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Measuring the Suicidal Mind: Implicit Cognition Predicts Suicidal Behavior

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Abstract

Suicide is difficult to predict and prevent because people who consider killing themselves often are unwilling or unable to report their intentions. Advances in the measurement of implicit cognition provide an opportunity to test whether automatic associations of self with death can provide a behavioral marker for suicide risk. We measured implicit associations about death/suicide in 157 people seeking treatment at a psychiatric emergency department. Results confirmed that people who have attempted suicide hold a significantly stronger implicit association between death/suicide and self than do psychiatrically distressed individuals who have not attempted suicide. Moreover, the implicit association of death/suicide with self was associated with an approximately 6-fold increase in the odds of making a suicide attempt in the next 6 months, exceeding the predictive validity of known risk factors (e.g., depression, suicide-attempt history) and both patients' and clinicians' predictions. These results provide the first evidence of a behavioral marker for suicidal behavior and suggest that measures of implicit cognition may be useful for detecting and predicting sensitive clinical behaviors that are unlikely to be reported.

Keywords

suicide, suicide attempt, prediction, IAT

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Suicide is a leading cause of death worldwide and is among the most perplexing of all human behaviors in that it fundamentally challenges the belief that all organisms are motivated by a drive for self-preservation. Although scholars and scientists have attempted to understand and measure the “suicidal mind” for centuries (Shneidman, 1998, 2004), a major barrier has been the near-universal reliance on self-report. This approach is limited by the fact that people often do not know their own minds (Nisbett & Wilson, 1977; Wilson, 2009) and is especially problematic in measuring suicidal thoughts because people often are motivated to deny or conceal such thoughts to avoid intervention or hospitalization. For instance, one recent study found that 78% of patients who die by suicide explicitly deny suicidal thoughts in their last verbal communications before killing themselves (Busch, Fawcett, & Jacobs, 2003). Another demonstrated that the risk of suicide is significantly elevated immediately after people are released from hospital care (Qin & Nordentoft, 2005), presumably following their verbal report that they are no longer considering killing themselves.

In an attempt to improve the understanding and prevention of suicide, scientists have searched for objective markers for

suicide risk (i.e., measurable characteristics that indicate the presence of an underlying disease process or elevated risk of this negative outcome). Most such work has examined potential biological markers (Mann et al., 2006). However, this approach has been limited in that the factors identified are not specific to suicidal behavior (Caspi et al., 2003) and because many of these results have failed to replicate (Risch et al., 2009). The complementary approach of identifying *behavioral* markers holds great promise given the possible specificity and the ease of use of behavioral tests. To date, however, the identification of behavioral markers for psychopathology and suicide has received surprisingly little empirical attention.

We tested whether individuals who have made a decision to kill themselves would reveal stronger implicit cognition associating self with death/suicide and whether the strength of such an association would predict actual suicide attempts. We developed and evaluated a version of the Implicit Association

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Test (IAT; Greenwald, McGhee, & Schwartz, 1998) that measures the association of death/suicide with self. Variations of this task have been used in previous research (Nock & Banaji, 2007a, 2007b); however, earlier studies were limited to predicting only past episodes of self-injurious or suicidal behavior and future suicide ideation in a laboratory setting. The current study was designed to provide a significant advance over prior research by examining the usefulness of a test of this putative behavioral marker administered to adults presenting to a psychiatric emergency department—some of whom had just made a suicide attempt. Given the alarmingly high risk of future suicide attempts among this population (Qin & Nordentoft, 2005), we also followed participants over the next 6 months to test whether an implicit association of death/suicide with self also predicted future suicide attempts. Finally, we tested whether this measure added incrementally to prediction above and beyond the use of known risk factors—the strongest possible test of any new marker. Evidence for such prediction would extend research on self-destructive behaviors, would add to recent evidence that the IAT can aid in the prediction of socially sensitive behaviors (Greenwald, Poehlman, Uhlmann, & Banaji, 2009), and would illustrate the usefulness of psychological science in the improvement of clinical prediction and decision making (Swets, Dawes, & Monahan, 2000).

Method

Participants

Participants were 157 adults presenting to the psychiatric emergency department of a large metropolitan hospital, drawn from a larger sample of 198 patients, 41 of whom were excluded from the analyses because (a) they were discharged from the emergency department before completing study measures (e.g., transported via ambulance to another hospital; $n = 28$); (b) they showed evidence of cognitive impairment (e.g., severe psychotic symptoms or somnolence from medication effects; $n = 12$); or (c) a computer malfunction occurred ($n = 1$). Those included did not differ from those excluded in age, sex, ethnicity, or psychiatric diagnoses ($ps = .24-.91$). Participants' characteristics are presented in Table 1. This sample size provided adequate statistical power to detect the medium-to-large effect sizes expected ($\alpha = .05$, $1 - \beta = .79$ and $.99$, for medium and large effects, respectively).

