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Adam C. Jaroszewski, Evan M. Kleiman, Patrick K. Simone, and Matthew K. Nock

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First-Person Stimuli: Improving the Validity of Stimuli in Studies of Suicide and Related Behaviors

Adam C. Jaroszewski
Harvard University

Evan M. Kleiman
Rutgers, The State University of New Jersey

Patrick K. Simone
Running Springs, California

Matthew K. Nock
Harvard University

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Researchers are increasingly using objective methods to study constructs related to suicidal thoughts and behavior (STB; e.g., self-identification with suicide), such as via behavioral tasks and brain imaging. Although promising, such approaches often are limited by the use of overly general stimuli (e.g., images, words) to represent constructs under study (e.g., suicide attempt). Overly general stimuli are problematic because they inadequately represent constructs, contributing to measurement error and thereby decreasing the internal and external validity of findings. To address this issue in suicide research specifically, we developed a set of first-person (FP) perspective suicide images depicting suicide attempt, evaluated its psychometric properties in one study, and examined whether people with recent suicidal thoughts rated FP-suicide images differently than people with no history of STB in a second study. Study 1 ($N = 221$) results suggest FP-suicide images have good construct validity (rs = .66–.87 with other suicide images) and internal consistency (Cronbach αs $>$ .80) across three subjective rating dimensions (i.e., valence, arousal, threat). Study 2 ($N = 73$) results suggest that people with recent suicidal thoughts display substantially lower aversion toward FP-suicide images (i.e., lower negative valence [$d = 1.22$, $p < .001$], lower arousal [$d = .61$, $p < .05$] and lower threat ratings [$d = 1.27$, $p < .001$]) than people with no STB history. FP-suicide images provide researchers using behavioral tasks/brain imaging paradigms with more self-relevant stimuli that may increase the internal and external validity of findings. First-person stimuli may improve both our understanding and prediction of STB as well as provide novel targets (e.g., lower aversion to suicide) for clinical intervention.

Public Significance Statement
This study provides evidence of the validity and reliability of a newly developed set of first-person perspective suicide images designed for use in computerized behavioral tasks investigating suicide-related constructs. These findings suggest that using such stimuli may contribute to improved prediction and prevention of suicide thoughts/behavior as well as help uncover novel targets for clinical intervention.

Keywords: suicide, first-person perspective, FP-suicide images, suicide stimuli, self-relevant

Supplemental materials: http://dx.doi.org/10.1037/pas0000823.supp

Suicide is among the leading causes of death in the United States and worldwide (Heron, 2017; World Health Organization, 2018). Although the mortality rate for many leading causes of death has dropped substantially over the past 100 years (e.g., cancer, pneumonia) due to scientific advances in these areas, the suicide rate has not changed during this time (CDC, 2019). Suicide deaths have not declined in part because scientific innovation has been slow, with suicide research investigating many of the same constructs (e.g., hopelessness) with the same approach (i.e., self-report) over the past five decades (Franklin et al., 2017). Relatedly, thinking about suicide and attempting suicide are distinct from, but necessary precursors to, dying by suicide (i.e., because one must first think about suicide in order to make an attempt and attempt in order to die by suicide), both of which are prevalent over the life course (i.e., suicidal thoughts interquartile range [IQR] = 7.9–13.9, [nonlethal] sui-

Adam C. Jaroszewski, Department of Psychology, Harvard University; Evan M. Kleiman, Department of Psychology, Rutgers, The State University of New Jersey; Patrick K. Simone, Independent Practice, Running Springs, California; Matthew K. Nock, Department of Psychology, Harvard University.

Correspondence concerning this article should be addressed to Adam C. Jaroszewski, Department of Psychology, Harvard University, 33 Kirkland Street, Cambridge, MA 02138. E-mail: jaroszewski@fas.harvard.edu

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cide attempt IQR = 3.0–5.1; Nock et al., 2008), highly burdensome in their own right (e.g., >$5 billion annual cost of non-lethal suicide attempt in the United States; Corso, Mercy, Simon, Finkelstein, & Miller, 2007; Shepard, Gurewich, Lwin, Reed, & Silverman, 2016; Spijker, Straten, Kerkhof, Hoeymans, & Smit, 2011), and show no signs of decreasing (Mathers & Loncar, 2006). Recently, in an effort to identify new, objective indicators of suicidal thoughts and behaviors (STB) and/or risk of STB, researchers have started to use computerized behavioral tasks that present participants with suicide methods and/or death-related stimuli and record their response (e.g., via reaction time [RT], neural responses), such as the Self-Injury Implicit Association Test (IAT; Nock & Banaji, 2007). These innovative methods hold great promise because they circumvent some of the limitations of self-report (e.g., motivation to conceal suicidal thoughts/intent), which are particularly salient in suicide research (Busch, Fawcett, & Jacobs, 2003). For instance, research using the IAT has shown that suicidal people respond differently (in RT) to death/suicide related stimuli than do nonsuicidal people, and these differences predict future suicide attempt above and beyond known risk factors, such as suicide attempt history and psychiatric diagnosis (OR = 5.88 [1.32 – 26.26]; Nock et al., 2010). For these reasons, objective tasks have improved our understanding of STB and our ability to identify objective markers of STB risk.

Despite this promise, the internal and external validity of objective tasks used in suicide research is limited because most tasks use overly general stimuli, such as suicide/death-related words (e.g., "gunshot", "funeral") and/or ambiguous negative images (e.g., deceased people, people in dangerous situations), which are not specific to suicide. Although there is considerable debate about what entities scientific constructs refer to (i.e., natural kinds, socially created "metaphors;" cf. Fried, 2017; Slaney & Garcia, 2015), there is greater consensus about what constructs consist of: namely, clusters of features (e.g., spatial attributes, behaviors) that reliably co-occur. The most reliably occurring features are called *prototypical* (Shaddish, Cook, & Campbell, 2001). In psychological science, stimuli used in behavioral tasks, such as images or words, are used to represent the construct(s) researchers intend to study (e.g., pictorial stimuli depicting angry faces used to represent the construct "social threat"). Importantly, a stimulus most accurately represents a construct if it displays all of the construct's prototypical features. Because attempting suicide entails engaging in potentially lethal behavior with at least some intent to die (Nock et al., 2008), the prototypical construct features of a suicide attempt include: (a) a person, (b) engaging in self-directed, (c) intentional, and (d) potentially lethal behavior (Supplemental Figure 1). Therefore, to most accurately represent a suicide attempt, a stimulus should depict these four features. Further, given that some features of suicide attempt must be inferred because they are not directly observable, such as the mental states (e.g., intentionality) of the person engaging in behavior, a valid suicide stimulus must depict prototypical features clearly, such that a person viewing the stimulus knows with a high degree of certainty that it depicts a suicide attempt.

Overly general stimuli can fail to adequately represent a behavioral construct under study in at least three ways: (a) failing to display all prototypical features, a limitation known as *construct underrepresentation*; (b) displaying features of irrelevant constructs (e.g., dismembered body parts), a limitation known as *construct confounding*; and (c) depicting prototypical features ambiguously (Shaddish et al., 2001). Currently, pictorial and word suicide stimuli used in the published literature suffer from construct underrepresentation, construct confounding, or ambiguous representation and, in some cases, all three issues simultaneously. Using imprecise stimuli is problematic because it can cause participants to misinterpret what the stimulus is intended to represent (e.g., suicide attempt) and therefore may undermine the purpose of using the stimulus in the first place. Although no stimulus is perfect, a stimulus with good construct validity decreases measurement error, thus increasing the validity of the behavioral tasks using it.

Although suicide stimuli are the focus of the present study, it is notable that various other clinical constructs are commonly studied using overly general stimuli too, such as substance use, alcohol use, nonsuicidal self-injury (NSSI), and eating/feeding behaviors, to name just a few. Thus, studies using overly general stimuli in tasks in order to represent these behaviors may also inadvertently reduce construct and external validity.

Recent findings suggest that the use of more precise stimuli can result in larger effects, and thus greater detection and prediction, when studying suicide and related outcomes. In a large cross-sectional study ($N > 7{,}000$) investigating self-harm related implicit associations, Glenn and colleagues (2017) found that the difference between people who have attempted suicide, thought about suicide but never attempted, and neither thought about nor attempted suicide was larger on the suicide IAT, $F(2, 1012) = 59.40$, $n^2 = .10$, which uses suicide method words (e.g., "gunshot," "hanging"), than on both the death IAT using death-related words (e.g., "dead," "die;" $F(2, 978) = 33.08$, $n^2 = .06$) and the self-injury IAT using NSSI images (i.e., cuts on arms; $F(2, 978) = 35.37$, $n^2 = .07$). Thus, the strongest differences between groups, which varied on suicide thought and behavior severity, were found with the IAT using stimuli more specific to suicide attempt per se (e.g., using the suicide method word of "hanging" vs. the more general word "dead"). Further, the death ($d = 0.44$, $p < .001$) and suicide ($d = 0.42$, $p < .001$) IATs differentiated people with and without STB history, whereas the self-injury IAT ($d = 0.18$, $p > .05$) did not, again reflecting the benefit of aligning the behavioral construct under study with the IAT stimuli used. It should be noted, however, that although the stimuli in the suicide IAT were relatively more specific to suicide attempts than the self-injury IAT, in absolute terms, the suicide IAT stimuli are still overly general because the words used (e.g., "gunshot") are not uniquely related to suicide.

We propose that one way to improve the suicide stimuli used in objective tasks is to use images depicting what the participant would see if they themselves were beginning to attempt suicide. Such images purposefully simulate the very kind of mental imagery people report experiencing while thinking about suicide: that is, seeing themselves, from their own perspective (i.e., first-person perspective), actively attempting suicide (e.g., holding a gun to their own head; Holmes, Crane, Fennell, & Williams, 2007; Crane, Shah, Barnhofer, & Holmes, 2011). Therefore, FP-suicide images may accurately resemble mental imagery (i.e., of attempting suicide) that suicidal people report experiencing when thinking about suicide. Depicting suicide attempts from the participant's own

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perspective can be accomplished by displaying an egocentric spatial view of the body engaging in behavior (e.g., looking down at one's own arms, torso, legs, etc., engaging in action). For example, an FP-suicide image might depict what it would look to hold a handgun pointed at one's own face and look down the gun barrel or what it would look like stand on the ledge of a skyscraper with one's toes hanging over the edge (Figure 1). Such first-person (FP) images limit the visual space primarily to the body, making the subject's behavior the main focus. This helps to clearly depict the prototypical features of suicide attempts and reduce the number of irrelevant constructs included. Therefore, FP-suicide images have the potential to simultaneously limit feature underrepresentation, construct confounding, and ambiguous representation. Thus, FP-suicide images may be valuable stimuli for studying variables related to the risk of suicidal thoughts, suicide attempt, and suicide completion/death, respectively, because thinking about suicide is a necessary precursor to attempting suicide, and attempting suicide is a necessary precursor to completing suicide. Also, people often report that when thinking about suicide, they experience mental images of attempting suicide. Therefore, suicidal thoughts, attempts, and completions are highly related and potentially assessable with the same instruments (e.g., IAT using FP-suicide images).

The goal of the current article is to present data from two related studies designed to first develop and then to validate FP stimuli representing suicide attempt. We did this by carrying out two studies. In Study 1, we developed and evaluated a set of FP-suicide pictorial stimuli (e.g., looking down the barrel of a gun) designed for use in computerized behavioral tasks. The primary aims of Study 1 were to test the face and construct validity and internal consistency of the FP-suicide images we developed. We asked participants to rate FP-suicide images and other images (e.g., IAPS negative, neutral, positive images; Lang, Bradley, & Cuthbert, 2005) on the dimensions of valence, arousal, and threat. We hypothesized that nonsuicidal participants would rate FP-suicide images as highly aversive (i.e., highly negative in valence, high arousal, and high threat ratings), more so than their ratings of IAPS neutral and IAPS- and FP-positive images, but consistent with ratings of other highly negative images. We also hypothesized that the FP-suicide images would demonstrate high internal consistency, indicating that participants rate them similarly to one another, suggesting they potentially represent the same construct (i.e., suicide attempt).

