Boredom, Interoceptive Ability, and Emotional Eating

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Boredom, Interoceptive Ability, and Emotional Eating

by

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DEDICATION

This dissertation is dedicated to the mentors, friends, and family who have supported me throughout this journey. I would like to offer my special thanks to Dr. Diana Rancourt for her support and guidance throughout my graduate training. She dedicated a tremendous amount of time and energy into my professional development, and I am very grateful. I would also like to express my gratitude for my dissertation committee members, Drs. Jonathan Rottenberg, Thomas Brandon, Kristen Salomon, and Brent Small, for their guidance throughout this process, as well as their flexibility when a global pandemic changed my plans. I am grateful to all my wonderful lab mates for their friendship, validation, and laughs. I would also like to thank Dr. Jacque Carlson, for her unwavering belief in me as a scientist and as a person, when I was an eager, but self-doubting undergraduate student. I am also beyond grateful to my wonderful partner and daughter, for the daily silliness and smiles, and to my family and friends for their support and encouragement. Finally, I would like to thank all of the study participants who shared their time, making this research possible.
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ABSTRACT

Emotional eating is a commonly described phenomenon reported by individuals across the weight spectrum. Not only does existing evidence suggest it is not an effective emotion regulation strategy, but emotional eating is also associated with difficulty losing weight during weight loss interventions and other negative health outcomes. The majority of existing work in the area of emotional eating has focused on the broad dimensions of negative and positive affect. Yet, there are data suggesting that different emotions appear to produce different changes in eating behaviors, suggesting the importance of investigating the influence of discrete emotions on eating. The lack of understanding regarding eating in response to boredom in particular, is a major gap in the current literature. Moreover, little is known about individual characteristics that could make some individuals more vulnerable to “bored eating.” Given data suggesting interoception as central to other forms of dysregulated eating, as well as its theoretical relevance, the current study focused on interoceptive ability as a vulnerability factor for bored eating. Utilizing an experimental design, Study 1 examined boredom as a trigger of snacking behaviors in a laboratory setting. Due to COVID-19, data collection was terminated early, but preliminary results provided tentative support for a causal role of boredom in food consumption. Study 2 was a cross-sectional, correlational extension of Study 1. Consistent with predictions, Study 2 found that boredom proneness was a significant predictor of emotional eating, even when accounting for the broad dimensions of negative and positive affect. Inconsistent with hypotheses, the association between boredom proneness and emotional eating was not moderated by interoception. Findings have implications for the prevention and treatment of emotional eating.
INTRODUCTION

As early as the 1950s, researchers recognized the frequency with which individuals endorse eating in response to negative emotions, even in the absence of internal hunger cues (Hamburger, 1957). Although the focus at this time was largely on emotional eating (a term used to describe eating in response to an emotional state, as opposed to an internal hunger cue) among those with obesity, it has since become clear that individuals across the weight spectrum engage in this problematic behavior (Evers et al., 2013; Macht et al., 2005). In subsequent decades, a great deal of research has been devoted to better understanding the associations between affect and disordered eating.¹

Many of the most well-supported theories of disordered eating describe negative affect as an antecedent to disordered eating and/or highlight affect modulation as an important maintenance factor; namely the escape model (Heatherton & Baumeister, 1991), the affect regulation model (Polivy & Herman, 1993), the cognitive-behavioral model (Fairburn et al., 2003), and the dual pathway model (Stice, 2001). These theoretical models most strongly argue for the role of emotions in triggering overeating behaviors. As a result of the theoretical contributions by these researchers, a significantly greater volume of empirical work has been devoted to understanding the role of affect in overeating, as compared to restrictive eating. Although this theoretical work was originally intended to explain the etiology and maintenance

¹ Affect is used here as an umbrella term capturing moods, emotions, and stress responses (Gross, 2007). In contrast, "emotion" is used to refer to specific person-situation transactions that compel attention, are relevant to current goals, and result in a coordinated, multifaceted responses (i.e., changes in experience, behavior, and physiology), which subsequently change the person-situation transaction (Gross, 2007).
of clinical eating disorders (e.g., binge eating disorder), many of the same processes have been found to apply to dysregulated eating in the general population (Blackburn et al., 2006; Haedt-Matt et al., 2014; Lindeman et al., 2001; Waller & Osman, 1998).

For purposes of clarity, it is important to distinguish between binge eating and other forms of dysregulated eating. “Binge eating” refers to eating what others would consider an excessive amount of food given the context, in a short period of time, accompanied by a sense of loss of control (American Psychiatric Association, 2013). The established criteria for a binge eating episode includes that the amount of food consumed is objectively larger than what “most people” would eat in a similar period of time, under similar circumstances. However, even if this threshold for an objective binge episode is not met, a person may still describe what is considered a subjective binge episode. In this case, the amount of food is not considered atypical, but the individual experiences a loss of control. In contrast, “overeating” can be defined as eating in the absence of hunger/ beyond the point of satiety, without a loss of control. The focus of the current study will be on emotional eating, which can manifest as many forms of dysregulated eating (all occurring in response to an emotion, as opposed to hunger cues), such as eating at unplanned times, eating unplanned foods, or eating a quantity larger than intended.

Emotional eating is a commonly described phenomenon reported by individuals across the weight spectrum. Moreover, reports of emotional eating appear to have increased in recent decades (Van Strien et al., 2009). The importance of studying emotional eating is highlighted by research suggesting that emotional eating is detrimental to physical and emotional health. Engagement in emotional eating is not an effective emotion regulation strategy, as mood actually worsens on average following such episodes (Haedt-Matt & Keel, 2011; Haedt-Matt et al., 2014). Additionally, emotional eating is associated with difficulty losing weight during weight
loss interventions (Butryn et al., 2009), and is prospectively associated with development of an eating disorder, weight gain (though this has not been consistently replicated), and other health outcomes (e.g., high blood pressure; Koenders & van Strien, 2011; Kornfeld, 2016; Risica et al., 2021; Stice et al., 2002). Thus, it is important to understand the triggers for emotional eating to improve prevention efforts and better educate those at risk. Intervention efforts for emotional eating, which commonly occur as part of weight loss treatment as well as eating disorder interventions, also could be improved by this work.

Previous Research on Affect and Overeating

The majority of existing work in the area of emotional eating has focused on negative affect. Correlational studies have found consistent support for associations between negative affect and reports of overeating and binge eating (Henderson & Huon, 2002; Shepherd & Ricciardelli, 1998). Moreover, chronic negative affect prospectively predicts binge eating onset among adolescent females (Stice et al., 2000; Stice et al., 1998). Support for the role of negative affect as a proximal antecedent to binge eating is demonstrated by ecological momentary assessment studies (EMA; Engelberg et al., 2007; Hilbert & Tuschen-Caffier, 2007; Johnson et al., 1995; Smyth et al., 2007) and a meta-analysis of EMA studies supported a significant, medium-sized effect of negative affect (Haedt-Matt & Keel, 2011). Likewise, experimental studies suggest that negative mood inductions increase consumption of highly palatable foods (e.g., chocolate; Chua et al., 2004) and high fat foods (Goldschmidt et al., 2011), as well as overeating and loss of control eating (Agras & Telch, 1998; Cardi et al., 2015; Telch & Agras, 1996).

Recently, positive affect has also gained attention as it relates to eating behaviors. Based on the two-factor model (Watson et al., 1988), positive affect is considered a separate dimension
of affect (i.e., is not equivalent to low negative affect), and thus has been examined as a unique predictor of eating behaviors. Among a group of undergraduate students, positive emotions were commonly endorsed as leading to emotional eating episodes (Zhu et al., 2013). The link between positive emotions and subsequent caloric intake has also been observed in food diary studies (Patel & Schlundt, 2001). Likewise, researchers utilizing positive mood inductions in the laboratory have observed greater consumption of unhealthy foods in response to positive, compared to neutral, affect (Cardi et al., 2015; Evers et al., 2013). However, findings from EMA studies of patients with bulimia nervosa also support the role of low positive affect as an antecedent to disordered eating (Smyth et al., 2007). This suggests that individual differences, as well as contextual differences, likely play a role in how positive affect influences eating, with high or low levels appearing to impact consumption. Of note, among adults with overweight or obesity, episodes of eating in response to positive emotions, though problematic for weight regulation, are not associated with psychological wellbeing (Braden et al., 2018). In contrast, negative-emotion based eating is associated with poorer psychological wellbeing, greater eating disorder symptoms, and emotion regulation difficulties (Braden et al., 2018).

Limitations of the Current Literature

Despite the tremendous progress being made in the area of emotional eating in recent decades, the extant research in this area continues to have a number of notable limitations. First, the literature is lacking in investigations of who might be at greatest risk of emotional eating. The most commonly explored individual difference has been dietary restraint. Several meta-analytic reviews have found support for the notion that those attempting to restrict caloric intake (i.e., dietary restraint) are more susceptible to emotional eating than those reporting low dietary restraint (Cardi et al., 2015; Evers et al., 2018). However, Evers et al. (2018) noted that
significant heterogeneity exists in emotional eating (i.e., whether and which negative emotions trigger eating), even among groups of restrained eaters. Additionally, it remains unclear why many restrained eaters are more likely to engage in emotional eating than unrestrained eaters. This highlights the importance of better understanding what other individual characteristics might be associated with emotional eating, such as internal awareness of hunger/satiety cues, a focus of the proposed study.

A second notable limitation is that the existing literature has suffered from an over-reliance on broad dimensions of positive and negative affect. Recently, it has been recognized that moving beyond general negative and positive affect may provide a more nuanced understanding of the associations between affect and overeating. This effort comes from research exploring a “trade off” hypothesis of binge eating, which proposes that engagement in binge eating is maintained not by a global decrease in negative affect following binge episodes (which has not been consistently supported; Haedt-Matt & Keel, 2011), but instead by the perceived benefits of “trading” one negative state, such as anxiety, for another, such as guilt (Kenardy et al., 1996). Though there is limited and somewhat contradictory empirical evidence for this viewpoint (Haedt-Matt & Keel, 2011), this work has shed light on the importance of moving away from global affect ratings and instead focusing on how specific affective states may play a role in eating behaviors.

Researchers have begun exploring the effects of specific affective states on eating behaviors, but the quantity and quality of this work varies depending on the mood state under study. For example, stress has been one of the most commonly studied triggers of emotional eating. Findings consistently suggest that perceived stress is associated with the desire to binge eat (Chua et al., 2004), greater food consumption (Costarelli & Patsai, 2012; Hill et al., 2021;
Macht et al., 2005; Royal & Kurtz, 2010), and eating unhealthy foods (Wallis & Hetherington, 2009). Relatively fewer researchers have examined the role of sadness, guilt, and anxiety in overeating and binge eating, but EMA data suggest that the trajectories of some negative emotions, such as guilt, are associated with binge eating episodes, whereas others, such as fear, are not (Berg et al., 2015). Likewise, experimental work suggests differences in food consumption following experimental paradigms designed to elicit anger versus anxiety (Schneider et al., 2010). Overall, extant data do not support that ratings of global negative affect are sufficient to describe the phenomenon of emotional eating. Instead, specific emotions appear to produce different changes in eating behaviors, suggesting the importance of investigating the influence of discrete emotions on eating.

Boredom and Emotional Eating

The lack of understanding regarding eating in response to boredom in particular is a major gap in the current literature. Although the potential association between boredom and overeating was noted as early as the 1940s (Hutton, 1948), it was not until the late 1980s that boredom gained attention from researchers in this area. This increase in interest was likely related to the development of validated measures of “boredom proneness,” which is described as a tendency to experience boredom in a variety of contexts. Still, most research has utilized correlational designs, with few examining the effects of boredom on eating experimentally. This is a notable limitation in the existing literature, as boredom may be one of the most important emotional states to consider in the context of emotional eating.

Though most individuals have a general idea of what it means to be bored, it will be helpful to first describe what is meant by “boredom” from a scientific perspective. Boredom is a distinct emotional state, as it represents an acute response to the environment, resulting from a
mismatch between one’s goals and current state of affairs, with predictable changes in
cognitions, behavior, and physiology (Bench & Lench, 2019; Van Tilburg & Igou, 2017).
Research supports that boredom is distinct from other related constructs such as anhedonia,
apathy, sadness, anger, frustration, fear, depression, shame, regret, and disappointment
(Goldberg et al., 2011; Van Tilburg & Igou, 2017).

Many have argued that boredom serves important functions in daily life. Elpidorou
(2018, p. 333) notes “Boredom functions optimally when it (a) informs us of the presence of a
boring situation and (b) successfully motivates us to pursue a more interesting, fulfilling, or
meaningful situation.” This description corresponds to a long history of boredom being primarily
characterized by a lack of meaning. A more recent account provides compelling evidence that
boredom not only involves a component of meaning, but also attention (Westgate & Wilson,
2018), suggesting that the experience of boredom not only tells us whether our current activities
(behavioral or mental) are those that we want to engage in, but also whether we are able to focus
on the activity. Thus, boredom not only occurs when an activity is not meaningful, but also when
people are not able to engage in what might be an otherwise meaningful activity (Damrad-Frye

Boredom is a ubiquitous experience and is frequently associated with problematic
behaviors. Adolescents report feeling bored over half the time in school (Mann & Robinson,
2009; Nett et al., 2011) and adults also report often feeling bored at work (Loukidou et al., 2009).
Boredom is associated with risk taking, substance use, depressive symptoms, job burnout, school
drop-out, unsafe driving, and self-injury (Kılıç et al., 2020; Lee & Zelman, 2019; Nederkoorn et
al., 2016; Oxtoby et al., 2019; Reschly & Christenson, 2006; Sousa & Neves, 2020; van Hooiff &
van Hooiff, 2014; Weybright et al., 2015). Of importance to research on disordered eating, studies
suggest that 66% of those endorsing a recent binge eating episode describe boredom as a trigger (Vanderlinden et al., 2001), surpassing anxiety and sadness. Others have supported the frequency with which people describe eating when bored (Abraham & Beumont, 1982). Using open-ended questions (i.e., “Please tell us the 4 things you are most likely to do if you are feeling…”) undergraduates reported eating in response to boredom more often than any other emotion assessed (Koball et al., 2012). Additionally, boredom proneness is associated with self-reported emotional eating (Crockett et al., 2015). Given the correlational nature of this work, understanding of directionality is limited.

One way to capture whether boredom is a proximal antecedent to emotional eating is to assess these behaviors in the natural environment using systematic prompts. EMA research suggests that boredom is a proximal antecedent to unplanned snacking (unintended foods or unplanned times), dietary lapses during behavioral weight loss treatment, and overeating behaviors (Carels et al., 2001; Goldstein et al., 2018; Grenard et al., 2013). Though EMA methodology has many advantages, it cannot assess the degree to which boredom was the cause of the dysregulated eating patterns observed.

To date, only four studies, from three publications, have experimentally examined the role of boredom in food consumption. Abramson & Stinson (1977) investigated whether those with obesity would eat more under conditions of boredom than those of a healthy weight status. All participants were first given a pre-load of sandwiches to ensure that any ensuing eating behaviors were not due to hunger cues. Subsequently, they engaged in a boring or neutral task during which snacks were available. Results suggested that both individuals with obesity and those of a healthy weight status ate significantly more during a boring task compared to a neutral task. These results were supported more recently by Havermans and colleagues using a repeated
measures design (2015). Participants came to the research lab on two separate occasions and watched either a 1-hour documentary (neutral) or an 85 second clip from the same documentary on loop for 1 hour (boring condition). Results suggested that participants ate significantly more candy when bored. The findings from these two studies suggest boredom is associated with increased snack and sweet food consumption. Still, there remains variability in emotional eating in response to boredom and identifying who might be at greatest risk can assist with emotional eating prevention efforts.

**Individual Differences in Eating in Response to Boredom**

Attempting to better understand individual differences in “bored eating,” Moynihan and colleagues (2015) recently conducted a series of experiments. The first study, a daily diary study, supported previous findings that state boredom was related to increased calorie consumption. The second study explored consumption of highly palatable foods in response to boredom, compared to a sad mood condition, hypothesizing that there would be greater consumption in response to boredom. They further hypothesized that this effect would be most pronounced among participants scoring high on a measure of self-consciousness due to the perceived need by these individuals to escape their own self-consciousness. Self-consciousness refers to the extent to which people spend time thinking about and paying attention to aspects of themselves, such as their own beliefs, goals, values, expressions, postures, behaviors, or appearance (Fenigstein et al., 1975). Their hypothesis was supported; participants higher on self-consciousness were most likely to engage in “bored eating.” Notably, no effect of self-consciousness was found for those in the sad mood condition.

Theoretical work sheds light on why individuals may overeat in response to boredom, and why self-consciousness might play a role. Specifically, the escape model of disordered
eating (Heatherton & Baumeister, 1991) suggests that the need to avoid experiencing an aversive self-awareness is at the root of binge-type eating behaviors. Specifically, the model proposes that those with greater self-consciousness are most likely to engage in comparisons between the ideal and actual self, which frequently leads to negative affect. This negative affect leads to the urge to escape self-awareness by engaging in cognitive narrowing. Cognitive narrowing shifts attention away from higher level thinking toward the immediate environment, which helps individuals to “escape” negative self-appraisals. In turn, the theory proposes that cognitive narrowing takes attention away from dietary monitoring, which decreases inhibitions and leads to overeating.

Aspects of this model have been tested and received empirical support in clinical and nonclinical samples (Blackburn et al., 2006; Engelberg et al., 2007; Rosenbaum & White, 2016). Likewise, this theory is supported by data described above suggesting those with greater self-consciousness were more likely to engage in emotional eating (Moynihan et al., 2015).

This “escape” process may be particularly likely to occur for those experiencing boredom. Being left with one’s own thoughts is often described as aversive. Female undergraduates rate boredom as the emotion producing the greatest amount of discomfort (Vanderlinden et al., 2001). Boredom is also more likely to co-occur with negative emotions than with positive emotions (Chin et al., 2017). One study found that on average, participants chose to willingly shock themselves ~22 times while watching a 60 minute video designed to induce boredom compared to only ~two times on average during a non-boring video (Havermans et al., 2015). A follow-up study found that this apparent willingness to engage in any activity, even a painful one, to escape boredom, was specific to boredom and did not occur during a sad mood.