Procedure

Consistent with standard clinical procedures, upon presenting to the emergency department, all patients with a mental health complaint were evaluated by a member of the psychiatric clinical staff and typically remained in the emergency department for 1 to 4+ hr while they underwent further evaluation, received medical or psychiatric treatment, or awaited transfer or discharge. During this time, a member of our research team

approached patients meeting the study's inclusion criteria, described the study, and obtained informed consent. The inclusion criteria were adult status (at least 18 years of age) and absence of any factor that impaired the ability to comprehend and effectively participate in the study (e.g., inability to speak English, gross cognitive impairment, or extremely agitated or violent behavior). These criteria were determined primarily by the clinician's examination. As an additional measure of cognitive impairment, we included several true/false questions about the study at the end of the consent form; participants had to answer these questions correctly to be invited to participate. Consenting patients completed all study measures in the emergency department while seated in their hospital bed, in a small office in the emergency department, or in the emergency department's waiting area.

Measurement

Death/suicide Implicit Association Test. The IAT is a brief computer-administered test that uses people's reaction times when classifying semantic stimuli to measure the automatic mental associations they hold about various topics, in this case, life and death/suicide (see Nosek, Banaji, & Greenwald, 2010, for demonstration tests). The death/suicide IAT was administered and scored in keeping with standard IAT procedures (Greenwald, Nosek, & Banaji, 2003). In the IAT version reported here, participants classified stimuli representing the constructs of "death" (i.e., *die, dead, deceased, lifeless, and suicide*) and "life" (i.e., *alive, survive, live, thrive, and breathing*) and the attributes of "me" (i.e., *I, myself, my, mine, and self*) and "not me" (i.e., *they, them, their, theirs, and other*). Response latencies for all trials were recorded and analyzed using the standard IAT scoring algorithm (Greenwald et al., 2003). The relative strength of each participant's association between "death" and "me" was indexed by calculating a D score for each participant; positive D scores represent a stronger association between death and self (i.e., faster responding on the "death"/"me" blocks relative to the "life"/"me" blocks), and negative scores represent a stronger association between life and self.

Demographic and psychiatric factors. Known demographic and psychiatric risk factors for suicide attempts were assessed to test the incremental predictive validity of the IAT. Each participant's age, sex, and race-ethnicity, as well as his or her principal psychiatric diagnosis, were recorded from the medical record during his or her emergency department visit.

History of suicidal behavior. Current and past history of suicidal behavior was assessed to determine group status at baseline and to examine the incremental predictive validity of the IAT, given that prior suicidal thoughts and attempts are among the strongest predictors of subsequent suicide attempts (Nock, Borges, et al., 2008). Presence of a suicide attempt was assessed using the Self-Injurious Thoughts and Behaviors

Table 1. Characteristics of the Sample

Variable	No suicide attempt in past week (n = 114)	Suicide attempt in past week (n = 43)	Statistical test	Effect size
Mean age (years)	35.1 (11.8)	36.6 (12.6)	$t(155) = -0.68$	$d = 0.11$
Sex (%)			$\chi^2(1) = 0.89$	$\Phi = .08$
Female	36.0	44.2		
Male	64.0	55.8		
Race (%)			$\chi^2(4) = 5.13$	$\Phi = .18$
White	82.5	76.7		
Black	7.9	18.6		
Hispanic	6.1	2.3		
Asian	1.8	2.3		
Other	1.8	0.0		
Mental disorders present (%)				
Any depressive disorder	68.4	88.4	$\chi^2(1) = 8.67^*$	$\Phi = .24$
Any psychotic disorder	6.1	0.0	$\chi^2(1) = 2.76$	$\Phi = .13$
Any anxiety disorder	23.7	25.6	$\chi^2(1) = 0.44$	$\Phi = .05$
Any impulse-control disorder	1.8	0.0	$\chi^2(1) = 0.76$	$\Phi = .07$
Any eating disorder	5.3	0.0	$\chi^2(1) = 2.35$	$\Phi = .12$
Any substance-use disorder	23.7	27.9	$\chi^2(1) = 0.30$	$\Phi = .04$
Any alcohol-use disorder	23.7	34.9	$\chi^2(1) = 2.00$	$\Phi = .11$
Any other disorder	6.1	4.7	$\chi^2(1) = 0.13$	$\Phi = .03$
Mean number of mental disorders	1.6 (1.0)	1.8 (0.7)	$t(155) = -1.70$	$d = 0.27$
Prior suicide attempt (%)			$\chi^2(1) = 13.3^{**}$	$\Phi = .29$
No prior attempt	57.0	30.2		
One prior attempt	19.3	18.6		
Multiple prior attempts	23.7	51.2		

Note: For means, standard deviations are given in parentheses.

