8-1-2022

Do Individuals with Functional Gastrointestinal Symptoms Experience Emotions Differently? An Examination of Emotional Responding During a Series of Emotion Induction Tasks

Sara Witcraft

DO INDIVIDUALS WITH FUNCTIONAL GASTROINTESTINAL SYMPTOMS EXPERIENCE EMOTIONS DIFFERENTLY? AN EXAMINATION OF EMOTIONAL RESPONDING DURING A SERIES OF EMOTION INDUCTION TASKS

A Dissertation

presented in partial fulfillment of requirements

for the degree of Doctor of Philosophy

in Clinical Psychology

The University of Mississippi

Sara Michelle Witcraft

August, 2022

ABSTRACT

Functional gastrointestinal disorders (FGIDs) are disorders of the brain-gut axis characterized by physiological and emotional disturbances, including heightened comorbidity with psychiatric disorders. Individuals with FGIDs experience difficulties with emotional processing, including the awareness, identification, and regulation of emotions. Although emotional processing is implicated in the maintenance and exacerbation of FGID pathology, literature examining these associations is limited. The current study aimed to enhance understanding of the emotional processing of individuals with FGIDs. We recruited individuals with and without FGID symptoms and examined the: (1) association between gastrointestinal distress and psychopathology; (2) association between gastrointestinal distress and emotional and physiological responsivity; (3) awareness, identification, and intensity of emotional experiences; and (4) distress, emotion regulation abilities, and deployment of specific emotion regulation strategies during emotion inductions. In total, 291 university students (M_{age} = 20.59; *SD* = 5.50; 72.5% female; 82.5% White) completed an online battery of self-report questionnaires. A portion of participants (n = 52) engaged in a neutral induction and a series of experimental emotion inductions to elicit anxiety, disgust, and sadness. Gastrointestinal distress was positively correlated with psychopathology and physiological and emotional responsivity, but not use of emotion regulation strategies. Throughout emotion inductions, participants in the FGID and control groups did not differ in their differentiation of negative emotions, distress, or emotion regulation. One significant within-subjects main effect of induction emerged, such that SUDS following the emotion inductions were higher than following the neutral induction, and that

anxiety and disgust resulted in greater SUDS than the sadness induction. Consistent with extant literature, findings suggest that college students may be at risk for FGID symptoms, and that gut symptoms are associated with both heightened emotional and physiological reactivity. Significant and null findings must be considered in the light of several limitations, including a nonclinical sample of participants with relatively low gastrointestinal distress, novel videoconferencing methodology, and data collection during a global pandemic. Future studies should replicate and extend this study by using a larger, in-person sample of individuals with verified FGIDs to determine whether functional gastrointestinal symptoms are indeed associated with difficulties distinguishing and regulating emotions.

ACKNOWLEDGEMENTS

I am enternally grateful for the years of mentoring, feedback, and support that my advisor, Dr. Laura Dixon, has provided me. I would not be where I am today without your steady guidance and dedication to improving my skills as a writer, researcher, and clinician. I am grateful for your consistent help and support throughout the development, implementation, and dissimination of this project, from the the pre-pandemic coffeeshop meetings to brainstorm methodology, to the Zoom meetings and phone calls as we pivoted to remote data collection. My development as an independent scientist has been bolstered by your guidance and support, and for that I am confident taking the next steps into my career. Thank you, thank you, thank you.

I am additionally appreciative to have had such an active dissertation committee, as Drs. Todd Smitherman, Aaron Lee, and Sujith Ramachandran took their responsibility as committee members to heart. Your thoughtful questioning, consideration for methodological adaptations, willingness to provide hands-on mentoring, and guidance throughout the COVID-19 pandemic has been integral in shaping this project to be as methodologically and statistically rigorous as it could be.

Lastly, my deepest gratitude for the years of unwaivering support from my family, friends, and wonderful partner. You have stayed by my side through the ups and downs of life, and for that, I will always be grateful.

TABLE OF CONTENTS

LIST OF TABLES

CHAPTER 1

INTRODUCTION

Gastrointestinal symptoms are common in the general population (Drossman et al., 1993; Thompson et al., 2002) and rates are even higher among individuals with psychological disorders, such as anxiety and depression (Hillila & Farkkila, 2004; Van Oudenhove et al., 2016). Gastrointestinal disorders that are psychosocial in nature are called functional gastrointestinal disorders (FGIDs). These disorders are characterized by visceral hypersensitivity (Mertz, 2003) and symptom perception rather than structural or biochemical abnormality (Drossman, 2016; Farrokhyar et al., 2006). The comorbidity of FGIDs and emotional disturbance results from a connection between the brain and gut, which allows bidirectional communication between the brain (i.e., central nervous system) and gastrointestinal tract (i.e., enteric nervous system; Drossman, 2016). Given the influence of neurophysiological, social and/or environmental, and psychological aspects in the manifestation of FGIDs, a biopsychosocial model is commonly used to understand FGIDs (Van Oudenhove et al., 2016). The dysregulation of the central and enteric nervous systems not only contributes to gastrointestinal distress bidirectionally, but also deficits in emotional processing (Elsenbruch et al., 2010; Fichna & Storr, 2012; Van Oudenhove et al., 2016). Specifically, individuals with FGIDs experience high levels of alexithymia, or the inability to understand and express emotions (Larsen et al., 2003; Porcelli et al., 1999; Portincasa et al., 2003), as well as difficulties identifying (Fournier et al., 2018) and regulating emotions (Mazaheri, 2015; Stanculete et al., 2015; Zvolensky et al., 2018).

Despite these proposed associations, there is limited research investigating emotion regulation processes within this population, including use of specific emotion regulation strategies and underlying emotion regulation potential. The current study describes the integration of these concepts and contributes to this body of knowledge by using an experimental approach to further understand responses to emotions among individuals with FGID symptoms.

Gastrointestinal Disorders

From the neonatal environment and continuing throughout the lifespan, gastrointestinal health is paramount to overall health (Hollister et al., 2014) and is generally considered to be a requirement for well-being (Drossman, 2016). In addition to aiding digestion and colon health (Guarner & Malagelada, 2003), a healthy gastrointestinal system contributes to immune system regulation (Cebra, 1999; Hansen et al., 2012; Kindt et al., 2009), prevention of allergic disease (Bisgaard et al., 2011), nondigestible nutrient absorption (Hooper et al., 2002), prevention of multisystem organ failure (Guarner & Malagelada, 2003), fewer physical (e.g., lower blood pressure) and mental health (e.g., depression) comorbidities, and greater overall health (Claesson et al., 2012). As such, dysregulation of the gastrointestinal tract results in myriad acute and chronic health issues (Aziz et al., 2013).