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2 Being left with one’s own thoughts is described as more enjoyable if given cues on pleasurable things to think about (Alahmadi et al., 2017).
condition (in a general undergraduate sample; Nederkoorn et al., 2016). It is likely the case that boredom, by its nature, exacerbates the experience of an aversive self-awareness. In the absence of a meaningful activity, there is greater opportunity to engage in self-reflection. For some, this self-reflection may focus on discrepancies between the ideal and actual self. The experience of boredom also may lead to more specific reflections related to being in a situation characterized by a lack of meaning or fulfillment. Thus, a tendency to engage in emotional eating during states of boredom is a theoretically supported consequence, particularly for those with greater self-consciousness. This work has shed light on one important trait-level difference that may promote “bored eating”; however, more work is needed in this area, as there are other potentially relevant individual differences that have been overlooked.

**Interoceptive Ability**

Many individuals who engage in disordered eating not only report heightened self-consciousness (Bauer & Anderson, 1989; Palmieri et al., 2021; Weisberg et al., 1987), which puts them at risk for emotional eating, but also poor awareness of internal physiological cues. Previously, this was referred to as deficits in “interoceptive awareness,” and this was considered synonymous with the objective ability to detect internal cues. However, recent definitional clarifications highlight important distinctions between these two concepts. Interoceptive awareness is most accurately defined as the *metacognitive awareness* of performance at detecting internal states. Interoceptive awareness captures the strength of correspondence between interoceptive accuracy (performance measured objectively; e.g., objective assessment of ability to detect pain) and interoceptive sensibility (beliefs about interoceptive ability, e.g., response to questions such as “do you think you know when you are experiencing pain?”). If accuracy and sensibility closely correspond, interoceptive awareness is considered strong. If the
correspondence is low (e.g., self-reported strong interoceptive ability, but low accuracy when measured objectively), interoceptive awareness is considered poor. In studies of the association between deficits in this area and disordered eating, researchers have most commonly captured interoceptive sensibility (self-report). A relatively small number of studies have assessed interoceptive accuracy.

Nonetheless, based on the extant data, poor interoceptive sensibility has been supported as a risk factor for all types of disordered eating using cross-sectional, longitudinal, and experimental methodologies (Jenkinson et al., 2018; Leon et al., 1993; Leon et al., 1995; Sysko et al., 2007). Moreover, network analyses also support interoception as a central component of eating disorder symptomatology (Monteleone et al., 2019; Olutunji et al., 2018). Deficits in the ability to detect hunger/satiety and more general internal states (e.g., pain) appear to be associated with disordered eating (Eshkevari et al., 2014; Klabunde et al., 2017). It is unclear at this stage how interoception develops, but preliminary data suggest significant variability in some aspects of interoceptive abilities (e.g., cardiac sensitivity) as early as 6-11 years of age (Koch & Pollatos, 2014). Overall, evidence of atypical interoception is primarily derived from clinical samples with an eating disorder diagnosis; however, deficits have also been observed among those in the general population scoring high on attitudes and behaviors reflective of disordered eating (Leon et al., 1995).

Poor interoceptive ability (IA) is thought to be related to overeating behaviors due to disruptions in an individual’s ability to effectively engage in regulatory behaviors. If an individual has difficulty perceiving whether they are hungry or sated, it becomes challenging to respond effectively. Indeed, an association between emotional eating and interoceptive ability has been established (van Strien, 2000) and neuropsychological evidence supports the theory that
interoception is closely linked to emotion processing (Damasio, 1994, 1999). Disruptions in the ability to identify visceral states, and subsequently emotions, makes it challenging to engage in effective emotion regulation (Barrett et al., 2001). Thus, individuals who have poor interoceptive abilities may be more likely to engage in suboptimal, generalized strategies (e.g., cognitive narrowing) as opposed to strategies more optimally suited to regulating emotions. Consistent with this idea, research measuring electrophysiological responses suggests that greater interoceptive ability is associated with better emotion regulation. Specifically, those with better interoceptive ability were more effective in using reappraisal strategies to downregulate emotional arousal (i.e., demonstrate less electrophysiological response) following exposure to negative stimuli (Füstös et al., 2013).

In the case of boredom, this work would suggest that deficits in interoceptive ability might make overconsumption of snack foods more likely for multiple reasons. First, boredom is described as highly aversive. As such, based on the escape model (Heatherton & Baumeister, 1991) boredom is proposed to lead to efforts to escape from self-awareness via cognitive narrowing. However, individuals who have poor awareness of hunger/satiety may be especially vulnerable to the disinhibition that follows, as they have less information about internal states available (i.e., regulating eating behaviors on the basis of hunger cues). Second, given that interoception is closely linked to emotion processing, it may be the case that cognitive narrowing, as a broad regulation strategy, may be a more likely regulation strategy to begin with for those with deficits in interoceptive abilities. Lastly, it may be the case that individuals with poor interoceptive ability more easily mistake emotional cues for other internal cues, such as hunger. It might be especially easy to conflate boredom, an emotion characterized by a lack or absence of something important (i.e., meaning, engagement, goal-directed behavior) with other
internal cues that also require an active approach response (e.g., hunger) to self-regulate (as opposed to cues eliciting inhibition/avoidance). When bored, individuals with poor interoceptive ability may only have a general sense that some action should be taken to improve the current state of affairs, but lack the ability to identify what specific action.

No previous research has explored the effect of the interaction between boredom and interoceptive ability on food consumption. A small number of studies have explored the association between interoceptive abilities and self-reported, general emotional eating, but all have relied on either self-reported interoception or heartbeat perception (an objective measure of interoception). Using heart beat perception as a proxy for general interoceptive ability relies on the assumption that interoception is a unitary construct (Murphy et al., 2017). Though information about bodily states does appear to be largely processed via the same areas in the insula and anterior cingulate cortex (Craig, 2002), support for the convergence of different measures (e.g., perceptions of heartbeat versus gastric distention) at the level of assessment has been mixed, with some finding only small to moderate correlations between measures (Garfinkel et al., 2016; Herbert et al., 2012). Objectively assessing interoceptive ability, with a measure more closely mapping on to hunger/satiety is an important next step for researchers examining who may be at greatest risk of problematic eating behaviors such as emotional eating.

Current Study

As outlined, important gaps in the literature remain, particularly with regard to the experience of boredom and internal awareness as they relate to eating. A small number of studies have reported on boredom as a cause of emotional eating, and none have accounted for interoceptive ability, which is a theoretically supported individual difference variable that might make some individuals more prone to consume food when bored. Understanding associations
between boredom and eating, as well as who may be most at risk for this type of emotional eating, are topics of theoretical and practical importance, given the frequency with which people report boredom as a trigger for emotional eating and the implications these findings might have for intervention efforts. This study sought to address these gaps in the literature using both experimental and correlational designs.

Utilizing an experimental design, Study 1 examined how accurate detection of one’s own internal states may play a role in making some individuals particularly prone to engage in emotional eating when bored. It was hypothesized that individuals in the bored mood condition, compared to those in the neutral mood condition, would engage in greater food consumption. It was also expected that boredom, over and above the broad dimensions of positive or negative affect, would explain this increased food consumption. Third, it was hypothesized that the effect of boredom on food consumption would be most pronounced among those with poor awareness of internal states.

Soon after beginning data collection, COVID-19 led to university-wide mandates limiting recruitment for in-person laboratory studies. Because 63 individuals had already participated in at least one visit for Study 1, some of the hypotheses were still examined in this small subset, albeit with limited power (see Study 1). Because these analyses were substantially under-powered, a second study was conducted, with adaptations to accommodate COVID-19 restrictions that included online, self-report methodology. The purpose of Study 2 was to provide preliminary tests of the remaining hypotheses, specifically whether boredom was predictive of emotional eating above and beyond general negative and positive affect, and whether there was a moderation effect of interoception (see Study 2 for more detail related to the aims and hypotheses).
STUDY 1

Method

As noted, soon after beginning data collection, COVID-19 led to university-wide mandates limiting recruitment for in-person laboratory studies. Therefore, the following sections describe data collected from the limited number of participants who were recruited prior to this unplanned study suspension.

Design Overview

Study 1 involved two lab visits (Visit 1 and Visit 2) and utilized a between-subjects factorial design, with mood as a manipulated independent variable and interoceptive ability and disordered eating as measured independent variables. Food consumption was the dependent variable. Measurement of self-reported interoceptive ability and disordered eating occurred as part of a mass testing survey prior to either study visit. Measurement of objective interoceptive ability occurred in Visit 1. The mood manipulation occurred during Visit 2. Mood was experimentally manipulated using a 30-minute video, with participants randomized to one of two conditions—bored or neutral mood. Ad labium food consumption took place during the video.

Participants

Participants aged 18-65 were recruited from an undergraduate research participant pool. A power analysis was conducted using simulation in R (2013) to identify the appropriate sample size for the planned analysis. To detect a medium sized effect of condition (.50), and small effects of interoceptive ability and the interaction of condition*interoceptive ability (.20, .35 respectively), with power .80, the total sample size required was 160. To account for 20% data
loss, an additional 32 participants were included, leading to an anticipated recruited sample of 192. Prior to COVID-19-related closures, 63 participants had participated in the first laboratory visit. Consistent with the broader undergraduate population enrolled in psychology courses, this sample was majority female (71.4% identified as female; 28.6% identified as male). The mean age was 19.89 ($SD = 2.49$) and the mean BMI was 23.61 ($SD = 4.44$), which falls in the healthy range. The majority identified as non-Hispanic (63.5%). The sample was 60.3% White/Caucasian, 4.8% Asian, 19.0% Black or African American, 3.2% American Indian/Alaskan Native, and 12.7% multi-racial or other. Participants ranged in year of school, including first (44.4%), second (22.2%), third (22.2%), fourth (9.5%), and fifth or beyond (1.6%). The majority reported being single (95.2%) and a full-time student (52.4%); however, a substantial number also reported working part-time or more (31.8%).

Of the 63 participants who completed Visit 1, 17 participants also completed Visit 2. The remaining 46 participants either had scheduled Visit 2 appointments, but did not attend the scheduled visit ($n = 7$), had their Visit 2 appointments canceled due to COVID-19-related study suspension ($n = 35$), or declined to participate in Visit 2 ($n = 4$). The subset who completed both Visit 1 and Visit 2 was also majority female (64.7%). The mean age was 19.41 ($SD = 1.77$) and the mean BMI was 22.69 ($SD = 3.68$), which falls in the healthy range. The majority identified as non-Hispanic (70.6%). The sample was 58.8% White/Caucasian, 29.4% Black or African American, and 11.8% multi-racial or other. Participants ranged in year of school, including first (52.9%), second (35.3%), and third (11.8%). The majority of the sample reported being single (94.1%) and a full-time student (41.2%); however, a substantial number also reported working part-time or more (29.4%).
Materials

Demographic Information. Participants were asked to self-report age, gender, and race/ethnicity. Height and weight were measured to calculate body mass index (BMI; kg/m²).

Disordered Eating. Overall disordered eating was measured using the Eating Disorder Examination Questionnaire (EDEQ; Fairburn & Beglin, 1994). The EDEQ is a 28–item self-report measure assessing a range of disordered eating attitudes and behaviors. Participants responded on a 7-point scale (0 = not one day, to 6 = every day), with higher scores reflecting greater eating-related pathology. Items (e.g., “Have you had a definite fear of losing control over eating?”) were summed and averaged to provide subscale scores (Eating Concerns, Restraint, Weight Concerns, and Shape Concerns), and a global score was calculated by calculating the average of all subscale scores. In the current sample, internal consistency was deemed adequate, \( \alpha = .97 \) (95% CI .95, .98). See Appendix A.

Interoceptive Ability. Based on recent recommendations to include objective measures of IA, multiple measures were used. Two self-report questionnaires captured interoceptive ability (i.e., interoceptive sensibility). The 37-item Multidimensional Assessment of Interoceptive Awareness Version 2 (MAIA-2; Mehling et al., 2018) was used to measure general interoceptive sensibility. Response options range from 0 (never) to 5 (always), with higher scores reflecting better interoceptive ability. Although a hierarchical structure was not supported in the original validation paper, a general factor based on the total score has received recent support (Ferentzi et al., 2020). The MAIA demonstrated adequate internal consistency in the current sample \( \alpha = .92 \) (95% CI .89, .95). See Appendix B.

The 10-item Eating Disorder Inventory- Interoceptive Awareness subscale (EDI-IA; Garner et al., 1983) is the most commonly used measure of interoceptive sensibility in the area of
eating behaviors. Unlike the MAIA, this scale includes some items related to hunger and satiety. Responses range from 1 (never) to 6 (always), with higher scores reflecting poorer interoceptive ability. In the current sample, the EDI-IA demonstrated adequate internal consistency, $\alpha = .85$ (95% CI .78, .90). See Appendix C.

A water load task (WLT II; Van Dyck et al., 2016) was used to objectively measure gastric interoceptive accuracy. This task was completed in the lab during Visit 1. Participants were asked to refrain from eating or drinking for 2 hours prior to this visit. Water was consumed through a straw from a non-transparent, 5-liter flask (only filled with 1.5 liters of water for safety; participants were unaware of the amount). Participants were asked to drink room temperature water during a 5-minute period using the following instructions: “During the following five minutes, we ask you to drink water until perceiving a sign of satiation. By satiation we mean the comfortable sensation you perceive when you have eaten a meal and you have eaten enough, but not too much.” Subsequently, participants were asked to drink water during a second 5-minute period, with a new set of instructions: “We now ask you to drink again during five minutes. Please continue drinking until your stomach is completely full, that is, entirely filled with water.” Participants were not informed ahead of time that there would be two drinking periods. At three time points ($T0 =$ before water intake; $T1 =$ after part 1; $T2 =$ after part 2), participants were asked to “concentrate on your current abdominal sensations, especially whether your stomach feels full or empty” and rate momentary feelings of satiation, fullness, thirst, stomach tension, immobility, discomfort, guilt, sluggishness, nausea, and arousal. Ratings were provided on a 7-point scale from 1 (no sensation/not at all) to 7 (extremely).

The WLT-II is a multidimensional measure producing indices of (1) subjective ratings of sensations (2) water volume (ml) required for satiation (sat_ml); (3) additional water volume
required for maximum fullness (Δfull_ml); (4) total water volume (total_ml = sat_ml + Δfull_ml); and (5) percentage of satiation to total volume (sat_%). This last measure, sat_%, represents gastric interoception that is not confounded by stomach capacity and is calculated by dividing the amount consumed in the first period (sat_ml) by the total amount consumed over both phases (total_ml), multiplied by 100. Higher scores on this measure reflect poorer interoceptive ability, as the gap between drinking to satiety and drinking to maximum fullness is smaller, thereby indicating a poorer awareness of the cues for satiety.

**Water Preload.** The Visit 2 water preload consisted of 500 mL of chilled, bottled water. Participants were asked to drink the water as quickly as they comfortably could. The maximum time allotted was 15 minutes. Though a 30-minute waiting period between water preload and test meal consumption has been previously recommended (e.g., Davy et al., 2008), research suggests that the water would be almost entirely emptied from the stomach within 30 minutes in a young adult population without obesity (Vist & Maughan, 1994). Instead, in this population, a water preload would optimally occur within 10 minutes of the test meal consumption to increase gastric distention, increase perceptions of fullness, and reduce energy intake in young adults (Corney et al., 2016). Thus, a 10-minute waiting period was used in the current study.

**Food Consumption.** Food consumption was measured during study Visit 2. Food offered to the participants included sweet and salty snacks. Specifically, milk chocolate M&Ms, Lays Original chips, and Goldfish crackers were provided on the table. Food consumption was measured by weighing the snack bowls before and after participants completed study Visit 2. Consumption was calculated as the difference (within 0.1 g) between weight at the beginning and end of Visit 2. Following completion of the experimental paradigm participants were also asked to report time since last food intake, prior to arriving at the study, in hours and minutes.
Manipulation Check. Participants rated mood before and after the mood manipulation using the Positive and Negative Affect Schedule (PANAS; Watson et al., 1988). Twenty items capture 10 positive emotions and 10 negative emotions, and were rated on a 5-point Likert scale from 1 (very slightly) to 5 (extremely). Boredom was not included in the original PANAS, but was added as the first item of this scale to avoid drawing attention to the aims of the study. Therefore, boredom was also rated on the same 1 to 5 Likert scale. See Appendix D.

In addition, boredom was rated during the mood induction video using a handheld dynamometer. Asking participants to report on emotions may interfere with the experience of the emotion in the moment (i.e., attenuation effect of affect labeling; Kassam & Mendes, 2013; Lieberman et al., 2007; Lieberman et al., 2011). Recent evidence suggests that when individuals are asked to translate their emotional states to a number on a self-report scale that includes verbal anchor points, there can be a disruption in the experience of that emotion. For example, Kassam and Mendes (2013) reported that when people were asked to rate their feelings of anger during a frustrating task using a scale with verbal anchors, they showed a different pattern of cardiovascular reactivity compared to when they were not asked to report on their levels of anger. Others have similarly reported that reporting on visceral states may disrupt the experience. Creswell et al. (2018) focused on hunger ratings and found that those in a nonverbal-first condition (rated hunger using a dynamometer before rating using a verbal self-report questionnaire) and those in a nonverbal only condition (only used the dynamometer) both reported a significantly greater increase from pre-cue exposure hunger to post-cue exposure hunger compared to those in a verbal-first condition (rated hunger using a questionnaire before rating hunger on a dynamometer).
A handheld dynamometer was used in the current study (Vernier Software & Technology) and the area under the force-time curve was used to measure boredom intensity (Logger Pro software). Prior to the mood induction video, participants were instructed to signal how bored they were when cued by a picture of the dynamometer on the monitor (see Appendix E), with no written or oral instructions at this time.

**Procedure**

This study was approved by the university’s Institutional Review Board (see Appendix F) and was partially funded by a Psi Chi Graduate Research Grant awarded to the Principal Investigator. Participants were recruited from a university research participant pool. Both self-reported interoceptive sensibility measures (MAIA and EDI-IA) were included in a mass testing packet administered to all undergraduates in this pool. Recruited participants completed tasks in the laboratory on two occasions separated by two weeks at minimum.