* $p < .05$. ** $p < .01$.

Interview (SITBI), a structured interview with good reliability and validity (Nock, Holmberg, Photos, & Michel, 2007). Consistent with current evidence-based assessment practices, the SITBI assesses the presence of suicide attempt (i.e., “an actual attempt to kill yourself in which you had at least some intent to die”) and distinguishes such behavior from suicide gestures (i.e., “doing something to lead someone to believe you wanted to kill yourself when you really had no intention of doing so”) and nonsuicidal self-injury (i.e., “purposely hurting yourself without wanting to die”). Patients’ severity of suicide ideation while in the emergency department was assessed with the Beck Scale for Suicide Ideation (Beck & Steer, 1991).

Clinician and patient predictions. The assessment of suicide risk in clinical settings relies largely on clinical prediction, which incorporates the clinician’s intuition, or gut feeling, based on his or her clinical interview with the patient and evaluation of all available information. Clinician prediction was assessed with the following question, via a brief questionnaire completed by each patient’s primary clinician (e.g., attending psychiatrist):

Based on your clinical judgment and all that you know of this patient, if untreated, what is the likelihood that this patient will make a suicide attempt in the next 6

months? (0–10, with 0 being no likelihood and 10 being very high likelihood).

Risk assessment also incorporates the patient’s own prediction of the likelihood of a future suicide attempt. Patient prediction was assessed with the question, “On this scale of 0 to 4, what is the likelihood that you will make a suicide attempt in the future?” We used clinicians’ and patients’ subjective, single-item estimates rather than administering a multi-item interview or rating scale because we wanted to compare the predictive ability of the IAT to what is commonly used in emergency department settings rather than what is possible using methods from other research studies. In addition, because prior studies have demonstrated differential prediction of suicide attempts using clinician versus patient report (Joiner, Rudd, & Rajab, 1999), these were included as distinct predictors in the current study.

Follow-up assessment. The presence of a suicide attempt during the 6 months following the emergency department visit was assessed in all participants using two methods: a telephone interview during which we readministered the SITBI and an examination of the hospital medical record of each participant to determine whether he or she had returned to the hospital due to a suicide attempt during this 6-month period—a commonly used approach in follow-up studies of suicide attempters

(McAuliffe, Corcoran, Hickey, & McLeavey, 2008; Tiihonen et al., 2006). A suicide attempt was considered to have occurred during the follow-up period if there was evidence for an attempt from either of these two sources, which showed a high level of agreement ($\kappa = .84$).

Data analysis

Performance on the IAT was compared, using a *t* test for independent samples, between participants who did and those who did not make a suicide attempt immediately before presenting to the emergency department. Next, we tested whether the IAT added incrementally to the prediction of suicide-attempt status at baseline beyond the effect of other predictors. In keeping with recommendations on the statistical prediction of suicidal behavior (Cohen, 1986), we used hierarchical logistic regression analyses in which significant correlates of suicide attempters were entered in the first step and performance on the IAT was entered in the second step. The same analytic procedure was followed in prospectively predicting suicide attempts during follow-up, with the addition of a step controlling for clinician/patient prediction and severity of suicide ideation while in the emergency department. The prediction of suicide attempts during the 6-month follow-up focused specifically on patients with a lifetime history of suicide attempt at baseline; this is a group known to be at significantly elevated risk of suicidal behavior (Nock, Borges, et al., 2008), and we wanted to test whether the IAT could predict suicide attempts among this high-risk group. Because all participants in this model had made a suicide attempt, the variable for history of prior suicide attempts in this analysis indicated whether each person had a history of multiple suicide attempts (coded 0 or 1), a factor known to further increase the risk of subsequent attempts (Rudd, Joiner, & Rajab, 1996).

Results

Results revealed that patients presenting to the emergency department after a suicide attempt had a significantly stronger implicit association between death/suicide and self than those presenting with other psychiatric emergencies, $t(155) = 2.46$,

$p < .05$. This difference was not explained by demographic or clinical differences. The groups differed on only two other factors: presence of a current depressive disorder and history of prior suicide attempts (Table 1). Although both of these factors were significantly associated with suicide attempts, the IAT predicted suicide attempts above and beyond the effects of these factors, $\chi^2(1, N = 157) = 4.12, p < .05$ (Table 2).