Gastrointestinal dysregulation is classified within three domains: organic gastrointestinal disorders, motility disorders, and functional gastrointestinal disorders (FGIDs; Drossman, 2016). Organic gastrointestinal disorders consist of those which result from organs with structural abnormalities, such as inflammatory bowel disease (IBD; i.e., Crohn's disease, ulcerative colitis) and gastroesophageal reflux disease (GERD), and may be identified by gut pathology through means such as endoscopy. Next, motility disorders, such as gastroparesis, are characterized by disturbances in organ functioning which result in altered motility in the gut and heightened

sensitivity to visceral sensations. Lastly, FGIDs, such as irritable bowel syndrome (IBS), are not caused by structural or biochemical abnormalities, but instead are characterized by the interpretation and experience of gastrointestinal symptoms (Drossman, 2016). As such, these symptoms cannot be seen by blood work or other tests such as endoscopies or x-rays, but rather, are diagnosed based on self-reported symptoms.

In comparing organic gastrointestinal diseases and disorders of motility with FGIDs, there are notable discrepancies in the prevalence and impact of these disorders. Patients with IBD spend more days hospitalized for their symptoms, often require surgery due to complications of their disease (e.g., hemorrhaging, perforation, intestinal obstructions), and experience higher risk of colorectal cancer contributing to increased rates of mortality (Ananthakrishnan et al., 2008; Barton & Ferguson, 1990; Berg et al., 2002; Pohl et al., 2000; Witte et al., 2000). Although FGIDs do not typically result in such severe morbidity or mortality, they occur more frequently in the general population and are associated with their own costs and consequences.

As many as 62 – 69% of individuals in the general population experience at least one FGID in any given three-month period (Drossman et al., 1993; Thompson et al., 2002). Relative to individuals without FGIDs, individuals with FGIDs utilize primary care and gastroenterology clinics more frequently, have a greater number of missed or less productive work days, and engage in fewer leisure activities (Farrokhyar et al., 2006). IBS is the most commonly diagnosed FGID and occurs in 11.2% of the worldwide population and between 5 – 25% of gastroenterological patients, accounting for 36% of all gastroenterologist visits (Chang, 2004; Lovell & Ford, 2012). In contrast to FGIDs, organic gastrointestinal and motility disorders occur at much lower rates. For instance, IBD affects less than 1% of individuals worldwide (Ng et al.,

2017), GERD between 5 – 20% (Dent et al., 2005; Fujiwara et al., 2005), and gastroparesis 6.3% (Jung et al., 2009).

While the physiological underpinnings of organic and motility disorders lend to a straightforward causal explanation, the etiology of FGIDs is more nuanced with diverse influences. FGIDs can affect numerous locations throughout the gastrointestinal tract, including the esophagus (e.g., functional heartburn; Aziz et al., 2016), gastroduodenal region (e.g., functional indigestion; Stanghellini et al., 2016), bowels (e.g., IBS; Lacy et al., 2016), gallbladder and sphincter (e.g., pain in this region that may result in nausea and vomiting; Cotton et al., 2016), and anorectal region (e.g., fecal incontinence; Rao et al., 2016). Additionally, centrally mediated disorders are a class of FGIDs that are independent of motility disturbances, and are instead are associated with disinhibition of pain signals that result in near constant abdominal pain which may be produced by digestive or non-digestive organs (e.g., urinary or gynecologic systems; Keefer et al., 2016). Although there are numerous FGIDs, they all have one commonality in that they are all disorders of brain-gut interaction (Drossman, 2016).

The brain-gut axis is characterized by the bidirectional relationship of the brain and gastrointestinal tract through the central nervous system (CNS) and the enteric nervous system (ENS), which control the functions of the brain and gastrointestinal tract, respectively (Cryan & O'Mahony, 2011; Drossman, 2016; Vanner et al., 2016). Importantly, the ENS, which is part of the autonomic nervous system, has both motor (i.e., efferent information) and sensory (i.e., afferent information) functions, and therefore is uniquely able to function without input from the CNS (Rao & Gershon, 2016). The CNS conveys information regarding emotional (e.g., fear, anger) and cognitive (e.g., pain regulation) stimuli through neurotransmitters to the ENS, which can cause gut dysfunction including decreased motility, diarrhea, and gut pain. Conversely, the

ENS delivers information regarding increased motility or visceral inflammation, amplifying visceral pathways to the CNS and thereby increasing the experience of pain, which may then alter mental functioning to beget anxiety and depression (Drossman, 2016). Notably, colloquialisms such as “I find this hard to swallow,” “I can’t stomach it,” “I have butterflies in my stomach,” and “my stomach is in knots” convey this relationship between the gut and stress and emotion (Drossman, 2016). As such, the brain-gut axis is critical for gut health, including regulation of food intake and digestion, gut sensations, and bowel movements, as well as psychological health and overall well-being (Fichna & Storr, 2012).

Stress plays a critical role in the bidirectional relationship of the CNS and ENS, which may result in FGID symptoms. Increased sympathetic activity of the autonomic nervous system (ANS) and hypothalamic-pituitary-adrenal (HPA) axis are the main systems responsible for stress response in humans (Fichna & Storr, 2012). Specifically, emotional arousal such as stress excites the HPA axis, which produces and releases cortisol (Vanner et al., 2016), the hormone responsible for increased allostatic load (Braveman & Gottlieb, 2014). The influx of cortisol due to stress contributes to increased autonomic activity as well as exaggerated HPA response, which lends to altered (i.e., decreased) gastrointestinal motor and immune functioning, leading to visceral signaling. Together, these systems contribute to worse gastrointestinal symptoms (Vanner et al., 2016; Van Oudenhove et al., 2016). As such, the HPA axis and ANS are thought to be the mechanisms through which brain and gut communicate (Van Oudenhove et al., 2016). Although the brain-gut axis is a critical component of FGIDs, it is important to consider other factors that contribute to the etiology and maintenance of these symptoms. Consistent with other chronic health conditions (see Sallis et al., 2015), a biopsychosocial conceptualization of FGIDs provides further understanding of relevant etiological and maintenance factors.

Biopsychosocial Model of FGIDs

As illustrated by the biopsychosocial model, the biological, psychological, and social components of FGIDs are reciprocally related to one another, in that they each affect and are affected by one another (Van Oudenhove et al., 2016). For instance, environmental factors such as culture and parental behavior alter CNS structure and function (e.g., modulation of visceral signals, fear conditioning) and can influence psychological (e.g., anxiety, hypervigilance) and gut factors (e.g., visceral sensation, motility). Through the brain-gut axis, altered CNS functioning and psychological morbidities can influence gut physiology and sensations, and vice versa. The reciprocal relations that the environment, brain, and gut have with one another contribute to the clinical presentation exhibited by individuals with FGIDs, including symptoms and disease severity, comorbidities, and resulting behavior. This resultant symptom presentation adversely affects quality of life and results in increased health care utilization, which in turn worsens symptom severity and other psychological and health-related comorbidities (Levy et al., 2006; Van Oudenhove et al., 2016).