Before arrival to the lab for Visit 1, participants were instructed to not eat or drink anything for 2 hours prior to the study. Upon arrival to the lab, the experimenter described the study as a “two-part study of water consumption and attention.” Participants then completed an informed consent and the water load task to measure gastric interoceptive accuracy. They also provided basic demographic information and height and weight were measured. They received partial course credit for their participation in Visit 1. During Visit 2, participants were asked first to consume a water preload. Participants then completed filler tasks (measures of attention) to support the cover story and to prevent the influence of demand characteristics. After 10 minutes, the effect of mood on food intake was tested. Time of day has been largely ignored in studies of emotional eating. However, time of day was standardized in this study as it can influence eating (Haynes et al., 2016). Emotional eating occurs most often in the evenings (Smyth et al., 2009);
therefore, the experimental component of the study (i.e., Visit 2) was conducted between 3 - 8 PM. Likewise, efforts were made to achieve situational congruency. Specifically, participants were seated on a couch with a large coffee table in front of them where the snacks were ultimately placed, and a large screen monitor was used for video display (Best et al., 2018). All participants were asked to put away watches and phones (Danckert & Allman, 2005).

Subsequently, they were instructed on use of the dynamometer and asked to provide an initial rating of boredom using this device. Participants then completed the online self-report mood questionnaire (PANAS + boredom rating). Next, participants were randomly assigned to watch a 30-minute video designed to induce bored or neutral mood. Similar to the study by Havermans et al. (2015), participants were randomly assigned to watch either the first 30 minutes of the documentary *In Search of Memory* (neutral) or an 85 second scene from this documentary that depicts a round of tennis on repeat for 30 minutes (boring). Pilot testing ($n = 102$) supported use of these videos for the mood induction in college students. Results suggested that boredom ratings increased significantly pre-test to post-test in the boring video condition ($p < .001, d = 1.40$), but not the neutral condition ($p = .637, d = .06$). Additionally, the boring video led to significantly greater boredom ratings than the neutral video at post-test ($p < .001, d = 1.63$).

During the film, snack foods were available and participants were instructed to eat as much or as little as they would like (Best et al., 2018). Participants were monitored via a two-way mirror to ensure attention to the video and note any problematic behaviors from a research perspective (e.g., pocketing food items). The proximity of the snack foods to the participants was standardized given the potential impact on consumption (Bucher et al., 2016; Knowles et al., 2019). At the 10- and 20-minute timestamps of the video participants were signaled to complete additional boredom ratings using the handheld dynamometer. Post-test ratings of boredom using
the dynamometer were requested immediately following the video, followed by completion of the post-test mood questionnaire (PANAS + boredom rating). Finally, participants were asked to report time since their last meal before arriving at Visit 2. Participants were then debriefed (see Appendix G) and compensated $10 for participation in Visit 2.

**Data Analytic Plan**

All analyses were conducted in SPSS (v. 25). Preliminary analyses included tests of the validity of the WLT-II in this sample, manipulation checks, and basic descriptives, including correlations among all variables. The validity of the WLT-II test was examined by evaluating changes in subjective ratings across the three time points (i.e., before the task, after Part 1, and after Part 2). Repeated measures ANOVAs with Bonferroni correction for multiple comparisons were used to evaluate whether participants increased in satiety and fullness and decreased in thirst from Time 0 (T0) to Time 1 (T1) and Time 1 to Time 2 (T2). Repeated measures ANOVA with Bonferroni correction for multiple comparisons were used to examine changes in ratings of stomach tension, immobility, discomfort, guilt, sluggishness, nausea, and arousal. Second, correlation analysis explored how sat_%, the primary measure of gastric IA, was associated with self-report measures of IA. Independent samples *t*-tests and chi-square tests were used to determine whether the participants in each condition differed on any demographic characteristics (age, gender, BMI), baseline characteristics (EDEQ global score, interoceptive ability), or time since last meal. Manipulation checks included independent (neutral versus bored) and paired sample (pre/post) *t*-tests to ensure that the bored mood condition elicited significantly stronger feelings of self-reported boredom compared to the neutral mood condition, and that boredom increased significantly from pre-test to post-test. Additionally, changes in broad dimensions of negative and positive affect pre-test to post-test were examined. A repeated measures ANOVA
also assessed for changes in boredom across the four mood ratings provided on the
dynamometer. All analyses included tests for equality of variances (e.g., Levene’s test) and
utilized corrected statistics when appropriate.

The original analytic plan involved regression analyses in SPSS (v. 25) to test the effect
of boredom on food consumption, over and above the effects of negative and positive affect, as
well as the moderation effect of interoception. However, given the limited sample size
independent samples t-tests were used to examine the effect of condition on food consumption.
Given the small sample size, interpretation focused on effect sizes.

Results

Preliminary Analyses

Water Load Task. Results of repeated measures ANOVA suggested that feelings of
satiation increased from T0 to T1 on average, but not from T1 to T2. In contrast, feelings of
fullness increased from both T0 to T1 and from T1 to T2. Results support the notion that
satiation and fullness are conceptually distinct. As expected, feelings of thirst decreased
significantly from T0 to T1 and from T1 to T2.

With regard to secondary ratings, results also suggested that while stomach tension,
immobility, discomfort, and nausea increased significantly from T1 to T2, these ratings did not
increase from T0 to T1. In other words, on average, participants felt considerably more
uncomfortable after the “maximum fullness” trial compared to the “satiation” trial. The only
secondary rating to change from T0 to T1 was sluggishness. Participants reported feeling less
sluggish on average following the satiation trial compared to before the satiation trial. No change
was observed across any of the time points for average ratings of guilt or arousal. These results
support the validity of the WLT-II in its ability to distinguish between satiation and maximum fullness. See Table 1.

**Table 1**

*Water Load Task Subjective Ratings*

<table>
<thead>
<tr>
<th>Variable</th>
<th>T0</th>
<th>T1</th>
<th>T2</th>
<th>p</th>
<th>η²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Satiation</td>
<td>2.97 (1.57)a</td>
<td>4.75 (1.57)b</td>
<td>4.86 (2.07)b</td>
<td>&lt;.001</td>
<td>.47</td>
</tr>
<tr>
<td>Fullness</td>
<td>2.60 (1.44)a</td>
<td>4.68 (1.35)b</td>
<td>6.22 (1.11)c</td>
<td>&lt;.001</td>
<td>.86</td>
</tr>
<tr>
<td>Thirst</td>
<td>4.35 (.20)a</td>
<td>1.73 (.12)b</td>
<td>1.19 (.09)c</td>
<td>&lt;.001</td>
<td>.77</td>
</tr>
<tr>
<td>Stomach tension</td>
<td>2.37 (1.50)a</td>
<td>2.71 (1.38)a</td>
<td>4.19 (1.62)b</td>
<td>&lt;.001</td>
<td>.69</td>
</tr>
<tr>
<td>Immobility</td>
<td>1.30 (.69)a</td>
<td>1.49 (.93)a</td>
<td>2.16 (1.34)b</td>
<td>&lt;.001</td>
<td>.38</td>
</tr>
<tr>
<td>Discomfort</td>
<td>1.81 (1.24)a</td>
<td>1.60 (.96)a</td>
<td>3.13 (1.45)b</td>
<td>&lt;.001</td>
<td>.65</td>
</tr>
<tr>
<td>Guilt</td>
<td>1.24 (.59)a</td>
<td>1.13 (.38)a</td>
<td>1.27 (.65)a</td>
<td>.160</td>
<td>.06</td>
</tr>
<tr>
<td>Sluggishness</td>
<td>2.48 (1.66)a</td>
<td>1.83 (1.17)b</td>
<td>2.33 (1.47)a</td>
<td>&lt;.001</td>
<td>.33</td>
</tr>
<tr>
<td>Nausea</td>
<td>1.46 (1.05)a</td>
<td>1.38 (.75)a</td>
<td>2.22 (1.53)b</td>
<td>&lt;.001</td>
<td>.29</td>
</tr>
<tr>
<td>Arousal</td>
<td>1.38 (.92)a</td>
<td>1.37 (.85)a</td>
<td>1.30 (.75)a</td>
<td>.665</td>
<td>.01</td>
</tr>
</tbody>
</table>

*Note.* T0 = Baseline. T1 = after satiation trial. T2 = after maximum fullness trial. η² = partial eta squared. Wilk’s Lamda interpreted with Bonferroni corrected pairwise comparisons. Superscripts indicate significantly different means.

Correlation analyses suggested that this objective measure of gastric interoception was not significantly correlated with self-report measures of general interoception. The correlation between the WLT measure of interoceptive ability (sat_ml%) and the MAIA was $r = -.05, p = .695$. Similarly, the correlation between the WLT interoceptive ability and the EDI-IA was $r = .07, p = .603$. Results suggest that the construct being captured by the WLT (presumably, interoceptive accuracy) is indeed distinct from the construct being captured by self-report measures (presumably, interoceptive sensibility). In other words, self-report measures of general interoceptive sensibility did not align well with the objective measure of interoceptive ability specific to gastric awareness. In contrast, the two self-report measures were negatively and significantly correlated $r = -.41, p = .001$. Given that higher scores in the MAIA and lower scores
on the EDI-IA reflect better interoceptive ability, the negative correlation suggests moderate agreement between the two measures.

**Baseline Characteristics.** Next, analyses were conducted to evaluate the success of random assignment. At the time enrollment closed due to COVID-19, seven participants had been assigned to the bored mood condition, and 10 participants had been assigned to the neutral condition. Results of independent samples *t*-tests suggested that participants in each condition did not statistically differ on any demographic characteristics (age, gender, BMI), baseline characteristics (EDEQ global score, interoceptive ability), or time since last meal (see Table 2). However, effect sizes suggested potentially meaningful differences in time since last meal and disordered eating behaviors as measured by the EDE-Q. Those in the bored mood condition reported more time elapsed since their last meal before arrival to the study (*d* = .69) and those in the neutral condition had higher disordered eating scores (*d* = .60).

**Table 2**

*Baseline Characteristics by Condition*

<table>
<thead>
<tr>
<th></th>
<th>Bored</th>
<th>Neutral</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><em>M</em> / % (SD)</td>
<td><em>M</em> / % (SD)</td>
<td><em>t</em> / <em>χ</em>²</td>
<td><em>p</em></td>
<td><em>d</em>/Cramer’s <em>V</em></td>
<td></td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td>19.57 (2.57)</td>
<td>19.30 (1.06)</td>
<td><em>t</em> (15) = .30</td>
<td>.767</td>
<td>.15</td>
<td></td>
</tr>
<tr>
<td><strong>Female</strong></td>
<td>57.1%</td>
<td>70.0%</td>
<td><em>χ</em>² (1) = .30</td>
<td>.585</td>
<td>.13</td>
<td></td>
</tr>
<tr>
<td><strong>BMI</strong></td>
<td>23.35 (3.52)</td>
<td>22.23 (3.91)</td>
<td><em>t</em> (15) = .60</td>
<td>.556</td>
<td>.30</td>
<td></td>
</tr>
<tr>
<td><strong>EDEQ-Global</strong></td>
<td>.42 (.33)</td>
<td>.99 (1.19)</td>
<td><em>t</em> (10.84) = -1.43a</td>
<td>.179</td>
<td>.60</td>
<td></td>
</tr>
<tr>
<td><strong>Objective IA (sat.%)</strong></td>
<td>53.27% (22.10)</td>
<td>49.67% (16.77)</td>
<td><em>t</em> (15) = .38</td>
<td>.708</td>
<td>.19</td>
<td></td>
</tr>
<tr>
<td><strong>Minutes since last meal</strong></td>
<td>287.14 (105.50)</td>
<td>221.44 (85.17)</td>
<td><em>t</em> (14) = 1.38</td>
<td>.189</td>
<td>.69</td>
<td></td>
</tr>
</tbody>
</table>

*Note. BMI = body mass index. EDEQ = Eating Disorder Examination Questionnaire. a unequal variances.*
Manipulation Check. Manipulation checks supported the success of the mood manipulation. Results of an independent samples t-test suggested that participants rated their feelings of boredom after the manipulation video as significantly greater in the bored condition ($M = 4.14, SD = .69$) compared to the neutral condition ($M = 2.78, SD = 1.48$), $t(11.86) = 2.44, p = .031, d = 1.13$. Likewise, boredom increased significantly in the bored condition from pre- ($M = 1.86, SD = .90$) to post-experiment ($M = 4.14, SD = .69$), $t(6) = 6.35, p < .001, d = 2.40$, but did not increase significantly in the neutral condition ($M_{pre} = 2.33, SD_{pre} = 1.23$ versus $M_{post} = 2.78, SD_{post} = 1.48$), $t(8) = .84, p = .426, d = .28$. Providing further support, the effect size for the change in boredom from pre- to post-video was large for the bored condition and small for the neutral condition.

Data from the handheld dynamometer also provided tentative support for the mood manipulation. The within-subjects effect of time*condition violated Mauchly’s test (Mauchley’s $W = .028, p < .001$); therefore the Greenhouse-Geisser statistic was interpreted, which was not significant ($p = .094$) and the effect size was small ($\eta^2_p = .17$). Given the small sample, contrasts were explored, but caution in interpretation is needed. Contrasts suggested that participants rated their boredom as significantly greater after 10 minutes spent watching the boring video ($M = 1362.92, SD = 649.12$), 20 minutes of the boring video ($M = 1694.72, SD = 507.37$), and 30 minutes of the boring video (i.e., the end of the video; $M = 1868.36, SD = 338.77$), compared to the baseline rating ($M = 229.29, SD = 82.50$). Although ratings increased across the 10-, 20-, and 30-minute time points, those differences were not statistically significant. In contrast, although ratings also increased slightly while watching the neutral video, no statistically significant differences emerged across any time points ($M_{baseline} = 125.83, SD = 72.75$; $M_{10min} = 153.34, SD = 572.46$; $M_{20min} = 340.11, SD = 447.46$; $M_{30min} = 468.75, SD = 298.77$), suggesting
participants did not indicate a change in boredom using the dynamometer during the neutral video.

Subsequent analyses tested whether broad dimensions of negative and positive affect changed pre-test to post-test. Results showed that positive affect significantly decreased in the bored mood condition ($M_{\text{pre}} = 23.14$, $SD = 8.15$; $M_{\text{post}} = 17.00$, $SD = 6.21$), $t(6) = 3.48$, $p = .013$, $d = 1.32$. Positive affect did not change significantly in the neutral condition and the effect size was small ($M_{\text{pre}} = 22.22$, $SD = 7.55$ versus $M_{\text{post}} = 20.00$, $SD = 6.40$), $p = .348$, $d = .33$. Though negative affect did not change significantly in the bored condition ($M_{\text{pre}} = 11.00$, $SD = 1.15$ versus $M_{\text{post}} = 12.86$, $SD = 3.67$), $p = .224$, there was a medium sized effect, $d = .51$. No change was observed for negative affect in the neutral condition and the effect was small ($M_{\text{pre}} = 12.33$, $SD = 3.08$ versus $M_{\text{post}} = 12.33$, $SD = 3.16$), $p = 1.00$, $d = .00$.

**Primary Analyses**

**Effect of Mood on Food Consumption.** Data were first examined for unusual values. One person in the bored mood condition reported an allergy to Goldfish crackers and therefore, this food item was not made available (0g consumed). This value was removed for analyses. Additionally, boxplots were used to visualize outliers in food consumption within each condition. Two extreme outliers (3*interquartile range) were detected within the bored condition (one participant consumed 150g chocolate; another consumed 129g of crackers). Following analyses with the full sample, a sensitivity analysis was conducted excluding these extreme values to assess their impact on findings.

Results indicated that participants in the bored mood condition consumed more chips, crackers, and candy on average compared to the participants in the neutral condition (see Figure 1). Specifically, participants consumed 8.04g more chips (~4 Lays potato chips), 25.83g more...
crackers (~47 Goldfish crackers), and 8.04g more chocolate (~8 M&Ms). Although the differences were not statistically significant (all $p > .05$), the effect sizes suggested moderate ($d = .48$) to large ($d = .85$) effects of condition on consumption for both chips and crackers, respectively. Additionally, the difference in cracker consumption was trending toward significance ($p = .054$). The effect of condition on chocolate consumption was small ($d = .35$).

Converting the difference from grams to kilocalories, the average difference in consumption across conditions represents approximately 46 kilocalories for chips, 149 kilocalories for crackers, and 69 kilocalories for chocolate in one 30-minute period.

![Food Consumption by Condition](image)

*Figure 1.* This figure shows the effect of condition on food consumption from Study 1, with two extreme values retained. Errors bars represent standard error.

Sensitivity analyses were conducted for the cracker and chocolate conditions, with the two outliers removed (see Figure 2). Findings demonstrated that results for cracker consumption remained largely the same. Those in the bored condition ate more crackers and the effect size remained large ($d = .910$); however, the results for chocolate consumption did change significantly. With the outlier removed, those in the neutral condition ate more chocolate on
average, but the difference was not significant and the effect size was small ($d = .30$). With the outliers removed, the average difference in consumption across conditions represents approximately 70 more kilocalories in crackers for those in the bored condition and 31 kilocalories in chocolate in the neutral condition.

**Figure 2.** This figure shows the effect of condition on food consumption from Study 1, with two extreme values removed. Errors bars represent standard error.

**Effect of Condition Across Levels of Interoceptive Ability.** Given the small sample size and power limitations, a formal moderation test was severely underpowered. Instead, the data were plotted for visualization (see Figure 3) and the mean differences were tested. A median split was used for interoceptive awareness. Given influential outliers present within the bored mood condition for chocolate and cracker consumption, and the small number of people per cell as it was, this analysis focused on chip consumption only.

Results showed that those with poorer interoceptive ability within the bored mood condition ate 24.66g of chips on average ($SD = 28.13$), compared to 10.29g ($SD = 7.44$) for those
with poorer interoceptive ability in the neutral condition, \( t(2.17) = .87, p = .471 \). The effect size was large, \( d = .83 \). Among those with higher levels of interoceptive ability, those in the bored mood condition consumed 14.59g of chips on average (\( SD = 13.71 \)), whereas those in the neutral condition consumed 11.45g on average (\( SD = 20.73 \)), \( t(7) = .26, p = .803 \). The effect size was small, \( d = .17 \).

