The Relationship Between Rejection Sensitivity and Higher Order Cognitive Functions

by

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A thesis submitted in partial fulfillment
of the requirements for the degree of
Master of Arts
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Date of Approval:
April 30, 2024

Keywords: Electroencephalography, Event-Related Potential, N200, Flanker, Inhibition

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Abstract

Rejection sensitivity indexes individual differences in the expectation of, reaction to, and interpretation of possible rejection. Research on mechanisms underlying these individual differences have identified a reduction in top-down emotion regulatory processes in those exhibiting heightened rejection sensitivity. Most of these studies utilize rejection-specific affective stimuli. This study examined the relationship between rejection sensitivity score, calculated from the 18-question RSQ, and the recruitment of higher level inhibition resources, as indexed by the conflict N2, on three novel Flanker tasks. In order to further examine previously identified patterns in affective inhibition across differing levels of rejection sensitivity, and to determine whether these patterns hold when affective stimuli do not contain social components, the present study utilized three novel flankers, two of which used affective stimuli: a social-affective flanker utilizing smiling and contemptuous faces, an asocial affective flanker utilizing human-free affective images, and a neutral flanker utilizing normed fractal images. Individuals who were highly rejection sensitive displayed reduced N2 amplitude when Flankers were negatively valanced, an effect which was strongest when these flankers were faces. They also showed reduced accuracy on incongruent trials regardless of flanker block. Individuals who are high in Rejection Sensitivity display reduced ability to recruit higher level inhibition only in affective context, however global inhibition differences are present in behavioral data, suggesting an additional aspect of inhibition outside of recruitment is associated with Rejection Sensitivity differences.

Chapter 1: Introduction

Humans are social creatures, heavily driven by a need to belong. While some may feel confident in their social belonging, others experience increased fear and doubt about the acceptance of those around them. Rejection Sensitivity (RS) is a cognitive-affective bias describing individual tendency to expect, perceive, and react towards social experiences that may be rejecting (Downey & Feldman, 1996). When someone is more rejection sensitive they experience more extreme negative reactions to social threat (Lesnick & Mendle, 2021; Levy et al., 2001; Zimmer-Gembeck et al., 2021), leading to difficulty maintaining close relationships and a greater likelihood to develop several psychological conditions (Levy et al., 2001; Rosenbach, 2013; Zimmer-Gembeck et al., 2021). The degree of rejection sensitivity someone develops is believed to develop as a learned response to early life experiences of rejection, but more recent data has found that the actual ostracization of children did not predict their rejection sensitivity (Zimmer-Gembeck et al., 2013). In fact, rejection sensitivity itself mediates the impact of negative life events on the development of psychological disorders (Goodman et al., 2014; White & Kistner, 2011). Some additional factors may be associated with increased perception of and distress towards rejection.

Research on mechanisms underlying rejection sensitivity have identified a reduction in top-down emotional regulatory processes (Kawamoto et al., 2015; Kross et al., 2007), and an association with poor emotional regulation strategies (Gardner et al., 2020; Velotti et al., 2015) in individuals high in rejection sensitivity. However, research on any direct connection between rejection sensitivity and inhibition outside of rejection context has been sparse. Our current understanding of how individuals come to develop high RS may indicate a missing factor which may predate the development of high RS. While the current study cannot conclude whether an underlying deficit in inhibition could serve as this vulnerability, it attempts to open the door for further research on the matter. There may be implications for possible protective measures which could help individuals to reduce the negative impacts of high rejection sensitivity, which may have downstream effects on risks for the development of disorders such as depression. If prevention is not possible, it may help to design more effective interventions. Increased rejection sensitivity is much more apparent at first glance than impairments in inhibition. If further research confirms that these processes are highly related, rejection sensitivity may prove to be a valuable warning sign of the heavy risk factor that impaired self-regulation can pose to both health and mortality (Amirian et al., 2010; Trossman et al., 2020).

The following research aimed to examine the interaction between rejection sensitivity and underlying inhibitory function, as well as whether this relationship differs depending on either affective or social context. If those with higher levels of rejection sensitivity exhibit broad deficits in the recruitment of inhibition, it will further current literature on the nature of processing bias towards social stimuli. While scattered literature connects rejection sensitivity to higher order regulation, very little directly examines the relationship between the two. Results may also further research on self-regulation by providing additional avenues by which self-regulation predicts life outcomes.

Self-Regulation and Executive Function

Self-regulation may be defined as control of oneself in pursuit of a goal. This term is an umbrella over processes of any scale- from delaying ones consumption of a marshmallow in order to receive two, or the downregulation of neural activity representing a competing response. Self-regulation requires the use of processes called Executive Functions (EF) (Diamond, 2013).

EF broadly refers to top-down regulatory processes which act as a higher level supervisory control system which presides over lower level (automatic) processes (Diamond, 2013; Miyake et al., 2000). There are three core EF processes inhibition, working memory updating, and cognitive flexibility (or set shifting). These core processes provide the basis for complex behaviors, like planning or reasoning (Lehto et al., 2003; Miyake et al., 2000). EF is inherently limited, with task performance decreasing as cognitive load increases (Jing Wen et al., 2019; Siregar, 2021; van't Veer et al., 2014). While there is clear evidence of some form of capacity limit, there are multiple theories on what the exact limiting factor may be. One of more recent prominence suggests attention, under the control of EF inhibition, as an inherent limiting factor across executive functions (Engle, 2002; Engle & Kane, 2003).

Inhibition

Inhibition involves the suppression of prepotent automatic responses. In order to focus attention on relevant information, neural representations of irrelevant cues must be suppressed. Similar to EF, inhibition is considered a family of functions separable into Response Inhibition (suppression of task-irrelevant motor response) and Resistance to Distractor Interference (the suppression of task-irrelevant cues) (Friedman & Miyake, 2004). Inhibition is often separated into additional subcomponents, including Affective (or emotional) Inhibition, the suppression of emotional stimuli or emotional response. Despite common portrayals of so called “Cognitive” (non-emotional) Inhibition and “Emotional” Inhibition as distinct processes, meta-analyses of research on inhibition across multiple domains (using such tasks as the Eriksen Flanker task) show several regions of shared activation across Cognitive, Affective, and Response inhibition which demonstrate the intractable connectedness of these functions (Hung et al., 2018).

Tasks used to measure inhibition often involve competing responses, such as the Stroop or Eriksen Flanker. The Eriksen Flanker task (Eriksen & Eriksen, 1974) is a measure of inhibition for which, in order to correctly respond to the central "target" stimulus, participants must correctly inhibit responses elicited by "flanking" stimuli. It functions as a two-choice forced alternative design. Electrophysiological data can be use in tandem with behavioral data in order to investigate time-order aspects of inhibition. Common ERP (event related potential) measures related to inhibition include the P300, believed to index working memory updating related to target stimulus (Donchin & Coles, 2010), and the N2, a measure of conflict detection, or an "alarm bell" recruiting the use of frontal inhibition circuitry (Groom & Cragg, 2015). These components are also modulated by emotion. Emotional words used in a Stroop task have been shown to enhance N2 amplitude(Kanske & Kotz, 2010). Individuals with high levels of trait anxiety also show reduced P300 amplitude on an emotional flanker (read: a flanker utilizing emotional stimuli) as well as more negative N2 towards incongruent trials (Yu et al., 2018).

Like other complex cognitive functions, the regulation of emotion itself recruits the use of self-regulatory processes such as EF inhibition (Zelazo & Cunningham, 2007). Measures of Executive Function (EF) ability have been found to correlate to effective use of emotional regulation strategies in adolescents (Lantrip et al., 2016), and measures of EF have been found to correlate to emotional regulation (ER) ability (Diamond, 2013; Sperduti et al., 2017). Research on the involvement of EF in emotionally or motivationally salient tasks has shown some level of functional distinction from more abstract executive functions, though some regions of involvement are shared (Hung et al., 2018; Zelazo & Cunningham, 2007). When a task is exclusively made up of emotional regulation, such as delayed gratification tasks or reaction to emotional faces, it is associated with activity in regions in the ventral prefrontal cortex (vPFC) such as the orbitofrontal cortex (OFC), which has a strong connection to limbic regions such as the amygdala (Zelazo & Cunningham, 2007). When a non ER task involves inhibition of task-irrelevant emotional stimuli, there is more recruitment of regions known to be involved in cognitive control such as lateral prefrontal cortex (lPFC), dorsal anterior cingulate cortex (dlPFC), and parietal regions such as the inter parietal sulcus (IPS) (Banich et al., 2001; Hung et al., 2018; Wang et al., 2010; Zelazo & Cunningham, 2007; Zysset et al., 2001). Both kinds of inhibition involve activation of the anterior insula (Hung et al., 2018; Wang et al., 2017). While these regions appear to be separable, evidence does not always support the dissociability of cognitive and emotional regulation (Allan & Lonigan, 2014). The difficulty may arise due to the heavy communication and connectedness between regions involved in cognitive inhibition and emotional inhibition. Emotional regulation may be best understood as one subcomponent of the larger inhibition system alongside cognitive inhibition, rather than categorizing both as completely distinct pathways (Zelazo & Cunningham, 2007).

Rejection Sensitivity

Downey and Feldman developed their theory of Rejection Sensitivity (RS) as an explanatory mechanism which underlies the impact of attachment style on relationships later in life. They define RS as trait level differences in the anxious expectation, ready perception, and affective response to social rejection (Downey & Feldman, 1996). According to their theory, RS is a stable personality trait measure which is associated with an individual's early life experiences with rejection. Individuals who experience higher amounts of rejection develop a cognitive-affective processing bias towards rejecting stimuli. This bias then leads them to intensely expect and fear rejection from those around them, more-so than their peers (Araiza et al., 2020; Godleski et al., 2019; Levy et al., 2001). Emotional response to rejection may involve either anger or anxiety, and each is often considered separately due to their divergent associations with behavioral outcomes (Preti et al., 2020; Richetin et al., 2018; Zimmer-Gembeck & Nesdale, 2013). RS is a unique predictor of social dysfunction and has been found to mediate the impact of aversive life experiences on the development of psychiatric disorders (Ayduk et al., 2000; Ayduk et al., 2008; Goodman et al., 2014; White & Kistner, 2011; Zimmer-Gembeck et al., 2016)

The relationship between RS and rejecting experiences is cyclical. RS is associated with greater use of maladaptive coping strategies such as isolation and rumination (Casini et al., 2022; Pearson et al., 2011). The use of these coping strategies (prompted by peer rejection) is then associated with further increase in RS in adolescents (Zimmer-Gembeck, 2015). However, not all adolescents appear vulnerable to this cyclical increase. Research on RS in children identified a large difference in self-perception of rejection experiences in highly rejection sensitive children compared to reports from peers. They found that, while highly rejection sensitive children saw themselves as more ostracized or victimized by peers, their peers do not identify these individuals as ostracized or victimized. RS was correlated not to reported ostracization by classmates, but to the individuals own perceived distress and lack of satisfaction with their friendships, believed to result in an overestimation of personal ostracization (Zimmer-Gembeck et al., 2013). Self-Perception of ostracization is mediated by a tendency to overestimate rejecting experiences rather than to peer reports of ostracization (White & Kistner, 2011). Rather than originating purely from learned experiences, high RS may arise from some dysregulation in self-regulatory systems which render certain individuals more vulnerable to the impact of aversive life experiences, which then compounds upon itself.

There is an argument to be made that perhaps the inability to identify peer rejection may serve as a protective barrier for some children, explaining the previous results. Electrophysiological research has investigated whether RS differences in facial processing of rejection cues may mediate the impact of rejection on distress towards rejection and found that there were no differences in ERP (Event Related Potential) correlates of facial feature processing based on RS (Kawamoto et al., 2015). Instead, evidence suggests that individuals high in RS exhibit hypervigilance towards facial cues. While individuals with average levels of RS show attentional bias away from facial images appearing “rejecting” (eyes averted) compared to neutral (eyes forward), highly rejection sensitive individuals show greater distribution of early attentional resources towards these faces as measured utilizing the P2 component, which indexes attention (Ehrlich et al., 2015). This increased bias towards negative stimuli is thought to represent a decrease in the ability to regulate emotional response through diverting attention away from painful non-threatening stimuli, which is theorized to be a risk factor in the development of mood disorders such as depression (Ehrlich et al., 2015; Klawohn et al., 2020). RS indexes a perceptual bias towards rejecting stimuli. Individuals who are high in RS are not accurate reporters of the level of rejection they experience, but are instead over-estimators who may interpret ambiguous interactions as rejection due to heightened vigilance and lack of protective biases away from negative stimuli.

Self-regulation may play an important mediating role in rejection sensitivity. Both early measures of automatic attentional processing and later inhibitory processes have been implicated in current literature. A longitudinal study which examined childhood self-regulation and its impact on adult outcomes found that self-regulation moderates the negative impact of rejection sensitivity. Highly rejection sensitive adults who had higher performance on delayed gratification tasks (i.e. they were able to self-regulate and resist immediate gratification for longer) had higher self-esteem and self-worth compared to other highly rejection sensitive adults who were not able to delay gratification for as long (Ayduk et al., 2000). Neural measures indicated a similar relationship between experienced distress towards rejection and top-down regulation ability, with reduced activity in frontal regions known to be involved with down-regulation of stimuli negatively correlating to both measures of rejection sensitivity and to perceived distress. Kross (2007) and colleagues sought to clarify which regions were involved in the neural mechanism underlying distress to rejecting images in more rejection sensitive individuals. When exposed to images depicting rejection (paintings by Edward Hopper), BOLD activity in several brain regions correlated to reported distress and negatively correlated to individual RS score. These regions included the superior frontal gyrus (SFG) and left Prefrontal Cortex (PFC) (Kross et al., 2007).

Rejection Sensitivity and Executive Function

Rejection sensitivity literature currently has few studies directly examining correlations with cognitive (non-affective) performance; however, it still suggests some overlap of function. The mechanisms which underly differences in the response of high and low RS individuals to negative stimuli involve regions such as the dACC, left lPFC, and dorsal superior frontal gyrus (SFG)(Kross et al., 2007). This evidence comes from fMRI differences between high and low RS individuals while viewing paintings which portray rejection related concepts like isolation. High RS individuals showed reduced activation in frontal regions compared to controls. This included two regions of the lPFC along with the dorsal superior frontal gyrus (SFG). Activity in these frontal regions was negatively correlated with reported distress. In addition, dorsal ACC activation was lower for high RS compared to low RS. It had a moderate strength negative correlation to distress as well as a strong positive correlation to activation in ventrolateral PFC activity (Kross et al., 2007). ACC and SFG activity have also been implicated in other forms of inhibition. Meta-analysis of proactive interference in working memory found strong connectivity between the IFC and ACC during tasks requiring interference control (Nee et al., 2007). ACC activation has been implicated in various measures of cognitive control (Krug & Carter, 2010), and LPFC regions are implicated in several aspects of EF (Hung et al., 2018; Teuber, 1972). Meta-analysis of studies published on the mechanism of cognitive inhibition in a cluster of dorsal brain regions which show significant concordance across studies. This dorsal cluster of activation involves the dACC and extends to dlPFC regions (Hung et al., 2018). DLPFC activity has also been associated with aggression. Longitudinal research on DLPFC development in children and the association with changes in aggression found a significant correlation between DLPFC activation on a startle task, wherein children heard an unpleasant blast of noise, with behavioral aggression. Children who showed greater developments in DLPFC also showed greater reductions in measured aggression (Achterberg et al., 2020). Despite much of literature describing the OFC as the primary region of activation responsible for emotional inhibition (Hung et al., 2018), LPFC regions are implicated in the mediation of distress and emotional dysregulation across the literature.

