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Negative affect influences suicide-specific attentional biases

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Abstract

Background: Studies using tasks that measure suicide-specific attentional biases have not specified which attentional processes are related to risk for suicidal thoughts and behaviors. This study distinguished suicide-specific engagement and disengagement biases from other forms of cognitive processing and investigated under which affective conditions suicide-specific biases emerged.

Method: An ethnoracially and socioeconomically diverse sample of 153 young adults (87 % female; 52 % Non-Hispanic White), ages 18–34, with moderate-to-high symptoms of anxiety, depression, or recent suicide ideation were randomly assigned to experience positive, negative, or neutral affect, completed cognitive tasks of attention, construct accessibility, and threat bias, and self-report measures.

Results: Individuals with recent ideation displayed facilitated disengagement from suicide-specific stimuli irrespective of affective state. Those with distal ideation showed slower disengagement from suicide-specific stimuli in the sad condition only.

Conclusions: Individuals with recent suicide ideation display automatic processing of suicide-related information, perhaps due to recent rehearsal of suicide-related content. In contrast, individuals with distal ideation experiencing negative affect appear to have difficulty disengaging attention from suicide-related content. Limits to generalizability of the findings include a predominantly female sample, although the sample's racial, ethnic, and socioeconomic diversity increase generality of the research.

Keywords

Attention engagement; Attention disengagement; Construct accessibility; Suicide ideation; Cognitive processing; Affect induction

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CRediT authorship contribution statement

BRW conceptualized and designed the study, collected and analyzed data, and drafted and edited the manuscript. RM assisted in study conceptualization and design, data interpretation, and provided critical revisions to the manuscript.

Declaration of Competing Interest

The authors have no conflicts of interest to declare.

Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.xjmad.2024.100081.

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1. Introduction

Suicide-specific attentional bias is thought to predict a suicide attempt [1-3] but remains understudied, because in the suicide literature, attentional bias has been poorly defined, and tasks used to measure attentional processes have low reliability [4,5]. Although previous work suggests that individuals with a previous suicide attempt display a suicide-specific "attentional bias," it is unclear whether this bias involves facilitated attention engagement or delayed attention disengagement, and whether these "attentional biases" differ from other cognitive processes, such as the accessibility of suicide-related cognitions or a bias toward threatening information. Additionally, prior studies have assumed that suicide-specific attentional biases are trait-like constructs and have not examined contextual factors that elicit them. The present study thus distinguished suicide-specific attentional biases from other forms of cognitive processing and examined affective states that might influence these biases.

1.1. Cognitive processing of suicide-relevant stimuli

Attentional bias refers to an exaggerated focus on specific stimuli [6]. Research demonstrates that individuals vulnerable to suicide ideation (SI) and attempts display biased *processing* of suicide-related stimuli [3,7]. While the suicide attention bias literature lacks conclusive evidence on which attentional processes confer risk for suicidal thoughts and behaviors, suicide-specific attentional biases may help to maintain risk. The cognitive model of suicidal behavior suggests that people selectively attend to suicide-relevant information when hopelessness-related schemas become activated in memory in response to stress. This selective engagement with suicide-relevant cues increases fixation on the suicide-relevant information, leading to difficulty disengaging attention from such stimuli and risk of attempting suicide once a person exceeds their "threshold of tolerance" for distress [8]. Thus, this model suggests selective attention, delayed attention disengagement (i.e., difficulty disengaging attention), and attentional fixation as three attentional processes related to suicidal thoughts and behavior. Consistent with this model, a recent study found that individuals with a previous suicide attempt displayed sustained attention to suicide-related images compared to depressed patients without a suicide attempt history [9]. Two recent studies have found that individuals with recent or more severe SI display facilitated disengagement from suicide-specific stimuli, potentially highlighting the automatic processing of suicide-relevant cognitions [10,11]. A fourth study using a modified suicide dot probe task found no suicide-specific attentional bias among recently-discharged psychiatric inpatients with differing lifetime histories of suicide attempts and severity of SI [4]. These are among the few studies to date that have examined suicide-specific attentional biases with behavioral tasks that purport to measure *attentional* bias, and findings from three of the studies suggest that attentional fixation and disengagement biases may underlie the biased processing of suicide-specific stimuli among individuals with SI or previous suicide attempts.

A limitation of previous engagement and disengagement bias tasks is that they do not meet recommended guidelines suggested to specify attentional processes [12]. Clarke and colleagues [12] delineate three criteria that tasks measuring engagement and disengagement

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biases should meet: they must 1) simultaneously present negative and neutral stimuli to prevent a "behavioral freezing" response when participants view negative stimuli in isolation; 2) secure attention in a predetermined location; and 3) assess the degree to which attention shifts (either proximally or distally to the initial focus cue) once it has been firmly secured. Thus, these tasks must manipulate the proximity of emotionally valenced stimuli to the initial focus cue to determine whether individuals show an engagement or disengagement bias. Following these guidelines, the current study used a novel paradigm adapted from previous research and designed to measure both engagement and disengagement biases separately [13].

In addition to accurately measuring attentional processes, this study sought to *distinguish* suicide-specific attentional biases from other forms of cognitive processing. Meta-analyses suggest that greater self-associations with death increase the odds of attempting suicide within six months [7], and individuals with previous suicidal behaviors show biased processing of suicide-specific content [3]. The present study focuses on suicide-related construct accessibility, which refers to how readily information is retrieved from memory [14]. While attentional bias requires that attention be shifted from one stimulus to another, construct accessibility varies by how much the schema associated with a construct is activated [15]. A person must first focus attention on a stimulus for a construct to be activated. Using word completion tasks and one behavioral task, studies have shown that individuals induced to experience failure display greater accessibility of suicide/death-relevant stimuli [16]. A recent study found a suicide-specific disengagement bias but not an accessibility bias, suggesting attentional bias might be independent of a general cognitive bias [11].

