THE FLORIDA STATE UNIVERSITY

COLLEGE OF ARTS AND SCIENCES

# DISTRUPTED INHIBITORY CONTROL OF NEGATIVE EMOTION IN SUICIDE RISK: A NEURAL AND BEHAVIORAL INVESTIGATION

By

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A Thesis submitted to the

Department of Psychology

in partial fulfillment of the requirements of graduation with

Honors in the Major

Degree awarded:

Summer, 2026

The members of the Defense Committee approve the thesis of Morgan Brown defended on April 16, 2026. Signatures are on file with the Honors Program.

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**Abstract**

Suicide remains a critical public health concern, with over 720,000 deaths reported annually worldwide. Despite its prevalence, the cognitive and behavioral mechanisms underlying suicide risk remain poorly understood, particularly in relation to impulsivity. One construct of interest is negative urgency, defined as the tendency to act impulsively in response to intense negative affect. However, limited research has examined how negative urgency may disrupt inhibitory control processes, especially within emotionally salient contexts. The present pilot study investigated how induced mood states modulate behavioral and neural indices of inhibitory control during an Emotional Stop Signal Task (ESST). Participants completed the task under neutral and negative mood induction procedure (MIP) conditions. Behavioral measures included stop-signal reaction time (SSRT), Go reaction time, and emotional classification accuracy. Neural activity was assessed using the P3 event-related potential, a marker of inhibitory control. Contrary to initial hypotheses, behavioral results revealed no significant differences in inhibitory control between MIP conditions, with SSRT values trending toward faster stopping under negative mood. Additionally, neural findings showed a non-significant reduction in P3 amplitude at frontocentral sites during negative image stop trials following the negative MIP, indicating a trend toward diminished neural engagement of inhibitory control processes. Notably, P3 latency did not differ between MIP conditions, suggesting preserved temporal dynamics despite reduced attentional allocation. Together, these findings reveal a dissociation between behavioral and neural indices of inhibitory control, suggesting that negative affect may disrupt underlying control mechanisms even when overt performance appears preserved. These results provide preliminary evidence that neural measures may be more sensitive to affect-related disruptions in

inhibitory control than behavioral indices alone. Future research examining these processes in clinical populations may further elucidate the role of negative urgency in suicide risk.

**Distinction of Work:**

While the broader focus of both the ASPIRE lab (PI: Brown) and this project is to examine the mechanisms underlying suicidal thoughts and behaviors in order to inform novel treatments, the proposed study is an independent study that is distinct from other studies being conducted in the ASPIRE lab in terms of its conceptualization, design, and data collection.

# Introduction

## Self-directed Violence

With an estimated 720,000 people worldwide dying by suicide each year, suicide remains a widespread public health issue that impacts not only those who have lost their lives, but also the families, friends, and communities left behind (WHO, 2026). In the United States, 49,316 Americans died by suicide in 2023 alone, with men dying by suicide 3.8 times more often than women (CDC, 2025). Moreover, the number of individuals who report suicide ideation (i.e., thinking about, considering, or planning for suicide; Crosby et al., 2011), has escalated in recent years with a global lifetime prevalence rate of approximately 9.2% (Nock et al., 2008). Whereas a staggering 12.8 million American adults in 2023 reported experiencing suicidal thoughts, fewer individuals (3.7 million) made a suicide plan (i.e., a systematic formulation of a program of action that has the potential for resulting in self-injury) (Silverman et al., 2007) and even fewer individuals (1.5 million) attempted suicide (i.e., engaged in a non-fatal potentially injurious behavior) (CDC, 2025; Crosby et al., 2011). In terms of identifying risk factors, previous suicide attempts are the strongest predictor of death by suicide (Bostwick et al., 2016; Irigoyen et al., 2019). Together, these findings suggest that specific factors may differentiate suicidal desire from suicidal behavior, highlighting the urgent need to identify variables linked to suicide attempts that may help us better determine who is most at risk for death by suicide.

Current literature in the field focuses on developing ideation-to-action theories that aim to distinguish factors linked to suicide ideation from factors associated with suicidal behavior. The Interpersonal Theory of Suicide (IPTS; Joiner, 2005; Van Orden et al., 2010) is one of the most studied theories and has been used extensively to examine risk for suicide ideation and suicidal behaviors transdiagnostically (Anestis et al., 2016; Bryan et al., 2015; Chu et al., 2017;

Ma et al., 2016; Ribeiro & Joiner, 2009; Stellrecht et al., 2005; Zeppegno et al., 2021). This theory posits that thwarted belongingness (i.e., a lack of reciprocal caring relationships and feelings of loneliness), and perceived burdensomeness (i.e., feelings of self-hate and the belief that others would be better off if one were dead), together with a sense of hopelessness that these states will not change give rise to active suicide ideation. Importantly, this theory states that when suicidal desire is coupled with acquired capability, indicated by fearlessness about death and elevated pain tolerance, the risk of lethal or near-lethal suicidal behavior is elevated (Van Orden et al., 2010).

In addition to the IPTS, other ideation-to action framework theories have emerged, including the three-step theory (Klonsky & May, 2015) and the integrated motivational-volitional model of suicide behavior (IMV; O'Connor, 2011). Each of these theories propose different factors linked to the development of suicide ideation. The three-step theory posits pain, hopelessness, and connectedness, whereas the IMV emphasizes feelings of defeat and entrapment. Within ideation-to-action frameworks, suicide capability is conceptualized as a multi-faceted construct involving fearlessness about death (i.e., suppression of the natural instinct for survival, often acquired through habituation to the fear and pain involved in death via repeated exposure to painful and provocative events), increased physical pain tolerance, and access to and familiarity with lethal means. Some theories also suggest that impairments in executive functioning, particularly under emotional distress, may further reduce an individual's ability to inhibit suicidal behavior and act as a factor enhancing suicide capability (Smith & Cukrowicz, 2010). Despite its central role, suicide capability remains poorly understood, especially in the context of heightened emotional states. Moreover, the literature presents contrasting findings regarding elevated suicide capability under strong affective states as one

study evidenced lower levels of acquired capability for suicide and physical pain tolerance among individuals with high negative urgency and low distress tolerance, a finding contrary to theory predictions (Anestis et al., 2011). Overall, the aim of this study is to determine how impulsivity, particularly negative urgency, may contribute to suicide capability, thereby increasing an individual's risk for suicidal behavior.

**Impulsivity and Negative Urgency**

Prior studies have found that suicidal behaviors are associated with greater levels of impulsivity (Baca-Garcia et al., 2001; Hadzic et al., 2020; Williams et al., 1980), whereas other studies suggest there are no significant associations between impulsivity and suicide risk (Anestis et al., 2014). These contradictory findings could potentially reflect the varied operationalizations researchers use to define impulsivity and an overreliance on self-report measures. Some researchers quantify impulsivity as the tendency to engage in risky behavior (Barratt, 1993), while others define impulsivity as the tendency to focus on smaller, immediate rewards instead of longer-term rewards (Bickel & Marsch, 2001). Despite these differences, there is consensus that impulsivity is a multifaceted construct, encompassing a broad umbrella of subcomponents such as negative urgency, deficits in planning, sensation seeking, and lack of perseverance (Anestis et al., 2014; Whiteside & Lynam, 2001).

Anestis and colleagues (2014) propose that while impulsive individuals may be more likely to engage in suicidal behavior, such acts are not always impulsive in nature. Suicidal behavior may involve episodic planning, with individuals delaying action due to an inability to overcome the fear of death in the moment. Over time, habituation to physical and psychological pain may increase acquired capability, allowing planned behavior to transition into action. From this perspective, trait impulsivity more broadly may not be associated with suicidal behavior;

however, there may be facets of impulsivity that account for more rapid transitions from suicidal thoughts to behaviors. Negative urgency is a specific facet of impulsivity characterized by the tendency to act impulsively in response to strong negative affect, which has been linked to emotion dysregulation and disinhibition (Allen et al., 2021; Whiteside & Lynam, 2001). Thus, negative urgency may play a critical role in the moments leading up to a suicide attempt, as ideation-to-action framework theories suggest this period of time involves intense emotional distress.

Prior studies have demonstrated a clear link between elevated suicide risk and high levels of self-reported negative urgency, as individuals may be more likely to quickly develop suicide ideation and potentially resort to self-injurious behaviors while under intense negative affective states (Anestis & Joiner, 2011; Scheve et al., 2024). In line with ideation-to-action theories, studies have demonstrated self-reported negative urgency amplifies associations between the three components of the IPTS (e.g., thwarted belongingness, perceived burdensomeness, and acquired capability) and suicide attempts (Anestis & Joiner, 2011). These findings suggest negative urgency may serve as another component of suicide capability, that acts as a critical mechanism driving individuals to engage in suicidal behaviors during periods of intense emotional distress. Additionally, there is extensive literature linking negative urgency to psychiatric conditions with elevated suicide rates such as borderline personality disorder, dysregulated eating, substance use disorders, and antisocial personality disorder (Anestis et al., 2009; Anestis et al., 2008; Verdejo-Garcia et al., 2007; Whiteside et al., 2005).

