

ORIGINAL ARTICLE

Examining implicit positive affect toward suicide among suicidal and nonsuicidal adults and adolescents

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Abstract

Objective: The purpose of this study was to examine implicit affect toward suicide (i.e., how good/bad suicide is perceived). Some people might be more likely to think about/choose suicide because they perceive it as a good option (to gain relief) relative to available alternatives.

Method: Implicit affect toward suicide among adults ($N = 72$) and adolescents ($N = 174$) with and without suicidal thoughts was examined using first-person (FP) perspective suicide pictures in the affect misattribution procedure (AMP).

Results: Suicidal adults' implicit positive affect toward suicide was associated with STB variables, such as explicit valence ($r = 0.34$) and arousal ($r = 0.44$) ratings of suicide pictures, and implicit affect differentiated groups above and beyond explicit valence ratings. Contrary to our hypothesis, suicidal participants did not display higher implicit positive affect toward suicide than nonsuicidal participants. However, suicidal participants displayed consistent implicit affect toward different suicide pictures, whereas nonsuicidal participants evaluated some pictures as more pleasant than others (ORs = 1.92–2.27).

Conclusions: Implicit affect toward suicide may relate to STB, but stimuli characteristics (e.g., color) likely influence the accuracy of assessment with the AMP and should be a focus of future research involving this and other implicit measures.

KEYWORDS

adolescents, affect, affect misattribution procedure, implicit affect, suicide

INTRODUCTION

Suicide is a leading cause of death among adolescents and adults (CDC, 2019). Attempting suicide requires a *decision* to potentially self-inflict lethal harm. The most commonly theorized and empirically supported reason for making this decision is to escape aversive contexts (e.g., intolerable emotional pain) to gain relief (Bryan et al., 2013). However, there are many ways to escape aversive contexts

and gain relief other than suicide (e.g., drugs/alcohol and habituation; DelleMijn & Vanneste, 1997; Groves & Thompson, 1970; Measelle et al., 2006). Thus, it is not clear why some people select suicide over alternative options. One possibility is that, compared to the available alternatives, suicide is perceived to be a good option. If so, suicide may involve a *value-based* decision, where an action/option is selected because it is expected to maximize subjective value or net benefit/"goodness" (i.e., benefit

minus the costs; Suri et al., 2020). Thus, if suicide involves a value-based decision, it may be possible to determine who is at risk of making this decision by assessing affect toward suicide.

Affect toward suicide equates to how good or bad suicide is perceived to be. Because affect is a core component of other valenced mental states (e.g., attitudes, moods, and emotions) that play an influential role in thoughts, decisions, and behaviors (Dolan, 2002; Kruglanski et al., 2015; Raghunathan & Pham, 1999; Zajonc, 1980), affect toward suicide may also influence thoughts, decisions, and behaviors related to suicide. In one recent study, *explicit* affect toward suicide was assessed by asking people with and without recent suicidal thoughts and behaviors (STB) to rate self-relevant pictures of suicidal behavior. Findings indicated that people with STB rated pictures of suicidal behavior as substantially more positive ($d = 1.22$) than people without STB (Jaroszewski et al., 2020). However, given the potential limitations of explicit measurement/self-report, which are particularly relevant to assessing stigmatized behaviors like STB (e.g., given the motivation to conceal suicidal thoughts/desire; Busch et al., 2003), measuring *implicit* affect to suicide may be beneficial.

The affect misattribution procedure (AMP; Payne et al., 2005) is a behavioral task specifically designed to assess affect. Arguably, the AMP is well suited to assess affect to suicide, because the AMP has validly assessed affect toward other stigmatized clinical behaviors. For instance, AMP derived implicit affect predicts past (i.e., retrospectively reported) tobacco smoking (Haight et al., 2012) and past and future nonsuicidal self-harm (NSSI; Fox et al., 2018; Franklin, Lee, et al., 2014; Franklin, Puzia, et al., 2014), alcohol consumption (Payne et al., 2008, 2016), and eating disordered behavior (Smith et al., 2018). Although the AMP has been used to study self-identification with suicide/death (Tucker et al., 2018; Wells et al., 2020), no implicit measure, including the AMP, has assessed *affect* toward suicide. Specifically assessing implicit affect toward suicide with the AMP may provide much needed data on whether some people (implicitly) perceive suicide as a relatively good option and, if so, whether this perception relates to STB risk. Such information could provide new targets for clinical research aimed at improving suicide prevention and treatment.

The purpose of this study was to examine implicit affect toward suicide among people with and without recent STB. We used the AMP to assess implicit affect toward self-relevant suicide pictures and other stimuli (e.g., positive pictures and self-related words) in two samples: sample 1 ($N = 72$) consisted of nonsuicidal and suicidal adults from the community; sample 2 ($N = 174$) consisted

of nonsuicidal community adolescents and suicidal adolescents from a local psychiatric hospital, many of whom were seeking inpatient care for self-injurious thoughts and behaviors. The primary aim of this study was to examine whether adults and adolescents with STB would display different levels of implicit affect toward self-relevant suicide pictures compared to participants with no STB. Based on prior work showing that people with recent NSSI displayed higher explicit and implicit positive affect toward self-relevant NSSI pictures (Franklin, Lee, et al., 2014; Franklin, Puzia, et al., 2014; Nock & Banaji, 2007), we hypothesized that suicidal participants would display higher implicit positive affect toward suicide compared to nonsuicidal participants, because NSSI and suicide are both conceptually and behaviorally highly related.