Threat bias requires some consideration when distinguishing suicide-specific attentional biases from other cognitive processes. Because anxiety and depression are comorbid with SI and attempts [17], individuals with recent suicidal thoughts and behaviors may display biased attentional processing of information due to an underlying mood or anxiety disorder that biases how they process information, rather than due to a suicide-specific bias related to their previous SI. Distinguishing suicide-specific attentional biases from threat biases is important to delineating the components of biased attentional processing related to suicide.

1.2. The role of affect in suicide-specific attentional processes

One contextual factor often neglected in the suicide literature is the impact that affective states have on basic cognitive processes related to suicidal cognitions. Both the cognitive model of suicidal behavior and the suicidal model assume that negative affect is necessary to capture suicide-specific biases [8,18]. The differential activation hypothesis proposes that how an individual processes cognitive information during a depressed mood will determine the degree to which the individual recovers from that depressed state [19]. Similarly, negative affect may be necessary to activate suicide-related cognitions stored in memory during depressed states [20], resulting in persistent SI and risk for suicide attempts. Still, the role of affect in eliciting suicide-specific attentional biases and other biased cognitive processing remains poorly understood.

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To date, only two studies of which we are aware have investigated biased cognitive processing of suicide-specific stimuli by inducing affect. First, a study examining the role of negative affect in activating implicit associations about life and death found that adults with SI induced to a negative affective condition demonstrated weaker implicit associations with life after vs. before the mood induction, while this was not the case for those without SI [21]. Additionally, participants who exhibited greater implicit associations with death (relative to life) were more likely to report SI at one-month follow-up [21]. One limitation was that the study did not include a control or comparison group with an alternate affect induction, limiting our understanding of how distinct affective states influence suicide-specific cognitive processes. The second study primed either failure or success to identify differences in self-referent associations with death based on these cognitive-affective states [22]. Priming failure resulted in greater identification with death, whereas priming success was associated with less identification with death. Together, the findings highlight the influence of negative affect in moderating how individuals process information related to suicide; they do not specify which *attentional* processes are elicited depending on which affective state.

To address limitations in assessing suicide-specific attentional biases, this study used an experimental design incorporating three distinct behavioral tasks to 1) distinguish suicide-specific attention engagement and disengagement biases from other cognitive processes such as construct accessibility and threat bias, and 2) examine the affective states under which selective engagement and disengagement biases are elicited. The first aim of the study was to distinguish suicide-specific engagement and disengagement biases from other cognitive processes among adults with recent SI (vs. lifetime SI). We hypothesized that: 1) facilitated engagement and disengagement biases would be more strongly associated with self-report measures of SI than would construct accessibility of suicide-related stimuli and general bias toward socially threatening stimuli; 2) engagement and disengagement biases would be distinguished from construct accessibility and bias toward and away from social threat, because the effects of the attentional biases would be stronger and independent of the effects of construct accessibility and general threat bias, suggesting specificity to suicidal cognitions; and 3) adults with recent SI would display stronger delayed disengagement biases than facilitated engagement biases.

The second aim was to examine the impact of affective state on attention biases. We predicted that: 1) adults with recent SI in a negative affective state would display both facilitated engagement toward and delayed disengagement from suicide-specific stimuli; 2) adults in a positive affective state would exhibit facilitated disengagement from and delayed engagement with suicide-specific stimuli; and 3) suicide-specific attentional biases would be evident independent of a general bias toward socially threatening stimuli and relevant clinical covariates.

2. Method

2.1. Participants

Young adults ($N = 174$) from across the United States were recruited from online platforms, including ResearchMatch, Craigslist, and Reddit, and from a public college campus in New

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York City, between January and September of 2022. Participants were eligible if they read and spoke English, were 18–34 years old, endorsed moderate to severe symptoms of anxiety or depression or past-month SI, and had access to a computer with a camera. Participants who endorsed symptoms of active psychosis, learning disabilities, or active substance use disorder were ineligible, because these factors may influence performance on behavioral tasks. Over 2000 entries were excluded based on exclusion criteria.[1] See Table 1 for sample characteristics.

2.2. Design and procedure

This study used a 3 (Mood: positive, negative, neutral) X 2 (Recency: recent SI, lifetime SI) between-subjects design. Study fliers were posted on online platforms. Interested participants completed a screener that assessed symptoms of anxiety and depression, past-month SI, demographic information (age, sex at birth, gender, race, ethnicity, education, and income), and items to establish exclusion criteria. Eligible participants were invited to a 90-minute online Zoom session to complete the study.

Baseline measures of valence and arousal, and single items assessing sadness, amusement, and calmness were administered.[2] Next, participants were randomly assigned to either a positive (amusing), negative (sad), or neutral (calm) affect induction. They then completed measures of affect to assess the effectiveness of the experimental manipulation. Next, participants completed the cognitive tasks (engagement/disengagement, construct accessibility, and threat bias) in counterbalanced order, followed by self-report questionnaires. Finally, a mood repair was administered, and participants were debriefed, assessed for suicide risk, and compensated. All participants received a list of national mental health resources.

Methods were approved by the City University of New York Institutional Review Board.

2.3. Experimental condition

2.3.1. Affect—Participants rated valence and arousal using five Self-Assessment Manikin figures [23]. The SAM allows for nonverbal expressions of emotion, because it measures subjective experiences of valence and arousal using figures. Prior to (and after) the affect induction, participants were instructed to rate their subjective experiences of pleasantness (valence) and arousal while viewing films and listening to music (described below). Additionally, participants responded to the single item, “I feel sad,” “I feel amused,” and “I feel calm,” using a 5-point Likert type scale, ranging from 1 “strongly disagree” to 5 “strongly agree.”