Psychosocial factors are thought to underlie FGID pathophysiology (Van Oudenhove et al., 2016), such that symptomatology is centered around psychosocial stressors and symptoms, rather than physical or functional abnormalities as found in organic gastrointestinal and motility disorders (Drossman, 2016; Farrokhyar et al., 2006). In chronic health conditions, pathological fear and behavior negatively affect psychosocial functioning, which in turn contribute to the maintenance and exacerbation of pathophysiology. Reciprocally, elevations in autonomic activity may contribute to avoidant behavior through processes such as catastrophization and perceived inability to cope with aversive physiological sensations (e.g., pain; Aue et al., 2013; Carver & Blaney, 1977; Norton & Asmundson, 2003), further exacerbating fear of physiological

(e.g., gut) sensations. Development of fear is posited to be threefold: 1) respondent conditioning of the feared stimulus, which causes the initial development of the fear; 2) operant conditioning, which maintains the fear through negative reinforcement of avoidant behavior; and 3) habitual avoidance, in which avoidance is maintained long-term *without* contact with the reinforcer (i.e., reduction in fear; LeDoux et al., 2017). Because contact with the feared, conditioned stimulus is necessary for extinction to take place (Craske et al., 2008, 2014; Foa & Kozak, 1986), extinction is unable to occur due to the processes involved in habitual avoidance (LeDoux et al., 2017).

In FGIDs, fear is introduced when an unconditioned gastrointestinal stimulus, such as pain or visceral sensations, occurs and is misappraised, which results in the unconditioned response of fear or threat of something bad occurring (e.g., an accident). Over time, gastrointestinal sensations become associated with a threat response, and the two become conditioned to one another. In order to prevent a feared outcome from occurring, an individual may engage in avoidance behaviors each time gastrointestinal sensations occur. Consequently, when the already unlikely feared outcome does not occur, the reason for this absence is misattributed to the avoidance, thereby negatively reinforcing this behavior. Through long-term avoidance, the individual becomes preoccupied with gastrointestinal symptoms and believes that they must be avoided, which reinforces avoidance even when symptoms are not present. Thus, extinction and new learning are disallowed as avoidance occurs without reinforcing properties (i.e., it becomes habitual). Principles of respondent and operant conditioning are exhibited throughout each domain of the biopsychosocial model.

Biological Influences

As disorders of brain-gut interaction, FGIDs are characterized by a combination of the following physiological and neuropsychological dysfunctions: disturbance in motility, altered

mucosal and immune functioning, altered gut microbiota, visceral hypersensitivity, and CNS dysregulation (Drossman, 2016; Drossman & Hasler, 2016; Tillisch et al., 2011). Stress and anxiety influence motility in the stomach (Geeraerts et al., 2005; Van Oudenhove & Aziz, 2013) and colon (Fukudo et al., 1998), and through activation of the HPA axis stress also has a deleterious effect on colonic mucosal functioning (Piche et al., 2007; Vanuytsel et al., 2014). Additionally, a healthy enteric microbiome is paramount to the development of the CNS and ENS and subsequently brain-gut communication, as well as the maintenance of homeostasis and physiological functioning throughout the lifetime (Carabotti et al., 2015). As such, disruption of the microbiome results in CNS (Cryan & Dinan, 2012; Stilling et al., 2014) and gastrointestinal dysfunction (Clarke et al., 2012), and increases stress reactivity through its effect on the HPA axis (Carabotti et al., 2015). Together, these psychophysiological processes influence emotion, cognition, and behavior by increasing anxiety, heightening attention toward visceral sensations, and conditioning avoidant responding, respectively.

Beyond physiological dysfunctions occurring in the gut, dysregulation of CNS activity also has detrimental effects on gastrointestinal health (Tillisch et al., 2011). For a typical individual, interoceptive gut cues that are communicated to and from the CNS to the ENS are not consciously perceived. However, individuals with FGIDs are hypersensitive to these signals (Boeckxstaens et al., 2016; Vanner et al., 2016; Van Oudenhove et al., 2016). For those with FGIDs, when a noxious (or sometimes, non-noxious) stimulus is introduced in the gut, the ENS signal is modulated by cognitive and affective neurocircuits in the brain, which results in perception of pain or feelings of discomfort in the gut, known as visceral hypersensitivity. The presence of psychopathology, such as anxiety and depression, results in greater visceral pain in IBS patients, which suggests that CNS processing of visceral signals may be modulated by

symptoms of anxiety and depression, resulting in increased pain perception (Elsenbruch et al., 2010; Van Oudenhove & Aziz, 2013). In addition, the brain is able to upregulate (i.e., increase pain) or downregulate (i.e., decrease pain) neural signals that contribute to the perception of pain. Individuals with FGIDs are not as effective at downregulating this sensory information, which results in greater gastrointestinal pain. In addition, the experience of psychosocial distress decreases the ability to downregulate further, contributing to the experience of even more pain (Drossman, 2016).

Social and Environmental Influences

Although individualized patient presentations are central to FGIDs, there are numerous cultural, social, and environmental factors that also influence one's perception of and symptoms related to FGIDs (Francisconi et al., 2016). For instance, perception and localization of pain related to IBS differs in Westerners compared to non-Westerners (Gerson et al., 2008; Zola, 1966). In addition, there are regional and cultural differences in the language used to describe symptoms (Callister, 2003). For example, the word "bloating" is often used by English speakers to describe the sensation that one's abdomen is distended, but this particular word does not translate to other languages. Instead, words such as "swelling" and phrases such as "feeling blown up like a balloon" are used to describe the same sensations of abdominal distention (Francisconi et al., 2016; Gwee et al., 2009; Quigley et al., 2012). Moreover, one's culture influences which foods are or are not eaten as well as attributions bestowed upon certain food and food groups, both of which may activate circuits of the CNS and contribute to functional symptoms (Mayer et al., 2006).

In addition to one's larger culture, familial and parental factors and early life stressors influence the presence, perception, and symptomatology of FGIDs. Although IBS has higher

concordance rates among monozygotic compared with dizygotic twins (Levy et al., 2001; Morris-Yates et al., 1998), there is also evidence that the presence of IBS is highly influenced by parental IBS, particularly through social learning (Levy et al., 2001). For instance, parents with IBS tend to pay more attention to their children's gastrointestinal symptoms, thereby positively reinforcing illness behavior and increasing the child's report of stomachaches and school absences (Levy et al., 2004). Ultimately, this pattern contributes to greater health-care seeking for both non-gastrointestinal and gastrointestinal symptoms (Levy et al., 2000). In a similar vein, through modeling and/or reinforcement, children's abdominal symptoms may correspond with their parents' complaints of anxiety, depression, and somatic catastrophization of abdominal pain (for a review, see Van Oudenhove et al., 2016).