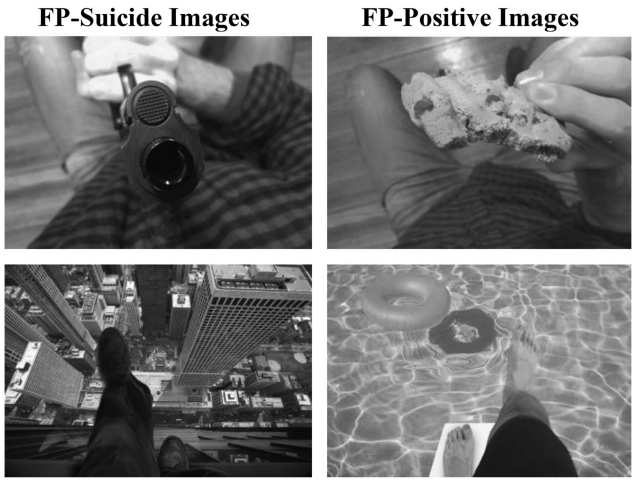

Figure 1. Two first-person (FP) suicide images and FP-Positive contrast images used in the present study. These images were designed to depict suicidal and appetitive behavior from the first-person perspective for use in behavioral tasks.

In Study 2, we recruited participants with recent and clinically significant suicidal thoughts as well as participants with no STB history whatsoever and asked them to rate FP-suicide and FP-positive images. The primary aim of Study 2 was to test the hypothesis that people with recent suicidal thoughts would rate FP-suicide images, which depict the content of common suicidal thoughts (i.e., imagining oneself attempting suicide), as less aversive than people who had never thought about suicide. This hypothesis derives from theoretical and empirical work suggesting that a diminished aversion to injury and death is a key factor failing to prevent those with suicidal and/or self-injurious thoughts from engaging in these behaviors (Fox et al., 2018; Franklin et al., 2016; Franklin, Lee, Puzia, & Prinstein, 2013; Franklin, Puzia, Lee, & Prinstein, 2014; Hooley & Franklin, 2018; Nock & Banaji, 2007). To our knowledge, this present study is the first to directly examine whether suicidal people find suicide less aversive than nonsuicidal people.

Study 1: Initial Validation of FP-Suicide Images

We had three goals in Study 1. First, we sought to evaluate the face validity of the FP-suicide images we created. Normatively, people find suicide to be highly aversive (Nazem, Forster, & Brenner, 2017). Therefore, images accurately depicting suicide attempt should be rated as highly aversive (i.e., low valence, high arousal, high threat), too. To determine this, we compared participants' ratings of FP-suicide images to IAPS neutral images as well as highly negative images (IAPS negative and third person [TP] perspective suicide images). Our second goal was to evaluate the construct validity of FP-suicide images by assessing these images' convergent and discriminant validity. To assess convergent validity, we tested whether ratings of FP-suicide images were similar to TP-suicide images, which depict other people attempting suicide (e.g., standing in front of an oncoming train). To assess discriminant validity, we tested whether ratings of FP-suicide images differed from ratings of positive images (i.e., IAPS positive images, FP-positive images). Our third and final goal was to assess the internal consistency of the FP-suicide images by testing the average intercorrelations among the group of images (i.e., Cronbach's alpha).

Method

Participants

Participants ($N = 221$) were recruited from Amazon Mechanical Turk (mTurk), drawn from a larger sample of 250 adult mTurk workers responding to a human intelligence task advertisement for a study on rating emotional images. All study methods were approved by the Committee for Use of Human Subjects at Harvard University. Of the 250 adult mTurk workers, 17 were excluded because of duplicate IP addresses, and 12 were excluded due to

unreliable response (e.g., response latency < 3 standard deviations below the mean, indicating ratings were provided extremely quickly). There were no significant differences between those included versus excluded from the study with respect to sex, race/ethnicity, or history of suicidal thinking, $\chi^2(1) = 0.00–0.23$, ps = .89–.95, Φs = .00–.14. Those included were older (M = 39.2, SD = 11.7) than those excluded (M = 34.2, SD = 7.8), $t(29.84) = 2.64$, $p = .01$, $d = 0.50$.

Nearly half of the sample identified as female (46.7%). The average age of participants was 39.19 years (Mdn = 36, SD = 11.62). The ethnic composition of the sample was 6.8% African American, 5.0% Asian American, 79.5% White, 4.1% Hispanic, 0.5% Native American, and 4.1% mixed race/other. Far more participants identified as White than any other racial/ethnic category (79.5% vs. 20.5%, $\chi^2[5] = 633.8$, $p < .001$). Participants signed an electronic informed consent form at the start of the study and received $1.00 for their participation (i.e., an hourly compensation rate of ~$4.50; study duration [minutes] *Median* = 12.8, M = 15.4, SD = 8.5).

Development of the FP-Suicide and FP-Positive Images

FP-suicide and matched FP-positive images were created using digital photography and modified with digital art techniques (see Figure 1 for an example of FP-Suicide and FP-Positive images). All images depict a White male from the subject's perspective.

FP-suicide images. The suicide images were intended to be highly negative in valence and depict the subject's perspective of attempting suicide. In total there are eight suicide images: (a) looking down the barrel of a gun; (b) looking down the barrel of a gun with a bright muzzle flash; (c) looking down at a butcher's knife moments before cutting the subject's arm; (d) looking down at butcher's knife held with both hands before the knife penetrates the subject's abdomen; (e) looking down at butcher's knife held by one hand before it penetrates the abdomen; (f) looking down from the ledge of a tall building as the left leg of the subject is about to step off; (g) looking down at a handful of colorful pills in the subject's left hand, and a bottle of whiskey in the right hand; and (h) looking at an oncoming train with the subject's left arm and hand outstretched in front of him. See Supplemental Figure 2 for all FP-suicide images and Supplemental Figure 3 for all FP-positive images.

FP-positive images. The positive contrast images were designed to match the FP-suicide images in terms of body position (e.g., arm raised, object held in hand) and self-directed and intentional action. They depict the subject's perspective of engaging in rewarding and/or appetitive behavior. In total there are six positive contrast images: (a) looking down at a chocolate chip cookie held by the subject; (b) looking down at a red apple held by the subject; (c) looking down at a cold drink held by the subject while the subject floats in pool on a sunny day; (d) looking down from the edge of a diving board before stepping into a swimming pool; (e) looking down at a handful of colorful candy (M&M's) held in the subject's left hand; and (f) looking out at a field of wheat at sunset with the subjects left hand outstretched in front of him.

Selection of IAPS Images and TP-Suicide Images

IAPS images were selected according to normative ratings outlined in the IAPS technical report (Lang et al., 2005). We selected images that would be representative of negative, neutral, and positive categories in terms of normative valence ratings. When possible, we selected images depicting a variety of content, including animals, humans, and inanimate objects. However, we excluded IAPS negative images depicting content related to death, mutilation, or potentially self-injurious behavior so as to ensure valid comparison between IAPS negative images with images depicting suicidal thought/behavior-related content (i.e., FP- and TP-suicide images). We selected IAPS negative images with highly negative valence ratings (7–9) and high arousal ratings (6–9). IAPS negative images included: 1050 (snake), 1200 (spider), 1300 (pit bull), 1930 (shark), 2703 (sad children), 2900 (crying boy), 6370 (masked man), 6571 (masked man with knife). We selected IAPS neutral images with moderate valence ratings (4–5) and low arousal ratings (2–3). IAPS neutral images included: 2191 (farmer), 2374 (girl reading), 2384 (man fishing), 5390 (boats), 5731 (door), 7026 (table), 7041 (baskets), 7546 (bridge). We selected IAPS positive images with highly positive valence ratings (1–3) and moderate to high arousal ratings (5–7). IAPS positive images included: 1463 (kittens), 1710 (puppies), 1750 (bunnies), 2070 (baby), 2345 (children), 4641 (man and woman), 8200 (man waterskiing), 8461 (teenagers), 8490 (roller-coaster).

TP-suicide images depict a person potentially attempting suicide from the third-person perspective. Among the set of TP-suicide images, we included one IAPS image (6570) depicting a man with a gun to his head. The remaining five images in this category were identified and selected from Internet searches, including two images depicting a person standing in front of an oncoming train, two images depicting a person standing on a ledge, and one image depicting a person with a handful of prescription medication and empty pill bottles. The first author subjectively judged the adequacy of TP-suicide images.

Measures

Demographics. With an online self-report survey, participants were asked to identify their age, sex, and race/ethnicity. Participants could elect to answer or not answer any or all of these questions. Participants were also provided a free response option.

History of suicidal thoughts. We used one item from the self-report module of the Self Injurious Thoughts and Behaviors Interview (SITBI), a valid and reliable measure, to assess the presence suicidal thoughts (Nock, Holmberg, Photos, & Michel, 2007). Specifically, we asked participants, "Have you ever had any thoughts of killing yourself?" We chose this item to assess the lifetime presence of suicidal thoughts because it assesses experience with thoughts that are unambiguously about suicide.

Explicit picture ratings. Participants explicitly rated how pleasant, threatening, and arousing they found a variety of digital images. Prior to rating the images, participants were required to read definitions of the terms pleasantness, threat, and arousal and correctly identify each term in a multiple choice test before continuing with the survey. On each trial, an image was presented and participants were asked to answer the following questions by rating the image on a 9-point scale: (a) How pleasant to you find

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this picture (−4 = *extremely unpleasant* to 0 = *neutral* to 4 = *extremely pleasant*)?; (b) how arousing do you find this picture (0 = *not arousing at all* to 8 = *extremely arousing*)?; and (c) how threatening do you find this picture (−4 = *extremely nonthreatening* to 0 = *neutral* to 4 = *extremely threatening*)? After completing their ratings for each image, participants clicked on a button to view and rate the next image. In total, there were 6 types of images: FP-suicide images (e.g., looking down the barrel of a gun), FP-positive images (e.g., looking down at a cookie), TP-suicide images (e.g., looking at person jumping off of a cliff), and IAPS positive (e.g., puppies), neutral (e.g., a door), and negative (e.g., a snake) images. Images were randomly presented to participants.

Procedure

Participants responded to an online mTurk "HIT" (human intelligence task) advertisement for a study on rating emotional images. Participants electronically signed an informed consent form, completed an explicit ratings survey, rerated all nine highly positive IAPS positive images in an attempt to improve mood, and answered questions about demographics and past suicidal thoughts via an online survey. Suicide crisis referrals were provided at the bottom of each survey page.

Data Analytic Plan

We used chi square tests to determine whether participants were equivalent on sociodemographic variables. We used three linear mixed effects regression models (one model for valence, arousal, and threat rating dimensions, respectively) to test the hypothesis addressing face validity, that is, that participants would rate FP-suicide images as more negative, arousing, and threatening than IAPS neutral images. Each mixed effects model regressed participant ratings onto image type (fixed effect; simple/treatment contrast coded) and included by-subject and by-image random intercepts to account for within-subject correlations in ratings and the unique variability of each image, respectively. Post hoc analyses to determine whether participants rated image types differently consisted of a series of independent samples *t* tests on the predicted marginal mean differences of image types. We computed Spearman correlations to evaluate the associations between image types. We computed Cronbach's alphas to evaluate internal consistency of the set of FP-suicide images. Exploratory analyses consisted of the following: chi square tests and a *t* test to determine whether people reporting having suicidal thoughts at least once in their lifetime (suicidal group) were equivalent on sociodemographic variables to people reporting no suicidal thoughts (nonsuicidal group), and a series of linear mixed effects regression models to evaluate whether people reporting having suicidal thoughts in their lifetime (suicidal group) rated FP-suicide images differently than participants reporting no suicidal thoughts (nonsuicidal group). Results of exploratory analyses are reported in the online supplemental materials.