[1]Before enrolling, participants completed a screener that assessed symptoms of anxiety and depression (the depression and anxiety subscales of the Depression, Anxiety, and Stress Scales; (DASS) [39], SI in the past month – i.e., questions from the Self-Injurious Thoughts and Behaviors Interview-Revised [40], as recommended by Gratch et al. [41] – symptoms of perceptual disturbance, a question that inquired about a learning disorder, and demographic information. Participants were eligible for the study if they scored at least 10 on the anxiety or 14 on the depression subscale of the DASS or if they reported past-month SI. They were ineligible if they screened positive for thought insertion or reported a learning disorder. Details about the screening procedure are available upon request.

[2]Due to experimenter error, 19 participants did not complete the amusement, sadness, and calmness items following the affect induction and the mood repair.

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2.3.2. Affect induction—Participants were randomly assigned to either a positive, negative, or neutral affect induction using a random number generator. The positive affect induction consisted of a 2.5-minute clip from the film "When Harry Met Sally" [24]. The clip presented Harry and Sally dining at a restaurant and having a conversation about orgasms. This clip has been used to elicit positive affect, particularly amusement [25]. Participants also listened to 4 min of "Coppélia, Act I: 1. Prélude et Mazurka," by Delibes, which has been used to increase positive moods in online research [26].

The negative affect induction consisted of a 2.5-minute clip from the film, "The Champ" [27]. The clip presented a boxer lying still on a table, surrounded by sad characters. His young son entered the room and cried over his dead father. This scene has been validated in previous research to elicit negative affect, primarily sadness [25]. Participants in this condition also listened to 4 min of Barber's "Adagio for Strings, Op. 11," which has previously been used to induce a negative mood [26].

The neutral condition consisted of 4-minutes of footage from the episode "Magnets" of the documentary Modern Marvels (season 9, episode 35), which featured narrated scenes on how magnets attract and repel other magnets. Previous research has successfully used this documentary to elicit neutral affect in an online sample [26]. Participants then listened to 4 min of Reich's "Variations for Winds, Strings, and Keyboards," which has also been successful in eliciting neutral affect [26].

Manipulation checks suggested that the affect inductions were effective in inducing the relevant moods.[3]

2.4. Measures

2.4.1. Cognitive tasks

2.4.1.1. Attention engagement and disengagement.: The Attentional Response to Distal vs. Proximal Emotional Information (ARDPEI) task is a modified dot-probe task that measures both engagement and disengagement bias separately [13]. In each trial, participants viewed arrows indicating where an anchor probe would appear. The anchor probe then appeared in that location for 150 ms. Next, a word and a non-word pair appeared on the screen (one above the other) for 500 ms or 1000 ms, followed by the target probe. Participants indicated whether the anchor probe and target probe matched.

[3]One-way ANOVAs revealed no baseline differences in ratings of valence, $F(2, 150) = 0.51$, amusement ($F(2, 150) = 0.76$, calmness, $F(2, 150) = 0.15$, or sadness, $F(2, 150) = 0.03$, all $ps > .05$. However, ANCOVAs revealed group differences in valence, $F(2, 150) = 52.46$, $p < .01$, amusement, $F(2, 150) = 76.37$, $p < .01$, calmness, $F(2, 150) = 7.36$, $p < .01$, and sadness, $F(2, 150) = 73.97$, $p < .01$, following the affect inductions. Participants in the positive affect condition ($M = 2.78$, $SD = 0.93$) exhibited higher levels of (pleasant) valence relative to peers in the negative ($M = 1.24$, $SD = 0.76$) and neutral ($M = 2.30$, $SD = 0.74$) conditions (Cohen's $d = 1.81$ and 0.57, respectively). Participants in the positive condition ($M = 2.92$, $SD = 0.83$) also reported higher levels of amusement than peers in the negative ($M = 0.72$, $SD = 0.82$) and neutral conditions ($M = 2.41$, $SD = 0.88$), Cohen's $d = 2.67$. and 0.60, respectively. Participants in the negative ($M = 1.94$, $SD = 0.92$) condition reported significantly lower levels of calmness than peers in the positive ($M = 2.54$, $SD = 0.95$) and neutral ($M = 2.72$, $SD = 0.94$) conditions (Cohen's $d = 0.64$ and 0.84, respectively). They also reported significantly higher ratings of sadness ($M = 3.03$, $SD = 0.74$) compared to peers in the positive condition ($M = 1.30$, $SD = 0.81$) following the affect induction but did not differ significantly from those in the neutral condition ($M = 1.50$, $SD = 0.94$), Cohen's $d = 2.23$ and 1.81, respectively. No differences in sadness ratings emerged between participants in the positive condition relative to peers in the neutral condition. Overall, results suggested that the affect induction was effective in eliciting sadness in the negative condition, and amusement and more pleasant valence in the positive condition (thereby less pleasant valence in the negative condition). The analyses applied a Bonferroni correction.

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The location of both the anchor probe and target probes was manipulated to index an engagement and disengagement bias. We used 16 suicide/death-related words, 16 happy words, and 16 sad words. Each word was paired with a non-word. Suicide/death-related words were presented four times, while sad words were presented eight times, for a total of 156 experimental trials.[4] We computed attention engagement and disengagement biases following recommendations by Grafton and colleagues [28].

2.4.1.2. Construct accessibility.: Participants completed a lexical decision task (adapted from Lepore and Brown [29]) to assess construct accessibility of semantic information. In this task, participants classified letter stimuli as English words or non-words. In each trial, an asterisk "*" was presented for 700 ms to signal the beginning of a new trial. Then, a string of letters was presented for 250 ms, followed by a blank screen. Participants then classified the letter stimuli as a word or a non-word by pressing either the "E" or "I" keys. Six practice trials (3 words and 3 nonwords) and 1 experimental block consisting of 13 words per valence category (positive, negative, neutral, suicide-related), with equivalent number of non-words, were administered.

