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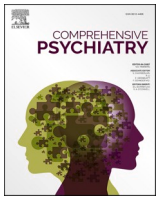

Exploring suicidal behaviour through implicit identity and control biases: Findings from the *Death-Implicit Association Test* and its novel control-adaptation

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ABSTRACT

Objective: This study examined two *Death-Implicit Association Test* versions targeting associations between the self-concept (standard identity D-IAT; iD-IAT) and internal versus external control (adapted control D-IAT; cD-IAT) and death among suicide attempters. Additionally, correlations with explicit psychological variables and psychometrics were explored.

Method: 116 psychiatric inpatients (58.1 % female; age $M = 33.6$, $SD = 12.4$) were classified as single versus multiple and recent versus lifetime suicide attempters. Implicit associations were measured using the iD-IAT and cD-IAT. Self-report measures included constructs relevant to suicidal behaviour.

Results: Recent attempters showed weaker self-life ($t(114) = 2.18$, $p = .016$) and internal control-life ($t(114) = 2.26$, $p = .013$) associations than lifetime attempters. Multiple attempters exhibited weaker internal control-life associations than single attempters ($t(114) = 2.25$, $p = .007$). The iD-IAT correlated with suicidal ideation ($r_s(114) = 0.20$, $p = .032$), depression ($r_s(114) = 0.20$, $p = .033$) and external control ($r_s(114) = 0.21$, $p = .021$), the cD-IAT with suicidal ideation ($r_s(114) = 0.25$, $p = .006$) and depression ($r_s(114) = 0.26$, $p = .006$). The cD-IAT predicted multiple attempts ($\chi^2(1116) = 3.88$, $p = .049$), showed higher internal consistency ($r_{sb} =. 31$, $p = .001$) and predictive validity in detecting multiple (AUC = 0.64; $p = .013$) and recent (AUC = 0.62; $p = .028$) attempters than the iD-IAT.

Conclusions: The cD-IAT shows preliminary potential to differentiate suicidal behaviour based on recency and frequency, offering a tentative step toward understanding cognitive vulnerabilities of at-risk subgroups, warranting further refinement, validation and prospective analyses.

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1. Introduction

Suicide is a pressing global health issue, with over 720,000 deaths annually [1] and an estimated 10 to 20 times more attempts worldwide [2]. Despite extensive research, predicting acute suicide risk remains a critical challenge in prevention efforts [3,4]. Traditional self-report measures, while valuable, rely greatly on explicit self-disclosure [5–9], which is often hindered by stigmatisation [10–12], fear of intervention or hospitalisation [13,14] or limited self-awareness [8,9,15]. These limitations necessitate complementary methods to assess automatic psychological and cognitive processes associated with suicidal behaviour [6,16,17].

Research on cognitive markers specific to suicidal behaviour rather than ideation remains limited [18,19], particularly regarding behavioural markers that reflect psychological distress and cognitive distortions linked to suicide attempts [20–22]. Understanding suicidal behaviour on different levels, e.g., based on frequency and recency of attempts, both strong indicators of future risk [23–26] may help identify vulnerable individuals. Recent attempters, who are thought to be in a suicidal mode characterised by heightened cognitive and affective dysregulation [27], are at acute risk due to the recency of their distress [28], cognitive dysfunction [29] and correlating symptom severity of clinical factors, e.g., severe depression [30]. Multiple attempters tend to exhibit greater psychological distress, impulsivity, and more entrenched maladaptive thought patterns, increasing their vulnerability to subsequent attempts [24,31]. Both recent and multiple attempters are a priority for intervention [32,33].

Implicit Association Tests (IATs), introduced by Greenwald et al. [34], measure automatic cognitive associations that individuals may not consciously recognise or willingly disclose. The *Death-Implicit Association Test* (D-IAT), developed by [35] and translated to German by Rath et al. [36], assesses associations between self-related (*me* versus *not me*) and death- and life-related constructs (*death* versus *life*). This approach has been shown to validly detect and predict suicidal ideation and behaviour across diverse populations [37–43]. Sohn et al. [42], in their comprehensive meta-analysis, highlighted the prospective predictive utility of the D-IAT over a 6-month period, demonstrating its effectiveness in identifying individuals at acute risk for suicide. Although some studies have reported mixed findings regarding its predictive validity over time [44] and stability in detecting differences among attempters [37,45] or ideators [46], Sohn et al.'s findings [42] provide crucial evidence of the D-IAT's potential to capture latent risk factors that may be otherwise inaccessible through traditional methods. Despite the D-IAT's utility in measuring implicit self-death associations, there remains a gap in addressing other critical cognitive constructs, such as control biases, potentially relevant to the susceptibility to suicidal behaviour [47,48].

LoC, introduced by Rotter [49], refers to the degree to which individuals attribute outcomes to personal agency (internal locus of control, iLoC) or external forces (external locus of control, eLoC; [50]). Previous literature has focused on eLoC as a factor linked to negative emotions, including an elevated risk of depression [51–53]. ILoC is often associated with adaptive outcomes such as coping [54–56], resilience [57], and well-being [58,59]. Under certain circumstances, however, it may contribute to feelings of guilt, self-blame, and hopelessness when individuals perceive themselves as responsible for failures or inability to change their circumstances [54,60,61]. Theoretical models of suicide propose that a perceived lack of iLoC over life fosters hopelessness, a key precursor to suicidal ideation and behaviour [62–64].

The literature on LoC in the context of suicidal behaviour presents mixed findings. Most studies suggest that an eLoC is associated with suicidal ideation and behaviour [52,65,66]. However, these studies often rely on measures that assess general feelings of LoC rather than specifically the controllability related to death. This distinction is critical, as individuals who attempt suicide may experience a complex interplay of LoC beliefs; a lack of control over life, i.e., an eLoC of life, may lead to feelings of helplessness [67], while simultaneously perceiving death as a controllable escape from this helplessness, a sense of resignation to external forces and a perceived restoration of control through death [68,69], what might be termed an internalised sense of control over death. Studies have shown that individuals who attempt suicide often exhibit higher levels of cognitive rigidity and a narrowed focus on escape as a solution to their suffering [70,71]. These findings align with the idea that an iLoC related to death may manifest as a belief in one's ability to control the timing and manner of their own death, reinforcing suicidal intent in high-risk individuals [72,73]. For example, individuals with higher-lethality suicide attempts were found to score more internally on LoC measures compared to those with lower-lethality attempts, suggesting a stronger belief in personal agency over the outcome of their actions [74]. Additionally, a high iLoC has been linked to decisions to hasten death in the context of irremediable health conditions, highlighting how death-specific control beliefs can shape attitudes toward death as a solution [75]. This belief system does not align with general LoC constructs but instead reflects a specific perceived controllability of death. While this perception may share psychological overlap with iLoC beliefs, it is conceptually distinct and should not be conflated with general LoC.

Existing measures of LoC, such as Rotter's [76] *Internal-External Control Scale* and its derivatives, e.g. the *Internal-External Locus of Control Short Scale-4* (IE-4; [77]), rely on self-reports and are susceptible to response biases, such as social desirability [78,79], stigmatisation [80] or the nonlinear and transient nature of emotions and thoughts, especially in the context of suicidal ideation [81,82]. Implicit measures could provide a supplementary understanding of how specific control-related biases, particularly concerning death, operate below conscious awareness [83–85], which is particularly relevant for high-risk populations, who may struggle to articulate or even recognise their cognitive biases [14,41,86].

To date, no implicit instrument has been developed to measure the controllability of death and life in the context of suicidal behaviour. To address this gap, the standard identity D-IAT (iD-IAT), which captures implicit associations between *me* or *not me*, i.e. the construct of self, and *life* or *death*, along with an adapted control D-IAT framework (cD-IAT) were applied. The cD-IAT was designed to assess domain-specific control biases, measuring the relative strength of automatic associations between *internal* or *external control* and *life* or *death*. While conceptually inspired by the broader LoC framework [49], the cD-IAT is not intended to measure general LoC but rather to target implicit control biases specifically in the context of life and death. Importantly, cD-IAT scores are interpreted such that stronger internal control-life and weaker internal control-death associations reflect an automatic alignment of life with control. Conversely, weaker internal control-life and stronger internal control-death associations indicate a shift away from life-directed control, which may reflect a loss of control over life and an implicit attribution of control to death. This conceptualisation aligns with theoretical accounts of suicidal behaviour that frame suicide as an act of perceived control, where individuals seek to regain control by escaping from overwhelming psychological pain and entrapment [72,87]. Further support comes from Tang et al. [88], who observed stronger implicit death-related associations under stress in individuals with internal control beliefs, suggesting that under high distress, death may become the locus of perceived control.

Thus, this study aimed to examine whether implicit identity and control biases related to life and death differ by frequency and recency of suicidal behaviour, specifically comparing high-risk patients (multiple [MSA] or recent [RSA] attempters) to lower-risk groups (single [SSA] or lifetime [LSA] attempters) and how these implicit biases relate to key psychological constructs relevant to suicidal behaviour. First, it was hypothesised that MSA and RSA would exhibit stronger self-death and internal control-death associations than SSA and LSA, respectively. Second, it was predicted that self-death and internal control-death associations would correlate positively with higher levels of depression, greater intensity of suicidal ideation, risk for suicidal behaviour,

elevated psychological pain, and general eLoC while showing negative associations with positive mental health and general iLoC. Finally, the performance of the iD-IAT and cD-IAT was explored with respect to their psychometric properties and potential to distinguish between the at-risk subgroups. While no strong a priori assumptions were made regarding the superiority of the cD-IAT over the iD-IAT, given the exploratory nature of this comparison, its inclusion was informed by conceptual and preliminary empirical work suggesting that perceived control over death may play a role in suicidal cognition under certain conditions, particularly among high-risk individuals [68–75,87,88].

2. Methods

2.1. Participants

This cross-sectional analysis included $N = 116$ psychiatric inpatients (58.1 % female; age $M = 33.6$ years, $SD = 12.4$) with a history of suicidal behaviour. Patients were consecutively recruited from the *University Hospital of Psychiatry and Psychotherapy Bern*, Switzerland, between May 2020 and November 2024 as part of a project on the expansion and re-evaluation of the iD-IAT. The study (ClinicalTrials.gov ID: NCT04585802) was approved by the local Ethics Committee (BASEC ID: 2019–01410). All patients provided written informed consent, with assurance of voluntary participation and the right to withdraw without penalty.

Inclusion criteria required patients to be aged between 18 and 65 years, capable of providing informed consent, and have a history of at least one suicide attempt. Exclusion criteria included severe cognitive impairments, acute psychosis, insufficient German-language skills, or any condition compromising comprehension of the study procedures and consent process.

Given the significant role of past and multiple suicide attempts in predicting future risk, patients were categorised twice into two behavioural subgroups. In the first analysis, they were classified based on the frequency of their suicide attempts recorded through the *Beck Scale for Suicidal Ideation* (BSS; [89,90]) into single (SSA; $n = 49$) and multiple attempters (MSA; $n = 67$). Patients were classified as SSA if item 20, concerning prior suicidal behaviour, indicated one prior attempt, and MSA if item 20 indicated two or more prior attempts. Second, the sample was classified according to the temporal proximity of their most recent attempt based on the *Mini-International Neuropsychiatric Interview* (M.I.N.I.; [91,92]) into recent (RSA; $n = 51$) and lifetime attempters (LSA; $n = 65$). Patients were screened using *Module C: Suicidality*. Those who affirmed item C5 ("Have you attempted suicide in the past month?") were categorised as RSA, while those who affirmed item C6 ("Have you attempted suicide at any time in your life?") but negated C5 were classified as LSA. Classifications were cross-validated with information provided by the patients in a sociodemographic questionnaire [93]. A total of $n = 41$ records were excluded from the originally recruited sample ($n = 157$) due to incompletion of the study session ($n = 38$) because of concentration or cognitive difficulties and psychotic symptoms based on the M.I.N.I. ($n = 3$).

2.2. Procedure

Study participation lasted approximately 1.5 h in a single session and began with the administration of 4 versions of the D-IAT to measure implicit biases across various domains. The validation of these additional D-IAT versions is currently being reviewed; the present analysis focuses on data from two versions (iD-IAT and cD-IAT, see 2.3.). The D-IATs were conducted on computers with screens ranging from 15.6 to 17.3 in. using *Presentation* software (Version 20.3, *Neurobehavioral Systems*); completion of all D-IATs took approximately 30 min. The order of D-IAT versions was randomised with *Presentation*'s built-in stimulus array shuffling to mitigate sequence and order effects. Prior to the start of each D-IAT version, participants were provided with both oral and written instructions explaining the meaning of each construct involved in the respective version. The written instructions were displayed on the screen using accessible language. Participants were asked whether they understood the constructs and were encouraged to ask questions. This step was implemented to ensure that all participants had a clear conceptual grasp of the attribute categories, which is essential for valid IAT performance [94,95].

Following the D-IAT tasks, participants completed demographic and clinical self-report questionnaires and underwent a clinical assessment using the M.I.N.I. [91,92] to screen Axis-I disorders. To mitigate fatigue and maintain engagement, participants were offered short breaks between tasks and were closely monitored by the study team throughout the session. Participants were continuously encouraged and supported and were reminded that they could pause or discontinue participation at any time.