![Diagram of Chip Consumption by Condition and Interoceptive Ability](image)

*Figure 3.* Interoceptive ability categories were created using a median split. From left to right, sample sizes per group were \( n = 3, 5, 4, 5 \).

**Study 1 Discussion**

At the point when data collection was halted, results of Study 1 provided tentative support for the first hypothesis. Within this small sample, there appeared to be an impact of boredom on eating behavior, particularly for salty foods. This finding is in accordance with the limited extant experimental work suggesting boredom is a trigger for snacking behaviors (Abramson & Stinson, 1977; Havermans et al., 2015; Moynihan et al., 2015). From a functionalist perspective, boredom is thought to be an important self-regulatory emotion, in that
it motivates people to seek out more meaningful or captivating tasks, environments, interactions, etc. (Elpidorou, 2018; Van Tilburg & Igou, 2011, 2012). Previous work measuring global negative affect highlights that eating substantial amounts of food in response to negative affect often leads to a worse mood immediately after eating, not an improved mood (Haedt-Matt & Keel, 2011; Haedt-Matt et al., 2014). The extent to which this is true of boredom—whether eating decreases feelings of boredom—needs further research. It is possible that “bored eating” is maintained by relief from boredom, even if only temporarily during the eating episode. To date, this has not been tested. Very few studies have explored changes in negative affect more broadly while eating, and all have been limited to binge eating episodes (Haedt-Matt & Keel, 2011). Of those, only one found support for the idea that negative affect declines during an eating episode (Deaver et al., 2003); four others found no change or increased negative affect (Hilbert & Tuschen-Caflè, 2007; Johnson & Larson, 1982; Powell & Thelen, 1996; Stickney & Miltenberger, 1999). In the current study, feelings of boredom remained high on average throughout the bored mood video, despite the availability of food, but a direct test of the influence of eating on boredom was not possible.

Importantly, the effect of boredom on food consumption did show variability across food type. For cracker consumption, even with an outlier removed, the effect size was large. Similarly, results for chip consumption suggested a moderate effect of boredom on consumption. Results were more tenuous for chocolate consumption; removal of one outlier reversed findings such that those in the neutral condition appeared to eat more chocolate. Previous work has supported the effect of boredom on both sweet (Havermans et al., 2015) and savory foods (Abraham & Beumont, 1982) when presented separately. In contrast to the current study, when salty and sweet foods were presented together, Moynihan (2015) did not find an effect for
“healthy” (but presumably salty) crackers, but did find an effect for chocolate. If the current finding of a stronger effect for crackers and chips compared to chocolate is replicated with a larger sample, it could be due to the influence of relative position to the participants. Though still within reach, the chocolate was consistently placed furthest from the participants on the table. Alternatively, it is possible the effect of boredom on chocolate consumption was reduced compared to chip or cracker consumption, because chocolate is the most commonly craved food in Western cultures (Tiggemann & Kemps, 2005; Weingarten & Elston, 1991), especially among women (the current sample was majority female; Osman & Sobal, 2006; Pelchat, 1997).

Participants in both conditions may have been more likely to experience and submit to chocolate cravings, especially at this time of day (Reichenberger et al., 2018), thus reducing observed differences in chocolate consumption between conditions. With a larger sample, it will be important to continue exploring differences across food types.

When the data were compared across levels of interoceptive ability (chip consumption only), the bar graph and effect sizes suggested initial support for the hypothesis that the effect of boredom on food consumption was stronger among those who had poorer interoceptive ability compared to those who had better interoceptive ability. In other words, among those who had more difficulties recognizing gastric signals, the bored mood condition led to greater snack consumption relative to the neutral condition. However, among those who were better at recognizing gastric signals, being bored did not result in a substantial increase in food consumption relative to being in a more neutral mood. If these results are maintained once a larger sample is collected and a formal test of moderation is possible, it would suggest that in accordance with the hypothesis, boredom plays a causal role in consumption of at least some
snack foods, and that those with poorer interoceptive ability may be especially vulnerable to bored eating.

**Limitations**

The sample size of 17 for the primary analyses was a major limitation. Small sample sizes decrease power and often lead to missing true effects (i.e., inflated type II error). For parametric tests in small samples, significant findings are less likely to be a false positives, because outliers increase error variance more than they impact the sample mean, typically resulting in a smaller \( t/F \) statistic (Friston, 2012; Zimmerman, 1994). Thus, the difference in cracker consumption that reached marginal significance (\( p = .054 \)) could indicate a true effect of boredom on cracker consumption. However, caution is warranted and results will be clearer when the study is able to continue and adequately powered analyses are possible. Care was taken to report all effect sizes, given research showing that interpreting only significant findings in small sample sizes could lead to overestimation of effect size estimates (i.e., the “Winner’s Curse”; Button et al., 2013). Lastly, overestimation of effect size estimates when relying on \( p \) thresholds is a greater problem when a large number of tests are conducted (Zöllner & Pritchard, 2007). A relatively small number of analyses were conducted in the present study and Bonferroni corrections were applied when multiple comparisons were conducted. Still, considering the limited ability to fully test the moderation hypothesis specifically, data collection for this study will resume when possible and findings should be considered exploratory and preliminary.

Another important consideration when interpreting the findings is the failure of random assignment for two baseline characteristics. Effect sizes suggested there were pre-existing differences across the participants in each condition. A large effect size was found for the
difference in time reported since the last meal prior to visit 2, as well as the difference in baseline EDEQ scores. Both differences are major confounds, with potential impacts on the amount of food consumed in the bored condition vs. the neutral condition. With a larger sample, it will be important to ensure baseline characteristics are equivalent across conditions and/or to control for these baseline differences in study analyses.

Lastly, the current methods for objectively assessing gastric interoceptive ability are somewhat limited. The Water Load Task (Van Dyck et al., 2016) is a fairly new approach and needs further validation. Self-report measures of interoception have their own limitations. Asking people to report on their own ability to detect internal cues necessarily contaminates the measure with aspects of confidence and level of insight. Additionally, although the EDI-IA scale used in the current study did include several items assessing hunger and satiety specific interoception, it did not focus on this aspect of interoception exclusively. Recent work suggests that hunger/satiety specific interoceptive sensibility may be a stronger predictor of many problematic eating behaviors (Ahlich et al., 2020). This is discussed further in the General Conclusions.
STUDY 2

Given the impact of COVID-19 on Study 1, a new data collection was planned and executed to test the remaining hypotheses regarding associations between boredom, interoception, and emotional eating. Unlike Study 1, Study 2 exclusively utilized self-report methodology, thus, the operationalization of the constructs being studied changed. Instead of focusing on the state experience of boredom as it relates to eating behaviors, Study 2 examined boredom proneness, which is the general tendency to experience boredom, and whether self-reported interoception moderated its association with self-reported emotional eating.

A significant association between boredom proneness and self-reported emotional eating has been previously reported (Crockett et al., 2015); however, it remains unclear whether boredom proneness adds predictive power above and beyond the general tendency to experience positive and negative affect. Understanding whether boredom proneness accounts for unique variance is important for guiding researchers and clinicians interested in affective experiences associated with emotional eating, especially as they seek to minimize participant/patient burden. Hypothesis 1 (H1) and Hypothesis 2 (H2) tested boredom proneness as a predictor of emotional eating (H1), as well as whether boredom proneness predicted unique variance in emotional eating after accounting for negative and positive affect (H2).

As highlighted previously, theoretical work also suggests that interoceptive ability is likely to play a role in the association between boredom and emotional eating. Preliminary findings from Study 1 provided some support for this. Hypothesis 3 (H3) analyses tested interoception as a moderator of the association between boredom proneness and emotional
eating. Put in the context of the operationalizations used, it was hypothesized that people who reported a greater tendency to be bored would also report greater engagement in emotional eating, and this association would be stronger among those who reported less confidence in their abilities to identify and act on internal signals (i.e., poorer interoceptive sensibility) compared to those who were more confident in their ability (i.e., better interoceptive sensibility).

As highlighted previously, the escape model (Heatherton & Baumeister, 1991) suggests that because boredom is often perceived as aversive, those who experience boredom frequently are also likely to pursue various means to escape from self-awareness. It is possible that those with stronger disordered eating attitudes (i.e., maladaptive views about weight, body shape, and appearance) and behaviors (specifically dietary restraint) might be especially prone to use eating as a form of escape when highly palatable food is available. First, there is an increasing recognition that those with an eating disorder show deficits in emotion regulation (Lavender et al., 2015), making it less likely that they have other, more adaptive strategies available for dealing with uncomfortable emotions such as boredom. Second, those with eating disorder symptomology also report greater food cravings (Cepeda-Benito et al., 2003), which may become more salient when feeling bored. Third, those with an eating disorder show an attentional bias to food stimuli compared to those without an eating disorder (Schmitz et al., 2014; Smeets et al., 2008). Among those with high levels of disordered eating, those who also have deficits in interoception may be especially vulnerable to eating in response to emotions and the disinhibition (i.e., emotional eating) that follows from attempts to escape self-awareness. Individuals with disordered eating behaviors have less information available about internal states that could otherwise facilitate self-regulation, allowing them either to choose an alternative (potentially more beneficial) activity to eating, or, following the onset of food consumption, help
them to avoid overeating. To that end, a secondary analysis (Hypothesis 4; H4) tested whether the effect of boredom on emotional eating was greater among those scoring higher on measures of disordered eating, and if this moderation effect was stronger among those with poorer interoceptive ability. Hypotheses were tested in two separate samples, undergraduates and community adults, to test robustness and to enhance external validity of study findings.

Method

Participants

Community Sample. Participants aged 18-65 were recruited from Amazon’s Mechanical Turk. Prior to recruitment, a power analysis was conducted using simulation in R to identify the appropriate sample size for the planned analysis. To detect small effects of boredom proneness, interoceptive ability, and their interaction (.20, .20, .15 respectively), with power .80, the total sample size required was 310. A total of 666 survey responses were collected. Those who did not provide consent to continue (n = 14), had a duplicate IP address (n = 6), or completed < 50% of the survey (n = 45) were removed. A significant number of cases were dropped due to failure of the attention check items (n = 236), either resulting from inconsistent responding (n = 27) or endorsement of infrequent/unusual items (n = 167). The final sample included 365 participants, which was sufficient to power the planned analyses.

The sample was 59.2% cisgender female, 40.0% cisgender male, and .5% non-binary or transgender. The majority identified as non-Hispanic (94.2%). The sample was 78.4% White/Caucasian, 9.6 % Asian, 6.0% Black or African American, .3% Native Hawaiian or Pacific Islander, and 5.8% multi-racial or other. The average age was 40.77 years old (SD = 11.46) and the average BMI was 27.20 (SD = 6.60), which falls in the overweight range. In terms of marital status, 45.8% were married, 10.7% cohabitating, 30.4% single, 9.3% divorced, and
3.6% separated or widowed. The majority were working full-time (66.5%) or part-time (12.1%), with an additional 8.8% unemployed, 1.9% disabled, and 10.6% describing other employment statuses (e.g., retired, full-time student, etc.).

**Undergraduate Sample.** Participants aged 18-65 were recruited from an undergraduate psychology research participant pool. Given that the same analyses were planned for both samples, the power analysis again indicated that the total sample size required was 310. A total of 537 survey responses were collected. Those who did not provide consent to continue \( (n = 2) \), had a duplicate IP address \( (n = 4) \), or completed < 50% of the survey \( (n = 17) \) were removed. Again, a number of cases were dropped due to failure of the attention check items \( (n = 53) \), either resulting from inconsistent responding \( (n = 22) \) or endorsement of infrequent/unusual items \( (n = 22) \). The final sample included 461 participants, sufficient to power the planned analyses.

The university sample was 52.9% cisgender female, 45.3% cisgender male, and 1.7% non-binary or transgender. The majority identified as non-Hispanic (76.6%). The sample was 62.8% White/Caucasian, 13.2% Asian, 9.8% Black or African American, 1.7% Arab or Middle Eastern, .4% American Indian/Alaskan Native, and 11.3% multi-racial or other. The average age was 21.12 years old \( (SD = 4.88) \) and the average BMI was 24.51 \( (SD = 5.64) \), which falls in the healthy range. Participants ranged in year of school, including first (16.5%), second (29.3%), third (29.1%), fourth (21.9%), and fifth or beyond (3.3%). The majority reported being single (90.2%). A roughly equal split occurred between those who endorsed being a full-time student (42.1%) or working at least part-time (41.5%).
**Materials**

**Demographic Information.** Participants were asked to self-report age, gender, sexual orientation, race/ethnicity, employment status, and income. Body mass index was also calculated using self-reported height and weight (kg/m²).

**Attention Check.** The Attentive Responding Scale - 18 (ARS-18; Maniaci & Rogge, 2014) was used to screen participants for attention to the survey. Participants completed two separate parts of this scale, each half containing nine items. Several items assessed the extent to which participants endorsed uncommon items (e.g., “My favorite subject is agronomy”). Additionally, similar item pairings were used to assess consistent responding across both parts of the scale. Standard cut scores of inconsistency = 6.5 or infrequency = 7.5 were used to identify problematic responding. See Appendix H.

**Boredom Proneness.** The 28-item Boredom Proneness Scale (BPS; Farmer & Sundberg, 1986) was used to assess boredom proneness. The scale asks participants to rate the extent to which these items applied to them on a 1 (highly disagree) to 7 (highly agree) scale. Higher scores reflect greater tendency toward feeling bored in a range of situations and circumstances. Example items include “In situations where I have to wait, such as a line or queue, I get very restless.” and “Many things I have to do are repetitive and monotonous.” Scores derived from the BPS have demonstrated acceptable levels of internal consistency (α = .79) and test re-test reliability (r = .83; Farmer & Sundberg, 1986). Internal consistency was also supported in both current samples: community sample α = .89 (95% CI .88, .91); student sample, α = .84 (95% CI .82, .86). See Appendix I.

**Emotional Eating.** Emotional eating was measured using the Emotional Eating subscale of the Dutch Eating Behavior Questionnaire (DEBQ-EE; Van Strien et al., 1986). This subscale
is comprised of 13 items and responses are made on a 1 (*never*) to 5 (*always*) scale. The items in this subscale ask about eating in response to specific emotions and diffuse emotions. The DEBQ has demonstrated strong psychometric properties including a stable factor solution (Wardle, 1987). In the current study, internal consistency was also adequate in the community adult sample, $\alpha = .96$ (95% CI .96, .97), and in the student sample, $\alpha = .95$ (95% CI .94, .95). See Appendix J.

**Disordered Eating.** Overall disordered eating was measured using the Eating Disorder Examination Questionnaire-7 (EDEQ-7; Grilo, Henderson, Bell, & Crosby, 2013), a shortened version of the full EDEQ (Fairburn & Beglin, 1994). The EDEQ-7 is a self-report measure that primarily focuses on dietary restraint (e.g., “Have you attempted to avoid eating any foods which you like in order to influence your shape or weight”), shape/weight overvaluation (e.g., “Has your weight influenced how you think about (judge) yourself as a person?”), and body dissatisfaction (“How dissatisfied have you felt about your weight?”). The first three items use a frequency scale ranging from 0 to 6 (0 = 0 days, 1 = 1–5 days, 2 = 6–12 days, 3 = 13–15 days, 4 = 16–22 days, 5 = 23–27 days, and 6 = every day). Four items use a severity scale ranging from 0 (*not at all*) to 6 (*extremely*). Items were summed to provide a total score. The EDEQ-7 has demonstrated acceptable psychometric properties in an undergraduate sample of men and women (Grilo et al., 2015). In the current study, internal consistency was adequate in the community adult sample $\alpha = .92$ (95% CI .91, .93) and in the student sample $\alpha = .92$ (95% CI .90, .93). See Appendix K.

**Negative and Positive Affect.** Participants rated positive and negative affect using the PANAS (Watson et al., 1988). Twenty items, 10 capturing positive affect and 10 capturing negative affect, were rated on a 5-point Likert scale from 1 (*very slightly*) to 5 (*extremely*).
Participants were given instructions to describe the extent to which they felt emotions “in
general, that is, on average.” Internal consistency was adequate in the community sample for the
positive affect subscale $\alpha = .92$ (95% CI .91, .93) and for the negative affect subscale $\alpha = .93$
(95% CI .92, .94). Internal consistency was also supported in the student sample for positive
affect $\alpha = .92$ (95% CI .90, .93) and for negative affect $\alpha = .88$ (95% CI .86, .89). See Appendix L.

**Interoceptive Sensibility.** Self-reported, general interoceptive ability (i.e., interoceptive
sensibility) was assessed using the Multidimensional Assessment of Interoceptive Awareness
Version 2 (described above; Mehling et al., 2018)). Internal consistency was adequate in the
community sample $\alpha = .92$ (95% CI .90, .93) and in the student sample $\alpha = .90$ (95% CI .89, .92).
See Appendix B.

Hunger and satiety-specific interoceptive sensibility was assessed using the Reliance on
Hunger and Satiety Cues subscale of the Intuitive Eating Scale-2 (Tylka & Kroon Van Diest,
2013). Unlike the EDI-IA, which has just two items focused on hunger and satiety, this subscale
includes six items that all assess the extent to which individuals trust and rely on hunger and
satiety signals (e.g., “I rely on my fullness (satiety) signals to tell me when to stop eating.”). Items
are rated on a 1 (*strongly disagree*) to 5 (*strongly agree*) scale. Adequate internal consistency
was found for the community sample $\alpha = .90$ (95% CI .86, .92) and the student sample $\alpha = .87$
(95% CI .85, .88). See Appendix M.

**Procedure**

Participants completed online, self-report measures of the aforementioned constructs.
Participants first reviewed and completed an informed consent document. All measures were
completed in a random order, except the attention check measure (ARS-18). Participants
completed the first half of the ARS-18 at the beginning of the survey and the second half at the end of the survey. Lastly, participants responded to several single item questions about demographics, height, and weight. Participants who completed the survey via MTurk were paid $1.00, whereas undergraduate students were compensated with partial course credit. This study was approved and deemed exempt by the university’s Institutional Review Board (see Appendix N).