In addition to parental influences, early life stressors such as physical, emotional, and especially sexual abuse are reported at higher rates among individuals, particularly women, with IBS relative to those without FGIDs (Bradford et al., 2012; Drossman et al., 1996). These adverse childhood events are associated with increased severity of FGID symptoms, psychopathology and psychosocial deficits, health-care utilization, and worse overall functioning in adulthood (Drossman, 2011; Lackner & Gurtman, 2004). As such, chronic stress associated with these adverse outcomes can result in poorer treatment outcomes and worse gastrointestinal symptom severity (Bennett et al., 1998). Extant literature purports that exposure to psychological trauma may have a deleterious effect on the CNS, whereby traumatic exposure causes dysregulation of the HPA axis resulting in increased release of cortisol and inflammatory substances (Drossman, 2011). The release of these factors may result in visceral hypersensitivity and inhibition of neural signals that downregulate pain, thereby resulting in enhanced experience of gastrointestinal distress and pain. Through the dysregulation of CNS functioning and

increased visceral pain, psychosocial distress such as anxiety and depression become more severe (Drossman, 2011; Drossman et al., 1996; Vaccarino et al., 2009).

Psychological Influences

Psychological distress is proposed to be both a vulnerability to and outcome of FGIDs (Van Oudenhove et al., 2016). A prospective population-based study found that individuals with FGIDs without anxiety at baseline were significantly more likely to develop symptoms of anxiety over a 12-year span, and similarly, individuals who had anxiety without FGIDs at baseline had a higher incident rate of FGIDs at follow-up (Koloski et al., 2012). Between 40% and as many as 90% of FGID patients at gastroenterology clinics experience psychological comorbidities, relative to 25% of patients with organic gastrointestinal conditions and 20% of individuals without FGIDs (Drossman et al., 2002). Although depression is common (e.g., 17.2%; Hillila & Farkkila, 2004) among individuals with FGIDs, anxiety disorders are the most common psychiatric comorbidity, with an approximate 30 – 50% overlap in co-occurrence (Van Oudenhove et al., 2016) relative to the 21.3% annual prevalence rate in the general population (Kessler et al., 2012). Such psychopathology may contribute to altered visceral processing and heightened activation of the ANS and HPA axis (e.g., cortisol release; Lembo et al., 1999; Wu, 2012), increasing sensitivity to gut pain (Elsenbruch et al., 2010) and accounting for the heightened stress response seen in patients with bowel symptoms (i.e., flare-ups; Dickhaus et al., 2003; Posserud et al., 2004). This alarmingly high co-occurrence could be due to shared cognitive and affective mechanisms such as hypervigilance of bodily sensations, which is exacerbated through processes such as catastrophization and contributes to use of maladaptive coping (e.g., avoidance; Lee et al., 2009; Van Oudenhove et al., 2016).

Visceral sensitivity, or gastrointestinal-specific anxiety, describes the cognitive, affective, and behavioral responses that occur as a result of gastrointestinal sensations or symptoms, or in the presence of contexts that elicit such sensations (Labus et al., 2007). Visceral sensitivity is purported to be a key predictor of IBS above worry and anxiety sensitivity (Hazlett-Stevens et al., 2003) and distinguishes IBS patients from individuals with IBS who have not sought medical aid as well as controls (Labus et al., 2007). Individuals with heightened visceral sensitivity, such as those with FGIDs (Mertz, 2003), have the propensity to label gastrointestinal sensations negatively, experience lower tolerance of these sensations (Naliboff et al., 1997), and are more reactive to low levels of abdominal and bowel sensations and pain (vs. healthy controls; Bradette et al., 1994). Furthermore, visceral sensitivity has been shown to have an even greater effect on quality of life, health-care utilization, and costs than the gastrointestinal symptoms themselves (Chang, 2004).

Visceral hypersensitivity is posited to contribute to avoidant behavior through catastrophization. Specifically, individuals with FGIDs may misinterpret the consequences of their gut sensations and underestimate their ability to cope with feared outcomes (Hunt et al., 2009), which contribute to worse psychosocial outcomes (Hunt et al., 2009) such as increased pain and worry (Lackner & Quigley, 2005; Van Oudenhove et al., 2016). At the same time, avoidance of situations (e.g., restaurants) or stimuli (e.g., certain foods) that may elicit gut sensations further reinforces the belief that gut sensations are dangerous and should be avoided. This habitual avoidance prevents extinction of the undesirable avoidant behavior (Bonnert et al., 2018; LeDoux et al., 2017). In the long-term, this avoidance leads to reduced quality of life (Van Oudenhove et al., 2016) and maintains gastrointestinal symptom severity (Bonnert et al., 2018) through prevention of emotional processing and new learning (e.g., ‘this sensation does not

always mean that I will have an accident;' Foa & Kozak, 1986). Given the role of avoidance in maintaining FGID pathology (Bonnert et al., 2018) and the frequent co-occurrence of emotional difficulties (Drossman et al., 2002), further exploration of the impact of emotions is critical for understanding how they perpetuate FGIDs.

Emotion and Its Regulation

Although "gut feelings" are frequently described as indicators of emotional responses to environmental cues, research examining these experiences in the context of FGIDs is limited. Historically, emotion research has attempted to understand the affective (Cannon, 1927), physiological (James, 1884; Lange, 1922), neurological (Davidson, 1984; Ekman et al., 1983), cognitive (Lang, 1979; LeDoux, 1984; Schachter & Singer, 1962), and behavioral (Panksepp, 1982) underpinning of emotions. These seminal works have paved the way for contemporary emotion research, which integrates these components to emphasize the physiological and affective correlates of discrete emotions (Gilchrist et al., 2016; Kragel & LaBar, 2013; Levenson et al., 2017; Prkachin et al., 1999). Consistent with the current conceptualization of FGIDs, the biopsychosocial model underscores the interlinking of the neurophysiological and affective influences upon FGID symptom presentation.

Regardless of valence, emotions are associated with increased autonomic arousal, such as increased heart rate and electrodermal activity (Levenson et al., 2017), which over time may contribute to dysregulation of the sympathetic nervous system and parallel stress-related response of the HPA axis (Charmandari et al., 2005), leading to worse FGID symptomatology and associated outcomes (Vanner et al., 2016; Van Oudenhove et al., 2016). However, discrete emotions differ in specific physiological responding (Kragel & LaBar, 2013; Prkachin et al., 1999). For instance, cardiovascular output is typically higher (e.g., increased systolic blood

pressure, lower stroke volume) in negative emotions relative to positive, and specifically, higher for sadness relative to fear and anger, but bears no relation to disgust (Prkachin et al., 1999). Rather than autonomic activation, disgust is characterized by lower cardiovascular activity (e.g., lower systolic blood pressure, higher stroke volume) and respiration (Gilchrist et al., 2016). That is, emotions such as anxiety, fear, and anger are associated with sympathetic nervous system activation ('fight or flight'; Lench et al., 2011), while disgust is associated with parasympathetic nervous system activation. In addition to the established effect of sympathetic nervous system arousal on FGIDs, lower activity of the parasympathetic nervous system has also been implicated, which may account for greater sympathetic activation and worse gastrointestinal symptom severity (Manabe et al., 2009; van Orshoven et al., 2006).

