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## Trait dimensions of anticipatory and consummatory reward relate differently to self-injurious thoughts and behaviors in a community adult sample

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### Abstract

**Background:** Self-injurious thoughts and behaviors (SITBs) are a major problem worldwide and continue to be a serious public health concern. Research investigating risk factors for suicide has shown that reward processes, such as the inability to feel pleasure, may confer risk for SITBs. However, less work has examined how different dimensions of trait reward relate to SITBs. Accordingly, the present study investigated the unique and interactive effects of trait anticipatory and consummatory reward for explaining SITBs.

**Methods:** 260 community adults ages 18–55 ( $M/SD = 32.79/10.54$ , females = 49.6 %, males = 50.4 %) completed an interview, neuropsychological tests, and questionnaires. We used hierarchical multivariate multiple regression analysis to assess cross-sectional associations between trait anticipatory and consummatory reward and different types of SITBs [self-injurious thoughts, nonsuicidal self-injury (NSSI), and suicide attempts] from the *Risky, Impulsive, and Self-destructive Behavior Questionnaire*.

**Results:** The unique variance associated with anticipatory and consummatory reward were differentially related to self-injurious thoughts but unrelated to self-injurious behaviors (NSSI/ suicide attempts). The interaction of anticipatory and consummatory reward was associated with self-injurious behavior, such that the inability to experience both anticipatory and consummatory reward was associated with higher frequency of NSSI.

**Limitations:** Limitations of the study include its cross-sectional nature and reliance on self-reported measures.

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

CRedit authorship contribution statement

**Wendy Huerta:** Conceptualization, Formal analysis, Writing – original draft, Data curation, Investigation, Project administration, Writing – review & editing. **Nadia Bounoua:** Conceptualization, Writing – review & editing, Formal analysis, Project administration. **Naomi Sadeh:** Funding acquisition, Supervision, Writing – review & editing, Project administration, Conceptualization, Formal analysis, Methodology, Resources, Software.

**Conclusions:** Low anticipatory reward and high consummatory reward may confer risk for self-injurious thoughts. Low levels of both trait anticipatory and consummatory reward may confer risk for NSSI. Findings suggest reward sensitivity may be an understudied risk factor for a range of SITBs.

### Keywords

Suicide ideation; Suicide attempts; Nonsuicidal self-injury; Anhedonia

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## 1. Introduction

Suicide remains one of the leading causes of death worldwide, with over 700,000 individuals dying from suicide each year (World Health Organization, 2021). Understanding and untangling relevant risk factors for different forms of self-injurious thoughts and behaviors (SITBs) is critical for tackling this public health concern, and investigating predictors of SITBs could lead to novel interventions to prevent suicide. SITBs encompass self-injurious thoughts, including suicidal ideation and suicide plans, which are characterized by thinking about and planning to kill oneself (Silverman et al., 2007). They also include self-injurious behaviors, including suicide attempts or hurting oneself with the intention to die (Silverman et al., 2007), and nonsuicidal self-injury (NSSI), or deliberating harming oneself without the intention to die (Chapman et al., 2006).

Previous research investigating risk factors for SITBs has shown that anhedonia, or the inability to experience pleasure from usually enjoyable activities (e.g., hobbies, and social activities) increases the risk of self-harm and suicidal ideation (Ducasse et al., 2018; Hawes et al., 2018; Winer et al., 2016; Yang et al., 2020). As anhedonia is a core symptom of various mental disorders, including major depressive disorder (MDD) and schizophrenia, researchers are interested in studying its transdiagnostic significance for explaining symptoms that cut across disorders, like SITBs. Research on anhedonia and the development of different types of SITBs has been mixed, with some studies showing risk associated with blunted reward (e.g., anhedonia) (e.g., Ducasse et al., 2018; Yang et al., 2020) and others showing SITBs are associated with elevated reward (e.g., Loas, 2007). The goals of this study are to help clarify reward relations with SITBs by examining the unique and interactive effects of trait dimensions of reward with these thoughts and behaviors.

