Bornova, Delany-Brumsey, Nick, & Lejuez, 2007; Gratz & Roemer, 2004; Gratz, Rosenthal, Tull, Lejuez, & Gunderson, 2006; Gratz & Tull, 2010; Vasilev, Crowell, Beauchaine, Mead, & Gatzke-Kopp, 2009). Higher scores indicate greater emotion dysregulation. Internal consistency in the current sample was acceptable for the overall scale (α = .95) and sub-scales (α s = 0.64–0.93).

Experiential avoidance, or the tendency to avoid unwanted internal experiences (particularly emotions), was assessed with the 9-item *Acceptance and Action Questionnaire* (AAQ; Hayes et al., 2004). The AAQ has been found to demonstrate adequate convergent, discriminant, and concurrent validity (Hayes et al., 2004), and to be significantly associated with a behavioral measure of willingness to tolerate distress (Gratz et al., 2006). Higher

scores indicate greater experiential avoidance. Internal consistency in the current sample was acceptable ($\alpha = .73$).

Laboratory tasks—The *Implicit Association Test* (IAT; Greenwald, Mcghee, & Schwartz, 1998) was used to assess the strength of the association between DSH and emotional relief (relative to disgust). The IAT is a computerized categorization task in which RT is used as a measure of the strength of the association between stimuli (Greenwald et al., 1998; Nosek, Greenwald, & Banaji, 2007). The IAT requires respondents to sort stimulus items into target and attribute dimensions that share response options. The IAT developed for this study required participants to sort stimuli into the target categories of DSH and furniture and the attribute categories of relief and disgust. Faster responses on the IAT are expected when two highly associated target-attribute pairings (i.e., DSH and relief) share the same response key.

Furniture was chosen as a control stimulus for the target category because it is not emotionally evocative (i.e., neutral) and unlikely to be associated with disgust or relief. It is also a common control stimulus in implicit association tests (e.g., Kahler, Daughters, Leventhal, Gwaltney, & Palfai, 2007; Perugini, Zogmaister, Richetin, Prestwich, & Hurling, 2013). Disgust was chosen as the control stimulus for the attribute category for two reasons. First, the use of a neutral emotional state as the control attribute was not an option, as the absence of intense emotional arousal (as reflected in a neutral emotional state) may be considered comparable with the attribute of relief, resulting in overlap between the attribute dimensions and interfering with the ability to distinguish between the attribute categories. Second, disgust was considered relevant to both DSH and non-DSH individuals. Specifically, in addition to the fact that disgust is one of the most common negative emotional consequences of DSH among self-harming individuals (e.g., Briere & Gil, 1998; Laye-Gindhu & Schonert-Reichl, 2005; Nixon, Cloutier, & Aggarwal, 2002), literature suggests that individuals without a history of DSH tend to associate only negative emotions with DSH, particularly disgust (e.g., Favazza, 1989; White-Kress et al., 2004; Zila & Kiselica, 2001). The IAT has been found to demonstrate good internal consistency, adequate convergent, discriminant, and predictive validity (Greenwald & Nosek, 2001; Nosek et al., 2007), and satisfactory test–retest reliability (Nosek et al., 2007).

The IAT was presented using EPrime 2.0 software (Psychology Software Tools, Pittsburgh, PA) on a Dell OptiPlex 755 desktop computer. Picture stimuli were presented for the “DSH” and “furniture” target categories and consisted of six personalized DSH-relevant images (see Procedure section for details) and six furniture images (e.g., couch, table). Word stimuli were presented for the attribute categories of “I feel relief” (e.g., calm, relax) and “I feel disgust” (e.g., sick, gross). Stimuli were presented in the middle of the screen and remained until a response was provided. Category labels were presented continuously in the upper left and right-hand corner of the screen.

This IAT consisted of seven trial blocks: (a) a 24-trial attribute discrimination block where words are sorted into either the relief (presented on the left) or disgust (presented on the right) category; (b) a 24-trial target discrimination block (left = DSH, right = furniture); (c) a 24-trial “practice” congruent (for DSH participants) combination block (left = DSH and relief, right = furniture and disgust); (d) a 40-trial congruent combination test block

consistent with block C; (e) a 24-trial reverse attribute discrimination block (left = disgust, right = relief); (f) a 24-trial “practice” incongruent (for DSH participants) combination block (left = DSH and disgust, right = furniture and relief); and (g) a 40-trial incongruent combination test block consistent with Block F. Stimuli in each block were presented randomly, with Blocks C–D and F–G counterbalanced across participants. All blocks began with an instruction screen. Participants were instructed to sort each presented stimulus into the correct category as fast and as accurately as possible by pressing “d” for category labels presented at the upper left of the screen and “k” for category labels presented at the top right of the screen. Following an incorrect response, participants were presented with a red “X” and required to provide a correct response before continuing. The interstimulus interval between a correct response and the next stimulus presentation was 500 ms.