This may have something to do with how pure emotional regulation tasks are measured. Pure emotional regulation tasks refer to tasks where the explicit goal is to regulate an emotion, often instructing participants to engage in effortful emotional regulation strategies such as reappraisal (Zelazo & Cunningham, 2007). This may not be completely reflective of how emotional regulation functions in daily life. Emotional regulation in daily life is often implicit or occurs as a secondary task. For example, in a situation where a child attempts to do their homework after a rough day at school, emotion regulation itself is not their focus but still must be accomplished effectively in order to meet their goals. Fewer studies still examine implicit emotional regulation. An example of a measure of implicit emotion regulation from literature involved showing participants distressing images accompanied by text describing the scenario as real and subsequently informing them the image was from a fictional scenario. Self-report distress ratings were collected both before and after participants were informed that the situation was fictional. This research found that cognitive control was implicated in reducing emotional distress through the integration of new information. Changes in distress ratings also correlated to measures of EF WM updating (Sperduti et al., 2017). Performance measures of executive function mediate the effect of implicit attitudes on behavior. Individuals who performed better on a digit span test, a measure of working memory capacity) showed an increased effect of self-regulatory goals on their behavior than those with poorer performance. This is evident in the ability to resist tempting food and also the ability to regulate anger response to provocation(Hofmann et al., 2008). The aspect of emotional regulation that is dysfunctional in highly rejection sensitive individuals may be more associated with LPFC activity and cognitive control rather than OFC emotional inhibition circuits.

The association of inhibition and rejection sensitivity has multiple possible explanations which may depend on the root cause of their shared functional activation. It is possible that these differences are context specific, with rejection sensitive individuals only showing dysfunction in self-regulatory or EF domains in the presence of emotional stimuli or rejection related stimuli. In this case, differences in LPFC and ACC activation in RS may be due to priming effects and may originate from regions outside of EF circuits. Anxiety research may indicate some support for this explanation. Individuals with anxiety show marked emotional interference, but some studies fail to find performance differences on reaction time or accuracy in cognitive interference tasks (Konig et al., 2021). Conversely the emotional dysregulation seen in RS may originate from differences within the self-regulatory system. Rather than originating purely from learned experiences, rejection sensitivity may arise from some dysregulation in self-regulatory systems which render certain individuals more vulnerable to the impact of aversive life experiences. As previously discussed, rejection sensitivity has been shown to mediate the impact of emotional mistreatment on the development of BPD (Goodman et al., 2014), and self-perception of ostracization is mediated by a tendency to overestimate rejecting experiences rather than to peer reports of ostracization (White & Kistner, 2011). Individuals with frontal lobe damage often present with emotional dysregulation. One case study on an individual with LPFC damage offers unique insight due to the patient suffering little damage to executive function and working memory processes, allowing him to describe his experience with clarity. Emotional dysregulation took the form of increased emotional reactivity to both positive and negative stimuli as well as reduced ability to regulate emotion (Salas et al., 2014). Supporting this possibility, a voxel-based morphometry study of gray matter volume found significant differences in gray matter volume (GMV) between high and low rejection sensitive groups. High RS groups showed lower gray matter volume around the region of the posterior cingulate cortex and precuneus (Sun et al., 2014). Some research supports the idea of a domain-general network of inhibition which is responsible for both cognitive and emotional inhibition, involving many of these same regions implicated by RS literature. High levels of functional connectivity were identified between regions associated with cognitive and emotional control. Disruption in one region within this network may have diffuse effects on multiple processes regulated within the network (Chen et al., 2018). If rejection sensitivity results from an underlying vulnerability within regions associated with EF or within the inhibition network, high RS individuals would be expected to perform more poorly on executive function measures compared to lower RS peers regardless of emotional valence.

More likely, the mechanism underlying this relationship is more complicated, and may differ on an individual basis. The same study which found reduced regional gray matter volume in high RS individuals found a relationship to increased inferior temporal gyrus volume, a possible mechanism for interference which arises outside of EF systems. The ITG is involved in occipito-temporal circuits which are sensitive to human faces and are heavily influential in social interactions. Heightened ITG activation has been observed in response to social exclusion (Bolling et al., 2011). It is also difficult to discern temporal precedence of neurological differences. These differences in function may exist prior to the development of high RS, but they also might occur as a result.

Individuals with high RS show lower performance on assessments of emotional regulation than those with lower RS (Velotti, 2015; Wu et al., 2022). As previously mentioned, rejection sensitivity is associated with outcome measures in a variety of pathopsychological conditions (Gardner et al., 2020; Harb et al., 2002; Zimmer-Gembeck et al., 2021). Executive function performance has been similarly seen to vary across different conditions. A common network has been identified across neuroimaging studies as involved in the ability to adapt to processing demands. This frontal-cingulate-parietal-insular network may be representative of the functional capacity limit of cognitive control (i.e., inhibition) (McTeague et al., 2016; Snyder et al., 2015). Similar to high RS, dysfunction in EF systems is associated with poorer behavioral outcomes (Cox et al., 2019; Franklin et al., 2018; McTeague et al., 2016; Snyder et al., 2015). In addition to evidence of poor inhibition, there is some evidence that high RS may be associated with lower performance on measures on Working Memory Updating. High RS individuals show a resistance to extinction of fear learning towards angry faces (Olsson et al., 2013). Further, social rejection is seen to impair inhibitory self-control (Lurquin et al., 2014). Given the increased effects of social rejection seen in high RS individuals, it is likely that these effects would be enhanced, causing an even greater decrease in EF following rejection.

Evidence from literature seems to support the notion that RS and EF are linked, likely through EF inhibition. Research may find broad EF dysfunction in individuals with high RS, in a similar manner to how it appears in functionally related conditions such as social anxiety. Conversely, the impairment may only be seen in emotional inhibition tasks. Measuring performance differences across both abstracted cognitive inhibition tasks and cognitive inhibition tasks which involve emotional interference may provide further clarity.

The Current Study

Evidence from the literature suggests that RS and higher order inhibition processes are linked through shared circuitry (Achterberg et al., 2020; Gyurak et al., 2012), though research examining this relationship outside of the context of social context is sparse. Neuroimaging research has identified considerable overlap in neural activation between cognitive and affective inhibition located in a region responsible for the recruitment of higher order processes in response to need (Hung et al., 2018) which has also been identified as involved RS research (Kross et al., 2007). Confirmation of an association between RS and broader inhibition circuitry may improve our understanding of this combined system and may help to explain how interpersonal sensitivity functions as a predictor of disease (Marin & Miller, 2013).

The current study utilized electrophysiological measures to examine the relationship between rejection sensitivity and the recruitment of higher-level inhibition in both emotional and non-emotional contexts. Both rejection-specific and non-rejection specific emotional stimuli were used in order to further examine the relationship between rejection sensitivity and inhibitory processes. The Flanker task was used due to its utility in recruiting cognitive inhibition and its flexibility of use in terms of stimulus categorization. If those with higher levels of rejection sensitivity show less ability to recruit inhibition regardless of context this will support the involvement of broader inhibitory dysfunction with RS. If the relationship between high RS and inhibition recruitment only appears in the presence of emotional stimuli this would instead indicate that the two have a relationship limited to emotion specific inhibition processes. If this relationship only appears in the presence of rejection related stimuli this would indicate that it is highly context driven and may be better explained through some outside mediator. Once the nature of the relationship is clear further research may further examine involved processes which may lead to a greater understanding of how certain individuals come to experience heightened risk for certain negative health outcomes.

Chapter 2: Methods

Participants

64 participants were recruited via the University of South Florida Department of Psychology subject pool in return for course credit. Of these participants, six were excluded for poor ERP reliability (>80%) and one participant was excluded after failing survey attention checks. Participants were considered ineligible if they had vision loss which could not be corrected via prescription eyewear, traumatic brain injury within the last two years, or history of

Table 1
Sociodemographic Characteristics of Participants

Baseline Characteristic		*Average RS* (N=45)	*High RS* (N=12)	*Overall* (N=57)
Age	Mean (SD)	20.4 (3.2)	19.3 (1.8)	20.2 (3.0)
	Median (IQR)	19.0 (1.0)	18.5 (2.0)	19.0 (2.0)
	Range	18.0 - 31.0	18.0 - 24.0	18.0 - 31.0
Gender	Female	38 (84.44%)	9 (75.00%)	47 (82.46%)
	Male	7 (15.56%)	3 (25.00%)	10 (17.54%)
Ethnicity	Asian	7 (15.56%)	4 (33.33%)	11 (19.30%)
	Black or African American	2 (4.44%)	0 (0.00%)	2 (3.51%)
	Latino	4 (8.89%)	2 (16.67%)	6 (10.53%)
	White	24 (53.33%)	5 (41.67%)	29 (50.88%)
	Other	1 (2.22%)	0 (0.00%)	1 (1.75%)
	Mixed (Various)	5 (11.10%)	1 (8.33%)	6 (10.50%)
	Missing	2 (4.44%)	0 (0.00%)	2 (3.51%)
Handedness	Both / Ambidextrous	1 (2.22%)	0 (0.00%)	1 (1.75%)
	Left Hand	4 (8.89%)	2 (16.67%)	6 (10.53%)
	Right hand	40 (88.89%)	10 (83.33%)	50 (87.72%)
Psychological Diagnoses	No	41 (91.11%)	9 (75.00%)	50 (87.72%)
	Yes	3 (6.67%)	3 (25.00%)	6 (10.53%)
	Missing	1 (2.22%)	0 (0.00%)	1 (1.75%)

or active drug use. Presence of psychiatric condition was not considered a disqualifying factor due to evidence suggesting heightened RS may lead to the development of psychiatric illness (Zimmer-Gembeck et al., 2021; Zimmer-Gembeck et al., 2016). A total of 57 subjects (47 female; Age: *M* = 20.2, *SD* = 3.0) were utilized for ERP analysis. Additional demographic information can be found in *Table 1*.

Measures

RSQ

The 18 question Rejection Sensitivity Questionnaire (RSQ) (Downey & Feldman, 1996) consists of theoretical social situations with a possibility of rejection which a college student may experience (i.e., "You ask someone in one of your classes to coffee"). While the classic RSQ only contains questions in regard to two dimensions (rejection expectation and rejection anxiety), this experiment used a modified version which included the separate dimension of rejection anger. Participants rate, on a Likert scale from 1 to 6, how strongly they expect a rejection (1 ("very unlikely") to 6 ("very likely")), how anxious they would be toward a rejection in this scenario(1 ("Very unconcerned") to 6 ("Very concerned")), and how angry they would be toward a rejection in this scenario (1 "not very angry" to 6 "very angry"). Traditional scoring creates a composite score by multiplying average scores from the expectation and anxiety dimensions. In addition to traditional scoring, separate dimensional scores will be calculated for each dimension (expectation, anger, anxiety) as per Richetin et al. Score distributions can be seen in *Table 2*.

Flanker

The Erikson Flanker Task is well validated for use examining inhibition in previous electrophysiology studies. Three Flanker tasks were presented, each individually consisting of three trial blocks with one of three stimulus types: neutral stimuli, affective stimuli (non-social),

Table 2

Rejection Sensitivity Score Distribution

Score Type		*Average RS*	*High RS*	*Overall*
		(N=45)	(N=12)	(N=57)
Global	Mean (SD)	7.3 (2.2)	12.8 (2.4)	8.5 (3.2)
	Median (IQR)	7.9 (2.8)	12.1 (3.0)	8.3 (3.3)
	Range	1.0 - 10.1	10.4 - 18.3	1.0 - 18.3
Expectation	Mean (SD)	2.4 (0.7)	2.9 (0.5)	2.5 (0.7)
	Median (IQR)	2.3 (0.7)	2.9 (0.5)	2.6 (0.9)
	Range	1.0 - 4.4	1.9 - 3.7	1.0 - 4.4
Anxiety	Mean (SD)	3.1 (0.7)	4.4 (0.5)	3.3 (0.9)
	Median (IQR)	3.2 (1.1)	4.3 (0.7)	3.4 (1.3)
	Range	1.0 - 4.4	3.6 - 5.3	1.0 - 5.3
Anger	Mean (SD)	2.7 (0.8)	2.7 (0.8)	2.7 (0.8)
	Median (IQR)	2.7 (0.9)	2.6 (0.9)	2.7 (0.9)
	Range	1.0 - 4.6	1.4 - 4.0	1.0 - 4.6

and affective (social) stimuli. Blocks will hereafter be referred to as “Neutral”, “Affect”, and “Social” blocks. The Neutral block consisted of fractal images sourced from a normed dataset (Ovalle-Fresa et al., 2022), with participants categorizing target images as containing “spiral” fractals or “circle” fractals. Affect (non-social) stimuli consisted of arousal matched positive and negative images sourced from the International Affective Pictures System (IAPS) (Lang, 2008), and rejection related affective stimuli on the Social block utilized smiling (or “happy”) and contemptuous faces sourced from the Complex Emotional Expression Database (CEED)(Scherf & Benda, 2019). Each block uses five varieties of each category of image arranged in a cross section with one central target surrounded by four flankers which may or may not match, creating 100 possible combinations per block. Participants saw each flanker image a total of three times, for a total of 300 trials per Flanker block. Flanker trial blocks (of 100 trials) were labeled by number (1,2,3). Incongruent and congruent flankers were equiprobable, with each of four possible conditions appearing for 25% of trials. In both affective trial blocks (Affect and

Social) participants were asked to respond based on the target valence category (positive/negative, happy/contemptuous), for the non-affective block, Neutral, they were to respond based on shapes present in the fractal (circle/spiral). Responses were logged using a four key response pad ("1" or "4" depending on category), with mappings randomized by participant.

The tasks were coded using E-Prime 3.0 presentation software and presented on an LCD monitor set to 1920x1080 resolution. The monitor refresh rate was 60.04 Hz, and viewing distance was standardized to 60 cm. Following instructions and a 15-trial practice round participants had the opportunity to express continued difficulty with the task, in which case the trial was repeated. Each experimental trial began with the presentation of a black screen. Stimulus onset latency was jittered between 60-800 ms, and inter-trial interval between 1000 and 2000 ms, for total possible differences up to 1740 ms per trial. This was done to correct for effects of expectation. Flanker images displayed for 800 ms and terminated early upon participant response. All tasks were designed to utilize white text on black background in order to reduce eye strain.

SAM

Valence and arousal rating were collected for all affectively valanced stimuli. Participants filled out the Self-Assessment Manekin (SAM)(Bradley & Lang, 1994), a pictorial assessment used to collect valence and arousal ratings for affective images, for a subset of 12 algorithmically chosen affective images used in both the Affect and Social Flanker blocks. These ratings were used to confirm normative valence and arousal data provided by the original normed datasets.