### 1.1. Self-Injurious thoughts and behaviors and dimensions of reward

Given SITBs cut across multiple mental disorders, previous research has examined whether transdiagnostic factors may confer risk for SITBs. One emerging factor that has been recently studied is reward sensitivity, and specifically reward sensitivity deficits, and its role with SITBs. Reward sensitivity deficits are often known as anhedonia, the reduced ability to feel pleasure or enjoyment, and research has increasingly examined this construct with SITBs (Daghigh et al., 2019; Ducasse et al., 2018; Winer et al., 2016; Yang et al., 2020). Drawing from the neuroscience literature, research has identified two distinct hedonic processes, termed “liking” and “wanting” (Berridge and Kringelbach, 2008; Berridge and Robinson, 2003). Disruptions in these reward dimensions have also been investigated, with research suggesting low levels of “wanting” and “liking” represent deficits in anticipatory

and consummatory pleasure, respectively (Heininga and Kuppens, 2021). Anticipatory pleasure has been defined as the anticipation of future rewards and the prediction of attaining pleasure from future rewards or events, such as feeling excited at the prospect of watching a favorite movie (Gard et al., 2006). It is believed to motivate the pursuit of pleasurable activities and experiences (Klein, 1984) as well as predict the amount of effort an individual is willing to expend to obtain rewards (e.g., Geaney et al., 2015). In contrast, consummatory pleasure has been defined as the amount of pleasure or enjoyment experienced in the presence of a reward or event, such as feeling satiated after eating a meal (Gard et al., 2006).

Anticipatory anhedonia (e.g., the reduced ability to anticipate rewarding events) has been linked with suicidal ideation (Yang et al., 2020), suggesting that feeling hopeless about attaining future rewarding experiences may contribute to thoughts about death. Previous literature on the hopelessness theory of depression and suicide (Abramson et al., 1989, 2000; Liu et al., 2015) states that the interaction between negative life events and feeling hopeless confers risk for suicidal ideation and behavior, underscoring the importance of examining facets of reward sensitivity, such as anticipatory and consummatory pleasure, and their relationships with SITBs. To this point, the interpersonal theory of suicide, states thwarted belongingness and perceived burdensomeness along with hopelessness about these states is a risk factor for suicidal desire and overall engagement in suicidal behavior (Van Orden et al., 2010). This theory may help explain how individuals with deficits in anticipating rewarding events and a lack of interest in rewarding experiences (e.g., social interactions) may be at higher risk for engaging in self-injurious thoughts and behaviors.

To date, research on the association between reward sensitivity and self-injurious thoughts has been equivocal with some studies showing suicide risk associated with reward deficits (e.g., Ducasse et al., 2018; Yang et al., 2020) and others showing SITBs are associated with elevated sensitivity to reward (e.g., Loas, 2007). Inconsistencies in the literature may reflect differences related to the dimensions of anticipatory and consummatory pleasure (Loas, 2014), which have not been thoroughly investigated in relation to SITBs to date. For example, one study found that trait anticipatory, but not trait consummatory, anhedonia was associated with suicidal ideation in a sample of inpatients (Loas et al., 2016). However, both anticipatory and consummatory dimensions of trait anhedonia were associated with suicidal ideation in a sample of college students (Yang et al., 2020). Thus, relations between anticipatory and consummatory dimensions of pleasure and self-injurious thoughts have yet to be established.

In terms of self-injurious behaviors, research investigating the association between anhedonia and *suicide attempts* has been limited and inconsistent, with some studies reporting a positive association (Daghighi et al., 2019) and others showing no association (Hawes et al., 2018; Loas et al., 2000; Winer et al., 2016). For example, Loas et al. (2000) examined the relationship between *trait* anhedonia and depressive symptoms in 106 subjects who had attempted suicide and 104 healthy controls. This study found that individuals who had attempted suicide were not significantly more anhedonic than healthy controls (Loas et al., 2000). Similar to suicide attempts, research on anhedonia and NSSI has also been mixed. One study found that *heightened sensitivity* to reward (i.e., *low* anhedonia)

during adolescence increased the maintenance of learned NSSI behaviors (Cummings et al., 2021), whereas a number of research has linked NSSI to anhedonia (Auerbach et al., 2015; Fawcett et al., 1990; Nock and Kazdin, 2002). In contrast, Zielinski et al. (2017) found that state anhedonia did not predict NSSI beyond self-reported depressive symptoms. The association between anhedonia and self-injurious behaviors has been overall inconclusive as some studies show positive associations, no association, or high sensitivity to reward for these behaviors.