2.4.1.3. Threat bias.: Participants completed a modified version of the dot-probe paradigm [6] to assess bias to socially threatening stimuli. Participants viewed a fixation cross "+" that appeared on the screen for 500 ms and indicated the beginning of a trial. Next, they viewed a pair of facial images for 500 ms followed by a "probe" arrow that appeared in the location of one of the images. The probe remained on screen until participants decided if the arrow was pointing to the left or right. Upon their response, an intertrial interval blank screen appeared for 500 ms, and then a new trial began. There were 120 trials, with 80 angry-neutral pairs and 40 neutral-neutral pairs. A threat-level bias score was computed, as described previously [30]. Positive scores indicated greater threat bias toward threatening images. Images were obtained from the Racially Diverse Affective Expression (RADIATE) Emotional Face Stimulus Set [31]. Images were matched by race and gender, and a relatively equal proportion of Asian, Black, Hispanic, and White faces were selected.

2.4.2. Self-report measures

2.4.2.1. Suicide ideation.: Suicide ideation was measured in two ways. First, SI severity was assessed with the Beck Scale for Suicide Ideation (BSS) [32], a 21-item self-report measure that assesses active and passive SI and suicidal behaviors. In this study, the BSS was modified to measure SI in the preceding two weeks. The BSS demonstrated adequate internal consistency (α = .73). Second, participants responded to several questions to classify their SI recency, such as: "Have you ever had thoughts of suicide or pictured yourself dying by suicide?" and "Have you felt there is no point in living anymore?" If they responded "yes" to the last item, a follow-up query asked, "When was the last time you thought about this?" Participants were classified as having SI in the past month if they

[4]Though we originally planned to compare suicide-related stimuli to life-related stimuli, due to a programming error, the life-related stimuli were not presented to participants. Instead, participants viewed sad stimuli eight times instead of four times. Thus, sad stimuli were presented twice more than the suicide/death-related words and the happy words. However, there is no scientific evidence that life-related stimuli elicit schemas unrelated to death or suicide. Thus, we compared suicide-related stimuli to sad stimuli. We compared suicide-related stimuli to sad stimuli, to delineate whether people with recent SI truly demonstrate a suicide-specific attentional bias that is distinct from attentional biases to negative content more broadly.

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endorsed SI on the BSS or indicated SI in the past month based on the previous items. Otherwise, participants who endorsed SI on any of the single items but longer than a month ago, were classified as having lifetime SI. Those who denied SI on all items were excluded from analyses.

2.4.2.2. Hopelessness.: The Beck Hopelessness Scale (BHS) [33] consists of 20 true/false statements designed to explore global predictions about the future. In the current study, the BHS demonstrated strong internal consistency reliability (α = .89).

2.4.2.3. Depressive symptoms.: The Beck Depression Inventory (BDI-II) [34] is a 21-item, multiple choice questionnaire that assesses cognitive and behavioral symptoms of depression. The BDI demonstrated strong internal consistency reliability (α = .89) in the study.

2.4.2.4. Anxiety symptoms.: The Beck Anxiety Inventory (BAI) [35] consists of 21 items used to assess cognitive and physical symptoms of anxiety. The internal consistency of the BAI was strong in the current study (α = .88).

2.5. Data reduction

Of the 174 participants recruited, 20 denied lifetime SI and were removed from analyses. An additional participant was removed due to missing data on all three cognitive tasks, resulting in a final sample of 153. We examined the response latency of each cognitive task to identify outliers and unreliable data. Data from eight participants who completed the attention task, three participants who completed the construct accessibility task, and five participants who completed the threat bias task were removed due to technical difficulties while participants completed these tasks, resulting in unreliable latency and accuracy scores. Threat bias task data from two additional participants were removed due to insufficient threat-level bias scores. Among participants with valid data, incorrect trials, trials with reaction times (RTs) lower than 150 ms or above 3000 ms, trials with RTs ± 2.5 *SD* above or below the sample mean, or trials with RTs ± 2.5 *SD* above or below individual means for each word category were excluded. This resulted in approximately 13 % of trials removed from the attention task, 9 % of trials removed from the construct accessibility task, and 3 % of trials removed from the threat bias task.

We then computed split-half reliability for each valence category in the three tasks. Split-half reliability indices were relatively high for happy (α = .95), sad (α = .96) and suicide/death-related (α = .94) stimuli in the attention task. Likewise, split-half reliability indices were high for positive (α = .92), negative (α = .91), neutral (α = .88), and suicide-related (α = .87) stimuli for the construct accessibility task. For the threat bias task, split-half reliability was acceptable for trial-level bias (TL-BS) assessing bias away from threatening stimuli (α = .80) and low for TL-BS assessing bias toward threatening stimuli (α = .56).

Next, we computed bias indices for the attention task and the threat bias task. We computed attention engagement and disengagement biases following recommendations by Grafton and colleagues [28]. As explained earlier, engagement bias trials consist of focusing on distal stimuli rather than proximal stimuli. We first subtracted RT of distal stimuli of suicide trials

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from RT of proximal suicide trials. Next, we subtracted RT of distal sad trials from RT of proximal sad trials. Finally, we subtracted the difference of the suicide trials from the difference of the sad trials, resulting in a difference score of engagement bias toward suicide stimuli relative to sad stimuli. Higher scores were indicative of an engagement bias toward suicide stimuli relative to sad stimuli. Similarly, to compute the attention disengagement bias indices, we subtracted the RT of proximal suicide trials from distal suicide trials. We repeated this step for sad trials. Finally, we subtracted the difference in RT of the suicide trials from the difference of the sad trials, which provided an index measuring delayed disengagement from suicide stimuli relative to sad stimuli. Higher scores were indicative of a delayed disengagement bias from suicide stimuli relative to sad stimuli. We computed the attention engagement and disengagement bias indices for trials lasting 500 ms and 1000 ms, to allow for distinguishing automatic and controlled processing of attention, respectively.