Hypotheses

If individuals who are high in rejection sensitivity display deficits in the recruitment of inhibition, certain patterns in data will emerge. Individuals high in rejection sensitivity will show reduced amplitude N2 to Incongruent trials across all three flanker blocks (social, affect, and neutral) when compared to those with normal levels of rejection sensitivity. These effects will be enhanced in trials where flanking stimuli are rejection related more so than in trials where stimuli are not rejection related, reflecting the attentional bias high RS individuals show towards rejection-related stimuli, further reducing N2 activity aimed at resolving response conflict. Individuals higher in RS should exhibit slower response times and reduced accuracy on incongruent trials compared to their peers, especially if those trials include rejection-related stimuli as flanking images.

Procedure

Participants signed up for the study through the USF SONA online participant pool. Upon arrival participants completed consent forms and confirmed the absence of any rule-out criteria. Participants filled out digitized surveys and completed Flanker tasks in counterbalanced order with the exception of image ratings, which always occurred last in order to avoid bias stemming from early exposure to experimental stimuli. Each Flanker block contained two breaks which could last up to 5 minutes. If participants were assigned to complete EEG tasks first, the net was then removed before survey administration.

EEG Acquisition

EEG data was acquired using 128-channel EGI sensor net (EGI, Eugene, Oregon, USA) with 500 Hz sampling and online high pass filtering at 70 Hz, low pass filtering at 0.01 Hz, and a 60 Hz notch filter. Data processing took place in EEGlab (Delorme & Makeig, 2004), based on guidelines proposed by Makoto Miyakoshi. Data was first down sampled to 250 Hz, high pass filtered with a 0.1 Hz 6^{th} order Butterworth filter and re-referenced to average. Following this, artifact correction was conducting using the ASR CleanRawData plugin (Kothe et al., 2019), and automated ICA decomposition and artifact rejection using ICLabel (Pion-Tonachini et al., 2019) followed by a low-pass 40hz 6th order Butterworth filter. Data was segmented from 200 ms before stimulus onset to 1000 ms after stimulus onset and baseline-correct to the 200ms pre-stimulus period.

N2 amplitude was calculated using time-window averaging across a fronto-central region of interest (Electrodes: 4, 9, 16, 19, 20, 22, 29, 111, 118) between 300ms and 400ms post-stimulus, which was determined based on a combination of previous research (Huster et al., 2010; Kanske & Kotz, 2010) and visual inspection. Trial by trial data was extracted for analysis.

Statistical Analysis

Behavioral

Prior to analysis trials featuring responses that were missing, incorrect, or considered to be outliers (further than 3 SD from the individuals mean RT) were excluded. Response time analysis was conducted on individual trial data using hierarchical linear modeling with fixed effects of Congruency (Incongruent/Congruent), Rejection Sensitivity (Average/High), Block (Social, Affect, Neutral), and Condition (Neutral: Circle/Spiral; Social Affect: Happy/Contempt; Non-Social Affect: Positive/Negative), with random effect of Subject with slopes influenced by trial. Post hoc testing was conducted using Tukey HSD to correct for multiple comparison. Accuracy analyses utilized hierarchical logistic regression with fixed effects Congruency (Incongruent/Congruent), Rejection Sensitivity (Average/High), Block (Social, Affect, Neutral), and Condition (Neutral: Circle/Spiral; Social Affect: Happy/Contempt; Non-Social Affect: Positive/Negative), and random effects of subject.

ERP

Analyses were conducted using hierarchical mixed models predicting N2 amplitude with Rejection Sensitivity ranking (Average/High), Congruency (Incongruent/Congruent), Flanker Condition (Neutral: Circle/Spiral; Social Affect: Happy/Contempt; Non-Social Affect: Positive/Negative), Block (Social, Affect, Neutral), and Trial block ("Trial", 1 = First 100 trials, 2 = trial 101-200, 3 = last 100 trials) as fixed effects. Subject and trial number were included as random effects in order to account for individual variation and amplitude decay (Heise et al., 2022). Post hoc testing used paired t-tests with Tukey HSM correction for multiple comparisons.

Chapter 3: Results

Behavioral

Reaction Time

Analysis revealed a main effect of Congruency associated with reaction time, $F(1,48767.59) = 38.85$, $p < .0001$, $f^2 = 0.03$ (*Table 4*). As expected, responses to Congruent

Table 3

Repeated-Measures Multi Level Model ANOVA Results: Reaction Time

Source	*SS*	*MS*	*Num df*	*Den df*	*F*	*p*
C	256,461.12	256,461.12	1	27,674.08	23.46	<0.0001 ***
RS	5,412.96	5,412.96	1	57.09	0.50	0.48
F	30,533.83	30,533.83	1	27,678.89	2.79	0.09 .
B	3,271,793.24	1,635,896.62	2	27,660.61	149.65	<0.0001 ***
C:RS	18,941.41	18,941.41	1	27,674.08	1.73	0.19
C:F	67,669.83	67,669.83	1	27,675.06	6.19	0.01 *
RS:F	100,636.30	100,636.30	1	27,678.89	9.21	0.002 **
C:B	76,808.43	38,404.22	2	27,672.81	3.51	0.03 *
RS:B	67,533.43	33,766.72	2	27,660.61	3.09	0.05 *
F:B	21,653.94	10,826.97	2	27,675.71	0.99	0.37
C:RS:F	10,657.92	10,657.92	1	27,675.06	0.97	0.32
C:RS:B	8,697.59	4,348.79	2	27,672.81	0.40	0.67
C:F:B	142,614.70	71,307.35	2	27,674.58	6.52	0.001 **
RS:F:B	21,937.68	10,968.84	2	27,675.71	1.00	0.37
C:RS:F:B	38,035.47	19,017.73	2	27,674.58	1.74	0.18

Note: C = Congruency Condition; F = Flanker Condition; RS = Rejection Sensitivity; B = Block; SS = sum of squares; Num df = Numerator degrees of freedom; Den df = Denominator degrees of freedom; MS = mean square;

Significance: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

trials (M = 586.1, SD = 113.05) were slightly faster than responses to Incongruent trials (M = 592.91, SD = 113.65), p < .0001.

There was a significant main effect of Block associated with reaction time, F(2,48767.68) = 315.23, p < .0001, $f^2 = 0.11$. Participant response was slowest when asked to identify the target emotion of faces in the Social block *(M = 608.31, SD = 119.98),* and quickest when asked to identify the presence of target shapes in the Neutral block *(M* = 575.68*, SD* = 111.02*),* all ps < .0001. Responses on Affect block (M = 584.52, SD = 106.82), where the task involved identifying target valance, were slightly slower than responses to the Neutral block, p < .0001.

There was a significant Congruency x Flanker interaction associated with change in Reaction Time, F(1,48768.17) = 44.7, p < .0001, f^2 = 0.03. It may be important to note that Flanker Type may be misleading to interpret alone due to the inclusion of Neutral Flanker conditions in categories otherwise selected due to affective valence. In the presence of Flanker condition A (Happy, Positive, Spiral), responses on Congruent trials (M = 581.95, SD = 113.07) are faster in comparison to Incongruent trials (M = 596.07, SD = 113.17), p < .0001. Conversely, Congruency effects are attenuated for group B Flankers (Contempt, Negative, Circle), with no reaction time difference between Congruent and Incongruent trials, p = .1.

There was a significant Rejection Sensitivity x Flanker interaction associated with change in Reaction Time, F(1,48767.62) = 6.22, p 0.01, f^2 = 0.01. For those with Average RS levels, their reaction speed did not differ based on Flanker group, p = 0.1. Those with High RS were slightly faster when responding to trials with group A Flankers (Happy, Positive, Spiral) (M = 586.62, SD = 116.15) compared to group B (Contempt, Negative, Circle) (M = 590.34, SD = 118.49), p = 0.05.

There was a significant Block x Congruency interaction associated with change in Reaction Time, $F(2{,}48767.41) = 10.63$, $p < .0001$, $f^2 = 0.02$. Congruency effects were present for only two of the three blocks. Participants responded faster in Congruent conditions during both Neutral (*Congruent* $M = 573.11$, $SD = 111.02$; *Incongruent* $M = 578.26$, $SD = 110.96$; $p = 0.01$) and Affect (*Congruent* $M = 577.69$, $SD = 105.2$; *Incongruent* $M = 591.35$, $SD = 108.1$; $p < 0.001$) Blocks. There was no reaction time difference based on Congruency during the Social block ($p = 0.4$).

There was a significant Rejection Sensitivity x Block interaction associated with Reaction Time, $F(2{,}48767.68) = 10.53$, $p < .0001$, $f^2 = 0.02$. Those with Average RS were slowest on the Social block ($M = 608.69$, $SD = 117.93$) compared to both Affect ($M = 582.85$, $SD = 105.82$) and Neutral ($M = 580.02$, $SD = 110.39$) blocks, but displayed no reaction time difference between Affect and Neutral blocks (p = 0.07). Those in the High RS group similarly showed slower reaction times during the Social block ($M = 607.92$, $SD = 126.49$) compared to both Affect ($M = 586.18$, $SD = 109.99$) and Neutral ($M = 571.34$, $SD = 112.86$), all ps < . 0001. In addition, they displayed slower reaction times on the Affect block compared to the Neutral block ($\beta = 14.84$, $p < .001$).

There was a significant three-way Congruency x Block x Flanker interaction associated with Reaction Time, $F(2{,}48768.17) = 23.03$, $p < .0001$, $f^2 = 0.03$. During the Social block reaction time was faster for Congruent trials ($M = 598.61$, $SD = 125.21$) compared to Incongruent trials ($M = 617.07$,$SD = 115.93$) only for those trials where the Flanker was a Happy face, $p < .0001$. When the Flanker condition showed a contemptuous face, reaction time was faster for Incongruent trials ($M = 601.16$, $SD = 123.24$) compared to Congruent trials ($M = 616.38$, $SD = 113.97$), $p < .0001$. There was a similar effect seen based on Flanker in the Neutral block. Reaction time was faster for Congruent trials (M = 568.56, SD = 105.81) compared to Incongruent trials (M = 580.16, SD = 117.17) only for trials where the Flanker showed a Spiral, $p < .0001$. When the Flanker condition showed a Circle there was no significant difference in reaction time between Congruent and Incongruent trials (p = 0.62). Congruency effects were typical in the Affect block with no difference based on Flanker condition, with faster reaction times on Congruent trials (*Positive* M = 578.68, SD = 105.83; *Negative* M = 576.69, SD = 104.56) compared to Incongruent trials (*Positive* M = 590.97, SD = 103.17; *Negative* M = 591.72, SD = 113.05), ps < .0001.

Accuracy

There was a significant main effect of Block associated with Accuracy, $\chi^2(2) = 55.83$, $p < .0001$. Participants were least accurate when tasked to correctly identify the emotion on target faces in the Social block (M = 0.93, SD = 0.28), with slightly higher accuracy on the Affect block (M = 0.94, SD = 0.26), and highest accuracy on the Neutral block (M = 0.95, SD = 0.22), ps < .0001.

There was a significant Congruency x Rejection Sensitivity interaction associated with Accuracy, $\chi^2(1) = 3.95$, p = 0.05. High RS individuals show a greater drop in Accuracy from Congruent (M = 0.94, SD = 0.94) to Incongruent (M = 0.93, SD = 0.93) trials (β = 0.21, p < .001) compared to Average RS individuals(*Congruent* M = 0.95, SD = 0.95 ;*Incongruent* M = 0.94, SD = 0.94;β = 0.1, p = 0.01)(*Figure 1*).

There was a significant Congruency x Block interaction associated with Accuracy, $\chi^2(2)$ = 22.4, p = < .0001. Participants were more accurate in Congruent condition compared to Incongruent in both Affect (Congruent M = 0.95, SD = 0.24; Incongruent M = 0.93, SD = 0.28; p < .0001) and Neutral (Congruent M = 0.96, SD = 0.22; Incongruent M = 0.95 , SD = 0.23; p =

.001) blocks. This effect was reversed for the Social block, with participants showing greater accuracy for Incongruent trials (M = 0.93, SD = 0.27) compared to Congruent trials (M = 0.92, SD = 0.28; p = 0.01).

Table 4

Repeated-Measures Multi Level Model ANOVA Results: Accuracy

Source	*Chi.sq*	*df*	*p*
C	2.37	1	0.12
RS	1.69	1	0.19
F	0.79	1	0.37
B	37.16	2	< 0.0001 ***
C:RS	4.45	1	0.03 *
C:F	1.93	1	0.17
RS:F	1.34	1	0.25
C:B	14.49	2	0.0007 **
RS:B	14.24	2	0.0008 **
F:B	21.19	2	< 0.0001 ***
C:RS:F	1.83	1	0.18
C:RS:B	8.13	2	0.02 *
C:F:B	34.72	2	< 0.0001 ***
RS:F:B	3.76	2	0.15
C:RS:F:B	3.14	2	0.21

Note: C = Congruency Condition; F = Flanker Condition; RS = Rejection Sensitivity; B = Block; SS = sum of squares; Num df = Numerator degrees of freedom; Den df = Denominator degrees of freedom; MS = mean square;

Significance: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

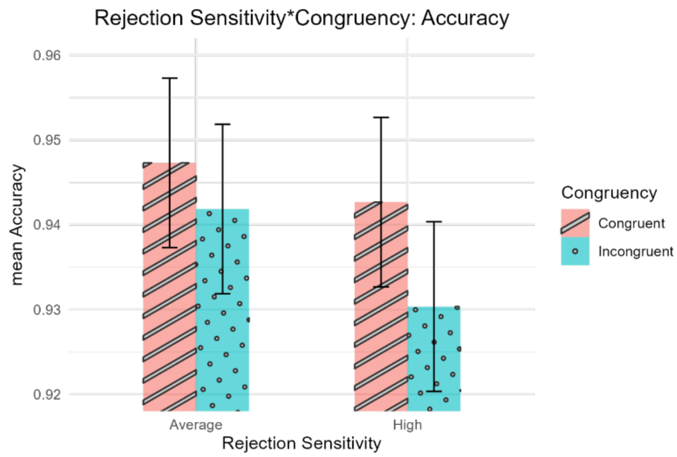

Figure 1 *Accuracy: Rejection Sensitivity x Congruency Interaction*

There was a significant Rejection Sensitivity x Block interaction associated with Accuracy, $\chi^2(2) = 10.93$, $p = 0.0042$. Those with Average RS were most accurate on Neutral block trials (M = 0.96, SD = 0.22), followed by Affect trials (M = 0.94, SD = 0.26), and the least accurate on Social trials (M = 0.93, SD = 0.27), ps < .01. Those with High RS were the least accurate on Social trials (M = 0.92, SD = .27, ps <.0001) in comparison to both Affect (M = 0.94, SD = 0.26) and Neutral (M = 0.95, SD = 0.24) blocks, but displayed no difference in accuracy between Neutral and Affect blocks (p = .29).