**Data Analytic Plan**

All analyses were conducted in SPSS (v. 25). A correlation matrix was produced including all demographic and self-report data. Subsequently, multiple linear regression analysis was used to test hypotheses in each sample. For H1, the association between boredom proneness and emotional eating was evaluated. For H2, analyses tested whether boredom proneness continued to predict unique variance in emotional eating, over and above the effects of negative and positive affect. A dominance analysis was utilized to test the $R^2$ values for all possible subset models (i.e., when each predictor is entered alone as well as when entered with every possible combination of other predictors). For H3, the moderation effect of interoceptive sensibility was examined. All variables were continuous except gender, which was treated as binary for the purpose of analysis (0 = male; 1 = female). Only those who reported gender as cis-gender male or female were included in the analysis. To detect a moderation effect, both variables were centered and multiplied. The two measures of interoceptive ability (IES, MAIA) were tested as independent variables in separate models. All regression analyses controlled for age, gender, and BMI. The three-way interaction between boredom proneness, disordered eating, and interoceptive ability served as a test of the secondary hypothesis (H4) that the association between boredom proneness and emotional eating would be greatest among those reporting more
disordered eating, and this moderation effect would be stronger among those with poorer interoceptive ability. Significant interactions were probed using simple slopes analysis at ± 1 SD values of the moderator. Plots were created in R.

With regard to diagnostics, data were screened for skewness, kurtosis, multicollinearity (correlations, VIF > 5), multivariate outliers (studentized residuals > 3, Mahalanobis’ distance > \( df = k, \) critical \( \alpha = .001 \)), leverage \( (3(k+1)/n) \), and influence \( (D_i > 1) \). No significant departures from normality were detected and diagnostics did not indicate problems with multicollinearity for any of the analyses. Handling of outliers is described in each section below. A small number of missing data were present and were handled using listwise deletion.

**Results**

**Preliminary Analyses**

Correlation analyses highlighted that the pre-identified covariates did show significant associations in the anticipated directions with the primary variables of interest (see Table 3). Higher BMI was associated with greater engagement in emotional eating in both samples, while those of older ages were less likely to report engaging in emotional eating or a tendency to experience boredom. Females reported more emotional eating. Both measures of interoceptive sensibility were significantly correlated with emotional eating, with stronger correlations for hunger/satiety specific interoception, compared to general interoception. As anticipated, boredom proneness, negative affect, and positive affect were all significantly associated with emotional eating in both samples. The correlation between boredom proneness and positive and negative affect were moderate in size, suggesting that the boredom proneness measure was not entirely overlapping with either general dimension of emotional experience. Overall, patterns were highly similar across samples.
Table 3
Means, Standard Deviations, and Correlations

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>Community M (SD)</th>
<th>College M (SD)</th>
<th>p</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td></td>
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<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. BMI</td>
<td></td>
<td>.18**</td>
<td>.00</td>
<td>.07</td>
<td>-.05</td>
<td>.04</td>
<td>-.05</td>
<td>-.24**</td>
<td>.25**</td>
<td>27.20 (6.60)</td>
<td>24.51 (5.64)</td>
</tr>
<tr>
<td>2. Age:</td>
<td>.13</td>
<td></td>
<td>-.09</td>
<td>-.17**</td>
<td>.13**</td>
<td>-.07</td>
<td>.18**</td>
<td>.10*</td>
<td>-.01</td>
<td>40.77 (11.46)</td>
<td>21.12 (4.88)</td>
</tr>
<tr>
<td>3. Gendera</td>
<td>.08</td>
<td>.00</td>
<td></td>
<td>.07</td>
<td>.09</td>
<td>-.11</td>
<td>.01</td>
<td>.12**</td>
<td>-.16**</td>
<td>59.2% Female</td>
<td>52.9% Female</td>
</tr>
<tr>
<td>4. Boredom Proneness</td>
<td>.12</td>
<td>-.20**</td>
<td>.00</td>
<td></td>
<td>-.47**</td>
<td>.41**</td>
<td>-.44**</td>
<td>-.30**</td>
<td>.30**</td>
<td>91.45 (23.89)</td>
<td>99.09 (20.59)</td>
</tr>
<tr>
<td>5. Positive Affect</td>
<td>-.08</td>
<td>.08</td>
<td>-.12*</td>
<td>-.53**</td>
<td></td>
<td>-.07</td>
<td>.43**</td>
<td>.25**</td>
<td>-.14**</td>
<td>32.44 (8.73)</td>
<td>32.16 (8.84)</td>
</tr>
<tr>
<td>6. Negative Affect</td>
<td>.12</td>
<td>-.21**</td>
<td>.13</td>
<td>.58**</td>
<td>-.36**</td>
<td></td>
<td>-.22**</td>
<td>-.31**</td>
<td>.31**</td>
<td>16.11 (7.42)</td>
<td>19.99 (7.38)</td>
</tr>
<tr>
<td>7. MAIA</td>
<td>-.12</td>
<td>.03</td>
<td>.00</td>
<td>-.51**</td>
<td>.49**</td>
<td>-.39**</td>
<td></td>
<td>.32**</td>
<td>-.19**</td>
<td>109.62 (25.01)</td>
<td>103.56 (24.87)</td>
</tr>
<tr>
<td>8. IES-H/S</td>
<td>-.24**</td>
<td>-.03</td>
<td>.05</td>
<td>-.30**</td>
<td>.30**</td>
<td>-.29**</td>
<td>.45**</td>
<td></td>
<td>-.35**</td>
<td>3.59 (.85)</td>
<td>3.49 (.92)</td>
</tr>
<tr>
<td>9. Emotional Eating</td>
<td>.34**</td>
<td>-.18**</td>
<td>.20**</td>
<td>.31**</td>
<td>-.10</td>
<td>.41**</td>
<td>-.19**</td>
<td>-.31**</td>
<td></td>
<td>29.85 (13.76)</td>
<td>27.44 (12.41)</td>
</tr>
</tbody>
</table>

Note. College sample is presented above the diagonal. Community sample is presented below the diagonal. BMI = Body Mass Index. MAIA = Multidimensional Assessment of Interoceptive Awareness. IES-H/S = Intuitive Eating Scale-2 Reliance on Hunger and Satiety Cues. p values represent results of t-tests (continuous) or chi square (categorical) tests comparing community and college samples. a0 = male, 1 = female. **p < .001
The samples were compared in terms of mean level differences across the study variables. The community sample had a higher BMI and older age on average compared to the undergraduate sample \((ps < .001, d_{BMI} = .44; d_{age} = 2.33)\). The community sample had greater general interoceptive sensibility \((p < .001)\) and emotional eating scores \((p = .009)\), but both effects were small \((d_{MAIA} = .24, d_{EE} = .19)\). Additionally, the community sample reported lower boredom proneness and negative affect, with the difference in negative affect being a medium sized effect \((ps < .001, d_{BP} = .35; d_{NegAft} = .53)\). The samples were comparable in hunger/satiety sensibility \((IES-HS; p = .091, d = .12)\), proportion of males to females \((p = .097, V = .06)\), and positive affect \((p = .654, d = .03)\). See Table 3.

**Primary Analyses**

**H1: Boredom Predicting Emotional Eating.** Consistent with hypotheses, greater boredom proneness was associated with more emotional eating in both samples. Within the community sample, regression analyses indicated that boredom proneness was a significant predictor of emotional eating \((p < .001)\), controlling for age \((p < .001)\), BMI \((p < .001)\), and gender \((p < .001)\). Two multivariate outliers were detected (based on residuals) and removed from the final analyses (see Table 4). Likewise, within the undergraduate sample, boredom proneness was a significant predictor of emotional eating \((p < .001)\), controlling for age \((p = .755)\), BMI \((p < .001)\), and gender \((p < .001)\). Five multivariate outliers were detected based on distance and influence characteristics. The dfbeta values suggested the influence was primarily on estimates for age \((n = 4)\) and BMI \((n =1)\). All were removed from the final analyses (see Table 4).

**H2: Accounting for Negative and Positive Affect.** Consistent with hypotheses, boredom proneness was a significant predictor of emotional eating, even accounting for the two
Table 4
Boredom Proneness Predicting Emotional Eating

<table>
<thead>
<tr>
<th></th>
<th>b</th>
<th>SE</th>
<th>95% CI</th>
<th>β</th>
<th>p</th>
<th>ΔR²</th>
<th>F</th>
<th>(df)</th>
</tr>
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<tbody>
<tr>
<td><strong>Community Sample</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Step 1</strong></td>
<td>.21</td>
<td>30.99</td>
<td>(3, 356)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>16.36</td>
<td>3.40</td>
<td>9.67, 23.04</td>
<td>.38</td>
<td>&lt;.001</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BMI</td>
<td>.78</td>
<td>.10</td>
<td>.58, .97</td>
<td>.38</td>
<td>&lt;.001</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>-.26</td>
<td>.06</td>
<td>-.37, -.15</td>
<td>-.22</td>
<td>&lt;.001</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td>4.56</td>
<td>1.31</td>
<td>1.99, 7.13</td>
<td>.17</td>
<td>&lt;.001</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td>.07</td>
<td>33.81</td>
<td>(4, 355)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>1.28</td>
<td>4.16</td>
<td>-6.90, 9.46</td>
<td>.34</td>
<td>&lt;.001</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BMI</td>
<td>.70</td>
<td>.09</td>
<td>.51, .89</td>
<td>.34</td>
<td>&lt;.001</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>-.19</td>
<td>.06</td>
<td>-.29, -.08</td>
<td>-.16</td>
<td>&lt;.001</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td>4.56</td>
<td>1.25</td>
<td>2.10, 7.02</td>
<td>.17</td>
<td>&lt;.001</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Boredom Proneness</td>
<td>.15</td>
<td>.03</td>
<td>.10, .21</td>
<td>.27</td>
<td>&lt;.001</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>College Sample</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Step 1</strong></td>
<td>.08</td>
<td>12.01</td>
<td>(3, 441)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>22.54</td>
<td>4.29</td>
<td>14.10, 30.98</td>
<td>.23</td>
<td>&lt;.001</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BMI</td>
<td>.54</td>
<td>.11</td>
<td>.32, .75</td>
<td>.23</td>
<td>&lt;.001</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>-.12</td>
<td>.15</td>
<td>-.41, .18</td>
<td>-.04</td>
<td>.431</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td>3.92</td>
<td>1.14</td>
<td>1.69, 6.15</td>
<td>.16</td>
<td>&lt;.001</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td>.09</td>
<td>21.63</td>
<td>(4, 440)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>3.39</td>
<td>4.95</td>
<td>-6.90, 9.46</td>
<td>.20</td>
<td>&lt;.001</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BMI</td>
<td>.47</td>
<td>.10</td>
<td>.51, .89</td>
<td>.01</td>
<td>&lt;.001</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>.04</td>
<td>.14</td>
<td>-.29, -.08</td>
<td>-.18</td>
<td>&lt;.001</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td>4.43</td>
<td>1.08</td>
<td>2.10, 7.02</td>
<td>.30</td>
<td>&lt;.001</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Boredom Proneness</td>
<td>.18</td>
<td>.03</td>
<td>.10, .21</td>
<td>.20</td>
<td>&lt;.001</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. Two multivariate outliers removed from community sample and five from college sample. $b =$ unstandardized regression coefficient; $SE =$ standard error; $CI =$ confidence interval.

broad dimensions of affect. Specifically, within both the community and undergraduate samples, results suggested that accounting for the variance predicted by positive and negative affect,
boredom proneness continued to add incremental predictive value (community sample $p = .01$, undergraduate sample $p < .001$) to emotional eating.

In the community sample, a dominance analysis indicated that negative affect was associated with the greatest total variance in emotional eating across all possible subset models ($R^2 = .106$), followed by BMI ($R^2 = .098$). The $R^2$ value for boredom proneness was approximately half the size of the $R^2$ value for negative affect ($R^2 = .048$; see Table 5). In contrast to the community sample, among undergraduate students, the dominance analysis suggested that the total $R^2$ values across all possible subset models for negative affect ($R^2 = .061$) and boredom proneness ($R^2 = .057$) were comparable, and larger than any other variable in the model (see Table 5). Of note, in the undergraduate sample only, positive affect was no longer a significant predictor of emotional eating when boredom proneness was added to the model. With regard to outliers, three were identified in the community sample (two based on residuals > 3; one based on distance and leverage values exceeding cutoffs) and five were identified in the undergraduate sample. All were removed from the final analyses.

**H3: Moderation by Interoceptive Sensibility.** Hypothesis 3—that interoception would moderate the association between boredom proneness and emotional eating—was not supported in either sample for either type of interoception (i.e., general, hunger/satiety-specific). Specifically, within the community sample, results suggested that after accounting for age, gender, BMI, negative affect, and positive affect, the interaction between boredom proneness and general interoceptive sensibility was not significant ($p = .888$). When the interaction was removed, accounting for all covariates, there was no significant main effect of general interoceptive sensibility on emotional eating in this sample ($p = .196$). Three multivariate outliers were detected (two based on residuals, one based on distance and leverage statistics) and
Table 5
Boredom Proneness, Negative Affect, and Positive Affect Predicting Emotional Eating

<table>
<thead>
<tr>
<th></th>
<th>Community Sample</th>
<th>College Sample</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Step 1</td>
<td>Step 2</td>
</tr>
<tr>
<td></td>
<td>b</td>
<td>SE</td>
</tr>
<tr>
<td>Intercept</td>
<td>-.41</td>
<td>4.58</td>
</tr>
<tr>
<td>BMI</td>
<td>.70</td>
<td>.09</td>
</tr>
<tr>
<td>Age</td>
<td>-.17</td>
<td>.05</td>
</tr>
<tr>
<td>Gender</td>
<td>3.59</td>
<td>1.22</td>
</tr>
<tr>
<td>Negative Affect</td>
<td>.69</td>
<td>.09</td>
</tr>
<tr>
<td>Positive Affect</td>
<td>.14</td>
<td>.07</td>
</tr>
<tr>
<td>Boredom Proneness</td>
<td>.12</td>
<td>.03</td>
</tr>
<tr>
<td></td>
<td>Step 1</td>
<td>Step 2</td>
</tr>
<tr>
<td>Intercept</td>
<td>14.39</td>
<td>4.78</td>
</tr>
<tr>
<td>BMI</td>
<td>.48</td>
<td>.10</td>
</tr>
<tr>
<td>Age</td>
<td>.05</td>
<td>.14</td>
</tr>
<tr>
<td>Gender</td>
<td>2.84</td>
<td>1.09</td>
</tr>
<tr>
<td>Negative Affect</td>
<td>.48</td>
<td>.07</td>
</tr>
<tr>
<td>Positive Affect</td>
<td>-.16</td>
<td>.06</td>
</tr>
</tbody>
</table>

Note. Three multivariate outliers removed from community sample and five from college sample. $b =$ unstandardized coefficient; $SE =$ standard error; $CI =$ confidence interval.
removed from the final analyses (see Table 6 for condensed results; Table O1 for full model details). Similarly, the interaction with boredom proneness and hunger/satiety-specific interoception was not significant ($p = .543$). However, when the interaction was removed, hunger/satiety specific interoceptive sensibility was a significant predictor of emotional eating ($p < .001$). Three multivariate outliers were detected (based on residuals) and removed from the final analyses (see Tables 6 and O2).

For the undergraduate sample analyses, two covariates (age and positive affect) were dropped from the models because they did not account for a significant amount of variance in emotional eating in previous models. Similar to the community sample, the interaction between boredom proneness and general interoceptive sensibility was not significant ($p = .941$). When the interaction was removed, accounting for gender, BMI, negative affect, and boredom proneness, general interoceptive sensibility was a significant predictor of emotional eating ($p = .043$). Two multivariate outliers were detected (based on distance and leverage statistics) and removed from the final analyses (see Tables 6 and O3). Also consistent with the community sample, the interaction between boredom proneness and hunger/satiety-specific interoception was not significant ($p = .467$). When the interaction was removed, accounting for covariates, hunger/satiety specific interoceptive sensibility was also a significant predictor of emotional eating ($p < .001$). Three multivariate outliers were detected (based on distance and leverage statistics) and removed from the final analyses (see Tables 6 and O4).

**Secondary Analyses**

**H4: Secondary Hypothesis Considering Disordered Eating Symptoms.** Partial support was found for the hypothesis that a three-way interaction would emerge among boredom proneness, interoception, and disordered eating predicting emotional eating. However, this three-
### Table 6
Condensed Regression Tables Predicting Emotional Eating

#### Community Adults

<table>
<thead>
<tr>
<th>BMI</th>
<th>Gender</th>
<th>Negative Affect</th>
<th>Positive Affect</th>
<th>Boredom Proneness</th>
<th>Interoception</th>
<th>Interaction IA*Boredom</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$b$ (SE)</td>
<td>$\beta$</td>
<td><em>p</em></td>
<td>$b$ (SE)</td>
<td>$\beta$</td>
<td><em>p</em></td>
</tr>
<tr>
<td>General IA</td>
<td>.67 (.09)</td>
<td>.33 &lt;.001</td>
<td>-1.15 (.05)</td>
<td>-.13</td>
<td>.004</td>
<td>4.21 (1.21)</td>
</tr>
<tr>
<td>Hunger/Satiety IA</td>
<td>.65 (.09)</td>
<td>-.16 &lt;.001</td>
<td>-1.13 (0.05)</td>
<td>-.11</td>
<td>.013</td>
<td>3.90 (1.20)</td>
</tr>
</tbody>
</table>

#### Undergraduates

<table>
<thead>
<tr>
<th>BMI</th>
<th>Gender</th>
<th>Negative Affect</th>
<th>Positive Affect</th>
<th>Boredom Proneness</th>
<th>Interoception</th>
<th>Interaction IA*Boredom</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$b$ (SE)</td>
<td>$\beta$</td>
<td><em>p</em></td>
<td>$b$ (SE)</td>
<td>$\beta$</td>
<td><em>p</em></td>
</tr>
<tr>
<td>General IA</td>
<td>.49 (.09)</td>
<td>.22 &lt;.001</td>
<td>-----</td>
<td>3.73 (1.06)</td>
<td>.19 &lt;.001</td>
<td>.31 (08)</td>
</tr>
<tr>
<td>Hunger/Satiety IA</td>
<td>.49 (.09)</td>
<td>.22 &lt;.001</td>
<td>-----</td>
<td>3.87 (1.06)</td>
<td>.16 &lt;.001</td>
<td>.30 (08)</td>
</tr>
</tbody>
</table>

Note. Regression analyses in two separate samples: community adults ($n = 365$; top) and undergraduate students ($n = 461$; bottom). $b =$ unstandardized regression coefficient; $SE =$ standard error; $\beta =$ standardized estimate. BMI = body mass index. IA = interoceptive ability.
way interaction only emerged for undergraduate students, and only when the measure of interoception was hunger/satiety-specific. Results are described in more detail below.

**H4: Community Sample.** Within the community sample, after accounting for age, BMI, gender, positive affect, and negative affect, results suggested that the three-way interaction between boredom proneness, disordered eating, and general interoception was not significant ($p = .522$). Given the lack of statistical significance, the three-way interaction was subsequently removed from the analysis, and the two-way interaction model was re-evaluated. No lower order interactions were significant. With the interactions removed, the main effects model suggested that after accounting for covariates, the only significant main effect was disordered eating, $p < .001$. Neither boredom proneness nor general interoceptive ability accounted for significant variance in emotional eating when disordered eating was included in the model.

The same sequence of analyses was conducted with the hunger/satiety-specific interoception measure. Results again did not support a three-way interaction ($p = .486$). However, in partial support of the hypotheses, when the three-way interaction was removed, the two-way interaction between hunger/satiety interoception and disordered eating was significant ($p = .037$). Probing revealed that the association between disordered eating and emotional eating was still statistically significant, but weaker among those with better hunger/satiety-specific interoception ($b = .25, p < .001$) compared to those with poorer hunger/satiety-specific interoception ($b = .47, p < .001$). See Figure 4.

**H4: Undergraduate Sample.** In the undergraduate sample, the three-way interaction between boredom proneness, general interoception, and disordered eating was not significant ($p = .489$). When the three-way interaction was removed, no significant two-way interaction terms...
emerged. With removal of all interaction variables, the main effects model suggested that disordered eating ($p < .001$) and boredom proneness ($p = .001$) both significantly predicted emotional eating.

When the measure of interoception was changed to hunger/satiety-specific interoception, the three-way interaction between boredom proneness, hunger/satiety specific interoception, and disordered eating was significant ($p = .048$). Probing revealed partial support for the hypothesis. Among those with better interoception, the effect of boredom on emotional eating was stronger for those scoring higher on disordered eating ($b = .16, p = .008$) than for those scoring lower on disordered eating ($b = .08, p = .045$). However, inconsistent with the hypothesis, this moderation effect was not stronger for those with poorer interoception. Instead, among those with poorer interoception, the effect of boredom on emotional eating was stronger for those scoring lower on
Figure 5. Significant three-way interaction between boredom proneness, disordered eating, and hunger/satiety specific interoception in the undergraduate sample.
disordered eating \((b = .18, \ p = .006)\) than those scoring higher on disordered eating \((b = .08, \ p = .057)\). See Figure 5.

**Study 2 Discussion**

Study 2 was a cross-sectional, correlational extension of Study 1, with a sufficiently powered design to allow for a test of self-reported interoception as a moderator of the association between boredom and emotional eating. Results of Study 2 provided partial support for the hypotheses. Consistent with predictions and with Study 1, boredom proneness did emerge as a significant predictor of emotional eating, even when accounting for the broad dimensions of negative and positive affect. However, the association between boredom proneness and emotional eating was not moderated by interoception, at least not interoceptive sensibility, as measured by self-report in Study 2.

Notably, among undergraduate students, boredom proneness emerged as an important predictor of emotional eating. The dominance analysis suggested it was comparable in importance to the broad dimension of negative affect. This was not replicated in the community sample, wherein negative affect accounted for approximately double the variance in emotional eating across the subset models. It is possible that the average difference in age across samples might explain the divergent outcomes. A large multicohort study found that feelings of boredom significantly increased among U.S. middle school and high school students between 2008 and 2017, particularly among girls (Weybright et al., 2020). In the current study, boredom proneness was greater in the undergraduate sample than in the community sample. Thus, limited data suggest a potential increase in boredom across cohorts. Yet, mean level differences in boredom proneness across samples would not alone explain the difference in the strength of prediction for emotional eating. One relevant question that remains unanswered is whether the *tolerability of*
boredom might be different across these cohorts. Vanderlinden et al. (2001) found that boredom was experienced as more aversive than other emotions among college students in the early 2000s, but no data have examined whether this has changed over time. If boredom is experienced as more aversive in younger adults, either as a result of developmental processes or cohort effects, this could explain the finding that boredom proneness was a stronger predictor of emotional eating in the undergraduate sample and would be consistent with the escape model (Heatherton & Baumeister, 1991). That said, the community sample in the current study did include a broad age range, including young adults; thus, this was not a true test of cohort differences.

Several other potential explanations exist as well. For example, it is possible that the predictive power of negative affect was smaller in the undergraduate sample, instead of the predictive power of boredom being greater. Multi-group structural equation modeling was beyond the scope of the current study, but could allow for a direct test of this question. Moreover, there may be environmental differences across college students and community adults that could influence the strength of association between boredom and emotional eating, such as the availability of highly palatable foods when bored (Byrd-Bredbenner et al., 2012; Greaney et al., 2009; Nelson & Story, 2009) or familial and peer influences on eating behaviors (Frankel et al., 2012; Herle et al., 2018; Keel et al., 2013). However, the current study took place within the context of a global pandemic and many of the students who participated were likely residing outside the typical college campus environment. Overall, more work is needed exploring if (with replication studies) and why differences in the proportion of variance in emotional eating accounted for by boredom proneness, compared to negative affect, might differ across undergraduate students and community adults.
Results also provided partial support for the secondary hypothesis that there would be a three-way interaction between disordered eating, interoception, and boredom proneness predicting emotional eating. In the undergraduate sample, among those with better interoception, the effect of boredom on emotional eating was stronger for those scoring higher on disordered eating than for those scoring lower on disordered eating. In contrast to hypotheses, this moderation effect was not stronger for those with poorer interoception, and instead, it was opposite. Among those with poorer interoception, the effect of boredom on emotional eating was stronger for those scoring lower on disordered eating. Importantly, given that this finding was not replicated in the community sample (which only showed a two-way interaction between disordered eating and hunger/satiety interoception) nor with a different measure of interoception in the same sample, it is possible this was a spurious effect, and notable limitations with the design are discussed below. However, if this finding of an interaction between boredom, disordered eating, and interoception were to be replicated in future work, one potential explanation draws on research suggesting that although interoceptive deficits are a central feature of disordered eating for many individuals, there remains variability, such that this is not true for all who report disordered eating (Jenkinson et al., 2018).

Among those with poor interoceptive abilities who also have more symptoms of disordered eating, interoceptive deficits may be a more integral part of their disordered eating symptomatology. These individuals may be especially prone to using cognitive strategies, including strict rules and beliefs about eating, to guide eating behaviors. Consistently acting in contrast to internal cues by using cognitive strategies may further exacerbate deficits in the ability to identify and use physical cues like hunger (Datta et al., 2021). This also may prevent other internal signals, like affective information, from triggering regulation strategies, like
emotional eating. Applying this more directly to the escape model (Heatherton & Baumeister, 1991), individuals with both poor interoception and disordered eating may be less susceptible to the disinhibition that typical follows from attempts to escape self-awareness, due to following rigid self-imposed rules related to eating. In contrast, those with poor interoceptive abilities and lower levels of disordered eating might also struggle to discriminate between physical cues (e.g., hunger and emotional information), but be more likely to use disinhibited eating as a strategy to escape from self-awareness, because there are no cognitive beliefs or rules preventing such behavior.

It is interesting that the opposite pattern was observed among undergraduate participants with high levels of interoception. The effect of boredom proneness was stronger for those with high levels of interoceptive ability and high levels of disordered eating than for those with high levels of interoceptive ability and low levels of disordered eating. Those with high levels of interoceptive sensibility and low levels of disordered eating reported the lowest levels of emotional eating. The effect of boredom proneness was still significant in this group, but the association was weaker. Among those with high levels of interoception and high levels of disordered eating, interoception is either 1) not a core feature of their symptomology or 2) an inaccurate self-report of objective interoceptive. If the latter is true, it might be the case that these individuals mistakenly believe they are identifying internal cues accurately (e.g., “I feel hungry and I am confident it is hunger”) and act on these cues accordingly. This could lead to greater engagement in dysregulated eating, such as emotional eating. In other words, if these individuals do not rely on rigid dietary rules despite having deficits in interoception, they might be especially prone to engage in emotional eating in response to an emotion like boredom, potentially mistaking it for hunger.
Overall, replication of this three-way interaction is needed, and future work would benefit from measuring additional variables that could elucidate what is underlying the observed interaction. For example, including an objective assessment of interoception would allow for a test of whether the differences described are related to true differences in interoceptive ability or differences in beliefs about interoceptive ability. It would also be valuable for future work to employ a longitudinal design to assess developmental changes in interoception and ways that individuals learn to cope with deficits, such as the development of strict dietary rules. This would allow for an exploration of how such coping strategies impact future emotional eating behaviors.

**Limitations**

Study 2 had several important limitations that should be taken into consideration. First, all of the constructs of interest in this study were measured via self-report. A review discussing the validity of such measures provided evidence that self-reported emotional eating does not accurately reflect actual food intake in response to emotional states based on objective measures (Bongers & Jansen, 2016). What has been called a “triple recall bias,” self-report measures are not only asking people to recall recent episodes of overeating, but also their past affective states and the temporal associations between the two (Devonport et al., 2019). Recall of food intake over time (Archer et al., 2013) and recall of emotional experiences (Kaplan et al., 2016) are both challenging for many people, and the measurement error in this study could have been substantial. Indeed, research suggests poor concordance across self-reported emotional eating and laboratory-based eating (Braden et al., 2020). That said, food intake occurring in the laboratory also has a number of potential biases, including the possibility of demand

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3 Food intake measured in the laboratory has its own limitations, and it can be argued that eating in such artificial settings does not reflect actual eating behaviors. However, in a handful of studies comparing self-reported emotional eating with naturalistic methods, there has been little support for self-report as an accurate indicator of food intake in response to affect (Boh et al., 2016; Bongers & Jansen, 2016).
characteristics if participants know food consumption is being measured (Robinson et al., 2014). This can be particularly apparent when people believe they are being observed when eating energy-dense foods (Robinson et al., 2016). Likewise, emotional experiences elicited in the lab are likely different in complexity and intensity compared to the emotions people experience in everyday life. Evaluation of the consistency and robustness of findings across these different methods will be important.

Future work would also benefit from finding ways to more accurately assess emotional eating. New wearable sensors, such as bite counters (Scisco et al., 2011) provide direct, objective assessment of eating, but are also subject to demand characteristics given that individuals must start and stop the counter before each meal. Moreover, a “bite” is a rather crude measure of consumption. A new tooth sensor (Tseng et al., 2018) has promise, especially given the potential for nutrient analysis, but this technology is still under development. Lastly, more objective approaches for assessing emotional responses, such as wrist worn sensors capturing heart rate variability, could be helpful in overcoming the biases of self-report (Juarascio, Crochiere, et al., 2020), but the extent to which these technologies can provide information about specific emotional experiences is limited. Additionally, affordability and minimization of individual burden will be necessary for widespread use of any monitoring device.

Likewise, measuring interoceptive ability via self-report has inherent shortcomings. This issue is discussed more broadly below (see General Conclusions). However, weaknesses in the measure used for general interoception in Study 2 is worth elaboration. The MAIA-2 (Mehling et al., 2018) is the most widely used self-report measure of general interoceptive sensibility and valid alternatives are scarce. However, the MAIA items assess both the extent to which someone believes they can identify internal cues (e.g., “I notice changes in my breathing, such as whether
it slows down or speeds up”) and their response to this information (e.g., “When I feel pain or discomfort, I try to power through it”). Even though there are subscales within the MAIA, only one subscale is devoted to purely “noticing” internal cues, and it is limited to four items. Beyond potential limitations with this specific measure, previous work has suggested that actual interoceptive ability and beliefs about interoceptive ability are dissociable constructs (Cali et al., 2015; Forkmann et al., 2016). Thus, caution is needed in interpreting the Study 2 results. Results suggested that interoceptive sensibility is associated with emotional eating, and this is theoretically supported. However, whether this would remain true for objectively measured interoceptive accuracy, and particularly for hunger/satiety specific interoceptive accuracy, requires further investigation.
GENERAL CONCLUSIONS AND FUTURE DIRECTIONS

General Conclusions

Study 1 and Study 2 fill important gaps in the literature on emotional eating by investigating boredom as an emotion that is important to eating behaviors, and the role of interoceptive awareness in the association between boredom and emotional eating. Overall, findings suggested that boredom, as a state (Study 1) or trait (Study 2), is predictive of food consumption (Study 1) and self-reported emotional eating (Study 2). Findings also suggested an important role of interoception. Study 1 provided (very) preliminary data that poor interoception may be a vulnerability factor for eating when bored. Though Study 2 did not find an interaction between boredom proneness and interoception, hunger/satiety specific interoception was an independent predictor of emotional eating in both undergraduate and community samples, and general interoception was also associated with emotional eating among undergraduates. Moreover, a three-way interaction emerged between boredom proneness, interoception, and disordered eating in the undergraduate sample.

Results support previous findings that boredom plays an important role in problematic eating behaviors. Extant data suggest that boredom is experienced as aversive (Vanderlinden et al., 2001). The current findings provide potential support for the notion that individuals are motivated to escape from self-awareness and the aversive experience of boredom. This escape from self-awareness is thought to ultimately lead to a shift in attention, away from higher level thinking toward the immediate environment. According to the escape model, this shift allows individuals to “escape” negative self-appraisals, but also takes attention away from dietary
monitoring, decreases inhibitions, and leads to overeating. Study 1 did provide tentative support that boredom triggers behavioral changes (i.e., eating). The current study did not directly test other aspects of this model, such as the use of regulation strategies like cognitive narrowing, but together with other work, this theory does appear to be a plausible explanation for emotional eating behavior (Blackburn et al., 2006; Engelberg et al., 2007; Moynihan et al., 2015; Rosenbaum & White, 2016).

An unanticipated finding of the current work relates to the relationship between boredom and the broad dimensions of positive and negative affect. In Study 1, which included a sample of undergraduate students only, in addition to heightened boredom, positive affect was reduced in the bored mood condition compared to the neutral condition. Though the difference in negative affect in the neutral compared to the bored condition reflected a medium effect size, this difference was not statistically significant. Further, the difference in negative affect across mood conditions was substantially smaller compared to the difference in positive affect (which showed a large effect), suggesting the potential importance of considering changes in positive affect when investigating boredom. When boredom proneness was added to the regression model in Study 2, the association between positive affect and emotional eating was no longer significant. Importantly, this was found only for undergraduate students. Though Study 2 found no notable difference in the strength of correlations between boredom and positive affect compared to boredom and negative affect, the different ways in which these associations are meaningful to eating behaviors might be important.

It is possible that the association between boredom and emotional eating may be driven by motivational aspects relevant to both negative and positive affect. The theoretical rationale for the current study emphasized boredom as aversive, and the motivation to escape from this
aversive experience as central to subsequent behaviors (i.e., an avoidance process). However, it is also possible that for some, boredom motivates behaviors to increase positive emotions or arousal (i.e., an approach process). Preliminary research on the association between boredom and gambling suggests that seeking arousal/sensation is more central to gambling than avoidance of negative affect, though this was a cross-sectional study with notable limitations (Mercer & Eastwood, 2010). Boredom also appears to play a role in other risk-taking behaviors, like risky driving and binge drinking (Biolcati et al., 2018; Oxtoby et al., 2019), which might suggest the motivation to increase arousal could be an important aspect of boredom, at least in some contexts. Like gambling and substance use, anticipation and consumption of highly palatable foods are powerful triggers of dopamine-based reward circuitry (Boileau et al., 2003; Joutsa et al., 2012; Lenoir et al., 2007; Small et al., 2003; Volkow et al., 2002).

Still other research suggests stronger support for the notion that the escape process is an important component of why boredom might lead to increased food consumption. Consistent with previous work, in a laboratory-based experimental study of gambling behaviors boredom was associated with increased risk taking, and self-control was associated with reduced risk-taking (Kılıç et al., 2020). Boredom also emerged as a moderator of the association between self-control and risk-taking. As state boredom increased, the negative association between self-control and risk-taking was reduced. The authors theorized that boredom might “undo” people's ability to exercise self-control. Given that these authors are truly proposing a mediation (i.e., that boredom leads to reduced self-control, which leads to increased risk taking), but did not test this question directly, additional data are needed to support this conclusion. However, findings do provide some additional support for the escape process proposed by Heatherton and Baumeister (1991), suggesting that when faced with an aversive state like boredom, the need to escape from
self-awareness leads to strategies, like cognitive narrowing, that cause disinhibition (i.e., reduced self-control) and the resulting behavioral outcomes, like problematic eating.

Of course, it is also possible that both pathways, escaping an aversive experience and increasing arousal/positive affectivity, are relevant to the association between boredom and emotional eating. Schell et al. (2019) found that “fun seeking” was indirectly associated with binge eating through the expectancy that eating would reduce boredom (avoidance) and the expectancy that eating is rewarding (approach). The authors also reported that the indirect effect was greater for the expectancy that eating would reduce boredom than for the expectancy that eating is rewarding. Overall, more research is needed to better understand the mechanisms underlying the association between boredom and emotional eating, as well as who may be particularly vulnerable. This would include replication of the current findings that suggest a potential role for disordered eating and interoception, as well as exploring other potential individual difference characteristics.

Disentangling the multi-dimensional nature of interoception is also necessary to understanding the current findings. Study 1 and Study 2 suggested a link between interoception and emotional eating. However, the theoretical underpinnings of the original hypothesis— that a reduced ability to identify and discriminate between internal states would be associated with emotional eating—emphasized interoceptive accuracy. Like prior research (Forkmann et al., 2016; Garfinkel et al., 2015), Study 1 found that gastric interoceptive accuracy measured via a laboratory task was not strongly associated with self-reported interoception. That said, the measures used in Study 1 were primarily general interoception (though the EDI-IA does include two items related to hunger/satiety). Future work should examine whether a more hunger/satiety-specific self-report measure of interoception would show greater concordance with an objective,
gastric interoception measure like the Water Load Task (Van Dyck et al., 2016). Still, other data similarly support only modest correlations (e.g., $r \sim .3$) between interoceptive accuracy, measured via a laboratory task (e.g., heartbeat perception) and interoceptive sensibility in the same domain measured via self-report (e.g., heartbeat perception; Forkmann et al., 2016). People’s confidence in their own interoceptive ability may be a poor predictor of objective ability, which has implications for whether the interoceptive measures used in Study 2 are a real reflection of the construct most relevant to the proposed hypothesis (that actual interoceptive ability would play a role in the association between boredom and emotional eating).

One reason for the discrepancy between self-reported ability and objective ability could relate to the neurobiology underlying interoception. Afferent nerve fibers carrying interoceptive information (including gastric distention) are received by regions such as right anterior insula (Critchley et al., 2004). However, the conscious processing of this information, which helps guide behavior, is influenced by other cognitive, motivational, and affective processes in other areas of the brain (e.g., the anterior cingulate cortex and orbitofrontal areas; Fleming et al., 2012; Kepecs et al., 2008; Medford & Critchley, 2010). Moreover, accuracy might differ across different domains (e.g., pain, touch, hunger). Although many bodily signals are processed by common neural substrates (Kleckner et al., 2017), at the behavioral level evidence suggests that being “good” at detecting some types of signals, such as heartbeat, does not strongly predict being “good” at detecting other types of signals, such as respiration or touch perception (Garfinkel et al., 2016). Beyond the processing and perception of internal cues, judging and assessing our own abilities calls upon still other neural networks. Research is still nascent with regard to the neurobiology of metacognition about interoceptive ability (i.e., thinking about and judging one’s own interoceptive ability), but based on work in other areas, such as perceptual
metacognition, data suggest that higher brain regions are involved (e.g., medial and lateral areas of the anterior prefrontal cortex; Fleming & Dolan, 2012; Fleming et al., 2010; Lau & Rosenthal, 2011; McCurdy et al., 2013). Overall, the gap between interoceptive ability and beliefs about interoceptive ability appear to have important neurobiological underpinnings and the associations between interoception, boredom, and emotional eating will likely show variability depending on method of measurement (self-report or task performance) and the specific physiological senses being assessed (pain, heart rate, touch, hunger, respiration, etc.).

Finally, although boredom was the focus of the current study, future work would benefit from continuing to explore how different emotional experiences are associated with eating behaviors. Study 1 and Study 2 supported associations between boredom and both measured and self-reported emotional eating. Moreover, Study 2 suggested that boredom is an important predictor of emotional eating, over and above the broad dimensions of positive and negative affect. The PANAS (Watson et al., 1988) is a widely used measure of affect and is commonly used in studies exploring the role of affect in eating behaviors. However, it is likely that variability exists in the extent to which each of the emotions included in the PANAS (e.g., hostility, fear, nervousness) are useful to the prediction of eating behaviors. A sum score of items gives each of the items the same weight, and ultimately only a single coefficient is interpreted when a total score of “negative affect,” for example, is used to predict emotional eating. Similarly, it is conceivable that individual differences exist in which emotions predict greater engagement emotional eating and which predict less engagement in emotional eating, or in other words, that not all people engage in emotional eating in response to the same emotions. Lastly, the original PANAS scale includes a limited number of emotions and it does not include boredom. Researchers and clinicians seeking to reduce participant and patient burden would
benefit from data showing which specific emotions are the strongest predictors of emotional eating. Currently, a great deal of uncertainty remains as to which emotions elicit what eating behaviors, why, and for whom.

**Implications**

The current investigation has important implications for future research and for individuals and providers working to reduce emotional eating. If Study 1 results are replicated with a larger sample, it would suggest that prevention and intervention efforts for emotional eating would benefit from considering the role of boredom. Once it is clearer what elements of boredom lead to emotional eating, interventions for emotional eating could seek to help individuals cope more effectively. Specifically, it will be helpful to understand whether it is the aversive nature of boredom that people are trying to avoid or an approach motivation to seek activities providing different sensations/greater arousal. This information could be used to develop new interventions for emotional eating, either within the context of weight loss treatment or disordered eating interventions, or to adapt existing interventions to target emotional eating.

If research supports a stronger avoidance mechanism in the relationship between boredom and emotional eating, dialectical behavior therapy ((DBT; Linehan, 1987) could be a valuable approach. Originally developed as a treatment for borderline personality disorder, affect regulation and distress tolerance are important components of DBT therapy. While full model DBT may not be needed, elements of DBT could prove beneficial to helping individuals respond more effectively to the aversive nature of boredom. In particular, learning to modulate emotional experiences when possible and using distress tolerance when needed (Linehan, 1987) may be useful strategies. Although not focused on boredom necessarily, others have proposed DBT for
treating emotional eating more broadly; however, the data are limited, with only one published case study (Glisenti & Strodl, 2012) and one published pilot study with adults (Roosen et al., 2012). Two others treatment studies combined components of DBT with other approaches, such as family-based therapy or behavioral weight loss, to reduce emotional eating among those with overweight/obesity. Both studies reported reductions in emotional eating, among adolescents (Boutelle et al., 2018) and adults (Braden & O’Brien, 2021). Research on DBT as a treatment for other dysregulated eating behaviors (e.g., binge eating, purging) is also growing. While DBT has shown promise in reducing disordered eating (Reilly et al., 2020), systematic reviews suggest outcomes may be comparable to traditional CBT approaches (Linardon et al., 2017). Still, data are limited, with few studies including large or diverse samples, or using randomized designs.

Though some components of cognitive behavioral therapies (including DBT), focus on strategies for increasing positive affect and arousal (e.g., behavioral activation), this area has received relatively less attention as a potential mechanism to reduce emotional eating compared to interventions targeting negative affect. A good example of this disproportionate interest comes from a recent exploratory component analysis of emotion regulation strategies to treat emotional eating (Juarascio, Parker, et al., 2020). The component analysis focused on three treatment components: emotional awareness, down-regulation of emotions, and tolerance of emotions. The workshop titled “down-regulation,” for example, focused on skills like checking the facts and using opposite action to reduce negative affect/overall distress. Little attention was given to skills that would more directly increase positive affect. A similar criticism has been raised recently by those working in the area of depression and efforts are being made to develop interventions that more effectively target the mechanisms involved in low positive affect (Craske et al., 2019). If future research supports low arousal, low pleasure, and sensation-seeking as aspects of boredom
that lead to emotional eating, researchers could explore the benefits of including more explicit positive affect interventions in the treatment of emotional eating.

Study 2 also highlighted that interoceptive awareness training may deserve consideration as a potential contributor to emotional eating (though the evidence to date has been largely correlational). Clinicians and researchers could consider whether interoceptive ability training might result in reduced emotional eating. One recently developed intervention for disordered eating, Mindfulness Based Eating Awareness Training (MB-EAT; Kristeller et al., 2014), has emphasized mindfulness practice in the treatment of problematic eating behaviors. MB-EAT incorporates meditation practice, self-monitoring, body awareness (in particular, attending to hunger and fullness cues), and self-acceptance. MB-EAT was originally developed for binge eating disorder and has yet to be subject to rigorous trials. However, given the focus of the treatment, interoceptive ability is one presumed mechanism of positive treatment outcomes. Indeed, participants in the original clinical trial reported anecdotal accounts of improvements in this area (Kristeller et al., 2014), but interoception was not measured as a primary outcome. Cross-sectional explorations have provided preliminary support for the indirect effect of interoception between greater engagement in mindfulness and reduced disordered eating behaviors (Lattimore et al., 2017). Still, prospective studies are needed to fully account for the extent to which MB-EAT actually results in objective improvements in hunger/satiety specific interoceptive ability. A recent review by experts in the field concluded that although interoception is a proposed mechanism in the theoretical rationale behind using mindfulness to treat eating disorders “…to our knowledge, it has not been examined as a potential mechanism of action.” (p. 1097, Vanzhula & Levinson, 2020). Even outside of research on mindfulness to improve awareness of hunger/satiety, there is mixed evidence as to whether mindfulness practice
results in improved interoception more broadly (Bornemann et al., 2015; Fischer et al., 2017; Krygier et al., 2015; Parkin et al., 2014).

Unfortunately, emotional eating is often not an outcome of interest in studies examining MB-EAT for disordered eating, limiting inferences from this line of work. A recent systematic review found that within mindfulness-based treatment studies that did measure emotional eating as a treatment outcome, only two of five studies demonstrated significant improvements in emotional eating (Katterman et al., 2014). A separate review with broader inclusion criteria (e.g., including intervention studies that incorporated mindfulness, even if mindfulness was not necessarily the primary intervention) reported that five out of eight studies found improvements in emotional eating (O'Reilly et al., 2014). Thus, additional research is needed exploring whether MB-EAT or other mindfulness-based interventions can produce clinically meaningful change in emotional eating behaviors. Likewise, more work is needed exploring whether there might be alternative ways to enhance interoception. For example, borrowing elements from Blood Glucose Awareness Training could be valuable, which has shown promise for improving accuracy of blood glucose estimation (Cox et al., 2006), but more rigorous trials are needed.

In conclusion, taken within the context of previously published work, the findings presented here further support associations between boredom, interoception, and emotional eating. Additional research is needed with methods of measurement that minimize the limitations of self-report and with designs that would allow for a better understanding of the temporal dynamics at play in how boredom and interoception relate to emotional eating. Research in this area will hopefully prove valuable in helping individuals who are engaging in emotional eating at a level of that is impacting mental or physical health.
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Appendix A: Eating Disorder Examination Questionnaire (Fairburn & Beglin, 2008)

Instructions: The following questions are concerned with the past four weeks (28 days) only. Please read each question carefully. Please answer all of the questions. Please only choose one answer for each question. Thank you.

Questions 1 to 12: Please circle the appropriate number on the right. Remember that the questions only refer to the past four weeks (28 days) only.

<table>
<thead>
<tr>
<th>On how many of the past 28 days ......</th>
<th>No days</th>
<th>1-5 days</th>
<th>6-12 days</th>
<th>13-15 days</th>
<th>16-22 days</th>
<th>23-27 days</th>
<th>Every day</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Have you been deliberately trying to limit the amount of food you eat to influence your shape or weight (whether or not you have succeeded)?</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>2 Have you gone for long periods of time (8 waking hours or more) without eating anything at all in order to influence your shape or weight?</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>3 Have you tried to exclude from your diet any foods that you like in order to influence your shape or weight (whether or not you have succeeded)?</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>4 Have you tried to follow definite rules regarding your eating (for example, a calorie limit) in order to influence your shape or weight (whether or not you have succeeded)?</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>5 Have you had a definite desire to have an empty stomach with the aim of influencing your shape or weight?</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>6 Have you had a definite desire to have a totally flat stomach?</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>7 Has thinking about food, eating or calories made it very difficult to concentrate on things you are interested in (for example, working, following a conversation, or reading)?</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>8 Has thinking about shape or weight made it very difficult to concentrate on things you are interested in (for example, working, following a conversation, or reading)?</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>9 Have you had a definite fear of losing control over eating?</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>10 Have you had a definite fear that you might gain weight?</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>11 Have you felt fat?</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>12 Have you had a strong desire to lose weight?</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
</tbody>
</table>
### Questions

13. Over the past 28 days, how many times have you eaten what other people would regard as an unusually large amount of food (given the circumstances)?

14. On how many of these times did you have a sense of having lost control over your eating (at the time that you were eating)?

15. Over the past 28 days, on how many \textbf{DAYS} have such episodes of overeating occurred (i.e. you have eaten an unusually large amount of food and have had a sense of loss of control at the time)?

16. Over the past 28 days, how many times have you made yourself sick (vomit) as a means of controlling your shape or weight?

17. Over the past 28 days, how many times have you taken laxatives as a means of controlling your shape or weight?

18. Over the past 28 days, how many times have you exercised in a “driven” or “compulsive” way as a means of controlling your weight, shape or amount of fat or to burn off calories?

Questions 19-21: Please circle the appropriate number. Please note that for these questions the term “binge eating” means eating what others would regard as an unusually large amount of food for the circumstances, accompanied by a sense of having lost control over eating.

<table>
<thead>
<tr>
<th>Question</th>
<th>Description</th>
<th>Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>19</td>
<td>Over the past 28 days, how many days have you eaten in secret (ie, furtively)? Do not count episodes of binge eating</td>
<td>0, 1, 2, 3, 4, 5, 6</td>
</tr>
<tr>
<td>20</td>
<td>On what proportion of the times that you have eaten have you felt guilty (felt that you’ve done wrong) because of its effect on your shape or weight? Do not count episodes of binge eating</td>
<td>None of the times, A few of the times, Less than half, Half of the times, More than half, Most of the time, Every time</td>
</tr>
<tr>
<td>21</td>
<td>Over the past 28 days, how concerned have you been about other people seeing you eat? Do not count episodes of binge eating</td>
<td>Not at all, Slightly, Moderately, Markedly</td>
</tr>
</tbody>
</table>
Questions 22-28: Please circle the appropriate number on the right. Remember that the questions only refer to the past four weeks (28 days)

<table>
<thead>
<tr>
<th>Question</th>
<th>Not at all</th>
<th>Slightly</th>
<th>Moderately</th>
<th>Markedly</th>
</tr>
</thead>
<tbody>
<tr>
<td>22 Has your <strong>weight</strong> influenced how you think about (judge) yourself as a person?</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>23 Has your <strong>shape</strong> influenced how you think about (judge) yourself as a person?</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>24 How much would it have upset you if you had been asked to weigh yourself once a week (no more, or less, often) for the next four weeks?</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>25 How dissatisfied have you been with your <strong>weight</strong>?</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>26 How dissatisfied have you been with your <strong>shape</strong>?</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>27 How uncomfortable have you felt seeing your body (for example, seeing your shape in the mirror, in a shop window reflection, while undressing or taking a bath or shower)?</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>28 How uncomfortable have you felt about others seeing your shape or figure (for example, in communal changing rooms, when swimming, or wearing tight clothes)?</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>
Appendix B: Multidimensional Assessment of Interoceptive Awareness – 2 (MAIA-2; Mehling et al., 2012)

Below you will find a list of statements. Please indicate how often each statement applies to you generally in daily life.

<table>
<thead>
<tr>
<th>Statement</th>
<th>Circle one number on each line</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. When I am tense I notice where the tension is located in my body.</td>
<td>Never 0 Always 5</td>
</tr>
<tr>
<td>2. I notice when I am uncomfortable in my body.</td>
<td>Never 0 Always 5</td>
</tr>
<tr>
<td>3. I notice where in my body I am comfortable.</td>
<td>Never 0 Always 5</td>
</tr>
<tr>
<td>4. I notice changes in my breathing, such as whether it slows down or speeds up.</td>
<td>Never 0 Always 5</td>
</tr>
<tr>
<td>5. I ignore physical tension or discomfort until they become more severe.</td>
<td>Never 0 Always 5</td>
</tr>
<tr>
<td>6. I distract myself from sensations of discomfort.</td>
<td>Never 0 Always 5</td>
</tr>
<tr>
<td>7. When I feel pain or discomfort, I try to power through it.</td>
<td>Never 0 Always 5</td>
</tr>
<tr>
<td>8. I try to ignore pain</td>
<td>Never 0 Always 5</td>
</tr>
<tr>
<td>9. I push feelings of discomfort away by focusing on something</td>
<td>Never 0 Always 5</td>
</tr>
<tr>
<td>10. When I feel unpleasant body sensations, I occupy myself with something else so I don’t have to feel them.</td>
<td>Never 0 Always 5</td>
</tr>
<tr>
<td>11. When I feel physical pain, I become upset.</td>
<td>Never 0 Always 5</td>
</tr>
<tr>
<td>12. I start to worry that something is wrong if I feel any discomfort.</td>
<td>Never 0 Always 5</td>
</tr>
<tr>
<td>13. I can notice an unpleasant body sensation without worrying about it.</td>
<td>Never 0 Always 5</td>
</tr>
<tr>
<td>14. I can stay calm and not worry when I have feelings of discomfort or pain.</td>
<td>Never 0 Always 5</td>
</tr>
<tr>
<td>Statement</td>
<td>Choices</td>
</tr>
<tr>
<td>---------------------------------------------------------------------------</td>
<td>---------</td>
</tr>
<tr>
<td>15. When I am in discomfort or pain I can’t get it out of my mind</td>
<td>0 1 2 3 4 5</td>
</tr>
<tr>
<td>16. I can pay attention to my breath without being distracted by things happening around me.</td>
<td>0 1 2 3 4 5</td>
</tr>
<tr>
<td>17. I can maintain awareness of my inner bodily sensations even when there is a lot going on around me.</td>
<td>0 1 2 3 4 5</td>
</tr>
<tr>
<td>18. When I am in conversation with someone, I can pay attention to my posture.</td>
<td>0 1 2 3 4 5</td>
</tr>
<tr>
<td><strong>How often does each statement apply to you generally in daily life? Circle one number on each line</strong></td>
<td></td>
</tr>
<tr>
<td>19. I can return awareness to my body if I am distracted.</td>
<td>0 1 2 3 4 5</td>
</tr>
<tr>
<td>20. I can refocus my attention from thinking to sensing my body.</td>
<td>0 1 2 3 4 5</td>
</tr>
<tr>
<td>21. I can maintain awareness of my whole body even when a part of me is in pain or discomfort.</td>
<td>0 1 2 3 4 5</td>
</tr>
<tr>
<td>22. I am able to consciously focus on my body as a whole.</td>
<td>0 1 2 3 4 5</td>
</tr>
<tr>
<td>23. I notice how my body changes when I am angry.</td>
<td>0 1 2 3 4 5</td>
</tr>
<tr>
<td>24. When something is wrong in my life I can feel it in my body.</td>
<td>0 1 2 3 4 5</td>
</tr>
<tr>
<td>25. I notice that my body feels different after a peaceful experience.</td>
<td>0 1 2 3 4 5</td>
</tr>
<tr>
<td>26. I notice that my breathing becomes free and easy when I feel comfortable.</td>
<td>0 1 2 3 4 5</td>
</tr>
<tr>
<td>27. I notice how my body changes when I feel happy / joyful.</td>
<td>0 1 2 3 4 5</td>
</tr>
<tr>
<td>28. When I feel overwhelmed I can find a calm place inside.</td>
<td>0 1 2 3 4 5</td>
</tr>
<tr>
<td>29. When I bring awareness to my body I feel a sense of calm.</td>
<td>0 1 2 3 4 5</td>
</tr>
<tr>
<td>30. I can use my breath to reduce tension.</td>
<td>0</td>
</tr>
<tr>
<td>31. When I am caught up in thoughts, I can calm my mind by focusing on my body/breathing.</td>
<td>0</td>
</tr>
<tr>
<td>32. I listen for information from my body about my emotional state.</td>
<td>0</td>
</tr>
<tr>
<td>33. When I am upset, I take time to explore how my body feels.</td>
<td>0</td>
</tr>
<tr>
<td>34. I listen to my body to inform me about what to do.</td>
<td>0</td>
</tr>
<tr>
<td>35. I am at home in my body.</td>
<td>0</td>
</tr>
<tr>
<td>36. I feel my body is a safe place.</td>
<td>0</td>
</tr>
<tr>
<td>37. I trust my body sensations.</td>
<td>0</td>
</tr>
</tbody>
</table>
Appendix C: Eating Disorder Inventory- Interoceptive Awareness (Garner, Olmstead, & Polivy, 1983)

These questions measure a variety of attitudes, feelings, and behaviors. There are no right or wrong answers so please try to be completely honest in your answers. Read each question and circle the number of the word that best describes how YOU usually are.