Data reduction and scoring procedures were performed as outlined by Greenwald, Nosek, and Banaji (2003). Trials greater than 10,000 ms and participants for whom more than 10% of trials were less than 300 ms were excluded from further analyses. This resulted in a total of 22 excluded trials (< 1%) and no excluded participants. After response latencies were averaged across blocks C, D, F, and G, a D score was calculated using the following formula:

$$\{[(\text{Mean}_{\text{Block 6}} - \text{Mean}_{\text{Block 3}}) / SD_{\text{Block 3 and 6}}] + [(\text{Mean}_{\text{Block 7}} - \text{Mean}_{\text{Block 4}}) / SD_{\text{Block 4 and 7}}]\} / 2$$

. Thus, higher D scores indicate a stronger association between DSH and relief (relative to disgust).

Procedure

All procedures received prior approval by the institutional review boards of the participating institutions. After providing written informed consent, participants completed the diagnostic interviews and measures of DSH. Next, participants completed a picture sorting task, designed to identify the specific DSH images to include in their personalized IAT. In this task, a series of 40 pictures (including 20 DSH-relevant images [e.g., a word carved into a person’s arm, cigarette burns on a person’s wrist] and 20 neutral images from the International Affective Pictures System [Lang et al., 1999]) were presented to participants sequentially. To prevent participants from developing new associations with DSH, participants were masked to the purpose of this procedure. Specifically, participants were asked to rank the extent to which each image represents the following constructs: (a) self-care, (b) DSH, (c) everyday items, (d) rare items, (e) isolation, and (f) community. The six images ranked as most representative of DSH (and least representative of the others) were used to create the participants’ personalized IAT. Participants were reimbursed \$30 for this session.

Eligible participants were then scheduled for the laboratory session. Participants were instructed to refrain from the use of alcohol and nonprescription drugs for at least 24 hr prior to the session. Abstinence from excluded substances was verified through the use of a breathalyzer and 12 panel urine drug test before the session. Participants who screened positive for any excluded substance were rescheduled ($n = 2$); those who screened negative were invited to begin the laboratory session. After completing a questionnaire packet, participants were seated in front of a computer screen and given instructions for completing

the laboratory portion of the study. Following completion of a 5-min, nondemanding, color-counting task designed to induce a neutral mood (the Vanilla Baseline; Jennings et al., 1992), participants completed the IAT. Participants were reimbursed \$30 for this session.

Finally, 6 months after the laboratory session, participants completed a follow-up assessment. Participant retention was high, with 209 participants (84% of the initial sample) completing this assessment. During this assessment, participants completed a series of self-report questionnaires, including the DSHI, online. Participants were reimbursed \$40 for this session.

Analysis Plan

Associations between IAT D scores and demographic variables were examined using correlation analyses and a one-way analysis of variance. Between-site differences in IAT D scores and demographic and DSH characteristics, as well as differences between DSH and non-DSH groups in demographic and clinical characteristics, were examined with a series of *t* tests and chi-square analyses. Differences in IAT D scores between the DSH and non-DSH groups, as well as between DSH participants with and without BPD, were examined using *t* tests. Associations between IAT D scores and relevant clinical constructs (including DSH characteristics, BPD pathology, and emotion dysregulation and avoidance) were examined using correlation analyses. Finally, a series of hierarchical multiple regression analyses was conducted to examine the unique associations of IAT D scores with DSH frequency and versatility above and beyond self-reported, explicit emotion relief motives for DSH.

Results

Preliminary Analyses

All continuous variables fell within the acceptable range of normality (Tabachnick & Fidell, 2001), with the exception of DSH frequency (skewness = 14.40). Following $\log_{10}$ transformations, all DSH frequency variables approximated a normal distribution (skewness = 2.97).

IAT D scores were normally distributed (skewness = 0.38, kurtosis = -0.04), and were not significantly associated with age, $r = -0.08$, $p > .05$; gender, $r = -0.11$, $p > .05$; or racial/ethnic background, $F(3, 237) = 0.52$, $p > .50$, $\eta_p^2 = .01$. IAT D scores also did not differ significantly across recruitment site, $t(246) = 0.29$, $p = .78$, $d = 0.04$.

Information on the demographic and clinical characteristics of the DSH and non-DSH groups is provided in Table 1. Results revealed no significant between group differences in age, education, income, or marital status. However, both women and White participants were overrepresented in the DSH group. Moreover, participants in the DSH group evidenced significantly higher rates of all psychiatric disorders, including BPD.

As for between-site differences, results revealed no significant between-site differences in gender, $\chi^2(1) = 0.09$, $p = .76$, $\phi = .02$. However, there were significant site differences in the racial/ethnic composition of the samples, $\chi^2(3) = 112.48$, $p < .001$, $\phi = .68$, with a greater proportion of participants at the Southern United States site identifying as Black/African

American and a greater proportion of participants at the Western Canadian site identifying as Asian/Asian Canadian. Furthermore, participants at the Southern United States site were significantly younger than those at the Western Canadian site, $t(246) = 2.01, p < .05, d = 0.26$. Finally, results revealed significant between-site differences in lifetime DSH frequency, $t(244) = 3.86, p < .001, d = 0.49$; and versatility, $t(244) = 3.11, p < .01, d = 0.44$, with participants at the Canadian site reporting greater lifetime DSH frequency and versatility (non-transformed *means* = 227.37 ± 586.05 and 3.05 ± 3.43 , respectively) than those at the U. S. site (nontransformed *means* = 101.64 ± 432.21 and 1.77 ± 3.19 , respectively). Notably, with one exception (see below), all findings remained the same when controlling for recruitment site in analyses.

Group Differences in IAT D Scores

Participants in the DSH group exhibited significantly higher D scores than those in the non-DSH group (*mean* D score = -0.19 ± 0.43 and -0.39 ± 0.32 , respectively, $t = 4.13, p < .001, d = .53$), indicating a stronger association between DSH and relief (relative to disgust) among participants with versus without DSH.¹ Likewise, within the DSH group, participants with BPD exhibited significantly higher D scores than those without BPD (*mean* D score = -0.06 ± 0.48 and -0.24 ± 0.40 , respectively, $t = 1.99, p < .05, d = .38$). These findings suggest stronger associations between DSH and relief (relative to disgust) among DSH participants with versus without BPD.

Associations of IAT D Scores With Relevant Clinical Constructs

As shown in Table 2, and consistent with hypotheses, IAT D scores were significantly positively correlated with lifetime DSH frequency and versatility, DSH frequency, versatility, and status at 6-month follow-up, BPD pathology (both overall and across the specific features of affective instability, identity disturbance, negative relationships, and self-harm), emotion dysregulation (both overall and across five of the six dimensions), and experiential avoidance among the full sample of participants. Furthermore, among all participants with recent recurrent DSH, IAT D scores evidenced significant positive correlations with lifetime DSH versatility, emotional relief motives for DSH, self-punishment motives for DSH, and the BPD feature of identity disturbance. Contrary to the findings for the sample as a whole, the associations between IAT D scores and DSH frequency (both lifetime and at 6-month follow-up) were not significant within the DSH group as a whole. However, among the subset of self-harming participants with BPD, IAT D scores were significantly positively associated with both lifetime DSH versatility and lifetime DSH frequency. Furthermore, although IAT D scores did not significantly predict DSH frequency or versatility at 6-month follow-up within this subsample, D scores did predict 5%–6% of the variance in these DSH characteristics (comparable with the predictive strength of this IAT within the full sample of participants). Finally, and providing support for the discriminant validity of this IAT, D scores were not significantly associated with

¹To examine if RTs on the IAT are influenced by between-group differences in reactions to the novel DSH images, we examined differences between DSH and non-DSH groups in reaction times during the target discrimination block of the IAT (i.e., the block in which DSH images are first presented). Results of these analyses revealed no significant between-group differences in reaction times during this block, $t(199) = .89, p = .38$, suggesting that any reactions of the non-DSH participants to the DSH stimuli did not influence their performance on this task.

interpersonal communication, interpersonal influence, or feeling generation motives for DSH among self-harming participants in general or those with BPD in particular (see Table 2). These findings remained the same when controlling for recruitment site, with one exception: The association between IAT D scores and overall BPD pathology within the DSH group as a whole became significant when controlling for recruitment site, $r = .19$, $p < .05$.

Unique Associations of IAT D Scores With DSH Characteristics Within the DSH Group

To examine the extent to which IAT D scores among participants with recent recurrent DSH relate to DSH frequency and versatility above and beyond self-reported emotion relief motives, hierarchical multiple regression analyses were conducted with self-reported emotion relief motives entered in the first step and IAT D scores entered in the second step. Results revealed a significant unique association between IAT D scores and lifetime DSH versatility, with the inclusion of IAT D scores in the second step significantly improving the model (see Table 3).² Furthermore, although self-reported emotion relief motives were significantly associated with DSH versatility in the first step of the model, these motives did not remain significant when IAT D scores were included in the second step of the model. Likewise, results of a reverse regression model with IAT D scores entered in the first step and self-reported emotion relief motives entered in the second step revealed a similar pattern, with IAT D scores evidencing a significant association with DSH versatility in both the first and second steps of the model and self-reported emotion relief motives not significantly improving the model when entered in the second step (see Table 3). As for the results of the regression analyses examining lifetime DSH frequency, neither self-reported emotion relief motives nor IAT D scores were significantly associated with lifetime DSH frequency in either step of the primary or reverse regression models within the DSH group as a whole (see Table 3). However, IAT D scores were significantly associated with DSH frequency (as well as DSH versatility) among the subset of self-harming participants with BPD, evidencing significant unique associations with both DSH outcomes above and beyond self-reported emotion relief motives (see Table 3).

Discussion

Results of this study expand upon past research examining the relevance of emotional relief motives to DSH, providing evidence that the association of DSH with relief (relative to disgust) is stronger among both individuals with a history of recent recurrent DSH (vs. those without a history of DSH) and self-harming individuals with BPD (vs. those without BPD). These findings provide further support for theories emphasizing the role of emotional relief in DSH and extend findings to DSH-relief associations that may occur with limited awareness. In particular, the results of this study suggest that the strength of the DSH-relief association may relate to greater DSH severity and play a role in the maintenance of this behavior among individuals with BPD.

²Findings remained the same when all self-reported DSH motives were included in the first step of the model, with the addition of IAT D scores in the second step significantly improving the model above and beyond self-reported DSH motives alone ($R^2 = .03$, $F = 4.98$, $p < .05$) and IAT D scores evidencing a significant unique relation to lifetime DSH versatility ($\beta = 0.20$, $t = 2.23$, $p < .05$).

Specifically, the strength of the association between DSH and relief (relative to disgust) on this IAT was significantly associated with several characteristics that have been linked to greater DSH severity, including the use of more DSH methods, higher levels of intrapersonal (e.g., emotion regulation) versus interpersonal motives for DSH, and greater BPD pathology (Klonsky & Glenn, 2009; Sansone, Gaither, & Songer, 2002; Turner et al., 2013; Tyrer et al., 2004). Indeed, within the DSH group as a whole, scores on this IAT were significantly associated with DSH versatility (albeit not with DSH frequency). Although the absence of a significant correlation between IAT D scores and DSH frequency among self-harming participants in general was unexpected, recent research highlights the unique clinical importance and greater relevance of DSH versatility versus frequency, suggesting that DSH versatility may be a better marker of both DSH severity and overall clinical severity than DSH frequency (Anestis et al., 2015; Dixon-Gordon et al., 2014; Turner et al., 2013). Thus, the pattern of associations within the DSH group as a whole suggests that among self-harming individuals in general, the strength of the DSH-relief association may relate to greater severity of DSH although not greater frequency of this behavior.

Notably, findings also highlight the particular relevance of the DSH-relief association to DSH among individuals with BPD. Specifically, findings revealed stronger associations between IAT D scores and DSH outcomes among self-harming participants with BPD, with the strength of the DSH-relief association evidencing significant moderate-to-large associations with both DSH frequency and versatility within this subsample. These findings, as well as the finding of a stronger DSH-relief association among self-harming participants with versus without BPD, are consistent with past research (Chapman & Dixon-Gordon, 2007; Kleindienst et al., 2008) and may help to explain findings of more severe, persistent, and treatment-resistant DSH within BPD versus non-BPD populations (Sansone et al., 2002; Tyrer et al., 2004). The results of this study suggest that one mechanism underlying the heightened severity and frequency of DSH within BPD may be the proneness of this population to developing particularly strong DSH-relief associations (Chapman & Dixon-Gordon, 2007; Kleindienst et al., 2008). It is possible that the heightened negative emotionality often observed among individuals with BPD (Rosenthal et al., 2008) could serve as an establishing operation, making DSH more reinforcing. Alternatively, it is possible that greater experience with DSH could lead to heightened DSH-relief associations. This possibility is consistent with Joiner's (2005) interpersonal-psychological theory of suicidal behavior, which posits that greater experience with self-harming behaviors strengthens the reinforcing properties of these behaviors while simultaneously weakening their aversive properties. Future research should examine the complex interrelations of BPD, DSH frequency, and DSH-relief associations in the development and maintenance of DSH over time.

Findings also provide preliminary support for the incremental validity and predictive utility of this IAT. With regard to its incremental validity, findings that the association of IAT D scores with DSH versatility remained significant when controlling for self-reported emotion relief motives suggest that the strength of the DSH-relief association on this IAT may confer unique clinical information about DSH severity that is not captured by self-report measures of DSH motives. Likewise, findings of a unique association between IAT D scores and DSH frequency among self-harming participants with BPD (together with findings that self-

reported emotion relief motives were not significantly associated with DSH frequency or versatility within this subsample) suggest that implicit measures of the strength of the DSH-relief association may be more useful in explaining the maintenance of DSH among those with BPD than explicit expectancies of relief following DSH. Indeed, across all of the regression analyses examining DSH frequency and versatility, IAT D scores accounted for greater variance in DSH characteristics than self-reported emotion relief motives.

As for the predictive utility of this IAT, IAT D scores during the laboratory session were significantly correlated with DSH frequency, versatility, and status (presence vs. absence) at the 6-month follow-up assessment within the full sample. Findings that the strength of the DSH-relief association on this IAT significantly predicted the presence, frequency, and versatility of DSH within the full sample but not the DSH group as a whole suggest that scores on this measure may be better at predicting risk for this behavior in general (and distinguishing individuals at risk for future DSH from those who are not) than in predicting the frequency and severity of this behavior among individuals with a DSH history. Nonetheless, findings that the magnitude of the prospective associations between IAT D scores and DSH frequency and versatility among the subset of self-harming participants with BPD was comparable with their magnitude within the full sample (accounting for more than 5% of the variance in these DSH characteristics 6 months later) suggest that scores on this measure may be better at predicting future DSH among self-harming individuals with BPD than those without this disorder.

Several limitations warrant consideration. First, a limitation of the bipolar IAT in general is that D scores may be driven by strong associations between nontarget stimuli (in this case, disgust and furniture). Although our neutral stimuli were chosen specifically to be nonemotionally evocative, the possibility that participants associated the neutral stimuli with the experience of disgust cannot be ruled out. Relatedly, given that our IAT assesses the relative strength of the association of DSH with relief versus disgust, it is possible that the group differences in IAT D scores observed in this study reflect the stronger associations of DSH with disgust among the non-DSH and DSH without BPD groups (rather than the stronger associations of DSH with relief among the DSH and DSH-BPD groups as proposed here). Although the use of a unipolar IAT in future studies could address these limitations, bipolar IATs have been found to have advantages over unipolar IATs in the examination of emotional associations of maladaptive behaviors, out-performing unipolar IATs in their associations with explicit measures and actual behavior (Houben, Nosek, & Wiers, 2010).

Likewise, the relative lack of familiarity of the non-DSH versus DSH group with DSH-related stimuli could have influenced performance on the IAT, increasing reactivity to the DSH images and, subsequently, RTs on the task. Notably, however, this concern is lessened by the use of personalized DSH images in this IAT (i.e., those ranked as most representative of DSH by that participant). Specifically, all participants were exposed to the DSH images included in the IAT prior to completing the task. Moreover, to the extent that the selected images were consistent with participants' own mental representations of DSH, the images would not be experienced as novel. Consistent with this suggestion, results revealed no significant differences between DSH and non-DSH groups in RTs during the target discrimination block of the IAT (i.e., the block in which DSH images are first presented).

Nonetheless, future studies using this IAT should assess physiological and subjective reactivity to the stimuli used in this task and their influence, if any, on task performance.