2.3. Measures

Implicit biases were assessed using two versions of the D-IAT: the iD-IAT [35,36] and the cD-IAT. Both D-IATs were presented in German, following ISPOR Task Force translation guidelines [96]. Each version consisted of 7 blocks. The practice blocks (1, 2, and 5) included 20 trials. Critical experimental blocks (3 and 6) included 20 and 40 trials, respectively (4 and 7), yielding 60 trials per combined experimental block pair (i.e., 3 + 4 and 6 + 7). Each version had the same length. Participants classified words into two bipolar target and attribute categories by pressing designated keys ("E" and "I") on a keyboard. Both versions used the target categories "Tod" ("death") and "Leben" ("life") with identical stimuli, along with attribute categories "Ich" ("me") and "Nicht-Ich" ("not me") in the identity version, and "Internale Kontrolle" ("internal control") and "Externale Kontrolle" ("external control") in the control version. In a randomised allocation, for one-half of the participants, the "life"/"me" and "life"/"internal control" blocks were presented first; for the other half, the "death"/"me" and "death"/"internal control" blocks were presented first. Stimuli selection in the "death"/"life" and "me"/"not me" categories followed the original version [35,36]. Selection for the "internal control"/"external control" categories was guided by best practices for constructing effective IATs, which recommend using clearly dichotomous and easily distinguishable categories to enhance the strength and clarity of automatic associations ([94]; see Tables 1 & 2 for a description of blocks and stimuli). The stimuli development was based on theoretically grounded material, including German-language patient statements from video-recorded therapy sessions of the *Attempted Suicide Short Intervention Program*

Table 1
Structure of the iD-IAT.

Order	Block	1	2	3 & 4	5	6 & 7
		Practice		Experimental	Practice	Experimental
A	left	Tod	Nicht-Ich	Tod/Nicht-Ich	Leben	Leben/Nicht-Ich
	right	Leben	Ich	Leben/Ich	Tod	Tod/Ich
B	left	Leben	Nicht-Ich	Leben/Nicht-Ich	Tod	Tod/Nicht-Ich
	right	Tod	Ich	Tod/Ich	Leben	Leben/Ich

Note. "left" and "right" indicate the position of category labels on the screen during the task and correspond to the respective response keys (i.e., "E" for left and "I" for right key press on a standard keyboard). The "Tod" ("death") category included the words "Suizid" ("suicide"), "sterben" ("die"), "Beerdigung" ("funeral"), "leblos" ("lifeless"), and "verstorben" ("deceased"), while the "Leben" ("life") category comprised "lebendig" ("alive"), "leben" ("living"), "gedeihen" ("thriving"), "überleben" ("surviving"), and "atmend" ("breathing"). The "Ich" ("me") category included the stimuli "Ich selbst" ("myself"), "mein" ("my"), "meins" ("mine"), "mich" ("I"), and "selbst" ("self"), while the "Nicht-Ich" ("not me") category comprised "ihnen" ("them"), "sie" ("they"), "ihres" ("theirs"), "ihr" ("their"), and "andere" ("other").

Table 2
Structure of the cD-IAT.

Order	Block	1	2	3 & 4	5	6 & 7
		Practice		Experimental	Practice	Experimental
A	left	Tod	Externale Kontrolle	Tod/Externale Kontrolle	Leben	Leben/Externale Kontrolle
	right	Leben	Internale Kontrolle	Leben/Internale Kontrolle	Tod	Tod/Internale Kontrolle
B	left	Leben	Externale Kontrolle	Leben/Externale Kontrolle	Tod	Tod/Externale Kontrolle
	right	Tod	Internale Kontrolle	Tod/Internale Kontrolle	Leben	Leben/Internale Kontrolle

Note. "left" and "right" indicate the position of category labels on the screen during the task and correspond to the respective response keys (i.e., "E" for left and "I" for right key press on a standard keyboard). The target categories "Tod" ("death") and "Leben" ("life") contain the same stimuli as the identity version. The "Internale Kontrolle" ("internal control") stimuli were "lenkbar" ("manageable"), "kontrollierbar" ("controllable"), "beeinflussbar" ("influencable"), "bestimmen" ("determine"), and "Fähigkeit" ("ability"). The "Externale Kontrolle" ("external control") stimuli included "machtlos" ("powerless"), "abhängig" ("dependent"), "Schicksal" ("fate"), "Zufall" ("chance"), and "Pech" ("bad luck").

(ASSIP; [93]), which were conducted as part of clinical interventions at the *University Hospital of Psychiatry and Psychotherapy Bern* and not collected for research purposes. These statements were thematically categorised according to LoC constructs. Additional terminology was drawn from German-language psychological literature and validated scales [77,97–103]. These candidate stimuli were then carefully reviewed by two independent experts in clinical psychology to ensure their semantic fit and construct relevance. Within the blocks, trials were presented in pseudorandomised order, i.e., not the same stimulus directly twice in succession. Error trials required a correct response before progressing. Reaction times (RTs) from the onset of the stimulus until key press were recorded in milliseconds for correct responses only. D-scores were computed using Greenwald et al.'s improved scoring algorithm [94], with data quality filters applied as described below. For the iD-IAT, positive D-scores indicate stronger automatic associations between "me" and "death" relative to "me" and "life", indicating implicit identification with death. For the cD-IAT, positive D-scores reflect stronger automatic associations between "internal control" and "death" relative to "internal control" and "life", which is interpreted as a shift away from control over life. Conversely, negative D-scores on the cD-IAT reflect stronger internal control-life associations and represent an automatic alignment of life with control. Blocks were randomised to control for sequence effects. Patients with more than 10 % of RTs under 300 ms or error rates exceeding 30 % across the critical blocks (or 40 % in any block) were excluded. RTs above 10,000 ms were treated as missing [34].

The *Beck Scale for Suicide Ideation* (BSS; [89, German version: 90]) measures the intensity of current suicidal ideation, with scores ranging from 0 to 38 through the first 19 items. Items 20 and 21 inquire about previous suicide attempts and, if a previous suicide attempt was affirmed, how strong the desire to die was during the last attempt. The German version has demonstrated excellent internal consistency (α = 0.94; [90]) and good consistency in our sample ($\alpha = 0.85$).

The *Beck Depression Inventory–II* (BDI-II; [[104], German version: [105]]) assesses the severity of depressive symptoms through 21 items, with a score of up to 63. The German adaptation has exhibited good internal consistency ($\alpha = 0.84$), retest reliability ($r = 0.75$), and validity [106]. Internal consistency in our sample was excellent ($\alpha = 0.92$).

The *Suicide Behaviors Questionnaire-Revised* (SBQ-R; [[107], German version: [108]]) is a brief instrument designed to assess dimensions of suicidal behaviour, including past ideation and attempts, frequency of recent suicidal ideation, communication of suicidal intent, and perceived likelihood of future attempts. Responses yield a total score between 3 and 18. While higher scores suggest greater suicide risk, with cutoffs of ≥11 for high risk and 7 to 10 for moderate risk, it is important to interpret these risk scores within the broader context of individual clinical assessments [109]. The German version has shown acceptable internal consistency ($\alpha = 0.72$; [108]), similar to its value in our sample ($\alpha = 0.69$).

The *Mee-Bunney Psychological Pain Assessment Scale* (MBPPAS; [110] German version: unpublished results) is a 10-item instrument that measures psychological pain, yielding scores between 10 and 50. The German version was translated using a forward-backwards translation procedure, ensuring linguistic and conceptual equivalence. The MBPPAS has demonstrated excellent internal consistency (α = 0.83 to 0.94; [110]). Internal consistency in our sample was good ($\alpha = 0.89$).

The *Internal-External Locus of Control Short Scale-4* (IE-4; [77]) is a 4-item self-report measure assessing perceived control over life events, with two subscales for iLoC and eLoC of which means are calculated. The IE-4 has demonstrated sufficient internal consistency across the whole scale ($\alpha = 0.74$; [77]). Internal consistency in our sample was acceptable for the iLoC ($\alpha = 0.69$) and unsatisfactory for the eLoC scale ($\alpha = 0.44$).

The *Positive Mental Health Scale* (PMH; [111]) evaluates psychological well-being using 9 items and summing responses. The PMH has demonstrated excellent internal consistency ($\alpha = 0.93$; [104]), similar to its value in our sample ($\alpha = 0.90$).

The *Mini-International Neuropsychiatric Interview* (M.I.N.I.; [91, German version: 92]) was employed to confirm psychiatric diagnoses and assess suicide risk according to DSM-IV Axis-I criteria. The interviews were conducted primarily by doctoral students in psychology and neuroscience, as well as master's students under the supervision of doctoral students.

Demographic and clinical variables, including age, gender, marital status, self-harming behaviours, and suicidal ideation or behaviours, were collected through a standardised questionnaire [93].

2.4. Statistical analysis

Statistical analyses were conducted using SPSS version 29.0 [112] and RStudio version 4.4.1 [113]. Records with missing D-scores were not included in the analyses (see 2.1.). Prior to analysis, outliers in both D-IAT versions were identified using z-scores based on D-scores, as normality was confirmed using the Kolmogorov-Smirnov test (ps = 0.200; [114]). Consistent with previous research [35,36,40], one-tailed independent samples t-tests were employed to analyse group differences, with and without the capping of outliers. Results were compared across uncapped and capped data using z-score thresholds of ±3.0 and ± 2.0 [115]. Using the ±3.0 threshold, no outliers were identified for either D-IAT version. Using the more conservative ±2.0 threshold, $n = 6$ outliers were identified for the iD-IAT and $n = 5$ for the cD-IAT. No changes in sample distribution, direction or significance of findings were observed. Thus, uncapped data were used in the final analyses. False Discovery Rate (FDR) correction [116] was applied to control for family-wise error, maintaining statistical power while controlling for false positives [117].

Spearman rank correlations were conducted between D-scores of both D-IAT versions and explicit psychological scales (BSS, BDI-II, SBQ-R, MBPPAS, IE-4, PMH) across the total sample. Missing data in the explicit scales were imputed using linear interpolation for trends and mean/median imputation for non-linear patterns, depending on skewness [118]. Using linear interpolation (linear trends $ps \leq 0.003$), $N = 9$ missing values were replaced for the BSS, $N = 5$ for the MBPPAS, $N = 2$

for the SBQ-R, and $N = 1$ for the IE-4 eLoC scale. No linear trends were identified in the BDI-II ($p = .211$), PMH ($p = .613$), and IE-4 iLoC scale ($p = .574$). For the BDI-II and IE-4 iLoC scale, where skewness values were close to zero (−0.07 and − 0.38, respectively), mean of nearby points imputation was used. For the PMH, which exhibited positive skewness (skewness = 1.02), median of nearby points imputation was applied to account for the asymmetry in distribution. In the BDI-II, $N = 12$ missing values were replaced, $N = 1$ in the IE-4 iLoC scale, and $N = 9$ in the PMH.

Based on Nock and Banaji [119], hierarchical logistic regressions were performed to assess the incremental discriminant validity of the D-scores in detecting group membership based on frequency and recency of suicidal behaviour. Age, gender, diagnoses of mood and anxiety disorders, given their known correlation with suicidal behaviour [35,120–122] and their prevalence within the sample ($n = 104$ for mood disorders; $n = 77$ for anxiety disorders; see Tables 3 and 4), and explicit suicidal ideation based on the BSS were controlled for. In the first block, age and gender were entered as covariates, followed by diagnoses for mood and anxiety disorders in the second block, BSS scores in the third block, and the D-score in the fourth and final block. Each model was run twice per grouping (i.e., MSA vs. SSA and RSA vs. LSA), once including the iD-IAT's D-score and once the cD-IAT's D-score in the final block. As an additional step, the analyses were run again, once for each grouping, including both D-scores together in the final block to assess the unique contribution of each D-IAT. To ensure the robustness of the regression models, multicollinearity was evaluated using Variance Inflation Factor (VIF) values, with all predictors falling within acceptable ranges (VIF < 5), indicating no significant multicollinearity issues. Full regression tables can be found in Supplementary Material 1.

Receiver operating characteristic (ROC) curve analyses were conducted to evaluate the discriminant accuracy of D-scores in distinguishing MSA vs. SSA and RSA vs. LSA. Split-half reliability was assessed using a permutation-based approach implemented in Kahveci et al.'s *rapidsplihalf* R package [123], which provides a more accurate and unbiased estimate of reliability for reaction-time tasks than traditional methods by computing and aggregating many random split-half correlations corrected with a modified Spearman-Brown formula.

As an exploratory step, we additionally computed a combined D-score by averaging the D-scores from the iD-IAT and cD-IAT for each participant, and re-ran all primary analyses using this combined measure; full results are reported in Supplementary Material 2.

Table 3
Demographic and clinical baseline characteristics of MSA and SSA.