Despite growing literature linking negative urgency to elevated suicide risk, most studies rely on self-report measures and cross-sectional approaches, which may partially explain the inconsistent findings in the literature (Anestis & Joiner, 2011; Maxfield & Pepper, 2017; Picou et

al., 2023). By relying solely on self-report measures to assess negative urgency, the construct may be inaccurately represented. Participants may find it difficult to accurately report on their impulsive tendencies under distress, and self-report tools often fail to capture the state dependent nature of negative urgency, which are driven by affective responses in the moment rather than stable trait characteristics (Cyders & Coskunpinar, 2011; Hedge, et al., 2020). Given the inconsistencies of self-reported negative urgency, this study aims to experimentally test the influence of negative affective states using a behavioral inhibition paradigm.

**Behavioral Indices: Emotional Response Inhibition**

As studies suggest, greater levels of impulsivity often reflect deficient inhibitory processes as an individual is unable to delay impulses without considering the implications of their actions (Bari & Robbins, 2013; Chen et al., 2021; Jauregi, et al., 2018). Response inhibition, defined as the ability to suppress context-inappropriate actions that interfere with goal-directed behavior, is a key construct assessed by an array of cognitive tasks (Mostofsky & Simmonds, 2008). Further, in line with this study's focus on the interaction between emotion and behavior, emotional response inhibition (ERI) represents a particularly relevant extension of this construct as it captures how emotional stimuli modulates inhibitory action. This is especially important within the context of suicide risk, as ideation-to-action framework theories suggest the transition from thought to behavior may rely on one's ability to inhibit maladaptive urges in moments of intense affect (Brudern et al., 2022; Joiner, 2005; Klonsky & May, 2015; O'Connor, 2011).

Response inhibition can be divided into distinct phases: an early stage involving the suppression of impulses before engaging in a motor response, and a later stage, typically referred to as action termination, that reflects the ability to cancel an already-initiated behavioral response

as indexed by a stop-signal task design (Allen et al., 2021). Across healthy and transdiagnostic clinical samples, studies have shown that emotion plays a critical role in either enhancing or impairing cognitive performance depending on the emotional potency of the stimuli in stop-signal paradigms (Hartikainen, et al., 2000; Pessoa et al., 2012; Phelps, et al., 2006). Some studies suggest that, regardless of emotional valence, stimuli with a high degree of arousal can lead to prolonged response times and longer stopping latencies. (Verbruggen & De Houwer, 2007; You et al., 2020). Furthermore, theories suggest that delays in response times may result from the disproportionate allocation of attentional resources to the emotional valence of the stimuli, thereby reducing attention to task-relevant demands (Hartikainen et al., 2000). Overall, there is a clear connection between the recruitment of attentional resources and the ability to effectively inhibit responses to emotionally valanced stimuli, such that intense negative affective states may impair one's ability to inhibit responses.

A few studies have found that action termination (i.e., later-stage ERI) impairment may underpin emotion dysregulation across transdiagnostic samples (Allen et al., 2021; Hoptman et al., 2024; Rogante et al., 2024). These findings suggest that an individual's potential difficulties in managing complex, negative emotions may be linked to increased risk for suicidal behaviors; however, there is limited research in this domain with only one study drawing a clear connection (McPherson et al., 2022). Similarly, one study assessing inhibition difficulties found similar response time and accuracy among adolescents with acute suicide risk compared to healthy controls (Porteous et al., 2021). Another study in a sample of individuals engaging in non-suicidal self-injury (NSSI) found individuals had worse negative emotion action termination compared to healthy controls, such that they were unable to accurately withhold prepotent responses to negative affective images (Allen & Hooley, 2019; Allen et al., 2021). Put together,

these limited and somewhat contrasting findings highlight the need for additional research that behaviorally assesses emotion-specific inhibitory control among suicide-risk populations.

For the purposes of this study, emotional response inhibition will serve as a behavioral proxy for negative urgency. Given the benefits of a controlled laboratory environment, a task-based approach in assessing the behavioral correlates of response inhibition was deemed appropriate for the current study. Therefore, to address the lack of understanding regarding behavioral indices of negative urgency and its role in suicide risk, this study aims to examine whether suicidal individuals evidence deficits in inhibitory control in response to negative information, using the Emotion Stop-Signal Task (ESST) as a validated behavioral task (Allen et al., 2021).

**Neural Markers of Response Inhibition**

The neural mechanisms underlying the association between negative urgency and suicide risk also remain largely unexplored. The neural markers underlying critical processes such as response inhibition offer valuable insight into how the brain regulates cognitive control and decision-making, particularly under affective conditions. Response inhibition is a core component of the broader executive control network, which encompasses a set of flexible, top-down cognitive processes that support goal-directed behavior, including working memory, attentional allocation, and cognitive flexibility (Diamond, 2013). These functions are primarily localized within the prefrontal cortex, which plays a vital role in maintaining and manipulating abstract information such as task goals (Munakata et al., 2012). While the right inferior frontal gyrus (rIFG) has been consistently implicated in enacting inhibitory control, evidence suggests that inhibition reflects a broader interaction among multiple prefrontal regions (Tabibnia et al., 2011). Notably, studies have observed increased bilateral activation in the dorsolateral prefrontal

cortex (DLPFC), ventrolateral prefrontal cortex (VLPFC), and parietal cortex (PC) during successful inhibition, supporting the notion of a distributed inhibitory network.

Event-related potentials (ERPs), time-locked voltage fluctuations in neural activity elicited by specific stimuli or events, offer a temporally precise method for examining the neural dynamics of response inhibition. Of particular interest is the fronto-central P300 (P3) component, which typically emerges 250 to 500 milliseconds after the presentation of task-relevant stimuli. The amplitude of the P3 has been linked to processes such as attention allocation, working memory, and notably, inhibitory control (Hajcak & Foti, 2020). In the context of stop-signal paradigms, numerous studies in healthy individuals have reported larger P3 amplitudes during successful stop trials compared to failed stop trials (Bekker et al., 2005; Dimoska et al., 2006; Greenhouse & Wessel, 2013; Waller, et al., 2021). In other words, these findings indicate a more robust P3 response reflects a stronger ability to inhibit responses. Additionally, the onset latency of the fronto-central P3 closely correlates with stop-signal reaction time (SSRT) in healthy populations and is sensitive to the success of the inhibition attempt itself (Wessel & Aron, 2014). Put differently, if an individual is successful in inhibiting a response, they would display a shorter P3 latency with even shorter latencies on successful trials.

Few studies to date have examined neural activity in response to the emotion stop-signal task in clinical populations. Studies among individuals with depression (Camfield et al., 2018) and high schizotypy (Jia et al., 2023) have found a reduced Stop-signal P3 component in response to both positive and negative stimuli, relative to neutral stimuli, suggesting impaired inhibitory processing across emotional contexts. Together, these findings provide evidence that the P3 is modulated by emotional contexts, and clinical samples show a smaller P3 response indicating impaired engagement of the inhibitory network and poorer behavioral control.

However, studies have yet to examine potential differences in P3 responses as they relate to emotional response inhibition among suicidal individuals. In the context of suicide risk, this pattern may reflect an inability to inhibit acting on suicidal thoughts and a greater risk for engaging in suicidal behavior, particularly in the context of intense negative emotional states linked to suicide ideation. This study aims to examine the neural correlates underlying negative urgency and emotional response inhibition as it relates to suicide risk.

**Simulating Affect-Driven Impulsivity**

Mood induction procedures (MIPs) are widely used in clinical research to experimentally alter participants' affective states in a controlled environment (Ferrer et al., 2015; Hewig et al., 2005; Rottenberg et al., 2007; Westermann et al., 1996). These techniques, often involving emotionally evocative stimuli such as film clips, music, or guided imagery (Gross & Levenson, 1995; Khalfa et al., 2008; Mayer et al., 1995), allow researchers to simulate real-world emotional experiences and investigate their impact on behavior and neural activity.

In the context of suicide research, MIPs offer a valuable opportunity to examine how transient mood states, particularly negative affect can influence mechanisms associated with elevated suicide risk, such as emotion regulation, decision-making, and inhibitory control (Bibb et al., 2025; Colmenero-Navarrete et al., 2022). For example, prior studies have demonstrated that individuals with a history of suicidal thoughts or behaviors often exhibit heightened emotional reactivity and impaired cognitive control under distress, factors not easily captured through self-report or tasks conducted in affectively neutral contexts (Bredemeier & Miller, 2015; Dougherty et al., 2004).