Next, we computed trial-level bias scores (TL-BS) to better capture attentional bias toward and away from threat [30]. Traditionally, researchers compute average scores and calculate mean differences between congruent and incongruent trials in the dot-probe task. However, given that attentional processes are dynamic rather than static, recent research recommends computing difference scores between adjacent congruent and incongruent trials to better capture dynamic processing of attentional biases [30]. Thus, TL-BS can more accurately capture changes in attentional processing between trials. To compute TL-BS for socially relevant biases, we matched congruent trials with the adjacent incongruent trials and computed differences between these two sets of trials. This was done for all trials in the threat bias task. Thus, instead of computing averages, the TL-BS consisted of a series of scores per participant that account for the sequential presentation of each type of stimuli. From these TL-BS, two overall mean scores were computed to assess biases toward threatening stimuli (greater positive scores) and biases away from threatening stimuli (greater magnitude in negative scores).

2.6. Data analysis

To assess the first part of Aim 1, we used linear regressions incorporating suicide-specific attentional biases, construct accessibility, and threat bias toward and away from social stimuli as predictors of SI. This would allow identification of the independent effect of suicide-specific attentional biases when adjusting for the impact of the other cognitive processes. To test the second part of Aim 1, we examined the effect of recency of SI on suicide-specific attentional biases using adjusted and unadjusted models. In the adjusted models, we included hopelessness, depressive symptoms, and anxiety symptoms as clinical covariates in step 1.[5] Suicide-specific construct accessibility and general threat bias indices were added as cognitive covariates in step 2. Correlations for each cognitive process index are available as Supplemental material.

To test Aim 2, we entered suicide-specific engagement and disengagement bias indices as the outcome variables. One set of analyses included suicide-specific engagement bias as the outcome, and a second set of analyses included suicide-specific attention disengagement

[5]Due to the redundancy of self-report measures of anxiety symptoms and reaction time measures of bias toward threatening information, the self-reported anxiety symptoms were dropped from the final models.

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bias at different durations (500 ms and 1000 ms) as the outcome. Then, we entered affect condition and recency of SI as factors. We used an interaction term between affect condition and recency of SI to predict suicide-specific attentional biases. Lastly, we included cognitive indices and symptom measures as covariates, given that participants with recent SI reported significantly higher levels of depressive symptoms, anxiety symptoms, and hopelessness than peers with lifetime SI (see Table 1). Bonferroni corrections were applied to account for multiple testing.

3. Results

3.1. Effects of recency of SI on suicide-specific attentional biases

We predicted that engagement and disengagement biases would be more strongly related to SI severity, independent of cognitive biases, and that the effects of attentional biases would be stronger than the effects of construct accessibility and general threat biases. Linear regression analyses revealed no significant effects of suicide-specific engagement or disengagement biases on SI severity when adjusting for cognitive biases (see Supplemental material).

We also predicted that adults with recent SI would display stronger delayed disengagement than engagement biases compared to peers with lifetime SI. The unadjusted regression analyses revealed no significant effect of recency of SI on suicide-specific engagement biases at 500 ms ($b = -0.04$, $p > .05$) or 1000 ms ($b = -0.12$, $p > .05$), nor were there significant effects of SI recency on disengagement biases at 500 ms ($b = -0.24$, $p > .05$) or 1000 ms ($b = -0.28$, $p > .05$). Similarly, in adjusted models, the effect of SI recency on suicide-specific attentional biases were non-significant when adjusting for depressive symptoms, hopelessness, accessibility of suicide-related stimuli, and general threat biases toward/away from socially threatening stimuli (see Steps 1 and 2 in Table 2 for Models 1–4). To test the specificity of attentional biases compared to construct accessibility, these analyses were replicated with suicide-related construct accessibility as the outcome variable and attentional biases as covariates. There was no significant effect of SI recency on construct accessibility when adjusting for clinical covariates, suicide-specific attentional biases, and general bias toward threatening stimuli. However, an effect of threat bias on accessibility of suicide-related stimuli emerged, such that greater bias away from socially threatening stimuli was associated with slower accessibility of suicide-specific stimuli (see Steps 1 and 2 in models 1–4 in Table 3).

3.2. Affect and suicide-specific attentional biases

The second study aim was to investigate the impact of mood and the interactive effects of affective states and recency of SI on suicide-specific attentional biases, while adjusting for covariates. A significant effect of sad affect ($b = 1.26$, $p < .01$) and a significant interaction between sad affect and recency of SI ($b = -1.27$, $p < .05$) emerged only for suicide-disengagement biases at 500 ms. Specifically, results revealed that participants assigned to the sad condition displayed slower disengagement from suicide-specific stimuli relative to peers assigned to the neutral or amused (positive) conditions. Probing the interaction effect, test of simple slopes suggested that, irrespective of affect induction, adults with

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recent SI displayed facilitated disengagement from suicide-specific stimuli. In contrast, participants with lifetime SI in the sad affect condition displayed slower disengagement from suicide-specific stimuli, while those in the neutral or positive conditions displayed facilitated disengagement (Fig. 1).

4. Discussion

This is the first study to examine the influence of three affective states on suicide-specific attentional biases. Individuals with recent SI showed suicide-specific disengagement biases, and negative affect appeared to play a role in eliciting these attentional biases for individuals with distal (but not recent) SI, independent of covariates. Consistent with prior research [11], we found no suicide-specific accessibility bias. We expand on and contextualize these findings within the overall literature on suicide-specific attentional biases.