There was a significant three-way Congruency x Rejection Sensitivity x Block interaction associated with Accuracy, $\chi^2(2) = 9.87$, $p = 0.0072$. Average RS individuals showed no difference in Accuracy based on Congruency during the Social block (p = 0.25), while High RS individuals showed a reversal of the typical Congruency effect with higher accuracy on Incongruent trials(M = 0.93, SD = 0.28) compared to Congruent trials (M = 0.91, SD = 0.31; $p <$ .05) On the Affect block High RS individuals showed a reduction in accuracy of 2.7% from Congruent to Incongruent trials (β = 0.027, p < .001), compared to a 1.6% reduction for Average RS individuals (β = 0.016, p < .001). On the Neutral block, once again Congruency effects were attenuated for the Average RS group (p = 0.19), but not for the High RS group (β = 0.018, p < .001).

There was a significant three-way Congruency x Flanker x Block interaction associated with Accuracy, $\chi^2(2)$ = 85.11, p = < .0001. There were no differences in Accuracy on the Social block regardless of Flanker type or Congruency (ps > .70). Participants had reduced Accuracy on Incongruent Neutral block trials with Spiral flankers (M = 0.94, SD = 0.24) compared to trials with Circle flankers (M = 0.95, SD = 0.22), p = 0.02. On the Affect block, Accuracy was higher on Incongruent trials with Positive Flankers (M = 0.94, SD = 0.24) compared to Incongruent trials with Negative Flankers (M = 0.91, SD = 0.31) p < .0001.

ERP

There was a significant main effect of Block on N2 amplitude, F(2,28534.27) = 128.01, p < .0001, f = 0.094. N2 amplitudes were greatest during the Affect block (M = -3.26, SD = 4.95) compared to both Social (M = -2.14, SD = 4.78; p < .0001) and Neutral (M = -2.24, SD = 4.58; p < .0001) blocks. There were no differences in amplitude between Social and Neutral blocks (p = 0.46)

There was a significant Block x Rejection Sensitivity interaction associated with N2 amplitude, F(2,28534.27) = 20.56, p < .0001, f = 0.038. For those individuals with Average RS, average N2 amplitude was smallest during the Neutral block (M = -2.29, SD = 4.64), followed by N2 amplitude during the Social block, (M = -2.69, SD = 4.86), and at its highest during the Affect block (M = -3.49, SD = 5.04), all ps < .0001. For High RS individuals these first two are reversed. Average N2 amplitude was at its smallest during the Social block (M = -1.6, SD = 4.26), followed by Neutral (M = -2.19, SD = 4.38), and highest on Affect (M = -3.03, SD = 4.56), all ps < .001.

Pairwise comparisons also identified some differences between RS groups. N2 amplitude for those with Average RS during the Affect block was higher than High RS participants during the Social block (β = 1.88, p = 0.007), and trended in this direction when compared against amplitudes for High RS Neutral (β = 1.30, p = 0.08).

There was a significant Block x Trial interaction associated with N2 amplitude, $F(4,28920.7)$ = 4.9, p < .0001, f = 0.026. N2 attenuated over time during the Social block, with amplitude at its highest during early trials (M = -2.37, SD = 4.77) compared to late trials (M = -1.91, SD = 4.99),p = 0.01. During the Affect block, N2 amplitude fell from early trials (M = -3.34, SD = 4.96) to middle trials (M = -3.01, SD = 4.85), p = 0.04, but rose again for late trials (M = -3.43, SD = 5.09); p = 0.01)There were no amplitude differences across trials in the Neutral block.

There was a significant three-way Congruency x Rejection Sensitivity x Flanker interaction associated with N2 amplitude, $F(1,29042.01)$ = 6.84, p = 0.01, f = 0.015. Average RS had had no significant difference in N2 amplitude based on Congruency (Congruent M = -2.74, SD = 4.82; Incongruent $M = -2.86$, SD =4.77; p = 0.11) in the presence of group A flankers (Happy, Positive, Spiral). When group B Flankers (Contemptuous, Negative, Circle) were present, Average RS had greater N2 amplitude on Congruent trials (M = -2.96, SD = 4.93) compared to Incongruent (M = -2.72, SD = 4.97; p = 0.004). There were no N2 differences based on Flanker for High RS, ps > .20.

Table 5

Repeated-Measures Multi Level Model ANOVA Results: N2

Source	*SS*	*MS*	*Num df*	*Den df*	*F*	*p*	*x*
C	0.05	0.05	1	29,043.37	0.00	0.96	0.00
RS	13.87	13.87	1	57.54	0.75	0.39	0.00
F	5.74	5.74	1	29,038.38	0.31	0.58	0.00
B	4,728.57	2,364.29	2	28,634.21	127.82	< .0001 ***	0.09
T	81.99	41.00	2	225.63	2.22	0.11	0.01
C:RS	15.19	15.19	1	29,043.37	0.82	0.36	0.00
C:F	1.66	1.66	1	29,048.73	0.09	0.76	0.00
RS:F	0.13	0.13	1	29,038.38	0.01	0.93	0.00
C:B	92.72	46.36	2	29,032.23	2.51	0.08	0.01
RS:B	761.05	380.52	2	28,634.21	20.57	< .0001 ***	0.04
F:B	18.52	9.26	2	29,043.15	0.50	0.61	0.01
C:T	0.56	0.28	2	29,034.78	0.02	0.99	0.00
RS:T	34.49	17.24	2	225.63	0.93	0.4	0.01
F:T	46.21	23.11	2	29,034.20	1.25	0.29	0.01
B:T	359.85	89.96	4	28,916.69	4.86	< .0001 ***	0.03
C:RS:F	126.40	126.40	1	29,048.73	6.83	0.009 **	0.01
C:RS:B	77.67	38.84	2	29,032.23	2.10	0.12	0.01
C:F:B	23.03	11.52	2	29,021.33	0.62	0.54	0.01
RS:F:B	44.65	22.33	2	29,043.15	1.21	0.3	0.01
C:RS:T	24.39	12.19	2	29,034.78	0.66	0.52	0.01
C:F:T	8.87	4.43	2	29,055.35	0.24	0.79	0.00
RS:F:T	69.89	34.94	2	29,034.20	1.89	0.15	0.01
C:B:T	49.05	12.26	4	29,038.73	0.66	0.62	0.01
RS:B:T	195.81	48.95	4	28,916.69	2.65	0.03 *	0.02
F:B:T	50.62	12.66	4	29,025.51	0.68	0.6	0.01

Note: C = Congruency Condition; F = Flanker Condition; RS = Rejection Sensitivity; B = Block; SS = sum of squares; Num df = Numerator degrees of freedom; Den df = Denominator degrees of freedom; MS = mean square;

Significance: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

There was a significant three-way Rejection Sensitivity x Block x Trial interaction associated with N2 amplitude, $F(4,28920.7) = 2.64$, $p = 0.03$, $f = 0.019$. High RS individuals (M =-1.60, SD = 4.26) had lower N2 amplitudes than Average RS individuals (M =-3.11, SD = 4.84; p = .018) on the Social block, but only during early trials. N2 amplitude for Average RS individuals attenuated over time during the Social block. N2 amplitude was increased in early trials (M =-3.11 , SD = 4.83) compared to middle trials (M =-2.54 , SD = 4.71, $p < .0001$) and late trials (M =-2.4 , SD = 5.08, $p < .0001$). There was no difference between middle and late trials, $p = 0.5$. During the Affect block, N2 amplitudes of those with High RS increased from early trials (M = -3.19, SD = 4.61) to late trials (M =-3.32, SD = 4.72, $p = 0.03$).

Chapter 4: Discussion

The current study sought to examine the relationship between Rejection Sensitivity and the recruitment of inhibition processes, as indexed by the N2, across several contexts. It was hypothesized that individuals who measured within the top 30% of RS scores would show a reduction in amplitude on incongruent trials when compared to those with lower RS scores, and that this effect would be apparent in flankers using affectively Neutral stimuli, affectively valanced but non-social stimuli, and affective social stimuli. It was additionally hypothesized that these effects would be heightened when Flankers contained negatively valanced affective imagery, most prominently if imagery was social. Analysis sought to clarify the exact nature and limitations of RS related inhibition differences.

Behavioral results were in the predicted direction: despite maintaining similar response speed to their peers, High RS individuals showed heightened congruency effects when it came to the accuracy of their responses regardless of affect or context. While those with Average RS scores were able to compensate for the presence of incongruent flankers, those with High RS had heightened error rates across all blocks compared to their peers. These effects were strongest when Flankers consisted of affective stimuli, especially when stimuli were negatively valanced. Those with Average RS appeared to be able to compensate for the impact of incongruency on their accuracy, displaying similar accuracy regardless of trial congruency. Highly rejection sensitive individuals were not.

High RS individuals had reduced accuracy towards congruent social trials, though the reason for this is unclear. Analysis was conducted to examine inhibition of distractor effects, which have been proven separate from target enhancement effects (Nigbur et al., 2015). Smiling faces are typically shown to be much stronger attention draws (Wirth & Wentura, 2020). This effect did not appear for those with High RS, who instead showed enhanced difficulty when flankers were negatively valanced. This is in line with previous findings where individuals with depression fail to show a bias towards positive images as seen in non-depressed individuals (Atchley et al., 2012). It is possible that reduced performance on congruent Social trials seen in High RS may be related to their failure to display attentional bias towards smiling faces. Their heightened performance on Incongruent trials with negative targets may be reflective of this lack of attention towards happy faces, rather than being primarily due to bias towards negative stimuli creating a facilitative effect. This is in direct contrast to the average RS group, which displayed heightened accuracy and speed when happy faces were targets, and experienced special difficulty on Incongruent trials where happy faces were flankers, consistent with literature which identifies smiling faces as uniquely salient among various facial expressions (Wentura et al., 2024).

This lack of positive bias towards smiling faces offers another tempting explanation for the theoretical gap highlighted by longitudinal data- perhaps the development of RS may be more accurately measured with the inclusion of some measure of the number of accepting, or positive, experiences. The presence of rejection and the absence of acceptance (or positive social experiences) may not reflect the same variable in reverse, but instead may be two separate variables which each provide unique explanatory power to the development of social biases, or in fact, the failure to develop social biases. Additional research is required in order to ascertain these differences.

Differences rooted in RS were less extreme for affective images without social context (or rather, those which were not faces). This may not necessarily indicate that the effects of RS are weaker in non-social affective context, but instead may stem from the fact that individuals did not show a strong bias towards positively valanced images, where they did for smiling faces. While there was still an enhanced effect of negative flankers on performance for those with higher RS levels, those with average RS had effects in the same direction. Negative images resulted in larger drops in accuracy regardless of RS group, and congruent trials with negative images resulted in higher levels of accuracy compared to incongruent. It appears that there is no bias towards positive images in either RS group, but instead a bias towards negative imagery which appears more strongly for those with higher levels of RS. It is possible this may be due to the nature of the images chosen- while images had similar arousal ratings, it is true that negative stimuli may sometimes be interpreted more strongly than positive (such as in the vast amount of literature comparing gains and losses, see (Gibbons et al., 2023)). It is possible that higher arousal positive images may be more equivalent in strength to similarly rated negative images.

Reaction time differences based on RS and flanker groupings showed that High RS individuals responded more quickly in the presence of Flankers grouped by positive valance. By the nature of this analysis, Spirals were arbitrarily included in this positive valance group regardless of their own neutral valance, while Circles were included in the negatively valanced groups. The significance of this effect may be as a result of the relative strength of the valance effects- positively valanced images and faces being less impactful distractors on individuals with High RS may simply carry this effect despite Spirals not falling into this pattern. However, it seems that there may be differences in the distractor effects of fractal images based on shape. Looking more closely at this interaction, overall results show Congruent trials of Flanker A (Positive and Spiral) appears to be faster, while when these flankers appear in incongruent trials the response is slower. In addition, accuracy on the Neutral block does not increase compared to the Affect block for those with High RS, while it does for Average RS. There may be some form of interaction where High RS individuals respond differently based on Flanker shape compared to Average RS. The current analysis is suited to examine these effects more closely, due to the inclusion of all three blocks in a singular analysis. The Neutral block itself consisted of a completely novel flanker using images which have not previously been used in a similar design. While it is worth the use of similarly complex Neutral images in order to avoid latency differences in N2 component across blocks, it is difficult to draw conclusions without literature to fall back on. Further research looking at this Flanker more closely is warranted in order to further examine the existence of response differences, and to understand what stimulus characteristics may be driving them.

The N2 potential was used in order to measure the recruitment of higher-level inhibition. N2 findings primarily suggested that group differences in the ability to recruit inhibition may be limited to affective stimuli, most strongly in social context. Only during early trials of the Social block, or when comparing across blocks, was there evidence of N2 amplitude enhancement for those with Average RS in comparison to those with High RS. While directly comparing N2 amplitudes from the Affect block between High RS and Average RS did not yield significant results, means were trending in the correct direction. This lack of significance may stem from task difficulty- ceiling effects may have hidden group differences. Lack of statistical power may additionally stem from the range of RS scores in participants. Only the top 30% of participants were considered “high” in RS, those with scores above 10.4, leaving only 12 participants in this category. Further, the highest score in this range was 18.2, while the highest possible score on the RSQ is 36. Limitations in RS severity among the sample population, and limitations in sample size, may have limited the ability to identify statistical effects.

These results support that high RS difficulties in recruiting inhibition are more strongly limited to affective context, most strongly social context, but that high RS displays a globally reduced capability to contend with cognitive conflict that may stem from other inhibition processes. Rejection Sensitivity may be said to index differences in the ability to recruit higher level inhibition in affective context. This follows effects seen across literature, such as those showing that distress towards rejecting images correlates to reduced dACC activity in High RS individuals (Kross et al., 2007). However, not all performance differences mapped onto N2 differences. N2 differences were primarily apparent during Social and Affect blocks. This doesn't account for accuracy differences, which were visible across all three blocks. These differences may be due to attentional orienting processes instead, as some research has found promising results here. It is apparent that individuals higher in RS have reduced inhibition across both affective and non-affective context, but it is not apparent what process these differences may stem from. Additional analysis may be needed in order to identify the root of these differences. While they may not stem from the recruitment of inhibition itself, these additional differences in inhibition ability which appear in non-affective tasks may be important to the risk of developing heightened RS. Other research has found that delayed gratification in childhood is able to predict the development of Rection Sensitivity in adulthood (Ayduk et al., 2000). While there may be broad differences in inhibition across RS, it may be that these differences in self-regulation may be more apparent in childhood before less rejection sensitive children catch up to their peers developmentally, or it may be that other measures of self-regulation may be more able to identify the root process responsible for these differences in adults.

In summary, highly rejection sensitive individuals show a reduction in the ability to recruit higher level inhibition in affective contexts. They show a lack of positive bias towards facial images, and heightened distractor effects when Flankers are negatively valanced. High RS individuals showed a reduction in accuracy compared to their peers regardless of block which appears not to stem from inhibition recruitment. Additional aspects of selective attention and inhibition may account for accuracy differences that were not captured by the N2. Results support that high RS difficulties in recruiting inhibition are more strongly limited to affective context, most strongly social context, but that high RS displays a globally reduced capability to contend with cognitive conflict that may stem from other inhibition processes. While they may not stem from the recruitment of inhibition itself, these additional differences in inhibition ability which appear in non-affective tasks may be important to the risk of developing heightened RS.