While the Emotion Stop-Signal Task (ESST) incorporates emotionally valanced images to disrupt inhibition, it does not manipulate or sustain broader mood states. In other words, it

captures transient emotional interference in response to momentarily appearing stimuli, rather than longer lasting mood states under which real-world impulsive or suicidal behaviors are likely to occur. Consequently, the ESST alone may not fully reflect the role of negative urgency because it lacks the mood-driven context in which these impulsive actions typically emerge. By combining MIPs with the ESST paradigm, this study introduces a state-based perspective on emotion response inhibition, capturing the influence of sustained negative affect on cognitive control. This combination provides a more ecologically valid and clinically meaningful approach for understanding how negative urgency and mood interact to impair inhibition and potentially elevate suicide capability. In doing so, the study moves beyond isolated stimulus-response associations and toward a broader understanding of suicide-related mechanisms under real affective conditions.

**Study Aims**

Despite extensive research, important gaps remain in our understanding of the role that negative urgency plays in elevated risk for suicidal behaviors. Moreover, no studies to date have examined how affective states may influence behavioral inhibition and its neural correlates among suicidal individuals. Thus, the present study aims to address these gaps by examining responses to an emotion-based behavioral inhibition task following a negative MIP while assessing neural fluctuations. Study aims are as follows:

**Aim 1.** We aim to examine 1a) whether individuals with a history of a suicide attempt and/or suicide ideation evidence deficits in response inhibition relative to healthy controls and 1b) if this deficit is pronounced in the context of negative mood states. To this end, the study utilizes the Emotion Stop-Signal Task (ESST) to examine key behavioral metrics, including stop-signal reaction time (SSRT), negativity bias, and miss rate. Particular emphasis is placed on the

nSSRT, as it reflects the efficiency of response inhibition for negatively valanced stimuli. Assessing these behavioral outputs is critical for understanding how affective states may alter cognitive control processes potentially leading to delayed inhibitory responses and biased classification of stimuli, regardless of their emotional valence. Therefore, we expect individuals in the suicide risk group to exhibit prolonged SSRTs in negatively valanced trials (nSSRT), an increased negativity bias, and higher miss rate, defined as the percentage of go trials in which response is omitted.

**Aim 2.** We aim to examine the neural correlates associated with suicidal behavior and negative emotional response inhibition. Given the extensive literature identifying the P3 event related potential (ERP) as a neural marker of response inhibition in general (Hajcak & Foti, 2020; Wessel & Aron, 2014) and findings that show reduced P3 amplitudes in transdiagnostic clinical populations (Camfield et al., 2018; Jia et al., 2023), this study seeks to investigate how P3 activity is modulated under negative mood states in an elevated suicide risk population compared to healthy controls. Specifically, we hypothesize that compared to healthy controls, individuals in the suicide risk group will exhibit a blunted P3 amplitude during stop trials, particularly trials involving negatively valenced stimuli, as negative images will demonstrate further impairments in inhibitory control. Additionally, we hypothesize that these differences will be pronounced in the context of experimentally induced negative mood states via the MIP. Secondary analyses will explore P3 responses (amplitude and latency) across Go and stop-signal trials for all MIP conditions (positive, negative, and neutral), to further characterize affect-specific modulation of cognitive control.

**Alterations to Study Design & Aims**

Due to the extensive scope of this project, both in terms of the research protocol and the training goals, and given the limited data collection window, my honor's thesis will reflect the initial piloting of this protocol and preliminary data analyses consistent with the original aims. See Appendix for a detailed outline of the extensive clinical and computation training I have completed. The original study aimed to compare inhibitory control performance between individuals at elevated suicide risk and healthy controls. However, this comparison was not feasible within the abbreviated timeline, nor was it possible to test suicide-related constructs given that pilot participants were instructed to generate false narratives and not to report personal experiences. Rather than examining between-group differences in suicide risk status, the revised aims and analyses focus on evaluating the within-person effects of experimentally manipulating mood states on behavioral and neural indices of response inhibition with healthy controls. Although the present pilot aims and analyses does not directly test the influence of negative urgency on suicide risk status, they advance current knowledge by identifying how mood-related disruptions may relate to deficits in executive control. Understanding how negative affect modulates inhibitory control processes provides valuable insight as to the mechanisms potentially underlying impulsive action under distress and connections to current models of suicide risk.

**Pilot Study Aim 1.** In revising Aim 1a, the central behavioral objective became evaluating differences in nSSRT between negative and neutral MIP conditions. Consistent with the framework underlying Aim1b, it was hypothesized that experimentally induced negative mood would impair inhibitory control efficiency. Specifically, emotional interference introduced by the negative MIP was expected to reduce the efficiency of inhibitory control networks, thereby delaying action termination processes and resulting in prolonged nSSRT values. In

addition to primary analyses, secondary analyses on all image types of miss rate, go-trials reaction time, and emotion identification accuracy were calculated.

**Pilot Study Aim 2.** Similar modifications were made to the neural aims. Rather than examining group-level differences in suicide risk, analyses compare neural activity between negative and neutral MIP conditions. Particular emphasis will be placed on the P3 component during negative image stop trials, with the hypothesis that the negative MIP condition will blunt P3 amplitude and delay P3 onset, which is consistent with disrupted inhibitory engagement. Exploratory analyses will examine potential associations between P3 amplitude and P3 latency with nSSRT values. It was hypothesized that larger nSSRT values would be associated with lower P3 amplitudes, as well as longer P3 latency.

## Method

### Participants

#### *Recruitment*

The Florida State University Institutional Review Board approved this research protocol, in accordance with the Declaration of Helsinki. A total of 6 pilot participants were recruited from the ASPIRE Lab personnel. The researcher employed blinding procedures to ensure the identity of pilot participants was preserved.

#### *Inclusion and Exclusion Criteria*

General inclusion in the study required participants to be between ages 18 and 35, able to give informed consent, speak English, and to be right-handed as to maintain standardization across the sample and eliminate lateralization differences (Lajtos et al., 2023; Provins & Cunliffe, 1972). Exclusion criteria included currently taking medications affecting neurophysiological arousal (stimulants, benzodiazepines), neurological disorders, active mania or

primary psychosis, active substance use, a history of brain surgery or traumatic brain injury, and potential imminent risk (e.g., resolved plans and intent; Depressive Symptom Index - Suicidality Subscale [DSI-SS; Joiner et al., 2002] score of ≥ 11 with current intent rating greater than 8). Lastly, day-of eligibility included having eaten and drank water in the past 8 hours before the session, no strenuous activity or caffeine consumption in the past 3 hours, and no nicotine, alcohol, or drug use up to a week prior.

**Behavioral Tasks**

***Emotion Stop Signal Task (ESST) (Allen et al., 2021)***

Participants indicate their response on stop-signal trials by quickly and accurately categorizing valanced images as either positive (i.e., 'pleasant') or negative (i.e., 'unpleasant') by keypress, based on their automatic, reflexive, or 'gut' reaction to the affective content of each image. However, on random trials, an auditory stop signal is presented, instructing participants to inhibit both their emotional response and accompanying motor action. Throughout the task, positive, neutral, and negative images were presented pseudo randomly with only positive or negative images being presented on stop-signal trials (See Figure 1). The task encompasses four blocks of 120 trials each *(N* = 480 total trials), with 75% containing go trials (*n* = 360; 90 per block) and the remaining 25% being stop-signal trials requiring emotional response inhibition (*n* = 120; 30 per block). Images have been procured from the International Affective Picture System

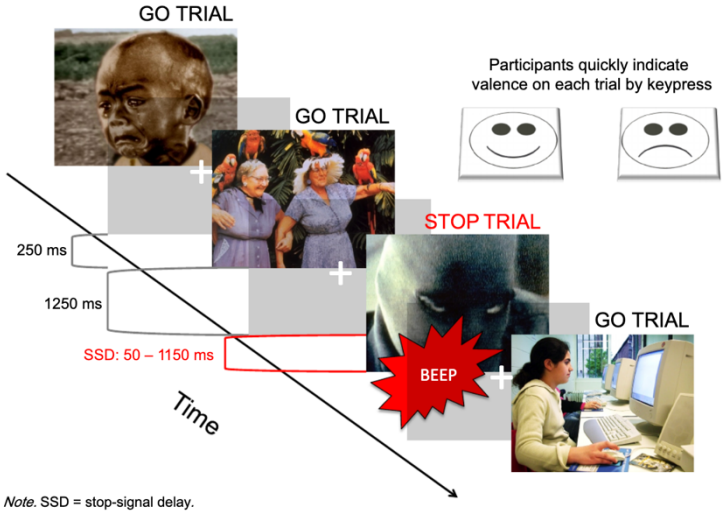


**Figure 1.** *Visual schematic of the Emotion Stop Signal Task adapted from Allen et al., 2018*

(IAPS; Bradley et al., 2017). Multiple behavioral indices can be derived from this task, including response time, accuracy, negativity bias, miss rate, and false alarm errors. The primary analysis will use the negative stop-signal reaction time (nSSRT), calculated using the field-standard integration methods (See Calculations of Key Metrics below). Secondary analyses will include positive and neutral stimuli SSRT; response accuracy, defined as the proportion of go trials without a stop-signal in which negative and positive stimuli are correctly identified; negativity bias, calculated based on the misclassification of stimulus valence; miss rate, defined as the proportion of unanswered go trials; and false alarm errors, calculated as the proportion of stop-signal trials in which participants fail to inhibit their response. The total duration of the task is approximately 15-20 minutes. The task was run on an acquisition PC using Python and PsychoPy.

### *Mood Induction Procedure (MIP)*

Participants watched three video clips over the course of the study with visual analog scales before and after each video presentation (See Visual Analog Scales below).

**Negative MIP.** Participants viewed a 2 minute 51 second clip from the ending scene of *The Champ* (1979). This short clip depicts a young boy mourning his father's death following a brutal wrestling match. In a sample of 52 adults, the clip produced a 94.2% hit rate, defined as the percentage of participants who reported experiencing sadness at least one point more intensely than each of six nontarget emotions. Further, a 5.71 mean rating on a scale of 0 to 8 for sadness was reported (Gross & Levenson, 1995; Gross et al., 1998).

**Neutral MIP.** Participants watched an edited 4-minute clip about magnets from the documentary program *Modern Marvels* (Dora et al., 2023).

**Positive MIP.** Participants viewed an uplifting 4-minute video clip entitled "Hakuna Matata" from the animated 1994 *The Lion King* (Dora et al., 2023).

## Interviews and Self-report Assessments

### *The Columbia-Suicide Severity Rating Scale (C-SSRS)*

The C-SSRS (Posner et al., 2011) is a comprehensive, evidence-based clinical measure designed to assess suicide ideation and suicidal behavior across both the past four months and lifetime. It includes five binary (yes/no) items that capture the type of suicide ideation an individual is experiencing, ordered by increasing severity (i.e., passive ideation, non-specific active ideation, active ideation with methods without intent, active ideation with intent, and active ideation with a specific plan and intent). The C-SSRS also includes five items rated on a 5-point ordinal scale that assess frequency, duration, controllability, deterrents, and reasons for ideation, specifically with respect to the most intense period of ideation during both the past four months and their lifetime. These intensity items are scored from 0 to 25, with higher scores indicating more severe worst point ideation. Four additional items capture past four-month and lifetime history of suicidal behaviors, including preparatory acts, aborted, interrupted, or actual suicide attempts. Given the semi-structured nature of the interview, follow-up questions can be asked to clarify responses. Data from this interview was primarily used for training purposes (See Appendix).

### *Self-Report Measures*

This study included a comprehensive battery of self-report assessments aimed at assessing mood states, impulsivity, common comorbidities, suicide ideation, and suicidal behaviors. All pilot participants were instructed to create a cohesive storyline allowing for potential connections to be drawn between mood, behavioral performance, and self-report data.

**Demographics.** A short demographics assessment created for the purposes of the study was administered to gather basic background information such as age, race, ethnicity, marital status, education status, history of self-reported psychiatric diagnosis, and psychiatric hospitalization.

**Patient Health Questionnaire (PHQ-9).** The PHQ-9 (Kroenke et al., 2001) is a 9-item self-report assessment indexing the severity of depressive symptoms. Participants rate items on a 5-point ordinal response metric ranging from 0 (*Not at all*) to 4 (*Nearly every day*). Total scores range from 0 to 27 with higher scores indicating greater severity of depressive symptoms. The PHQ-9 has evidenced high internal consistency among clinical samples ($\alpha$ = .86 - .89; Kroenke et al., 2001) and convergent reliability (i.e., positively correlated with anxiety [General Anxiety Disorder-7; Spitzer et al., 2006] and depression [Patient Health Questionnaire Anxiety and Depression Scale; Kroenke et al., 2016] among international university students (Rahman et al., 2022). Additionally, there is evidence of a high degree of test-retest reliability with an estimate of 0.82 (Kroenke et al., 2001).

**Diagnostic and Statistical Manual of Mental Disorders 5th Edition (DSM-5) Level 1 Cross- Cutting Symptom Measure (CCSM).** The CCSM (APA, 2013) is a 23-item self-report assessment developed to screen a broad range of psychiatric symptoms relevant to common mental disorders. There are 13 total symptoms domains assessed: depression, anger, mania, anxiety, somatic symptoms, suicide ideation, psychosis, sleep problems, memory, repetitive thoughts and behaviors, dissociation, personality functioning, and substance use. Participants rate items on a 5-point ordinal response metric ranging from 1 (*None/ Not at all*) to 5 (*Severely/ Nearly every day*), with higher scores indexing greater severity of symptoms within each domain. The CCSM domains have shown excellent internal consistency ($\alpha$ = 0.96 for all items)

and strong convergent validity with corresponding symptom measures: depression (PHQ-9; $r$ = 0.73), anxiety (PSWQ; $r$ = 0.60), substance use (AUDIT; $r$ = 0.45), (DAST-10; $r$ = 0.44), and personality functioning (LPFS-SR; $r$ = 0.7). Other CCSM domains were also significantly associated with mental health measures. However, discriminant validity was poor for the anxiety and personality functioning domains (Doss & Lowmaster, 2022). This data will be used to characterize the suicide risk sample.

**Barratt Impulsiveness Scale Version 11 (BIS-11).** The BIS-11 (Patton et al., 1995) is a 30-item self-report assessment assessing various subdomains such as attention, cognitive instability, motor impulsiveness, cognitive complexity, perseverance, and self-control. Participants rate items on a 4-point ordinal response metric ranging from 1 (*Rarely/ Never*) to 4 (*Almost always*). Total scores range from 0 to 55 with higher scores indicating greater impulsivity across the subdomains. The BIS-11 has demonstrated good internal consistency (α = .71- .83), test-retest reliability over a four-week period ($r$ = .83), and convergent validity with behavioral tasks and related self-report measures of sensation seeking and impulsivity in clinical and non-clinical samples (Stanford et al., 2009).

**Difficulties in Emotion Regulation Scale Short Form (DERS-SF).** The DERS-SF (Kaufman et al., 2015) is a 36-item self-report assessment examining difficulties in emotion regulation and includes 6 subscales: nonacceptance of emotional response, difficulties engaging in goal-directed behavior, impulse control difficulties, lack of emotional awareness, limited access to emotion regulation strategies, and lack of emotional clarity. Participants rate items on a 5-point ordinal response metric ranging from 1 (*Almost never)* to 5 (*Almost always*). Total scores range from 36-180, with higher scores indicating greater difficulties with emotion regulation. The DERS total and subscale scores have demonstrated excellent internal consistency (α = .93 -

.95) and strong construct validity, including positive associations with measures of emotional avoidance and negative mood (Fowler et al., 2014). Test-retest reliability over 4–8 weeks is good ($r$ = .88; Gratz & Roemer, 2004). Most relevant to the current study, the impulse control subscale (6 items) assesses how well an individual can control impulsive behaviors when experiencing negative emotions and has shown good internal consistency (α = .88; Hallion et al., 2018).

**Short UPPS-P Impulsive Behavior Scale (SUPPS-P).** The SUPPS-P (Cyders et al., 2014) is a 20-item self-report assessment capturing multiple facets of impulsivity via 5 distinct subscales: Negative urgency, lack of perseverance, lack of premeditation, sensation seeking, and positive urgency. Participants rate items on a 4-point ordinal response metric ranging from 1 (*Agree strongly*) to 4 (*Disagree strongly*). Total scores range from 20 to 80, with higher scores indicating greater impulsivity. The negative urgency subscale (4 items) assesses impulsive decision making under negative affective states. The SUPPS-P has shown good internal consistency (α = .74 – .88 across subscales) and convergent validity with the original full-length UPPS-P, behavioral disinhibition, and self-report measures of risk-taking and emotional dysregulation (Cyders et al., 2014). Test-retest reliability has been demonstrated over periods of up to 3 months ($r$ = .81; Cyders et al., 2014).

**Positive and Negative Mood Affect Scale (PANAS).** The PANAS scale (Watson et al., 1988) is a 20-item self-report assessment of current positive and negative affect. Participants rate items on a 5-point ordinal response metric ranging from 1 *(Very slightly or not at all)* to 5 (*Extremely*). The scale is comprised of two subscales: positive (10 items) and negative (10 items). Subscale scores range from 10 to 50 points with higher scores indicating stronger affect. The PANAS evidenced strong internal consistency for both subscales (α = .86 – .90 for Positive

Affect; α = .84 – .87 for Negative Affect) and good test-retest reliability over 8 weeks (*r* = .68 – .71; Watson et al., 1988). It has been shown to have adequate convergent validity with mood and anxiety measures (BDI-II: Beck et al., 1996; PHQ-9: Kroenke et al., 2001; BAI: Beck et al., 1988) and has been validated across clinical and non-clinical populations (Diaz-Garcia et al., 2020).

**Depressive Symptom Index - Suicidality Subscale (DSI-SS).** The DSI-SS (Joiner et al., 2002) assesses key aspects of suicidal thoughts including their frequency, intensity, controllability, and the presence of suicide-related impulses over the past two weeks. Participants rate items on a 4-point ordinal response metric ranging from 0 *(I am not having thoughts of killing myself)* to 3 (*I am having thoughts about suicide and have formulated a definite plan*) for example. Total scores range from 0 to 12 with higher scores indicating greater severity of suicide ideation. The DSI-SS has evidenced good internal consistency (α = .89 - .91) and has shown convergent validity (*r* = .52 - .74) with other suicide-related measures (Beck Scale for Suicide Ideation [Beck et al., 1996]) (Stanley et al, 2021). It is also sensitive to clinical populations and predictive of suicide attempts in high-risk samples (Stanley et al, 2021).

**Acquired Capability with Rehearsal for Suicide Scale (ACWRSS).** The ACWRSS (George et al., 2016) is a 7-item self -report assessment of aspects of acquired capability including pain tolerance, fearlessness about death, and preparations for suicide. Participants rate items on a 9-point ordinal response metric ranging from 0 *(Not at all)* to 8 (*Very strongly*) with higher scores indicating greater suicide capability. The ACWRSS has evidenced excellent internal reliability (α = .91; George et al., 2016) and strong convergent validity as scores were positively correlated with suicide risk factors (e.g., thwarted belongingness, perceived

burdensomeness, suicide ideation, intent, readiness, and attempts) and negatively correlated with meaning in life.

**Visual Analog Scale (VAS).** The VAS (Hayes & Patterson, 1921) is a 1-item self-report assessment indexing current mood rating and will be administered as part of the ESST task. Participants utilize a sliding scale response metric to represent their current mood ranging from 0 (*Extremely negative*) to 100 (*Extremely positive*). Furthermore, given presentation of the VAS is unique to the ESST, a revised version of the Visual Analog Mood Scales (VAMS-R; Kontou et al., 2021) has evidenced high internal consistency in healthy and clinical populations (α = .74, α = .80, respectively). For MIP videos, participants completed a 3-item VAS scale assessing sadness, happiness, and neutrality using a 0 (*None*) to 100 (*Completely*) slider scale.

**Procedures (Figure 2)**

Prior to the session, participants would complete a brief phone screening to determine eligibility and provide an overview of the study. If the participant is deemed eligible and is interested in participating, they were be scheduled for the in-person study visit. For the purposes of piloting, the phone screening was administered at the beginning of the

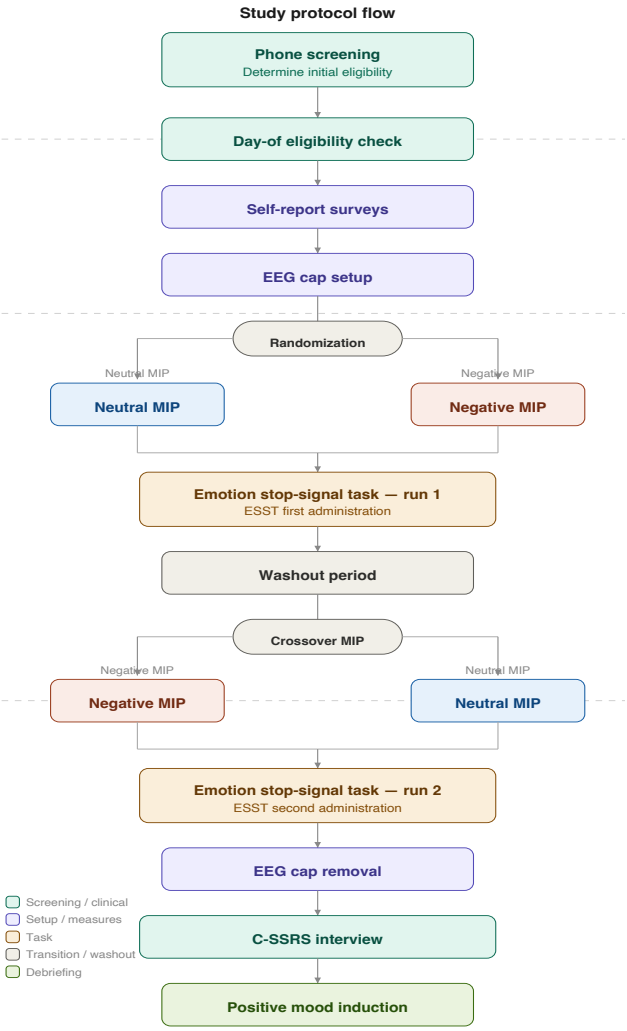


**Figure 2.** *The study protocol flow detailing each step participants were walked through.*

scheduled session date. Participants were provided information on how to prepare for their in-person visit, including expectations regarding eating, drinking, and medications in the hours and days before their scheduled visit.

At the beginning of the visit, all study procedures were explained by the research staff informed consent was obtained. Next, participants completed a physical data form to assess day-of eligibility. Participants who were unable to adhere to day-of eligibility were rescheduled. If deemed eligible for the assessment session, participants completed the brief self-report battery in RedCap while they are being fitted with the high-density EEG cap. Continuous EEG was recorded utilizing the EGI geodesic 64-channel saline-based system using standard 10/20 formatting (Magstim EGI, Minneapolis, United States). Next, participants complete either the neutral MIP or the negative MIP, which will be counterbalanced across participants within each group to control for ordering effects. Participants provide subjective mood ratings (VAS) pre- and post- each MIP. Afterwards, the ESST task was explained thoroughly, and the participant had the opportunity to practice under supervision of the researcher. Participants then completed the ESST following both the negative MIP and the neutral MIP, with continuous EEG data recorded during each task session.

Once the mood and ESST tasks were complete, the EEG cap was removed, and the participant was guided to an interview room to complete the C-SSRS interview with a trained researcher. In the case of pilot participants, participants were reminded to create fictitious stories. Lastly, participants completed the positive MIP. Prior to leaving, all participants are provided a study resource packet that includes a list of local and national crisis services.

**Data Analysis Plan**

Data analysis was performed using custom behavioral & statistical scripts in MATLAB (2025a) and EEG/ ERP pre and post processing was completing in MATLAB (2025a) (Mathworks Inc.) Additionally, EEG preprocessing utilized a custom script establishing a sophisticated pipeline designed to process event-related EEG recordings through a series of filtering, artifact rejection, and re-referencing steps. Specifically, event labels were matched with behavioral files when creating trial-specific epochs. After epochs were visually inspected and rejected for electrical or muscle noise, independent component analysis (ICA) was run. This process is critical in separating mixed signals recorded by scalp electrodes into statistically independent components (ICs), effectively isolating neural activity from artifacts. Then, non-brain ICs/ ICs with artifact were rejected. Once the data was pre-processed in a standardized manner, the MATLAB integrated toolbox ERPLAB was used to process, visualize, and analyze ERP data from the cleaned EEG recording (Lopez-Calderon & Luck, 2014). ERPs were time-locked from -100 ms to 500 ms relative to image onset as image-locked epoching reliably captures neural processes associated with image valence and the subsequent decision to engage inhibitory control networks. Additionally, ERP analyses were localized to the frontocentral cluster (Fz [E6]/ Cz [E31]). One participant was excluded from neural analyses due to data saving errors.

**Calculation of Key Behavioral Metrics**

The stop-signal reaction time (SSRT) served as the primary behavioral index of inhibitory control, reflecting the estimated time required to terminate an initiated response. Because reaction time cannot be directly measured on trials in which a stop-signal is presented, SSRT must be estimated using computational models. Importantly, the stop-signal paradigm is based on the independent horse race model, which conceptualizes the Go process and Stop

process as two independent processes racing toward completion. During stop-signal trials, successful inhibition occurs when the Stop process finishes before the Go process. Conversely, if the Go process finishes first, the participant fails to inhibit their response.

To maintain an appropriate level of task difficulty, the stop-signal delay (SSD), referred to as the time interval between stimulus onset and the stop-signal, is dynamically adjusted throughout the task using a staircase procedure. Following successful inhibition, the SSD increases in small increments (50 ms), making subsequent stop trials more difficult. Conversely, following failed inhibition, the SSD decreases, making stopping easier. This adaptive procedure aims to maintain stopping probability approximately 50%, ensuring that the task remains neither too easy nor too difficult.

While different models can compute the SSRT, the SSRT in this study was estimated using the integration method described by Logan and Cowan (1984). In this approach, Go reaction times are rank ordered to form a cumulative distribution. Next, the probability of responding on stop trials (*p(respond|signal)*) is calculated, representing how often participants failed to inhibit their response when a stop-signal appeared. This probability is then used to identify a corresponding point in the ordered Go reaction time distribution. Specifically, the probability is multiplied by the total number of Go trials to determine which reaction time in the distribution represents the estimated finishing time of the Go process when stopping fails. Finally, the mean stop-signal delay (SSD) is then subtracted from this value to produce the SSRT estimate. Larger SSRT values indicate slower inhibitory processing and reduced efficiency of response inhibition.

In addition to valuable metrics such as the SSRT, several relevant behavioral metrics can be derived. For example, emotional response accuracy was calculated as the proportion of all Go

and stop trials where participants correctly categorized the emotional valance of the stimuli. This metric targets emotional processing and classification ability, with greater emotional response accuracy indicative of appropriate prefrontal regulation of emotional stimuli. Additionally, negativity bias, defined as the proportion of all trials classified as "negative" regardless of true stimulus valance, reflects the tendency to categorize stimuli as negative. Miss rate calculations rely on the proportion of Go trials in which a participants failed to make a response, indicating an omission error. Go reaction time (Go RT) was calculated as the mean response time across all Go trials and false alarm probabilities were computed based on the probability of a commission error on stop trials containing either negative or positive images.

### Pilot Study Aims Data Analysis Plan

Primary analyses examined within-subject differences in behavioral and neural indices of inhibitory control as a function of mood condition (negative vs. neutral).

**Aim 1**. To evaluate behavioral outcomes, paired-samples t-tests were conducted to compare mean negative stop-signal reaction time (nSSRT) between negative and neutral mood conditions. Secondary exploratory analyses using paired-sample t-tests examined mood-related differences in miss rate, negativity bias, and Go reaction time.

**Aim 2.** For neural analyses, mean ERP amplitude and latency were computed separately for each mood condition and trial type. Given the pilot sample size and within-subject design, paired-samples t-tests were conducted to compare mean P3 amplitude and latency between negative and neutral mood conditions. Correlation analyses were conducted to test exploratory hypotheses related associations between nSSRT values, P3 amplitudes, and P3 latency. Analyses were run for both Fz and Cz electrodes.

## Results

**Preliminary Analyses**

A total of 6 participants completed the ESST. Across participants, mean Go reaction time ranged between 678 – 901 ms, consistent with expected response latencies for stop-signal paradigms involving emotional categorization (Coccaro, et al., 2024). Miss rates ranged from 5-17%, indicating participants understood task instructions and were generally attentive. Furthermore, the false alarm rates during stop trials ranged from 36-41%, meaning the task accurately employed a staircase design to maintain the probability of false alarms around 50%. Additionally, participants demonstrated high levels of stimuli identification accuracy across both MIP conditions with mean emotion identification accuracy at 91.25% (*SD* = 7.80) during the negative MIP condition and 90.98% (*SD* = 5.82) during the neutral MIP condition. Furthermore, a paired-samples t-test revealed no significant difference in emotion identification accuracy between the negative and neutral MIP conditions ($t$ [5] = 0.09, p = 0.929, $d$ = 0.04), suggesting participants ability to reliably identify stimuli valence regardless of mood context.

**Mood Alterations Throughout the Study**

To assess the effectiveness of the MIPs, participants completed a bi-polar Visual Analog Scale (VAS) rating of current mood prior to each ESST run from 0 (*Extremely negative*) to 100 (*Extremely positive*). A paired-samples t-test comparing pre- ESST task VAS ratings between the negative and neutral MIP conditions indicated no significant difference, $t$ [5] = -0.17, $p$ = .874, $d$ = -0.07. Descriptively, mean VAS ratings were slightly lower in the negative condition ($M$ = 43.67, $SD$ = 8.02) relative to the neutral condition ($M$ = 44.67, $SD$ = 8.43), though this difference was non-significant and small in magnitude. These findings may suggest that, within this limited pilot sample, the negative MIP did not produce a long-lasting shift in overall mood prior to ESST task onset. It is also possible that these findings may reflect a methodological limitation of the

bipolar VAS format, as it has been shown to produce limited discriminative power as a single-item measure of mood state (Killgore, 1999; Stern et al., 1997). Specifically, the bipolar structure may have made it difficult for participants to meaningfully differentiate between the absence of negative affect and the presence of positive affect, potentially obscuring mood differences between conditions. Additionally, post- ESST task VAS ratings were largely missing due to a data recording issue and were therefore not interpreted.

In terms of specific mood alterations from the MIPs, participants completed VAS ratings of sad, happy, and neutral from 0 (*None*) to 100 (*Completely*) anchored at 50 before and after each video clip (negative, neutral, positive). Ideally, mood ratings would be analyzed using a series of 2 (Time: pre, post) × 3 (MIP Condition: negative, neutral, positive) repeated-measures ANOVAs conducted separately for each emotion category (sad, happy, neutral). However, given the limited sample size in this pilot study, such analyses would be underpowered; therefore, results are presented descriptively to characterize patterns across conditions. Overall, changes in mood ratings generally aligned with the intended emotional valance of each MIP condition (see Figure 3). As expected, the negative MIP demonstrated a substantial increase in sadness ratings across participants ($n$ = 2 due to data saving issue), yielding an average increase of $M$ = 39.50 points

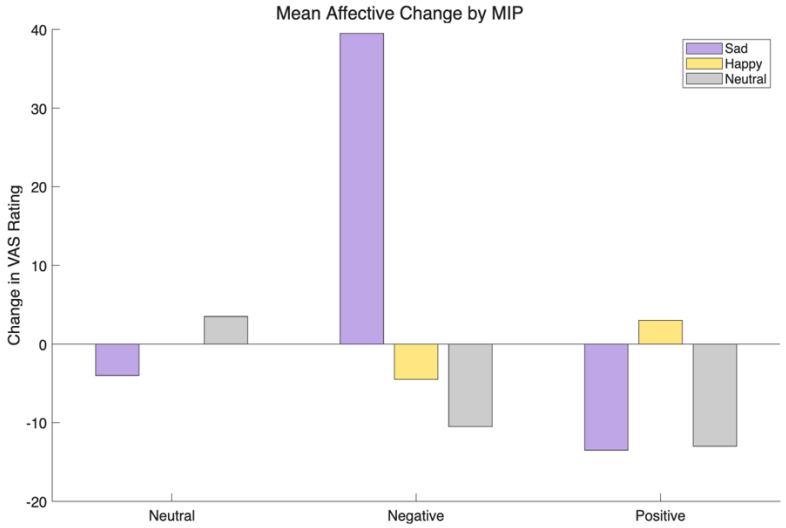


**Figure 3.** *Mean affect change from pre- and post-manipulation visual analog scale (VAS) ratings for sadness, happiness, and neutral affect across neutral, negative, and positive mood induction procedure (MIP) conditions. The negative MIP condition showed a more negative affective profile at pre-ESST task relative to the neutral MIP, supporting the effectiveness of the manipulation. Changes from pre- to post-MIP are shown descriptively.*

(*SD* = 45.96). Further, happiness (*M* change = -4.50, *SD* = 0.71) and neutral (*M* change= -10.50, *SD* = 12.02) ratings decreased slightly after the negative MIP. Changes following the neutral MIP (Sadness: *M* = -4.00, *SD* = -5.66; Happiness: *M* = 0, *SD* = 11.31; Neutral: *M* = 3.50, *SD* =. 27.58) and positive MIP (Sadness: *M* = -13.50, *SD* = 6.36; Happiness: *M* = 3.00, *SD* = 4.24; Neutral: *M* = -13.00, *SD* = 11.31) were less robust but consistent with expected changes in mood. Overall, these patterns represent the MIPs effectiveness in shifting affective states, particularly the negative MIP produced the largest increases in sadness.

**Response Inhibition Performance (Aim 1)**

Response inhibition performance was assessed using the stop-signal reaction time (SSRT) and mean Go reaction time (Go RT). Negative SSRT (nSSRT) values were slightly faster following the negative MIP (*M* = 103.57 ms, *SD* = 17.83) compared to the neutral MIP (*M* = 111.30 ms, *SD* = 77.64), though this difference was not statistically significant (*t* [5] = −0.49, *p* = .645, *d* = -0.20). Similarly, positive SSRT values were comparable between the negative MIP (*M* = 122.53 ms, *SD* = 101.17) and neutral MIP (*M* = 151.25 ms, *SD* = 66.68) conditions, with no significant difference observed (*t* [5] = -1.59, *p* = .172, *d* = -0.65). Mean Go reaction times were somewhat slower during the negative MIP condition (*M* = 831.96 ms, *SD* = 62.50) relative to the neutral MIP

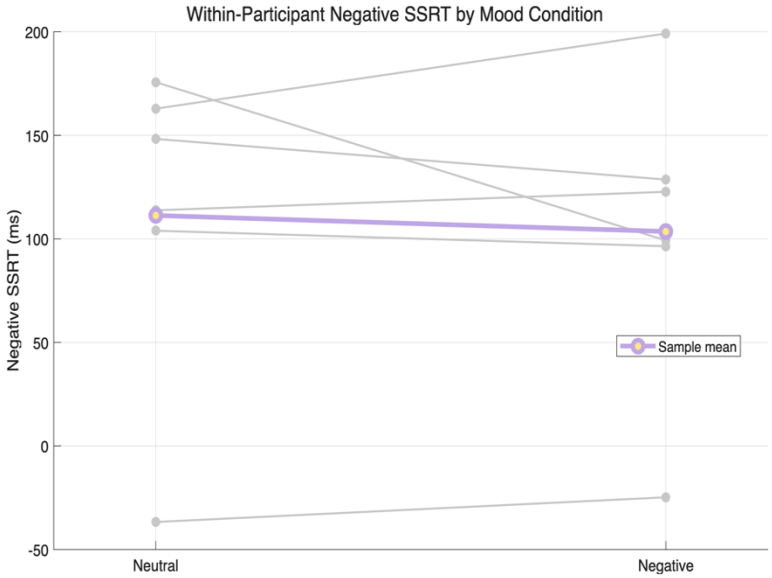


**Figure 4.** *Within-participant negative stop-signal reaction time (SSRT) across neutral and negative mood induction procedure (MIP) conditions. Each grey line represents an individual participant, with the thicker purple line indicating the sample mean. Although negative SSRT was descriptively faster in the negative MIP condition, this difference was not statistically significant.*

condition (*M* = 801.48 ms, *SD* = 117.98); however, this difference was also not statistically significant (*t*[5] = 0.72, *p* = .504, *d* = 0.29). Across conditions, effect sizes were small to moderate. Taken together, these findings suggest that the negative MIP did not significantly alter response inhibition or response speed in this pilot sample.

**Neurophysiological Signals Associated with Inhibition (Aim 2)**

Neural indices of inhibitory control were assessed via the P3 component during correct stop trials, defined within a 250–400 ms time window at the central electrode (Cz; E31) and the frontal electrode (Fz; E6). A paired-samples t-test revealed no significant reduction in P3 amplitude at Cz for negative images in the ESST following the negative MIP relative to the neutral MIP, *t* (4) = -0.094, *p* = .930, *d* = 0.52. Descriptively, P3 amplitudes were non-significantly lower following the negative MIP (*M* = 4.89 µV) compared to the neutral MIP (*M* = 5.84 µV), indicating slight diminished neural engagement of inhibitory control processes under negative affect conditions. Further analyses focusing on the frontal electrode (Fz; E6) also revealed no significant reduction in P3 amplitude, *t*(4) = 0.580, *p* = .593, *d* = 0.26. Additionally, no significant differences were observed for positive-image trials at Cz, *t* (4) = 0.55, *p* = .611, *d* = 0.25, or at Fz, *t*(4) = .59 , *p* = .586 , *d* = 0.26. Given the moderate effect size, these findings,

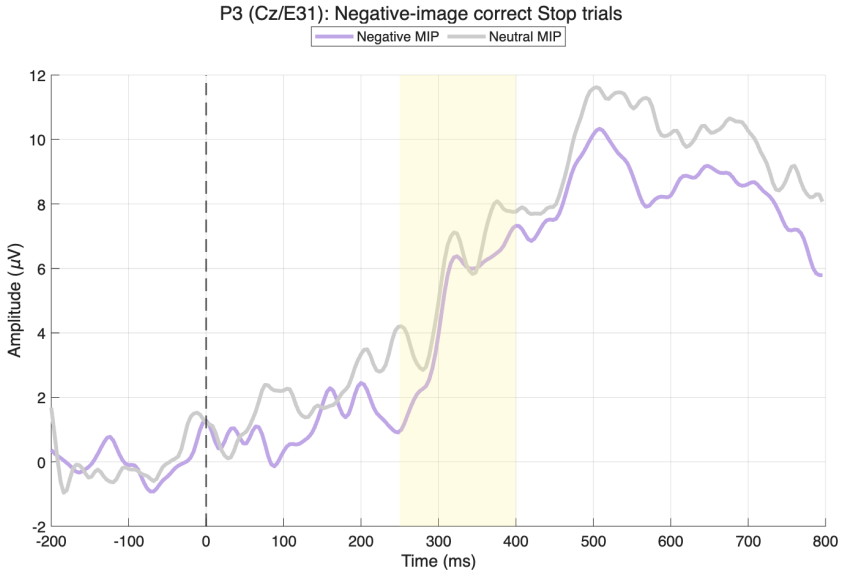


***Figure 5.*** *Grand-average event-related potentials (ERPs) at the central electrode (Cz; E31) for correct Stop trials to negative stimuli across MIPs. Waveforms are time-locked to stimulus onset (0 ms). The shaded region (250–400 ms) represents the time window used to quantify the P3 component. Descriptively, P3 amplitude was reduced in the negative MIP relative to the neutral MIP, indicating diminished neural engagement of*

while non-significant, align with hypotheses as they suggest negative affect selectively disrupts neural indices of inhibitory control, particularly in response to negatively valanced stimuli.

On the other hand, P3 latency for negative images in the ESST did not differ significantly between negative and neutral MIP conditions at Cz, $t$ (4) = -0.09, $p$ = .930, $d$ = -0.04 or Fz , $t$ (4) = 0.572, $p$ = .598, $d$ = 0.26, suggesting that the timing of inhibitory processing remained relatively stable across mood states. Similarly, no significant differences were observed for positive-image trials P3 latency at Cz ($t$ [4] = .55 , $p$ = .611 , $d$ = 0.25) or at Fz, ($t$ [4] = -1.05 , $p$ = .355 , $d$ = -0.47). Together, these findings suggest that negative affect selectively reduces the magnitude of neural inhibitory control responses without altering their temporal dynamics. Stated differently, negative affective states did not appear to slow down when the brain triggered the inhibitory control response, rather it appeared to reduce how strongly that control process was recruited.

To further examine the relation between neural and behavioral indices of inhibitory control, an exploratory analysis was conducted assessing the association between the Cz P3 amplitude and negative SSRT (nSSRT). Inspection of the data suggested no association, such that greater P3 amplitudes were not associated with faster (i.e., lower) nSSRT values ($r$ = 0.016, $p$ = .978). This pattern suggests that

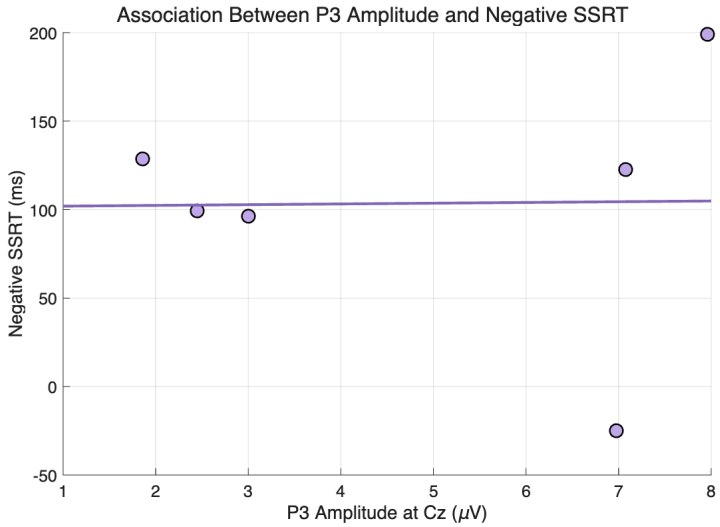


**Figure 6.** *Association between P3 amplitude at Cz (E31) and negative stop-signal reaction time (nSSRT). Each point represents an individual participant. Greater P3 amplitude was not associated with faster (lower) nSSRT, suggesting no association between behavioral and neural indices of inhibitory control.*

variability in P3 amplitude does not predict variability in response inhibition as indexed by the nSSRT. Furthermore, analyses examining the association between P3 latency and nSSRT yielded a moderate but non-significant negative association ($r$ = -0.58, $p$ = .224). Contrary to initial hypotheses, this pattern suggests individuals with slower neural processing (later P3) may show more efficient action termination (stopping). Furthermore, a similar non-significant pattern was reflected when using Fz (Amplitude & nSSRT: $r$ = 0.340, $p$ = .509; Latency & nSSRT: $r$ = -0.536, $p$ = .273).

## Discussion

Suicide remains a critical public health concern, with other 720,000 deaths reported annually worldwide with rising rates of suicide ideation and behavior across populations. Despite extensive theoretical development, the precise behavioral and neural mechanisms underlying the transition from suicidal thoughts to behavior remain unknown. One construct of interest is negative urgency, defined as an increased propensity to engage in an impulsive action because of intense negative affect. Much of the existing literature relies on self-report measures, which may fail to accurately capture the momentary behavioral and neural correlates underlying negative urgency. The broader aims of this study were to investigate the role negative mood states in modulating the efficiency of inhibitory control networks. As proof of concept, the present pilot study examined how induced mood states modulate behavioral and neural markers of inhibitory control during an Emotional Stop Signal Task (ESST). Specifically, we investigated whether negative emotional contexts would impair participants' ability to appropriately inhibit responses following a stop signal.

Contrary to initial hypotheses, the negative MIP did not significantly impair behavioral inhibitory control. Preliminary behavioral analyses revealed no significant differences in

inhibitory control between neutral and negative MIP conditions, as indexed by negative stop-signal reaction time (nSSRT). Notably, mean nSSRT values were lower in the negative MIP condition relative to the neutral MIP condition, suggesting faster stopping and potentially enhanced inhibitory efficiency. Although this difference was not statistically significant, the observed small effect size suggests that mood-related changes in inhibitory control may become more meaningful with increased statistical power capable of showing significance. Prior work has demonstrated that heightened negative affect can interfere with cognitive control processes (Feutren et al., 2026), aligning with the predicted direction of effects; however, the present findings highlight variability in this association within a small pilot sample. This pattern may reflect increased vigilance or arousal under negative affect, which may reflect intact emotion regulation abilities and indicate participants experienced more of a protective effect from the negative MIP compared to hypothesized impaired cognitive control. Although the present pilot sample demonstrated a non-significant trend toward faster inhibitory control following negative MIP, elevated-risk groups would be expected to exhibit the opposite pattern (i.e., impaired inhibition), thereby producing a measurable difference between groups. In secondary behavioral analyses, participants demonstrated high emotional classification accuracy and stable Go reaction times across conditions, further supporting the interpretation that the MIPs did not broadly disrupt task engagement or basic perceptual processing. Stop-signal failure rates were also consistent with expectations for an adaptive staircase paradigm, supporting the validity of the SSRT estimates. Furthermore, although small effect size estimates indicated a potential trend toward altered inhibitory control in negative emotional contexts, overall task performance remained consistent with expectations for a stop-signal paradigm and demonstrated participant engagement in the task.

Similarly to behavioral findings, neural indices did not provide significant evidence of mood-related modulation of inhibitory control. Although no significant differences were observed, descriptive patterns indicated reduced P3 amplitude in the negative MIP condition, which may reflect diminished neural resource allocation for inhibitory processing, while unchanged P3 latency suggests the timing of action termination initiation is not disrupted. This pattern suggests that negative mood may impair specific mechanisms underlying the inhibitory control response, but not the timing associated with withholding a response. Furthermore, this pattern is consistent with resource competition theories (e.g., Hartikainen et al., 2000) where negative affect occupies prefrontal attentional capacity that would otherwise support robust inhibitory engagement. Importantly, this neural reduction was of moderate effect size and occurred in the absence of behavioral impairment, suggesting that healthy individuals may maintain sufficient capacity to sustain performance despite limited neural recruitment, of which may be a mechanism that is absent or diminished in populations with elevated suicide risk.

Given the pilot nature of this study, several limitations should be noted. Most notably, the small sample size ($N = 6$) substantially limited statistical power and the ability to detect subtle effects. Despite this limitation, the observed effect sizes and directional patterns provide strong preliminary evidence for the impact of negative mood on inhibitory control, though replication with a larger sample size will be necessary to more precisely estimate the effects of emotional context on inhibitory control mechanisms. Additionally, although visual analog scales (VAS) were used to assess mood changes, self-report measures of clinical history and negative urgency (e.g., UPPS-P) were not incorporated into the final analysis, limiting the ability to link trait-based differences related to inhibitory control with behavioral and neural outcomes. Finally, the use of a healthy sample restricts generalizability to clinical populations, who may exhibit greater

dysregulation of inhibitory control processes. Despite these limitations, this pilot study provides strong preliminary support for our experimental paradigm and methodological approach, such that were able to obtain valid behavioral and neural data.

Consistent with the broader study aims, future research should examine these processes in populations at elevated risk for suicide or individuals with heightened emotion-driven impulsivity. Such populations may exhibit stronger mood-related disruptions in inhibitory control, providing further insight into the mechanisms linking negative affect and maladaptive behavior. Future studies should directly replicate the proposed methods to assess an association between elevated suicide risk and dysregulated inhibitory control networks. Additionally, future studies could consider incorporating more personally relevant emotional stimuli such as themes of personal distressing events [i.e. loss, accidents, etc.] to further enhance ecological validity and strengthen mood induction effects.

In summary, this pilot study provides preliminary support for an association between mood states and inhibitory control. Although behavioral and neural findings were not statistically significant, moderate effect sizes for primary metrics point toward negative mood impairing inhibitory control. Together, these findings suggest that multi-method approaches using both behavioral and neural indices are necessary to understand inhibitory control mechanisms. Further investigation of these mechanisms may improve our understanding of how emotional dysregulation contributes to maladaptive decision-making in elevated risk groups and inform prevention strategies targeting affective states preceding harmful actions.

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# Appendix

This appendix details the research training and technical skills developed throughout the development of this project. Emphasis is placed on the methodologies, software tools, and analytical techniques used to support behavioral and electrophysiological data collection and analysis.

## A. Clinical Training

Clinical training was conducted under the supervision of Dr. Sarah Brown and focused on the administration and scoring of suicide risk assessments. This training included completion of the Columbia–Suicide Severity Rating Scale (C-SSRS) Rater Training and Certification for Research modules, as well as an extensive review and independent scoring of recorded assessment sessions from Dr. Brown's prior studies. During structured meetings with lab coordinators, these clinical cases were discussed, and independent scores were evaluated to ensure reliability and adherence to standardized clinical protocols. From there, the author administered C-SSRS interviews with pilot participants and lab graduate students for further training experiences. Additionally, the author attended Suicide Risk Assessment (SRA) workshops and was trained in administering SRAs with another trained clinician present.

## B. Experimental Design and Task Modification

Given the experimental paradigm was provided from a researcher in the Department of Psychology, modifications in PsychoPy were made to integrate our electrophysiology (EEG) system. The author implemented and verified digital trigger signaling (e.g., stimulus onset, stop-signal onset, behavioral responses) for synchronization of behavioral and electrophysiological data.

## C. EEG Preprocessing and ERP Analysis

The author crafted custom EEG preprocessing scripts using MATLAB 2026a and EEGLAB 2026.0.0. This script was reformatted to fit the current study design from a preprocessing script provided by Dr. Justin Riddle. In this script, the author independently linked behavioral files to each EEG file, ran Independent Components Analysis (ICA), completed manual independent components & epoch rejection, and aligned behavioral markers to each trial epoch. Then, the author used ERPLAB 12.20 to extract and visualize the P3 amplitude/ latency values at Fz/ Cz.

### D. Behavioral Data Processing and Analysis

The author independently created custom behavioral analysis scripts in MATLAB 2026a. This included cleaning raw trial-level data, organizing datasets by participant and mood induction condition, and computing key performance metrics such as stop-signal reaction time (SSRT), Go reaction time, accuracy, and miss rate. The author also developed sections of code to compute participant-level summaries and conduct statistical analyses comparing inhibitory control across MIP conditions.

### E. Survey Creation in REDCap

While self-report data was not analyzed, the author designed and implemented the study surveys & management documents using REDCap. This process involved constructing survey instruments to collect demographic and psychological data, incorporating branching logic, and ensuring standardized formatting across participants.

### F. Institutional Review Board Approval

The author and thesis director, Dr. Sarah Brown, worked together on the submission of in-depth study materials for review by the Florida State University Institutional Review Board. This included the development of study protocols, consent forms, recruitment materials, self-

report surveys, and data management procedures. All study procedures were conducted in accordance with IRB approval and ethical guidelines for research involving human participants.