4.1. Attentional biases

Our hypothesis that individuals with recent SI would display stronger suicide-specific disengagement biases than engagement biases, relative to peers with lifetime SI, was not supported, perhaps due to the classification of recency of SI. Although our classification of SI accounted for recency of their SI, it did not capture the severity of these thoughts, which might play a role in processing suicide-related information [1,10]. Future studies should examine how recency, severity, and variability of SI relate to different stages of attentional processing. Identifying nuances in profiles of SI and their relationship to attentional processing of suicide-related stimuli could enhance the quality of interventions designed to reduce SI and attempts.

We also did not find that individuals with recent SI displayed greater accessibility of suicide-related content, in contrast to past research that primed schemas related to success and failure and found an impact on schemas related to suicidal thoughts and behaviors [16]. Our study differs methodologically from previous research, in that we manipulated affect, but not specific schemas related to suicide. Individuals might experience SI or engage in suicide attempts after experiencing or perceiving failure [36,37]. Therefore, the association between failure schemas and SI may be strongly linked in memoty, such that when failure is activated, so are suicide-related schemas. Relatedly, the cognitive model suggests that schemas related to hopelessness and distress intolerance must first be activated for people to demonstrate exaggerated attentional processing of suicide-related stimuli [8]. Additionally, Chatard and Selimbegović [16] recruited participants without pre-selecting for SI history, while everyone in the present study had at least lifetime SI. Thus, it could be that accessibility of suicide-related content may be more pronounced when comparing individuals with histories of SI vs. those without. Alternatively, individuals with SI histories may show similar accessibility of suicide-related information, irrespective of their SI recency. We encourage future work to account for both affective states and self-relevant schemas associated with biased processing of suicide-related information and to compare individuals with and without SI.

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4.2. Impact of affect

We expected individuals with recent SI experiencing negative affect to show facilitated engagement with, but delayed disengagement from, suicide-specific stimuli and that adults experiencing positive affect would show the opposite pattern: delayed engagement with and facilitated disengagement from suicide-specific stimuli. Our findings did not support these hypotheses. Irrespective of affect condition, young adults with recent SI exhibited facilitated disengagement from suicide-specific stimuli at 500 ms. In contrast, young adults in the sad condition exhibited delayed disengagement from suicide-specific stimuli, whereas those in the positive or neutral conditions exhibited facilitated disengagement from suicide-specific stimuli.

Altogether, these findings suggest that individuals with recent SI show automatic processing of suicide-specific information irrespective of their current affective state, and this is distinguishable from adults with distal SI who show differential disengagement processing depending on their affective state. Drawing from Teasdale's differential activation hypothesis [19], researchers have proposed that how people process suicidal cognitions in a depressed state may activate schemas stored in memory in subsequent depressive episodes [20]. The implication is that in negative affective states, suicide-related schemas become activated and readily accessible, eliciting specific processing patterns of suicide-related content. Our findings suggest that this may be more pronounced for individuals with distal SI and not as pronounced for individuals with recent SI, who do not appear to show differential processing of suicide-related content, irrespective of their current affective state. Granted, all participants in the study experienced some level of depression or anxiety. However, participants with recent SI exhibited more severe hopelessness, anxiety, and depressive symptoms. The severity of their clinical symptoms may have been stronger than the transient increase in positive or negative affect in the affect inductions. Considering the severity of their clinical symptoms and how recently they thought about suicide, perhaps these young adults showed facilitated disengagement from suicide-related content because they had rehearsed the information and because their current overall affective state already had those semantic networks activated that increase their ability to disengage quickly from suicide-related information.

In contrast, individuals with distal SI and less severe clinical symptomology may not have had suicide-related schemas readily available to show automatic processing. Indeed, those assigned to the sad affect condition seemed to have difficulty disengaging from suicide-related stimuli, while those in the amused and calm affective states did not. For these participants, viewing content about suicide while experiencing some sadness may have impaired their ability to disengage from this content. However, if the differential activation hypothesis [19] posits that depressed individuals experiencing negative affect (or a depressed mood) would show greater accessibility of semantic networks related to suicide content, why were there effects for suicide-specific disengagement biases but not for accessibility of suicide-related stimuli? This might be due the distinction between construct accessibility and attentional biases; accessibility relates to how quickly semantic networks are activated and accessible, whereas attentional biases relate to how people process or focus on specific stimuli. Even though participants experienced sadness and were already

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experiencing moderate-to-high severity in clinical symptoms, the schemas associated with suicidal cognitions may not have been readily available during the construct accessibility task; however, in the ARDPEI task, participants were "required" to focus their attention on specific stimuli to capture facilitated or delayed engagement and disengagement biases. Attentional biases may not require the activation of semantic networks stored in memory in the same way that construct accessibility might, because attentional biases relate to how focus is *allocated* to specific stimuli. The stimulus needs to be present first. Additionally, accessibility of suicide-related content may depend on how frequently individuals think about suicide, because the greater the frequency with which a construct is activated, the more accessible it becomes [15]. Our classification of SI recency may have been too broad. A better comparison might have been individuals with past-week vs. past-month SI, as those semantic networks may no longer be readily accessible.

