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Assessment of Self-Harm Risk Using Implicit Thoughts

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Assessing for the risk of self-harm in acute care is a difficult task, and more information on pertinent risk factors is needed to inform clinical practice. This study examined the relationship of 6 forms of implicit cognition about death, suicide, and self-harm with the occurrence of self-harm in the future. We then attempted to develop a model using these measures of implicit cognition along with other psychometric tests and clinical risk factors. We conducted a prospective cohort of 107 patients (age $>$ 17 years) with a baseline assessment that included 6 implicit association tests that assessed thoughts of death, suicide, and self-harm. Psychometric questionnaires were also completed by the patients, and these included the Beck Hopelessness Scale (Beck, Weissman, Lester, & Trexler, 1974), Barratt Impulsiveness Scale (Patton, Stanford, & Barratt, 1995), Brief Symptom Inventory (Derogatis & Melisaratos, 1983), CAGE questionnaire for alcoholism (Ewing, 1984), and the Drug Abuse Screening Test 10 (Skinner, 1982). Medical and demographic information was also obtained for patients as potential confounders or useful covariables. The outcome measure was the occurrence of self-harm within 3 months. Implicit associations with death versus life as a predictor added significantly (odds ratio = 5.1, 95% confidence interval [1.3, 20.3]) to a multivariable model. The model had 96.6% sensitivity and 53.9% specificity with a high cutoff, or 58.6% sensitivity and 96.2% specificity with a low cutoff. This scale shows promise for screening emergency department patients with mental health presentations who may be at risk for future self-harm or suicide.

Keywords: self-injurious behaviors, risk assessment, psychiatry, psychology, emergency medicine

The assessment of self-harming patients is a common occurrence in primary care (Gaynes et al., 2004) and the emergency department (ED; Doshi, Boudreaux, Wang, Pelletier, & Camargo, 2005). Research in the ED has both scientific (this is when or where patients are at acute risk) and practical (this is where decisions are made about level of care based on likelihood of future harm) merit. Development of assessment methods in this environment has important ramifications. It fills an unmet need of clinicians, particularly ED physicians with less training in psychiatry, for better ways to assess patients at risk for self-harm (Randall, Colman, & Rowe, 2011). Second, examining those who are at acute risk will help researchers better understand the proximal factors related to self-harm. There has been research on risk factors and their relationship with self-harm and suicide (Colman, Newman, Schopflocher, Bland, & Dyck, 2004; Doshi et al., 2005; Fliege, Lee, Grimm, & Klapp, 2009; Skogman, Alsen, & Ojehagen, 2004). This research has found that many factors increase the risk of these behaviors; however, there is a lack of evidence for methods and measures that are clinically useful for risk assessment of individual patients. Objective methods for the assessment of self-harm risk in the ED, in particular, are lacking (Randall et al., 2011). Research in this area has focused mainly on questionnaire assessment of potentially useful constructs, but these measures

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Conflicts of interest: None. Matthew K. Nock developed the IAT measures tested in this study.

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have been ineffective at determining individual risk (Cooper et al., 2006; Cooper, Kapur, & Mackway-Jones, 2007; Feinstein & Plutchik, 1990; Hockberger & Rothstein, 1988; McAuliffe, Corcoran, Hickey, & McLeavey, 2008; Randall, Rowe, & Colman, 2012). Recently, measures have been adapted that attempt to measure relevant constructs through patients' behavior and ability to perform tasks. These measures may prove useful in clinical settings.

Performance-based measures such as the Implicit Association Test (IAT) have been developed to allow researchers to gain insight into the nature of people's implicit thoughts (Greenwald, McGhee, & Schwartz, 1998). The IAT is a brief (approximately 5-min) computer-based task in which subjects are asked to categorize stimuli (both words and images) into one of two groups on the left or right side of a computer screen using two different keys on a standard keyboard. The IAT uses the fact that people classify related stimuli (e.g., *jockey* and *short*) more quickly than unrelated stimuli (e.g., *jockey* and *tall*) to obtain a measure of the extent to which they associate different constructs of interest. Faster and more accurate sorting of two constructs together using a particular computer key, compared with sorting those constructs using different keys, indicates a stronger implicit link in those constructs for the subject (Greenwald et al., 1998; Nock & Banaji, 2007a; 2007b).