	MSA $n = 67$	SSA $n = 49$	Test Statistic	*p*-value
Gender, female/male and others (*n*, %)	44 (66)/23 (34)	24 (49)/25 (51)	5.57[a]	0.062
Age in years, *M* (*SD*)	33.5 (12.0)	33.9 (13.1)	1640.00[b]	0.996
Diagnosis (DSM-IV) (*n*, %)				
Mood Disorders	60 (90)	43 (88)	0.60[a]	0.740
Anxiety Disorders	47 (70)	30 (61)	13.98[a]	**0.003**
Substance-Related Disorders	26 (39)	18 (37)	4.65[a]	0.098
Eating Disorders	7 (10)	4 (8)	0.17[a]	0.678
Obsessive-Compulsive Spectrum	13 (19)	5 (10)	1.83[a]	0.177
Trauma-Related Disorders	21 (31)	6 (12)	5.78[a]	**0.016**
BSS, *M* (*SD*)	15.4 (10.3)	10.5 (8.3)	1160.50[b]	**0.007**
BDI-II, *M* (*SD*)	34.2 (12.7)	27.0 (10.6)	1082.50[b]	**0.002**
SBQ-R, *M* (*SD*)	14.1 (3.1)	11.9 (3.2)	941.50[b]	**< 0.001**
MBPPAS, *M* (*SD*)	33.5 (8.0)	31.9 (6.7)	1377.50[b]	0.140
IE-4 (iLoC), *M* (*SD*)	3.4 (1.0)	3.6 (1.1)	1492.00[b]	0.398
IE-4 (eLoC), *M* (*SD*)	3.2 (0.9)	2.9 (0.8)	1344.00[b]	0.098
PMH, *M* (*SD*)	16.4 (6.5)	17.6 (5.8)	1402.00[b]	0.180

Note. Diagnoses recorded with the M.I.N.I. = Mini-International Neuropsychiatric Interview; MSA = Multiple suicide attempters; SSA = Single suicide attempters; BSS = Beck Scale for Suicide Ideation; BDI-II = Beck Depression Inventory–II; SBQ-R = Suicide Behaviours Questionnaire-Revised; MBPPAS = Mee-Bunney Psychological Pain Assessment Scale; IE-4 = Internal-External Locus of Control Short Scale-4; PMH = Positive Mental Health Scale; iLoC = internal locus of control; eLoC = external locus of control. [a] Chi-square test. [b] Mann-Whitney-*U* test.

Table 4
Demographic and clinical baseline characteristics of RSA and LSA.

	RSA $n = 51$	LSA $n = 65$	Test Statistic	*p*-value
Gender, female/male and others (*n*, %)	29 (57)/22 (43)	39 (60)/26 (40)	0.13[a]	0.937
Age in years, *M* (*SD*)	31.4 (12.4)	35.5 (12.2)	1316.00[b]	0.057
Diagnosis (DSM-IV) (*n*, %)				
Mood Disorders	48 (94)	55 (85)	2.59[a]	0.273
Anxiety Disorders	34 (67)	43 (66)	2.98[a]	0.395
Substance-Related Disorders	19 (37)	25 (38)	1.64[a]	0.440
Eating Disorders	4 (8)	7 (11)	0.29[a]	0.593
Obsessive-Compulsive Spectrum	9 (18)	9 (14)	0.32[a]	0.575
Trauma-Related Disorders	14 (27)	13 (20)	0.89[a]	0.346
BSS, *M* (*SD*)	16.5 (9.2)	10.8 (9.5)	1112.50[b]	**0.002**
BDI-II, *M* (*SD*)	34.2 (12.9)	28.9 (11.5)	1229.00[b]	**0.017**
SBQ-R, *M* (*SD*)	13.5 (3.2)	12.8 (3.4)	1415.50[b]	0.176
MBPPAS, *M* (*SD*)	34.0 (7.4)	31.9 (7.4)	1410.50[b]	0.169
IE-4 (iLoC), *M* (*SD*)	3.3 (1.0)	3.6 (1.0)	1407.00[b]	0.159
IE-4 (eLoC), *M* (*SD*)	3.1 (0.8)	3.1 (1.0)	1653.50[b]	0.982
PMH, *M* (*SD*)	16.6 (6.0)	17.2 (6.4)	1576.50[b]	0.652

Note. Diagnoses recorded with the M.I.N.I. = Mini-International Neuropsychiatric Interview; RSA = Recent suicide attempters; LSA = Lifetime suicide attempters; BSS = Beck Scale for Suicide Ideation; BDI-II = Beck Depression Inventory–II; SBQ-R = Suicide Behaviours Questionnaire-Revised; MBPPAS = Mee-Bunney Psychological Pain Assessment Scale; IE-4 = Internal-External Locus of Control Short Scale-4; PMH = Positive Mental Health Scale; iLoC = internal locus of control; eLoC = external locus of control. [a] Chi-square test. [b] Mann-Whitney-U test.

3. Results

3.1. Sample characteristics

MSA were more likely to fulfil the diagnostic criteria for anxiety ($\chi^2(3) = 13.98$, $p = .003$) and trauma-related ($\chi^2(3) = 5.78$, $p = .016$) disorders than SSA. Additionally, MSA scored higher than SSA on the BSS ($U = 1160.50$, $p = .007$), BDI-II ($U = 1082.50$, $p = .002$), and SBQ-R ($U = 941.50$, $p < .001$), reflecting greater severity in suicidal ideation, suicide risk and depressive symptoms. Compared to LSA, RSA reported higher levels of suicidal ideation in the BSS ($U = 1112.50$, $p = .002$) and depressive symptoms in the BDI-II ($U = 1229.00$, $p = .017$). No differences in diagnoses were observed between RSA and LSA. Overall, $N = 92$ (78.6 %) patients met the criteria for multiple diagnoses, highlighting the complexity of clinical presentations among patients with prior suicidal behaviour. Key demographic characteristics, diagnoses and clinical variables are shown in Tables 3 and 4.

3.2. Descriptive statistics of the D-IAT

For the iD-IAT, the mean D-score in the total sample was $M = -0.30$ ($SD = 0.32$), ranging from −1.03 to 0.59. For the cD-IAT, the mean was $M = -0.27$ ($SD = 0.33$), with a range from −1.16 to 0.58. Since the mean D-scores in both versions remained negative, the direction of associations tended toward life rather than death. The negative mean D-scores indicate faster reaction times on "life"/"me" and "life"/"internal control" paired trials than on "death"/"me" or "death"/"internal control" paired trials, respectively. Descriptive and comparative statistics can be found in Table 5.

Table 5
Descriptive statistics and comparisons for both D-IAT versions.

	MSA (n = 67)		SSA (n = 49)		One-tailed t-test	p-value	FDR adjusted p_{corr}	Effect Size
	M (*SD*)	*95 % CI*	*M* (*SD*)	*95 % CI*				
iD-IAT D-scores	−0.27 (0.33)	[−0.35, −0.19]	−0.34 (0.31)	[−0.43, −0.25]	1.18	0.121	0.121	0.32
cD-IAT D-scores	−0.21 (0.33)	[−0.29, −0.13]	−0.36 (0.33)	[−0.45, −0.27]	2.48	0.007	0.014	0.33
	RSA (n = 51)		LSA (n = 65)		One-tailed t-test	p-value	FDR adjusted p_{corr}	Effect Size
	M (*SD*)	*95 % CI*	*M* (*SD*)	*95 % CI*				
iD-IAT D-scores	−0.23 (0.31)	[−0.32, −0.14]	−0.36 (0.32)	[−0.44, −0.28]	2.18	0.016	0.016	0.32
cD-IAT D-scores	−0.19 (0.31)	[−0.28, −0.11]	−0.33 (0.35)	[−0.42, −0.25]	2.26	0.013	0.016	0.33

Note. iD-IAT = identity Death-Implicit Association Test; cD-IAT = control Death-Implicit Association Test; MSA = multiple suicide attempters; SSA = single suicide attempters; RSA = recent suicide attempters; LSA = lifetime suicide attempters; *M* = mean; *SD* = standard deviation; CI = confidence interval; FDR = false discovery rate.

3.3. Group differences in implicit associations with death

The iD-IAT showed no difference between MSA and SSA ($t(114) = 1.18$, $p = .121$, $d = 0.32$), indicating comparable implicit self-life associations. The cD-IAT showed a small difference, suggesting weaker implicit internal control-life associations in MSA compared to SSA ($t(114) = 2.48$, $p = .007$, $d = 0.33$). Small differences were found between RSA and LSA in both versions, suggesting weaker implicit self-life ($t(114) = 2.18$, $p = .016$, $d = 0.32$) and internal control-life associations ($t(114) = 2.26$, $p = .013$, $d = 0.33$) in RSA compared to LSA. See Fig. 1 for the distributions per group and D-IAT version. After accounting for multiple comparisons in MSA vs. SSA, the difference in the cD-IAT retained significance ($p_{corr} = 0.014$). For the comparison between RSA and LSA, differences in both versions remained significant after adjustment ($p_{corr} = 0.016$).

3.4. Relations between implicit associations with death and explicit psychological constructs

For the iD-IAT, small but statistically significant positive correlations were observed with the IE-4 eLoC scale ($r_s(114) = 0.21$, $p = .021$), BSS ($r_s(114) = 0.20$, $p = .032$), and BDI-II ($r_s(114) = 0.20$, $p = .033$). For the cD-IAT, significant positive correlations were found with the BSS ($r_s(114) = 0.25$, $p = .006$) and BDI-II ($r_s(114) = 0.26$, $p = .006$), indicating small associations. Detailed descriptions of correlations are shown in Fig. 2 (iD-IAT) and Fig. 3 (cD-IAT).

3.5. Incremental validity of D-scores for suicidal behaviour

For the iD-IAT differentiating MSA from SSA in the logistic regression analysis, the overall classification accuracy for the model improved from 58.0 % in the initial block to 63.4 % in the final block. In the final model, the BSS score was a significant predictor ($\chi^2(1, 116) = 4.27$, $p = .039$). Model fit indices showed modest improvement, with −2 log-likelihood

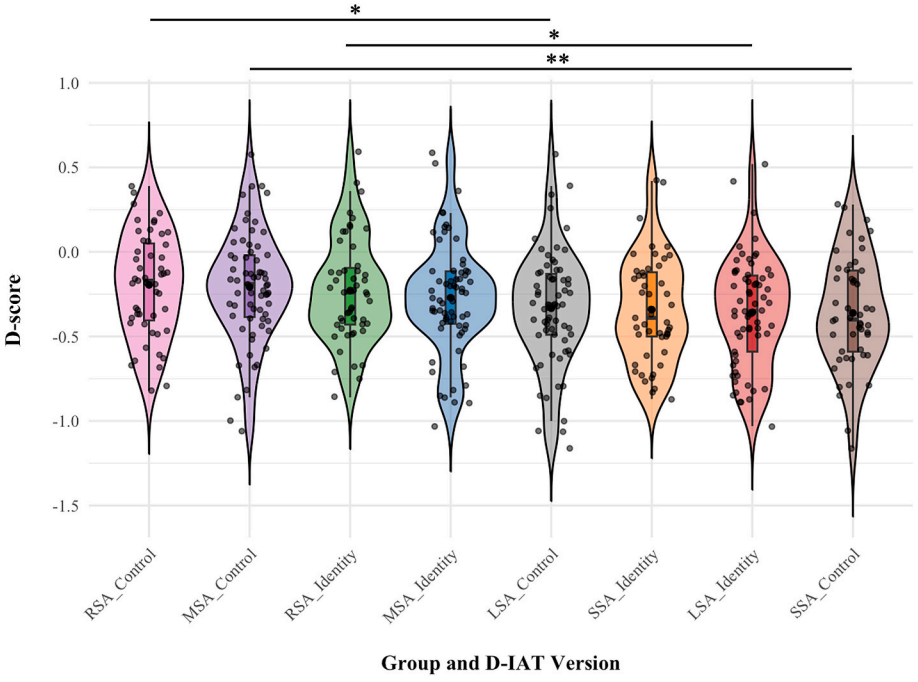

Fig. 1. Distribution of D-scores per group (MSA, SSA, RSA, LSA) and D-IAT version.
Note. RSA = Recent suicide attempters (n = 51); MSA = Multiple suicide attempters (n = 67); LSA = Lifetime suicide attempters (n = 65); SSA = Single suicide attempters (n = 49). Mean D-scores are arranged by group/version combination with the weakest association with life listed on the left, then in descending order. * $p \leq .05$, ** $p \leq .01$.

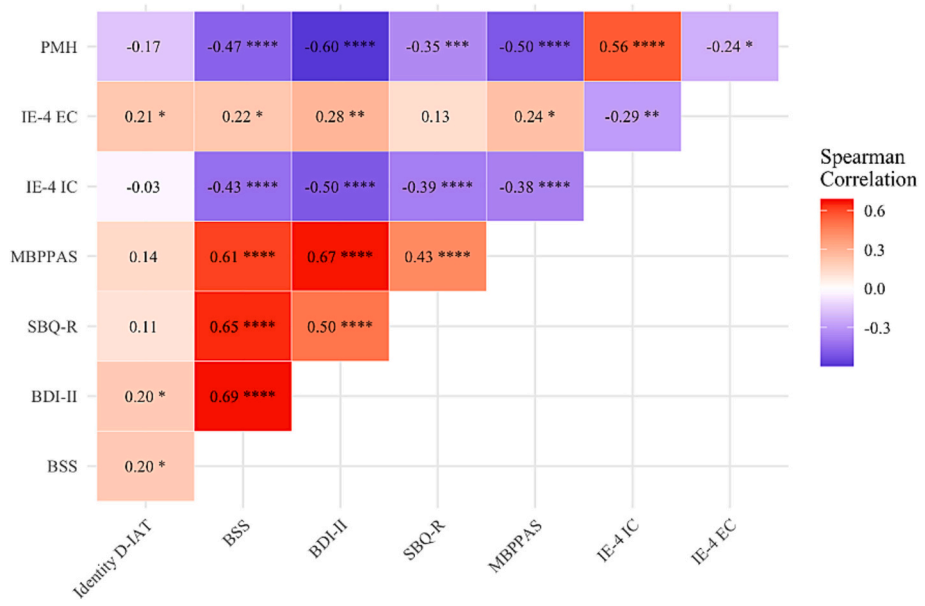

Fig. 2. iD-IAT spearman rank-order correlations with psychological rating scales.
Note. PMH = Positive Mental Health Scale; IE-4 EC = Internal-External Locus of Control Short Scale-4 (External Control); IE-4 IC = Internal-External Locus of Control Short Scale-4 (Internal Control); MBPPAS = Mee-Bunney Psychological Pain Assessment Scale; SBQ-R = Suicide Behaviours Questionnaire-Revised; BDI-II = Beck Depression Inventory-II; BSS = Beck Scale for Suicide Ideation. Spearman rank-order correlation with two-tailed significance test. $N = 116$. * $p \leq .05$, ** $p \leq .01$, *** $p \leq .001$, **** $p \leq .0001$.