Another indication of the discrete nature of emotions is differences in experiential components, such as behavior and cognition (Roseman et al., 1994). Although negatively valenced emotions such as anxiety, sadness, and disgust are associated with behavioral avoidance, they differ in presentation and function (Levenson et al., 2017). Avoidance related to anxiety aims to escape from anxiety-provoking situations (Beck et al., 2010), sadness is characterized by avoidance of activity through behavioral inhibition (Hong, 2007), and avoidance of disgust functions to protect from disease and bodily harm (Oaten et al., 2009). Regarding cognition, those relevant to anxiety concern the future (i.e., worry, catastrophization), sadness concern the past (i.e., rumination), while disgust relates to repulsion (Roseman et al., 1994). Individuals with FGIDs frequently engage in avoidance behaviors (Bonnert et al., 2018), catastrophize gut pain and social consequences of gastrointestinal symptoms (Hunt et al., 2009, 2014; Lackner & Quigley, 2005), and experience worse psychosocial outcomes after ruminating (Martin & Chapman, 2010).

Despite broad physiological and behavioral similarities, there are clearly distinct differences in the processes by which emotional information is internalized and expressed in general and within FGIDs. Emotion differentiation, or the ability to make distinctions between discrepant emotions and physiological sensations (Oh & Tong, 2020), appears to be particularly salient to HPA axis activation (Hua et al., 2014), suggesting that difficulties distinguishing emotional experiences increase cortisol production. Given individuals with FGIDs may experience difficulty with identifying and being aware of emotions (Fournier et al., 2018) and the role of HPA axis activity and heightened cortisol levels in FGID symptomatology (Butler et al., 2019), further examination of emotion processes in FGIDs is warranted.

Beyond the physiological regulation of emotion information, a growing area of literature has emphasized emotion regulation as a psychological process. Emotion regulation, defined as the ability to be aware of, identify, and regulate or respond to emotions, is paramount to emotional wellbeing (Aldao et al., 2010) and physical health (Smyth & Arigo, 2009). Two prominent models of emotion regulation have been used to inform an integrative conceptualization of emotion regulation (Gratz et al., 2018). At a micro level, the process of identifying and expressing an emotion is a function of the particular emotion regulation strategy employed (i.e., process or strategies model; Gross, 2015a). More broadly, the dispositional potential to understand and respond to an emotional experience is considered one's emotion regulation ability (i.e., abilities model; Gratz & Roemer, 2004).

With regard to the strategies model, emotion regulation focuses on the timing and type of emotion regulation strategy selected in a given situation in the service of one's goal(s), and the emotional consequences of selecting a particular strategy (Gross, 1998, 2015a; Gross et al., 2011). The specific strategy selected may have adaptive or maladaptive consequences on future

strategy selection and resultant emotional experiences. One commonly studied maladaptive strategy is expressive suppression, described as the intentional avoidance of emotional expression and experience, which paradoxically increases sympathetic nervous system activation and the intensity and frequency of the undesired emotion (Gross, 1998). Conversely, cognitive reappraisal is considered an adaptive regulation strategy that reduces the emotional impact of a situation by engaging in thought restructuring, effectively reducing physiological activation in emotionally salient situations (Gross, 1998). Emotion regulation strategies can be used to either upregulate or downregulate both positive and negative emotions, such that the intensity, duration, and quality of an emotion are altered (Gross, 2015a). Accordingly, there are multiple steps to regulating one's emotions wherein individuals identify, select, and implement a specific emotion regulation strategy to achieve an identified goal (Gross, 2015b). Selected strategies may be subsequently modified in accordance to one's physiological and behavioral responding in a given situation, resulting in alterations in cognition, behavior, and emotional experience both immediately and across time (Gross, 2015a; Gross & John, 2003).

The abilities model of emotion regulation is a higher-level approach to the understanding of emotion regulation that emphasizes the dynamic nature of emotions in various different situations, and focuses on the adaptive response to such emotions rather than the use of specific skills (Gratz et al., 2018). Gratz and Roemer (2004) posit that adaptive emotion regulation involves the ability to modulate one's emotional experience to inhibit unhelpful, impulsive behavior and instead act in line with one's goals in a given situation despite the occurrence of negative emotions. There are hypothesized to be six dimensions of the ability to regulate emotions: 1) awareness of emotions and emotional responding, 2) knowledge of the nature of emotions, 3) acceptance of and reaction to emotions, 4) flexible use of non-avoidant situation-

specific strategies, 5) ability to inhibit impulsive behavior when experiencing negative emotions, and 6) ability to engage in goal-directed behavior when experiencing negative emotions (Gratz & Roemer, 2004). Accordingly, the response to an emotional experience affects the trajectory and consequences of that emotion (Gratz et al., 2018).

In the integration of these models, emotion regulation abilities are posited to influence the particular strategies that are selected in any given situation and result in the generation of an emotional state consistent with the situational demands and goals, which may be either adaptive or maladaptive in the short- and/or long-term (Tull & Aldao, 2015). For example, an individual who is non-accepting of emotional experiences may be more likely to rigidly engage in avoidant strategies regardless of the situation, whereas an individual with awareness and acceptance of emotions may be more likely to stay attuned to emotions. On the other hand, emotion regulation strategies may also influence emotion regulation abilities. Repeated, inflexible use of a particular emotion regulation strategy, such as situational or experiential avoidance, regardless of the context may lead to a reduction in the ability to understand and distinguish emotional experiences. However, flexible and situationally appropriate use of emotion regulation strategies may increase self-efficacy for emotion regulation abilities by fostering awareness and acceptance of emotions. Taken together, the integration of the two emotion regulation models yields a positive (i.e., adaptive) or negative (i.e., maladaptive) feedback loop (Tull & Aldao, 2015). The positive feedback loop occurs when the chosen emotion regulation strategy (e.g., reappraisal) enhances underlying abilities (e.g., promoting acceptance and awareness of emotions), while the negative feedback loop occurs when the chosen strategy (e.g., suppression) undermines emotion regulation potential (e.g., reinforcing non-acceptance of emotions).

Numerous studies provide evidence that the inability to regulate emotions is associated with greater use of maladaptive or avoidant regulation strategies (e.g., experiential or situational avoidance, escape behaviors, expressive suppression) across a broad array of psychopathology (e.g., Briere et al., 2010; Gratz, 2007; Iverson et al., 2012). Difficulties in selecting appropriate regulatory strategies and the underlying ability to regulate emotions are considered key transdiagnostic features underlying numerous psychological syndromes (Aldao et al., 2010; Gratz et al., 2018) including depression (Brockmeyer et al., 2012; Ehring et al., 2010), anxiety (Amstadter, 2008; Vujanovic et al., 2008), posttraumatic stress disorder (Tull et al., 2007), borderline personality disorder (Baer et al., 2012; Gratz et al., 2013), and maladaptive behaviors such as substance use (Fox et al., 2008; Weiss et al., 2012) and disordered eating (Svaldi et al., 2012).