Results

Face Validity

Results of linear mixed effects regression analyses testing the association between participant image ratings and image type are presented in Table 1. Participants rated FP-suicide images as highly aversive, that is, much more negative ($\beta = -0.64$, $p < .001$), arousing ($\beta = 0.49$, $p < .001$), and threatening ($\beta = 0.74$, $p < .001$) than IAPS neutral images and similar to both TP-suicide and IAPS negative images across all three rating dimensions (see Supplemental Table 1 and Supplemental Figure 4). These results suggest that the FP-suicide images have good face validity.

Table 1
Study 1 Results of Linear Mixed Effects Regression Analyses Testing the Association Between Image Categories and Participant Image Ratings

	Valence ratings				Arousal ratings				Threat ratings			
Variables	*B*	*SE*	β	*p*	*B*	*SE*	β	*p*	*B*	*SE*	β	*p*
Fixed parts												
(Intercept)	5.55	0.2		**<.001**	1.84	0.23		**<.001**	0.37	0.28		.177
FP-suicide images	−4.86	0.28	−0.64	**<.001**	3.38	0.3	0.49	**<.001**	6.39	0.39	0.74	**<.001**
TP-suicide images	−4.49	0.34	−0.44	**<.001**	3.49	0.37	0.38	**<.001**	6.18	0.48	0.53	**<.001**
IAPS negative images	−4.71	0.28	−0.62	**<.001**	3.19	0.3	0.46	**<.001**	5.61	0.39	0.65	**<.001**
FP-positive images	0.26	0.3	0.03	.395	1.47	0.33	0.19	**<.001**	0.06	0.42	0.01	.887
IAPS positive images	0.83	0.27	0.12	**.002**	2.41	0.3	0.37	**<.001**	0.19	0.38	0.02	.611
Random parts												
σ^2	1.66				3.44				1.68			
$\tau_{00,\ subject}$	0.14				1.88				0.28			
$\tau_{00,\ picture}$	0.31				0.35				0.60			
$N_{subject}$	221				221				221			
$N_{picture}$	43				43				43			
$ICC_{subject}$	0.07				0.33				0.11			
$ICC_{picture}$	0.14				0.06				0.23			
Observations	9098				9098				9103			
Marginal R^2/conditional R^2	0.758/0.809				0.217/0.526				0.776/0.853			
Deviance	29639.793				36360.652				29910.081			

Note. FP = first-person; TP = third person; ICC = intraclass correlation; IAPS = international affective picture system. Bold indicates *p* values < .05.

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Construct Validity

Ratings of FP-suicide images should be positively associated with other images depicting suicide attempt, less associated with images depicting negative but not suicidal content (e.g., growling dog), and negatively or not associated with images depicting positive/rewarding information (e.g., smiling babies). We computed average scores for participants' ratings of each image type and computed correlations between all image types for each dimension using Spearman rank correlations because FP- and TP-suicide images were highly skewed. We used Bonferroni adjustment to correct for multiple comparisons. As hypothesized, FP-suicide images were strongly positively associated with TP-suicide images (i.e., images depicting the suicidal behavior of others) in valence ($r_s = 0.66$, $p < .001$; see Supplemental Table 2), arousal ($r_s = 0.87$, $p < .001$), and threat ratings ($r_s = 0.69$, $p < .001$). Conversely, FP-suicide images were negatively associated with both IAPS positive images ($r_s = -0.34$, $p < .001$) and FP-positive images ($r_s = -0.34$, $p < .001$) in valence and not associated with either of these image types in threat ratings (i.e., r_ss $= 0.12$ – -0.10, ps $> .05$). In terms of arousal ratings, FP-suicide images were moderately positively associated with IAPS positive images ($r_s = 0.37$, $p < .001$) but not with FP-positive images ($r_s = 0.17$, $p < .001$). To determine whether FP-suicide images were rated as more similar in arousal to other images depicting suicidal content (i.e., TP-Suicide; $r_s = 0.87$) than IAPS positive images ($r_s = 0.37$), we conducted a Fisher's r-to-z transformation for testing the difference between two dependent correlations, which indicated that FP- and TP-suicide image arousal ratings were more strongly related than FP-suicide and IAPS positive images ($z = 9.86$, $p < .001$).

FP-Suicide images also were positively associated with IAPS negative images in valence ($r_s = 0.52$, $p < .001$), arousal ($r_s = 0.86$, $p < .001$), and threat ratings ($r_s = 0.54$, $p < .001$). To determine whether FP-suicide images were rated as more similar to other images depicting suicidal content (i.e., TP-suicide) than images depicting merely highly negative (but not suicidal) content (i.e., IAPS Negative), we computed Fisher's r-to-z transformation tests, which indicated that the FP- and TP-suicide images were more strongly associated than FP-suicide and IAPS negative images in valence ($r_s = 0.66$ vs. $r_s = 0.52$; $z = 2.26$, $p = .01$) and threat ($r_s = 0.69$ vs. $r_s = 0.54$; $z = 2.40$, $p = .02$) ratings. In sum, these results suggest that FP-suicide images have strong construct validity because they are strongly positively associated with other images depicting suicide (i.e., TP-suicide images) and significantly associated with other types of images, including highly negative, nonsuicidal images.

Internal Consistency

FP-suicide images had good internal consistency on valence ($\alpha = .83$), arousal ($\alpha = .87$), and threat ($\alpha = .84$) rating dimensions. These results suggest that participants rated the FP-suicide images similarly to one another.

Discussion

The purpose of this study was to develop and evaluate a set of images depicting what attempting suicide might look like from the point of view of an individual engaging in this action, simulating the mental imagery people report experiencing when seriously thinking about suicide (Crane et al., 2011; Holmes et al., 2007). This study has three main findings. First, FP-suicide images demonstrated face validity, as they were rated as much more aversive than IAPS neutral images across valence, arousal, and threat rating dimensions and in line with other highly negative images (IAPS negative and TP-suicide images). Second, the FP-suicide images demonstrated construct validity, as ratings of these images were highly correlated to ratings of other images depicting suicide attempt (i.e., TP-suicide images) across all three rating dimensions and, conversely, significantly less correlated with both negative and positive images. Third, the set of FP-suicide images demonstrates good internal consistency, with standardized Cronbach's alphas greater than .8 for valence, arousal, and threat rating dimensions, indicating that participants rated FP-suicide images similarly to one another. These findings suggest that our novel set of FP-suicide images are valid and reliable.

This study had several strengths, such as a relatively large sample ($N = 221$) and the use of multiple, validated image types (i.e., IAPS images), which varied considerably along rating dimensions (e.g., valence). These strengths notwithstanding, this study had several important limitations that warrant comment. First, the study was conducted online, and, therefore, it is possible that participants were distracted and/or motivated to move through the study as quickly as possible, two factors that could compromise the accuracy of the data provided. However, these potential sources of inaccuracy are not unique to online settings. Indeed, many studies demonstrate that data obtained online are just as valid as data obtained in traditional, laboratory settings (e.g., Germine, Nakayama, Duchaine, & Wilmer, 2012; Hauser & Schwarz, 2016). Additionally, we made efforts to exclude data from participants providing either incomplete data and/or ostensibly invalid data (i.e., 3 SDs beyond the mean) in terms of response time and variance of response. Second, we assessed history of suicidal thoughts with a single item, precluding an in-depth examination of the association between theoretically relevant aspects of STB history, such as recency, frequency, and severity of suicidal thoughts. We chose to assess suicidal thoughts with one item to reduce participant burden because examining differences between people with and without a history of suicidal thoughts was ancillary to the primary aim of this study. In the future, studies examining affect toward suicide and other types of images among individuals with a STB history should include in-depth questionnaires assessing STB history, such as the SITBI (Nock et al., 2007).

Study 2: Group Differences In Explicit Ratings of FP-Suicide Images

The primary aim of Study 2 was to test the hypothesis that people with recent suicidal thoughts would rate FP-suicide images as less aversive than people who had never thought about suicide. We had two goals in Study 2. First, we sought to determine whether the nonsuicidal and suicidal groups differed in ratings of FP-suicide images. Second, within the suicidal group, we sought to examine the relationship between participants' ratings of FP-suicide images and important aspects of their STB history (e.g., frequency and recency of suicidal thoughts).

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Method

Participants

Nonsuicidal group. The nonsuicidal group consisted of 36 individuals (44.4% identifying as female) from the greater Boston area responding to an advertisement for a study on emotional images and learning. Participants voluntarily signed up for the study, which was described to them during a phone screen as a study on a variety of topics, including past experiences with suicidal thoughts and behavior. Participants were included in the nonsuicidal group if they reported no history of STBs as assessed by the Self-Injurious Thoughts and Behaviors Interview (SITBI) during both the phone screen and participation in the study (see the SITBI section for more detail). The nonsuicidal group had an average age of 30.2 years ($Mdn = 26$, $SD = 11.9$) and an ethnic composition of 5.6% African American, 25.0% Asian American, 8.3% Hispanic, 5.6% mixed race/other, and 55.5% White. Within the nonsuicidal group, no demographic variable was significantly associated with explicit ratings of FP-suicide or FP-positive images ($ps > .05$). Sample characteristics and between-groups comparisons are presented in Supplemental Table 6.

Suicidal group. The suicidal group consisted of 37 individuals (45.9% identifying as female, 2.7% as other) from the greater Boston area responding to an advertisement for a study on STBs. Like the nonsuicidal group, participants in the suicidal group voluntarily signed up for the present study after undergoing a phone screen assessing their STB experiences. Participants were included in the suicidal group if (a) they reported having serious thoughts about suicide (e.g., made a suicide plan) for more than 5 minutes in the three months prior or (b) if they made a suicide attempt in the year prior. The suicidal group had an average age of 32.7 years ($Mdn = 28$, $SD = 11.9$) and an ethnic composition of 71.4% White, 11.4% African American, 5.7% Hispanic, 2.8% Asian American, and 8.7% mixed race/other. Within the suicidal group, no demographic variable was significantly associated with explicit ratings of FP-suicide or FP-positive images ($ps > .05$). All study methods were approved by the Committee for Use of Human Subjects at Harvard University.

Procedure

Participants arrived in the lab, signed an informed consent form, and answered demographic questions. Participants then completed the explicit ratings survey and the SITBI. To mitigate risk and help ensure the safety of all participants, a PhD level clinician was physically present during all participants' visit to the laboratory, and an additional PhD level clinician was on call at all times.

Measures

Demographics. Participants were asked to identify their age, sex, race/ethnicity, current use of psychotropic medication, and any use of psychological treatment.

Current depressive symptoms. The Mini-International Neuropsychiatric Interview (M.I.N.I.; Sheehan, 2014) 7.0 Major Depressive Episode module is a brief structured diagnostic interview assessing current and past depression symptoms. We derived a total score by summing the current (i.e., past 2-week) depressive symptoms endorsed.

Hedonic capacity. The Snaith–Hamilton Pleasure Scale (SHAPS; Snaith et al., 1995) is a 14-item self-report 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.

Risk-seeking attitudes. The 30-item version of the Domain-Specific Risk-Taking scale (DOSPERT; Blais & Weber, 2006) was used to measure risk-seeking attitudes. This measure is a self-report scale of the likelihood of engaging in risky activities/behaviors, covering five risk-taking domains (i.e., ethical, financial, health/safety, social, and recreational), using a 7-point scale ranging from 1 (*Extremely Unlikely*) to 7 (*Extremely Likely*). Higher scores indicate greater risk-taking attitudes/preferences. We derived a total score by summing item responses.

History of suicidal thoughts. In this study, we used items from the structured interview version of the SITBI. The SITBI measures the presence, frequency, and characteristics of various types of self-injurious thoughts and behaviors. It has modules for suicidal ideation, suicide plans, suicide gestures, suicide attempts, and NSSI. The SITBI has strong interrater reliability (average $\kappa = .99$, $r = 1.0$) and test–retest reliability (average $\kappa = .70$, intraclass correlation coefficient = .44) over a 6-month interval (Nock et al., 2007). The SITBI shows strong construct validity, which converges with other measures of suicidal ideation (average $\kappa = .54$) and suicide attempts (average $\kappa = .65$). The following SITBI item was used to assess presence of suicidal thoughts: "Have you ever had thoughts of killing yourself (e.g., 'maybe I should kill myself', 'I should kill myself', 'I am going to kill myself') that lasted more than a few minutes?" If the participant answered yes to this question, they were then asked, how many days in (a) the past week, (b) past month, (c) past year, and (d) in [the participant's] lifetime such thoughts occurred? These questions were used to assess frequency and recency of suicidal thoughts. Participants were also asked, "have you ever tried to kill yourself? In other words, have you ever purposely hurt yourself *with some intent to die*?" This question was used to assess history of suicide attempt.