Most important, this effect was specific to suicidal self-injury, as participants who made a suicide attempt had a significantly stronger implicit association with death/suicide than did those who engaged in self-injurious behavior with no intent to die (i.e., suicide gesture or nonsuicidal self-injury), $t(59) = 2.84, p < .05$, and the latter group did not differ from noninjurious patients, $t(122) = 1.69, n.s.$

Next, we tested whether implicit associations with death/suicide prospectively predicted the occurrence of suicide attempts. Fourteen participants made a suicide attempt during the follow-up period. As Table 3 shows, of the explicitly reported patient and clinician factors, only patients' prediction of their likelihood of making a future suicide attempt predicted actual attempts. Performance on the IAT predicted the occurrence of future suicide attempts above and beyond the influence of these clinical predictors, $\chi^2(1, N = 157) = 4.71, p < .05$ (Table 3).

In a final analysis, we dichotomized scores on the IAT indicating whether each person's score represented an association between death/suicide and self (*D* score > 0) versus life and self (*D* score < 0), to test this theoretically and clinically meaningful cut point. Patients whose performance revealed a stronger association between death/suicide and self were significantly more likely to make a suicide attempt after leaving the emergency department (31.8%) than were those with a stronger association between life and self (10.1%), $\chi^2(1, N = 91) = 6.02, p < .05$. This cut point yielded adequate sensitivity and positive predictive value, as well as strong specificity and negative predictive value (see Table 4). With this cut point, the IAT significantly predicted future suicide attempts beyond the other clinical predictors and provided a more stable estimate of the association between implicit cognition and odds of a subsequent suicide attempt (see Table 3, Step 3b). Specifically, the presence of an implicit association with death/suicide was

Table 2. Hierarchical Logistic Regression Analysis Predicting Suicide-Attempt Status at Presentation to the Emergency Department ($N = 157$)

Step and variable	<i>b</i>	<i>SE</i>	Wald statistic	Odds ratio (95% confidence interval)	χ^2	R^2
Step 1					$\chi^2(3) = 20.20^{**}$	.18
Any depressive disorder	1.35	0.58	5.55	3.87 (1.26–11.94)*		
Prior suicide attempt						
No prior attempt			9.63			
One prior attempt	0.82	0.52	2.50	2.27 (0.82–6.27)		
Multiple prior attempts	1.35	0.44	9.60	3.84 (1.64–9.01)*		
Step 2					$\chi^2(1) = 4.12^*$	.21
Implicit Association Test	1.85	0.94	3.93	6.38 (1.02–39.93)*		

* $p < .05$. ** $p < .01$.

Table 3. Hierarchical Logistic Regression Analysis Predicting Suicide Attempt During the 6-Month Follow-Up Period Among Baseline Suicide Attempters ($n = 91$)

Step and variable	<i>b</i>	<i>SE</i>	Wald statistic	Odds ratio (95% confidence interval)	χ^2	R^2
Step 1					$\chi^2(2) = 5.46$	.10
Any depressive disorder	0.91	1.10	0.70	2.50 (0.29–21.35)		
Multiple suicide attempts	1.42	0.80	3.13	4.14 (0.86–19.96)		
Step 2					$\chi^2(3) = 11.00^*$	.29
Scale for Suicide Ideation	−0.01	0.04	0.08	0.99 (0.92–1.06)		
Clinician prediction	0.15	0.15	1.09	1.16 (0.88–1.55)		
Patient prediction	0.76	0.27	7.91	2.13 (1.26–3.61)**		
Step 3a					$\chi^2(1) = 4.71^*$	.36
IAT (continuous)	3.42	1.66	4.25	30.68 (1.18–795.12)*		
Step 3b					$\chi^2(1) = 5.86^*$	.38
IAT (dichotomous)	1.77	0.76	5.39	5.88 (1.32–26.26)*		

Note: IAT = Implicit Association Test.

* $p < .05$, ** $p < .01$.

associated with an approximately 6-fold increase in the odds of making a suicide attempt in the next 6 months.

Discussion

The decision to end one's own life is perhaps the most important determination a person can make; however, suicidal thoughts often are held privately and are not detectable by others or even by oneself, creating a deep epistemological quandary. This study addresses this long-standing scientific and clinical dilemma by identifying a behavioral marker—an implicit association between death/suicide and self—that distinguishes suicide attempters from other psychiatrically distressed patients, predicts future suicide attempts, and provides superior prediction compared with currently used methods.