Researchers have adapted the IAT methodology to measure the implicit associations that people hold about suicide, death, and self-injury (Nock & Banaji, 2007a, 2007b; Nock et al., 2010) and have shown that measures of these associations can predict future self-harm events (Nock & Banaji, 2007a, 2007b; Nock et al., 2010). We attempted to expand the knowledge surrounding these tools by testing additional versions of the IAT in addition to other psychometric tests and clinical risk factors that are relevant to self-harm risk.

Our first objective was to expand on previous results indicating that a death/life version of the IAT is predictive of future suicidal behavior (Nock et al., 2010) by expanding the outcome to include both suicidal and nonsuicidal behavior. Second, we tested newer versions of the IAT that have not been tested in this setting previously. These newer IATs measure cognitions that are more directly related to suicide and self-harm, and therefore, it is thought that their association with future self-harm would be stronger than the death/life IAT.

We also used a broader clinical sample by including all those at risk for self-harm in the follow-up (the previous study focused only on those with a previous history of suicidal behavior) in order to test the usefulness of this assessment method more generally. Additionally, we hoped to determine the specificity of the relationship between implicit cognitions and future incidences of self-harm. This would be done by determining whether the death/life IAT was unique in its ability to predict future self-harm or whether other forms of cognitions related to self-harm would be similarly predictive of these behaviors. Furthermore, in this study, we extended research in this area by developing a prediction algorithm for self-harm and evaluated the psychometric properties of this algorithm as a measure of prospective self-harm risk. It is hoped that this algorithm will advance the development of a comprehensive and objective assessment for self-harm in the ED that could be used on a broader spectrum of patients at risk for these behaviors.

Method

Sample

Patient enrollment occurred within the EDs of the Royal Alexandra and University of Alberta Hospitals in Edmonton, Alberta, Canada. Study enrollment began in late August 2009 and was completed in May 2010. These sites are the two largest teaching hospital EDs in the Edmonton region. Both sites are staffed by full-time emergency physicians and emergency and other interns and residents, and function as intake centers for patients with mental health emergencies. They both function with full-time day ED psychiatric staff and inpatient mental health services.

Patients were enrolled as they were being assessed in the ED. They were enrolled based on the presence of recent self-harm or endorsement of suicidal ideation, and eligibility for the study was determined by the attending physician. Patients were only eligible for enrollment in the study once. Enrollment was limited to the adult population (age $\geq$18 years). In order to maximize our follow-up rates, participants were excluded if they were not permanent residents of Alberta. We excluded patients who were violent (i.e., those presenting a significant risk to research staff) or did not have the capacity to provide informed consent (as determined by the treating physician). Those who were unable to understand and communicate in English also were excluded.

Assessments

Patients who agreed to participate in this study were administered a questionnaire that asked about demographic (e.g., age, gender, education level, living situation) and medical (e.g., history of psychiatric disorders and self-harm) information while in the ED. Information on patient medical history was obtained by asking participants if they had been diagnosed with a psychiatric disorder or had self-harmed in the past (but not as part of the current presentation). If the patients endorsed having been diagnosed with a mental illness, they were asked to specify which disorder(s) they were diagnosed with, and these responses were categorized into the following groups: mood (not including bipolar), anxiety, bipolar, psychotic, posttraumatic stress, and personality disorders. A chart review using a standardized form was performed to examine all of the records for the visit after the patients' discharge. This chart review was used to determine if self-harm occurred as part of the presentation and the method used by the patients.