## 1.2. Present study

Research on the association between trait reward and SITBs has been inconsistent, which may, in part, be due to a lack of attention to different dimensions of pleasure in the same study. Based on the aforementioned limitations in previous research, the aims of this study were to (1) clarify the unique contributions of reward dimensions for different forms of SITBs and (2) explore the interplay between reward dimensions for explaining engagement in SITBs. For the first aim, we expected trait anticipatory reward to show negative associations with self-injurious thoughts based on previous work, such that individuals reporting lower anticipatory reward scores would also report a higher frequency of lifetime self-injurious thoughts. Given there has been limited work on the association between anticipatory reward and suicidal behaviors (i.e., suicide attempts and NSSI), we did not have a specific hypothesis for this relationship. Similarly, because associations between trait consummatory reward and SITBs have been limited and mixed, we did not have a specific hypothesis for the relationship between trait consummatory reward and SITBs. For the second aim, we conducted an exploratory analysis of the interactive effects of anticipatory and consummatory reward for explaining engagement in the different forms of SITBs. Given that no prior research has investigated these interactive associations in relation to SITBs, we did not have specific hypotheses about the direction of the synergistic effects if present.

## 2. Materials and methods

### 2.1. Participants

The present sample included 260 community adults ages 18–55 ( $M/SD = 32.79/10.54$ ; women = 49.6 %, men = 50.5 %) who responded to an advertisement for a study on risky behavior. Data for this project were collected between 2019 and 2023 as part of a larger study on the neural correlates of inhibitory control. Individuals who were ages 18–55, had an estimated IQ > 80, and spoke English as a first language met inclusion criteria for the larger parent study. Individuals who reported a history of psychosis, serious medical or neurological condition (e.g., epilepsy), current pregnancy, metallic implants or other contraindications to MRI were excluded from participation in the larger study.

The sample was relatively diverse, with 41.9 % ( $n = 109$ ) of participants identifying as a racial or ethnic minority and 58.1 % ( $n = 151$ ) identifying as White Non-Hispanic. A substantial minority of participants identified as Black/African American (26.5 %,  $n = 69$ ), followed by Asian (8.5 %,  $n = 22$ ), Hispanic/Latino(a) (7.7 %,  $n = 20$ ), American Indian/Alaska Native (1.9 %,  $n = 5$ ), and Native Hawaiian (1.3 %,  $n = 3$ ). The average past year household income among the sample was \$66,455 ( $SD = \$50,836$ ,  $Median = \$50,000$ ). In

terms of educational attainment, a few participants reported less than high school education (4.6 %,  $n = 12$ ) and half of the sample reported receiving a high school diploma equivalent (50.0 %,  $n = 130$ ), with the remainder of participants reporting higher education such as an Associate's degree (10.0 %,  $n = 26$ ), Bachelor's degree (20.4 %,  $n = 53$ ), Master's degree (11.9 %,  $n = 31$ ) or Doctorate/Professional degree (3.1 %,  $n = 8$ ).

## 2.2. Procedures

Community adults were recruited using online advertisements (e.g., Craigslist, Facebook) and flyers posted in the local community (e.g., libraries, federal and state probation and parole centers, bus stops, mental health centers) that described a study on risky behavior, life experiences, decision-making, and mental health at the University of Delaware. Participants completed study measures during an approximately four-hour session at the University of Delaware and were paid \$25/hour for their time. All participants completed a clinical interview, battery of self-report questionnaires, and neuropsychological testing in a closed room with limited distractions. Prior to data collection, informed consent was obtained from participants after reviewing the study description and procedures. The University of Delaware Institutional Review Board approved all protocols and procedures (Protocol #: 1361164–1). Study data were collected and managed using REDCap electronic data capture tools hosted at the University of Delaware (Harris et al., 2009, 2019).

## 2.3. Measures

**Self-Injurious Thoughts and Behaviors (SITBs).**—Lifetime SITBs were measured using the *Risky, Impulsive, and Self-Destructive Questionnaire* (RISQ; Sadeh and Baskin-Sommers, 2017). The RISQ includes four items which ask participants to estimate the number of times they engaged in self-injurious thoughts and behaviors. For example, “*How many times TOTAL have you: Thought about killing yourself?*” (self--injurious thoughts), “*Had a plan to kill yourself?*” (self-injurious plans), “*Tried to kill yourself?*” (suicide attempts), and “*Cut, burned, or hurt yourself on purpose without trying to die?*” (NSSI). Participants were asked to estimate the number of times they engaged in these behaviors using a 5-point scale (Never = 0, 1 = 1–10 times, 2 = 11–50 times, 3 = 51–100 times, 4 = >100 times). The Self-Harm subscale, reflecting the average of these four items, had acceptable internal consistency (Cronbach's alpha = 0.70), although we analyzed the suicidal thoughts (ideation, plans), NSSI, and suicide attempt items separately in this study. Items from the Self-Harm subscale have been used to assess SITBs in adult community and veteran samples in previous research (Bounoua, Hayes, and Sadeh, 2020; Sheehan et al., 2022).