These findings are important for both the scientific understanding and clinical prediction of suicidal behavior. Current theories of suicide suggest that people kill themselves to escape intolerable circumstances, such as those resulting from negative life circumstances and the experience of

mental disorders (Hawton & van Heeringen, 2009; Nock, Hwang, Sampson, & Kessler, 2009). However, most people experiencing these things never attempt to kill themselves, and these risk factors do not explain why some people cope with difficult circumstances through adaptive methods (e.g., seeking treatment) but others choose suicidal behavior as a means of escape. Our findings suggest that a person's implicit cognition may guide which behavior he or she chooses to cope with extreme distress. More specifically, an implicit association with death/suicide may represent one of the final steps in the pathway to suicide that is activated when a person is deciding how to respond to extreme distress (Nock, 2009). Notably, however, this study provides no evidence that such implicit cognitions are causally related to suicide attempts, or even precede them. An alternative account would be that an implicit association between death/suicide and self is a consequence of prior suicidal behaviors. We statistically controlled for past history of suicide attempts in our analyses to address this issue but cannot confidently rule it out entirely. Future studies aimed at changing implicit cognition and observing

Table 4. Classification Statistics for the Implicit Association Test in Prospectively Predicting Suicide Attempt ($n = 91$)

Suicide attempt at follow-up		Sensitivity	Specificity	Positive predictive value	Negative predictive value
Yes	No				
D score > 0 : $n = 7$	D score > 0 : $n = 15$	.50 (7/14)	.81 (62/77)	.32 (7/22)	.90 (62/69)
D score < 0 : $n = 7$	D score < 0 : $n = 62$				

Note: Scores on the Implicit Association Test were dichotomized to indicate either an association between death/suicide and self (D score > 0) or an association between life and self (D score < 0). Sensitivity is the proportion of actual suicide attempts correctly identified by the test; specificity is the proportion of non-suicide attempts correctly identified by the test. Positive predictive value is the proportion of individuals with a positive test who were correctly classified as a suicide attempter; negative predictive value is the proportion of individuals with a negative test who were correctly classified as a nonattempter. Raw numbers for proportions are given in parentheses.

the effect on future suicidal behavior are needed to answer questions about the potentially causal relation with suicide attempts.

The lack of an association between clinician prediction and subsequent suicidal behavior is unfortunate but consistent with research on the limited value of human judgment in clinical decision-making processes (Dawes, Faust, & Meehl, 1989; Swets et al., 2000). That the measure used here was able to predict suicide attempts beyond the effect of known risk factors (e.g., depression) is particularly noteworthy and suggests that the assessment of implicit cognition may prove valuable for improving prediction in clinical settings. The fact that scores above the zero point on the IAT prospectively predict suicide attempts supports the consequential validity of this measure (Greenwald, Nosek, & Sriram, 2006) and provides evidence for a cut point that ultimately may facilitate the use of the IAT in the clinical decision-making process. Most risk factors for suicidal behavior have high sensitivity but poor specificity (e.g., mental disorders); therefore, the high specificity of the IAT renders it especially useful when combined with measures of these other constructs in the prediction of suicidal behavior.

These encouraging results must be interpreted in the light of several limitations, which point toward important directions for future research. First, patients were recruited from only one emergency department in the northeastern United States. Replication of this study at other sites is required to test the generality of the observed results. Second, although the prediction of suicide attempts among this high-risk sample represents a significant advance over what was previously possible, future studies are needed to test the ability of this approach to also predict first-onset suicide attempts, high-lethality suicide attempts, and suicide death. Such studies require larger samples and longer follow-up periods than those used in the current study but represent important next steps in this line of research. Third, the stimuli used in the IAT tested here focused mostly on death; future versions targeting suicide-related cognitions more narrowly may provide even better prediction and require testing in subsequent studies. Fourth, although we demonstrated that the assessment of implicit cognition can improve on assessment methods currently used by clinicians, we did not compare this improvement with that provided by other scientifically based approaches (e.g., biological measures or structured risk-assessment measures; Mann et al., 2006; Nock, Wedig, Janis, & Deliberto, 2008). Future research is needed not only to further develop the understanding of behavioral markers for the risk of suicidal behavior but for combining such information with that from other data sources (e.g., biological or historical) to advance the understanding, prediction, and prevention of suicidal behavior.

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The authors declared that they had no conflicts of interest with respect to their authorship or the publication of this article.

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