The patients then completed the IATs. The IATs require subjects to sort stimuli into groups by hitting one of two possible response keys on the computer. Each subject was required to classify words or images appearing in the middle of the computer screen as belonging on either the left or right side of the screen based on sorting instructions provided in each task. All of the IATs had the patient sort words into *me* (e.g., *I*, *mine*) and *not me* (e.g., *they*, *theirs*) categories. In addition, the patient also had to simultaneously sort other stimuli that varied slightly depending on the specific IAT being completed. For instance, the subject might have to sort death words (i.e., *die, dead*, *deceased*) and life words (i.e., *alive*, *survive*, *live*) at the same time as he or she sorts the words categorized as *me* or *not me*. Each IAT would be completed twice; for the previous example, the subject would perform the task once with the *death* and *me* words sorted using the same key and then

again with the *death* and *not me* words sorted together on one key. It was expected that those carrying implicit thoughts of death or self-harm would respond more quickly when words associated with *death* and *me* were paired on the same computer key. Patient reaction times were measured for each trial and if the patients performed faster when the self-harm-related stimuli were aligned with the *me* stimuli, then they were considered to have scored positively on that particular version of the IAT (for demonstration tests, see www.implicitmentalhealth.com).

We tested six versions of the IAT. First, we tested the Death/Life = Me IAT that had been shown to predict suicide attempts in an earlier ED-based study (Nock et al., 2010). Second, we tested the Cutting/No Cutting = Me IAT shown to predict suicidal ideation in an earlier lab-based study (Nock & Banaji, 2007b). Third, we tested a more suicide-specific Suicide/Life = Me IAT, with the assumption that using more suicide-specific stimuli (e.g., hanging, cutting, overdose) would yield better prediction. Fourth, we tested three versions of the single-category IAT (Cha, Najmi, Park, Finn, & Nock, 2010), a variant of the standard IAT that requires people to pair words representing only one concept with *me* versus *not me* words (e.g., pairing only *death* stimuli with *me* or *not me* rather than pairing both *death* and *life* words), with the assumption that this simpler sorting task would yield stronger prediction. Two of these tests had the *death* (e.g., *deceased*, *die*, *dead*) and *suicide* (e.g., *hanging*, *cutting*, *overdose*) words from the two-category IATs described earlier, and the third had suicide-related images (e.g., two pictures of visibly despondent people, one picture of someone cutting her wrist, and two pictures of deceased persons, one next to an open bottle of pills and one with cut wrists). These new versions of the IAT were developed and pilot tested in a lab-based study of nonsuicidal participants who showed no iatrogenic effects of presenting participants with suicide-related words and images (Cha & Nock, 2009). The order of the tests was semirandom; the two death IATs were always the last two tests administered; however, the other four tasks were performed in a random order. The order of the task within each IAT version was randomly varied (i.e., the suicide stimuli would start being paired with *me* for some patients and *not me* for others).

Participants also completed several other questionnaires including the Beck Hopelessness Scale (BHS; Beck, Weissman, Lester, & Trexler, 1974), Brief Symptom Inventory (BSI; Derogatis & Melisaratos, 1983), Barratt Impulsiveness Scale (BIS; Patton, Stanford, & Barratt, 1995), CAGE screen for alcohol abuse (Ewing, 1984), and Drug Abuse Screening Test 10 (DAST; Skinner, 1982) while in the ED. These questionnaires were chosen because they attempt to measure a variety of factors that are thought to relate to self-harming behavior (hopelessness, psychological distress, impulsiveness, and substance abuse) and could potentially be predictors or confounders in multivariable modeling. In addition, the SAD PERSONS assessment (Patterson, Dohn, Bird, & Patterson, 1983) and Manchester Self-Harm Rule (Cooper et al., 2007) risk assessment were derived by the research staff during the index visit.