**Trait Reward Dimensions.**—The *Temporal Experience of Pleasure Scale* (TEPS; Gard et al., 2006) is an 18-item measure of trait disposition in anticipatory and consummatory pleasure. Participants were asked to carefully decide how true a statement was for them in general on a 6-point Likert scale: 1=*very false for me* to 6=*very true for me*. Examples of the anticipatory items include: “*When I hear about a new movie starring my favorite actor, I can't wait to see it*”, “*When something exciting is coming up in my life, I really look forward to it*”, and “*I look forward to a lot of things in my life*”. Examples of the consummatory items include: “*The smell of freshly cut grass is enjoyable to me*”,

“I appreciate the beauty of a fresh snowfall”, and “I really enjoy the feeling of a good yawn”. The scores for items in each subscale were averaged to create an overall score for anticipatory reward (Cronbach’s alpha = 0.69) and consummatory reward (Cronbach’s alpha = 0.57).

#### 2.4. Psychopathology symptoms

Participants also completed portions of the *Structured Clinical Interview for DSM-5-Research Version* (SCID-5-RV; First et al., 2015), which was administered by a Clinical Psychologist or advanced doctoral student. Research staff underwent extensive training on clinical interviewing, administration of the SCID-5-RV, and symptom ratings prior to conducting interviews with research participants. Independent secondary ratings were conducted on 90 % of the interviews to assess reliability across interviewers and raters. Analysis of these secondary symptom ratings indicated reliability among the different raters was high (Intraclass Correlation Coefficients ranged from = 0.93–0.98 for symptom totals across disorders).

#### 2.5. Covariates

*Inhibitory Control:* Participants completed a neuropsychological test from the *Delis–Kaplan Executive Function System* (D-KEFs; Delis et al., 2001) to measure inhibitory control. The Color-Word Interference test required participants to name the *ink color* of a color word (e.g., red, green, blue) and inhibit the prepotent response to read the word. Scaled scores from the Color-Word Interference Test (number of errors) were used to index inhibitory control. *Demographic Information.* Age, gender, educational attainment, parental status, and ethnoracial minority status were assessed through a brief interview.

#### 2.6. Data analysis

All data analysis was conducted in SPSS (v29.0) (IBM Corp, 2023). There was no missing data on any of the measures examined. Given SITB scores were excessively skewed and kurtotic, we applied a Blom’s transformation to reduce the impact of outliers at the positive end of the distribution and better approximate the normal distribution. This transformation resulted in acceptable skewness and kurtosis for self-injurious thoughts (skewness/ kurtosis = 0.72/–0.42), suicide attempts (skewness/ kurtosis = 1.92/2.22), and NSSI (skewness/ kurtosis = 1.60/1.37).

Pearson correlations were used to assess bivariate correlations among the study variables. A hierarchical multivariate linear regression analysis was used to examine relations between anticipatory reward, consummatory reward and lifetime total SITBs. Because the different types of SITBs were moderately correlated, we used a single hierarchical multivariate linear regression analysis to assess associations between trait reward dimensions and different types of SITBs. Using a hierarchical multivariate linear regression analysis allowed us to perform a single analysis and avoid conducting multiple tests, which would be necessary if we analyzed each dependent variable separately (i.e., in a separate linear regression model). Different types of variables were entered into the regression model sequentially in blocks, with the covariates entered in Block 1, the main effects of the independent variables in Block 2, and the interactions between the independent variables in Block 3. Results are reported

for each block sequentially to avoid issues of multicollinearity associated with interpreting main effects and interaction terms in the same model without mean centering the variables. We evaluated potential multicollinearity issues within blocks by examining tolerance levels and found they were all within acceptable ranges (e.g., values  $>0.20$ ; Gaur and Gaur, 2006). Covariates were selected based on prior research on SITBs (Cassels et al., 2020; Hamza et al., 2015; Simon et al., 2001; Van Orden et al., 2010) and demographic heterogeneity in our sample. All multivariate analyses included age, gender, parental status, ethnoracial minority status (i.e., ethnic or racial minority status vs. White Non-Hispanic), educational attainment, and inhibitory control as covariates.