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
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<tbody>
<tr>
<td>Never</td>
<td>Rarely</td>
<td>Sometimes</td>
<td>Usually</td>
<td>Often</td>
<td>Always</td>
</tr>
</tbody>
</table>


Never

I get frightened when my feelings are too strong. 1 2 3 4 5 6
I get confused about what emotion I am feeling. 1 2 3 4 5 6
I can clearly identify what emotion I am feeling. 1 2 3 4 5 6
I don't know what's going on inside me. 1 2 3 4 5 6
I get confused as to whether or not I am hungry. 1 2 3 4 5 6
I worry that my feelings will get out of control. 1 2 3 4 5 6
I feel bloated after eating a small meal. 1 2 3 4 5 6
When I am upset, I don't know if I am sad, frightened, or angry. 1 2 3 4 5 6
I have feelings I can't quite identify. 1 2 3 4 5 6
When I am upset, I worry that I will start eating. 1 2 3 4 5 6
Appendix D. Positive and Negative Affect Schedule- Study 1 (PANAS; Watson, Clark, & Tellegen, 1988)

This scale consists of a number of words that describe different feelings and emotions. Indicate to what extent you feel this way right now, that is, at the present moment.

Response Scale: very slightly or not at all (1), a little (2), moderately (3), quite a bit (4), extremely (5)

- *Bored
- Interested
- Distressed
- Excited
- Upset
- Strong
- Guilty
- Scared
- Hostile
- Enthusiastic
- Proud
- Irritable
- Alert
- Ashamed
- Inspired
- Nervous
- Determined
- Attentive
- Jittery
- Active
- Afraid

*Not originally in the PANAS
Appendix E. Pictorial Cue to Provide Dynamometer Rating
Appendix F. IRB Approval Letter for Study 1

Dear E. Altich:

On 6/28/2019, the Institutional Review Board (IRB) reviewed and APPROVED the above application and all documents contained within, including those outlined below. Please note this study is approved under the 2013 version of 45 CFR 46 and you will be asked to confirm ongoing research annually in place of a full Continuing Review. Amendments and Reportable Events must still be submitted per USF HRPP policy.

Approved Item(s):
Protocol Document(s):
   Protocol Version 1 June 14 2019

Consent/Assent Document(s):
   Consent Form Version 1 June 28 2019.pdf

*Please use only the official IRB stamped informed consent/assent document(s) found under the "Attachments" tab. Please note, these consent/assent documents are valid until the consent document is amended and approved.

The determination of the IRB that your study qualified for expedited review which includes activities that: (1) present no more than minimal risk to human subjects, and (2) involve only procedures listed in one or more of the categories outlined below. The IRB may review research through the expedited review procedure authorized by 45 CFR 46 110 and 21 CFR 56 110. The research proposed in this study is categorized under the following expedited review category:

(4) Collection of data through nonintrusive procedures (not involving general anesthesia or sedation) routinely employed in clinical practice, excluding procedures involving X-rays or microwaves. Where medical devices are employed, they must be cleared/approved for marketing.

(7) Research on individual or group characteristics or behavior (including, but not limited to, research on perception, cognition, motivation, identity, language, communication, cultural beliefs, or practices, and social behaviors) or research employing survey, interview, oral history, focus group, program evaluation, human factors evaluation, or quality assurance methodologies.

As a reminder, please contact USF IT at help@usf.edu to set up your Box.com study folders before storing data on the cloud. You will need to include the name of the Principal Investigator (folder owner), study title, data to be stored, and a list of IRB-approved study team members in your email to USF IT. For additional information, please see section 12.2 of USF HRPP Policy.

As the principal investigator of this study, it is your responsibility to conduct this study in accordance with IRB policies and procedures and as approved by the IRB. Any changes to the approved research must be submitted to the IRB via an Amendment for review and approval. Additionally, all unanticipated problems must be reported to the USF IRB within five (5) business days.

We appreciate your dedication to the ethical conduct of human subjects research at the University of South Florida and your continued commitment to human research protections. If you have any questions regarding this matter, please call 813-974-5638.

Sincerely,

[Signature]
Kristen Salomon, Ph.D., Chairperson
USF Institutional Review Board
Appendix G: Debriefing Script

The experiment is over now, but before you go, I’d like to talk to you a little bit. At the beginning of the session, I told you what the study was about, but I didn’t tell you anything about what our hypotheses were, or what we were expecting to find. I was wondering if you had any ideas about what we were expecting to find?

Pause, and let people give their ideas. If participant says anything at this point, be encouraging and enthusiastic about hearing his/her thoughts. Ask questions such as “what made you think that?” If participant has no thoughts to contribute here, say: That’s fine, and continue onto the next part.

Sometimes when people participate in psychology experiments, they feel a little suspicious because they think that there might be a hidden purpose to the experiment. Did you have any feelings of suspicion about anything that happened during this session? Was there ever a time when you suspected that I was lying to you about anything?

Pause after each question to give participant a chance to respond. If participant says anything other than a firm “no” to any of these questions, ask open-ended questions in an effort to determine precisely which aspects of the experiment he/she was suspicious about. Try to get her to elaborate. Try not to reveal what was actually going on during the experiment until you’ve fully assessed the participant’s level of suspicion. If participant does voice a suspicion:

Could you tell me a little bit about that? Like, what specifically made you feel that way?

Were you certain [about whatever suspicion they just revealed], or were you just suspicious?

Do you think that having that suspicion might have influenced any of your responses during the session? It’s okay if it did, but it’s important for me to know about it.

When you’re finished discussing any suspicions that the participant had:

Okay, then, I can explain what the study is about. Your consent form states that the purpose of this study was to collect data to examine the effect of water consumption on attention, but this does not describe the entire study. In fact, we really are interested in how mood impacts food consumption, as well as how certain characteristics, like sensitivity to internal cues, might influence this relationship. The water drinking task you did during the first visit was our measure of sensitivity to internal cues, and the videos you watched were meant to prompt a certain mood state. We then measured food consumption. Did you have any idea that we were interested in how much food was consumed?

Discuss participants’ reactions to the test with him/her. If he/she was suspicious, ask: Were you certain about that or were you just suspicious about that? Do you think that having that suspicion might have influenced any of your behavior during the session?

Pause for response, assess level of suspicion and influence.
I also want to mention that we were monitoring you through a two-way mirror while you were watching the video. We do this to assess whether people are attentive to the video or engaging in other activities. Were you aware of this?

Discuss participants’ reactions to this information with him/her. If he/she was suspicous, ask: Were you certain about that or were you just suspicious about that? Do you think that having that suspicion might have influenced any of your behavior during the session?

Pause for response, assess level of suspicion and influence.

At this point, I should stop and let you ask any questions you have. Is everything clear so far?

Answer any questions

Please understand that although we try to avoid using deception if possible, we needed to use deception in this experiment to really study the processes we’re interested in. If people know beforehand what we’re really studying, it might influence their behavior.

Also, I want to ask you to please not discuss this study with anyone else you know who might participate. It is very important that people who participate in this study do not know beforehand what it is about. Okay?

If you would like any of your data withdrawn for any reason, please let me know now. Data includes our measurements of food consumption, your performance on the water drinking task in the first visit, and responses to questionnaires. Once you leave, your data will only be known by a number, it will be included in a large pool of data, and there will be no way to identify yours from other participants.

Pause for response and answer any questions. Give participant a copy of informed consent and mental health resources sheet.

Finally, sometimes participating in a study can trigger an emotional response. We’re going to give you a copy of the informed consent and some resources you can access should you feel upset or be concerned about feelings this study may have triggered.

We hope that you enjoyed participating in this study and if you have any more questions feel free to ask me! We sincerely appreciate the time you took to participate.

***************
Appendix H. Attentive Responding Scale – 18 (ARS-18; Maniaci & Rogge, 2014)

<table>
<thead>
<tr>
<th>0 = Not at all true</th>
<th>1 = A little True</th>
<th>2 = Somewhat True</th>
<th>3 = Mostly True</th>
<th>4 = Very True</th>
</tr>
</thead>
</table>

Scale Part 1

1. I am an active person
2. I enjoy the company of my friends
3. I don’t like being ridiculed or humiliated (R)
4. I enjoy relaxing in my free time
5. I spend most of my time worrying
6. My favorite subject is agronomy
7. It frustrates me when people keep me waiting
8. I am a very energetic person
9. I enjoy the music of Marlene Sandersfield

Scale Part 2

1. I have an active lifestyle
2. I like to spend time with my friends
3. I don’t like getting speeding tickets (R)
4. In my time off I like to relax
5. I worry about things a lot
6. It feels good to be appreciated (R)
7. It’s annoying when people are late
8. I have a lot of energy
9. I’d rather be hated than loved
Appendix I. Boredom Proneness Scale (Farmer and Sundberg, 1986)

Highly disagree 1- 2- 3- 4 Neutral- 5-6- 7 highly agree

_____ 1. It is easy for me to concentrate on my activities.
_____ 2. Frequently when I am working I find myself worrying about other things.
_____ 3. Time always seems to be passing slowly.
_____ 4. I often find myself at “loose ends”, not knowing what to do.
_____ 5. I am often trapped in situations where I have to do meaningless things.
_____ 6. Having to look at someone’s home movies or travel slides bores me tremendously.
_____ 7. I have projects in mind all the time, things to do.
_____ 8. I find it easy to entertain myself.
_____ 9. Many things I have to do are repetitive and monotonous.
_____ 10. It takes more stimulation to get me going than most people.
_____ 11. I get a kick out of most things I do.
_____ 12. I am seldom excited about my work.
_____ 13. In any situation I can usually find something to do or see to keep me interested.
_____ 14. Much of the time I just sit around doing nothing.
_____ 15. I am good at waiting patiently.
_____ 16. I often find myself with nothing to do- time on my hands.
_____ 17. In situations where I have to wait, such as a line or queue, I get very restless.
_____ 18. I often wake up with a new idea.
_____ 19. It would be very hard for me to find a job that is exciting enough.
_____ 20. I would like more challenging things to do in life.
_____ 21. I feel that I am working below my abilities most of the time.
_____ 22. Many people would say that I am a creative or imaginative person.
_____ 23. I have so many interests, I don’t have time to do everything.
_____ 24. Among my friends, I am the one who keeps doing something the longest.
_____ 25. Unless I am doing something exciting, even dangerous, I feel half-dead and dull.
_____ 26. It takes a lot of change and variety to keep me really happy.
_____ 27. It seems that the same things are on television or the movies all the time; it’s getting old.
_____ 28. When I was young, I was often in monotonous and tiresome situations.
Appendix J. Dutch Eating Behavior Questionnaire – Emotional Eating (van Strien, Frijters, Bergers, & Defares, 1986)

Response Scale: Never (1) Seldom (2) Sometimes (3) Often (4) Very Often (5)

1. Do you have the desire to eat when you are irritated?
2. Do you have a desire to eat when you have nothing to do?
3. Do you have a desire to eat when you are depressed or discouraged?
4. Do you have a desire to eat when you are feeling lonely?
5. Do you have a desire to eat when somebody lets you down?
6. Do you have a desire to eat when you are cross?
7. Do you have a desire to eat when you are expecting something unpleasant to happen?
8. Do you get the desire to eat when you are anxious, worried, or tense?
9. Do you have a desire to eat when things are going against you or when things have gone wrong?
10. Do you have a desire to eat when you are frightened?
11. Do you have a desire to eat when you are disappointed?
12. Do you have a desire to eat when you are emotionally upset?
13. Do you have a desire to eat when you are bored or restless?
Appendix K. Eating Disorder Examination Questionnaire - 7 items (EDE-Q7; Grilo, Henderson, Bell, & Crosby, 2013)

Instructions: The following questions are concerned with the past four weeks (28 days) only. Please read each question carefully. Please answer all the questions. Thank you.

On how many of the past 28 days …

Response: 0 days, 1–5 days, 6–12 days, 13–15 days, 16–22 days, 23–27 days, every day

1. Have you been consciously trying to restrict the amount of food you eat to influence shape or weight?
2. Have you attempted to avoid eating any foods which you like in order to influence your shape or weight?
3. Have you attempted to follow definite rules regarding your eating in order to influence your shape or weight; for example, a calorie limit, a set amount of food, or rules about what or when you should eat?

Response: 0 (“not at all”) 1 2 3 4 5 6 (“extremely”)

4. Has your weight influenced how you think about (judge) yourself as a person?
5. Has your shape influenced how you think about (judge) yourself as a person?
6. How dissatisfied have you felt about your weight?
7. How dissatisfied have you felt about your shape?
Appendix L. Positive and Negative Affect Schedule – Study 2 (PANAS; Watson, Clark, & Tellegen, 1988)

This scale consists of a number of words that describe different feelings and emotions. Indicate to what extent you feel this way in general, that is, on the average.

Response Scale: very slightly or not at all (1), a little (2), moderately (3), quite a bit (4), extremely (5)

- Interested
- Distressed
- Excited
- Upset
- Strong
- Guilty
- Scared
- Hostile
- Enthusiastic
- Proud
- Irritable
- Alert
- Ashamed
- Inspired
- Nervous
- Determined
- Attentive
- Jittery
- Active
- Afraid
- Stressed
- Lonely
Appendix M. Intuitive Eating Scale-2 Reliance on Hunger and Satiety Cues (Tylka & Kroon Van Diest, 2013)

Directions for participants: For each item, please check the answer that best characterizes your attitudes or behaviors.

Strongly Disagree  Disagree  Neutral  Agree  Strongly Agree

1. I trust my body to tell me when to eat.
2. I trust my body to tell me what to eat.
3. I trust my body to tell me how much to eat.
4. I rely on my hunger signals to tell me when to eat.
5. I rely on my fullness (satiety) signals to tell me when to stop eating.
6. I trust my body to tell me when to stop eating.
Appendix N. IRB Approval Letter for Study 2

UNIVERSITY OF SOUTH FLORIDA

EXEMPT DETERMINATION

June 5, 2020

Erika Ablich

Dear Erika Ablich:

On 6/5/2020, the IRB reviewed and approved the following protocol:

<table>
<thead>
<tr>
<th>Application Type</th>
<th>Initial Study</th>
</tr>
</thead>
<tbody>
<tr>
<td>IRB ID</td>
<td>541010000013</td>
</tr>
<tr>
<td>Review Type</td>
<td>Exempt 2</td>
</tr>
<tr>
<td>Title</td>
<td>Blood Pressure and Emotional Eating: The Moderating Role of Cognitive Ability</td>
</tr>
<tr>
<td>Protocol</td>
<td>Protocol May 5, 2020 v1</td>
</tr>
</tbody>
</table>

The IRB determined that this protocol meets the criteria for exemption from IRB review.

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

Please note, as per USF policy, once the exempt determination is made, the application is closed in IRB@USF. This does not limit your ability to conduct the research. Any proposed or anticipated change to the study design that was previously declared exempt from IRB oversight must be submitted to the IRB as a new study prior to initiation of the change. However, administrative changes, including changes in research personnel, do not warrant a modification or new application.

Ongoing IRB review and approval by this organization is not required. This determination applies only to the activities described in the IRB submission and does not apply should any changes be made. If changes are made and there are questions about whether these activities impact the exempt determination, please submit a new request to the IRB for a determination.

Sincerely,

Jennifer Walker
IRB Research Compliance Administrator

Institutional Review Boards / Research Integrity & Compliance
FWA No. 0001093
University of South Florida / 3702 Spectrum Blvd., Suite 165 / Tampa, FL 33612 / 813-974-5336
Appendix O: Full Regression Tables

Table O1
Boredom Proneness and General Interoceptive Sensibility Predicting Emotional Eating among Community Adults

<table>
<thead>
<tr>
<th>Predictor</th>
<th>$b$</th>
<th>SE</th>
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<th>$\beta$</th>
<th>$p$</th>
<th>$\Delta R^2$</th>
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Note. Three outliers were removed. $b$ = unstandardized coefficient; SE = standard error; CI = Confidence Interval.
Table O2
Boredom Proneness and Hunger/Satiety Interoceptive Sensibility Predicting Emotional Eating among Community Adults

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<th>p</th>
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Note. Three outliers were removed. b = unstandardized regression coefficient; SE = standard error; CI = Confidence Interval; IES = Intuitive Eating Scale.
Table O3
Boredom Proneness and General Interoceptive Sensibility Predicting Emotional Eating among College Students

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<th>95% CI</th>
<th>( \beta )</th>
<th>( p )</th>
<th>( \Delta R^2 )</th>
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Note. Two outliers were removed. \( b \) = unstandardized regression coefficient; \( SE \) = standard error; \( CI \) = Confidence Interval.
### Table O4

**Boredom Proneness and Hunger/Satiety Interoceptive Sensibility Predicting Emotional Eating among College Students**

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*Note.* Three outliers were removed. \( b \) = unstandardized regression coefficient; \( SE \) = standard error; \( CI \) = Confidence Interval; \( IES \) = Intuitive Eating Scale.