Explicit picture ratings. Following the same procedure described in Study 1, participants in the present study rated how pleasant, threatening, and arousing they found FP-suicide and FP-positive images. Images were randomly presented to participants.

Data Analytic Plan

Baseline characteristics. To determine whether groups differed in 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., depression symptoms), and χ^2 tests for nominal variables (e.g., sex).

Group differences in explicit affect. Similar to Study 1, we constructed a linear mixed effects regression model for each rating dimension (i.e., valence, arousal, and threat) to evaluate whether the groups rated FP-suicide and FP-positive images differently. Each mixed effects model regressed participant ratings onto Image Type, Group, and Image Type × Group interaction (fixed effects) and included by-subject and by-

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image random intercepts to account for within-subject correlations in ratings and the unique variability of each image, respectively. Post hoc analyses to determine whether groups rated image types differently consisted of independent samples *t* tests on the predicted marginal mean differences.

Associations among variables in the suicidal group. Within the Suicidal group, we examined Spearman rank correlations between explicit ratings and STB variables (e.g., lifetime frequency of suicidal thoughts) with Bonferroni adjustment to correct for multiple comparisons. There are no universally accepted procedures for calculating STB frequency, recency, or severity. Therefore, we calculated these variables in ways that were either (a) consistent with prior literature (e.g., Franklin et al., 2013) and/or (b) allowed for adequate group sizes for statistical comparisons.

Frequency. We used a median split to transform raw suicidal thoughts frequency values into class intervals in which (a) values between 1 and 450 were assigned a value of 1 ($n = 19$) and (b) values greater than 450 were assigned a value of 2 ($n = 18$).

Recency. For recency analyses, participants were sorted into the following groups: no history of suicidal thoughts ($n = 36$; i.e., participants in the nonsuicidal group); presence of suicidal thoughts at some point in the three months before assessment, but no suicidal thoughts within the week before assessment ($n = 16$); and presence of suicidal thoughts within the week before assessment ($n = 26$). We chose these intervals in part to approximate nonrecent, moderately recent, and very recent suicidal thoughts.

Severity. For severity analyses, participants were sorted into the following groups: no history of thinking of suicide nor making a suicide attempt (No STBs; $n = 36$); history of suicidal thoughts (ST), but no suicide attempts (ST only; $n = 28$); history of both thinking about suicide and engaging in suicidal behavior, that is, a suicide attempt (STBs; $n = 9$).

To investigate the effect of these frequency, recency, and severity groups on explicit affect toward suicide, we conducted a series of Kruskal-Wallis tests, a nonparametric method for testing whether multiple samples originate from the same distribution. A Kruskal-Wallis test is appropriate when assumptions of a one-way ANOVA test are not met (e.g., unequal sample size, nonsphericity; both of which were not met in the present study). Pending significant effects, we used pairwise Wilcoxon's rank sum tests to investigate differences among frequency, recency, and severity subgroups.

Results

Baseline Characteristics

Group differences in baseline characteristics are reported in Supplemental Table 6. Compared to nonsuicidal participants, suicidal participants were more likely to report current psychotropic medication (5.6% vs. 48.6%, $\chi^2 = 17.03$, $OR = 7.3$ [2.76, 19.31], $p < .001$) and psychological treatment use (16.7% vs. 89.1%, $\chi^2 = 38.50$, $OR = 45.2$ [13.8, 156.5], $p < .001$), greater depressive symptoms ($Mdn = 0$ vs. $Mdn = 4$, $U = 1244$, $r = .81$ [0.71, 0.90], $p < .001$), and lower hedonic capacity ($Mdn = 50$ vs. $Mdn = 40$, $U = 235.5$, $r = .56$ [0.38, 0.70], $p < .001$).

Group Differences in Explicit Affect

As hypothesized, the suicidal group rated FP-suicide images as much more pleasant ($t = 5.11$; $d = 1.22$, $p < .001$), moderately less arousing ($t = -2.63$; $d = .61$, $p < .05$), and much less threatening than the nonsuicidal group ($t = -5.00$; $d = 1.27$, $p < .001$). The suicidal group also rated FP-positive images as less pleasant than the nonsuicidal group ($t = -2.39$; $d = .57$, $p < .05$) but just as arousing, $t = 0.53$; $d = .09$, $p > .05$, and threatening, $t = 1.22$; $d = .30$, $p > .05$. In all three models (i.e., valence, arousal, and threat rating dimensions), the main effects for group and the interaction between group and image type significantly predicted ratings (see Figure 2). Results of linear mixed effects regression analyses testing the association between participant image ratings, image type, and group are presented in Table 2. These linear mixed effects regressions were also conducted while controlling for clinical covariates on which groups differed (i.e., past 2-week depression symptoms, hedonic capacity, past psychological treatment, and current psychotropic medication use; see Supplemental Table 7). Notably, covariate and noncovariate con-

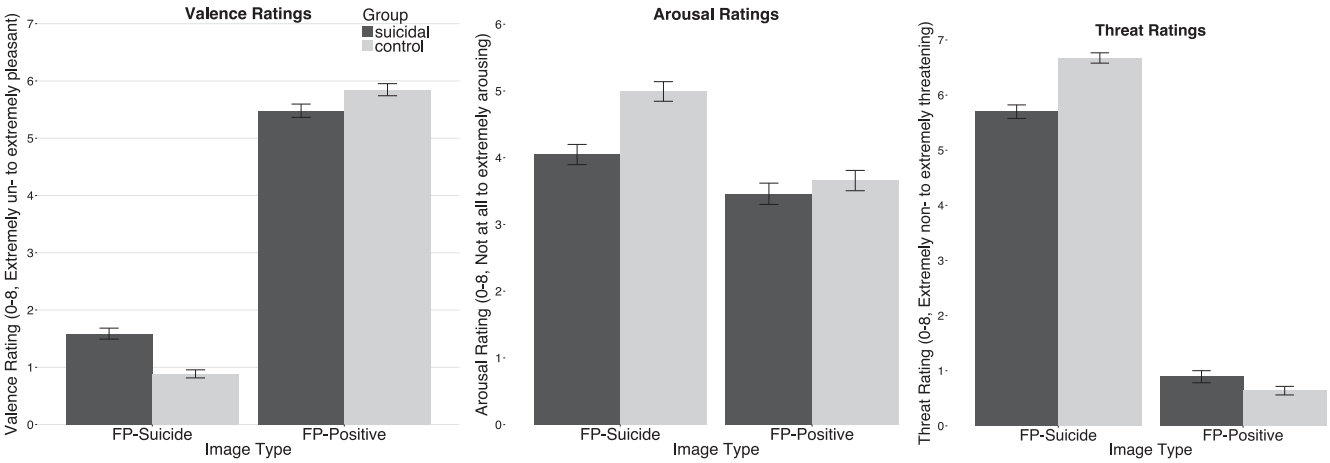

Figure 2. Study 2 group differences in explicit affect toward FP-suicide and FP-positive images. FP = first-person. Error bars represent ± 1 standard error of the mean.

Table 2
Study 2 Results of Linear Mixed Effects Regression Analyses Testing the Association Between Group, Image Category, and Participant Image Ratings

Variables	Valence ratings				Arousal ratings				Threat ratings			
	B	*SE*	β	*p*	*B*	*SE*	β	*p*	*B*	*SE*	β	*p*
Fixed parts												
(Intercept)	5.85	0.23		**<.001**	3.66	0.30		**<.001**	0.64	0.22		**<.001**
Suicidal group	−4.96	0.29	−0.91	**<.001**	1.34	0.27	0.26	**<.001**	6.03	0.26	0.94	**<.001**
FP-suicide images	−0.37	0.15	−0.07	**.017**	−0.20	0.37	−0.04	.595	0.25	0.21	0.04	.222
Suicidal Group × FP-Suicide Images	1.07	0.18	0.18	**<.001**	−0.77	0.25	−0.14	**.003**	−1.23	0.19	−0.17	**<.001**
Random parts												
σ^2	2.017				4.020				2.298			
$\tau_{00,\ subject}$	0.089				1.847				0.394			
$\tau_{00,\ picture}$	0.236				0.129				0.161			
$N_{subject}$	73				73				73			
$N_{picture}$	14				14				14			
$ICC_{subject}$	.038				.308				.138			
$ICC_{picture}$	.101				.022				.056			
Observations	1021				1021				1021			
Marginal R^2/conditional R^2	.731/.731				.417/.410				.788/.788			
Deviance	3680.258				4480.286				3864.399			

Note. FP = first-person; ICC = intraclass correlation. Bold indicates *p* values < .05.

trolled results (see Table 2) were nearly identical, suggesting the significant Group × Image-type interactions are not accounted for by these clinical variables. Predicted marginal means for each group's ratings of FP-suicide and FP-positive images and predicted marginal means differences between groups are displayed in Supplemental Table 8.

Associations Among Variables Within Suicidal Group

Valence ratings of FP-suicide images were strongly correlated with frequency of suicidal thoughts, regardless of whether frequency was calculated by ranking the raw totals provided by participants ($r_s = 0.64$, $p < .001$) or if these raw values were transformed into classes ($r_s = 0.62$, $p < .001$; Supplemental Table 9). Valence ratings also were strongly negatively correlated with threat ratings ($r_s = -0.63$, $p < .001$). Threat ratings were moderately negatively correlated with STB severity ($r_s = -0.42$, $p < .01$), such that having a suicide attempt history was associated with finding FP-suicide images as less threatening. In contrast, arousal ratings were not correlated with any other explicit rating dimension nor STB variable (*p*'s all >.05).

Patterns Across STB Frequency Intervals

A Kruskal-Wallis test revealed that there was a significant effect of frequency interval on valence ratings of FP-suicide images, $H(2) = 24.47$, $p < .001$, $n^2 = .32$, (see Figure 3 for suicidal thinking frequency effects). Post hoc tests revealed that the nonsuicidal group, reporting having never thought of suicide (the "Never" group; see Figure 3), displayed very similar responses to the suicidal subgroup reporting thinking about suicide between 1 and 450 times ($p = .88$, $d = .04$) but displayed significantly more negative ratings compared with the subgroup reporting thinking about suicide >450 times ($p < .001$, $d = .92$; see Figure 3).

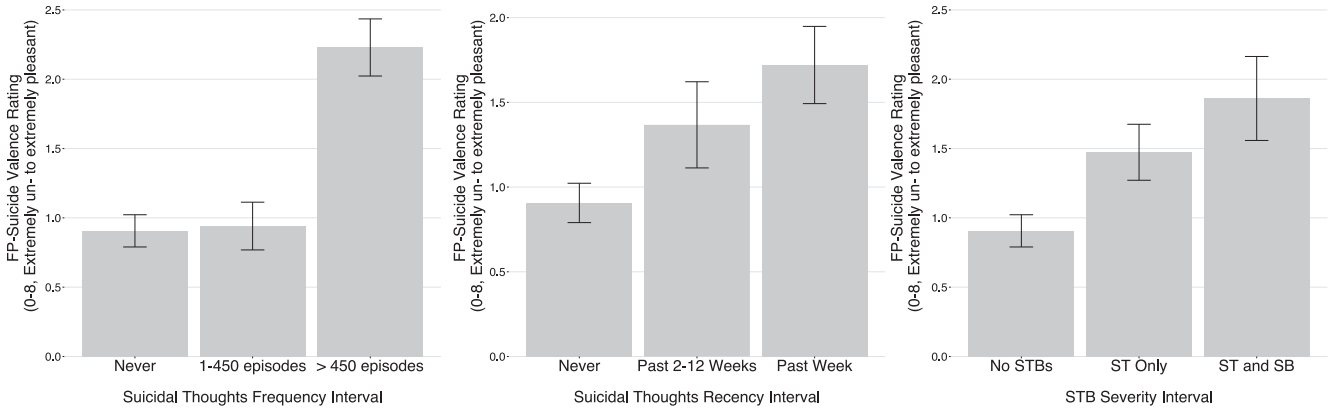

Figure 3. Study 2 Suicidal thoughts frequency effects, recency effects, and severity effects on explicit affect to FP-suicide images. FP = first-person; STB = suicidal thoughts and behavior; ST = suicidal thoughts; SB = suicidal behavior. Error bars represent ± 1 standard error of the mean.