### 3. Results

#### 3.1. Sample characteristics

Rates of lifetime psychopathology were elevated in the sample relative to the general population. Assessment of internalizing psychopathology indicated Major Depressive Disorder was the most prevalent diagnosis 47.3 % ( $n = 123$ ), followed by Generalized Anxiety Disorder 16.5 % ( $n = 43$ ), Social Anxiety Disorder 9.5 % ( $n = 25$ ), Bipolar I Disorder 3.8 % ( $n = 10$ ), and Panic Disorder 2.3 % ( $n = 6$ ). In regard to externalizing psychopathology, 43.1 % ( $n = 112$ ) met criteria for Substance Use Disorder, 34.6 % ( $n = 90$ ) for Alcohol Use Disorder, 16.2 % ( $n = 42$ ) for Borderline Personality Disorder, and 10.8 % ( $n = 28$ ) for Antisocial Personality Disorder. In addition, 60.8% ( $n = 158$ ) of the sample reported a history of mental health treatment and almost half of the sample (43.8 %,  $n = 114$ ) reported prior legal system involvement.

Participants reported a range of SITBs across the lifetime. More than half of the sample reported a history of SITBs (60.0 %,  $n = 156$ ), with the most common one being suicidal ideation and/or suicide plans (53.1 %,  $n = 138$ ). Almost a quarter of the sample reported a history of NSSI (24.2 %,  $n = 63$ ) and approximately 17 % reported past suicide attempts (16.5 %,  $n = 43$ ).

#### 3.2. Trait reward dimensions and lifetime SITBs

Bivariate correlations among the study variables are reported in Table 1. As expected, the SITBs were all positively intercorrelated as was anticipatory and consummatory reward. The reward dimensions were uncorrelated with the SITBs at a bivariate level.

Next, we examined the unique and interactive associations of trait reward with different types of SITBs, and the results of this analysis are presented in Table 2. The first block of the hierarchical multivariate linear regression model indicated age and inhibitory control showed differential associations with SITBs. Age was positively associated with suicide attempts but unrelated to self-injurious thoughts and NSSI. Inhibitory control showed inverse associations with the two forms of suicidal behaviors examined, specifically suicide attempts and NSSI, but was unrelated to self-injurious thoughts.

The second block of the hierarchical multivariate linear regression analysis tested the main effects between dimensions of trait reward and the SITBs, above and beyond the covariates entered in the first block. Results showed that the unique variance associated with the

dimensions of trait reward was associated with self-injurious thoughts but was unrelated to suicide attempts and NSSI. Interestingly, anticipatory reward was inversely related to self-injurious thoughts, whereas consummatory reward was positively associated with self-injurious thoughts.

In the third block of the hierarchical multivariate regression analysis, we entered the interaction between anticipatory and consummatory reward, which was significant. Examination of the between-subjects effects revealed a significant interaction between the reward dimensions for NSSI but not suicide attempts or self-injurious thoughts. Anticipatory reward was negatively related to NSSI frequency at low levels of consummatory reward [-1SD: Effect = -0.172,  $SE = 0.085$ ,  $p = .045$ ] but unrelated to NSSI at high levels of consummatory reward [+1SD: Effect = 0.068,  $SE = 0.103$ ,  $p = .508$ ]. This pattern indicates the relationship between anticipatory reward and NSSI depends on consummatory reward, such that individuals low on anticipatory *and* consummatory reward reported the highest levels of NSSI.

#### 4. Discussion

To help clarify the relevance of reward processes for explaining engagement in self-injurious thoughts and behaviors, the current study investigated associations between trait anticipatory and consummatory pleasure and lifetime engagement in different types of suicide-related phenotypes. As expected based on previous literature (Loas et al., 2016; Yang et al., 2020), we found that trait anticipatory reward was negatively associated with the frequency of self-injurious thoughts, consistent with findings indicating that the tendency to anticipate less pleasure from the expectation of future rewards (i.e., anticipatory anhedonia) is a risk factor for long-term suicidal thinking. In contrast, the unique variance associated with trait consummatory reward was positively associated with lifetime frequency of suicidal ideation, a new finding that suggests the tendency to find rewards highly pleasurable also confers risk for suicidal ideation across the lifespan. Results from our exploratory analysis indicated that low levels of *both* anticipatory and consummatory reward were associated with greater engagement in nonsuicidal self-injury, suggesting that the reduced ability to anticipate and enjoy rewards confer risk for self-harm behaviors. Together, these findings advance the understanding of SITBs by demonstrating the importance of considering the unique and interactive contributions of different dimensions of trait reward as potential risk factors for these distressing and harmful outcomes.