Outcome

Three months after enrollment, patients were contacted via telephone by the first author and asked whether they had engaged in self-harm (suicidal and/or nonsuicidal) since their visit to the hospital. If a patient endorsed engaging in purposeful behavior that led to self-injury, then he or she was coded (for this study) as engaging in self-harm. Several electronic health record databases were also checked by the first author to determine whether enrolled patients had utilized any health services due to an incident of self-harm. Both outcome assessment methods were used for all patients. If either of the methods indicated the occurrence of any form of self-harm, then the patient was coded as engaging in self-harm. In the event of an electronic record that was ambiguous (e.g., overdose presentation where it was uncertain whether it was intentional or unintentional), then it was not counted as an incident of self-harm. Kappa statistics was calculated for the two outcome assessment methods. Agreement between the two methods was 89.2% ($\kappa = 0.55$). Outcomes were assessed by the same person, and this assessment was performed prior to analysis of the IAT results to prevent bias and improve the consistency of the outcome determination.

Analysis

Statistics are reported and were compared using chi-square statistics and odds ratios (OR) with 95% confidence intervals (CIs). The IAT data were analyzed using the standard IAT scoring algorithm (Greenwald, Nosek, & Banaji, 2003). Scoring of the IATs was reduced to a dichotomous variable using a cutoff of 0 (i.e., scores higher than 0 were considered positive) with a positive score indicating an association with self-harm (i.e., that the subject responded faster when the self-harm stimuli were paired on the same key with the *me* stimuli than he or she did when the same stimuli were paired on the same key as *not me*). The analyses were also performed with continuous results of the IAT assessments. Results were similar for continuous and binary variables. To simplify presentation of the results, we focused on the dichotomous analysis in this article.

We analyzed variables individually using logistic/logit regression for their relationship with future self-harm events. Purposeful selection modeling was performed on identified risk factors and the significant IAT scores in order to derive a model (Bursac, Gauss, Williams, & Hosmer, 2008). Model building was employed because the researchers were interested in not only whether the IAT task was a significant predictor after controlling for other variable but also in determining which other variables needed to be controlled.

A p value of less than 0.1 and previous research indicating clinical relevance was needed before a variable would be included in the initial model. Variables assessed during the initial purposefully selected model were age, gender, presentation with self-harm (i.e., a self-harm event precipitated this ED visit), lifetime history of self-harm (excluding self-harm associated with current visit), education level, marital status, history of mood disorder, personality disorder, psychotic disorder and comorbid psychotic disorder, and depressive symptoms (as measured by the Depression Scale of the BSI and the patient's self-report history of mental illness). The variable with the highest p value was removed if the p value increased to more than 0.1, and the removed variable was tested to determine if it had a confounding effect on the remaining variables. The threshold for a confounding effect was set at a 15% change in the beta coefficients of the logit regression. Additional factors that were assessed for confounding in addition to the

previous variables were hospital site and whether the patient was admitted or discharged.

Results of the questionnaires, including significant subscales of the BIS and BSI, and other potentially relevant clinical variables were added individually to the initial model to test if they would add significantly to the model. The univariable analysis of the questionnaire results that determined which of the scores would be tested in the hierarchical regression has been described in Randall, Rowe, and Colman (2012).

Receiver operating characteristic (ROC) analysis was performed on the IAT results. A two-cutoff scoring method was adapted for the final model created during the regression analysis. Cutoffs were chosen by examining the ROC curve and identifying points that had high sensitivity or specificity (~95% or higher) and strong positive (+) likelihood ratio (LR) or negative (−) LR. All analyses were completed with Stata Intercool Version 11 (StataCorp, 2009).

Ethics

This study received approval from the Health Research Ethics Board of the University of Alberta. Written informed consent was obtained from each participant.

Results

Sample

During the enrollment phase, 270 potentially eligible patients were approached to participate in the study, and of these, 181 (67%) agreed to participate. A total of 147 patients completed at least a portion of the IAT task, and 127 patients completed the entire IAT task. Overall, 107 of the patients' outcomes were successfully determined 3 months after their index visit and were included in the final regression model.

The characteristics of the 107 patients with complete information were not significantly different from those not enrolled in the study with respect to history of self-harm, presentation to the ED with self-harm, and rate of admission (Table 1). The rate of psychiatric consultation by the emergency physician (patients at these sites are assessed by mental health staff at the discretion of the attending emergency physician) was significantly higher in the final sample group ($p < .01$) compared with the refusal group. In addition, the rate of enrollment and task completion at the University of Alberta site was significantly ($p < .001$) lower than the rate at the Royal Alexandra Hospital. Patients over the age of 45 were less likely to complete the full computer task ($p < .05$). There were no other significant differences in gender, occurrence of self-harm at presentation, admission rate, lifetime history of self-harm, ethnicity, living arrangements, and marital status between the final sample and those who refused or had incomplete information.

The study sample consisted of 56 (52.3%) men and one patient was identified as transgendered (0.9%). Forty-five (42.1%) of the patients presented with a self-harm event at baseline (57.1% presented with ideation but no current self-harm behavior); overdose ingestion/poisoning occurred in 28.0% of the total sample. Half (48.6%) of the patients were admitted to the hospital during their index visit; 75.7% of the sampled patients had a history of prior self-harm (i.e., excluding any self-harm that precipitated the current ED visit). Twenty-nine (27.1% of the follow-up group) patients had an incident of self-harm (including both suicidal and nonsuicidal injuries) in the 3-month follow up period.

Table 1
Demographics and Medical Characteristics of Study Sample and Refusal Group

	Complete data		Incomplete data		Refused	
Category	*N*	%	*N*	%	*N*	%
Gender						
Male	56	52.3	37	49.3	49	55.1
Female	50	46.7	36	50.7	40	44.9
Transgendered	1	0.9	0	0.0	—	—
Site						
University of Alberta	43	40.2	54	74.0***	57	64.0**
Royal Alexandra	64	59.8	19	26.0***	32	36.0**
Age (in years)						
18–29	42	39.3	23	31.5*	35	39.3
30–44	43	40.2	21	28.8*	30	33.7
45+	22	20.6	29	39.7*	24	27.0
Method of self-harm[a]						
Overdose/poisoning	30	28.0	25	34.2	27	30.3
Hanging/suffocation	3	2.8	2	2.7	1	1.1
Laceration/puncture	14	13.1	6	8.2	8	9.0
All other	2	1.9	4	5.5	3	3.4
Any self-harm	45	42.1	37	50.7	37	43.8
Psychiatry consulted	101	94.4	68	93.2	71	79.8**
Admission decision						
Admitted	52	48.6	37	50.7	35	39.3
Discharged	55	51.4	36	49.3	54	60.7
Education						
No diploma	29	27.1	19	26.0		
High school diploma	20	18.7	23	31.5		
Some college courses	15	14.0	9	12.3		
Postsecondary	43	40.2	22	30.1		
History of self-harm						
Yes	81	75.7	23	68.1		
No	26	24.3	49	31.9		
Ethnicity						
White	95	88.8	61	84.7		
First Nations/Métis	6	5.6	6	8.3		
Other	6	5.6	5	6.9		
Lives with/in:						
Family	28	26.2	18	25.0		
Significant other	35	32.7	14	19.4		
Friends	11	10.3	6	8.3		
Alone	26	24.3	23	31.9		
Institution	0	0.0	4	5.6		
No fixed address	7	6.5	7	9.7		
Marital status						
Single/never married	52	48.6	32	44.4		
Married/common-law	37	34.6	19	26.4		
Divorced/widowed	18	16.8	21	29.2		

[a] Some patients presented with multiple methods of self-harm.
* $p < .05$. ** $p < .01$. *** $p < .001$.

Bivariate Logistic Regression Analysis Predicting Self-Harm During the Follow-Up Period

The only variable derived from the IATs that significantly predicted self-harm during the follow-up period was the Death/Life IAT (OR = 2.8; 95% CI [1.15, 6.96]). The single-category

Death IAT approached significance (OR = 2.3; 95% CI [0.96, 5.30]). The remaining four IAT tasks were not significant predictors of self-harm, with odds ratios ranging from 1.1 to 1.3 and wide confidence intervals.