Finally, suicide-specific engagement and disengagement indices were unrelated to SI severity, suggesting that how individuals attend to suicide-related stimuli is unrelated to what they think about or the frequency of these thoughts. For instance, individuals may have passive thoughts about death, or they may intentionally think about killing themselves, having considered a method and generated a plan. These factors concern the content of SI. In contrast, engaging more quickly, disengaging more quickly, or having greater accessibility of suicide-related content relates to how they process information about suicide. Thus, the specific cognitions (intent or plans to kill oneself, whether or not one has disclosed their SI) people have about suicide can be unrelated to the way they process information about suicide, because specific cognitions are distinct from how attention is allocated. These findings are seemingly contradictory. We would expect that if individuals show exaggerated processing of suicide-related stimuli, there would be some relationship between this processing of suicide-related stimuli and the content they process. Given that research shows variability in the intensity and duration of SI [38], one could also expect variability in how these cognitions are processed. Therefore, what people think and how they think about such content can be independent. Future research may add to this literature by examining how different stages of attentional processing relate to the specific SI content (e.g., active vs. passive SI).

4.3. Strengths and limitations

This is the first study to use three cognitive tasks to distinguish attentional biases from construct accessibility and biases toward and away from threatening information, allowing for specificity in cognitive processes associated with suicidal thoughts. Further, this is the first study to assess the impact of affective states on suicide-specific engagement and disengagement biases. Finally, the sample was diverse, with regard to racial, ethnic, sexual identity, and socioeconomic background.

Limitations are worth noting. Conducting the study virtually increased technological problems outside of the researchers' control (e.g., reliability of internet connection, software updates, security settings interfering with task completion), though it increased ecological validity. Further, several participants complained that the ARDPEI task was difficult to complete and extensive. The length of the task could have produced fatigue and boredom,

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potentially compromising performance. The study was heavily dependent on language, which may have affected the reaction time of multilingual speakers. Further, the sample was predominantly female, which may limit generalizability to males or gender-fluid individuals. Of note, the sample size was small for some of the interaction effects due to the low number of participants who reported lifetime SI.

4.4. Conclusion

These findings highlight that attention *disengagement* bias is a critical attentional process associated with SI recency. Specifically, individuals with recent SI appear to display automatic processing of suicide-related content irrespective of their affective state, whereas those with distal SI seem to have difficulty disengaging from suicide-related content when experiencing sadness. Overall, this research enhances the conceptual and methodological rigor implemented in suicide-related attentional bias research.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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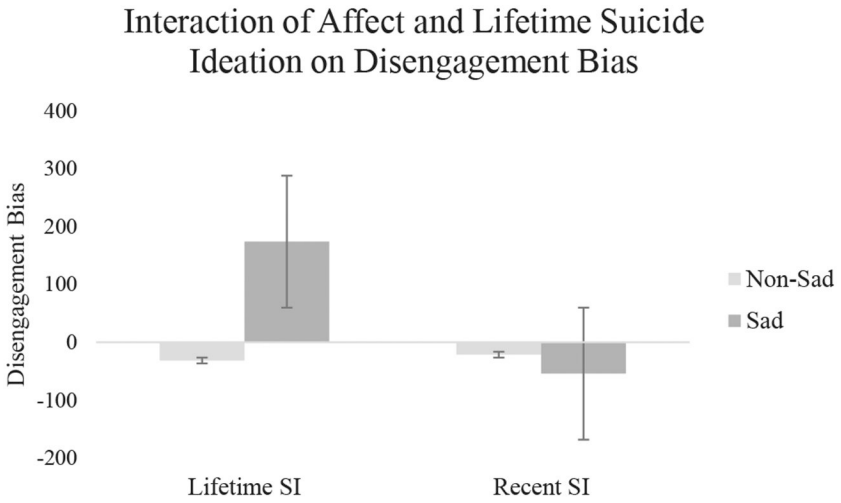

Fig. 1.

The interaction between sad condition and recency of SI is presented. Irrespective of condition, participants with recent SI displayed facilitated disengagement from suicide-specific stimuli. However, participants with lifetime SI displayed facilitated disengagement from suicide-specific stimuli in non-sad conditions and delayed disengagement in the sad condition.

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Table 1

Sample characteristics, means, and standard deviations.

	Overall sample (*n* = 153)	Lifetime SI (*n* = 47)	Recent SI (*n* = 106)	X^2
	***n* (%)**	***n* (%)**	***n* (%)**	
Sex				0.53
Male	19 (12)	4 (9)	15 (14)	
Female	133 (87)	43 (92)	90 (86)	
Gender				6.17
Cisgender Woman	114 (75)	37 (79)	77 (73)	
Cisgender Man	17 (11)	4 (9)	13 (12)	
Transgender	2 (1)	2 (4)	0 (0)	
Gender non-conforming/Queer/Other	20 (13)	4 (9)	16 (15)	
Sexual Orientation				1.71
Asexual	6 (4)	1 (2)	5 (5)	
Bisexual	35 (23)	12 (27)	23 (23)	
Gay or Lesbian	10 (7)	4 (9)	6 (6)	
Heterosexual	64 (42)	20 (44)	44 (43)	
Pansexual (± bisexual)	15 (10)	4 (9)	11 (11)	
Queer/Other	17 (11)	4 (9)	13 (13)	
Race/Ethnicity				1.89
Asian	24 (16)	9 (20)	15 (14)	
Black	12 (8)	4 (9)	8 (8)	
Hispanic	28 (18)	6 (13)	22 (21)	
White	80 (52)	24 (52)	56 (53)	
Other	8 (5)	3 (7)	5 (5)	
Income				6.46
< 25,000	33 (22)	7 (15)	26 (25)	
25,000–49,999	43 (28)	10 (21)	33 (31)	
50,000–74,999	25 (16)	12 (26)	13 (12)	
75,000–99,999	22 (14)	8 (17)	14 (13)	
> 100,000	30 (20)	10 (21)	20 (19)	
Psych Treatment				1.24
No treatment	55 (36)	16 (34)	39 (37)	
Therapy only	38 (25)	13 (28)	25 (24)	
Medication only	16 (11)	6 (13)	10 (9)	
Therapy & Medication	43 (28)	12 (26)	31 (29)	
Other	1 (1)	0 (0)	1 (1)	
Diagnosis	112 (73)	32 (68)	80 (76)	0.57
Lifetime SA	45 (29)	17 (36)	28 (26)	1.06
		M (SD)	***M (SD)***	***t***
Age	25.07 (4.79)	25.11 (4.49)	25.06 (4.94)	0.06

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	Overall sample (*n* = 153)	Lifetime SI (*n* = 47)	Recent SI (*n* = 106)	X^2
Hopelessness	7.61 (5.07)	4.85 (4.25)	8.84 (4.93)	−4.81**
Depressive Symptoms	19.88 (10.40)	13.91 (9.23)	23.28 (9.96)	−5.49**
Anxiety Symptoms	20.75 (10.5)	16.55 (10.02)	22.61 (9.53)	−3.57**

Note: Comparisons between sex and recency of SI, diagnosis and recency of SI, and lifetime SA and recency of SI applied a Yate's Continuity Correction. Bonferroni corrections were applied to control for multiple *t*-tests. SA = suicide attempt. * $p < .05$; ** $p < .01$.

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Table 2

Adjusted models predicting suicide-specific attentional engagement and disengagement biases.

	Model 1: Suicide Engagement 500 ms			**Model 2: Suicide disengagement 500 ms**		
	b	***S.E.***	***p***	***b***	***S.E.***	***p***
Step 1						
Depression	− 2.70	1.80	.14	0.72	2.06	.73
Hopelessness	5.91	3.58	.10	−5.48	4.13	.19
Step 2						
Suicide accessibility	− 0.02	0.19	.90	− 0.26	0.21	.21
Positive Threat Bias	− 0.02	0.54	.97	− 0.64	0.61	.29
Negative Threat Bias	0.18	0.59	.76	− 0.28	0.67	.68
SI Recency	− 6.00	36.94	.87	− 29.41	41.95	.49
Step 3						
Sad condition	47.67	71.45	.51	259.98**	78.73	< .01
Amused condition	39.95	63.56	.53	92.48	70.02	.19
Sad Condition × SI Recency	− 126.52	86.38	.15	− 261.63**	94.76	< .01
Amused Condition × SI Recency	− 95.16	76.77	.22	− 53.52	84.59	.53
	Model 3: Suicide Engagement 1000 ms			**Model 4: Suicide disengagement 1000 ms**		
	b	***S.E.***	***p***	***b***	***S.E.***	***p***
Step 1						
Depression	1.07	1.77	.55	− 3.69	2.51	.14
Hopelessness	− 3.32	3.55	.35	− 6.12	5.03	.23
Step 2						
Suicide accessibility	0.14	0.18	.44	− 0.16	0.26	.55
Positive Threat Bias	0.20	0.52	.70	− 0.62	0.75	.41
Negative Threat Bias	1.01	0.58	.08	− 0.97	0.83	.25
SI Recency	− 25.71	36.03	.48	− 9.51	51.72	.85
Step 3						
Sad condition	20.06	69.43	.77	62.57	99.75	.53
Amused condition	19.57	61.75	.75	− 19.71	88.72	.83
Sad Condition × SI Recency	− 13.01	83.57	.88	− 31.42	120.07	.79

Amused Condition × SI Recency	− 92.91	74.60	.22	130.35	107.18	.23

Note: * $p < .05$; a Bonferroni correction was applied at $p < 0.013$ (.05/4).

** $p < .01$.

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Table 3

Adjusted models predicting accessibility of suicide-specific stimuli.

	Model 1			Model 2		
	b	***S.E.***	***p***	***b***	***S.E.***	***p***
Step 1						
Depression	1.49	0.92	.11	1.30	0.91	.16
Hopelessness	− 2.26	1.82	.22	− 2.27	1.83	.22
Step 2						
Suicide engagement 500 ms	− 0.01	0.04	.90	-	-	-
Suicide disengagement 500 ms	-	-	-	− 0.04	0.04	.21
Positive Threat Bias	− 0.30	0.25	.22	− 0.30	0.25	.22
Negative Threat Bias	1.09**	0.26	< .001	1.09**	0.26	< .001
SI Recency	23.11	16.98	.18	21.56	16.97	.21
Step 3						
Sad condition	− 5.39	32.94	.87	5.52	34.30	.87
Amused condition	− 11.78	29.28	.69	− 7.19	29.49	.81
Sad Condition × SI Recency	42.09	39.92	.29	25.39	40.74	.53
Amused Condition × SI Recency	3.25	35.55	.93	0.38	35.46	.99
	Model 3			**Model 4**		
	b	***S.E.***	***p***	***b***	***S.E.***	***p***
Step 1						
Depression	1.30	0.91	.16	1.30	0.91	.16
Hopelessness	− 2.27	1.83	.22	− 2.27	1.83	.22
Step 2						
Suicide engagement 1000 ms	0.03	0.04	.44	-	-	-
Suicide disengagement 1000 ms	-	-	-	− 0.02	0.03	.55
Positive Threat Bias	− 0.28	0.25	.26	− 0.29	0.25	.25
Negative Threat Bias	1.11**	0.26	< .001	1.10**	0.26	< .001
SI Recency	23.82	17.01	.16	22.88	17.01	.18
Step 3						
Sad condition	−5.60	33.08	.87	−4.34	33.13	.90
Amused condition	−11.49	29.41	.70	−11.32	29.41	.70
Sad Condition × SI Recency	36.65	39.68	.36	35.97	39.70	.37
Amused Condition × SI Recency	4.65	35.74	.90	4.30	35.74	.90

Note: Each model adjusts for a different type of suicide-specific attentional bias.

* $p < .05$; Bonferroni correction was applied at $p < 0.013$ (.05/4).

** $p < .01$.