MATERIALS AND METHOD

Procedure

All study methods were approved by the Committee for Use of Human Subjects at [Redacted] University. Participants 18 years and older, or the guardian of participants younger than 18 years, signed an informed consent. Participants completed self-report measures and the AMP behavioral task. Following completing the AMP (see Behavioral Task section below for more details), all participants were asked whether they spoke/read Chinese or recognized any of the Chinese pictographs used in the task. Those responding in the affirmative were excluded from the study, because possessing knowledge of the pictographs may bias implicit affect ratings. To ensure safety and monitor risk, a PhD and/or MD level clinician was available while all participants completed the study.

Sample 1 adult participants

Participants were adults (18–65 years old) from the greater Boston area responding to an advertisement for a study about emotional images and learning or for a study about strong emotions and mental health. Before coming into the laboratory, participants were assessed by a postbaccalaureate- or masters-level study team member via in-depth telephone screen for STB history with questions from the Self-Injurious Thoughts and Behaviors Interview (SITBI; Nock et al., 2007). In particular, participants were asked (a) “Have you ever had thoughts of killing yourself?”, (b) “Have you ever actually made a plan to kill yourself?”, (c) “Have you ever made an actual attempt to kill yourself in which you had at least some intent to die?”, and (d) “Have you ever done anything to purposefully hurt yourself

without wanting to die (e.g., cutting or burning your skin)?” Answers in the affirmative were followed up with person-specific probes to verify (i) when the most recent STB episode occurred, and (ii) whether the reported experiences were, in fact, consistent with the constructs being assessed (e.g., that “thoughts of suicide” involved thinking of engaging in self-directed harm in order to die [i.e., not merely thinking about death/dying] or that “suicide attempt” involved actually engaging in self-directed harm with some intention to die). Persons endorsing thinking about suicide or making a suicide plan or attempt in the three months before the screening were invited to come into the laboratory and participate in the study as part of the suicidal group. Those reporting no lifetime history of self-injurious thoughts or behaviors (SITB; including NSSI and “passive” suicide thoughts like, “I wish I were dead” and “I wish I went to sleep and never woke up”) were invited to participate as part of the nonsuicidal group. Persons reporting NSSI only (i.e., NSSI but no STB within the prior three months) were excluded from both groups ($n = 3$).

Following both the telephone screen and completion of the study, all potential enrollees and study participants completed a risk assessment. Participants reporting current suicidal thoughts completed a personalized safety plan and received clinical resources. Sample 1 data were collected as part of a larger study lasting for approximately 3 h. Participants were compensated \$30.

Nonsuicidal group

Sample 1 nonsuicidal group consisted of 36 (16 women, 1 nonidentifying) adults. The control group had an average age of 30.2 years ($Mdn = 26$, $SD = 11.9$) and an ethnic composition of 55.5% Caucasian, 5.5% African American, 8.3% Hispanic, 25.0% Asian American, and 5.7% mixed race/other. No participants reported speaking/reading Chinese or recognizing Chinese pictographs used in the AMP. Sample characteristics and between-group comparisons are presented in Table 1.

Suicidal group

Sample 1 suicidal group consisted of 36 (18 women, 1 non-identifying) adults. The suicidal group had an average age of 32.4 years ($Mdn = 28$, $SD = 11.8$) and an ethnic composition of 72.2% Caucasian, 11.1% African American, 5.6% Hispanic, 2.8% Asian American, 2.7% Native American, and 5.6% mixed race/other. No participants reported speaking/reading Chinese or recognizing Chinese pictographs used in the AMP.

Self-reported Questionnaires

Demographics and treatment history

Participant demographics (age, sex, and education level) were collected.

History of self-injurious thoughts and behaviors

The structured interview version of the Self Injurious Thoughts and Behaviors Interview (SITBI; Nock et al., 2007), a valid and reliable measure, was used to assess the presence and other characteristics of SITB. Additionally, participants reporting the presence of suicide thoughts were asked, “How many days in your life have you had thoughts of killing yourself?” This question was used to assess frequency of suicidal thoughts.

Hedonic capacity

The Snaith-Hamilton Pleasure Scale (SHAPS; Snaith et al., 1995) is a 14-item self-reported measure assessing current hedonic capacity, with four response categories ranging from definitely agree to strongly disagree. Higher scores indicate greater hedonic capacity. We derived a total score by summing item responses.

Explicit picture ratings

As reported in greater detail elsewhere (Jaroszewski et al., 2020), participants explicitly rated how pleasant ($-4 =$ extremely unpleasant to $4 =$ extremely pleasant), threatening ($-4 =$ extremely non-threatening to $4 =$ extremely threatening), and arousing ($0 =$ not arousing at all to $8 =$ extremely arousing) they found first-person (FP) perspective suicide images (e.g., looking down the barrel of a gun) and FP-positive images (e.g., looking down at a cookie). Participants’ average scores for FP-suicide and FP-positive image types were calculated on each rating dimension.

Behavioral task

Affect misattribution procedure

The AMP (Payne et al., 2005) is a brief computer-based task that measures affect indirectly/implicitly (see Figure 1 for AMP trial details). On each trial of the AMP, an emotionally evocative picture (i.e., the

TABLE 1 Sample 1 ($N = 72$) and Sample 2 ($N = 174$) group differences in baseline characteristics

Variable	Sample 1 Adults				Test statistic	Effect size [95% CI]
	Nonsuicidal group ($n = 36$)		Suicidal group ($n = 36$)			
	<i>n</i>	%	<i>n</i>	%		
Sex at birth ^a					χ^2	OR
Female	16	44.4%	18	50.0%	0.22	1.22 [0.52–2.88]
Male	19	52.7%	17	47.2%		
Other	1	2.7%	1	2.7%		
Race/ethnicity ^a					9.04	3.92 [1.56, 9.81]
African American	2	5.5%	4	11.1%		
Asian American	9	25.0%	1	2.8%		
White	20	55.5%	27	72.2%		
Hispanic	3	8.3%	2	5.6%		
Native American	0	0.0%	1	2.7%		
Other/mixed race	2	5.7%	3	5.6%		
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>		
Age ^b	30.2	11.9	32.4	11.9	0.81	0.2 [–0.66, 0.28]
	<i>Med</i>	<i>SD</i>	<i>Med</i>	<i>SD</i>	<i>U</i>	<i>r</i>
Hedonic capacity ^c	48	5.3	41	8.6	235.5*	0.56 [0.38, 0.70]
	Sample 2 Adolescents					
	Nonsuicidal group ($n = 83$)		Suicidal group ($n = 91$)			
	<i>n</i>	%	<i>n</i>	%		
Sex at birth ^a					χ^2	OR
Female	55	66.2%	69	75.8%	1.33	1.37 [0.80, 2.37]
Male	26	31.3%	22	24.2%		
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>t</i>	<i>d</i>
Age ^b	16.6	1.82	16.0	1.57	2.34*	0.35 [0.05, 0.56]
	<i>Med</i>	<i>SD</i>	<i>Med</i>	<i>SD</i>	<i>U</i>	<i>r</i>
Hedonic capacity ^c	51	4.50	40	8.8	6255*	0.60 [0.50, 0.69]

Abbreviations: 95% CI, 95% confidence interval.

^aGroups compared with a chi-square test and odds ratio effect size reported.

^bGroups compared with a *t*-test and Cohen's *D* effect size reported.

^cGroups compared with a Wilcoxon-Mann-Whitney *U* test and *r* (i.e., z/\sqrt{N}) effect size reported.

* $p < 0.05$.

prime) is flashed for 75 ms, followed by a blank screen for 125 ms, a Chinese symbol for 100 ms, and finally, a blank gray screen that remains displayed until the participant presses a key. The AMP is a forced-choice task. Participants were instructed to press one key (i.e., “i”) if they judged the Chinese symbol to be more pleasant than an average symbol or another key (i.e., “e”) if they judged the Chinese symbol to be less pleasant than an average symbol. Participants were instructed to ignore

the emotionally evocative pictures and use their “gut feelings” to make judgments of the Chinese symbols. Despite this warning, judgments of the symbols tend to be influenced by the valence of the picture, with more pleasant pictures eliciting a higher proportion of pleasant evaluations of subsequent Chinese symbols (e.g., Payne et al., 2005). The primary dependent variable for the AMP was the proportion of trials on which a positive evaluation occurs to the total number of trials within a

Affect Misattribution Procedure (AMP)

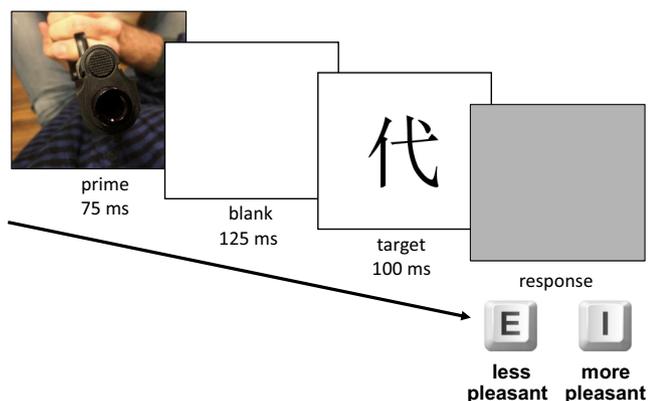


FIGURE 1 Affect misattribution procedure (AMP) trial details. On each trial, participants see a prime, followed by a blank screen, then an ambiguous Chinese symbol, and finally a gray screen. The AMP is a forced-choice task. Thus, the gray screen remains until participants respond by pressing either the “E” or “I” on a keyboard in front of them. Pressing the “E” key indicates the Chinese symbol seemed less pleasant than average, whereas the “I” key indicates more pleasant than average. Participants were instructed to ignore the emotionally evocative prime and use their “gut feelings” to judge the pleasantness of the Chinese symbols. Despite this warning, judgments of symbols tend to be influenced by the valence of the picture, with more pleasant pictures eliciting a higher proportion of pleasant evaluations of subsequent Chinese symbols. Thus, participants are thought to *misattribute* the valence of the prime for the valence of the Chinese symbol

given picture category, termed “percent positive affect.” In this study, we included four first-person (FP) suicide images, four FP-positive contrast images (see Figure S1 for all FP images used), four neutral IAPs images (Lang et al., 2008), four self- (i.e., “me,” “my,” “myself,” and “mine”), and four other-related words (e.g., “not me,” “other,” “them,” and “their”), resulting in 20 unique AMP trials. Following a procedure similar to that used in other AMP studies (e.g., Franklin, Lee, et al., 2014; Franklin, Puzia, et al., 2014; Payne et al., 2005, 2008), the task consisted of 64 trials. We presented each unique trial up to four times to increase reliability.

Sample 2 adolescent participants

Participants reporting no history of SITB (including NSSI) or current psychosis or cognitive impairment were invited to complete the study. The guardian(s) of potential enrollees under the age of 18 were informed of the study and provided informed consent prior to their child’s participation. Sample 2 data were collected as part of a larger study lasting for approximately 2.5 h. Nonsuicidal adolescent

participants were compensated \$25, whereas suicidal adolescent participants were not compensated per hospital policy.

Nonsuicidal group

Sample 2 nonsuicidal participants were adolescents (12–19 years old) recruited from the community via paper and digital study advertisements for a study on how people respond to emotions, which were placed in the community and online message boards (e.g., craigslist). Nonsuicidal participants completed a brief online screening survey where they answered the same screening questions as sample 1 participants (described above). Participants reporting never experiencing/engaging in SITB were included in the nonsuicidal group. Sample 2 nonsuicidal participants are 83 ($n = 55$ women; 66.2%) 12- to 19-year-old adolescents ($M = 16.6$ years, Median = 17.0, $SD = 1.82$) from the greater Boston area. These 83 participants were drawn from a larger sample of 125 participants, 42 of whom were excluded because (a) they spoke/read Chinese and/or recognized Chinese pictographs used in the AMP ($n = 18$), or (b) they reported experiencing a self-injurious thought or behavior ($n = 24$). Those included did not differ from those excluded in age, sex, or hedonic capacity ($ps = 0.25–0.89$). Data concerning race/ethnicity were not collected. Sample characteristics and between-group comparisons are presented in Table 1. Following the study, nonsuicidal participants were assessed for risk that had the opportunity to complete a personalized safety plan and received clinical resources if they wished.

Suicidal group

Sample 2 suicidal participants were adolescents (12–19 years old) who were admitted to an inpatient psychiatric unit located at the [redacted] Hospital in Boston, Massachusetts. A research staff member determined eligibility by reviewing patients’ medical records for likely the presence of suicidal thoughts or attempt in the month prior to admission. Exclusion criteria included psychiatric conditions that could impair the participant’s ability to provide informed consent (current psychosis or cognitive impairment) or make it unsafe for the patient or research staff (e.g., due to extreme agitation or violent behavior). Research staff approached eligible patients’ ages 18–19 shortly after their admission to the hospital and described the study. For eligible patients’ ages 12–17, research staff first approached the patient’s parent(s). If the parent provided informed consent, the patient was then invited to complete the study.

Participants reporting thinking about suicide, making a suicide plan, or attempt in the year before the study were included in the suicidal group. Persons reporting NSSI only (i.e., NSSI but no STB) were excluded ($n = 2$). Sample 2 suicidal group are 91 ($n = 69$ women; 75.8%) 12- to 19-year-old adolescents ($M = 16.0$, Median = 17.1, $SD = 1.57$) who were hospitalized for various mental health issues, often relating to recent SITB. These 91 participants were drawn from a larger sample of 116 participants, 25 of whom were excluded because (a) their STB history could not be determined because they did not complete the SITBI ($n = 16$), (b) they did not experience STB in the year before the study ($n = 6$), and (c) they did not complete the AMP behavioral task due to a computer malfunction ($n = 3$). No participants reported speaking/reading Chinese or recognizing Chinese pictographs used in the AMP. Those included did not differ from those excluded in age, sex, or hedonic capacity ($ps = 0.17-0.93$). Participants included had an ethnic composition of 83.5% White, 2.2% Black, 6.6% Hispanic, 7.7% Asian American, 1.1% Native American, and 1.1% not documented (total percentage exceeds 100, because two subjects identified with two ethnic/racial categories).

Sample 2 Self-report Questionnaires

Demographics. Participant's age and sex at birth were collected.

History of self-injurious thoughts and behavior. Self-injurious thoughts and behavior were assessed with the SITBI as described.

Hedonic capacity. Hedonic capacity was assessed with the SHAPS as described.

Data analytic plan

Baseline characteristics

To determine whether groups in either sample 1 or 2 differed on baseline characteristics, we computed a series of independent-samples t -tests for normally distributed continuous variables (e.g., age), Wilcoxon-Mann-Whitney U tests for count and/or skewed variables (e.g., hedonic capacity), and chi-square tests for nominal variables (e.g., sex).

Group differences in implicit affect

To increase validity of AMP data, we excluded all AMP trials (1.8% in sample 1; 3.9% in sample 2) with extremely

short (<250 ms) and long (>4500 ms) response latencies, indicative of unreliable responding. To determine whether groups in either sample differed on implicit affect, we constructed generalized linear mixed-effects regression model (GLMER) with a binomial likelihood function using the lme4 package in R (Bates et al., 2015). The GLMER regressed participants' affective evaluation (pleasant/not pleasant; dependent variable [DV]) on each trial onto the independent variables (IV) Group, Prime type, and Group x Prime type interaction (fixed effects) and included by-subject random intercepts to account for within-subject correlations in affect evaluations. Post hoc analyses to determine whether groups evaluated prime types (e.g., suicide and positive primes) differently consisted of independent-samples t -tests on the estimated marginal mean differences using the emmeans package in R (Lenth et al., 2021).

Within-group differences in affect across different suicide pictures

We tested whether groups consistently rated suicide primes by computing GLMERs (one for each group in sample 1 and 2; four in total), regressing affective evaluation (DV) onto suicide-prime type (i.e., gun, train, knife, and ledge), and a by-subject random intercept. We stratified the data by group and sample, because our primary question was whether affect toward suicide pictures varied within groups, not between. We used simple/treatment contrast coding, specifying the gun suicide picture as the reference level.

Group differences in implicit affect while controlling for image color

To determine whether the color features of images influenced implicit affect, we extracted the average hue (color in the color spectrum), saturation (intensity of the color), and value (brightness of the color) of each image (excluding word stimuli) with the ImaginR package in R (Stenger, 2017), as prior research indicates these color features influence affective evaluations of images (Lakens et al., 2013; Wilms & Oberfeld, 2018). Next, we limited the data to trials with an image prime (i.e., positive, neutral, and suicide) and computed a binomial GLMER, regressing implicit affective evaluation on each trial (DV) onto the average color hue, saturation, and value for the image displayed along with a by-subject random intercept. Last, we computed two additional binomial GLMERs for each sample, respectively, regressing affective evaluation onto (a) Group, Prime type, and Group x Prime type interaction

and a by-subject random intercept, and (b) onto these same variables along with average hue, saturation, and value as covariates.

Correlations

Within the suicidal and nonsuicidal groups for each sample, respectively, we computed Pearson's and Spearman's rank correlations for normally and non-normally distributed variables correcting for multiple comparisons (Benjamini & Hochberg, 1995).

Incremental validity

To determine whether implicit affect toward suicide captured unique variance in group membership above and beyond explicit affect ratings (only collected for sample 1 adults), we computed a binomial regression, with group (DV) regressed onto both average explicit valence ratings of suicide pictures and average implicit positive affective ratings of suicide pictures (IVs).

RESULTS

Baseline characteristics

Group differences in baseline characteristics for both Sample 1 and Sample 2 are reported in Table 1.

Group differences in implicit affect

In Sample 1, A GLMER showed a significant Group \times Prime type interaction (OR = 0.67 [0.45–0.99], $p < 0.05$; see Figure 2 and Table S1), where, relative to neutral pictures, both groups of adults displayed less positive affect to suicide pictures; however, contrary to our hypothesis, the suicidal group displayed even less positive affect to suicide pictures ($M = 40.3\%$) than the nonsuicidal group ($M = 50.2\%$). Notably, the estimated marginal mean difference on suicide pictures was not significant (OR = 1.68 [0.79–3.56], $p = 0.44$). In Sample 2 adolescents, a GLMER showed that, relative to neutral pictures, both groups displayed less positive affect toward suicide pictures (OR = 0.53 [0.44–0.63], $p < 0.001$); however, contrary to our hypothesis and to Sample 1 findings, suicidal and nonsuicidal adolescents did not differ on this effect (OR = 0.93 [0.72–1.20], $p > 0.05$ see Figure 2 and Table S1).

Within-group differences in affect across different suicide pictures

Nonsuicidal participants displayed lower than anticipated implicit affect to suicide. One possible reason for this might be that nonsuicidal participants misinterpreted some or all of the briefly presented (75 ms) self-relevant suicide primes, which depict what it might look like to personally engage in suicidal behavior, because they are personally unfamiliar with thinking about or attempting suicide. If nonsuicidal

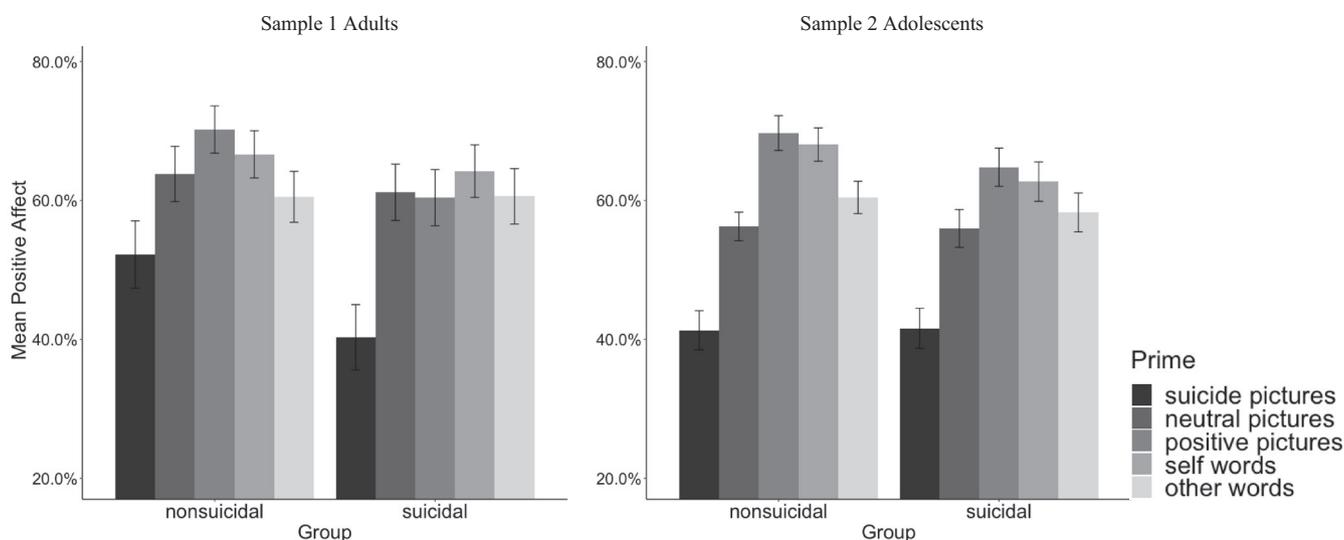


FIGURE 2 Group differences in implicit positive affect. Error bars represent standard error of the mean. Both suicidal and nonsuicidal adults (left pane) and adolescents (right pane) displayed lower implicit positive affect to suicide pictures (black bar) relative to neutral pictures (darkest gray bar). Contrary to hypotheses, neither suicidal adults nor adolescents displayed higher implicit positive affect toward suicide pictures than nonsuicidal participants

participants misinterpreted the suicide primes (as depicting content other than suicidal behavior), they might display higher variability in affect ratings across different suicide pictures relative to suicidal participants' ratings. To investigate this, we stratified the data by sample and group and computed GLMERs to analyze within-group variability in affect toward each suicide-picture prime.

In Sample 1, a GLMER revealed that, relative to the gun-picture prime, nonsuicidal adults displayed substantially higher positive affect toward the oncoming train picture (OR = 2.27 [1.23–4.23], $p < 0.01$; see Figure 3), whereas suicidal adults displayed consistent affect across suicide pictures (ORs = 0.70–1.07, $p > 0.05$; see Figure 3). In Sample 2, a GLMER on nonsuicidal adolescents' data revealed that, relative to the gun picture, nonsuicidal adolescents displayed higher positive affect toward both the oncoming train (OR = 1.99 [1.33–2.99], $p < 0.001$) and ledge (OR = 1.92 [1.28–2.86], $p < 0.01$) pictures, whereas suicidal adolescents displayed consistent affect across suicide pictures (ORs = 0.83–1.24, $p > 0.05$; see Figure 3). Taken together, these findings indicate that suicidal participants displayed consistent affect across suicide-picture primes, whereas nonsuicidal participants did not. Nonsuicidal groups' inconsistent affect may be due to misinterpreting the suicide-related information in some suicide pictures, particularly the oncoming train picture, which is the brightest and most saturated suicide prime and arguably the most ambiguous, too.

Implicit affect toward image primes while controlling for image color

Prior research indicates that color influences affective ratings of images (Lakens et al., 2013; Wilms & Oberfeld, 2018). Thus, we tested whether aspects of images' color influenced affective ratings across Samples 1 and 2. A GLMER on Sample 1 and Sample 2 data (combined) revealed that implicit positive affect was related to images' average hue (OR = 0.65 [0.46–0.92], $p < 0.05$), saturation (OR = 2.44 [1.73–3.44], $p < 0.05$), and value (OR = 6.90 [3.76–12.67], $p < 0.05$). In Sample 1, GLMERs suggested that image color influenced ratings of positive images, where the main effect of positive image (OR = 1.34, $p = 0.05$) reduced in magnitude when controlling for average image hue, saturation, and value (OR = 1.18, $p = 0.36$; see Table S2). In Sample 2, GLMERs revealed the opposite effect, where the main effect of positive image (OR = 1.84, $p < 0.01$) increased in magnitude when controlling for average image hue, saturation, and value (OR = 2.19, $p < 0.01$; see Table S2). Taken together, these findings suggest that image features (e.g., color) aside from the type of behavior depicted likely influence implicit affect ratings

and, thus, should be a focus of future research involving this and other implicit measures.

Correlations

Bivariate correlations between implicit affect ratings of suicide primes and other variables are reported in Table 2. Sample 1 suicidal adults' implicit affect to suicide was moderately correlated with both *explicit* valence ($r = 0.34$, $p < 0.05$) and arousal ratings of suicide pictures ($r = 0.44$, $p < 0.05$) and ST lifetime frequency ($r_s = 0.29$, $p = 0.09$); however, this latter correlation did not survive correction for multiple comparisons. Notably, observed power was low for Sample 1 data, given the modest sample and effect sizes, potentially leading to type II errors (i.e., incorrectly failing to reject the null hypothesis). Also, nonsuicidal participants' implicit affect was correlated with explicit arousal ($r = 0.39$, $p < 0.05$) but, importantly, not explicit valence ratings ($r = 0.03$, $p > 0.05$). This suggests that, across different assessment methods, nonsuicidal participants displayed inconsistent affect toward suicide. See Tables S3 and S4 for all bivariate correlations among suicidal and nonsuicidal adults, respectively.

No variable assessed correlated with Sample 2 suicidal adolescents' implicit affect toward suicide (see Table 2); however, nonsuicidal adolescents' affect toward suicide was negatively correlated with positive images ($r = -0.24$, $p < 0.05$) and positively correlated with neutral images ($r = 0.24$, $p < 0.05$). We note here that we did not collect explicit ratings of suicide pictures from Sample 2 participants. See Tables S5 and S6 for all bivariate correlations among suicidal and nonsuicidal adolescents, respectively.

Incremental validity

In Sample 1, a binomial regression revealed that implicit affect toward suicide ($b = -2.09$, OR = 0.12 [0.02–0.75], $p < 0.05$) adds incremental validity, capturing variance in group membership above and beyond explicit valence ratings ($b = 1.01$, OR = 2.75 [1.52–5.48], $p < 0.05$). These findings highlight the potential utility of using implicit methods to interrogate affect toward suicide.

DISCUSSION

The purpose of this study was to examine implicit affect toward suicide among adults (Sample 1) and adolescents (Sample 2) with and without recent suicidal thoughts. There were three main findings. First, contrary to our hypothesis, participants with recent and clinically

Implicit Affect toward Individual Suicide Picture Primes

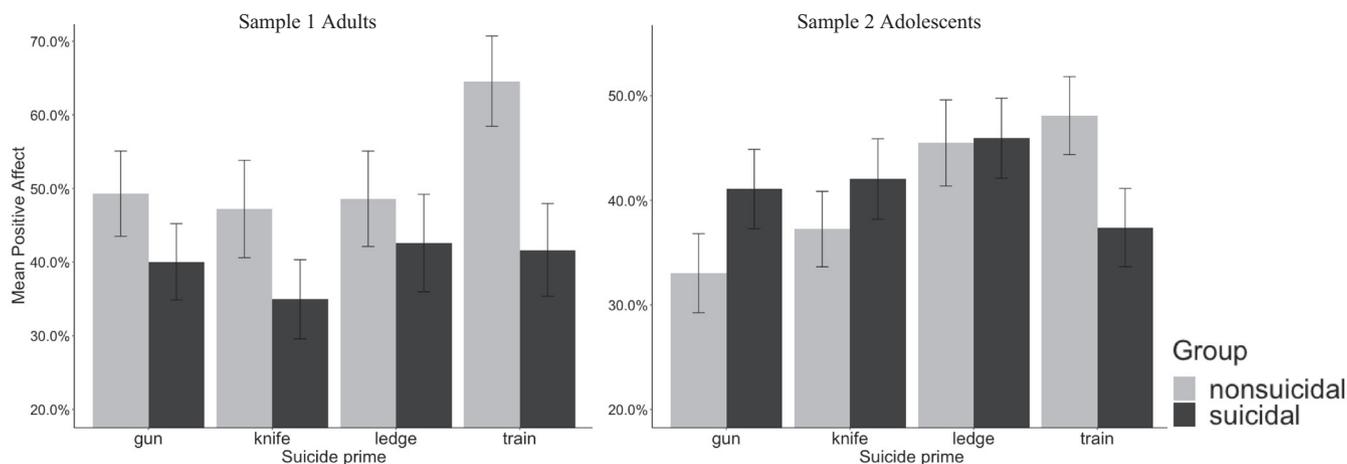


FIGURE 3 Group differences in implicit positive affect toward suicide-picture primes. Error bars represent standard error of the mean. Both nonsuicidal adults and adolescents (gray bars) displayed inconsistent implicit positive affect toward the different suicide-picture primes relative to suicidal participants (black bars)

TABLE 2 Sample 1 and Sample 2 correlations between implicit affect toward suicide primes and other variables

Variable	Implicit positive affect ratings of suicide primes			
	Sample 1 Adults		Sample 2 Adolescents	
	Suicidal (<i>n</i> = 36)	Nonsuicidal (<i>n</i> = 36)	Suicidal (<i>n</i> = 91)	Nonsuicidal (<i>n</i> = 83)
Implicit ratings of positive primes ^a	−0.02	−0.08	−0.13	−0.24*
Implicit ratings of neutral primes ^a	0.28	0.13	0.13	0.24*
Implicit ratings of me primes ^a	0.00	0.05	0.05	−0.18
Implicit ratings of other primes ^a	0.10	0.41*	0.23*	0.14
Age ^a	−0.33*	0.03	0.06	−0.05
Hedonic capacity ^a	0.14	0.04	0.01	−0.05
Frequency of suicidal thoughts ^b	0.29 [†]	n/a	0.11	n/a
Explicit valence ratings of suicide ^a	0.34*	0.03	n/a	n/a
Explicit arousal ratings of suicide ^a	0.44*	0.39*	n/a	n/a
Explicit threat ratings of suicide ^a	−0.16	−0.23	n/a	n/a

Note: N/a, these data were not collected.

^aPearson's correlation coefficient reported.

^bSpearman's correlation coefficient reported.

**p* < 0.05 adjusting for multiple comparisons.

[†]*p* < 0.10 adjusting for multiple comparisons.

significant suicidal thoughts displayed lower or equivalent (not higher) positive affect toward suicide than nonsuicidal participants. Second, suicidal participants evaluated suicide pictures more consistently than nonsuicidal participants, possibly due to nonsuicidal participants misinterpreting the content of the suicide pictures. Third, implicit affect toward suicide correlated with STB variables among suicidal adults and added incremental validity in differentiating groups above and beyond explicit valence ratings of suicide pictures. Each of these findings warrants additional comment.

Contrary to our hypothesis, suicidal participants did not display higher positive affect toward suicide than nonsuicidal participants when averaging across all suicide pictures. Notably, both adult ($M = 40.3\%$) and adolescent ($M = 41.6\%$) suicidal participants displayed expected levels of positive affect toward suicide. These expectations were based on prior studies investigating implicit positive affect among NSSI participants in relation to self-relevant NSSI pictures ($M \approx 35\%$; Franklin, Lee, et al., 2014; Franklin, Puzia, et al., 2014) and toward death-related pictures (e.g., skull and graveyard; $M \approx 40\%$; Fox et al., 2018). Thus, it is

possible that *nonsuicidal* participants in the present study displayed higher (not lower) implicit positive affect toward suicide because they misinterpreted the content of the suicide pictures as not depicting suicidal behavior. If so, this misinterpretation may have been driven by the rather brief presentation (75 ms) of relatively complex suicide-picture primes. The suicide primes are relatively complex because the construct they depict (i.e., suicide attempt and from the viewer's perspective) is itself complex, consisting of several prototypical construct features (e.g., the self, potentially lethal behavior, and intentionality; Jaroszewski et al., 2020). Additionally, some construct features require the viewer to infer the presence of hidden mental states (e.g., intentionality) in order to correctly interpret the content of the pictures as suicidal. This inference may have been particularly difficult for nonsuicidal participants regardless of the suicide method depicted because, having never thought about suicide before, they were naturally less able to recognize depictions of *self-relevant* suicidal behavior.

The suicidal group displayed consistent affect toward different suicide pictures, each depicting a distinct suicide attempt method, whereas nonsuicidal participants' (both adult and adolescent) affect varied, displaying significantly higher positive affect toward some suicide pictures (oncoming train and ledge) relative to others (gun and knife). We chose pictures depicting different suicide attempt methods in order to match the diversity in suicide thoughts and behaviors commonly experienced by suicidal participants. However, these pictures vary in color and on other dimensions, likely leading to variability in their perception and/or interpretability and, thus, variability in implicit affect ratings. Indeed, we found that several aspects of image color (i.e., average hue, saturation, and brightness) relate to implicit affect ratings and that statistically controlling for these aspects influenced how positive images were rated. Thus, image features aside from the type of behavior depicted influence implicit affect ratings and, thus, should be a focus of future research involving the AMP and other implicit measures. Moreover, the complexity of the images may have influenced implicit affect ratings. Recent findings suggest that awareness (not misattribution) of the prime's influence on the target strongly predicts affective evaluations in the AMP (Cummins et al., 2019). Presumably, it is easier to become aware of, and thereby be influenced by, less-complex/easily interpretable stimuli. It is possible, then, that nonsuicidal participants evaluated some suicide pictures (e.g., oncoming train) as more neutral/pleasant than others (e.g., gun), because these pictures depicted suicide attempt less clearly to them. This lack of clarity may have made some participants less aware of the suicidal content depicted in the picture, in turn, making the picture less likely to influence affective evaluations, thus leading to inconsistent implicit

affect across suicide pictures. Another possible reason that nonsuicidal people displayed higher-than-expected implicit positive affect toward suicide might be that the suicide images used in the AMP depicted some or all of the suicide methods they would actually consider using, and thus, they rated these images accurately (i.e., more positively). However, this possibility seems unlikely given that nonsuicidal adults' explicit valence ratings of suicide images were not correlated with implicit positive affect toward the same suicide images. Nonetheless, future research could further examine this possibility by using different and/or more varied suicide stimuli in the AMP and/or asking participants to indicate how favorability they find a wider array of suicide methods.

Implicit affect to suicide correlated with STB variables among suicidal adults. In particular, suicidal adults with higher positive affect toward suicide tended to explicitly rate suicide pictures as more positive and more arousing. Also, suicidal adults with higher positive affect reported thinking about suicide more frequently (although this association did not survive correction for multiple comparisons). Notably, suicidal adolescents' positive affect to suicide was not related to how frequently they thought about suicide. It is possible that this discrepancy is due to between-sample differences, in both quantitative (e.g., lifetime frequency of ST, and proportion of life experiencing ST) and qualitative variables (e.g., reporting styles); we note here that, as expected, suicidal adults reported thinking about suicide much more frequently (Median = 425) than suicidal adolescents (Median = 30). Also, nonsuicidal adults' implicit affect toward suicide correlated with explicit arousal but, surprisingly, not valence ratings, possibly because nonsuicidal adults did not accurately interpret the suicide primes as depicting suicidal behavior. Taken together, these correlational findings again suggest that suicidal adults displayed relatively consistent affect toward suicide (i.e., correlated with explicit valence and arousal ratings of the same suicide pictures), whereas nonsuicidal adults did not. Lastly, implicit affect toward suicide helped differentiate groups above and beyond explicit valence ratings of suicide images. This indicates that implicit approaches, such as the AMP, may capture unique information about how good/bad people perceive suicide and, thus, could prove useful to clinical researchers and practitioners attempting to better measure suicide risk.

The findings from this study must be interpreted in the context of several important limitations. First, several aspects of the assessment procedure limit the conclusions that can be drawn from this study. The AMP may not have measured implicit affect equally well across participants. Per standard AMP instructions, participants were asked to ignore the affect-laden prime and focus on the Chinese pictograph target; however,

individual differences in various mental processes (e.g., attention, executive control, and motivation) and knowledge/beliefs (i.e., regarding automaticity of cognition and priming effects; Wilson & Brekke, 1994) likely influence the ability to follow these instructions and block/ignore the prime. Additionally, it is possible that variation in psychiatric presentation/acuity, the physical location participants completed the study, and compensation structure influenced participant attention and/or motivation and, thus, valid assessment. All sample 1 participants and Sample 2 nonsuicidal participants completed the study in the same university laboratory and were compensated about \$10 per hour, whereas Sample 2 suicidal participants completed the study in an inpatient hospital setting (given their acute psychiatric symptoms) and, per hospital policy, were not compensated. Future studies would benefit by better accounting for psychiatric diagnoses, acuity, and standardizing assessment setting and compensation structure whenever possible. Also, variation in features of the suicide pictures used, such as color, complexity, and/or ambiguity, may have inadvertently contributed to inaccuracy in measuring affect toward suicide. Future studies investigating affect toward suicide could use suicide pictures that are more narrowly focused (e.g., gun picture) and/or suicide-related words (“suicide” and “hanging”).

Second, the generality of findings may be restricted. Contrary to our hypotheses, suicidal and nonsuicidal groups displayed similar implicit affect toward suicide; however, it is not clear whether no group difference is due to (a) a true null effect, which would be contrary to explicit affect findings, (b) nonsuicidal participants misinterpreting the self-relevant suicide images, thereby displaying invalid implicit affect toward suicide, or (c) other factors. We caution against generalizing these findings lest researchers prematurely abandon the hypothesis that affect toward suicide might relate to increased STB risk. Future studies could provide much needed clarity by using more narrowly focused suicide pictures or suicide-related words in the AMP or a different measure of implicit affect, such as a version of the Suicide Implicit Association Test (IAT), requiring participants to sort suicide-related words and/or pictures into good vs. bad categories instead of self versus other categories.

CONCLUSIONS

In spite of these limitations, several important research directions follow from this work. First, future research in this area should incorporate the modifications outlined above, particularly using less ambiguous/complex suicide pictures in behavioral tasks that present stimuli for very short durations, like the AMP, and assessing psychiatric diagnoses

and lethality/severity of suicidal behavior, as both may relate to and influence affect toward suicide. Second, future studies should use larger adult samples to increase statistical power and longitudinal designs to better understand the directionality of relations between implicit affect toward suicide and variables, such as ST frequency. Incorporating these modifications may shed new and much needed light on why some people perceive suicide as a tenable or even a relatively attractive option, providing new clinical targets to improve suicide prevention and treatment.

CONFLICT OF INTEREST

The authors have no conflicts of interest to disclose.

ETHICS STATEMENT

All study methods were approved by the Committee for Use of Human Subjects at Harvard University.

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