The first hypothesis we tested focused on understanding whether the unique variance associated with dimensions of trait reward could help explain engagement in SITBs. As hypothesized, trait anticipatory reward correlated negatively with the frequency of self-injurious thoughts across the lifespan, such that anticipatory anhedonia was associated with a higher frequency of suicidal ideation and plans. In contrast, the unique variance associated with anticipatory reward was unrelated to self-injurious behaviors, specifically NSSI and suicide attempts. These findings are consistent with previous research showing that deficits in anticipating future physical and social rewards are risk factors for self-injurious thoughts (Loas et al., 2016; Yang et al., 2020). Based on hopelessness theories of suicide (Abramson et al., 2000; Liu et al., 2015), we interpret the negative association between trait anticipatory



reward and self-injurious thoughts as an inability to envision a pleasurable future (e.g., hopelessness), which may negatively impact seeking out rewarding experiences that could counteract feelings of hopelessness and, in turn, confer risk for suicidal ideation and plans.

Although consistent with prior work, these findings also extend it by showing that anticipatory reward is associated with self-injurious thoughts in models that include other key risk factors, such as inhibitory control. One next step in understanding the relevance of trait anticipatory reward for SITBs is to conduct studies investigating the contributions of different domains of anticipatory anhedonia, such as social vs. physical anhedonia, for explaining self-injurious thoughts, as previous theories of suicide suggest that thwarted belongingness (i.e., loneliness) is a risk factor for SITBs (Van Orden et al., 2010). Another question for future study is whether the severity of anticipatory anhedonia relates to motivational mechanisms that may explain why low anticipatory reward is related to SITBs. For example, since prior work has shown that anticipatory reward is associated with physical effort for rewards (Geaney et al., 2015), future research should investigate whether effort expenditure for reward is associated with suicidal thoughts and behaviors.

In regard to trait consummatory reward, we found the tendency to experience pleasure from rewards was positively associated with self-injurious thoughts, suggesting that individuals who score high on trait consummatory reward are also at risk of self-injurious thoughts. Given that this is a new finding, it will be important to replicate the association in other samples. We hypothesize that the positive association between trait consummatory reward and suicidal ideation may, in part, be dependent on *state* consummatory reward, which was not measured as it was outside the scope of this study. For example, this may mean that, for individuals who are normally high on consummatory reward at a *trait* level, this heightened consummatory reward trait may be a risk factor when *state* consummatory reward levels are low. To clarify this point, future research should investigate whether *state* consummatory reward moderates the association between *trait* consummatory reward and self-injurious thoughts. Trait consummatory reward was not uniquely associated with self-injurious behaviors in this study (e.g., suicide attempts/NSSI). The non-significant association between trait reward and suicide attempts is consistent with prior work (Winer et al., 2016), though more research is needed to disentangle the interactive effects of state and trait consummatory reward on suicidal behaviors.

Notably, we also identified interactive effects for the trait reward dimensions and found that the tendency to experience low anticipatory and consummatory reward was associated with suicidal behaviors, specifically NSSI. To our knowledge, the current study is the first to explore the interactive effects of dimensions of trait reward on different suicide-related phenotypes. Thus, our findings bring new insights into prior work with mixed findings between anhedonia and suicidal behaviors (Ducasse et al., 2018; Hawes et al., 2018; Loas, 2007; Watson and Kucala, 1978; Winer et al., 2016; Yang et al., 2020). The synergistic effects of the inability to predict and seek future rewards (i.e., anticipatory anhedonia) and deficits in hedonic responses to current rewards (i.e., consummatory anhedonia) may relate to nonsuicidal self-injury because scoring low on both dimensions of reward may indicate a particularly severe form of anhedonia. It is theorized that experiencing anhedonia may be intolerable for certain individuals and lead to self-injurious behavior as a result (Nock

and Kazdin, 2002), consistent with the theory that suicidal behaviors are an attempt to escape from an intolerable state (Baumeister, 1990). To explore whether scoring low on both anticipatory and consummatory reward may be intolerable to individuals who engage in SITBs, future research should explore whether anticipatory and consummatory anhedonia severity is indicative of engaging in NSSI more specifically. Future research in this matter can help establish whether trait anhedonia is a direct pathway to self-injurious thoughts and NSSI.