Additionally, although the IAT was developed to assess the strength of associations between stimuli, there is some debate in the literature as to the specific cognitive processes that contribute to IAT performance (Fiedler, Messner, & Bluemke, 2006). For example, some researchers have suggested that IAT D scores may capture differences in cognitive flexibility (i.e., the ability to develop a cognitive strategy to aid in the active sorting of stimuli into relief and DSH categories; Fiedler et al., 2006). As such, it is possible that the strength of the DSH-relief association on this IAT may reflect cognitive processes other than the learned associations of DSH with relief. Nonetheless, it is important to note that this interpretation of the findings (i.e., that the DSH group evidenced greater cognitive flexibility than the non-DSH group) is inconsistent with extant theoretical and empirical literature suggesting deficits in cognitive flexibility and related cognitive processes among self-harming individuals (Dixon-Gordon, Gratz, McDer-mott, & Tull, 2014; Fikke, Melinder, & Landrø 2011). Moreover, findings that D scores on our IAT were significantly associated with self-reported emotion relief motives for DSH (as well as other related constructs, such as emotion regulation difficulties) further lessen this concern.

Furthermore, although most participants in the DSH group had a psychiatric diagnosis, participants were not drawn specifically from a clinical setting. Thus, it is unclear to what extent results of this study are applicable to more severe clinical populations, especially inpatient populations. The extent to which findings are applicable to other relevant nonclinical populations is also unclear. For example, because our sample consisted of only individuals aged 18–35, the extent to which our findings generalize to younger adolescents is unclear. In addition, although we included a mixed-gender sample, the majority of participants were female, limiting the generalizability of the results to men. Future research examining the utility of this IAT and its relations to DSH and other clinical characteristics in relevant clinical (e.g., psychiatric inpatients) and nonclinical (e.g., community adolescents, young adult men) populations is needed.

In addition, although results provided support for significant associations between IAT D scores and the clinical constructs of interest, much of the variance in DSH frequency and versatility remained unexplained and the effect sizes of the observed relations between IAT D scores and DSH characteristics were modest (particularly for the subset of self-harming participants without BPD). Thus, research is needed to examine other factors that may contribute to the development and maintenance of DSH among individuals with and without BPD, including barriers to DSH, treatment status, exposure to stressful life events, and changes in life circumstances (e.g., Turner, Chapman, & Gratz, 2014). Likewise, although results suggest that the strength of the DSH-relief association may increase risk for later engagement in DSH (particularly among those with BPD), future research is needed to clarify the precise set of risk factors and their interrelations most predictive of more frequent and severe DSH among individuals with a history of this behavior.

Finally, the present study did not examine the impact of emotional arousal or distress on the strength of the DSH-relief association. Given evidence that emotional distress may increase

motivations to avoid emotions and use maladaptive emotion regulation strategies (Tice, Bratslavsky, & Baumeister, 2001), it is possible that the association between DSH and relief may become stronger under conditions of emotional distress. Indeed, research by Tice, Bratslavsky, and Baumeister (2001) suggests that individuals in a state of emotional distress are more likely to allocate internal resources toward the immediate elimination of that distress (regardless of the longer-term negative consequences of the behavior), thus increasing their risk for maladaptive emotion regulating behaviors in that context. Accordingly, when self-harming individuals are in a state of emotional distress, the positive emotional associations of DSH with relief would be expected to outweigh its negative emotional associations. Future research should examine the strength of the DSH-relief association in different emotional contexts, as well as the extent to which this association is context-dependent.

In sum, results of this study highlight the utility of incorporating implicit measures of the DSH-relief association into research on the maintenance and underlying mechanisms of DSH. The strength of the DSH-relief association as assessed with this novel IAT distinguished adults with recent, recurrent DSH from those without DSH, evidenced significant associations with several indices of DSH severity (in general and among self-harming participants in particular), distinguished between self-harming individuals with and without BPD, exhibited significant associations with DSH frequency and versatility among self-harming participants with BPD, predicted DSH prospectively, and demonstrated incremental validity above and beyond explicit measures of emotion relief motives for DSH. Findings suggest that the learned emotional associations of DSH may play an important, unique role in the maintenance of DSH among individuals with BPD and should be investigated further in future research. These findings also have potential clinical implications, highlighting the importance of assessing learned associations of DSH and relief that may operate with limited awareness. Especially among self-harming individuals with BPD, these learned associations seem to be more relevant to DSH frequency than explicit expectancies of relief following DSH. Given that not all factors that motivate or predict behaviors are within an individual's awareness, results highlight the potential utility of using this IAT to track change in the risk for DSH (both across time and in different contexts) in treatments for BPD. Given that this task takes less than 8 min to complete, it could be a useful tool for tracking treatment progress and risk for DSH among patients with BPD in particular.

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Table 1**Demographic and Clinical Characteristics of Participants by Group**

	<u>No DSH (<i>n</i> = 135)</u>	<u>DSH (<i>n</i> = 113)</u>	
	<i>M</i> (<i>SD</i>) or <i>n</i> (%)	<i>M</i> (<i>SD</i>) or <i>n</i> (%)	Test statistic (effect size)
Demographic characteristics			
Age	23.61 (4.69)	23.63 (4.82)	$t = 0.04$ ($d = .00$)
Gender: Female	97 (71.9%)	94 (83.2%)	$\chi^2 = 4.46^*$ ($\phi = .13$)
Race/ethnicity			$\chi^2 = 17.09^{**}$ ($\phi_v = .27$)
White	47 (34.8%)	62 (54.9%)	
Black/African American/Canadian	40 (29.6%)	17 (15.0%)	
Asian/Asian American/Canadian	32 (23.7%)	13 (11.5%)	
Other	14 (10.4%)	16 (14.2%)	
Marital status			$\chi^2 = .87$ ($\phi_v = .06$)
Single	123 (91.1%)	98 (86.7%)	
Married	7 (5.2%)	8 (7.1%)	
Separated/divorced	3 (2.2%)	4 (3.5%)	
Highest educational attainment			$\chi^2 = 7.78$ ($\phi_v = .18$)
Less than high school	5 (3.7%)	3 (2.7%)	
High school graduate	16 (11.9%)	25 (22.1%)	
Some college/technical school	69 (51.1%)	60 (53.1%)	
College graduate or beyond	43 (31.9%)	22 (19.5%)	
Income			$\chi^2 = 3.18$ ($\phi_v = .12$)
<\$20,000	40 (29.6%)	45 (39.8%)	
\$20,000–\$59,999	53 (39.3%)	35 (31.0%)	
\$60,000	29 (21.5%)	22 (19.5%)	
Clinical characteristics			
Lifetime DSH frequency ^a	—	390.32 (738.33)	
Lifetime DSH versatility		5.66 (2.88)	
Presence of DSH at 6-month follow-up ^{a,b}	0 (0%)	45 (39.8%)	
DSH frequency at 6-month follow-up ^b	0.00	33.14 (246.31)	
DSH versatility at 6-month follow-up ^b	0.00	1.03 (1.38)	
Lifetime mood disorder	27 (20.0%)	86 (76.1%)	$\chi^2 = 77.34^{***}$ ($\phi = .56$)
Bipolar disorder	2 (1.5%)	14 (12.4%)	$\chi^2 = 12.02^{**}$ ($\phi = .22$)
Major depressive disorder	24 (17.8%)	73 (64.6%)	$\chi^2 = 56.04^{***}$ ($\phi = .48$)
Lifetime anxiety disorder	23 (17.0%)	70 (61.9%)	$\chi^2 = 52.37^{***}$ ($\phi = .46$)
Panic disorder	6 (4.4%)	20 (17.7%)	$\chi^2 = 11.38^{**}$ ($\phi = .22$)
Social phobia	6 (4.4%)	27 (23.9%)	$\chi^2 = 19.97^{***}$ ($\phi = .28$)
Obsessive compulsive disorder	1 (0.7%)	17 (15.0%)	$\chi^2 = 18.55^{***}$ ($\phi = .27$)
Posttraumatic stress disorder	3 (2.2%)	19 (16.8%)	$\chi^2 = 16.05^{***}$ ($\phi = .26$)

	No DSH (<i>n</i> = 135)	DSH (<i>n</i> = 113)	
	<i>M</i> (<i>SD</i>) or <i>n</i> (%)	<i>M</i> (<i>SD</i>) or <i>n</i> (%)	Test statistic (effect size)
Generalized anxiety disorder	2 (1.5%)	18 (15.9%)	$\chi^2 = 17.17^{***}$ ($\phi = .26$)
Lifetime substance use disorder	16 (11.9%)	55 (48.7%)	$\chi^2 = 40.38^{***}$ ($\phi = .40$)
Alcohol abuse	12 (8.9%)	29 (25.7%)	$\chi^2 = 12.36^{***}$ ($\phi = .22$)
Alcohol dependence	5 (3.7%)	28 (24.8%)	$\chi^2 = 23.46^{***}$ ($\phi = .31$)
Drug abuse	7 (5.2%)	21 (18.6%)	$\chi^2 = 10.89^{**}$ ($\phi = .21$)
Drug dependence	5 (3.7%)	26 (23.0%)	$\chi^2 = 20.76^{***}$ ($\phi = .29$)
Borderline personality disorder	1 (0.7%)	32 (28.3%)	$\chi^2 = 40.55^{***}$ ($\phi = .40$)

Note. DSH = deliberate self-harm.

^aRaw frequency data are presented, but these data were log₁₀ transformed for analyses.

^b209 participants completed the 6-month follow-up.

*
 $p < .05$.

**
 $p < .01$.

 $p < .001$.

Table 2

Correlations Between IAT D Scores and Relevant Clinical Constructs Within the Full Sample (N = 248), the Overall DSH Group (n = 113), and the Subset of DSH Participants With BPD (n = 32)

	Correlations with IAT D Scores		
	Full sample	DSH group	DSH-BPD
Lifetime DSH frequency	.27 ***	.10	.41 *
Lifetime DSH versatility	.31 ***	.22 *	.39 *
DSH status (presence vs. absence) at 6-month follow-up ^a	.27 ***	.19 †	.19
DSH frequency at 6-month follow-up ^a	.19 **	.08	.25
DSH versatility at 6-month follow-up ^a	.25 ***	.18 †	.22
DSH motives			
Emotion relief	—	.29 **	.23
Feeling generation	—	.16 †	.04
Self-punishment	—	.21 *	.26
Interpersonal communication	—	-.07	-.01
Interpersonal influence	—	-.03	-.07
BPD pathology	.26 ***	.18 †	.22
Affective instability	.25 ***	.17 †	.06
Identity disturbance	.22 **	.21 *	.23
Interpersonal problems	.23 ***	.11	.05
Self-harm	.17 **	.06	.21
Emotion dysregulation	.22 **	.13	.02
Emotional nonacceptance	.19 **	.12	.06
Difficulties with goal-directed behavior	.14 *	.07	.02
Difficulties controlling impulsive behavior	.25 ***	.17 †	.20
Lack of access to effective ER strategies	.23 ***	.14	.12
Lack of emotional awareness	.06	-.01	-.15
Lack of emotional clarity	.13 *	.04	-.22
Experiential avoidance	.15 *	.06	-.01

Note. IAT = Implicit Association Test; DSH = deliberate self-harm; BPD = borderline personality disorder; DSH-BPD = self-harming participants with BPD.

^a209 participants completed the 6-month follow-up.

† $p < .10$.

* $p < .05$.

** $p < .01$.

*** $p < .001$.

Table 3

Regressions Examining IAT D Scores and Self-Reported Emotional Relief Motives as Predictors of DSH Within the Overall DSH Group (n = 113) and the DSH-BPD Group (n = 32)

	DSH frequency						DSH versatility					
	DSH group			DSH-BPD group			DSH group			DSH-BPD group		
	F	R ² (R ²)	f ²	β	t		F	R ² (R ²)	f ²	β	t	
Primary models												
Step 1	1.66	.02	.02		1.16	.04	7.05**	.06	.06		1.10	.04
Emotion relief motives				.12	1.29					.25	2.66**	.19
Step 2	1.47	(.01)	.03		3.13 [†]	(.14)*	6.11**	(.04)*	.11		3.59*	(.16)*
Emotion relief motives				.09	.90					.19	1.93 [†]	.09
IAT D score				.11	1.13					.21	2.22*	.42
Reverse models												
Step 1	2.14	.02	.02		6.04*	.17	8.27**	.07	.08		7.07*	.19
IAT D score				.14	1.46					.27	2.88**	.44
Step 2	1.47	(0.01)	.03		3.13 [†]	(.01)	6.11**	(.03)	.11		3.59*	(.01)
IAT D score				.11	1.13					.21	2.22*	.42
Emotion relief motives				.09	.90					.19	1.93 [†]	.09

Note. IAT = Implicit Association Test; DSH = deliberate self-harm.

[†] $p < .10$.

* $p < .05$.

** $p < .01$.

*** $p < .001$.