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Patterns Across STB Recency Intervals

A Kruskal-Wallis test revealed that there was a significant effect of recency interval on valence ratings of FP-suicide images, $H(2) = 9.89$, $p < .01$, $n^2 = .11$, (see Figure 3 for suicidal thinking recency effects). Post hoc tests indicated that nonsuicidal participants displayed very similar valence ratings of FP-suicide images as the suicidal subgroup reporting thinking about suicide 2–12 weeks prior to assessment ($p = .67$, $d = .14$); however, the "Never" group displayed significantly more negative ratings compared with the subgroup reporting thinking about suicide within the week before assessment ($p < .01$, $d = .73$; Figure 3).

Patterns Across STB Severity Intervals

A Kruskal-Wallis test revealed that there was a significant effect of STB severity interval on valence ratings of FP-suicide images, $H(2) = 10.02$, $p < .01$, $n^2 = .12$, (see Figure 3 for STB severity effects). Post hoc tests indicated that the nonsuicidal group displayed significantly more negative ratings than the ST only subgroup ($p < .05$, $d = .54$). The ST only subgroup rated FP-suicide images as less pleasant ($M = 2.47$) than the ST and SB subgroup ($M = 2.86$); however, this difference was not significant ($p = .57$, $d = .18$), potentially because the unbalanced subgroup sample sizes and a small number of individuals in the ST and SB subgroup ($n = 9$) resulted in too low statistical power (i.e., $<.80$).

Discussion

There were three main findings in Study 2. First, the suicidal group demonstrated substantially lower aversion toward suicide images, rating FP-suicide images much more pleasant, moderately less arousing, and much less threatening than the nonsuicidal group. This suggests that people with recent STBs may lack a natural and widely held protective aversion toward suicide information. These results are consistent with the reduced barriers theory of self-injury that proposes some people purposefully hurt themselves because natural barriers (e.g., high aversion) that usually inhibit self-injury are reduced (Franklin et al., 2016; Hooley & Franklin, 2018; Fox et al., 2018). Second, the suicidal group's lower aversion toward suicide images was particular to suicide images, not generalizing to positive images. Specifically, although the suicidal group rated FP-positive images as less pleasant than the nonsuicidal group, the groups rated these images similarly in terms of arousal and threat. Third, lower aversion toward suicide was related to how frequently and recently people thought about suicide as well as whether they had made a suicide attempt, a marker of STB severity. Specifically, suicidal thoughts that were more frequent and more recent and/or more severe were related to lower levels of aversion to FP-suicide images. Taken together, these findings suggest that people with STBs may possess less of a protective aversion to suicide specifically, and that this lower aversion is related to how often, recent, and severe their suicidal thoughts/behaviors are. While speculative, these results support the possibility that lower aversion to suicide may represent a novel predictor of suicidal thoughts and behavior, which is consistent with theoretical and empirical work on NSSI, a self-injurious behavior closely associated with STB, demonstrating that reduced aversion to NSSI stimuli is associated with a history of (cf. Nock & Banaji, 2007; Franklin et al., 2013; 2014; Hooley & Franklin, 2018) and future engagement in NSSI (Fox et al., 2018).

This study had several strengths, such as the inclusion of individuals with recent and severe suicidal thoughts. This study also had several limitations that warrant comment. First, all data were collected via self-report, making it possible that various biases (e.g., self-presentation) or other issues (e.g., poor recall) lead to inaccuracies, particularly with respect to estimating the frequency of past suicidal thoughts. Future studies should aim to not rely solely on self-report but instead use objective measures whenever possible, such as medical records to confirm presence of suicidal thoughts/behaviors and/or provide tools (e.g., an algorithm and calculator) to help participants better estimate the frequency of past suicidal thoughts and behaviors. Second, participants in the present study rated only FP-suicide and positive images, not negative, neutral, or positive images (e.g., IAPS) as participants did in Study 1, nor did they rate suicide/death-related word stimuli, precluding our ability to directly compare 'overly general' suicide stimuli with FP-suicide images. We chose to limit the number of stimuli participants rated in order to reduce burden, given that examining group differences in ratings of suicidal behavior images (i.e., not other images) was the primary aim of this study. Future studies examining explicit affect to suicide information among individuals with a STB history may benefit by including a variety of other types of images (e.g., neutral images, nonsuicidal negative images, TP-suicide images) and words ("suicide," "death," "deceased") in order to explore whether group differences in explicit affect are indeed specific to suicide or generalize more broadly to other types of information and whether the specificity of the stimuli influence ratings.

General Discussion

This study reports on the development and evaluation of FP-suicide images, a new set of images designed for use in behavioral tasks that depict what attempting suicide might look like from the point of view of an individual engaging in this action (i.e., from the first-person perspective). This examination provided initial evidence for the validity and reliability of FP-suicide images as well as evidence that people with recent suicidal thoughts rate FP-suicide images as substantially less aversive than people with no suicidal history. Although various stimuli representing suicide exist, very few have been purposefully designed for use in behavioral tasks and validated (Nazem et al., 2017). Indeed, most other suicide stimuli represent suicide in an overly general way, potentially reducing the validity and generality of the tasks using them. FP-suicide images address these limitations by more clearly depicting all of the prototypical features of suicide and by not depicting nonprototypical/confounding features. By doing so, FP-suicide images may prove useful to researchers studying suicide with behavioral tasks. Several aspects of these initial findings warrant additional comment.

FP-suicide images are the only suicide stimuli that both simulate common forms of mental imagery people experience when thinking about suicide and depict all of the prototypical features of suicide attempt (i.e., a person engaging in potentially lethal, intentional, and self-directed behavior). Therefore, they have the potential to represent suicide more accurately than other stimuli. The development of valid and reliable suicide-stimuli allows research-

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ers to better measure psychological factors related to suicide, which in turn may lead to improved prediction and prevention of suicidal thoughts and behavior, the ultimate aim of suicide research.

As expected, participants in Study 1 rated FP-suicide images as much more aversive than IAPS neutral images and just as aversive as two kinds of highly negative images (IAPS negative images and TP-suicide images). Also, FP-suicide image ratings were significantly more correlated with other suicide images (TP-suicide) than any other image type, including highly negative, nonsuicidal images. Together, this suggests that FP-suicide images are highly negative and depict suicidal behavior, not merely negative information, and, therefore, have good face and construct validity. Our analyses also revealed good internal consistency for the set of FP-suicide images across valence, arousal, and threat rating dimensions. The consistency in ratings is notable given that six different suicide attempt methods were depicted (among the eight images) in the set, indicating that the images elicited similar levels of aversion despite displaying different types of suicide attempt (e.g., jumping from a height vs. standing in front of an oncoming train). One possible explanation for this consistency may be that, despite the variety of suicide methods contained in the set, each image depicts the prototypical features of suicide attempt and, therefore, at a deep level each image accurately represents the same construct.

Last and most importantly, the suicidal group in Study 2 demonstrated much lower aversion toward FP-suicide images relative to the nonsuicidal group, whereas both groups rated FP-positive images similarly, indicating that the suicidal group's lower aversion was at least somewhat specific to the suicide images. Our analyses also revealed that more frequent, recent, and/or severe STBs were associated with lower levels of aversion (i.e., increased positive valence ratings) toward FP-suicide images, suggesting that individual differences in suicide aversion covary with clinically relevant features of STB history. Interestingly, the moderate-to-large association between frequency of lifetime suicidal thoughts and suicide aversion was driven by people on the higher end of suicidal thought frequency. The finding that people on the higher end of suicidal thought frequency ($>$450 lifetime episodes) drove the association between frequency of suicide thoughts and aversion to FP-suicide images is similar to the finding reported by Franklin and colleagues (2013) in which people reporting $<$10 NSSI episodes were indistinguishable from people who had never engaged in NSSI on NSSI image valence ratings, whereas people with $>$10 episodes of NSSI rated NSSI images as much more pleasant than both other subgroups. Taken together, these data suggest that there may be a critical threshold for thinking about/engaging in self-directed violence, with people beyond this threshold experiencing a relatively reduced protective aversion to these self-injurious behaviors.

To our knowledge, this is the first study to directly demonstrate that people with suicidal thoughts display less aversion to suicide information than people without suicidal thoughts. Previous studies either have indicated no group differences (i.e., in startle response to suicide measured via psychophysiological assay; Smith, Cukrowicz, Poindexter, Hobson, & Cohen, 2010) or found indirect evidence for group differences (i.e., reduced neural activation to suicide-method/death-related words in brain regions associated with sadness; Just et al., 2017). Notably, previous studies used nonvalidated, overly general suicide/death stimuli (e.g., images of dead bodies, suicide and/or death words) and, therefore, may have presented participants with poor representations of the suicide construct(s) they intended to investigate, potentially leading to measurement error and inaccurate effect size estimates. The present findings demonstrating group differences in suicide aversion are similar to data from individuals with a history of frequent NSSI, who display reduced implicit and explicit aversion to NSSI images (e.g., cut arms; Franklin et al., 2013, 2014). Additionally, these findings are consistent with the benefits and barriers model of self-injurious behavior (Hooley & Franklin, 2018), proposing that some people hurt themselves because natural barriers (e.g., high aversion) that typically deter/inhibit self-directed violence are lower. Although the benefits and barriers model was proposed in relation to NSSI (i.e., not suicide), NSSI and suicide are similar in important ways, suggesting that the theory may also apply to suicide: Namely, both involve intentional, self-directed violence requiring an individual to override their instinct to protect and preserve themselves. Indeed, an influential theory of suicide (i.e., the Interpersonal Theory of Suicide; Joiner, 2005) posits that, through repeated exposure to fear-inducing and/or physically painful events (e.g., nonlethal suicide attempts, NSSI), one may become less fearful of death and less sensitive to pain and, therefore, acquire the capability for suicide. Acquiring the capability for suicide is thought to be a crucial factor that helps one override their self-preservation instinct. Although there appears to be high conceptual overlap between lower aversion to suicide and reduced fear of death, it remains an open question whether aversion to suicide images is associated with fear of death and, further, how lower aversion to suicide occurs.

One possible explanation for how lower aversion to suicide occurs and why we observe this among people with more acute/substantial STB histories is that, through a process of habituation, the more one thinks about suicide, the less aversive it becomes. Another possible explanation is that for some people experiencing acute distress, thinking about suicide actually provides temporary relief/sense of control, because suicide represents a potential way to escape intolerable emotional pain, and, gradually, through the repeated pairing of suicidal thoughts with relief/control, suicide information becomes less aversive (Kleiman et al., 2018). Similar to the model proposed by Franklin and colleagues (2013, 2014) and Hooley and Franklin (2018), we hypothesize that there may be a transactional relationship between these two possibilities, where thinking about suicide gradually diminishes aversion toward suicide, facilitating more thoughts of suicide and, in turn, leading to less aversion toward suicide.

The findings from this study must be interpreted in the context of several important limitations. First, the generality of the findings may be restricted. Study 2 found that the association between lifetime frequency of suicidal thoughts and valence ratings of FP-suicide images was driven by participants reporting $>$450 episodes of suicidal thoughts (i.e., the median amount); however, it is not clear whether 450 episodes represents a meaningful threshold or an arbitrary and/or sample-specific threshold that, when exceeded, allows lower aversion to emerge/become detectable. Thus, these results may not generalize to samples with different distributions of suicidal thought episodes. Additionally, Study 1 results indicate participants with and without STBs did not differ in aversion to suicide; however, Study 1 did not include an

in-depth assessment of STB history, making it impossible to further probe this finding. Thus, future studies should assess STB history with an in-depth assessment (e.g., SITBI), as Study 2 did. Lastly, although some evidence suggests that the digital FP-suicide images participants rated closely simulate the mental imagery people experience when thinking about suicide (i.e., attempting suicide from their own perspective; cf. Crane et al., 2011; Holmes et al., 2007), these results may not generalize to real-life settings where people encounter suicide information in other forms (e.g., verbal accounts of others' attempts).