Limitations

There are several additional limitations to the use of this research design. While the flanker has undergone previous analysis to indicate whether it does measure what it purports to measure, it is impossible to ensure that it does not also recruit the use of other processes outside of inhibition. No task is a pure measure of a single cognitive process, and performance may not reflect a direct effect of the primary process of interest. In addition, effects may not be evident due to ceiling effects. Heightened task difficulty may be necessary to provoke effects. Further testing with heightened cognitive load may be necessary. This research cannot determine the source of any effects which are occurring. Due to limitations in subject pool, there may be underlying bias to scores. All participants are being drawn from a limited age range in a university subject pool. There may be age related, location related, or university culture related effects on the measures in question.

The ability to detect differences in performance may have been limited by a ceiling effect. The flanker task used was basic and did not alter presentation speed based on participant response. Flanker tasks may not be able to replicate differences in performance that may exist in a non-experimental setting due to relative ease. Heightening task difficulty may be necessary in order to identify differences in inhibition ability.

Finally, there is some ongoing debate on the useability of interference tasks to measure executive function. Self-report measures of inhibition are largely uncorrelated to performance measures of inhibition, such as the Stroop and Flanker (Eisenberg et al., 2019; Paap et al.). Paap and colleagues suggest that these tasks may not be representative of latent inhibition but may be specific to the exact task being measured. Others still continue to advocate for the use of EF performance measures- Malagoli and colleagues (2021) found that reaction time and accuracy measures on tasks including the flanker map on to a latent inhibition construct and correlate to other performance measures of inhibition (Malagoli et al., 2022). In this regard the results of this study may be used as indication of potential differences in inhibition, but further research utilizing other measurement tools such as self-report are necessary to expand on the nature of any functional differences.

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Appendix I: Supplemental Tables

Table A1

Reaction Time: Estimated Marginal Means of Congruency

Congruency	*Estimate*	*SD*
Congruent	586.10	113.05
Incongruent	592.91	113.65

Table A2

Reaction Time: Paired T-tests of Congruency

Term	*Contrast*	*Estimate*	*SE*	*Z*	*p*
Congruency	Cong. – Incong.	-6.81	1.09	-6.23	< 0.0001 ***

Note: Tukey HSD used to correct for multiple comparisons
Significance: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Table A3
Reaction Time: Estimated Marginal Means of Block

Block	*Estimate*	*SD*
Social	608.31	119.98
Affect	584.52	106.82
Neutral	575.68	111.02

Table A4
Reaction Time: Paired T-tests of Block

Term	*Contrast*	*Estimate*	*SE*	*Z*	*p*
Block	Social - Affect	23.79	1.35	17.68	0.001 ***
Block	Social - Neutral	32.62	1.34	24.35	0.001 ***
Block	Affect - Neutral	8.83	1.33	6.64	0.001 ***

Note: Tukey HSD used to correct for multiple comparisons
Significance: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Table A5

Reaction Time: Congruency x Flanker Estimated Marginal Means

Congruency	*Flanker*	*Estimate*	*SD*
Congruent	A (Happy,Pos,Spiral)	581.95	113.07
Incongruent	A (Happy,Pos,Spiral)	596.07	113.17
Congruent	B (Contempt,Neg,Circle)	590.24	112.97
Incongruent	B (Contempt,Neg,Circle)	589.75	114.04

Table A6

Reaction Time: Congruency x Flanker Pairwise Comparisons

Flanker	*Contrast*	*Estimate*	*SE*	*Z*	*p*
A (Happy,Pos,Spiral)	Cong. - Incong.	-14.12	1.55	-9.13	0.001 ***
B (Contempt,Neg,Circle)	Cong. - Incong.	0.49	1.54	0.32	0.75

Note: Tukey HSD used to correct for multiple comparisons
Significance: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Table A7

Reaction Time: Rejection Sensitivity x Flanker Estimated Marginal Means

Rejection Sensitivity	*Flanker*	*Estimate*	*SD*
Average RS	A (Happy,Pos,Spiral)	591.39	112.38
High RS	A (Happy,Pos,Spiral)	586.62	116.15
Average RS	B (Contempt,Neg,Circle)	589.65	111.92
High RS	B (Contempt,Neg,Circle)	590.34	118.49

Table A8

Reaction Time: Rejection Sensitivity x Flanker Pairwise Comparison

Rejection Sensitivity	*Contrast*	*Estimate*	*SE*	*Z*	*p*
Average RS	A - B	1.74	1.06	1.64	0.10
High RS	A - B	-3.71	1.91	-1.94	0.05 *

Note: Tukey HSD used to correct for multiple comparisons;
A = Happy, Positive , or Spiral Flankers; B = Contempt, Negative, or Circle Flankers.
Significance: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Table A9

Reaction Time: Congruency x Block Estimated Marginal Means

Block	*Congruency*	*Estimate*	*SD*
Social	Congruent	607.49	119.99
Social	Incongruent	609.12	119.97
Affect	Congruent	577.69	105.20
Affect	Incongruent	591.35	108.10
Neutral	Congruent	573.11	111.02
Neutral	Incongruent	578.26	110.96

Table A10

Reaction Time: Congruency x Block Post Hoc Comparisons

Block	*Contrast*	*Estimate*	*SE*	*Z*	*p*
Social	Cong. – Incong.	-1.62	1.92	-0.85	0.40
Affect	Cong. – Incong.	-13.66	1.89	-7.23	0.001 **
Neutral	Cong. – Incong.	-5.15	1.87	-2.75	0.01 *

Note: Tukey HSD used to correct for multiple comparisons
Significance: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Table A11

Reaction Time: RS x Block Estimated Marginal Means

Rejection Sensitivity	*Block*	*Estimate*	*SD*
Average RS	Social	608.69	117.93
High RS	Social	607.92	126.49
Average RS	Affect	582.85	105.82
High RS	Affect	586.18	109.99
Average RS	Neutral	580.02	110.39
High RS	Neutral	571.34	112.86

Table A12

Reaction Time: RS x Block Pairwise Comparison

Rejection Sensitivity	*Contrast*	*Estimate*	*SE*	*Z*	*p*
Average	Social - Affect	25.84	1.30	19.84	0.0001 ***
Average	Social - Neutral	28.67	1.29	22.15	0.0001 ***
Average	Affect - Neutral	2.83	1.29	2.19	0.07
High	Social - Affect	21.74	2.35	9.23	0.0001 ***
High	Social - Neutral	36.58	2.35	15.59	0.0001 ***
High	Affect - Neutral	14.84	2.33	6.38	0.0001 ***

Note: Tukey HSD used to correct for multiple comparisons

Significance: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Table A13

Reaction Time: Block x Flanker x Congruency Estimated Marginal Means

Block	*Flanker*	*Congruency*	*Estimate*	*SD*
Social	Happy	Congruent	598.61	125.21
Social	Happy	Incongruent	617.07	115.93
Social	Contempt	Congruent	616.38	113.97
Social	Contempt	Incongruent	601.16	123.24
Affect	Positive	Congruent	578.68	105.83
Affect	Positive	Incongruent	590.97	103.17
Affect	Negative	Congruent	576.69	104.56
Affect	Negative	Incongruent	591.72	113.05
Neutral	Spiral	Congruent	568.56	105.81
Neutral	Spiral	Incongruent	580.16	117.17
Neutral	Circle	Congruent	577.65	115.97
Neutral	Circle	Incongruent	576.36	104.42

Table A14

Reaction Time: Block x Flanker x Congruency Pairwise Comparisons

Block	*Flanker*	*Contrast*	*Estimate*	*SE*	*Z*	*p*
Social	Happy	Cong. – Incong.	-18.47	2.71	-6.81	0.0001 ***
Social	Contempt	Cong. – Incong.	15.22	2.71	5.62	0.0001 ***
Affect	Positive	Cong. – Incong.	-12.29	2.67	-4.61	0.0001 ***
Affect	Negative	Cong. – Incong.	-15.03	2.68	-5.61	0.0001 ***
Neutral	Spiral	Cong. – Incong.	-11.60	2.65	-4.37	0.0001 ***
Neutral	Circle	Cong. – Incong.	1.29	2.64	0.49	0.62

Note: Tukey HSD used to correct for multiple comparisons

Significance: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Table A15
Accuracy: Estimated Marginal Means of Block

Block	*Estimate*	*SD*
Social	0.93	0.28
Affect	0.94	0.26
Neutral	0.95	0.22

Table A16
Accuracy: Paired T-tests of Block

Term	*Contrast*	*Estimate*	*SE*	*Z*	*p*
Block	Social - Affect	-0.25	0.05	-5.17	0.0001 ***
Block	Social - Neutral	-0.49	0.05	-9.97	0.0001 ***
Block	Affect - Neutral	-0.25	0.05	-4.72	0.0001 ***

Note: Tukey HSD used to correct for multiple comparisons
Significance: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Table A17
Accuracy: RS x Congruency Estimated Marginal Means

Rejection Sensitivity	*Congruency*	*Estimate*	*SD*
Average RS	Congruent	0.95	0.24
Average RS	Incongruent	0.94	0.25
High RS	Congruent	0.94	0.26
High RS	Incongruent	0.93	0.28

Table A18
Accuracy: RS x Congruency Pairwise Comparison

Rejection Sensitivity	*Contrast*	*Estimate*	*SE*	*Z*	*p*
Average RS	Cong. - Incong.	0.10	0.04	2.48	0.01 *
High RS	Cong. - Incong.	0.21	0.07	2.97	0.0001 ***

Note: Tukey HSD used to correct for multiple comparisons
Significance: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Table A19

Accuracy: Block x Congruency Estimated Marginal Means

Block	*Congruency*	*Estimate*	*SD*
Social	Congruent	0.92	0.28
Social	Incongruent	0.93	0.27
Affect	Congruent	0.95	0.24
Affect	Incongruent	0.93	0.28
Neutral	Congruent	0.96	0.22
Neutral	Incongruent	0.95	0.23

Table A20

Accuracy: Block x Congruency Pairwise Comparison

Block	*Contrast*	*Estimate*	*SE*	*Z*	*p*
Social	Cong. - Incong.	-0.16	0.06	-2.58	0.01 *
Affect	Cong. - Incong.	0.38	0.07	5.29	0.0001 ***
Neutral	Cong. - Incong.	0.25	0.08	3.25	0.0001 ***

Note: Tukey HSD used to correct for multiple comparisons
Significance: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Table A21

Accuracy: RS x Block Estimated Marginal Means

Block	*Rejection Sensitivity*	*Estimate*	*SD*
Social	Average RS	0.93	0.27
Affect	Average RS	0.94	0.26
Neutral	Average RS	0.96	0.22
Social	High RS	0.92	0.30
Affect	High RS	0.94	0.26
Neutral	High RS	0.95	0.24

Table A22

Accuracy: RS x Block Pairwise Comparisons

Rejection Sensitivity	*Contrast*	*Estimate*	*SE*	*Z*	*p*
Average RS	SOCIAL - AFFECT	-0.13	0.05	-2.80	0.01 *
Average RS	SOCIAL - NEUTRAL	-0.50	0.05	-9.56	0.0001 ***
Average RS	AFFECT - NEUTRAL	-0.36	0.05	-6.74	0.0001 ***
High RS	SOCIAL - AFFECT	-0.36	0.08	-4.35	0.0001 ***
High RS	SOCIAL - NEUTRAL	-0.49	0.08	-5.83	0.0001 ***
High RS	AFFECT - NEUTRAL	-0.14	0.09	-1.50	0.29

Note: Tukey HSD used to correct for multiple comparisons

Significance: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Table A23

Accuracy: Block x Flanker Estimated Marginal Means

Block	*Flanker*	*Estimate*	*SD*
Social	Happy	0.93	0.28
Social	Contempt	0.93	0.25
Affect	Positive	0.94	0.22
Affect	Negative	0.94	0.27
Neutral	Spiral	0.95	0.26
Neutral	Circle	0.95	0.23

Table A24

Accuracy: Block x Flanker Pairwise Comparisons

Block	*Contrast*	*Estimate*	*SE*	*Z*	*p*
Social	Happy - Contempt	-0.01	0.06	-0.16	0.88
Affect	Pos. – Neg.	0.00	0.07	0.04	0.97
Neutral	Spiral - Circle	-0.02	0.08	-0.27	0.79

Note: Tukey HSD used to correct for multiple comparisons

Significance: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Table A25
Accuracy: RS x Block x Congruency Estimated Marginal Means

Rejection Sensitivity	*Congruency*	*Block*	*Estimate*	*SD*
Average RS	Congruent	Social	0.93	0.27
Average RS	Incongruent	Social	0.93	0.26
High RS	Congruent	Social	0.91	0.31
High RS	Incongruent	Social	0.93	0.28
Average RS	Congruent	Affect	0.95	0.24
Average RS	Incongruent	Affect	0.93	0.27
High RS	Congruent	Affect	0.95	0.23
High RS	Incongruent	Affect	0.93	0.28
Average RS	Congruent	Neutral	0.96	0.21
Average RS	Incongruent	Neutral	0.96	0.22
High RS	Congruent	Neutral	0.96	0.22
High RS	Incongruent	Neutral	0.94	0.26

Note: Estimate shown as proportion of correct response

Table A26
Accuracy: RS x Block x Congruency Pairwise Comparison

Rejection Sensitivity	*Block*	*Contrast*	*Estimate*	*SE*	*Z*	*p*
Average	Social	Cong. - Incong.	-0.07	0.07	-1.14	0.25
High	Social	Cong. - Incong.	-0.25	0.11	-2.33	0.02 *
Average	Affect	Cong. - Incong.	0.28	0.07	3.98	0.0001 ***
High	Affect	Cong. - Incong.	0.48	0.12	3.83	0.0001 ***
Average	Neutral	Cong. - Incong.	0.11	0.08	1.30	0.19
High	Neutral	Cong. - Incong.	0.39	0.13	3.02	0.0001 ***

Note: Tukey HSD used to correct for multiple comparisons
Significance: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Table A27

Accuracy: Block x Flanker x Congruency Estimated Marginal Means

Flanker	*Congruency*	*Block*	*Estimate*	*SD*
Happy	Congruent	Social	0.92	0.28
Happy	Incongruent	Social	0.93	0.27
Contempt	Congruent	Social	0.92	0.28
Contempt	Incongruent	Social	0.93	0.27
Positive	Congruent	Affect	0.94	0.27
Positive	Incongruent	Affect	0.94	0.24
Negative	Congruent	Affect	0.96	0.21
Negative	Incongruent	Affect	0.91	0.31
Spiral	Congruent	Neutral	0.96	0.20
Spiral	Incongruent	Neutral	0.94	0.24
Circle	Congruent	Neutral	0.95	0.23
Circle	Incongruent	Neutral	0.95	0.22

Note: Estimate shown as proportion of correct responses

Table A28

Accuracy: Block x Flanker x Congruency Pairwise Comparisons

Congruency	*Block*	*Contrast*	*Estimate*	*SE*	*Z*	*p*
Congruent	Social	Happy - Contempt	-0.03	0.09	-0.38	0.70
Congruent	Affect	Pos. – Neg.	-0.52	0.11	-4.77	0.0001 ***
Congruent	Neutral	Spiral - Circle	0.20	0.12	1.74	0.08
Incongruent	Social	Happy - Contempt	0.01	0.09	0.14	0.89
Incongruent	Affect	Pos. – Neg.	0.53	0.09	5.75	0.0001 ***
Incongruent	Neutral	Spiral - Circle	-0.24	0.10	-2.39	0.02 *

Note: Tukey HSD used to correct for multiple comparisons
Significance: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Table A29
N2: Estimated Marginal Means of Block

Block	*Estimate*	*SD*
Social	-2.14	4.78
Affect	-3.26	4.96
Neutral	-2.24	4.58

Table A30
N2: Paired T-tests of Block

Contrast	*Estimate*	*SE*	*Z*	*p*
Social - Affect	1.09	0.08	14.08	< .0001 ***
Social - Neutral	0.07	0.08	0.88	0.38
Affect - Neutral	-1.02	0.08	-13.43	< .0001 ***

Significance: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Table A31

N2: Block x RS Estimated Marginal Means

Rejection Sensitivity	*Block*	*Mean*	SE
Average	Social	-2.71	0.30
High	Social	-1.63	0.57
Average	Affect	-3.49	0.30
High	Affect	-3.04	0.57
Average	Neutral	-2.29	0.30
High	Neutral	-2.19	0.57

Table A32

N2: Block x RS Pairwise Comparison

Contrast	*Estimate*	*SE*	*Z*	*p*
Average RS Social - High RS Social	-1.09	0.64	-1.70	0.15
Average RS Social - Average RS Affect	0.80	0.07	11.32	< .0001 ***
Average RS Social - High RS Affect	0.34	0.64	0.53	0.64
Average RS Social - Average RS Neutral	-0.40	0.07	-5.67	< .0001 ***
Average RS Social - High RS Neutral	-0.50	0.64	-0.79	0.54
High RS Social - Average RS Affect	1.88	0.64	2.94	0.0071 **
High RS Social - High RS Affect	1.43	0.14	10.25	< .0001 ***
High RS Social - Average RS Neutral	0.69	0.64	1.07	0.39
High RS Social - High RS Neutral	0.58	0.14	4.23	< .0001 ***
Average RS Affect - High RS Affect	-0.46	0.64	-0.72	0.55
Average RS Affect - Average RS Neutral	-1.20	0.07	-17.09	< .0001 ***
Average RS Affect - High RS Neutral	-1.30	0.64	-2.03	0.08
High RS Affect - Average RS Neutral	-0.74	0.64	-1.15	0.37
High RS Affect - High RS Neutral	-0.84	0.14	-6.21	< .0001 ***
Average RS Neutral - High RS Neutral	-0.10	0.64	-0.16	0.87

Note: Tukey HSD used to correct for multiple comparison

Significance: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Table A33

N2: Block x Trial Estimated Marginal Means

Trial	*Block*	*Mean*	*SE*
1	Social	-2.40	0.33
2	Social	-2.18	0.33
3	Social	-1.92	0.34
1	Affect	-3.35	0.32
2	Affect	-3.04	0.33
3	Affect	-3.42	0.34
1	Neutral	-2.16	0.32
2	Neutral	-2.21	0.33
3	Neutral	-2.36	0.34

Table A34

N2: Block x Trial Pairwise Comparison

Block	*Contrast*	*Estimate*	*SE*	*Z*	*p*
Social	tri1 - tri2	-0.22	0.13	-1.62	0.24
Social	tri1 - tri3	-0.46	0.15	-2.98	0.0082 **
Social	tri2 - tri3	-0.24	0.14	-1.71	0.2
Affect	tri1 - tri2	-0.32	0.13	-2.43	0.04 *
Affect	tri1 - tri3	0.09	0.15	0.56	0.84
Affect	tri2 - tri3	0.41	0.14	2.93	0.0096 **
Neutral	tri1 - tri2	0.07	0.13	0.50	0.87
Neutral	tri1 - tri3	0.22	0.15	1.46	0.31
Neutral	tri2 - tri3	0.15	0.14	1.11	0.51

Note: Tukey HSD used to correct for multiple comparison

Significance: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Table A35

N2: RS x Congruency x Flanker Estimated Marginal Means

Flanker	*Congruency*	*RS*	*Mean*	*SE*
A	Congruent	Average	-2.74	0.30
B	Congruent	Average	-2.97	0.30
A	Incongruent	Average	-2.88	0.30
B	Incongruent	Average	-2.73	0.30
A	Congruent	High	-2.33	0.58
B	Congruent	High	-2.21	0.58
A	Incongruent	High	-2.23	0.58
B	Incongruent	High	-2.38	0.58

Note: A = Happy, Positive , or Spiral Flankers; B = Contempt, Negative, or Circle Flankers.

Table A36

N2: Congruency x RS x Flanker Pairwise Comparisons

RS	*Flanker*	*Contrast*	*Estimate*	*SE*	*Z*	*p*
Average RS	A	Congruent - Incongruent	0.14	0.08	1.757727	0.08
High RS	A	Congruent - Incongruent	-0.10	0.16	-0.632973	0.53
Average RS	B	Congruent - Incongruent	-0.23	0.08	-2.923479	0.0035 **
High RS	B	Congruent - Incongruent	0.17	0.16	1.064961	0.29

Note: A = Happy, Positive , or Spiral Flankers; B = Contempt, Negative, or Circle Flankers.
Tukey HSD used to correct for multiple comparison
Significance: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Table A37

N2: RS x Congruency x Trial Estimated Marginal Means

RS	*Block*	*Trial*	*Mean*	*SE*
Average RS	SOCIAL	1	-3.14	0.30
Average RS	SOCIAL	2	-2.56	0.30
Average RS	SOCIAL	3	-2.42	0.31
High RS	SOCIAL	1	-1.66	0.58
High RS	SOCIAL	2	-1.80	0.59
High RS	SOCIAL	3	-1.43	0.61
Average RS	AFFECT	1	-3.51	0.30
Average RS	AFFECT	2	-3.41	0.30
Average RS	AFFECT	3	-3.56	0.31
High RS	AFFECT	1	-3.19	0.58
High RS	AFFECT	2	-2.66	0.59
High RS	AFFECT	3	-3.29	0.61
Average RS	NEUTRAL	1	-2.23	0.30
Average RS	NEUTRAL	2	-2.29	0.30
Average RS	NEUTRAL	3	-2.36	0.32
High RS	NEUTRAL	1	-2.09	0.58
High RS	NEUTRAL	2	-2.13	0.59
High RS	NEUTRAL	3	-2.36	0.61

Table A38

N2: Block x Trial x RS Pairwise Comparison

Block	*Trial*	*Contrast*	*Estimate*	*SE*	*Z*	*p*
SOCIAL	1	AVERAGE- HIGH	-1.48	0.65	-2.27	0.023 *
AFFECT	1	AVERAGE- HIGH	-0.32	0.65	-0.50	0.62
NEUTRAL	1	AVERAGE- HIGH	-0.14	0.65	-0.21	0.83
SOCIAL	2	AVERAGE- HIGH	-0.76	0.66	-1.15	0.25
AFFECT	2	AVERAGE- HIGH	-0.76	0.66	-1.14	0.25
NEUTRAL	2	AVERAGE- HIGH	-0.16	0.66	-0.24	0.81
SOCIAL	3	AVERAGE- HIGH	-0.98	0.69	-1.43	0.15
AFFECT	3	AVERAGE- HIGH	-0.27	0.69	-0.39	0.7
NEUTRAL	3	AVERAGE- HIGH	0.00	0.68	0.00	1

Note: Tukey HSD used to correct for multiple comparison
Significance: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Appendix II: Supplemental Figures

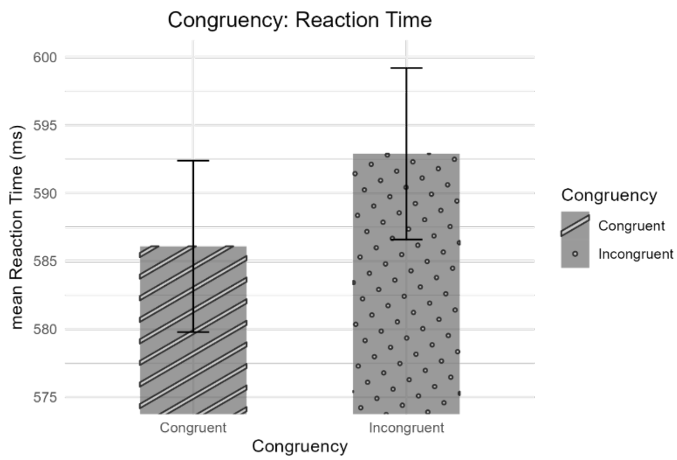

Figure A1 *Reaction Time: Main effect of Congruency*
Note: Error bars represent standard error of the mean.

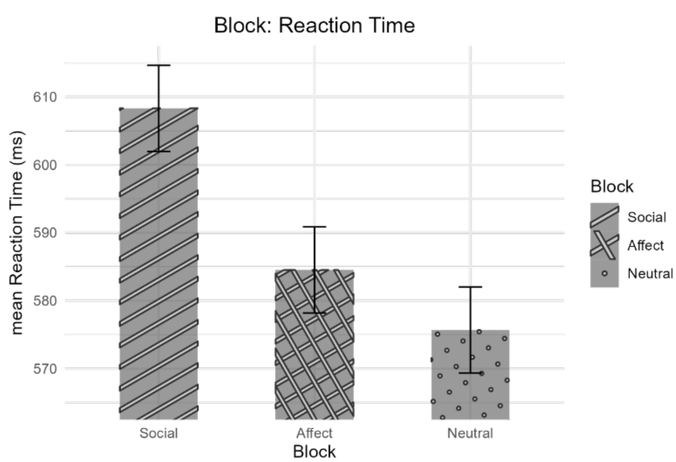

Figure A2 *Reaction Time: Main effect of Block*
Note: Error bars represent standard error of the mean.

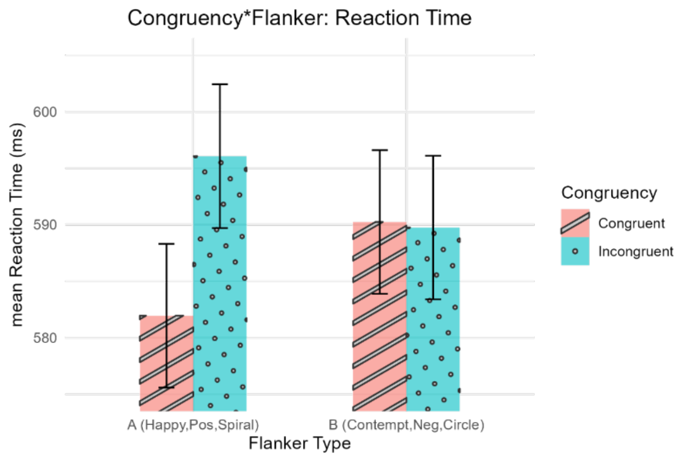

Figure A3 *Reaction Time: Congruency x Flanker Interaction*
Note: Error bars represent standard error of the mean.

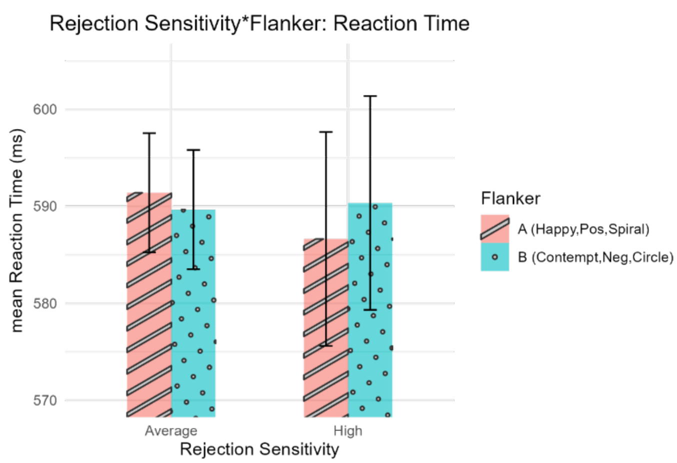

Figure A4 *Reaction Time: Rejection Sensitivity x Flanker Interaction*
Note: Error bars represent standard error of the mean.

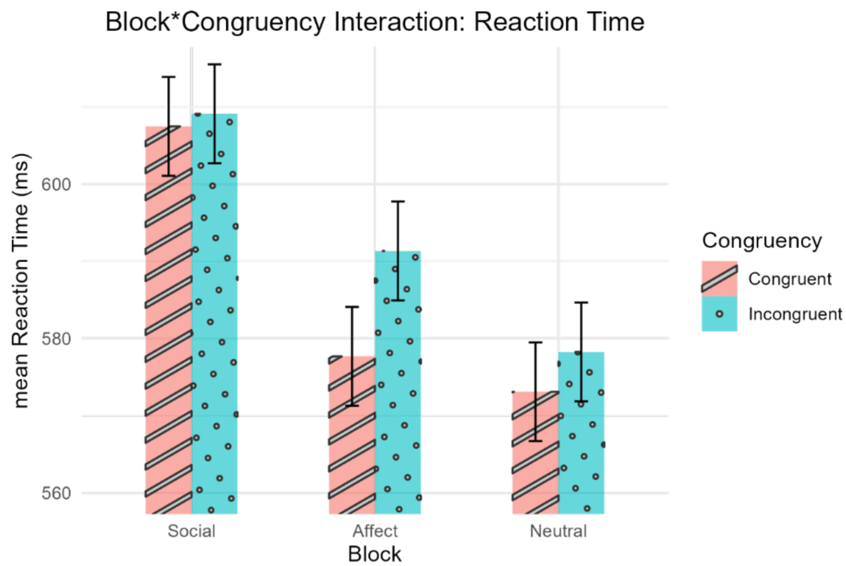

Figure A5 *Reaction Time: Block x Congruency Interaction*
Note: Error bars represent standard error of the mean.

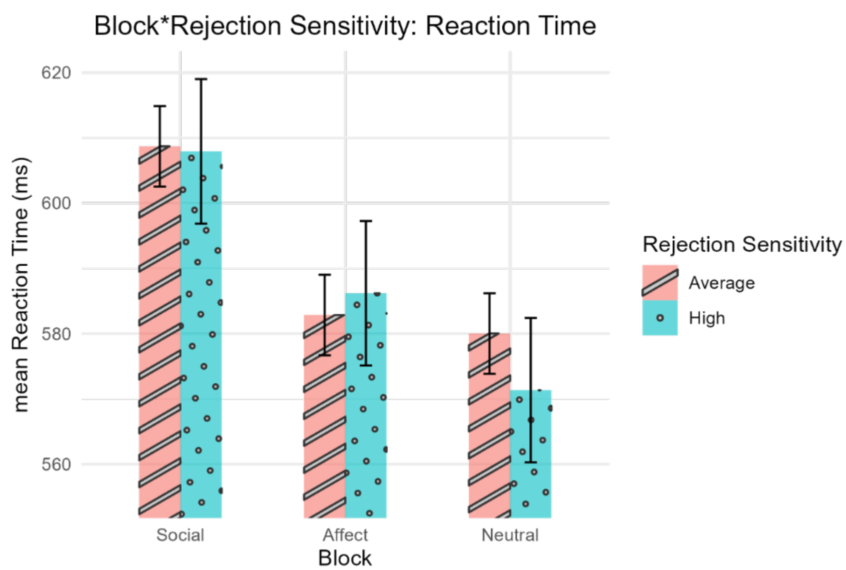

Figure A6 *Reaction Time: Block x Rejection Sensitivity Interaction*
Note: Error bars represent standard error of the mean.

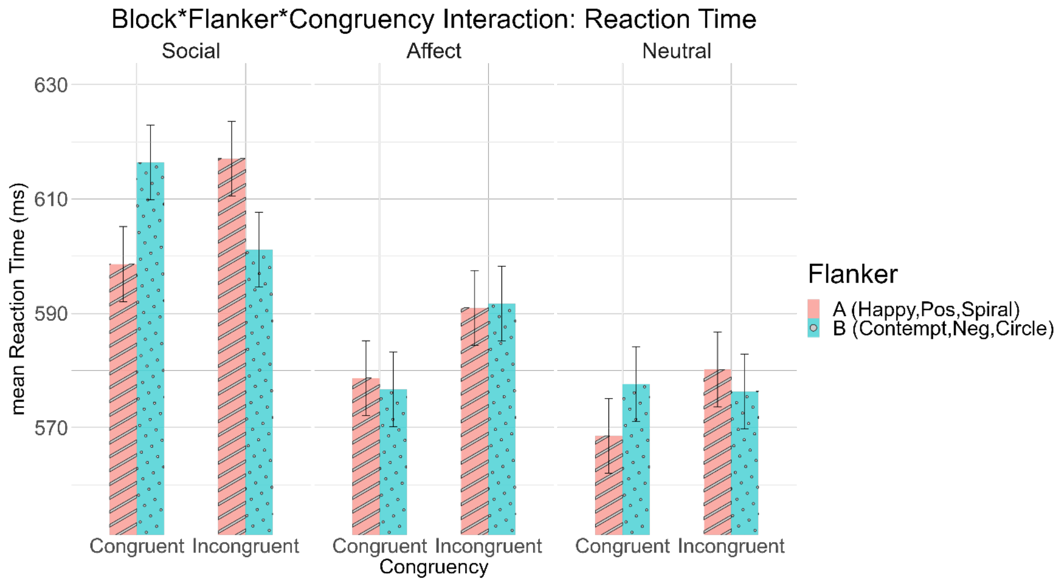

Figure A7 *Reaction Time: Block x Flanker x Congruency Interaction*
Note: Error bars represent standard error of the mean.

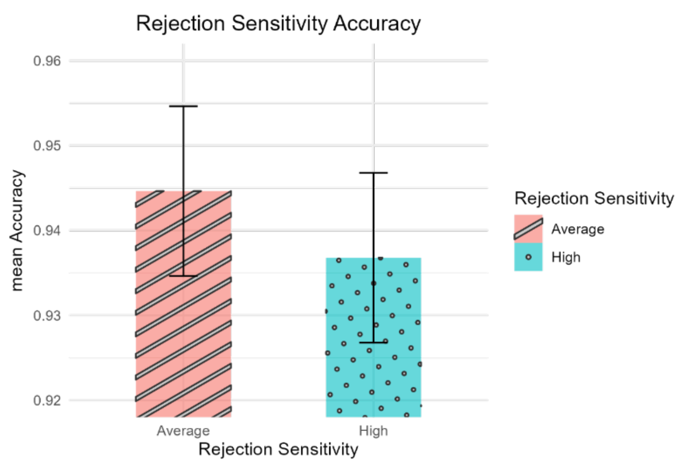

Figure A8 *Accuracy: Main Effect of Rejection Sensitivity*
Note: Error bars represent standard error of the mean.

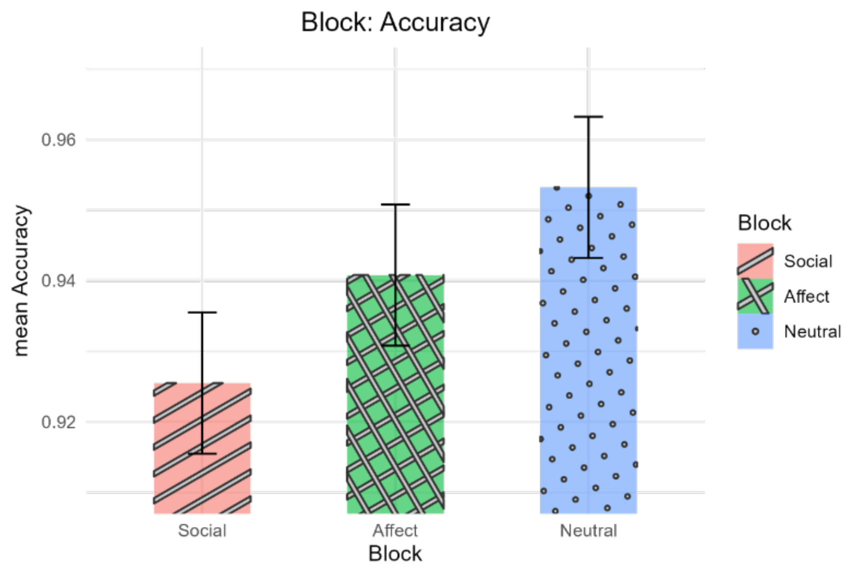

Figure A9 *Accuracy: Main Effect of Block*
Note: Error bars represent standard error of the mean.

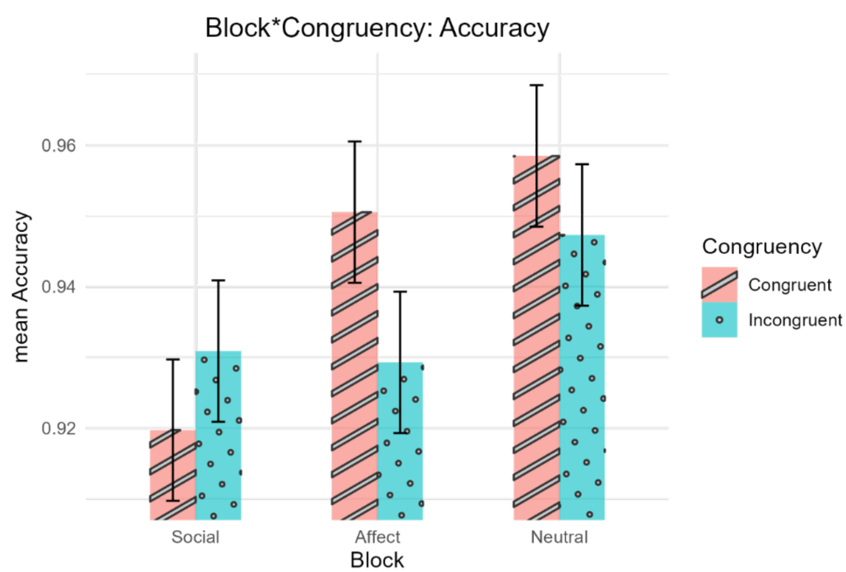

Figure A10 *Accuracy: Block x Congruency Interaction*
Note: Error bars represent standard error of the mean.

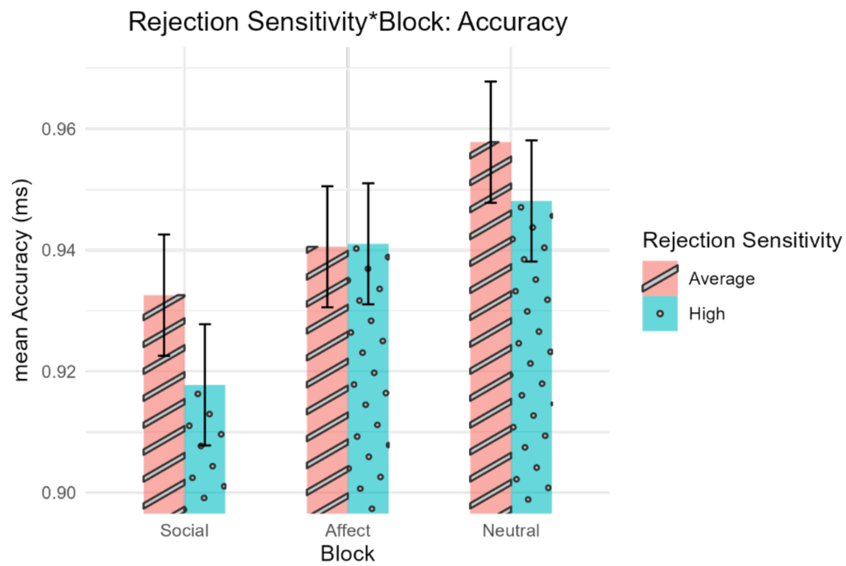

Figure A11 *Accuracy: Rejection Sensitivity x Block Interaction*
Note: Error bars represent standard error of the mean.

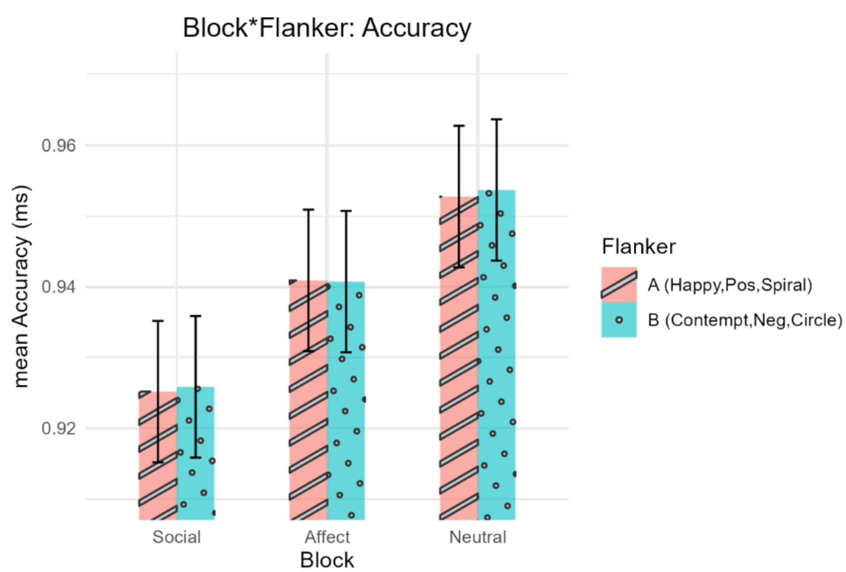

Figure A12 Accuracy: Block x Flanker Interaction
Note: Error bars represent standard error of the mean.

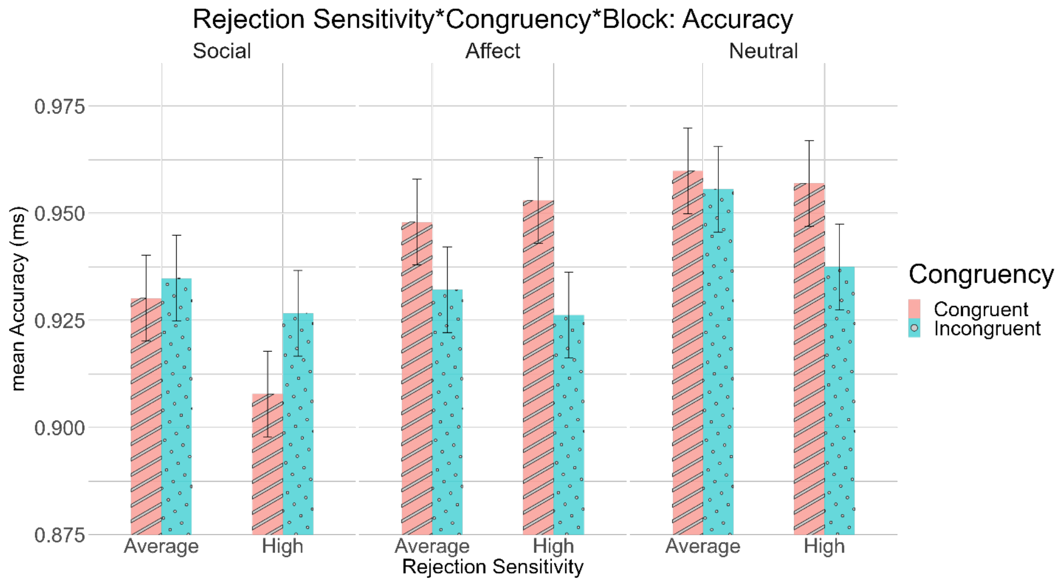

Figure A13 *Accuracy: Rejection Sensitivity x Congruency x Block Interaction*
Note: Error bars represent standard error of the mean.

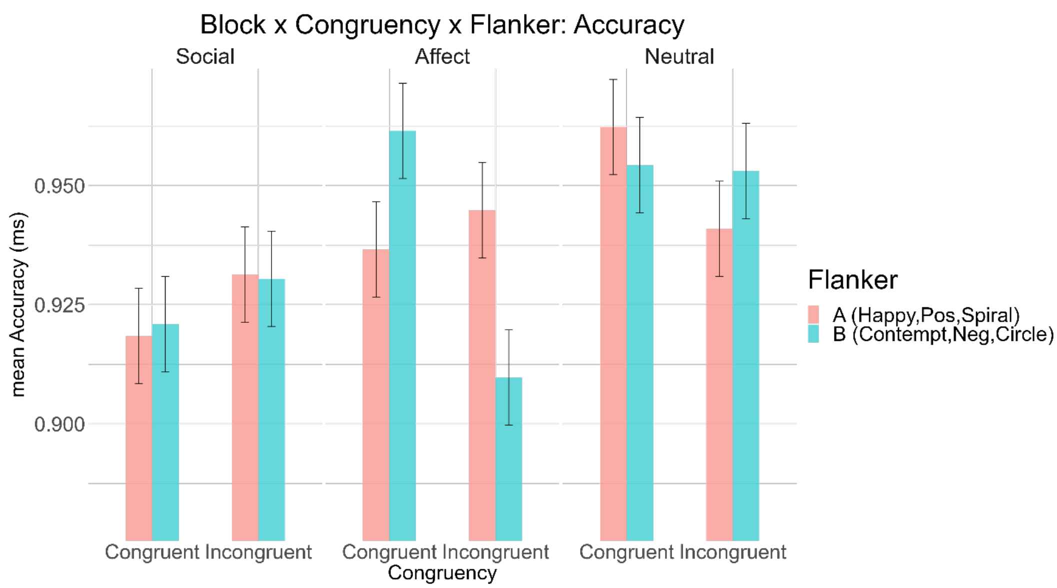

Figure A14 *Accuracy: Block x Congruency x Flanker Interaction*
Note: Error bars represent standard error of the mean.

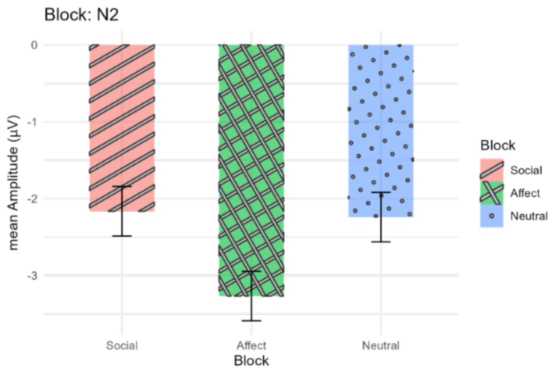

Figure A15 *N2: Main Effect of Block*
Note: Error bars represent standard error of the mean.