Multivariable Model Building

A total of 107 patients had sufficient information to be included in the final model. The multivariable model for prediction of self-harm during the 3-month follow-up period included prior history of self-harm (0 events, 1–4 events, 5+ events), education level (high school diploma or higher vs. no diploma), history of psychotic disorder with comorbid depressive symptoms (indicated by a high score on the BSI Depression subscale) during current presentation, presentation with a nonoverdose self-harm event, and the Death/Life IAT. Adding the results from the questionnaires, including the significant subscales of the BSI and BIS, resulted in none of the questionnaire variables achieving a p value of less than 0.1 (full statistics displayed in Table 2). In this model, patients who scored high on the Death/Life IAT had a fivefold increase in the odds of self-harm in the follow-up period (full model information in Table 3). The adjusted risk ratio for the Death/Life IAT after controlling for the other variables in the model was 1.8 (95% CI [1.1, 3.0]).

We performed multiple imputation to check for biased results in the model due to incomplete patient information. The five-variable model was tested again, and all of the variables remained below the removal cutoff. The logit coefficient for the psychosis/comorbid depression variable decreased to be more in line with the other variables in the model; possibly indicating the coefficient in the regression model may be overestimated. There was, however, no indication that patient attrition significantly biased the regression model or caused a type I error.

ROC Analysis

The Death/Life IAT alone produced a sensitivity of 43.3% (95% CI [25.5%, 62.6%]) and a specificity of 78.8% (95% CI [68.2%, 87.1%]; +LR = 2.04, −LR = 0.72) with a cutoff score of 0 on the IAT. The multivariable model (using the regression coefficients as the weight for each variable) had a sensitivity and specificity of 96.6% (95% CI [82.2%, 99.9%]) and 53.8% (95% CI: [42.2%, 65.2%]; +LR = 2.09, −LR = 0.06) with a low cutoff (≥ 0.34) and 58.6% (95% CI [38.9%, 76.5%]) and 96.2% (95% CI [89.2%, 99.2%]; +LR = 15.2, −LR = 0.43) with a high cutoff (≥ 3.48). The multivariable model assigned 58.9% of the sample into either a high-risk or low-risk category with a high degree of diagnostic certainty. Of the 20 classified as high risk (scoring above the high cutoff), 17 (85%) engaged in self-harm while only one out of the 43 (2.3%) in the low-risk category (scoring below the low cutoff) had an incident of self-harm. The 44 patients who fell between the high and low cutoffs (moderate risk) included 11 (25%) with a self-harm event during follow-up. Possessing a high score on the Death/Life IAT immediately precludes a patient from falling into the low-risk category. Removal of the Death/Life IAT from the model resulted in the following sensitivities and specificities: 94.7% sensitivity and 27.6% specificity (low cutoff), and 44.7% sensitivity and 95.2% specificity (high cutoff). Loss of the Death/Life IAT in the model resulted in a significant decrease in the specificity of the low cutoff and a nonsignificant decrease in the sensitivity of the high cutoff.

Table 2
*Regression Model Building Predicting Self-Harm During a 3-Month Follow-Up Period (*n = *107)*

Step and model/variable	χ^2 (*df*)	*p*	Odds ratio
Step 1. Initial model[a]			
History of self-harm			
0 previous events	13.14 (2)	.001	—
1–4 attempts			2.9
5+ attempts			33.7
Education (diploma or higher)	4.07 (1)	.044	0.3
Nonoverdose self-harm presentation	10.02 (1)	.002	11.4
Comorbid psychotic disorder/ depressive symptoms	5.56 (1)	.018	44.5
Death/Life Implicit Association Test	5.37 (1)	.021	5.1
Step 2. Hierarchical regression (questionnaires)[b]			
Beck Hopelessness Scale[c]	0.44 (1)	.505	0.8
Global Severity Index[c]	0.48 (1)	.490	0.8
Anxiety subscale[c]	0.01 (1)	.932	1.0
Hostility subscale[c]	0.09 (1)	.760	0.9
Obsessive–compulsive subscale[c]	0.20 (1)	.658	0.9
Somatization subscale[c]	0.04 (1)	.840	1.1
Barrett Impulsiveness Scale[c]	0.25 (1)	.616	1.2
Attention subscale[c]	1.37 (1)	.241	1.6
Attentional Impulsiveness subscale[c]	1.62 (1)	.203	1.6
Cognitive Instability subscale[c]	1.02 (1)	.313	1.4
Motor subscale[c]	0.05 (1)	.825	1.1
Motor Impulsiveness subscale[c]	0.07 (1)	.787	1.1
CAGE screen for alcohol abuse	1.17 (1)	.680	1.1
Drug Abuse Screening Test 10 (score > 8)	1.15 (1)	.284	1.3
SAD PERSONS score			
0–2	1.03 (3)	.795	—
3–4			0.6
5–6			0.5
7–8			0.3
Step 3. Hierarchical regression (other clinical)[b]			
Canadian Triage Acuity Scale[d]	0.01 (1)	.914	1.1

[a] Initial model derived by purposeful selection analysis of risk factors for self-harm and Death/Life Implicit Association Test. [b] Variables tested individually for significance in initial model. [c] These questionnaires were used as continuous measures standardized so that the odds ratio equals the increase of odds for every increase in score equal to one standard deviation. [d] Dichotomized; 3–5 recoded to 0 and 1 & 2 recoded to 1.

Discussion

In this study of 107 patients at risk for self-harm, several factors were identified as significant predictors of self-harm during a 3-month follow-up period; one of these was the patient's score on a component of the IAT. The Death/Life = Me IAT significantly predicted posthospital episodes of self-harm; however, the other IATs that we tested did not. This extends previous work that

Table 3
*Final Regression Model Predicting Self-Harm During a 3-Month Follow-Up Period (*n = *107)*

Final model	Beta coefficient	Odds ratio	95% Confidence interval
History of self-harm (0, 1–4 events, 5 + events)			
1–4 events	1.05	2.9	[0.3, 27.4]
5 + events	3.52	33.7	[3.0, 380]
Education (high school diploma or higher)	−1.29	0.3	[0.1, 1.0]
Comorbid psychotic disorder/depressive symptoms	3.97	44.5	[1.9, 1042]
Nonoverdose self-harm presentation	2.43	11.4	[2.5, 51.3]
Death/Life Implicit Association Test	1.63	5.1	[1.3, 20.3]

identified the Death/Life IAT as a significant predictor of self-harm in this setting (Nock et al., 2010) by demonstrating that it is still predictive when used for outcomes that include suicidal and nonsuicidal self-harm. This result also indicates that there is something unique about this cognitive association compared with the other types of associations tested. Model building and ROC analysis demonstrated that this assessment tool has potential as part of a model for estimating patient risk, given the high sensitivity and specificity compared with other predictive models (Cooper et al., 2007; Feinstein & Plutchik, 1990; Nock et al., 2010; Randall et al., 2012). A simple regression model containing only five variables—all with previous research supporting their association with increased risk of self-harm (Cooper et al., 2007; Hawton, 2010; Nock et al., 2010; Taylor, Page, Morrell, Carter, & Harrison, 2004; Upthegrove et al., 2010), including the Death/Life IAT—was effective at predicting self-harm in the 3 months following assessment.