Second, several aspects of the assessment procedure limit the conclusions that can be drawn from this study. Various features of the FP-suicide images may have limited their accuracy/relevance. For example, all images depicted a White male subject; however, a substantial proportion of participants in Studies 1 and 2 were neither White nor male, potentially limiting accuracy/relevance of the FP-suicide images for non-White males. To address this, future studies should create FP-suicide images depicting a variety of demographic characteristics (e.g., skin tones). Additionally, groups differed on several clinical variables we collected (e.g., hedonic capacity, past-two week depression symptoms). Although differences in these variables did not explain observed between-groups differences in picture ratings, many other variables might help explain/contribute to differences in picture ratings (e.g., elevated psychiatric symptoms among suicidal participants). Thus, determining whether the suicidal group's STB history is the sole/main contributor of these between-groups differences requires a different experimental procedure (e.g., case-psychiatric control matching study, longitudinal study with multiple observations) than the procedure used in the present study. Lastly, all data in the present study are cross-sectional, and, therefore, the directionality of the association between frequency of suicidal thoughts and valence ratings of FP-suicide images cannot be determined. As noted above, we propose a positive feedback loop whereby thinking about suicide reduces aversion toward suicide, leading to higher incidence of suicidal thoughts, further reducing aversion toward suicide. To test this transactional hypothesis, future studies should assess the frequency, recency, and severity of STBs along with aversion to suicide information (e.g., images depicting suicide attempt) at multiple time points to determine if, how, and for whom the association between thinking about and/or engaging in suicide covaries with aversion to suicide.

Ensuring Participant Safety/Wellbeing When Viewing FP-Suicide Images

Although several prior studies have found no iatrogenic effects associated with answering questions about self-injurious thoughts and behaviors (Gould et al., 2005; Muehlenkamp, Swenson, Batejan, & Jarvi, 2015; Whitlock, J., Pietrusza, C., & Purington, 2013) and/or repeatedly viewing SITB visual stimuli (i.e., FP-NSSI and TP-suicide pictures, suicide words; Cha et al., 2016; Nazem et al., 2017), or even attempting suicide via virtual reality (Franklin, Huang, & Bastidas, 2019), it is still possible that individual participants could experience distress or increased risk of thinking about suicide after answering and/or viewing suicide-related words or images. We share this concern and took steps to mitigate potential iatrogenic effects, which we outline here for others to consider for use in their own work. In Study 1, which was conducted online, we clearly described all study procedures/instruments in the informed consent, allowed participants to withdraw at any time without penalty, provided mental health/crisis resources on every survey page, and included a positive mood induction at study conclusion. In Study 2, which was conducted in person, we also conducted risk assessment and safety planning at study conclusion for all participants and had clinicians available onsite and on call to assess/manage risk if necessary.

These steps represent a useful starting point, and in future research, we also recommend that researchers using FP- and other suicide stimuli consider incorporating the following, fully automatable safety precautions, regardless of whether the study is lab- or web-based or in situ (e.g., via ecological momentary assessment [EMA]; please also see Kraut et al. (2014) for a robust discussion of protecting web-based participants). First, the informed consent document should clearly state: (a) that participants will be asked to answer SITB questions and view/rate images depicting suicide attempt and provide an example description of such images (e.g., "looking down the barrel of a gun"); (b) the potential risks of participating (e.g., increased distress); and (c) that participants can withdraw from the study at any time without penalty. In order to ensure comprehension of this and other important information in the consent document, the opportunity for participants to provide consent can be conditioned on correctly answering several True/False questions (e.g., "this study contains SITB questions/images, T/F;" Kraut et al., 2004). Second, mental health resources can be provided at the bottom of every survey page/screen (e.g., "if you are feeling unsafe at any time please call the National Suicide Prevention Lifeline 1–800-273–8255 or 911"). Third, affect ratings (e.g., mood, desire to hurt oneself/die) can be included at the beginning, middle, and end of the study to evaluate potential iatrogenic effects on an ongoing basis, and a brief (~3–5 min) positive mood induction can be included toward the end of the study (e.g., via repeatedly rating highly positive images) to improve mood. Fourth, a brief risk assessment can be included to measure current STB by asking about current presence/absence of variables like (a) suicide plan, (b) suicide thoughts, and (c) current level of intention/urge to act on suicide thoughts/plan. All participants can receive readily accessible mental health resources (e.g., call/text Samaritans 877–870 HOPE [4673]), and participants indicating presence and/or nonzero level of current STB can fill out a personalized safety plan, listing: (a) several methods of relaxing/distracting (with several stock-examples provided, e.g., shower, listen to music, exercise); (b) supportive people to talk to (e.g., call/text friend, family member, therapist); and (c) additional sources of external/formal help (e.g., call 911, go to local emergency room, call 1–800-SUICIDE [1–800-784–2433]). This personalized safety plan can be emailed to web-based/EMA participants or printed out for lab-based participants. Additionally, an automated or in-person brief (~2–3 min) motivational enhancement/attitudinal barrier reduction intervention (BRI) can be included at the end of the risk assessment/safety plan to increase the likelihood that the resources provided will be used (cf., Jaroszewski, Morris, & Nock, 2019). Fifth, in-person studies should require that a clinician trained in suicide risk assessment/management is physically present for each participant's study visit. Lastly, EMA studies assessing STB variables (e.g., current level of suicide intention/urge) can set thresholds (e.g., 8 or higher out of 10) at which an on-call clinician is alerted to conduct risk assessment/

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consultation with the participant within a predetermined time window.

Conclusion

Limitations notwithstanding, several important research directions follow from this work. First, future research in this area should incorporate the modifications outlined above, replicate these findings in a larger sample of participants with a history of frequent, recent, and clinically significant STBs. Second, future studies should use longitudinal designs in order to better understand the mechanism(s) that lead to lower aversion toward suicide. Third, given that the limitations of self-report (e.g., self-presentation bias, motivation to conceal thoughts/intent) are particularly relevant to suicide research, future studies should use objective measures (e.g., IAT, AMP, Attentional Blink) that incorporate validated suicide stimuli, such as FP-suicide images. As discussed earlier, the FP-suicide and FP-positive images were purposefully designed for inclusion in existing behavioral tasks in the hopes that they would increase validity by providing better stimuli to investigate STBs. These findings contribute to an emerging literature suggesting that lower aversion toward self-injury may explain why some people think about and ultimately decide to hurt themselves. Future studies that incorporate the modifications outlined above may help us better understand if lower aversion toward suicide partially explains why some people think about and decide to attempt suicide. This may improve the prediction and prevention of suicide as well as provide novel targets for clinical intervention.

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Supplemental Method

Participants

Control group. The Control group consisted of 118 individuals (51 females, 66 males, and 1 non-identifying). Participants were included in the control group if they reported no history of suicidal thoughts or behavior as assessed by one item from the self-report module of the Self-Injurious Thoughts and Behaviors Interview (SITBI; Nock, Holmberg, Photos, & Michel, 2007; see the SITBI section for more detail). The Control group had an average age of 38.9 (*Mdn*= 26, *SD*=11.4) and an ethnic composition of 81.4% Caucasian, 7.6% African American, 5.9% Hispanic, 5.9% Asian American, and 0.8% Native American. Within the Control group no demographic variable was significantly associated with explicit ratings of FP-Suicide or FP-Positive images (*p*s > .05). Sample characteristics and between-group comparisons are presented in **Supplemental Table 3**.

Suicidal group. The Suicidal group consisted of 94 individuals (48 females, 46 males). Participants were included in the Suicidal group if they reported having thoughts of suicide in their lifetime as assessed by one item from the self-report module of the SITBI. The Suicidal group had an average age of 38.9 (*Mdn*= 26, *SD*=11.4) and an ethnic composition of 83.0% Caucasian, 7.4% African American, 4.3% Hispanic, 5.3% Asian American, 4.3% Native American, and 1.1% other/mixed race. Within Suicidal group no demographic variable was significantly associated with explicit ratings of FP-Suicide or FP-Positive images (*p*s > .05). Sample characteristics and between-group comparisons are presented in **Supplemental Table 3**.

Data Analytic Plan

Group differences. Exploratory analyses were conducted to evaluate whether participants reporting that they experienced at least one suicidal thought in their lifetime rated FP-Suicide and FP-Positive images differently than participants reporting no suicidal thoughts. To do so, we constructed three linear mixed effects regression models, one for each rating dimension. Each mixed effects model regressed participant ratings onto image type, group (i.e., suicidal thoughts, no suicidal thoughts), and image type*group interaction (fixed effects) and included by-subject and by-image random intercepts. A significant regression coefficient for an interaction term in these models indicates that the difference in ratings of IAPS neutral images (i.e., the reference category) and another image type (e.g., FP-Suicide images) was larger for one group than the other. Importantly, groups did not rate IAPS neutral images differently on any dimension (see **Supplemental Table 4**), suggesting that significant interaction effect(s) were due to group differences in ratings of the other image types, not IAPS neutral images.

Supplemental Results

Group Differences

Demographics

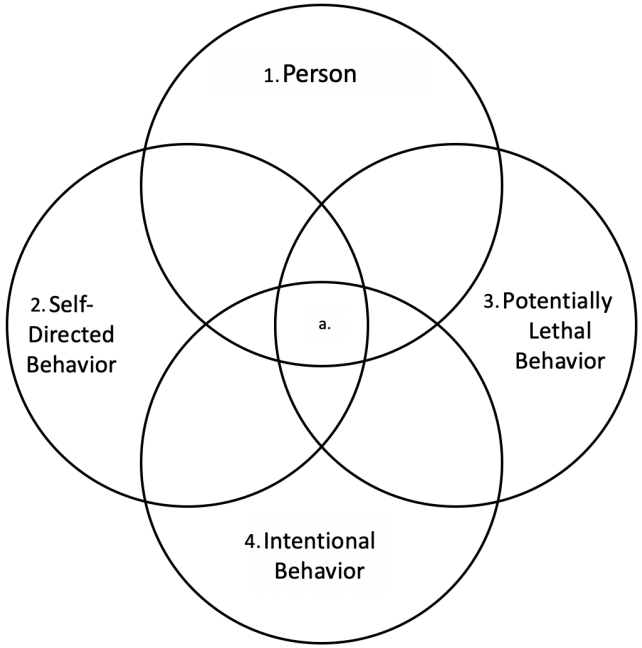
Participants reporting thinking about suicide (Suicide group) at least once in their lifetime did not differ from participants reporting no suicidal thoughts (Non-suicide group) in terms of gender identification, race/ethnicity, or age (*p*s > .05; see **Supplemental Table 3).**

Image ratings

Results of linear mixed effects regression analyses testing the association between participant image ratings, image type, and group are presented in **Supplemental Tables 4 and 5**.

First, across all three rating dimensions (i.e., valence, arousal, and threat) groups did not rate IAPS neutral images differently (βs = -0.10 – 0.03, *p*s>.05; **Supplemental Table 4**). Thus, we used IAPS neutral images as a reference category in subsequent regression analyses including all other image types. Second, in all three models (i.e., valence, arousal, and threat rating dimensions) the main effects for group and image type and the interaction between group and some image types significantly predicted ratings (see **Supplemental Figure 3** and **Supplemental Table 5**). In terms of valence, the Suicide group rated TP-Suicide images as significantly more pleasant (β=0.02; *p*<.05) and FP-Positive images as less pleasant (β=-0.02; *p*<.05) than the Non-suicide group. In terms of arousal, the Suicide group rated FP-Suicide (β=0.08; *p*<.01), TP-Suicide (β=0.05; *p*<.01), and IAPS negative images (β=0.09; *p*<.01) as significantly more arousing than the Non-suicide group. In terms of threat, the Suicide group rated FP-Suicide (β=-0.02; *p*<.01) and TP-Suicide (β=-0.02; *p*<.05) images as significantly less threatening than the Non-suicide group.