Overall, the results from this study have several important clinical implications. First, given the relevance of trait reward dimensions for self-injurious thoughts and NSSI, evaluating individuals for chronic anticipatory and consummatory reward deficits may provide novel information about SITB risk that is not currently captured by standard risk assessments. Additional research on the incremental utility of including trait reward dimensions in assessment batteries to better predict SITBs and ultimately suicide is needed, however, before drawing conclusions about their clinical utility for the prevention of SITBs.

Second, targeting chronic reward deficits in psychosocial treatment could be a useful treatment for decreasing SITBs, particularly among individuals who display hopelessness. For example, Behavioral Activation (BA), an evidence-based behavioral therapy designed to increase the number of pleasant activities, has been shown to improve depressive symptoms (Cuijpers et al., 2007; Dimidjian et al., 2014) and decrease anhedonia scores from pre- to post-treatment (Walsh et al., 2019). Furthermore, novel treatments designed to increase reward sensitivity (i.e., Positive Affect Treatment; Craske et al., 2019), a treatment approach incorporating behavioral activation, cognitive restructuring, and positivity approaches (e.g., silver lining, gratitude) have been shown to reduce the probability of suicidal ideation at 6 month-follow-up compared to a cognitive-behavioral treatment approach alone (Craske et al., 2019). Thus, delivering specific treatments targeting transdiagnostic risk factors such as reward sensitivity deficits is a potential method for reducing the probability of suicidal thoughts. The current results extend this literature by suggesting that individuals with deficits in anticipatory reward may benefit from cognitive interventions that improve the ability to mentalize the positive and rewarding features of future pleasurable events, whereas individuals with consummatory reward deficits may benefit from interventions aimed at increasing in-the-moment awareness of pleasurable sensations, like mindfulness training. Although speculative, these interpretations highlight a potential role for considering the type of reward deficit or deficits an individual is experiencing when developing treatment plans. Given that research has not specifically examined whether psychosocial treatments designed for reward deficits would help decrease NSSI, more research is needed to examine these associations and to understand whether treatments targeting both anticipatory and consummatory anhedonia can reduce the probability and frequency of nonsuicidal self-injury.

This study has several strengths. First, it involved examining the associations between trait reward and multiple forms of SITBs, which extends prior work that has not analyzed suicide ideation, attempts, and NSSI, simultaneously. Second, we examined multiple dimensions of trait reward, which gives insight into the different manifestations of anhedonia and its association with self-injurious thoughts and behaviors. Third, our study controlled for

multiple variables that may contribute to SITBs that have not been controlled for in previous work (i.e., inhibitory control, parental status). Finally, our study recruited a relatively diverse community sample of adults who are at elevated risk for SITBs, given the sample characteristics (e.g., socioeconomic status, legal system involvement) are understudied in prior work examining SITBs. Although we did not specifically advertise or recruit for self-injurious thoughts and behaviors, our general sampling method resulted in a relatively diverse sample of adults who struggle with SITBs. This recruitment strategy resulted in a sample who were generally underrepresented from research on this topic as they were not restricted to individuals who were psychiatrically hospitalized or seeking mental health treatment.

Limitations to the study design should be considered when interpreting the findings. First, our study was limited to self-reported measures of trait reward dimensions and self-injurious thoughts and behaviors. Although our measure of trait reward has been widely used (Dolan et al., 2022; Hallford and Austin, 2022; Hallford et al., 2023), its internal consistency in our sample was lower than expected, suggesting the construct of trait consummatory reward was measured less reliably in our sample than in other studies. Previous research has noted some items may require revisions or removal and suggest the need for changes based on cultural preferences (Hallford and Austin, 2022), which may have been a factor given the diverse nature of our sample. Replication in other diverse community samples using other measures of trait reward is an important next step in assessing the reliability of our findings. Further, future research should examine multi-method approaches when measuring trait reward sensitivity, including self-report, behavioral measures, and neuroimaging approaches. For example, previous research has shown that anticipatory and consummatory reward is associated with well-validated behavioral measures of reward sensitivity (Geaney et al., 2015; Sherdell et al., 2012; Pizzagalli et al., 2008), like the Effort Expenditure for Rewards Task (Geaney et al., 2015; Treadway et al., 2009), which were not included in our study. Another limitation is the relatively low prevalence of certain types of SITBs in our sample, which may bias the parameter estimates of the regression analyses. In particular, the small percentage of individuals who endorsed suicide attempts and nonsuicidal self-injury may lead outliers to disproportionately influence the estimated regression coefficients and cause them to be unstable and unreliable. Replication of the findings in larger samples with higher rates of SITBs, particularly NSSI and suicide attempts, are needed before strong conclusions can be drawn about the relationships we observed in this study. Our study was also cross-sectional, which prohibits inferences about causality. Future research should employ intensive longitudinal methods, such as ecological momentary assessments, to clarify the temporal associations between trait and state anticipatory and consummatory reward, and the onset of SITBs. Finally, we did not measure *state* anhedonia, which may be important for understanding how trait-level dimensions of reward interact with changing mood states over time.