Additionally, difficulties in emotion regulation and use of avoidant strategies may also exacerbate outcomes related to chronic health conditions due to the association with increased HPA axis activity (Gratz et al., 2018; Gross & Levenson, 1997; Lam et al., 2009). However, studies examining the relationship between emotion regulation difficulties and health outcomes are limited. Emotion regulation difficulties have been implicated as a risk factor for worse psychological and physiological outcomes among various health populations including those with HIV/AIDS (Brandt et al., 2013), chronic pain (Kökönyei et al., 2014), and FGIDs (Mazaheri, 2015; Zvolensky et al., 2018). Individuals with gastrointestinal distress and pain may experience difficulties understanding, expressing, and regulating emotions (Fournier et al., 2018), which contribute to worse psychosocial distress (Zvolensky et al., 2018) and abdominal pain (Mazaheri, 2015). Therefore, further empirical work is needed to enhance the understanding

of emotional identification, expression, and regulation among individuals with FGIDs, as well as the role these factors play in psychophysiological outcomes.

Emotion and Its Regulation in Relation to FGIDs

As described, the extant literature indicates that emotional processes may underlie the maintenance and exacerbation of FGID pathology; however, there are few studies investigating these associations. The brain-gut connection is attributed to shared underlying structures and processes involved in the cognitive-affective processes of emotional responding (e.g., arousal, conditioning, catastrophization, negative affect) and visceral perception. Specifically, the brain regions involved in the processing of visceral information are also involved in the generation and regulation of emotions and cognition (Van Oudenhove & Aziz, 2009). Given that the processing of visceral information is altered in individuals with FGID (Elsenbruch et al., 2010; Lembo et al., 1999; Posserud et al., 2004; Wu, 2012), it would follow that emotional processing would also be disrupted.

Research examining emotional processes in FGIDs has primarily emphasized alexithymia. Alexithymia means "without words for emotions," and is characterized by a reduction in the experience of and ability to verbalize emotions, absence of thinking about emotions, and difficulty identifying emotions (Larsen et al., 2003). Although empirical evidence suggests that alexithymia and emotion regulation are distinct (Edwards & Wupperman, 2017; Pandey et al., 2011), they overlap in that they are both associated with difficulties in identification and awareness of emotions (Swart et al., 2009). The prevalence of alexithymia among individuals with FGIDs ranges from 43.0% – 75.9% (Porcelli et al., 1999, 2004; Portincasa et al., 2003), which is markedly higher than among IBD patients (38.0%; Porcelli et al., 1999), the general population (9.9% – 25.7%; Mattila et al., 2006; Tolmunen et al., 2011),

and healthy controls (4.5%; Mazaheri et al., 2012; Porcelli et al., 1999). Alexithymia in FGIDs is associated with worse gastrointestinal symptom severity (Mazaheri et al., 2012) and psychological treatment outcomes (Porcelli et al., 2003; Portincasa et al., 2003). Additionally, despite the critical role of visceral sensitivity in FGIDs, alexithymia may be a more robust predictor of gastrointestinal symptom severity and treatment success than visceral sensitivity (Porcelli et al., 2014, 2017). Together, this body of literature indicates that individuals with FGIDs experience broad deficits in cognitive processing of emotions that may be characterized by the inability to identify, describe, and express emotions, which in turn worsens gastrointestinal symptom severity.

Similar to alexithymia, awareness of emotions is central to the ability to regulate emotions (Gratz & Roemer, 2004). Individuals with IBS experience difficulty identifying emotions, particularly during heightened stress, leading to increased experience of negative emotions such as sadness and anger (Fournier et al., 2018). The identification and expression of emotions is just one, albeit important, component of emotion regulation; there are far fewer studies examining other emotion regulation strategies or abilities within FGIDs. The studies that do exist suggest that these individuals engage in more avoidant coping styles than their healthy counterparts (Jones et al., 2006; Stanculete et al., 2015), and that this avoidance is associated with worse outcomes (Rutter & Rutter, 2002; Sugawara et al., 2017) relative to use of adaptive coping strategies (Torkzadeh et al., 2019). Individuals with FGIDs were also found to engage in rigid use of coping strategies regardless of the situation and frequent monitoring of internal and external stimuli, thereby exacerbating co-occurring psychological symptoms (Cheng et al., 2000). With regard to emotion regulation abilities, nonacceptance of emotions, emotion-driven impulse control difficulties, difficulty engaging in goal-directed behavior, and limited access to

emotion regulation strategies have been associated with psychological symptoms among patients with FGIDs (Mazaheri, 2015). Additionally, emotion dysregulation accounted for the relationship between visceral sensitivity and psychopathology among individuals with current or past gastrointestinal symptoms (Zvolensky et al., 2018). Cumulatively, these studies provide preliminary evidence for the connection between emotion regulation processes and FGIDs, while also highlighting the need for additional research.

Current Study

The underlying neurophysiological mechanisms and the biopsychosocial model demonstrate numerous connections between FGIDs and emotion (e.g., Cryan & O'Mahony, 2011; Drossman, 2016; Vanner et al., 2016). As emotions are associated with increased autonomic arousal (Levenson et al., 2017), their dysregulation prolongs the autonomic stress response (Vanner et al., 2016; Van Oudenhove et al., 2016) and adversely affects physiological syndromes. As individuals with FGIDs experience deficits in the understanding and awareness of their emotional experiences (Fournier et al., 2018; Mazaheri et al., 2012), they are at increased risk for even worse autonomic reactivity, exacerbating their gastrointestinal distress. Research demonstrates a high co-occurrence between emotional disorders and FGIDs (Drossman et al., 2002); however, a more nuanced examination of emotional processes is needed to elucidate the connections between these disorders and identify potential targets for intervention. Specifically, further research is needed to examine how individuals with FGIDs distinguish emotions, regulate emotions across contexts, and whether or not they select and utilize regulation strategies flexibly or rigidly.

To address this gap in the literature, the current study examined emotional processing among individuals with current FGID symptoms. Specifically, this study used an experimental

induction and compared individuals with and without FGID symptoms with regard to their: (1) underlying propensity to regulate emotions; (2) awareness, identification, and intensity of emotional experiences; and (3) deployment of specific emotion regulation strategies. A series of three experimental emotion inductions were conducted to induce anxiety, disgust, and sadness, in addition to a control (neutral) induction. The primary dependent variables in the current study were: 1) psychological and emotional correlates of FGID symptoms, 2) characterization of emotional experiences, and 3) underlying emotion regulation abilities and use of specific strategies throughout emotion inductions. The study tested the following hypotheses:

1. As demonstrated by previous research, individuals with FGID symptoms would report higher levels of depression, anxiety, and stress than those without FGID symptoms. *COVID-19 Update* (see below for additional details): Depression, anxiety, and stress would be significantly positively associated with gastrointestinal symptoms.
2. Individuals with FGID symptoms, relative to those without, would report higher emotional responsivity and poorer awareness of emotions, and given the role of physiological responding in emotion, greater physiological sensation awareness. *COVID-19 Update* (see below for additional details): Heightened emotional responsivity, difficulties understanding emotions, and greater physiological sensation awareness would be significantly positively associated with gastrointestinal symptoms.
3. Throughout a series of emotion induction trials, individuals with FGID symptoms would exhibit significantly lower negative emotion differentiation abilities than individuals without FGID symptoms.