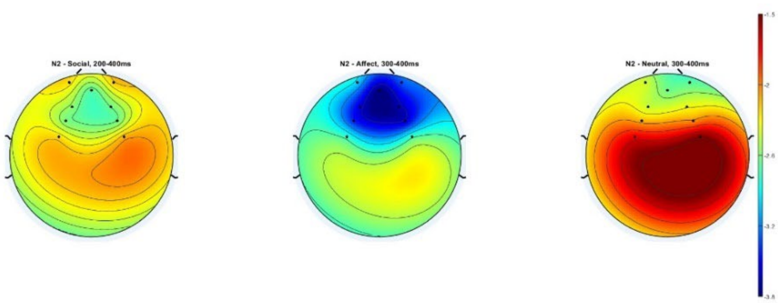

Figure A16 *Topographical Scalp Maps: Block*
Note: Left = Social; Middle = Affect; Right = Neutral;

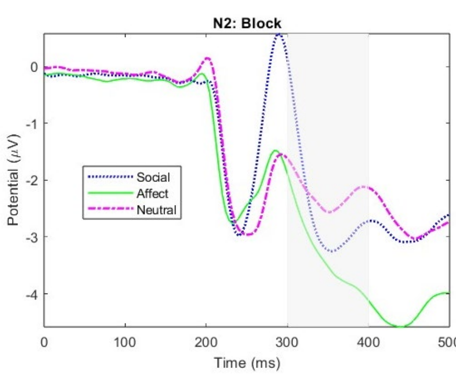

Figure A17 *N2 Waveforms: Block*
Note: Waveforms across time over front-central leads. N2 time-window shown highlighted in grey.

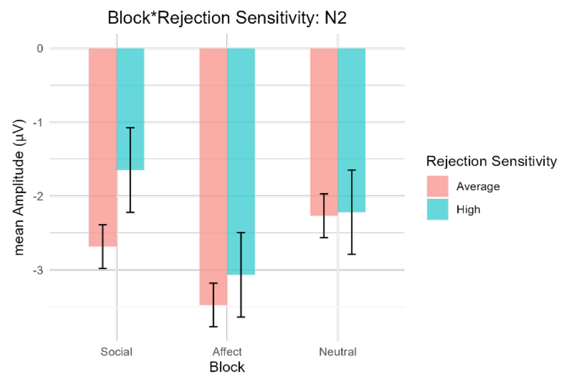

Figure A18 *N2: Block x Rejection Sensitivity Interaction*
Note: Error bars represent standard error of the mean.

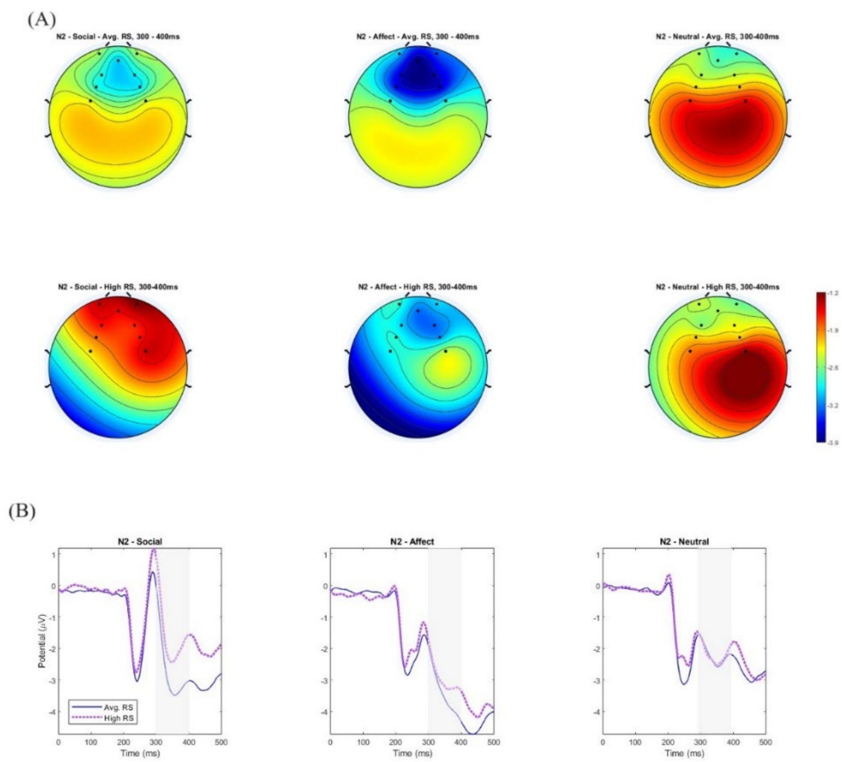

Figure A19 *N2: Block x Rejection Sensitivity :Scalp Topography and Waveform plots*
Note: (A) Topographical Scalp Maps averaged over 300-400ms. First Row: Left = Average RS, Social block; Middle = Average RS, Affect block; Right = Average RS, Neutral Block; Second Row: Left = High RS, Social block; Middle = High RS, Affect block; Right = High RS, Neutral block; (B) Waveform plots averaged over ROI; N2 highlighted in grey; Left = Social block; Middle = Affect block; Right = Neutral block;

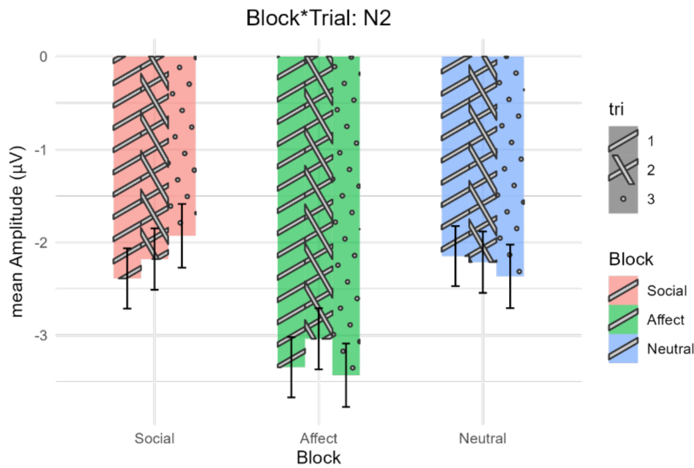

Figure A20 *N2: Block x Trial Interaction*
Note: Error bars represent standard error of the mean.

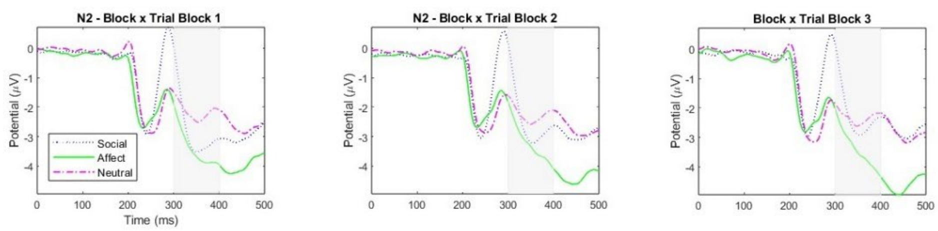

Figure A21 *N2 Waveform plots: Block x Trial*
Note: Waveforms averaged over ROI; N2 indicated in grey; Left = Trial block 1; Middle = Trial block 2; Right = Trial block 3;

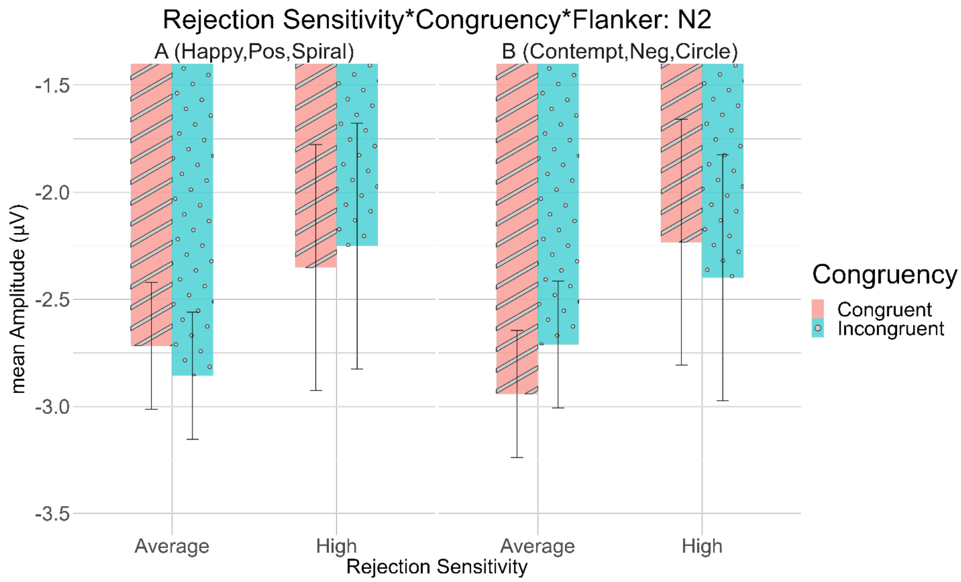

Figure A22 *N2: Rejection Sensitivity x Congruency x Flanker Interaction*
Note: Error bars represent standard error of the mean.

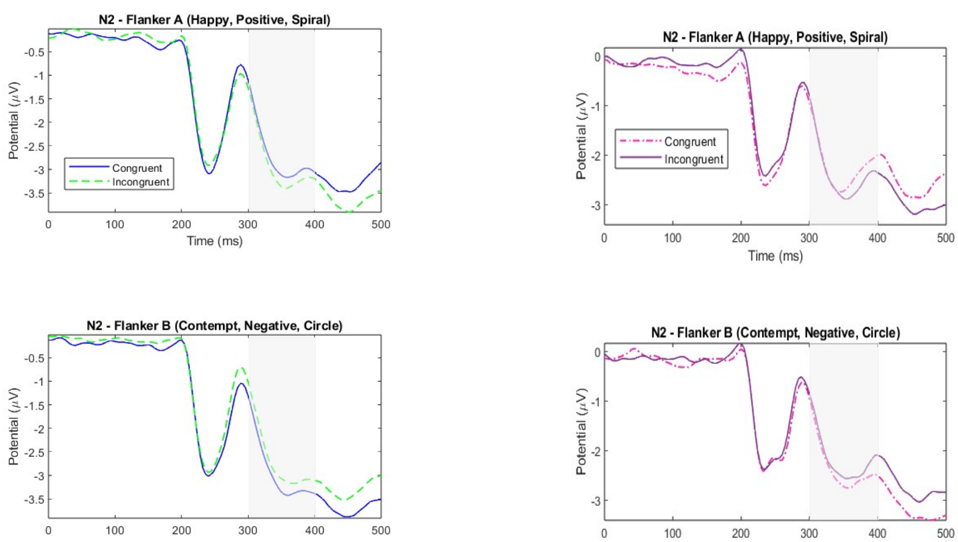

Figure A23 *N2 Waveform plots: RS x Congruency x Flanker*
Note: Waveforms averaged over ROI; N2 indicated in grey; First Row: Left = Average RS, Flanker A; Right = High RS, Flanker A; Second Row: Left = Average RS, Flanker B; Right = High RS, Flanker B;

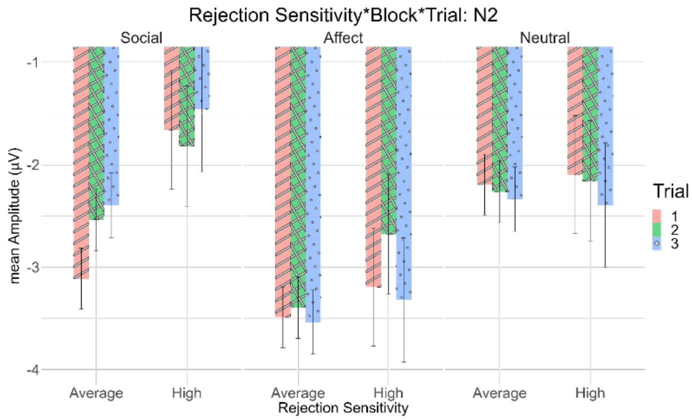

Figure A24 *N2: Rejection Sensitivity x Block x Trial Interaction*
Note: Error bars represent standard error of the mean.

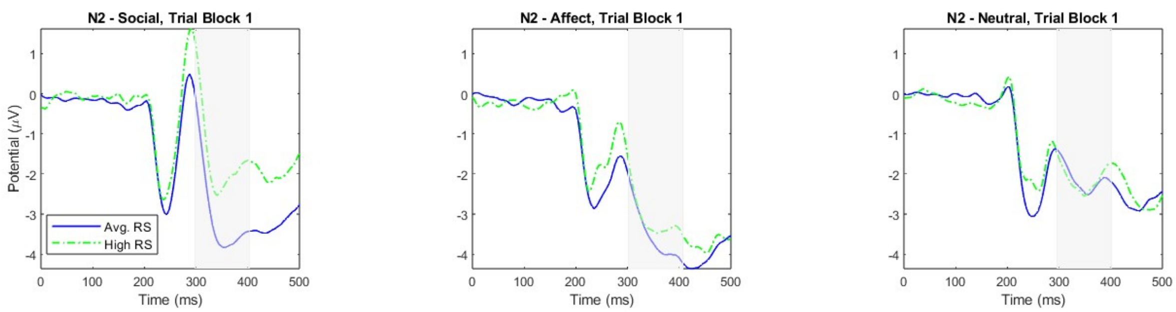

Figure A25 *N2 Waveform Plots: RS x Block x Trial*
Note: Waveform plots averaged over ROI; N2 indicated in grey; Left = Trial block 1, Social; Middle = Trial block 1, Affect; Right = Trial block 1, Neutral;

Appendix III: IRB Approval Letter

UNIVERSITY of SOUTH FLORIDA

APPROVAL

May 20, 2022

Rachel Gaynor

Dear Rachel Gaynor:

On 5/20/2022, the IRB reviewed and approved the following protocol:

Application Type:	Initial Study
IRB ID:	STUDY004148
Review Type:	Expedited 4, 7
Title:	The Relationship Between Rejection Sensitivity and Higher Order Cognitive Functions
Approved Protocol and Consent(s)/Assent(s):	• RSEF Protocol Version 1 5-18-2022 .docx; • 4148 RSEF Informed Consent; Approved study documents can be found under the 'Documents' tab in the main study workspace. Use the stamped consent found under the 'Last Finalized' column under the 'Documents' tab.

Within 30 days of the anniversary date of study approval, confirm your research is ongoing by clicking Confirm Ongoing Research in BullsIRB, or if your research is complete, submit a study closure request in BullsIRB by clicking Create Modification/CR.

In conducting this protocol you are required to follow the requirements listed in the INVESTIGATOR MANUAL (HRP-103).

Sincerely,

Jennifer Walker
IRB Research Compliance Administrator

Institutional Review Boards / Research Integrity & Compliance
FWA No. 00001669
University of South Florida / 3702 Spectrum Blvd., Suite 165 / Tampa, FL 33612 / 813-974-5638