## 5. Conclusion

In summary, the present study examined the unique and interactive effects of dimensions of trait anticipatory and consummatory reward for explaining lifetime SITBs. The tendency to struggle with the anticipation of future rewards (i.e., anticipatory anhedonia) and the

tendency to find events highly pleasurable (e.g., *heightened* consummatory reward) were both positively associated with the frequency of self-injurious thoughts. Furthermore, the results suggest that being low on both anticipatory and consummatory pleasure at a trait level was associated with self-injurious behaviors, specifically nonsuicidal self-injury. These findings advance understanding of SITBs by demonstrating the importance of considering the unique and interactive contributions of different dimensions of trait reward sensitivity for explaining these harmful and distressing experiences, an insight that can inform prevention and interventions efforts.

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**Table 1**

Bivariate Associations Between Study Variables.

	1	2	3	4
<sup>1</sup> Self-Injurious Thoughts Lifetime Total				
<sup>2</sup> Suicide Attempts Lifetime Total	0.53**			
<sup>3</sup> Nonsuicidal Self-Injury Lifetime Total	0.36**	0.30**		
<sup>4</sup> Anticipatory Reward	-0.08	0.03	-0.01	
<sup>5</sup> Consummatory Reward	0.09	-0.02	0.09	0.41**

Note.  $N = 260$ .

\*\*  
 $p < 0.001$ .

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**Table 2**  
 Hierarchical Multivariate Analysis of Trait Reward Dimensions and Self-Injurious Thoughts and Behaviors.

	Between-Subjects Effects							
	Multivariate Test		Self-Injurious Thoughts		Suicide Attempts		Nonsuicidal Self-Injury	
	F Statistic	P-Value	B [+/-95 % CI]	P-Value	B [+/-95 % CI]	P-Value	B [+/-95 % CI]	P-Value
<i>Block 1</i>								
Age	4.03	0.008	0.01 [-0.001/0.023]	0.081	0.01[-.002/0.019]	0.013	-0.01 [-0.017/0.004]	0.196
Gender	1.24	0.296	-0.19 [-0.40/0.015]	0.069	-0.05 [-0.197/0.088]	0.454	-0.10 [-0.278/0.071]	0.244
Parent	2.11	0.099	-0.32 [-0.59/-0.044]	0.023	0.20 [-0.388/0.013]	0.036	-0.08 [-0.314/0.145]	0.468
Ethnoracial Minority	0.62	0.604	-0.01 [-0.229/0.204]	0.911	0.05 [-0.100/0.195]	0.527	-0.09 [-0.266/0.095]	0.354
Educational Attainment	1.96	0.121	0.00 [-0.087/0.080]	0.931	-0.06 [-0.118/-0.003]	0.038	-0.02 [-0.090/0.050]	0.572
Inhibitory Control	3.97	0.009	-0.01 [-0.056/0.032]	0.586	0.04 [-0.071/0.011]	0.008	-0.04 [-0.081/-0.007]	0.020
<i>Block 2</i>								
Anticipatory Reward	2.96	0.033	0.20 [-0.367/0.031]	0.021	0.01 [-0.104/0.129]	0.827	-0.08 [-0.221/0.062]	0.271
Consummatory Reward	2.93	0.034	0.19 [0.022/0.357]	0.027	-0.01 [-0.125/0.108]	0.888	0.11 [-0.027/0.255]	0.113
<i>Block 3</i>								
Anticipatory × Consummatory Reward	2.72	0.045	-0.12 [-0.318/0.086]	0.260	-0.05 [-0.191/0.090]	0.480	0.17 [0.002/0.341]	0.048

Note. N = 260. Gender: Female = 1, Male = 2. Parent: No = 0, Yes = 1. Ethnoracial Minority: 0 = White Non-Hispanic, 1 = Racial or ethnic minority group. B = Unstandardized Beta.