4. Differences in distress and emotion regulation strategies and abilities would be observed between individuals with and without FGID symptoms across emotion induction trials relative to the neutral trial.
    a. Individuals with FGID symptoms, relative to those without, would evidence significantly greater distress during emotion inductions compared to the neutral trial.
    b. Individuals with FGID symptoms, relative to those without, would evidence greater deficits in the ability to regulate emotions during emotion inductions compared to the neutral trial.
    c. Individuals with FGID symptoms, relative to those without, would evidence greater use of maladaptive emotion regulation strategies and limited use of adaptive emotion regulation strategies during emotion inductions compared to the neutral trial.

CHAPTER 2

METHOD

Participants

In total, 291 individuals enrolled in the study, of which 52 completed the experimental procedures. The sample included university students (M_{age} = 20.59, *SD* = 5.50; 72.5% female) enrolled at a large, Southeastern public university. The full sample was comprised of individuals who primarily identified as White (82.5%) and non-Latinx (93.5%), heterosexual (86.9%), freshmen (51.9%), and not currently employed (64.3%). Participants who completed experimental procedures were undergraduate students (M_{age} = 19.33, *SD* = 1.88; 82.4% female; 67.3% freshmen) who primarily identified as White (63.5%) and non-Latinx (94.1%). See Table 1 for complete demographic information.

Eligibility and Recruitment

Eligibility was based on a screening questionnaire assessing current gastrointestinal discomfort (GSRS; see below). To be eligible, participants had to: 1) be at least 18 years of age; 2) be an enrolled student; and 3) report at least one gastrointestinal symptom consistent with FGIDs (FGID group; Vivier et al., 2020), or no current gastrointestinal symptoms (control group). Exclusionary criteria included mild to moderate discomfort in the absence of more severe symptoms, or current gastrointestinal symptoms due to primary organic (e.g., IBD) or motility (e.g., gastroparesis) gastrointestinal disorders. Eligible participants were invited via email to schedule an experimental study session.

Baseline Measures

Demographics and Medical History

Participants reported their age, sex and gender, race and ethnicity, and year in school. Regarding gastrointestinal-related diagnoses, the presence of organic gastrointestinal disorders, motility gastrointestinal disorders, and other medical conditions that impact or influence gut sensations (e.g., endometriosis, stomach flu) were assessed. Women indicated whether or not gastrointestinal distress was experienced as a result of their menstrual cycle (e.g., cramping, bloating). Appointments with a medical provider and use of over-the-counter medication for gastrointestinal pain were also assessed. Additionally, engagement in avoidance behaviors (e.g., avoiding eating at restaurants) related to gastrointestinal symptoms was evaluated. See Appendix A for the Demographic and Medical Questionnaire.

Gastrointestinal Symptoms

The Gastrointestinal Symptom Rating Scale (GSRS; Svedlund et al., 1988) is a 15-item self-report measure of common gastrointestinal symptoms that occur throughout the digestive tract, such as stomachache and bloat. Additional instruction specified for females to only consider gastrointestinal symptoms when they are *not* menstruating. Symptoms are clustered into five subscales: abdominal pain, reflux, diarrhea, indigestion, and constipation (only the total score was used in the current study). Severity of symptoms are rated on a 7-point Likert-type scale from 1 (“no discomfort”) to 7 (“very severe discomfort”), and items are averaged to comprise the total score and individual subscale scores. Higher scores are indicative of more severe gastrointestinal symptom severity. The original GSRS was developed as a clinician-administered interview (Svedlund et al., 1988), and was subsequently adapted to self-report and has since been widely used and validated among a variety of gastrointestinal disorders such as dyspepsia (Kulich et al., 2008), GERD (Revicki et al., 1998), stomach ulcers (Dimenäs et al.,

1995), Celiac disease (Lohiniemi et al., 2000), and IBS (Wiklund et al., 2003). The GSRS is negatively correlated with measures of psychological and physical wellbeing and each of the five subscales demonstrate acceptable internal consistency (αs = .61 – .83; Revicki et al., 1998). In the current study, the GSRS was used to identify presence, quality, and severity of gastrointestinal symptoms for FGID symptom characterization and group assignment. In the current sample, Cronbach's α was excellent (α = .91). See Appendix B for the GSRS.

Psychopathology Symptoms

The 21-item version of the Depression, Anxiety, and Stress Scale (DASS-21; Lovibond & Lovibond, 1995) is a self-report measure of depression ("I felt down-hearted and blue") and the physiological (anxiety; "I felt I was close to panic") and cognitive (stress; "I tended to over-react to situations") symptoms of anxiety. Items are rated on a 4-point Likert-type scale from 0 ("did not apply to me at all") to 3 ("applied to me very much, or most of the time"), with higher scores indicating greater levels of distress. Although not validated in a sample of individuals with FGIDs, patients diagnosed with IBS scored an average of 14.8 (moderate severity) on the depression and anxiety subscales, and an average of 20.2 (moderate severity) on the stress subscale (Mazaheri, 2015). The three subscales demonstrate good (α_{anx} = .81; α_{stress} = .89) to excellent (α_{dep} = .91) internal consistency among undergraduate students, and the depression subscale is highly correlated with other measures of depression, while the anxiety and stress subscales are highly correlated with other measures of anxiety (Lovibond & Lovibond, 1995). In the current sample, the DASS-21 subscales (α_{dep} = .93; α_{anx} = .88; α_{stress} = .88) demonstrated good to excellent internal consistency. See Appendix C for the DASS-21.

Emotional Intensity

The Emotional Intensity Scale – Revised (EIS-R; Geuens & de Pelsmacker, 2002) is a 17-item self-report measure of trait affective intensity with two subscales consisting of positive and negative emotional experiences. Items are hypothetical situations (e.g., "someone complements me," "someone I know is rude to me"), and respondents are asked to identify how they would typically feel in that situation. Items are rated on a 5-point Likert-type scale and summed, with higher scores indicating more emotional intensity. The EIS-R is adapted from the original 30-item EIS (Bachorowski & Braaten, 1994), which has a factor structure that is unable to yield emotional intensity of both positive and negative emotions. Relative to other measures of emotional intensity (e.g., Affect Intensity Measure), the EIS is a "pure" measure of emotional intensity as it does not measure frequency of emotions and only measures intensity regardless of frequency (Geuens & de Pelsmacker, 2002). The total score and two subscales have demonstrated good to excellent internal consistency (αs > .80) and test-retest reliability (ρs > .80). Additionally, the subscales also demonstrate adequate convergent validity in that both subscales are positively related to affect intensity (r_{pos} = .80; r_{neg} = .62) and the negative emotionality subscale is related to neuroticism (r = .68; Geuens & de Pelsmacker, 2002). In the current study, the EIS-R total score (α = .79) and two subscales (α_{pos} = .78; α_{neg} = .78) demonstrated acceptable internal consistency. See Appendix D for the EIS-R.