Prediction of Self-Harm

The Death/Life IAT alone was significantly associated with future self-harm; however, the IAT was not a particularly effective risk assessment by itself. When combined with other predictive variables, the strength of association increased, as did other variables included in the multivariable model. The sample was not large enough for us to reliably examine this change for its significance; therefore these increases may be random variation. It is possible that measuring implicit death/suicide-related cognition is both a significant predictor of future self-harm events and measures something distinct from what is captured from questionnaires and clinical examination. Therefore, this assessment method appears to measure a relevant risk factor not strongly correlated with previously determined risk factors and thus could be very useful in establishing clinical risk assessment models for self-harm. Another benefit to using this method of assessment is that it is more difficult for patients to manipulate the results (Steffens, 2004) in an attempt to conceal their true level of suicidal intent.

The significance of the Death/Life IAT and nonsignificance of the more suicide-specific IATs could indicate that general thoughts of death are more relevant than suicidal ideation for predicting the occurrence of future self-harm. The other versions of the IAT may measure constructs or use stimuli that are too specific to be endorsed by many of those assessed. Specifically, these measures use method-specific stimuli that will not apply to all patients. For instance, people who do not cut themselves will not associate themselves with the cutting stimuli. In addition, the fact that the IAT measuring associations with both death and life were predictive of future self-harm but the IAT measuring death only (but not life) was not predictive suggests that it may be important to measure implicit (and perhaps explicit) associations about life when conducting suicide risk assessments.

Strengths and Limitations

The prospective design used in this study increases the strength of the results obtained as these measures were employed in a manner very similar to how they would be employed in actual clinical use in this setting. This study is limited in that its sample was composed of only patients from two hospitals located within one metropolitan area and represents a convenience sample of patients presenting to hospital with current suicide ideation or self-harm. Although those who refused to participate were similar to those who participated in terms of clinical characteristics, only a limited comparison was possible due to local research ethics restrictions.

Type I errors during model selection is possible due to the small sample size used in this study. We reduced this risk by focusing on risk factors that are both significant in this study and also have previous research support suggesting that they would be useful contributors to the prediction of self-harm risk.

It also is possible that the loss of patients during the follow up period could have affected the results of the study; however, a high follow-up rate (85.6%) reduced this possibility. Multiple imputation was also performed in an attempt to determine whether subject attrition biased the results and did not detect evidence of a significant bias in the model. Additionally, our measurement of self-harm during this period did not distinguish between suicidal and nonsuicidal self-injury. Prior studies have suggested that risk factors, including those measuring implicit cognition (Nock et al., 2010), may differ between suicidal and nonsuicidal self-harm outcomes, and it will be important to continue to test the specificity of risk factors for these different forms of self-harm in future studies. However, it is often difficult to determine when behavior should be considered nonsuicidal or suicidal in nature, especially when relying on the patients' responses or secondhand information obtained from health records, which could potentially suffer from improper classification of intent. Recent research has supported the view that these outcomes are closely related and that nonsuicidal self-injury may be on a causal pathway to suicide attempts for some patients (Brent, 2011; Wilkinson, Kelvin, Roberts, Dubicka,

& Goodyear, 2011). Since the risk for both of these outcomes is important, and often is measured simultaneously, a combined outcome measure may be practical and appropriate in this setting. Finally, this study is limited by the lack of reliability analysis for the measures discussed. Previous research has suggested that IAT measures have satisfactory reliability (Nosek, Greenwald, & Banaji, 2007). We acknowledge the limited data available on the psychometric properties of the IAT and recognize uncertainty exists regarding the reliability of this specific version in this setting.

Conclusion

The results of this study suggest that Death/Life IAT has potential diagnostic/prognostic properties in the ED setting. This IAT remained significant in adjusted analyses the included other clinically important variables. Continued research using the Death/Life IAT as an assessment tool has potential for improving the ability of health care personnel to assess self-harm risk in patients presenting to the ED. A five-variable model has been presented that merits further research to determine its assessment potential. Additionally, this study has shown that not all of the suicide-related IATs are effective at predictive future behavior. It is possible that newer variations of the IAT will prove more effective than the Death/Life IAT and research on new variations should be pursued as well.

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