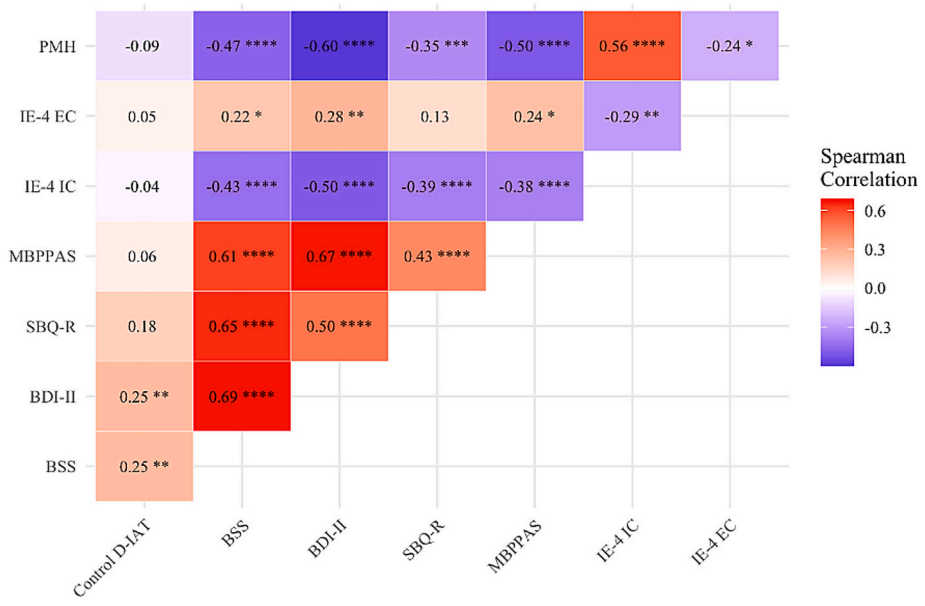

Fig. 3. cD-IAT spearman rank-order correlations with psychological rating scales.
Note. PMH = Positive Mental Health Scale; IE-4 EC = Internal-External Locus of Control Short Scale-4 (External Control); IE-4 IC = Internal-External Locus of Control Short Scale-4 (Internal Control); MBPPAS = Mee-Bunney Psychological Pain Assessment Scale; SBQ-R = Suicide Behaviours Questionnaire-Revised; BDI-II = Beck Depression Inventory-II; BSS = Beck Scale for Suicide Ideation. Spearman rank-order correlation with two-tailed significance test. $N = 116$. * $p \leq .05$, ** $p \leq .01$, *** $p \leq .001$, **** $p \leq .0001$.

(LL) decreasing from 149.235 to 142.063, Nagelkerke R^2 increasing from 0.037 to 0.118; Hosmer–Lemeshow test remained nonsignificant ($\chi^2(8) = 5.66$, $p = .685$). Omnibus Test of Model Coefficients (OT) was nonsignificant for the final model ($\chi^2(6) = 10.297$, $p = .113$). Thus, the new model is not an improvement over the base model.

For the cD-IAT, the overall classification accuracy increased from 58.0 % to 62.5 %. The D-score added in the final model was the only significant statistical predictor of multiple suicidal attempts ($\chi^2(1, 116) = 3.88$, $p = .049$). A one-unit increase in the D-score was associated with 3.72 times higher odds of multiple suicide attempts (OR = 3.72, 95 % CI [1.01, 13.76]. Model fit indices reflected more substantial improvement than when including the iD-IAT's D-score in the final model, with −2 LL decreasing from 149.235 to 138.147, Nagelkerke R^2 increasing from 0.037 to 0.160; Hosmer–Lemeshow test remained nonsignificant ($\chi^2(8) = 1.562$, $p = .992$). OT did indicate an improvement for the final model ($\chi^2(6) = 14.213$, $p = .027$).

For the iD-IAT differentiating RSA from LSA, the model improved from 55.4 % to 69.6 %. Model fit indices demonstrated better

performance, with −2 LL decreasing from 150.788 to 137.400 and Nagelkerke R^2 increasing from 0.038 to 0.184; Hosmer–Lemeshow test remained nonsignificant ($\chi^2(8) = 3.564$, $p = .894$). OT was significant for the final model ($\chi^2(6) = 16.577$, $p = .011$), suggesting an improvement over the baseline model. The BSS added in the final model was a statistically significant predictor ($\chi^2(1, 116) = 6.63$, $p = .010$).

For the cD-IAT, overall classification accuracy improved from 55.4 % to 64.3 %, with −2 LL decreasing from 150.788 to 139.305 and Nagelkerke R^2 increasing from 0.038 to 0.164; Hosmer–Lemeshow test indicated a good fit, although nonsignificant ($\chi^2(8) = 3.778$, $p = .877$). OT was significant ($\chi^2(6) = 14.672$, $p = .023$), indicating an improvement over the baseline model. The BSS added in the final model was a statistically significant predictor ($\chi^2(1, 116) = 6.19$, $p = .013$).

Results showed limited incremental value when both D-scores were included in the final block. For differentiating MSA from SSA, the cD-IAT's D-score remained a marginally significant statistical predictor of group membership beyond demographic and diagnostic variables, explicit suicidal ideation, and the iD-IAT's D-score ($\chi^2(1, 116) = 3.74$, $p = .053$). In contrast, for differentiating RSA from LSA, only the BSS score remained significant ($\chi^2(1, 116) = 5.49$, $p = .019$), with neither D-IAT contributing uniquely to group differentiation.

3.6. Detecting differences in suicidal behaviour based on D-scores

In the ROC analysis for identifying MSA, the iD-IAT showed an AUC of 0.57 (*SE* = 0.06, $p = .179$, 95 % *CI* [0.47, 0.68]). The cD-IAT demonstrated a higher AUC of 0.64 (*SE* = 0.05, $p = .013$, 95 % *CI* [0.53, 0.74]). For identifying RSA, the iD-IAT yielded an AUC of 0.60 (*SE* = 0.05, $p = .073$, 95 % *CI* [0.49, 0.70]), and the cD-IAT an AUC of 0.62 (*SE* = 0.05, $p = .028$, 95 % *CI* [0.52, 0.72]). Both versions of the D-IAT exhibited poor discriminant ability in distinguishing MSA and RSA based on Hosmer and Lemeshow [124].

3.7. Convergent validity

A moderate positive correlation was found between the two D-IAT versions ($r(116) = 0.34$, $p < .001$, 95 % *CI* [0.17, 0.50]), suggesting that both versions measure related constructs, supporting moderate convergent validity.

3.8. Reliability

For the iD-IAT, the permutation-based split-half reliability coefficient was $r_{sb}(114) = 0.23$, 95 % CI [−0.12, 0.51] ($p = .011$), based on 5000 permutations. The cD-IAT showed a slightly higher reliability coefficient of $r_{sb} = 0.31$, 95 % CI [−0.07, 0.59] ($p = .001$). Both coefficients reflect low reliability based on de Vet et al. [125]. Notably, when using all trials combined, the reliability increased to a moderate level of $r_{sb}(114) = 0.54$, 95 % CI [0.22, 0.74] ($p < .001$) (see Figs. 4–6).

4. Discussion

This study integrated theoretical LoC theory with advanced implicit measures to differentiate suicidal behaviour based on frequency and recency of attempts, contributing to a multidimensional understanding of behavioural markers in suicide risk. Using the iD-IAT and the newly developed cD-IAT, this study aimed to advance the development of cognitive marker identification in suicide risk, particularly in capturing automatic biases related to the controllability of death.

4.1. The novel cD-IAT: a marker of death-related control cognitions

The development of the cD-IAT represents a novel approach to understanding implicit cognitive associations between internal or external control and life or death, an area previously underexplored in suicide research. Findings revealed weaker internal control-life associations in MSA compared to SSA, suggesting that individuals with repeated attempts may implicitly feel less connected to life as a domain under personal control and perceive a greater sense of external forces governing life. These findings extend prior research by demonstrating that such feelings of lack of control may not only be explicitly but also implicitly embedded in the cognitive architecture of recurrent attempters. The cD-IAT also differentiated RSA from LSA at the group level, suggesting its potential sensitivity in identifying recent suicidal states. RSA's weaker internal control-life associations again support a maladaptive bias in patient experiences, suggesting that acute suicidal states may be marked by a disconnection from control over life, potentially shifting control toward death [122]. In this context, it is critical to conceptualise the cD-IAT not as a general measure of LoC but as an implicit measure of the controllability over life and death, a related but distinct construct. This refined conceptualisation aligns with theoretical frameworks such as learned helplessness and hopelessness theories [63,126–128], which emphasise the role of perceived control in psychological distress. It is also important to acknowledge that IATs generally assess relative rather than absolute associations [131]. Thus, a weaker internal control-life association, as observed in MSA and RSA, may reflect a stronger association between external control and death, or a dual shift in both domains. While this relative and comparative structure increases sensitivity to cognitive contrasts, it also limits interpretability by collapsing distinct biases into a single summary score [132]. This makes it difficult to determine which component drives the observed effects, i.e., weaker internal control-life association, stronger external control-death association, or both.

The results of the present study reinforce the exploratory sensitivity

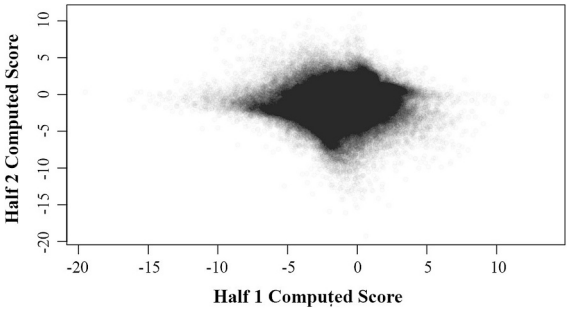

Fig. 4. Split-half scatterplot for all iterations (n = 5000) across the trials of the iD-IAT.
Note. Each point in the scatterplot represents one of $n = 5000$ random split-half permutations used to estimate the reliability of the iD-IAT in $n = 13{,}920$ individual trials. In each iteration, trials were randomly divided into two equal halves per participant, and a split-half correlation was calculated.

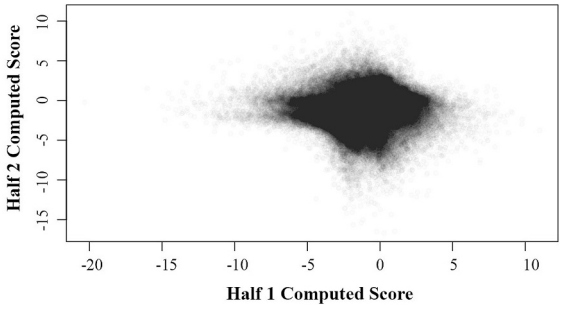

Fig. 5. *Split-half Scatterplot for all Iterations (n = 5000) across the Trials of the cD-IAT.*
Note. Each point in the scatterplot represents one of $n = 5000$ random split-half permutations used to estimate the reliability of the cD-IAT in $n = 13{,}920$ individual trials. In each iteration, trials were randomly divided into two equal halves per participant, and a split-half correlation was calculated.

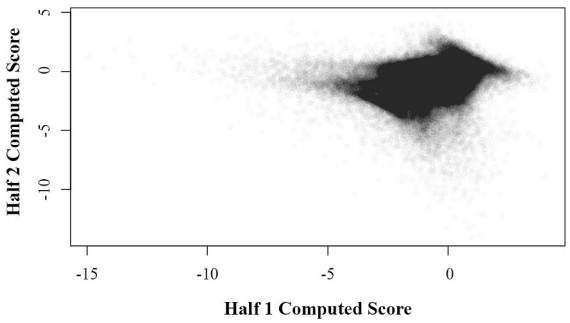

Fig. 6. Split-half scatterplot for all iterations (n = 5000) across all trials of both D-IAT versions.

Note. Each point in the scatterplot represents one of $n = 5000$ random split-half permutations used to estimate the reliability of the cD-IAT in $n = 27{,}840$ individual trials. In each iteration, trials were randomly divided into two equal halves per participant, and a split-half correlation was calculated.

of the cD-IAT to subgroup-specific cognitive vulnerabilities and highlight its potential relevance in risk stratification, though findings must be interpreted with caution given the small group effects and preliminary nature of the task. Still, the cD-IAT shows potential to assess automatic control-death associations, addressing the limitations of explicit control-related measures prone to biases [129,130] and providing new insights into the cognitive underpinnings of suicidal behaviour. These findings should be viewed as proof-of-concept and do not yet support direct clinical application without further replication and validation.