Alexithymia

The 20-item Toronto Alexithymia Scale (TAS-20; Bagby, Parker, et al., 1994; Bagby, Taylor, et al., 1994) is a self-report questionnaire that measures the cognitive experience of alexithymia. The TAS-20 has three subscales that assess difficulty identifying and describing feelings as well as externally-oriented thinking (only the total score was used in the current

study). Items, which range from 1 (“strongly disagree”) to 5 (“strongly agree”), are summed and higher scores indicate more severe alexithymia. A clinical cutoff indicative of alexithymia is ≥ 61, while non-alexithymia is measured by scores ≤ 51 (Taylor et al., 1997). The TAS-20 demonstrates good internal consistency overall (α = .81) and acceptable consistency in each subscale (αs = .66 – .78) across nonclinical and psychiatric patient samples (Bagby, Parker, et al., 1994; Loas et al., 2001). Further, the TAS-20 is positively correlated with measures of anxiety, depression, and neuroticism, and negatively associated with the propensity to be open and experience positive emotions (Bagby, Taylor, et al., 1994). The TAS-20 total score achieved good internal consistency (α = .85) in the current sample. See Appendix E for the TAS-20.

Emotion Regulation Strategies

The Emotion Regulation Questionnaire (ERQ; Gross & John, 2003) is a 10-item self-report questionnaire that assesses the tendency to regulate one’s emotions by using expressive suppression or cognitive reappraisal. Items are rated on a 7-point Likert scale from 1 (“strongly disagree”) to 7 (“strongly agree”) and those from the suppression and reappraisal subscales are summed separately to yield two scores. The test-retest reliability (both ρs = .69) and internal consistency of the two subscales is acceptable (α_{sup} = .73; α_{re} = .79). Both the suppression and reappraisal subscales are positively correlated with measures of perception of successful emotion regulation, demonstrating adequate convergent validity overall. Further, suppression was positively associated with measures of inauthenticity and venting and negatively associated with openness and extraversion, while reappraisal was positively associated with reinterpretation and negatively associated with rumination (Gross & John, 2003). In the current study, the rumination subscale had good internal consistency (α = .86), while suppression was acceptable (α = .73). See Appendix F for the ERQ.

Emotion Regulation Abilities

The Difficulties in Emotion Regulation Scale (DERS; Gratz & Roemer, 2004) is a 36-item self-report measure assessing underlying difficulties with awareness, acceptance, and modulation of emotions. Items are rated on a 5-point Likert-type scale from 1 ("almost never [0-10%]") to 5 ("almost always [91-100%]"), with higher scores indicating more difficulties regulating emotions. The DERS consists of six subscales, which reflect the six domains of emotion regulation abilities proposed by Gratz & Roemer (2004), including nonacceptance of emotional responses (nonaccept), difficulties engaging in goal-directed behavior (goals), impulse control difficulties (impulse), lack of emotional awareness (awareness), limited access to emotion regulation strategies (strategies), and lack of emotional clarity (clarity). The DERS total score displays excellent internal consistency (Cronbach's $\alpha = .93$) and good test-retest reliability overall ($\rho = .88$, $p < .01$), while internal consistency within each subscale is good (αs > .80; Gratz & Roemer, 2004). Available data on psychometric properties of the DERS in FGID populations is lacking. However, the DERS has shown adequate to excellent internal consistency in other psychosomatic populations such as psychogenic nonepileptic seizures ($\alpha = .94$; Roberts et al., 2012) and chronic pain (αs > .70; Kökönyei et al., 2014). The DERS total score demonstrated excellent internal consistency in this sample ($\alpha = .91$). See Appendix G for the DERS.

Visceral Sensitivity

The Visceral Sensitivity Index (VSI; Labus et al., 2004; Labus et al., 2007) is a 15-item self-report scale measuring gastrointestinal-specific anxiety. Respondents indicate to what extent items correspond to their experience of abdominal discomfort on a 6-point Likert-type scale from 1 ("strongly agree") to 6 ("strongly disagree"). Items are then reverse scored (i.e., 1-6 becomes

5-0) and summed to comprise a total score wherein higher scores indicate worse hypersensitivity to gastrointestinal symptoms (range 0 – 75). Internal consistency was excellent ($\alpha > .90$) among individuals with IBS (Labus et al., 2004) and non-selected undergraduate students (Labus et al., 2007). Further, the VSI is positively correlated with measures of anxiety sensitivity ($r = .66$), trait anxiety ($r = .73$), and gastrointestinal symptom severity ($r = .49$), suggesting strong convergent validity (Labus et al., 2004). Cronbach's α for the VSI in this sample was excellent ($\alpha = .95$). See Appendix H for the VSI.

Perception of Body Sensations

The Body Perception Questionnaire Short Form (BPQ-SF; Cabrera et al., 2018) is a 46-item self-report measure that assesses the degree to which individuals are aware of physiological sensations and processes (26 items) as well as ANS reactivity (20 items). Body awareness is one factor, while ANS reactivity is comprised of two sub-factors reflected by organ systems above (i.e., supradiaphragmatic) and below (i.e., subdiaphragmatic) the diaphragm. Items are rated on a 5-point Likert-type scale from 1 ("never") to 5 ("always") then dichotomized (0 = "never", 1 "occasionally or more often") and summed, with higher scores indicating higher body awareness and ANS reactivity. One item ("I feel like vomiting") is included on both ANS subscales. Across three independent samples of community members and undergraduate students, internal consistency measured by the categorical omega coefficient was excellent for the body awareness factor ($\omega = .92 – .96$) and adequate to excellent for the supradiaphragmatic ($\omega = .88 – .94$) and subdiaphragmatic ($\omega = .77 – .87$) subfactors of the ANS reactivity subscales (Cabrera et al., 2018). All BPQ-SF subscales are associated with measures of stress reactivity and hypersensitivity to psychosomatic sensations (Cabrera et al., 2018). Internal consistency across

the subscales was good to excellent (α_{aware} = .73; α_{supra} = .88; α_{sub} = .81) in the current study. See Appendix I for the BPQ-SF.

Experimental Measures

The following measures assess state psychological characteristics and were administered after the neutral induction and each emotion induction trial.

Emotion Identification, Intensity, and Differentiation

The Positive and Negative Affect Scale (PANAS; