J. Behav. Ther. & Exp. Psychiat. 51 (2016) 1–9

Contents lists available at ScienceDirect

Journal of Behavior Therapy and Experimental Psychiatry

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

Individuals with current suicidal ideation demonstrate implicit "fearlessness of death"

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ARTICLE INFO

Article history:
Received 10 June 2015
Received in revised form
25 September 2015
Accepted 10 November 2015
Available online 17 November 2015

Keywords:
Suicide
Fearlessness of death
Implicit attitudes
Implicit Relational Assessment Procedure

ABSTRACT

Background and objectives: Suicidal behaviour has proved to be difficult to predict, due in part to the particular limitations of introspection within suicidality. In an effort to overcome this, recent research has demonstrated the utility of indirect measures of "implicit" attitudes within the study of suicidality. However, research to date has focused predominantly on implicit self-evaluations and self-death associations. No work has examined implicit evaluations of death, despite the theoretical importance of such evaluations; "fearlessness of death" is central to both the Interpersonal Theory of Suicide and the Integrated Motivational-Volitional model of suicide..

Methods: Twenty-three psychiatric patients with current suicidal ideation and twenty-five normative university students completed two versions of the Implicit Relational Assessment Procedure (IRAP) that targeted evaluations of death. One task specified personal death (i.e., was self-focused) and the other targeted death in the abstract.

Results: Self-focused evaluations of death reliably distinguished between the two groups, correctly classifying 74% of cases, but evaluations of death in the abstract did not. The suicidal group produced specific biases indicating a rejection of the negativity of death. Results are consistent with the definition of suicidality as involving a self-focused wish to die..

Limitations: For ethical reason, suicidal behaviours were not assessed in the normative group. Groups were therefore not mutually exclusive. This may have decreased the specificity of the IRAP.

Conclusions: Suicidal ideation is associated with an implicit "fearlessness of death". The utility of implicit death-evaluations should therefore be considered alongside self-evaluations and self-death associations in the future..

1. Introduction

Suicide is recognized to be a leading cause of death worldwide, with roughly one million individuals taking their own life each year (WHO, 2014). Furthermore, for each individual who dies by suicide, roughly twenty more make an attempt, hundreds are admitted to hospital for self-inflicted wounds, and thousands engage in self-harm without making contact with health services (McMahon et al., 2014). Despite the scale of the issue, our ability to predict suicidal behaviours is relatively poor (Glenn & Nock, 2014b; Klonsky & May, 2014; Rudd et al., 2006; Silverman & Berman, 2014). Recent reviews have suggested that this limited ability is due in part to the field's heavy reliance on self-reports (O'Connor & Nock, 2014; Randall, Colman, & Rowe, 2011). Due to the limits of introspection (Nisbett & Wilson, 1977), self reports of various format have been shown to be of particularly limited utility within suicidality. For example, individuals have been shown to be particularly poor forecasters of their future behaviour in the context of suicidality (Janis & Nock, 2008). Assessments by an observer have not fared much better; clinical judgment has repeatedly been shown to have low reliability and predictive validity (see Berman & Silverman, 2014). Finally, assessment using psychometrically sound self-report measures has also been shown to have limited predictive validity, especially within relatively short clinically meaningful time scales (Glenn & Nock, 2014b; Rudd et al., 2006; Silverman & Berman, 2014).

In light of this, several commentators have called for the investigation of "objective" behavioural measures (Glenn & Nock,

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http://dx.doi.org/10.1016/j.jbtep.2015.11.003
0005-7916/

2014a; Nock, 2012) and greater use of algorithmic decision making in the assessment and prediction of self-harmful behaviours (Claassen, Harvilchuck-Laurenson, & Fawcett, 2014). To this end, several variations of the Implicit Association Test (IAT: Greenwald, McGhee, & Schwartz, 1998) have been used to explore suicidal and self-harmful behaviours. The IAT is one of several computer-based measures of reaction time biases that are referred to as measures of implicit attitudes (see De Houwer, Teige-Mocigemba, Spruyt, & Moors, 2009; Nosek, Hawkins, & Frazier, 2011).

Research to date using the IAT to understand suicidal behaviours can be classified into two categories. First, research has examined the relationship between implicit evaluations of self (hereafter referred to as self-evaluation biases) and suicidal behaviours. Such research has demonstrated the concurrent predictive validity of the implicit self-evaluation biases (Creemers, Scholte, Engels, Prinstein, & Wiers, 2013; Franck, De Raedt, Dereu, & Van den Abbeele, 2007; although see Glashouwer et al., 2010), and their sensitivity to therapeutic change (Price et al., 2014; Price, Nock, Charney, & Mathew, 2009). Second, research elsewhere has examined the relationship between implicit associations between self and death (hereafter referred to as death-identity biases) and suicidal behaviours. Similarly, the concurrent predictive validity (Dickstein et al., 2015; Harrison, Stritzke, Fay, Ellison, & Hudaib, 2014) and sensitivity to therapeutic change has been explored (Ellis, Rufino, & Green, 2015). Critically, death-identity biases on the IAT have been shown to be prospectively predictive of future self-harm and suicide attempts (Nock et al., 2010; Randall, Rowe, Dong, Nock, & Colman, 2013). Furthermore, such biases were shown to outperform self-forecasts, clinical judgment, traditional self-reports (e.g., suicidal ideation, hopelessness and impulsivity), and known risk factors (e.g., history of previous attempts, diagnosis of depressive disorder). Specifically, both Nock et al. (2010) and Randall et al. (2013) showed that the IAT demonstrate good prospective predictive validity, with adequate sensitivity (.43–.50) and high specificity (.79–.81). Nock et al. (2010) further demonstrated that the IAT predicted additional variance ($R^2 = .38$) over and above traditional self-reported and clinical-assessed risk factors ($R^2 = .29$). Finally, Randall et al. (2013) demonstrated that a multivariate model combining the results of such traditional risk factors and the IAT could predict the presence or absence of future self-harm with either high (>95%) sensitivity or specificity in 59% of cases. Removal of the IAT from the model resulted in a significant decrease in its specificity. Such results are therefore encouraging, given that research in this area has typically struggled to obtain high specificity values, and suggests that implicit measures represent a potentially fruitful avenue of research for the prediction of self-harmful behaviours (Claassen et al., 2014; Glenn & Nock, 2014a; Nock, 2012).

It is worth noting at this point that while research to date has explored "self-evaluation" and "death-identity" biases, no research has examined the third possible combination of these categories: "death-evaluation" biases. This is somewhat surprising, given the central role that evaluations of death (and life) play in both of the leading contemporary theories of suicidal behaviour: the Interpersonal Theory of Suicide (IPT: Joiner, 2005; Van Orden et al., 2010) and the Integrated Motivational-Volitional model of suicide (IMV: O'Connor, 2011). Specifically, both theories posit that unbearable psychological pain associated with living provides a motivation for the development of suicidal ideation, although they postulate different mediators. Specifically, the IPT argues that the co-occurrence of feelings of "perceived burdensomeness" (i.e., that one is a burden on others) and "thwarted belongingness" (i.e., feeling that one is alienated from others), in addition to high levels of hopelessness regarding the potential for change of both these variables, results in suicidal ideation. In contrast, the IMV argues that the co-occurrence of experience feelings of "defeat and humiliation" (i.e., perceptions of low social rank) and "entrapment" (i.e., feeling unable to escape said defeat or humiliation), along with the threat these circumstances pose to the sense of self (assessed via variables such as social problem solving and coping skills), leads to suicidal ideation. The two theories converge in the assertion that the transition from ideation to actual attempts is moderated by the learned ability to make such attempts. Specifically, both theories argue that individuals demonstrate an innate avoidance of bodily harm, and that such avoidance behaviours must be undermined for an individual to make a potentially lethal suicide attempt. This repertoire of learned behaviours is typically referred to as the "acquired capacity for suicide", which includes a "fearlessness of death" (e.g., Van Orden et al., 2010). It should therefore be noted that, in the context of these theories of suicide, "fearlessness of death" refers to the broad set of cognitive and affective correlates of such avoidance behaviours, including evaluations of death.

Consistent with this assertion, research using self-report measures has consistently found differential evaluations of life and death across normative and suicidal individuals. For example, using the Multi-Attitude Suicide Tendency scale (e.g., Ferrara, Terrinoni, & Williams, 2012; Muehlenkamp & Gutierrez, 2004; Orbach et al., 1991; Osman et al., 2000); by examining the comfort some individuals derive from suicidal ideation (Crane et al., 2014); and by comparing the desirability of life versus death (Brown, Steer, Henriques, & Beck, 2005; Kovacs & Beck, 1977). The current study therefore seeks to fill this gap in the literature by examining the validity of implicit evaluations of death. This was done by comparing normative university students and psychiatric patients attending a treatment groups for self-harm who reported current suicidal ideation.

In contrast to previous research which predominantly employed the IAT, we elected to use the Implicit Relational Assessment Procedure in the current study (IRAP: Barnes-Holmes, Barnes-Holmes, Stewart, & Boles, 2010; see Nosek et al., 2011), on the basis that the IRAP can separate out four individual bias scores (e.g., life-positive, life-negative, death-positive, death-negative) whereas the IAT produces only one overall bias score (e.g., life-positive/death-negative). Specifically, we speculated that the IRAP's ability to separate out such biases might increase our ability to link theories of suicide to the data produced by the implicit measures, for example, by differentiating between an aversion to life and an attraction to death. Two recent meta analyses have examined the IRAP's psychometric properties (Golijani-Moghaddam, Hart, & Dawson, 2013) and demonstrated that it possesses good predictive validity in predicting a range of clinically relevant criterion effects (Vahey, Nicholson, & Barnes-Holmes, 2015).

It is worth noting that the IRAP was derived from Relational Frame Theory, a functional account of language and cognition (RFT: Hayes, Barnes-Holmes, & Roche, 2001; Hughes & Barnes-Holmes, in press; see also De Houwer, 2011). The core premise of RFT is that the fundamental components of cognition are relational rather than associative (Hughes, Barnes-Holmes, & De Houwer, 2011). In order to assess such relational responding, the IRAP was constructed in a way that assesses the relative strength of individual stimulus relations (or propositions) rather than patterns of stimulus pairings (or associations). Specifically, each trial on the IRAP presents a specific category pairing in isolation (e.g., a "death-negative" trial contains no stimuli related to either "life" or "positive"). In doing so, the IRAP produces four separate and "non-relative" bias scores (Hussey, Thompson, McEnteggart, Barnes-Holmes, & Barnes-Holmes, 2015; although see Hussey, Ní Mhaoileoin, et al., 2015). In the context of the current study, this allows for the separation of evaluations of life as positive, life as negative, death as positive and death as negative. We therefore

hoped to link the results of the current study more closely with existing theory on evaluations of death within suicidality, which have implicated both a "fearlessness of death" (Joiner, 2005; Van Orden et al., 2010) and a negative bias towards life and the world (Beck, Rush, Shaw, & Emery, 1979).

In the service of also linking the construction of such measures more closely with existing theory, it is important to recognize that suicide is characterized as involving a self-focused wish to die (i.e., to distinguish it from homicidal intent; Silverman, 2006; Silverman, Berman, Sanddal, O'Carroll, & Joiner, 2007). That is, the self plays an essential role in how death and the future are constructed for individuals contemplating suicide. In order to assess this theoretical supposition, we created two separate death-evaluation IRAPs and manipulated the role of self across them. The "personal IRAP" included a reference to self (e.g., "my death"), whereas the "abstract IRAP" did not (e.g., "death"). The tasks were otherwise identical, and as such any differential effects between them may be attributed to the presence or absence of a reference to the self.

We made two hypotheses, one specific and one exploratory. First, given that suicidality is characterized in part by a self-focused wish to die, we hypothesized that the self-focused measure of implicit evaluations of death (i.e., personal IRAP) would be a superior predictor of group membership than the measure of abstract implicit evaluations of death (i.e., abstract IRAP). Second, we hypothesized that the normative and suicidal groups would be separated by performance on one or more specific biases (e.g., performance on the IRAPs' life-positive, life-negative, death-positive, or death-negative trial-types). However, given the mixed results obtain by previous research using self-report measures, no specific predictions were made regarding which trial-type(s) would separate the groups (e.g., negative evaluations of life, or negative evaluations of death).

2. Method

2.1. Participants

2.1.1. Participants were recruited from two populations

The normative sample consisted of undergraduate students at Maynooth University, Ireland; and the suicidal ideation sample consisted of psychiatric patients attending St. Patrick's University Hospital, a large private psychiatric hospital in Dublin. Participants at the St. Patrick's site were recruited in an ad hoc manner from an evidence-based treatment group for self-harm based on the skill's training portion of Dialectic Behavior Therapy (see Booth, Keogh, Doyle, & Owens, 2014). Twenty-five university students and twenty-four service users at St. Patrick's were recruited (see Table 1 for demographic information). Participants reported that they had completed a maximum of one IRAP previous to the current study ($M = .15$, $SD = .36$). Written informed consent was obtained prior to participation and no remuneration was offered.

Inclusion criteria were fluent English, normal or corrected-to-normal vision, and full use of both hands. Participants in the suicidal ideation group were required to report current suicidal ideation (i.e., Beck Scale for Suicidal Ideation [BSSI] ≥ 2: see (Beck, Steer, & Ranieri, 1988; Brown, Beck, Steer, & Grisham, 2000). For ethical reasons, participants at the Maynooth University site were not screened for suicidal ideation. Instead, participants at this site were recruited if they scored in the normative range of a proxy measure of suicidality that has also been shown to be predictive of suicide risk: the Beck Hopelessness Scale (BHS: Beck, Weissman, Lester, & Trexler, 1974; Brown et al., 2000).

2.2. Measures

2.2.1. The Beck Hopelessness Scale

The BHS (Beck et al., 1974) is a 20-item Guttmann scale assessing the degree to which an individual is pessimistic about the future (e.g., "I might as well give up because there's nothing I can do to make things better for me."). The BHS has been shown to be prospective of suicide attempt and death by suicide (see McMillan, Gilbody, Beresford, & Neilly, 2007 for meta-analysis). Internal consistency was excellent in the current sample ($\alpha = .93$).

2.2.2. Depression Anxiety Stress Scale-21

The DASS depression subscale is a 7-item Likert scale assessing an individual's depressive symptoms over the past week. Each item is scored on a four-point Likert scale from 0 (did not apply to me at all) to 3 (applied to me very much, or most of the time), with higher scores indicative of greater levels of depression. It has demonstrated strong correlations with other well-established depression scales such as the Beck Depression Inventory II ($r = .74$: Lovibond & Lovibond, 1995). Internal consistency was excellent in the current sample ($\alpha = .92$).

2.2.3. Beck Scale for Suicidal Ideation

The BSSI is a 21-item Thurstone scale that assesses an individual's motivation and preparedness for a suicide attempt (Beck et al., 1988). Due to ethical constraints, this scale was used to assess the severity of past week suicidal ideation in the suicidal ideation group only. The BSSI has been shown to have high internal consistency and test-retest reliability in psychiatric samples, and to be predictive of subsequent suicide attempts (Beck, Brown, Steer, Dahlsgaard, & Grisham, 1999). The "current" (i.e., past week)

Table 1
Demographic and self-report data for the normative and suicidal ideation groups.

Variable	Normative group	Suicidal ideation group	Statistical test	Effect size
Gender	14 female, 11 male	13 female, 10 male	$\chi^2(1) = .75$	$\Phi = .13$
SITBI lifetime prevalence:				
Non-suicidal self-injury	–	52%	–	–
Suicidal ideation	–	100%	–	–
Suicidal planning	–	65%	–	–
Suicide attempt	–	57%	–	–
Mean:				
Age	18.7 (2.7)	38.6 (12.4)	$t(46) = -7.81^{***}$	$g_s = 2.22$
BHS	3.4 (2.0)	13.6 (4.5)	$t(46) = -10.10^{***}$	$g_s = 2.87$
DASS depression	4.1 (3.6)	13.6 (4.5)	$t(46) = -8.20^{***}$	$g_s = 2.33$
BSSI	–	16.0 (9.4)	–	–

Note: For means, standard deviations are given in parentheses. SITBI = Self-Injurious Thoughts and Behaviors Interview, BHS = Beck Hopelessness Scale; DASS depression = Depression Anxiety Stress Scales depression subscale; BSSI = Beck Scale for Suicidal Ideation; g_s = Hedges' g_s $^{***}p < .001$.

version of the scale was employed in the present study. Internal consistency was found to be good in the current sample ($\alpha = .88$).

2.2.4. Self-injurious thoughts and Behaviors interview

Although originally designed as a structured clinical interview (SITBI: Nock, Holmberg, Photos, & Michel, 2007) this measure has since been converted to a self-report format (Latimer, Meade, & Tennant, 2013), which was used here. Both formats have demonstrated good reliability and validity. The SITBI defines a variety of behaviours for the participant and asks the individual to report their presence, severity, recency, and frequency, including suicide attempt (i.e., "an actual attempt to kill yourself in which you had at least *some* intent to die"), non-suicidal self-injury (i.e., "purposely hurting yourself *without* wanting to die") and suicidal ideation (i.e., "*thoughts* about killing yourself"). The SITBI was used to establish the lifetime prevalence of thoughts about non-suicidal self-injury, non-suicidal self-injury, suicidal ideation, suicidal planning, and suicide attempts.

2.2.5. Death-evaluation IRAPs

The IRAP is a computer-based measure of reaction time biases that requires participants to respond to stimulus pairings under speed and accuracy pressure (for a detailed description of the generic task see Barnes-Holmes et al., 2010). Each participant completed two IRAPs that targeted evaluations of death. The "personal IRAP" presented one of the two label stimuli "my life" or "my death" on each trial along with either a positive (enjoyable, exciting, great,[1] lovely, pleasant, satisfying) or negative (negative stimuli: awful, distressing, hurtful, horrible, painful, upsetting) target stimulus. The "abstract IRAP" was identical but simply removed the word "my" from the label stimuli. The combination of a label and a target stimulus on each trial therefore formed one of four "trial-types" (i.e., life-positive, life-negative, death-positive, and death-negative). These stimuli were selected in order to target the positive reinforcement (e.g., enjoyable) and positive punishment (e.g., upsetting) associated with life and death. Finally, the two response options "True" and "False" were employed in both IRAPs.

2.3. Procedure

Participants completed the self-report measures first, followed by the two death-evaluation IRAPs. The order of presentation of the two IRAPs, and the rule order presentation of the blocks within them (i.e., "A" block first vs. "B" block first: see below), was fully counterbalanced between participants. All experiments were conducted one-to-one in an experimental cubicle with a trained researcher. Participants were instructed verbally throughout the task using a prewritten script that emphasized the importance of speed and accuracy in the task (Hussey, 2015).

Before each block on the IRAP, a pre block rule screen reminded the participant of the responding contingencies within the forthcoming block (i.e., "Please answer as if life is positive and death is negative" vs. "Please answer as if life is negative and death is positive"). Each block consisted of 24 trials. On each trial, participants were presented with either a life or death related stimulus, and either a positive or a negative stimulus. Participants are required to respond to stimuli in opposite directions across pairs of blocks. For example, in order to progress to the next trial, "A" blocks required pro life and anti death responses (e.g., responding to "death" and "negative" with "True"), whereas "B" blocks required anti life and pro death responses (i.e., responding to "death" and "negative" with "False"). Participants completed up to four pairs of practice blocks, until they met accuracy (≥80%) and latency (median latency ≤ 2000 ms) mastery criteria on both blocks within a pair. They then complete three pairs of test blocks, from which scores were calculated. After each block, participants were presented with their percentage accuracy as well as their median latency performance as well as the mastery criteria.

2.4. IRAP scoring

Following standard practice, the magnitude of response latency biases on the IRAPs' trial-type were first quantified using an adaption of the Greenwald, Nosek, and Banaji (2003) D_1 algorithm, which is itself a variant of Cohen's *d*. Second, participants who failed to maintain the accuracy and latency mastery criteria across both the practice and test blocks had their data excluded. One participant failed to meet the mastery criteria on one IRAP's practice blocks and was therefore were not presented with the critical test blocks. In eight cases, participants failed one test block-pair and therefore had that block-pair only excluded from their final *D* score. In four cases, participants failed more than one test block-pair and thus had their *D* scores for that IRAP excluded from the analyses. The final sample therefore contained 25 individuals in the normative group and 23 individuals in the suicidal ideation group who had data for at least one IRAP. Finally, *D* scores for the "death" trial-types were inverted (multiplied by −1) in both IRAPs so as to create a common vertical axis across all four trial-types. Positive *D* scores therefore represented "positive" or "*not*-negative" biases, whereas negative *D* scores represented "negative" or "*not*-positive" biases (see Hussey, Thompson, et al., 2015 for an article length discussion of how IRAP data is typically treated and interpreted).

3. Results

3.1. Self-reports measures

A series of analyses explored differences between the normative and suicidal ideation groups on the demographic and self-report measures. A Pearson's Chi-squared test revealed no significant differences in gender distribution between the normative and suicidal ideation groups ($p = .94$). Independent *t*-tests revealed that the suicidal ideation group reported significantly higher hopelessness and depression than the normative group, as expected based on the use of these measures as screening tools (all $ps < .001$). The suicidal ideation group also reported a higher average age ($p < .001$). All effects were very large (Hedges' $g_s \geq 2.22$).[2] As per the inclusion criteria, all participants in the suicidal ideation group reported experiencing suicidal ideation in the last week, as measured by the BSSI. Furthermore, 52% of the sample reported a lifetime history of non-suicidal self-injury on the SITBI, 65% reported a history of suicidal planning, and 57% reported one or more suicide attempts (see Table 1).

3.2. Group differences on the IRAPs

Mean *D* scores on both IRAPs are depicted in Fig. 1. These reflect the magnitude of the reaction time biases towards responding to the stimulus categories in a trial-type (e.g., "death" and "negative")

[1] Vernacular usage of the word "great" in Ireland is most frequently as a synonym of positively valenced words (e.g., "excellent") rather than denoting quantity or rank (cf. "substantial" and "prominent").

[2] Hedges' *g* is a variant of Cohen's *d* that corrects for smaller samples sizes. Its interpretation is identical to Cohen's *d* (see Lakens, 2013). Its interpretation is identical to Cohen's *d*. For the purposes of consistency, it is reported throughout the current article.

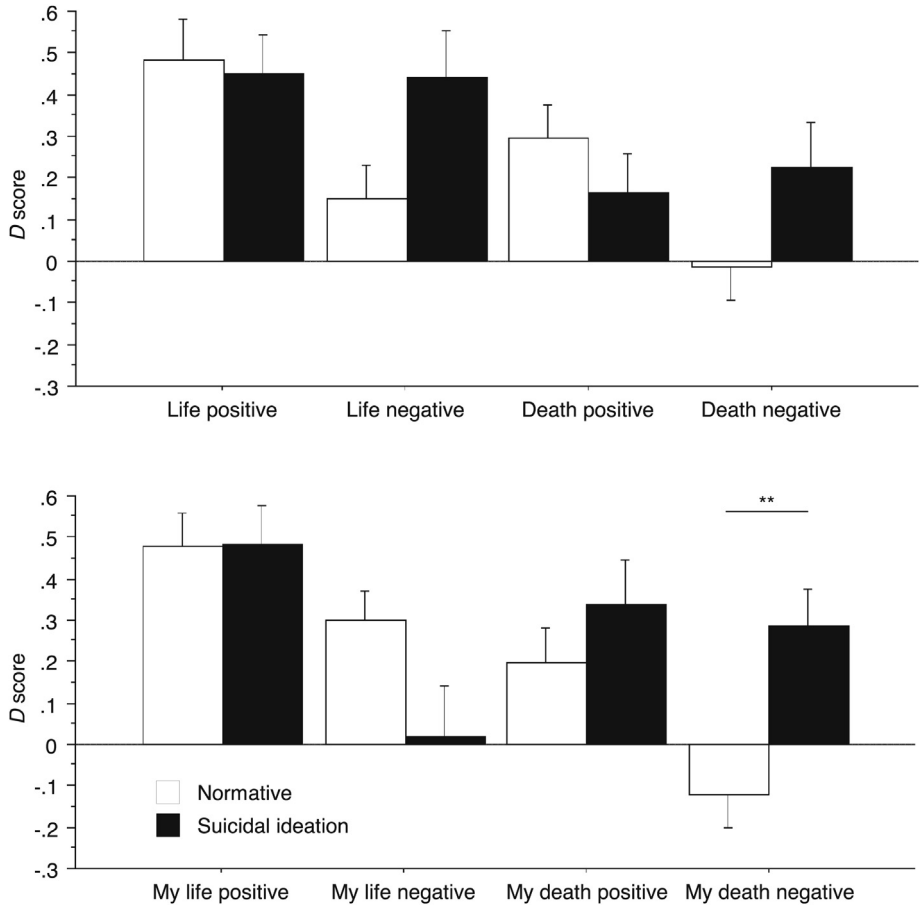

Fig. 1. Performance on the IRAPs between the normative and suicidal ideation groups. Upper panel: abstract death-evaluation IRAP. Lower panel: personal death-evaluation IRAP. Notes: Positive *D* scores represent "positive" or "*not*-negative" biases and negative *D* scores represent "negative" or "*not*-positive" biases. Error bars represent standard errors. $^{**}p < .01$.

with "True" and "False" across blocks. Both groups produced comparable "life-positive" and "death-positive" biases on the two IRAPs. The pattern of effect appeared to diverge on the negative trial-types, however. The normative group produced moderate "life-*not*-negative" biases on both IRAPs, whereas the suicidal ideation group produced strong "life-*not*-negative" biases on the abstract IRAP and no bias on the personal IRAP. Finally, the suicidal ideation group produced moderate "death-*not*-negative" biases on both IRAPs, whereas the normative group showed no such biases.

A 2 × 4 × 2 mixed within-between ANOVA was employed to assess the relationship between performances on the two IRAPs across the two groups, with IRAP (abstract vs. personal) and trial-type as within group variables, and group (normative vs. suicidal ideation) as a between groups variable. No main effects were found for either group ($p = .08$) or IRAP type ($p = .36$). In other words, performance did not differ significantly based on group membership or whether the content of the IRAP referred evaluations of personal death or abstract death. Critically, however, a three-way interaction effect was found between group, IRAP type, and trial-type, $F(3, 37) = 3.88$, $p = .01$. Post hoc estimations indicated that this finding was adequately powered (i.e., >.8). A series of Bonferroni-corrected post hoc comparisons demonstrated that this three-way interaction was driven by differential performance on a single trial-type: only *D* scores on the personal IRAP's "my death-negative" trial-type differed between the two groups. Specifically, the suicidal ideation group produced a moderate "my death-*not*-negative" bias ($M = .29$, $SD = .41$), whereas the normative group produced a weak "my death-negative" bias ($M = -.12$, $SD = .38$, $p < .01$). This differential performance was of a very large effect size (Hedges' $g_{av} = 1.02$).

The suicidal ideation group was therefore characterized by a specific rejection of negative emotions related to their own death, but not death in the abstract. In contrast, the normative group had no strong biases regarding the negativity of death, whether personal or in the abstract. It is worth noting that the presence or absence of a reference to the self (i.e., the word "my") therefore produced a significantly different pattern of effect across the two IRAPs and between the two groups.

3.3. Concurrent predictive validity of the IRAP

A series of analyses were then conducted to assess the degree to which individuals could be classified into their known groups (normative vs. suicidal ideation) based on the results of the abstract or personal IRAPs alone. A series of ROC curves demonstrated that only one IRAP trial-type was found to have a significant Area Under the Curve (AUC) value: the personal IRAP's "My death-negative" trial-type, AUC = .76, $p < .01$ (all other $ps \geq .13$; see Table 2). In effect, this trial-type correctly ranked 76% of cases by their known groups. It is worth noting, therefore, that the "death-negative" trial-type on the abstract IRAP did not significantly rank individuals (AUC = .64, $p = .13$). The IRAP's ability to correctly rank individuals by their known groups was therefore dependent on the presence of a reference to self (i.e., the word "My") in the stimulus set.

Table 2
The abstract and personal death-evaluation IRAPs as predictors of group membership (normative vs. suicidal ideation).

IRAP trial-type	AUC	95% CI
Abstract death IRAP		
Life positive	.46	(.28–.65)
Life negative	.62	(.44–.80)
Death positive	.40	(.22–.58)
Death negative	.64	(.47–.82)
Personal death IRAP		
My life positive	.49	(.30–.68)
My life negative	.36	(.19–.54)
My death positive	.60	(.42–.78)
My death negative	.76**	(.60–.91)

Note: AUC = Area under the curve, 95% CI = 95% Confidence interval.
**$p < .01$.

Whereas ROC curves allow us to assess the proportion of correctly ranked individuals, contingency tables and classification statistics based on a cut-off value allow us to make predictions about specific individual cases. For example, to estimate the probability that an individual who produced a given *D* score is a member of the suicidal ideation group rather than the normative group. A cut-off *D* score was therefore derived from the ROC curve for the "my death-negative" trial-type (on the grounds that only it yielded a significant AUC). The choice of an "optimum" cut-off value is necessarily subjective (Rutter & Miglioretti, 2003), therefore we elected to follow the approach employed by relevant previous research (Beck et al., 1999; Harriss & Hawton, 2005; Niméus, Alsén, & Träskman-Bendz, 2002). Specifically, the optimal cut-off value was considered to be the one that maximized the correct classification of both groups (i.e., maximized the sum of sensitivity and specificity, at the point of furthest displacement of the ROC curve). This was found to be at *D* score = .03. Interestingly, this value closely corresponds to the procedurally meaningful value at which participants responded to "my death-negative" with both response options (True and False) at equal speed (i.e., *D* score = 0). Previous research using the IAT to explore implicit death-identity effects has also elected to use cut-off score of *D* score = 0 (Nock et al., 2010). We therefore selected zero as a cut-off point.

Scores on the "my death-negative" trial-type were dichotomized using this cut-off. A Fisher's exact test demonstrated that the IRAP was a significant predictor of group membership (OR = 10.50 [95% CI 2.34 to 47.03], $p < .01$), correctly classifying 74% of individual cases as being a member of the suicidal ideation or normative group.[3] A *D* score > 0 on the "my death-negative" trial-type therefore increased the probability of being in the suicidal ideation group by approximately 10 times. This cut-off also yielded good sensitivity and adequate specificity (see Table 3). Specifically, the proportion of true positives to false negatives was high (.86), and the ratio of true negatives to false positives was moderate (.64). The positive likelihood ratio implies that 2.36 individuals were correctly identified as suicidal ideators for every normative individual who was misidentified as an ideator. The negative likelihood ratio implies that .22 ideators were misidentified as normative for every normative individual who was correctly identified as normative.

[3] It should be noted that when the exact cut-off value derived from the ROC curve (i.e., *D* score > .03) was employed in an identical analysis, concurrent predictive validity was slightly improved (OR = 12.86). However, this was at the expense of face validity and consistency with comparable previous research.

4. Discussion

The current study sought to determine whether implicit evaluations of death differed between normative university students and psychiatric patients reporting suicidal behaviours (e.g., current ideation, history of planning, and/or attempts). Furthermore, we manipulated whether such evaluations are self-focused or abstract in nature by comparing two implicit measures, one of which referred to life and death without a reference to self, and the other to "my life" and "my death". Results demonstrated that self-focused negative evaluations of death on the IRAP reliably distinguished between individuals with suicidal ideation and normative individuals, whereas evaluations of abstract death did not. Results are therefore consistent with definitions of suicidal behaviour as involving a self-focused wish to die (Silverman, 2006; Silverman et al., 2007). The simple inclusion of the word "my" thus produced key differences in the concurrent predictive validity of the IRAP, underscoring the need for theoretically well-informed stimulus selection strategies in the service of maximizing predictive validity (Nosek & Greenwald, 2009).

Additionally, suicidal ideation was associated with performance on a specific implicit bias: the personal death IRAP's "my death-negative" trial-type. Participants who rejected the negativity of their own death (i.e., produced positive *D* scores) were roughly 10 times more likely to be a member of the suicidal ideation group. This cut-off score was also shown to have good sensitivity and adequate specificity. In contrast, positive evaluations of death, and both positive and negative evaluations of life, showed no concurrent predictive validity. These classification rates are comparable to those found in previous research using IATs to assess other implicit associations, such as between self and death (Nock et al., 2010) or self and self-harm methods (e.g., cutting: (e.g., cutting: Nock & Banaji, 2007). Results therefore indicate that evaluations of death may also be useful in predicting suicidal behaviours among low and high-risk individuals. This adds to previous research on suicidal behaviours which has focused predominantly on evaluations of self (e.g., Franck et al., 2007; Glashouwer et al., 2010; Price et al., 2014) and associations between death and self (e.g., Dickstein et al., 2015; Ellis et al., 2015; Harrison et al., 2014; Nock et al., 2010; Randall et al., 2011).

Furthermore, the current results are consistent with the "acquired capacity for suicide" postulated by both leading theories of suicidal behaviour (i.e., IPT: Joiner, 2005; IMV: O'Connor, 2011). Such theories argue that individuals' innate fear of death is undermined or eroded by either direct or indirect experience of physically dangerous and life threatening behaviours (e.g., ideation, self-harm, suicide attempts). The suicidal ideation group's rejection of the negativity of death on the IRAP is therefore supportive of the concept of "fearlessness of death" within suicidality, as posited by both the IPT and IMV. It should be noted that, to the best of the authors' knowledge, this is the first time that "fearlessness of death" in suicidality has been observed using an "objective" behavioural measure (Glenn & Nock, 2014a) rather than self-reports (e.g., Ribeiro et al., 2014).

It is worth considering, if only briefly, the "death-positive" biases that were found in both the normative and clinical groups across both IRAPs given their somewhat counterintuitive nature. However, research elsewhere has noted a positivity bias on the IRAP, and suggested that this may be due in part to interaction between the valence of the target stimuli (i.e., positive vs. negative) and the valence of the response options (i.e., true vs. false, which are slightly positively and negatively valenced, respectively: see Hussey, Daly, & Barnes-Holmes, 2015). Similar valence asymmetries have also been found on other implicit measures, such as the Brief IAT (Nosek, Bar-Anan, Sriram, Axt, & Greenwald, 2014). While such asymmetries may affect the mean bias scores, they do not

Table 3
Classification table for the personal death-evaluation IRAP's "my death−negative" trial-type in predicting group membership (cut-off *D* score ≥ 0; *N* = 43).

D score	Group		Sensitivity	Specificity	+LR	-LR	Diagnostic odds ratio [95% CI]
	Suicidal ideation	Normative					
>0	18	8	.86	.64	2.36	.22	10.50
≤0	3	14					[2.34 to 47.03]**

Notes: Scores on the IRAP were dichotomized to indicate either "My death negative" (*D* score ≤ 0) or "My death *not*-negative" (*D* score > 0) effects. +LR = positive likelihood ratio, -LR = negative likelihood ratio, OR = odds ratio, CI = confidence interval.
** Fischer's exact test: $p < .001$.

appear to undermine the predictive validity of implicit measures, as can be seen in the current results. Nonetheless, such "death-positive" effects warrant further investigation.

A limitation of the current study's sampling method should be acknowledged at this point. For ethical reasons, suicidal ideation was not assessed in the student population, thus the groups were not necessarily mutually exclusive. As such, it is possible that some individuals in this sample may have met criteria for current suicidal ideation. Should this have been the case, it may have artificially inflated the false positive rate (and therefore suppressed the specificity and negative likelihood ratio) of responses on the IRAP. Future research might employ mutually exclusive groups in order to explore whether this influenced the results.

Given the low incidence rate of actual suicide attempts and the difficulty in differentiating ideators from those who go on to make an attempt, the most persuasive evidence for a given measure's utility must come from prospective studies (see Cohen, 1986; Glenn & Nock, 2014b; Klonsky & May, 2014). As such, future work might examine, either together or separately, the prospective predictive validity of (a) the IRAP, given its ability to determine which specific biases drive an effect (cf. "relative" measures such as the IAT: Greenwald et al., 1998), and; (b) the assessment of death-evaluations using implicit measures more generally. Such work might employ increasingly fine-grain comparison (e.g., suicidal ideators with vs. without attempts) and prospective designs (see Randall et al., 2013). Furthermore, the relative utility or interactions between measures of death-evaluations, death-identity, and self-evaluations could be assessed.

In closing, it is worth considering how future research might tie the design and results of such implicit measures more closely with theory in the service of improving predictive validity. Similar improvements have been achieved within domains such as depression (Remue, De Houwer, Barnes-Holmes, Vanderhasselt, & De Raedt, 2013), obsessive compulsive behaviours by (Nicholson & Barnes-Holmes, 2012), and body image (Heider, Spruyt, & De Houwer, 2015) through the use of measures of implicit propositional responding such as the IRAP. By employing semantically complex stimuli and appealing to responses on a single trial-type, the results of the current study rely on the "non-relative" nature of the IRAP's four trial-types. While the task's four trial-types are indeed procedurally separated (e.g., "life-positive" trials did not contain stimuli related to either "death" or "negative"), it is worth noting that research that we have conducted elsewhere has demonstrated that responding on one IRAP trial-type is influenced by the contents of the others (Hussey, Ní Mhaoileoin, et al., 2015). For example, that responses on the "my death-negative" trial-type may have differed if this had been contrast with a category other than "my life". Such research suggests the context set by the task as a whole must be borne in mind when interpreting results. Perhaps more importantly, however, such contextual influences within the task could be employed to increase the precision of such measures, as follows. Given that the current results demonstrated that the self-focused IRAP showed greater utility than the abstract IRAP, future research could attempt to build on this by manipulating the degree of emphasis placed on the self by comparing two highly similar IRAP stimulus sets. For example, both tasks could refer to both self and death, but differentially emphasise either the life/death distinction (e.g., "my *death*" vs. "my *life*") or the self/others distinction (e.g., "*my* death" vs. "*others*' deaths"). Both tasks would require participants to respond to "my death" as being positive or negative, but in self-emphasized versus death-emphasized contexts. Any differences between such IRAPs would provide a fine-grained understanding of such implicit biases and their contextual influences within suicidal behaviours. Of course, the preceding suggestion is somewhat speculative and requires empirical investigation. Nonetheless, we feel that it highlights the potential to make increasingly fine-grained and precise distinctions in future research.

On a related point, given that both the IPT and the IMV conceptualize the acquired capacity for suicide as a learned repertoire of behaviour, it is therefore worth considering whether effects on the measures are governed by participants' proximal or distal learning histories. Put simply, were the effects observed on the IRAP in the suicidal ideation group (or in previous research using the IAT) driven by participants' current psychological context (i.e., attending a treatment group for self-harmful behaviour) or their more distant past (e.g., suicide attempts that may have occurred years beforehand)? While the current design cannot speak to this issue, it is worth noting that this question has not yet received attention in the literature more generally. For example, it is equally unclear whether the IATs employed by Nock et al. (2010) or Randall et al. (2013) would retain their predictive validity if participants had been assessed outside the context of the immediate aftermath of a self-harm incident requiring hospitalization (see Hussey & Barnes-Holmes, 2015). Indeed, previous research has demonstrated that conceptually relevant effects on both the IAT and IRAP (e.g., within depression) are sensitive to current psychological context, such as mood state (Gemar, Segal, Sagrati, & Kennedy, 2001; Hussey & Barnes-Holmes, 2012). Future research might therefore seek to determine the role of participants' current psychological context (e.g., proximity to previous self-harm incidences, level of distress) in determining the predictive utility of implicit measures within suicidal behaviours. Indeed, this too may represent a useful avenue in which the results of such measures can be better linked with theories of suicide.

Conflicts of interest

The authors declare they have no conflict of interest.

Sources of funding

The first author was supported by a Government of Ireland postgraduate scholarship from the Irish Research Council.

Acknowledgements

The authors would like to sincerely thank the service users and staff at St Patrick's University Hospital for facilitating this research. In particular, the authors would like to thank those who

participated in the study, as well as Dr. Katie Baird, Ms. Jennifer Cuppage, Dr. Rosemary Keane, Ms. Georgina Mullen and Ms. Aisling Ryan. We would also like to thank our two anonymous reviewers for their particularly helpful comments on an earlier version of this article.

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