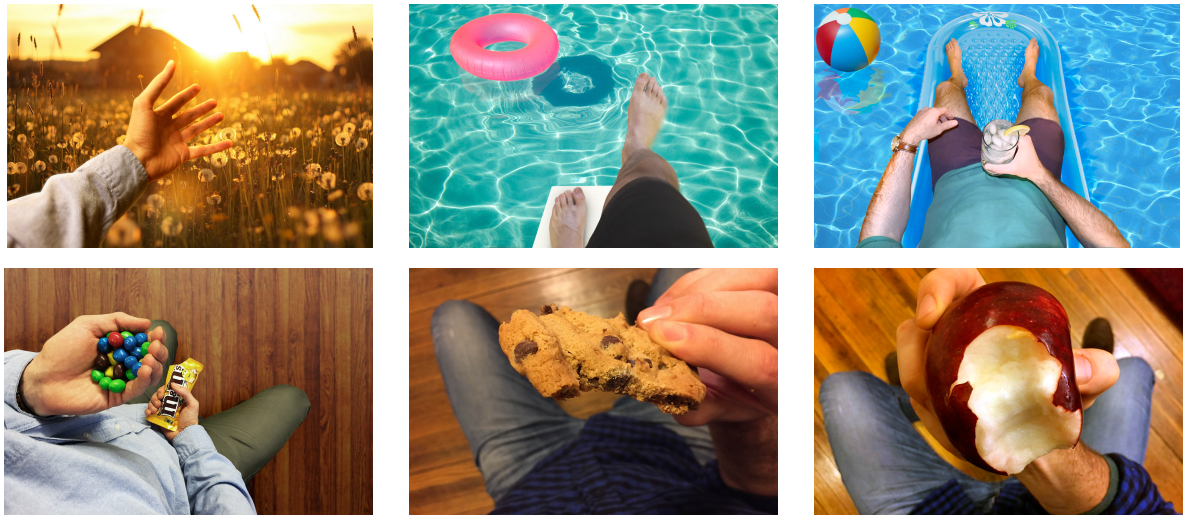
Supplemental Figure 1. The Prototypical Construct Features That a Visual Stimulus of Suicide Attempt Should Depict



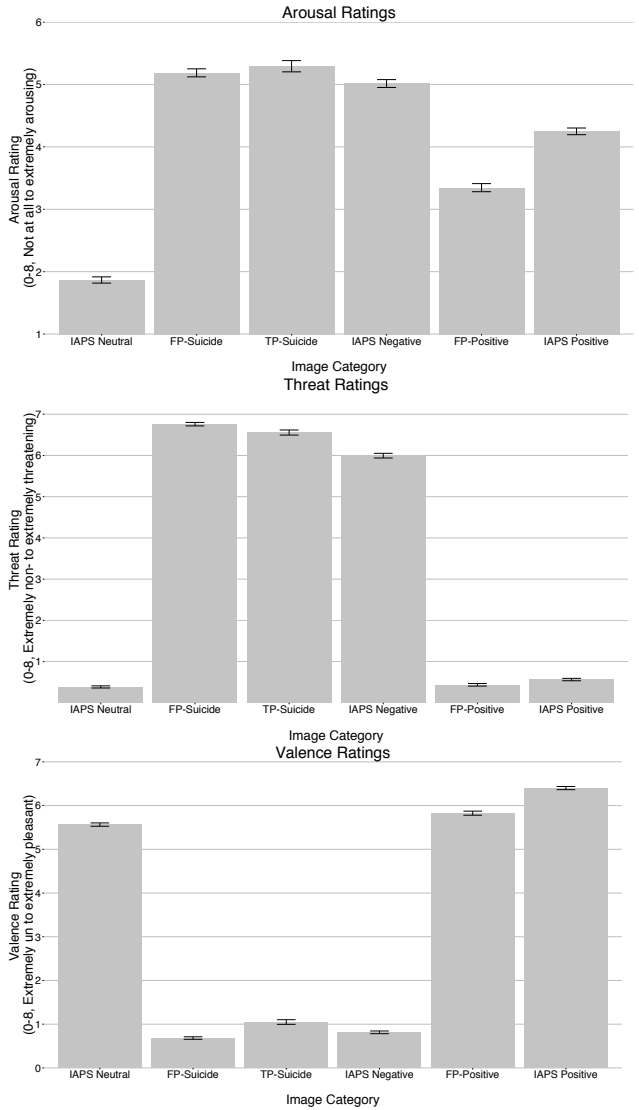
Note. A Venn diagram of the prototypical construct features of suicide attempt that a visual stimulus (e.g., image) should depict: 1. a person engaged in behavior; 2. self-directed behavior, i.e., action produced by a person in order to cause an effect to and/or for themselves; 3. potentially lethal behavior, i.e., action that significantly increases the probability of dying; and 4. intentional behavior, i.e., action that is goal-directed/purposeful. a. A person engaging in self-directed, intentional, and potentially lethal behavior defines suicide attempt.

Supplemental Figure 2. First-person suicide images

Supplemental Figure 3. First-person positive images

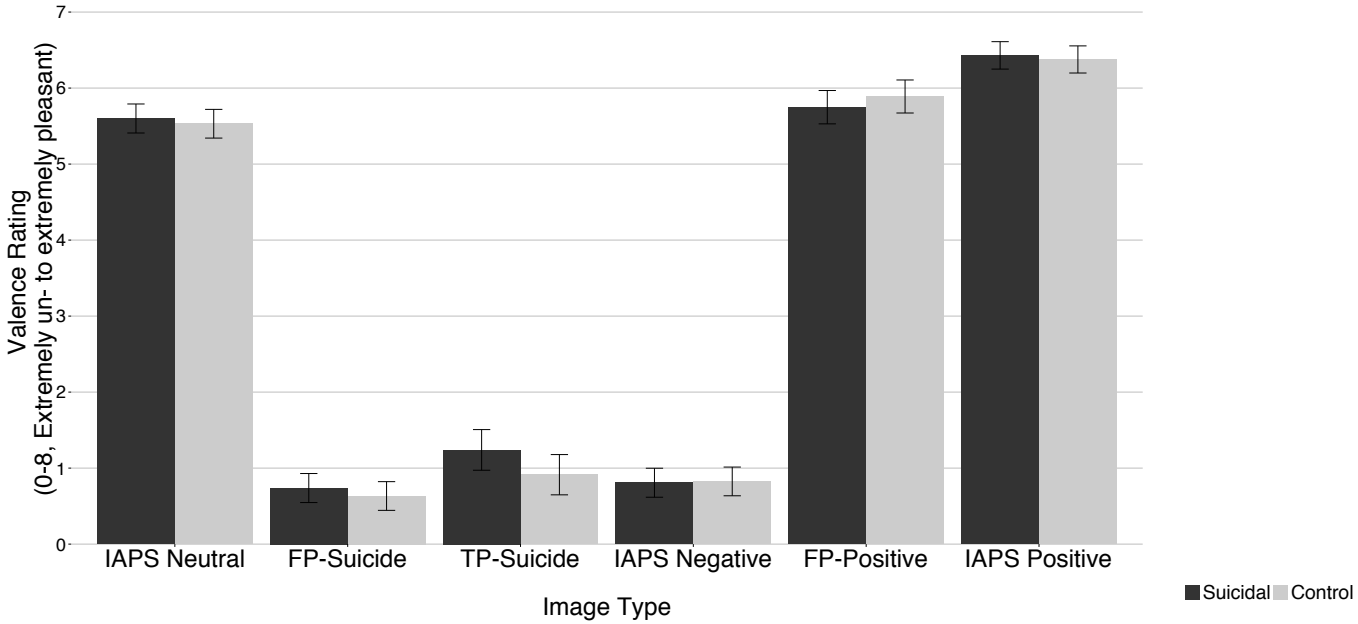


Supplemental Figure 4. Explicit Ratings for Each Picture Category



Note. FP = First-Person; TP = Third-Person. Error bars represent ±1 standard error of the mean.

Supplemental Figure 5. Group Differences in Explicit Affect for Each Image Type



Note. FP = First-Person; TP = Third-Person. Error bars represent ±1 standard error of the mean.

Supplemental Table 1. Predicted Marginal Means (PMM) for Each Image Type and the PMM Differences between FP-Suicide Images and All Other Image Types

Variable	FP-Suicide	TP-Suicide	IAPS Negative	IAPS Neutral	IAPS Positive	FP-Positive
Valence						
Predicted Marginal Means (*SE*)	0.69 (0.19)	1.06 (0.28)	0.83 (0.19)	5.55 (0.19)	6.38 (0.18)	5.80 (0.22)
Mean difference [95% CI]		-0.36 [-1.02 – 0.30]	-0.14 [-0.66 – 0.38]	-4.85 [-5.39 – -4.30]	-5.69 [-6.21 – -5.16]	-5.11 [-5.69 – -4.52]
t value for difference (*p* value)		-1.07 (0.89)	-0.52 (0.99)	-17.37 (0.00)	-20.94 (0.00)	-16.93 (0.00)
Cohen's *d*		0.25	0.12	4.12	4.97	4.01
Arousal						
Predicted Marginal Means (*SE*)	5.21 (0.23)	5.32 (0.23)	5.03 (0.23)	1.84 (0.23)	4.24 (0.22)	3.31 (0.26)
Mean difference [95% CI]		-0.11 [-0.85 – 0.64]	0.19 [-0.43 – 0.78]	3.36 [2.77 – 3.94]	0.97 [-0.43 – 0.78]	2.01 [1.25 – 2.77]
t value for difference (*p* value)		-0.29 (0.99)	0.62 (0.98)	11.11 (0.00)	3.28 (0.02)	5.13 (0.00)
Cohen's *d*		0.06	0.14	2.63	0.77	0.78
Threat						
Predicted Marginal Means (*SE*)	6.76 (0.28)	6.55 (0.39)	5.98 (0.27)	0.37 (0.27)	0.57 (0.26)	0.43 (0.32)
Mean difference [95% CI]		0.20 [-0.75 – 1.18]	0.8 [-0.02 – 1.55]	6.38 [5.63 – 7.12]	6.19 [5.46 – 6.91]	6.32 [5.50 – 7.14]
t value for difference (*p* value)		0.43 (0.99)	1.99 (0.34)	16.42 (0.00)	16.39 (0.00)	15.06 (0.00)
Cohen's *d*		0.10	.46	3.90	3.89	3.57

Note. FP = First Person. TP = Third Person. SE = Standard Error. CI= Confidence Interval.
p values adjusted using the Tukey method for comparing a family of six estimates.

Supplemental Table 2. Correlations among Image Types for Each Rating Dimension

Valence						
		IAPS Neutral	FP-Suicide	TP-Suicide	IAPS Negative	FP-Positive
	FP-Suicide	-0.32***				
	TP-Suicide	-0.21	0.66***			
	IAPS Negative	-0.17	0.52***	0.55***		
	FP-Positive	0.55***	-0.34***	-0.25*	-0.27**	
	IAPS Positive	0.55***	-0.34***	-0.21	-0.32***	0.64***
Arousal						
		IAPS Neutral	FP-Suicide	TP-Suicide	IAPS Negative	FP-Positive
	FP-Suicide	0.07				
	TP-Suicide	0.07	0.87***			
	IAPS Negative	0.13	0.86***	0.84***		
	FP-Positive	0.73***	0.17	0.16	0.21	
	IAPS Positive	0.66***	0.37***	0.35***	0.43***	0.73***
Threat						
		IAPS Neutral	FP-Suicide	TP-Suicide	IAPS Negative	FP-Positive
	FP-Suicide	-0.15				
	TP-Suicide	-0.10	0.69***			
	IAPS Negative	0.03	0.54***	0.57***		
	FP-Positive	0.56***	-0.10	0.00	0.04	
	IAPS Positive	0.54***	0.12	0.14	0.19	0.51***

Note. *p < .05. **p < .01. ***p < .001.

FP = First Person; TP = Third Person; IAPS = International Affective Picture System

Supplemental Table 3. Study 1 Descriptive Statistics and Between-group Comparisons of Participants

Variable	Control Group (n = 118)		Suicidal Group (n = 94)		Between-group Comparison	
	n	%	*n*	%	χ^2	*p*
Gender					1.97(2)	.37
Female	51	43.2%	48	51.1%		
Male	66	55.9%	46	48.9%		
Other	1	0.8%	0	0.0%		
Race/Ethnicity					1.26(5)	.56
African-American	9	7.6%	7	7.4%		
Asian-American	7	5.9%	5	5.3%		
Caucasian	96	81.4%	78	83.0%		
Hispanic	7	5.9%	4	4.3%		
Native American	1	0.8%	4	4.3%		
Other/Mixed Race	0	0.0%	1	1.1%		
	M	SD	*M*	SD	*t*(df)	*p*
Age	38.9	11.4	39.5	12.0	.36(203.7)	.71

Supplemental Table 4. Results of Linear Mixed Effects Regression Analyses Testing the Association between IAPS neutral Images, Participant Ratings, and Group

	Valence Ratings				Arousal Ratings				Threat Ratings			
	B	*SE*	β	*p*	*B*	*SE*	β	*p*	*B*	*SE*	β	*p*
Fixed Parts												
(Intercept)	6.52	0.22		**<.001**	2.98	0.24		**<.001**	1.40	0.08		**<.001**
Suicidal group	0.08	0.13	0.03	.568	-0.26	0.21	-0.10	.217	-0.04	0.11	-0.01	.726
Random Parts												
σ^2	1.313				1.635				0.528			
$\tau_{00,\ subject}$	0.743				2.134				0.561			
$\tau_{00,\ picture}$	0.308				0.286				0.006			
$N_{subject}$	212				212				212			
$N_{picture}$	8				8				8			
$ICC_{subject}$	.314				.526				.512			
$ICC_{picture}$	.130				.070				.006			
Observations	1630				1628				1630			
R^2 / Ω_0^2	.515 / .505				.651 / .647				.581 / .574			
Deviance	5454.717				5955.577				4062.080			

Note. FP = First Person; TP = Third Person; IAPS = International Affective Picture System; ICC = Intraclass Correlation.
Note. ICC = Intraclass Correlation.

Supplemental Table 5. Study 1 Results of Linear Mixed Effects Regression Analyses Testing the Association between Group, Image Categories, and Participant Ratings of Images

	Valence Ratings				Arousal Ratings				Threat Ratings			
	B	*SE*	β	*p*	*B*	*SE*	β	*p*	*B*	*SE*	β	*p*
Fixed Parts												
(Intercept)	5.53	0.19		**<.001**	1.97	0.24		**<.001**	0.40	0.26		**<.001**
Suicidal Group	0.07	0.08	0.01	.402	-0.25	0.21	-0.05	.240	-0.03	0.10	-0.00	.740
FP-Suicidal images	-4.90	0.26	-0.64	**<.001**	3.02	0.29	0.44	**<.001**	6.49	0.36	0.75	**<.001**
TP-Suicidal images	-4.62	0.32	-0.45	**<.001**	3.14	0.35	0.34	**<.001**	6.29	0.45	0.54	**<.001**
IAPS negative Images	-4.71	0.26	-0.62	**<.001**	2.79	0.29	0.41	**<.001**	5.62	0.36	0.65	**<.001**
FP-Positive images	0.36	0.28	0.04	.213	1.56	0.31	0.20	**<.001**	0.01	0.39	0.00	.980
IAPS positive images	0.85	0.26	0.12	**.002**	2.38	0.28	0.36	**<.001**	0.14	0.35	0.02	.685
Suicidal Group x FP-Suicide images	0.04	0.09	0.00	.694	0.74	0.13	0.08	**<.001**	-0.26	0.09	-0.02	**.004**
Suicidal Group x TP-Suicide Images	0.26	0.11	0.02	**.021**	0.71	0.16	0.05	**<.001**	-0.28	0.11	-0.02	**.013**
Suicidal Group x IAPS negative Images	-0.09	0.09	-0.01	.343	0.84	0.13	0.09	**<.001**	-0.01	0.09	-0.00	.888
Suicidal Group x FP-Positive images	-0.21	0.10	-0.02	**.033**	-0.16	0.14	-0.01	.253	0.10	0.10	0.01	.334
Suicidal Group x IAPS positive Images	-0.02	0.09	-0.00	.862	0.02	0.13	0.00	.851	0.09	0.09	0.01	.324
Random Parts												
σ^2		1.655				3.409				1.672		
$\tau_{00,\ subject}$		0.137				1.881				0.287		
$\tau_{00,\ picture}$		0.261				0.300				0.515		
$N_{subject}$		212				212				212		
$N_{picture}$		43				43				43		
$ICC_{subject}$		.067				.336				.116		
$ICC_{picture}$		.127				.054				.208		
Observations		8725				8725				8731		
R^2 / Ω_0^2		.815 / .815				.537 / .537				.856 / .856		
Deviance		29621.434				36256.227				29882.320		

Note. FP = First Person; TP = Third Person; IAPS = International Affective Picture System; ICC = Intraclass Correlation.

Supplemental Table 6. Study 2 Descriptive Statistics and Between-group Comparisons

Variable	Control Group (*n* = 36)		Suicide Ideation Group (*n* = 37)		Test Statistic	Effect Size (95% CI)
	n	%	*n*	%	χ^2	*OR*
Sex at birth[a]					1.48	1.68 [0.71 , 3.97]
Female	16	44.4%	19	51.4%		
Male	20	55.6%	17	45.9%		
Other	0	0.0%	1	2.7%		
Gender[a]					5.43	2.78 [1.14 , 6.74]
Female	16	44.4%	16	43.2%		
Male	20	55.6%	16	43.2%		
Other	0	0.0%	5	13.6%		
Race/Ethnicity[a]					10.50	4.41 [1.75 , 11.09]
African-American	2	5.6%	4	10.8%		
Asian-American	9	25.0%	1	2.7%		
Caucasian	20	55.5%	27	72.9%		
Hispanic	3	8.3%	2	5.4%		
Other/Mixed Race	2	5.6%	3	8.2%		
Past psychological treatment(yes)[a]	6	16.7%	33	89.1%	38.50*	45.2 [13.8 , 156.5]
Current psychotropic medication(yes)[a]	2	5.6%	18	48.6%	17.3*	7.3 [2.76 , 19.31]
	M	SD	*M*	SD	*t*	*d*
Age[b]	30.2	11.9	32.7	11.9	0.89	0.3 [0.2 , 0.7]
Risk Seeing Attitudes[b]	99.6	16.6	96.6	25.3	0.59	0.14 [-0.32 , 0.61]
	Med	SD	*Med*	SD	*U*	*r*
Education[c]	5	1.6	4	1.4	501.5	0.22 [0.02 , 0.46]
Past two-week depression symptoms[c]	0	0.3	4	3.0	1244*	0.81 [0.71 , 0.90]
Hedonic Capacity[c]	48	5.3	41	8.6	235.5*	0.56 [0.38 , 0.70]

Note: 95% CI=95th Confidence Interval.

[a] Groups compared with a χ^2 test and Odds Ratio effect size reported.

[b] Groups compared with a t-test and Cohen's D effect size reported.

[c] Groups compared with a Wilcoxon-Mann-Whitney U test and *r* (i.e., *z /sqrt[N]*) effect size reported.

* $p < .05$

Supplemental Table 7. Results of Linear Mixed Effects Regression Analyses Testing the Association between Group, Image Category, and Study 2 Participant Ratings of Images Controlling for Clinical Covariates

	Valence Ratings				**Arousal Ratings**				**Threat Ratings**			
	B	*SE*	β	*p*	*B*	*SE*	β	*p*	*B*	*SE*	β	*p*
Fixed Parts												
(Intercept)	5.89	0.60		**<0.001**	1.62	1.70		0.342	3.26	0.87		**<0.001**
Suicidal Group	-4.96	0.29	-0.91	**<0.001**	1.34	0.26	0.26	**<0.001**	6.03	0.26	0.94	**<0.001**
FP-Suicide images	-0.44	0.22	-0.08	**0.046**	-0.50	0.61	-0.10	0.407	0.07	0.32	0.01	0.823
Depression symptoms	0.02	0.01	0.05	0.071	0.04	0.03	0.13	0.160	-0.03	0.01	-0.07	0.051
Hedonic capacity	0.03	0.03	0.04	0.287	0.03	0.09	0.03	0.759	0.01	0.05	0.01	0.901
Past psychological treatment	0.18	0.17	0.03	0.286	0.45	0.51	0.09	0.376	0.01	0.26	0.00	0.978
Current psychotropic medication	-0.09	0.15	-0.01	0.557	0.51	0.45	0.09	0.256	-0.24	0.23	-0.03	0.300
Suicidal Group x FP-Suicide images	1.07	0.18	0.18	**<0.001**	-0.76	0.25	-0.14	**0.003**	-1.23	0.19	-0.17	**<0.001**
Random Parts												
σ^2		2.02				4.02				2.30		
$\tau_{00,\ subject}$		0.08				1.73				0.35		
$\tau_{00,\ picture}$		0.24				0.13				0.16		
ICC		0.13				0.32				0.18		
$N_{subject}$		73				73				73		
$N_{picture}$		14				14				14		
Observations		1021				1021				1022		
Marginal R^2 / Conditional R^2		0.677 / 0.720				0.074 / 0.367				0.724 / 0.774		
Deviance		3675.99				4476.27				3858.27		

Note. FP = First Person; ICC = Intraclass Correlation.

Supplemental Table 8. Predicted Marginal Means (PMM) for Each Image Type and the PMM Group Differences between Image Types

Statistic	FP-Suicide images		FP-Positive images	
	Non-suicidal	Suicidal	Non-suicidal	Suicidal
Valence				
Predicted Marginal Means (*SE*)	0.88 (0.21)	1.58 (0.21)	5.84 (0.24)	5.48 (0.24)
Mean difference [95% *CI*]	-0.70 [-0.97 – -0.43]		0.36 [0.06 – 0.67]	
t value for difference (*p* value)	-5.11 (0.00)		2.39 (0.02)	
Cohen's *d*	1.22		0.57	
Arousal				
Predicted Marginal Means (*SE*)	4.99 (0.29)	4.03 (0.28)	3.65 (0.31)	3.46 (.30)
Mean difference [95% *CI*]	0.96 [0.23 – 1.67]		0.19 [-0.54 – 0.94]	
t value for difference (*p* value)	2.63 (0.01)		0.53 (0.59)	
Cohen's *d*	0.61		0.09	
Threat				
Predicted Marginal Means (*SE*)	6.76 (0.20)	5.69 (0.20)	0.63 (0.23)	0.89 (0.22)
Mean difference [95% *CI*]	1.07 [0.58 – 1.36]		-0.26 [-0.66 – 0.15]	
t value for difference (*p* value)	5.00 (0.00)		-1.22 (0.23)	
Cohen's *d*	1.27		0.30	

Note. FP = First Person. SE = Standard Error. CI= Confidence Interval.

Supplemental Table 9. Correlations Among Suicidal Thoughts and Explicit Affect Within the Suicidal Group

	Explicit Ratings of FP-Suicide Images		
Variable	Valence	Arousal	Threat
Explicit Valence	—	—	—
Explicit Arousal	-.08	—	—
Explicit Threat	-.63***	.10	—
Frequency – Raw	.64***	.09	-.29
Frequency – Class	.62***	.10	-.29
Recency – Class	.17	.14	-.19
Severity – Class	.22	.10	-.42*

Note: Frequency – Raw = exact self-reported SI frequency;
Frequency – Class = SI frequency grouped into class categories;
Recency – Class = SI recency grouped into class categories;
Severity – Class = SI severity grouped into class categories. N = 37.
*p < .05. **p < .01. ***p < .001.