4.2. Self-death associations and suicidal mode

The iD-IAT shows weaker self-life associations in RSA compared to LSA, supporting models in which death becomes unconsciously intertwined with one's sense of self during acute crises [133,134]. The presence of weaker self-life and internal control-life associations in RSA may reflect a duality in suicidal cognition, whereby suicidal crises are potentially linked to both perceived external pressures and reduced control over life as well as a distorted self-concept. These interpretations align with theoretical models of cognitive entrapment, where internalised and externalised cognitive biases sustain acute suicidal ideation [135]. However, given ongoing debates regarding what the IAT captures [136–138], these findings should be interpreted with caution. The iD-IAT did not differentiate between MSA and SSA, suggesting that implicit self-life or self-death associations may be more reflective of acute cognitive states than of patterns tied to the frequency of suicidal behaviour. This aligns with the concept of the suicidal mode [27], which is likely currently or recently activated in RSA, intensifying the integration of death with one's self-concept. By contrast, MSA may experience a vulnerability to suicidal behaviour driven more by enduring psychological distress and less by the immediate activation of a mode. Our findings, along with the partly heterogeneous literature on null findings in group differences with the iD-IAT [37,45,46], suggest that the iD-IAT's sensitivity to suicidal subgroups may vary, highlighting the need for implicit measures with high specificity and different cognitive foci to distinguish between acute and persistent risk factors.

4.3. Relationships between implicit and explicit measures

The observed correlations between the iD-IAT and explicit measures of suicidal ideation intensity, depressive symptom severity, and general eLoC suggest a potential relationship between automatic self-death associations and psychological vulnerabilities, such as emotional distress and perceived external constraints. Similarly, the associations between the cD-IAT and explicit measures of suicidal ideation intensity and depressive symptom severity may reflect a link between weaker internal control-life associations and depressive cognitions or suicidal ideation. These findings suggest that diminished internal control-life associations, reflecting a weaker implicit linkage between life and the control of it, may co-occur with explicit symptoms of distress. However, these findings are correlational and do not establish causation. The directionality and underlying mechanisms of these relationships remain unclear.

Interestingly, the lack of correlation between the cD-IAT and the IE-4, an explicit measure of general LoC, emphasises specific independence of implicit and explicit processes in control-related cognition. This divergence may stem from the distinct constructs each measure assesses; the cD-IAT captures automatic associations between control and life or death, whereas the IE-4 evaluates generalised and conscious perceptions about control across various life domains. This distinction aligns with literature suggesting that explicit and implicit measures tap into different aspects of cognitive-psychological constructs [83,139]. From this perspective, the cD-IAT may serve as a useful marker of context-sensitive, automatic cognitive responses to life and death stimuli, rather than reflecting stable, internalised beliefs about control.

The cD-IAT's ability to identify weakened associations between life and iLoC suggests it taps into automatic cognitive schemas tied to a sense of powerlessness or external constraint, schemas that may remain inaccessible through introspection or self-report. The ambivalent relationships between implicit values and explicit measures observed in our study point to the complexity of automatically biased behaviour, as captured by tasks like the IAT. Rather than assuming a fixed dual-process interaction between implicit and explicit cognition, a growing body of literature suggests that implicit bias is best understood as behaviour that emerges automatically in response to contextual cues [139], rather than as a reflection of stable, internal constructs [e.g., [140,141]]. From this perspective, the IAT may serve as a noisy but experimentally useful marker of how contextual features can influence rapid behavioural responses.

4.4. Validity and reliability of the D-IAT

The cD-IAT's D-score shows potential as a statistical predictor variable of multiple suicide attempts, as it contributed significantly to the regression models after controlling for demographic and clinical variables, explicit suicidal ideation and the iD-IAT's D-score performance. This finding tentatively supports the relevance of internal control biases in understanding multiple suicidal behaviours. However, the incremental discriminant utility of the cD-IAT remains limited, as overall model fits were modest and individual predictors, apart from the D-score, were not consistently significant. For recent suicidal behaviour, neither the iD-IAT nor the cD-IAT demonstrated incremental discriminant validity, though both improved model fit slightly. These results suggest that implicit associations captured by the D-IATs may have limited sensitivity to acute, situational suicidal states compared to more entrenched behavioural patterns, such as multiple attempts. The cD-IAT demonstrated slightly better internal consistency than the iD-IAT, though both showed low levels of reliability. This reduced reliability may be due to the brevity of the tasks and the inherent noisiness of reaction time-based measures [136,142]. Notably, reliability increased when all trials across participants were pooled, suggesting greater stability at the group level. Additionally, the limited discriminant ability of both D-IAT versions in identifying the subgroups suggests that, while these tools provide valuable insights into implicit cognition, they should complement rather than replace other clinical assessments. Taken together, the findings offer preliminary support for both D-IATs' validity but do not yet justify its use in clinical settings, where higher and prospective reliability and stronger individual-level discrimination accuracy are essential.

4.5. Diagnostic sample characteristics and explicit measures

Multiple attempters (MSA) demonstrated higher levels of suicidal

ideation intensity, depressive symptoms, and suicide risk factors compared to single attempters (SSA), confirming expected patterns of psychological distress and emotional dysregulation across subgroups with suicidal behaviour [22,143–146]. This pattern aligns with prior research indicating that individuals with multiple suicide attempts experience more psychological distress, often rooted in prolonged exposure to stressors and cognitive entrapment, processes that exacerbate feelings of hopelessness and perceived burden [24,31,132,135]. Additionally, MSA showed a higher prevalence of anxiety and trauma-related disorders than SSA, reflecting the role of comorbid psychopathology in suicidal behaviour. Such disorders can amplify suicide-related cognitive distortions and increase vulnerability to cognitive and emotional dysregulation, fostering a cycle of recurrent suicidal ideation and behaviour [147,148].

Recent attempters (RSA) exhibited higher levels of suicidal ideation (BSS) and depressive symptoms (BDI-II) compared to lifetime attempters (LSA), reflecting acute psychological distress often associated with proximity to a suicide attempt [149,150]. These findings are consistent with models of emotional dysregulation, where recent attempters experience heightened affective arousal and cognitive rigidity, potentially driving immediate suicidal behaviour [28,29]. Unlike MSA, differences in diagnoses were not observed between RSA and LSA, suggesting that acute crises may be more strongly driven by situational stressors or transient cognitive states rather than chronic psychopathology. Such transient states are often conceptualised within the framework of the *suicidal mode*, a cognitive-affective state characterised by heightened emotional arousal, cognitive rigidity, and an increased focus on death as a solution [27]. The suicidal mode is thought to be triggered by acute stressors, such as interpersonal conflicts or significant life events, which interact with pre-existing vulnerabilities to produce an immediate crisis [71]. This dynamic contrasts with MSA, where suicidal behaviour may be sustained by entrenched cognitive and emotional patterns, highlighting the importance of differentiating between acute and chronic drivers of suicidal behaviour.

4.6. Clinical implications

Identifying specific implicit associations that operate at an automatic level may provide insights into cognitive vulnerabilities that precede or accompany suicidal crises, emphasising the integration of implicit tools into suicide risk assessments, particularly for high-risk groups. The weaker internal control-life associations in MSA and RSA suggest the potential benefit of interventions targeting LoC, such as cognitive-behavioural therapies focused on enhancing perceived agency or self-efficacy [151,152]. By addressing control-related associations at the automatic level, interventions could disrupt automatic cognitive patterns that may reinforce suicidal behaviour. However, given that this study served as a proof-of-concept for the cD-IAT, and that its reliability and discriminant validity were limited, such intervention implications remain speculative.

Although the effectiveness of implicit bias interventions varies [153,154], conditioning-based research suggests biased cognitive patterns can be modified [155]. Studies targeting biases related to race [156] and substance use [157] demonstrate the potential to influence implicit associations and processes related to control. For RSA, crisis-focused interventions, such as dialectical behaviour therapy [158] or mindfulness-based cognitive therapy [159], could address the acutely weakened self-life associations. Notably, recent research shows that combining intermittent theta-burst stimulation with D-cycloserine leads to reductions in both suicidal ideation and implicit suicide risk, as measured by the D-IAT, in individuals with treatment-resistant depression. This suggests that neurobiologically informed interventions may effectively target implicit cognitive vulnerabilities tied to suicide risk [160]. Nevertheless, such clinical translation requires a stronger empirical foundation, and future studies should aim to replicate and extend the present results in larger, longitudinal, and intervention-focused clinical designs.

4.7. Limitations and future directions

Several limitations warrant consideration. The cross-sectional design precludes causal inferences about the observed relationships. Although the retrospective models of this study offer preliminary insight, prospective research is needed to determine whether the implicit associations identified act as precursors or consequences of suicidal behaviour. Notably, a recent meta-analysis by Sohn et al. [42] demonstrated the prospective utility of the IAT in predicting suicidal ideation and behaviour, supporting its potential as a valuable tool in longitudinal risk assessment. Nonetheless, caution is warranted when interpreting the present study's findings due to the lack of temporal data. The challenges in developing suicide risk markers reflect the multifactorial nature of suicidal behaviour, shaped by complex interactions between psychological, biological, and social factors [6].

A key methodological limitation of the IAT lies in its relative nature; it may be able to assess the strength of the association between internal control and life vs. external control and death, but cannot disentangle which specific component drives the observed effect. Future research could benefit from process-dissociation procedures and multinomial modelling approaches that enable the extraction of more independent or absolute implicit associations [161]. Another related limitation concerns the emotional valence of the stimuli used in the cD-IAT. Internal control items were predominantly positive in tone, whereas external control items carried more negative connotations. Although this design choice follows established best practices for creating dichotomous IAT categories [94], it raises the possibility that participants may have recoded the task as a positive-negative attitude IAT rather than one targeting implicit control constructs. This interpretation is particularly relevant given that the cD-IAT did not significantly correlate with explicit measures of LoC. Additionally, while the stimuli were theoretically derived and reviewed for content validity, they were not empirically validated through pre-testing. Future research should consider including valence-matched bipolar explicit items that directly reflect the implicit constructs assessed, as these are more likely to yield stronger implicit-explicit correspondence [162,163].

The sample was drawn exclusively from a German-speaking psychiatric inpatient population with prior suicidal behaviour and did not include a control group without a history of suicidal ideation or behaviour, limiting the cultural and clinical generalisability of findings. The RSA conceptualisation based on behaviour during the month prior to testing was especially broad. The study also relied solely on the D-IAT as the cognitive task, without control measures like the *d2 Test of Attention* (D2; [164]) or Trail Making Test (TMT; [165]), making it unclear whether the observed effects are specific to suicide-related stimuli or reflect a broader cognitive impairment in suicidal patients.

Future research should validate the cD-IAT in diverse populations and different psychiatric profiles, particularly using more refined definitions of suicidal ideation and behaviour and including non-suicidal control groups. Neurocognitive studies should explore its integration with neurobiological markers, such as brain imaging or stress hormones, to develop multidimensional risk profiles. Experimental studies are also needed to test the efficacy of interventions targeting implicit cognitive biases.

5. Conclusion

This study suggests that the newly developed cD-IAT may provide added value in assessing domain-specific control biases, i.e., the relative strength of automatic associations between life or death and internal or external control, offering a complementary perspective on the cognitive processes involved in suicidal behaviour. The ability of the cD-IAT to differentiate suicidal behaviour by frequency and recency of attempts suggests its relevance in identifying specific suicide risk profiles.

However, findings should be interpreted with caution, as they are preliminary and based on a single cross-sectional sample. Integrating implicit measures with traditional explicit assessments may enhance accuracy in identifying individuals at elevated risk and inform the development of targeted intervention strategies. Further research should focus on replicating these findings, and on evaluating the stability and predictive validity in practical applications of the cD-IAT over time in clinical and research settings.

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CRediT authorship contribution statement

Lara Marie Aschenbrenner: Writing – original draft, Visualization, Project administration, Investigation, Formal analysis, Data curation. **Adriana Frei:** Writing – review & editing, Project administration, Investigation. **Thomas Forkmann:** Writing – review & editing, Validation, Methodology. **Dajana Schreiber:** Writing – review & editing, Validation, Methodology. **Heide Glaesmer:** Writing – review & editing, Methodology, Conceptualization. **Juliane Brüdern:** Writing – review & editing, Validation, Methodology, Conceptualization. **Maria Stein:** Writing – review & editing, Validation, Methodology. **Marie-Anna Sedlinská:** Writing – review & editing. **Kristina Adorjan:** Writing – review & editing, Resources, Funding acquisition. **Sebastian Walther:** Writing – review & editing, Resources, Funding acquisition. **Anja Gysin-Maillart:** Writing – review & editing, Supervision, Methodology, Conceptualization.

Declaration of generative AI and AI-assisted technologies in the writing process

During the preparation of this work the author(s) used ChatGPT by OpenAI in order to improve language and readability and shorten text passages. After using this tool, the author(s) reviewed and edited the content as needed and take(s) full responsibility for the content of the publication.

Declaration of competing interest

The authors declare that they have no conflicts of interest in relation to this work.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.comppsych.2025.152621.

Data availability

The data supporting this study's findings are publicly available on Mendeley Data at https://doi.org/10.17632/hv2bj2wv3t.1. Researchers are encouraged to access the dataset for further validation and secondary analysis.

References

[1] World Health Organization. Suicide. https://www.who.int/news-room/fact-sheets/detail/suicide;; 2023 [accessed 6 January 2025].
[2] World Health Organization. Figures and facts about suicide. https://iris.who.int/bitstream/handle/10665/66097/WHO_MNH_MBD_99.1.pdf?sequence=1;; 1999 [accessed 6 January 2025].
[3] Doupnik SK, Rudd B, Schmutte T, Worsley D, Bowden CF, McCarthy E, et al. Association of suicide prevention interventions with subsequent suicide attempts, linkage to follow-up care, and depression symptoms for acute care settings: a systematic review and meta-analysis. JAMA Psychiatry 2020;77(10):1021–30. https://doi.org/10.1001/jamapsychiatry.2020.1586.
[4] O'Connor EA, Perdue LA, Coppola EL, Henninger ML, Thomas RG, Gaynes BN. Depression and suicide risk screening: updated evidence report and systematic review for the US preventive services task force. JAMA 2023;329(23):2068–85. https://doi.org/10.1001/jama.2023.7787.
[5] Apter A, Horesh N, Gothelf D, Graffi H, Lepkifker E. Relationship between self-disclosure and serious suicidal behavior. Compr Psychiatry 2001;42(1):70–5. https://doi.org/10.1053/comp.2001.19748.
[6] Franklin JC, Ribeiro JD, Fox KR, Bentley KH, Kleiman EM, Huang X, et al. Risk factors for suicidal thoughts and behaviors: a meta-analysis of 50 years of research. Psychol Bull 2017;143(2):187–232. https://doi.org/10.1037/bul0000084.
[7] Haghish EF, Nes RB, Obaidi M, Qin P, Stänicke LI, Bekkhus M, et al. Unveiling adolescent suicidality: holistic analysis of protective and risk factors using multiple machine learning algorithms. J Youth Adolesc 2024;53(3):507–25. https://doi.org/10.1007/s10964-023-01892-6.
[8] Millner AJ, Lee MD, Nock MK. Single-item measurement of suicidal behaviors: validity and consequences of misclassification. PLoS One 2015;10(10):e0141606. https://doi.org/10.1371/journal.pone.0141606.
[9] Nock MK, Borges G, Bromet EJ, Cha CB, Kessler RC, Lee S. Suicide and suicidal behavior. Epidemiol Rev 2008;30(1):133–54. https://doi.org/10.1093/epirev/mxn002.
[10] Ammerman BA, Piccirillo ML, O'Loughlin CM, Carter SP, Matarazzo B, May AM. The role of suicide stigma in self-disclosure among civilian and veteran populations. Psychiatry Res 2022;309:114408. https://doi.org/10.1016/j.psychres.2022.114408.
[11] Nicholas A, Haregu T, Henderson C, Armstrong G. Suicide stigma measures: a scoping review. J Affect Disord 2023;321:114–25. https://doi.org/10.1016/j.jad.2022.10.023.
[12] Rimkeviciene J, Hawgood J, O'Gorman J, De Leo D. Personal stigma in suicide attempters. Death Stud 2015;39(10):592–9. https://doi.org/10.1080/07481187.2015.1037972.
[13] Hom MA, Stanley IH, Joiner Jr TE. Evaluating factors and interventions that influence help-seeking and mental health service utilization among suicidal individuals: a review of the literature. Clin Psychol Rev 2015;40:28–39. https://doi.org/10.1016/j.cpr.2015.05.006.
[14] Van Orden KA, Witte TK, Cukrowicz KC, Braithwaite SR, Selby EA, Joiner Jr TE. The interpersonal theory of suicide. Psychol Rev 2010;117(2):575–600. https://doi.org/10.1037/a0018697.
[15] Schmidt NB, Woolaway-Bickel K, Bates M. Evaluating panic-specific factors in the relationship between suicide and panic disorder. Behav Res Ther 2001;39(6):635–49. https://doi.org/10.1016/s0005-7967(00)00034-6.
[16] Moreno M, Gutiérrez-Rojas L, Porras-Segovia A. Implicit cognition tests for the assessment of suicide risk: a systematic review. Curr Psychiatry Rep 2022;24(2):141–59. https://doi.org/10.1007/s11920-022-01316-5.
[17] Owsiany MT, Fiske A. Control in relation to suicidal ideation and nonfatal suicidal behavior among older adults: a systematic review. Aging Ment Health 2024:1–12. https://doi.org/10.1080/13607863.2024.2365885.
[18] Mann JJ, Rizk MM. A brain-centric model of suicidal behavior. Am J Psychiatry 2020;177(10):902–16. https://doi.org/10.1176/appi.ajp.2020.20081224.
[19] Sobanski T, Peikert G, Kastner UW, Wagner G. Suicidal behavior: advances in clinical and neurobiological research and improvement of prevention strategies. World J Psychiatry 2022;12(9):1115–26. https://doi.org/10.5498/wjp.v12.i9.1115.
[20] Jager-Hyman S, Cunningham A, Wenzel A, Mattei S, Brown GK, Beck AT. Cognitive distortions and suicide attempts. Cogn Ther Res 2014;38(4):369–74. https://doi.org/10.1007/s10608-014-9613-0.
[21] May AM, Klonsky ED. What distinguishes suicide attempters from suicide ideators? A meta-analysis of potential factors. Clin Psychol Sci Pract 2016;23(1):5–20. https://doi.org/10.1037/h0101735.
[22] Miranda R, Tsypes A, Gallagher M, Rajappa K. Rumination and hopelessness as mediators of the relation between perceived emotion dysregulation and suicidal ideation. Cognit Ther Res 2013;37(4):786–95. https://doi.org/10.1007/s10608-013-9524-5.
[23] Demesmaeker A, Chazard E, Vaiva G, Amad A. Risk factors for reattempt and suicide within 6 months after an attempt in the French ALGOS cohort: a survival tree analysis. J Clin Psychiatry 2021;82(1):20m13589. https://doi.org/10.4088/JCP.20m13589.
[24] Forman EM, Berk MS, Henriques GR, Brown GK, Beck AT. History of multiple suicide attempts as a behavioral marker of severe psychopathology. Am J Psychiatry 2004;161(3):437–43. https://doi.org/10.1176/appi.ajp.161.3.437.
[25] Nichter B, Maguen S, Monteith LL, Kachadourian L, Norman SB, Hill ML, et al. Factors associated with multiple suicide attempts in a nationally representative study of U.S. military veterans. J Psychiatr Res 2021;140:295–300. https://doi.org/10.1016/j.jpsychires.2021.06.012.

[26] Smith L, Shin JI, Carmichael C, Oh H, Jacob L, López Sánchez GF, et al. Prevalence and correlates of multiple suicide attempts among adolescents aged 12-15 years from 61 countries in Africa, Asia, and the Americas. J Psychiatr Res 2021;144:45–53. https://doi.org/10.1016/j.jpsychires.2021.09.047.
[27] Rudd MD. The suicidal mode: a cognitive-behavioral model of suicidality. Suicide Life Threat Behav 2000;30(1):18–33. https://doi.org/10.1111/j.1943-278X.2000.tb01062.x.
[28] Boudreaux ED, Camargo Jr CA, Arias SA, Sullivan AF, Allen MH, Goldstein AB, et al. Improving suicide risk screening and detection in the emergency department. Am J Prev Med 2016;50(4):445–53. https://doi.org/10.1016/j.amepre.2015.09.029.
[29] Fernández-Sevillano J, Alberich S, Zorrilla I, González-Ortega I, López MP, Pérez V, et al. Cognition in recent suicide attempts: altered executive function. Front Psychol 2021;12:701140. https://doi.org/10.3389/fpsyt.2021.701140.
[30] Aaltonen K, Sund R, Hakulinen C, Pirkola S, Isometsä E. Variations in suicide risk and risk factors after hospitalization for depression in Finland, 1996-2017. JAMA Psychiatry 2024;81(5):506–15. https://doi.org/10.1001/jamapsychiatry.2023.5512.
[31] Christiansen E, Jensen BF. Risk of repetition of suicide attempt, suicide or all deaths after an episode of attempted suicide: a register-based survival analysis. Aust N Z J Psychiatry 2007;41(3):257–65. https://doi.org/10.1080/00048670601172749.
[32] Berardelli I, Forte A, Innamorati M, Imbastaro B, Montalbani B, Sarubbi S, et al. Clinical differences between single and multiple suicide attempters, suicide ideators, and non-suicidal inpatients. Front Psychol 2020;11:605140. https://doi.org/10.3389/fpsyt.2020.605140.
[33] Carrigan CG, Lynch DJ. Managing suicide attempts: guidelines for the primary care physician. Prim Care Companion J Clin Psychiatry 2003;5(4):169–74. https://doi.org/10.4088/pcc.v05n0405.
[34] Greenwald AG, McGhee DE, Schwartz JL. Measuring individual differences in implicit cognition: the implicit association test. J Pers Soc Psychol 1998;74(6):1464–80. https://doi.org/10.1037/0022-3514.74.6.1464.
[35] Nock MK, Park JM, Finn CT, Deliberto TL, Dour HJ, Banaji MR. Measuring the suicidal mind: implicit cognition predicts suicidal behavior. Psychol Sci 2010;21(4):511–7. https://doi.org/10.1177/0956797610364762.
[36] Rath D, Hallensleben N, Glaesmer H, Spangenberg L, Strauss M, Kersting A, et al. Implizite Assoziationen mit dem Tod: Erste Validierung einer deutschen Version des Impliziten Assoziationstests für Suizidalität (Suizid-IAT). Psychother Psychosom Med Psychol 2018;68(3–4):109–17. https://doi.org/10.1055/s-0043-105070.
[37] Barnes SM, Bahraini NH, Forster JE, Stearns-Yoder KA, Hostetter TA, Smith G, et al. Moving beyond self-report: implicit associations about death/life prospectively predict suicidal behavior among veterans. Suicide Life Threat Behav 2017;47(1):67–77. https://doi.org/10.1111/sltb.12265.
[38] Brüdern J, Spangenberg L, Stein M, Forkmann T, Schreiber D, Stengler K, et al. Implicit measures of suicide vulnerability: investigating suicide-related information-processing biases and a deficit in behavioral impulse control in a high-risk sample and healthy controls. Behav Res Ther 2024;180:104601. https://doi.org/10.1016/j.brat.2024.104601.
[39] Glenn CR, Millner AJ, Esposito EC, Porter AC, Nock MK. Implicit identification with death predicts suicidal thoughts and behaviors in adolescents. J Clin Child Adolesc Psychol 2019;48(2):263–72. https://doi.org/10.1080/15374416.2018.1528548.
[40] Millner AJ, Coppersmith DDL, Teachman BA, Nock MK. The brief death implicit association test: scoring recommendations, reliability, validity, and comparisons with the death implicit association test. Psychol Assess 2018;30(10):1356–66. https://doi.org/10.1037/pas0000580.
[41] Nock MK, Banaji MR. Prediction of suicide ideation and attempts among adolescents using a brief performance-based test. J Consult Clin Psychol 2007;75(5):707–15. https://doi.org/10.1037/0022-006X.75.5.707.
[42] Sohn MN, McMorris CA, Bray S, McGirr A. The death-implicit association test and suicide attempts: a systematic review and meta-analysis of discriminative and prospective utility. Psychol Med 2021;51(11):1789–98. https://doi.org/10.1017/S0033291721002117.
[43] Tello N, Harika-Germaneau G, Serra W, Jaafari N, Chatard A. Forecasting a fatal decision: direct replication of the predictive validity of the suicide-implicit association test. Psychol Sci 2020;31(1):65–74. https://doi.org/10.1177/0956797619893062.
[44] Scheunemann J, Jelinek L, Peth J, Runde A, Artl S, Gallinat J, et al. Do implicit measures improve suicide risk prediction? An 18-month prospective study using different tasks. Suicide Life Threat Behav 2021;51(5):993–1004. https://doi.org/10.1111/sltb.12785.
[45] Glenn CR, Kleiman EM, Coppersmith DDL, Santee AC, Esposito EC, Cha CB, et al. Implicit identification with death predicts change in suicide ideation during psychiatric treatment in adolescents. J Child Psychol Psychiatry 2017;58:1319–29. https://doi.org/10.1111/jcpp.12769.
[46] Chiurliza B, Hagan CR, Rogers ML, Podlogar MC, Hom MA, Stanley IH, et al. Implicit measures of suicide risk in a military sample. Assessment 2018;25:667–76. https://doi.org/10.1177/1073191116676363.
[47] Evans WP, Owens P, Marsh SC. Environmental factors, locus of control, and adolescent suicide risk. Child Adolesc Soc Work J 2005;22:301–19. https://doi.org/10.1007/s10560-005-0013-x.
[48] Lauer S, de Man AF, Marquez S, Ades J. External locus of control, problem-focused coping and attempted suicide. N Am J Psychol 2008;10:625–32.
[49] Rotter JB. Generalized expectancies for internal versus external control of reinforcement. Psychol Monogr 1966;80:1–28. https://doi.org/10.1037/h0092976.
[50] Rotter JB. Some problems and misconceptions related to the construct of internal versus external control of reinforcement. J Consult Clin Psychol 1975;43:56–67. https://doi.org/10.1037/h0076301.
[51] Fu J, Zhao Y, Feng X, Wang Y, Yu Z, Hua L, et al. How is fatalistic determinism linked to depression? The mediating role of self-control and resilience. Personal Individ Differ 2021;180:110992. https://doi.org/10.1016/j.paid.2021.110992.
[52] Lin YC, O'Connell KL, Law KC. Moderating roles of grit and locus of control on rumination and suicidality. J Affect Disord 2023;330:250–8. https://doi.org/10.1016/j.jad.2023.02.148.
[53] Roberts RE, Roberts CR, Chen IG. Fatalism and risk of adolescent depression. Psychiatry 2000;63:239–52. https://doi.org/10.1080/00332747.2000.11024917.
[54] Buddelmeyer H, Powdthavee N. Can having internal locus of control insure against negative shocks? Psychological evidence from panel data. J Econ Behav Organ 2016;122:88–109. https://doi.org/10.1016/j.jebo.2015.11.014.
[55] Lefcourt HM. Locus of control and the response to aversive events. Can Psychol Rev 1976;17:202–9. https://doi.org/10.1037/h0081839.
[56] Parkes KR. Locus of control, cognitive appraisal, and coping in stressful episodes. J Pers Soc Psychol 1984;46:655–68. https://doi.org/10.1037//0022-3514.46.3.655.
[57] Felicia F, Satiadarma MP, Subroto U. The relationship between locus of control and resilience in adolescents whose parents are divorced. Adv Soc Sci Educ Humanit Res 2022:655. https://doi.org/10.2991/assehr.k.220404.228.
[58] Kesavayuth D, Binh Tran D, Zikos V. Locus of control and subjective well-being: panel evidence from Australia. PLoS One 2022;17:e0272714. https://doi.org/10.1371/journal.pone.0272714.
[59] Popova S. Locus of control: predictor of health and subjective well-being. Eur Med Health Pharm J 2012:4. https://doi.org/10.12955/emhpj.v4i0.367.
[60] Alloy LB, Abramson LY, Metalsky GI, Hartlage S. The hopelessness theory of depression: attributional aspects. Br J Clin Psychol 1988;27:5–21. https://doi.org/10.1111/j.2044-8260.1988.tb00749.x.
[61] Singhal K, Chukkali S. The role of guilt-shame proneness and locus of control in predicting moral injury among healthcare professionals. Cogent Psychol 2023;10:2264669. https://doi.org/10.1080/23311908.2023.2264669.
[62] Abramson LY, Metalsky GI, Alloy LB. Hopelessness depression: a theory-based subtype of depression. Psychol Rev 1989;96:358–72. https://doi.org/10.1037/0033-295X.96.2.358.
[63] Beck AT, Brown G, Steer RA. Prediction of eventual suicide in psychiatric inpatients by clinical ratings of hopelessness. J Consult Clin Psychol 1989;57:309–10. https://doi.org/10.1037/0022-006X.57.2.309.
[64] Beck AT, Kovacs M, Weissman A. Hopelessness and suicidal behavior. An overview. JAMA 1975;234:1146–9. https://doi.org/10.1001/jama.1975.03260240050026.
[65] Pearce CM, Martin G. Locus of control as an indicator of risk for suicidal behaviour among adolescents. Acta Psychiatr Scand 1993;88:409–14. https://doi.org/10.1111/j.1600-0447.1993.tb03482.x.
[66] Shahid F, Beshai S, Del Rosario N. Fatalism and depressive symptoms: active and passive forms of fatalism differentially predict depression. J Relig Health 2020;59:3211–26. https://doi.org/10.1007/s10943-020-01024-5.
[67] Heinström J. From fear to flow: Personality and information interaction. Oxford: Chandos Publ; 2010.
[68] Pavulans KS, Bolmsjö I, Edberg AK, Ojehagen A. Being in want of control: experiences of being on the road to, and making, a suicide attempt. Int J Qual Stud Health Well-being 2012;7:16228. https://doi.org/10.3402/qhw.v7i0.16228.
[69] Ringel E. The presuicidal syndrome. Suicide 1976;6:131–49. https://doi.org/10.1111/j.1943-278X.1976.tb00328.x.
[70] O'Connor RC. Towards an integrated motivational-volitional model of suicidal behaviour. In: O'Connor RC, Platt S, Gordon J, editors. Int handb suicide prev: res policy pract. Chichester: Wiley Blackwell; 2011. p. 181–98. https://doi.org/10.1002/9781119998556.ch11.
[71] Schotte DE, Clum GA. Problem-solving skills in suicidal psychiatric patients. J Consult Clin Psychol 1987;55(1):49–54. https://doi.org/10.1037//0022-006x.55.1.49.
[72] Baumeister RF. Suicide as escape from self. Psychol Rev 1990;97(1):90–113. https://doi.org/10.1037/0033-295x.97.1.90.
[73] Jobes DA, Jacoby AM, Cimbolic P, Hustead LAT. Assessment and treatment of suicidal clients in a university counseling center. J Couns Psychol 1997;44(4):368–77. https://doi.org/10.1037/0022-0167.44.4.368.
[74] Goldney RD. Locus of control in young women who have attempted suicide. J Nerv Ment Dis 1982;170(4):198–201. https://doi.org/10.1097/00005053-198204000-00003.
[75] Blake RR. Moral locus of control in hastened death when faced with irremediable health conditions. Mortality 2023;29(4):631–44. https://doi.org/10.1080/13576275.2023.2203804.
[76] Rotter JB. Rotter's internal-external control scale. APA PsycTests 2025. https://doi.org/10.1037/t01671-000.
[77] Kovaleva A, Beierlein C, Kemper CJ, Rammstedt B. Internale-Externale-Kontrollüberzeugung-4 (IE-4) [internal-external locus of control-4 (IE-4)]. Köln: GESIS; 2014. https://doi.org/10.6102/zis184.
[78] Rosenman R, Tennekoon V, Hill LG. Measuring bias in self-reported data. Int J Behav Healthcare Res 2011;2(4):320–32. https://doi.org/10.1504/IJBHR.2011.043414.

[79] van de Mortel TF. Faking it: social desirability response bias in self-report research. Aust J Adv Nurs 2008;25(4):40–8. http://www.ajan.com.au/archive/Vol25/Vol_25-4_vandeMortel.pdf.
[80] Deming CA, Harris JA, Castro-Ramirez F, Glenn JJ, Cha CB, Millner AJ, et al. Inconsistencies in self-reports of suicidal ideation and attempts across assessment methods. Psychol Assess 2021;33(3):218–29. https://doi.org/10.1037/pas0000976.
[81] Bryan CJ, Butner JE, May AM, Rugo KF, Harris J, Oakey DN, et al. Nonlinear change processes and the emergence of suicidal behavior: a conceptual model based on the fluid vulnerability theory of suicide. New Ideas Psychol 2020;57:10. https://doi.org/10.1016/j.newideapsych.2019.100758.
[82] Nock MK, Prinstein MJ, Sterba SK. Revealing the form and function of self-injurious thoughts and behaviors: a real-time ecological assessment study among adolescents and young adults. J Abnorm Psychol 2009;118(4):816–27. https://doi.org/10.1037/a0016948.
[83] Dewey JA, Knoblich G. Do implicit and explicit measures of the sense of agency measure the same thing? PLoS One 2014;9(10):e110118. https://doi.org/10.1371/journal.pone.0110118.
[84] Hough TM, Labansat HA, Forest Moore F, Wallace R, Higgins K. Control yourself! Examining the dimensions of eudaimonic psychological well-being as related to locus of control using structural equation modeling. Adv J Soc Sci 2021;8(1):246–55. https://doi.org/10.21467/ajss.8.1.246-255.
[85] Schwarzer R, Fuchs R. Self-efficacy and health behaviors. In: Conner M, Norman P, editors. Predicting health behaviour: Research and practice with social cognition models. Maidenhead: Open University Press; 1996. p. 163–96.
[86] Rudd MD, Berman AL, Joiner Jr TE, Nock MK, Silverman MM, Mandrusiak M, et al. Warning signs for suicide: theory, research, and clinical applications. Suicide Life Threat Behav 2006;36(3):255–62. https://doi.org/10.1521/suli.2006.36.3.255.
[87] Chatard A, Selimbegović L. When self-destructive thoughts flash through the mind: failure to meet standards affects the accessibility of suicide-related thoughts. J Pers Soc Psychol 2011;100(4):587–605. https://doi.org/10.1037/a0022461.
[88] Tang J, Wu S, Miao D. Experimental test of escape theory: accessibility to implicit suicidal mind. Suicide Life Threat Behav 2013;43(4):347–55. https://doi.org/10.1111/sltb.12021.
[89] Beck AT, Steer RA. Beck scale for suicide ideation (BSS). Bloomington: Pearson; 1993.
[90] Kliem S, Lohmann A, Mößle T, Brähler E. German Beck scale for suicide ideation (BSS): psychometric properties from a representative population survey. BMC Psychiatry 2017;17(1):389. https://doi.org/10.1186/s12888-017-1559-9.
[91] Sheehan DV, Lecrubier Y, Sheehan KH, Amorim P, Janavs J, Weiller E, et al. The Mini-international neuropsychiatric interview (MINI): the development and validation of a structured diagnostic psychiatric interview for DSM-IV and ICD-10. J Clin Psychiatry 1998;59:22–33. https://www.psychiatrist.com/read-pdf/11980/.
[92] Ackenheil M, Stotz G, Dietz-Bauer R, Vossen A, Dietz RS, Vossen-Wellmann A, et al. MINI international neuropsychiatric interview: German version 5.0.0 DSM-IV. München: Psychiatrische Universitätsklinik München; 1999.
[93] Gysin-Maillart A, Schwab S, Soravia L, Megert M, Michel K. A novel brief therapy for patients who attempt suicide: a 24-months follow-up randomized controlled study of the attempted suicide short intervention program (ASSIP). PLoS Med 2016;13(3):e1001968. https://doi.org/10.1371/journal.pmed.1001968.
[94] Greenwald AG, Nosek BA, Banaji MR. Understanding and using the implicit association test: I. An improved scoring algorithm. J Pers Soc Psychol 2003;85(2):197–216. https://doi.org/10.1037/0022-3514.85.2.197.
[95] De Houwer J. The implicit association test as a tool for studying dysfunctional associations in psychopathology: strengths and limitations. J Behav Ther Exp Psychiatry 2002;33(2):115–33. https://doi.org/10.1016/s0005-7916(02)00024-1.
[96] Wild D, Grove A, Martin M, Eremenco S, McElroy S, Verjee-Lorenz A, et al. ISPOR task force for translation and cultural adaptation. Principles of good practice for the translation and cultural adaptation process for patient-reported outcomes (PRO) measures: report of the ISPOR task force for translation and cultural adaptation. Value Health 2005;8(2):94–104. https://doi.org/10.1111/j.1524-4733.2005.04054.x.
[97] Egger JW. Selbstwirksamkeit. In: Integrative Verhaltenstherapie und psychotherapeutische Medizin. Wiesbaden: Springer; 2015. https://doi.org/10.1007/978-3-658-06803-5_12.
[98] Jakoby N, Jacob R. Kurzskala Interne und Externe Kontrollüberzeugungen. Köln: GESIS; 2014. https://doi.org/10.6102/zis129.
[99] Hartung S. Partizipation – Eine relevante Größe für individuelle Gesundheit? Auf der Suche nach Erklärungsmodellen für Zusammenhänge zwischen Partizipation und Gesundheit. Berlin: Wissenschaftszentrum Berlin für Sozialforschung; 2011. http://hdl.handle.net/10419/56928.
[100] Krampen G. Zur Spezifität von Kontrollüberzeugungen für Problemlösen in verschiedenen Realitätsbereichen. Schweizerische Zeitrschrift Psychol 1986;45(1/2):67–85.
[101] Maes J. Kontrollieren und kontrolliert werden – Konstruktion und Analyse eines Zwei-Wege-Fragebogens zur Erfassung von Kontrollüberzeugungen. Trier: ZPID; 1995. https://doi.org/10.23668/psycharchives.8962.
[102] Rudolph U, Thomas A, Schweizer J. Kontrollüberzeugungen und subjektive Lebensqualität bei chronischen Erkrankungen: Zur Bedeutung von Mechanismen der Krankheitsbewältigung [control beliefs and quality of life in patients with chronic diseases: analyzing the influence of specific coping strategies]. Prävent Gesundheitsförderung 2006;1(3):182–9. https://doi.org/10.1007/s11553-006-0027-z.
[103] Schwarzer R, Jerusalem M. Das Konzept der Selbstwirksamkeit. Zeitschrift Pädagogik 2002;48:28–53. https://doi.org/10.25656/01:3930.
[104] Beck AT, Steer RA, Brown GK. Beck depression inventory-II. San Antonio: Psychological Corporation; 1996. https://www.brown.edu/academics/public-health/research/mens-health-initiative/bdiii.
[105] Hautzinger M, Keller F, Kühner C. BDI-II. Beck–depressions–Inventar revision – Manual. Frankfurt: Harcourt Test Services; 2006.
[106] Kühner C, Bürger C, Keller F, Hautzinger M. Reliabilität und Validität des Revidierten Beck-Depressionsinventars (BDI-II). Befunde aus deutschsprachigen Stichproben [reliability and validity of the revised Beck depression inventory (BDI-II). Results from German samples]. Nervenarzt 2007;78(6):651–6. https://doi.org/10.1007/s00115-006-2098-7.
[107] Osman A, Bagge CL, Gutierrez PM, Konick LC, Kopper BA, Barrios FX. The suicidal behaviors questionnaire-revised (SBQ-R): validation with clinical and nonclinical samples. Assessment 2001;8:443–54. https://doi.org/10.1177/107319110100800409.
[108] Glaesmer H, Kapusta ND, Teismann T, Wagner B, Hallensleben N, Spangenberg L, et al. Psychometrische Eigenschaften der Deutschen Version des Suicide Behaviors Questionnaire Revised (SBQ-R). [Psychometric properties of the German version of the Suicide Behaviors Questionnaire Revised (SBQ-R).]. PPmP Psychother Psychosom Med Psychol 2018;68:346–52. https://doi.org/10.1055/s-0043-118335.
[109] National Institute for Health and Care Excellence. Self-harm: Assessment, management and preventing recurrence [NICE guideline no. 225]. https://www.nice.org.uk/guidance/ng225/chapter/Recommendations;; 2022 [accessed 6 January 2025].
[110] Mee S, Bunney BG, Bunney WE, Hetrick W, Potkin SG, Reist C. Assessment of psychological pain in major depressive episodes. J Psychiatr Res 2011;45:1504–10. https://doi.org/10.1016/j.jpsychires.2011.06.011.
[111] Lukat J, Margraf J, Lutz R, van der Veld WM, Becker ES. Psychometric properties of the positive mental health scale (PMH-scale). BMC Psychol 2016;4:1–14. https://doi.org/10.1186/s40359-016-0111-x.
[112] IBM Corp. IBM SPSS statistics for Macintosh. Version 29.0 [software]. 2023.
[113] R Core Team. R: a language and environment for statistical computing. Version 4.4.1 [software]. 2021.
[114] Mishra P, Pandey CM, Singh U, Gupta A, Sahu C, Keshri A. Descriptive statistics and normality tests for statistical data. Ann Card Anaesth 2019;22(1):67–72. https://doi.org/10.4103/aca.ACA_157_18.
[115] Schober P, Mascha EJ, Vetter TR. Statistics from a (agreement) to Z (z score): a guide to interpreting common measures of association, agreement, diagnostic accuracy, effect size, heterogeneity, and reliability in medical research. Anesth Analg 2021;133(6):1633–41. https://doi.org/10.1213/ANE.0000000000005773.
[116] Benjamini Y, Hochberg Y. Controlling the false discovery rate: a practical and powerful approach to multiple testing. J R Stat Soc Ser B Stat Methodol 1995;57(1):289–300. https://doi.org/10.1111/j.2517-6161.1995.tb02031.x.
[117] Jafari M, Ansari-Pour N. Why, when and how to adjust your p values? Cell J 2019;20(4):604–7. https://doi.org/10.22074/cellj.2019.5992.
[118] Zhang Z. Missing data imputation: focusing on single imputation. Ann Transl Med 2016;4(1):9. https://doi.org/10.3978/j.issn.2305-5839.2015.12.38.
[119] Nock MK, Banaji MR. Assessment of self-injurious thoughts using a behavioral test. Am J Psychiatry 2007;164(5):820–3. https://doi.org/10.1176/appi.ajp.164.5.820.
[120] Brådvik L. Suicide risk and mental disorders. Int J Environ Res Public Health 2018;15(9):2028. https://doi.org/10.3390/ijerph15092028.
[121] de Beurs D, Ten Have M, Cuijpers P, de Graaf R. The longitudinal association between lifetime mental disorders and first onset or recurrent suicide ideation. BMC Psychiatry 2019;19(1):345. https://doi.org/10.1186/s12888-019-2328-8.
[122] Wiebenga JXM, Dickhoff J, Mérelle SYM, Eikelenboom M, Heering HD, Gilissen R, et al. Prevalence, course, and determinants of suicide ideation and attempts in patients with a depressive and/or anxiety disorder: a review of NESDA findings. J Affect Disord 2021;283:267–77. https://doi.org/10.1016/j.jad.2021.01.053.
[123] Kahveci S, Bathke AC, Blechert J. Reaction-time task reliability is more accurately computed with permutation-based split-half correlations than with Cronbach's alpha. Psychon Bull Rev 2025;32(2):652–73. https://doi.org/10.3758/s13423-024-02597-y.
[124] Hosmer DW, Lemeshow S. Applied logistic regression. 2nd ed. New Jersey: Wiley; 2000.
[125] de Vet HCW, Mokkink LB, Mosmuller DG, Terwee CB. Spearman-Brown prophecy formula and Cronbach's alpha: different faces of reliability and opportunities for new applications. J Clin Epidemiol 2017;85:45–9. https://doi.org/10.1016/j.jclinepi.2017.01.013.
[126] Alloy LB, Abramson LY. Learned helplessness, depression, and the illusion of control. J Pers Soc Psychol 1982;42(6):1114–26. https://doi.org/10.1037//0022-3514.42.6.1114.
[127] Seligman ME, Maier SF. Failure to escape traumatic shock. J Exp Psychol 1967;74(1):1–9. https://doi.org/10.1037/h0024514.
[128] Ursin H, Eriksen HR. Cognitive activation theory of stress (CATS). Neurosci Biobehav Rev 2010;34(6):877–81. https://doi.org/10.1016/j.neubiorev.2009.03.001.
[129] Hansen LJ. A possible response bias in locus of control research. J Psychol Interdiscip Appl 1984;116(2):175–7. https://doi.org/10.1080/00223980.1984.9923634.
[130] Hjelle LA. Social desirability as a variable in the locus of control scale. Psychol Rep 1971;28(3):807–16. https://doi.org/10.2466/pr0.1971.28.3.807.

[131] Nosek BA, Greenwald AG, Banaji MR. Understanding and using the implicit association test: II. Method variables and construct validity. Personal Soc Psychol Bull 2005;31(2):166–80. https://doi.org/10.1177/0146167204271418.
[132] O'Shea BA, Wiers RW. Moving beyond the relative assessment of implicit biases: navigating the complexities of absolute measurement. Soc Cogn 2020;38(Suppl): 187–207. https://doi.org/10.1521/soco.2020.38.supp.s187.
[133] Joiner T. Why people die by suicide. Cambridge: Harvard University Press; 2005.
[134] Ribeiro JD, Witte TK, Van Orden KA, Selby EA, Gordon KH, Bender TW, et al. Fearlessness about death: the psychometric properties and construct validity of the revision to the acquired capability for suicide scale. Psychol Assess 2014;26 (1):115–26. https://doi.org/10.1037/a0034858.
[135] O'Connor RC, Kirtley OJ. The integrated motivational-volitional model of suicidal behaviour. Philos Trans R Soc Lond Ser B Biol Sci 2018;373(1754):20170268. https://doi.org/10.1098/rstb.2017.0268.
[136] Connor P, Evers ERK. The bias of individuals (in crowds): why implicit bias is probably a noisily measured individual-level construct. Perspect Psychol Sci 2020;15(6):1329–45. https://doi.org/10.1177/1745691620931492.
[137] Fiedler K, Messner C, Bluemke M. Unresolved problems with the "I", the "A", and the "T": a logical and psychometric critique of the implicit association test (IAT). Eur Rev Soc Psychol 2006;17:74–147. https://doi.org/10.1080/10463280600681248.
[138] Schimmack U. The implicit association test: a method in search of a construct. Perspect Psychol Sci 2021;16(2):396–414. https://doi.org/10.1177/1745691619863798.
[139] De Houwer J. Implicit Bias is behavior: a functional-cognitive perspective on implicit Bias. Perspect Psychol Sci 2019;14(5):835–40. https://doi.org/10.1177/1745691619855638.
[140] Fabio RA, Caprì T, Romano M. From controlled to automatic processes and back again: the role of contextual features. Eur J Psychol 2019;15(4):773–88. https://doi.org/10.5964/ejop.v15i4.1746.
[141] Evans JS, Stanovich KE. Dual-process theories of higher cognition: advancing the debate. Perspect Psychol Sci 2013;8(3):223–41. https://doi.org/10.1177/1745691612460685.
[142] Calcagnotto L, Huskey R, Kosicki GM. The accuracy and precision of measurement: tools for validating reaction time stimuli3. Amsterdam University Press; 2021. p. 1–20. https://doi.org/10.5117/CCR2021.2.001.CALC (2).
[143] Ginley MK, Bagge CL. Psychiatric heterogeneity of recent suicide attempters: a latent class analysis. Psychiatry Res 2017;251:1–7. https://doi.org/10.1016/j.psychres.2017.02.004.
[144] Guo L, Wang W, Wang T, Li W, Gong M, Zhang S, et al. Association of emotional and behavioral problems with single and multiple suicide attempts among Chinese adolescents: modulated by academic performance. J Affect Disord 2019; 258:25–32. https://doi.org/10.1016/j.jad.2019.07.085.
[145] Rasmussen SA, Elliott MA, O'Connor RC. Psychological distress and perfectionism in recent suicide attempters: the role of behavioural inhibition and activation. Pers Individ Differ 2012;52(6):680–5. https://doi.org/10.1016/j.paid.2011.12.011.
[146] Turton H, Berry K, Danquah A, Green J, Pratt D. An investigation of whether emotion regulation mediates the relationship between attachment insecurity and suicide ideation and behaviour. Clin Psychol Psychother 2022;29(5):1587–98. https://doi.org/10.1002/cpp.2735.
[147] Fawcett J. Diagnosis, traits, states, and comorbidity in suicide. In: Dwivedi Y, editor. The neurobiological basis of suicide. Boca Raton: CRC Press/Taylor & Francis; 2012.
[148] Whiteman SE, Witte TK, Cero I, Kramer LB, Weathers FW. Posttraumatic stress disorder and suicidal ideation: the moderating effect of posttraumatic cognitions. J Trauma Stress 2021;34(6):1178–87. https://doi.org/10.1002/jts.22598.
[149] Puuskari V, Aalto-Setälä T, Komulainen E, Marttunen M. Suicidal ideation, suicide attempts, and psychological distress among intoxicated adolescents in the pediatric emergency department. Nord J Psychiatry 2018;72(2):137–44. https://doi.org/10.1080/08039488.2017.1400099.
[150] Sinani L, Kola V, Dyrma A. Assessment and treatment of patients with suicidal thoughts and attempts in emergency psychiatry. Eur Psychiatry 2011;26(1):1646. https://doi.org/10.1016/S0924-9338(11)73350-8.
[151] Ryum T, Kazantzis N. Elucidating the process-based emphasis in cognitive behavioral therapy. J Contextual Behav Sci 2024;33:100819. https://doi.org/10.1016/j.jcbs.2024.100819.
[152] Zlomuzica A, Preusser F, Schneider S, Margraf J. Increased perceived self-efficacy facilitates the extinction of fear in healthy participants. Front Behav Neurosci 2015;9:270. https://doi.org/10.3389/fnbeh.2015.00270.
[153] Cha CB, Najmi S, Amir N, Matthews JD, Deming CA, Glenn JJ, et al. Testing the efficacy of attention bias modification for suicidal thoughts: findings from two experiments. Arch Suicide Res 2017;21(1):33–51. https://doi.org/10.1080/13811118.2016.1162241.
[154] FitzGerald C, Martin A, Berner D, Hurst S. Interventions designed to reduce implicit prejudices and implicit stereotypes in real world contexts: a systematic review. BMC Psychol 2019;7(1):29. https://doi.org/10.1186/s40359-019-0299-7.
[155] Clerkin EM, Teachman BA. Training implicit social anxiety associations: an experimental intervention. J Anxiety Disord 2010;24(3):300–8. https://doi.org/10.1016/j.janxdis.2010.01.001.
[156] Calanchini J, Lai CK, Klauer KC. Reducing implicit racial preferences: III. A process-level examination of changes in implicit preferences. J Pers Soc Psychol 2021;121(4):796–818. https://doi.org/10.1037/pspi0000339.
[157] Copersino ML. Cognitive mechanisms and therapeutic targets of addiction. Curr Opin Behav Sci 2017;13:91–8. https://doi.org/10.1016/j.cobeha.2016.11.005.
[158] Linehan MM, Comtois KA, Murray AM, et al. Two-year randomized controlled trial and follow-up of dialectical behavior therapy vs therapy by experts for suicidal behaviors and borderline personality disorder. Arch Gen Psychiatry 2006; 63(7):757–66. https://doi.org/10.1001/archpsyc.63.7.757.
[159] Barnhofer T, Crane C, Brennan K, Duggan DS, Crane R, Eames C, et al. Mindfulness-based cognitive therapy (MBCT) reduces the association between depressive symptoms and suicidal cognitions in patients with a history of suicidal depression. J Consult Clin Psychol 2015;83(6):1013–20. https://doi.org/10.1037/ccp0000027.
[160] Sohn MN, Cole J, Bray SL, McGirr A. Intermittent theta-burst stimulation with adjunctive D-cycloserine rapidly resolves suicidal ideation and decreases implicit association with death/suicide. Psychol Med 2025;55:e13. https://doi.org/10.1017/S0033291724003313.
[161] Elder J, Wilson L, Calanchini J. Estimating the reliability and stability of cognitive processes contributing to responses on the implicit association test. Personal Soc Psychol Bull 2024;50(10):1451–70. https://doi.org/10.1177/01461672231171256.
[162] Axt JR. The best way to measure explicit racial attitudes is to ask about them. Soc Psychol Personal Sci 2018;9(8):896–906. https://doi.org/10.1177/1948550617728995.
[163] Irving LH, Smith CT. Measure what you are trying to predict: applying the correspondence principle to the implicit association test. J Exp Soc Psychol 2020; 86:103898. https://doi.org/10.1016/j.jesp.2019.103898.
[164] Brickenkamp R, Zilmer E. d2 test of attention (d2). Göttingen: Hogrefe & Huber Publishers; 1998. https://doi.org/10.1037/t03299-000.
[165] Parkington JE, Leiter RG. Partington's pathway test. Psychol Serv Center Bull 1949;1:9–20.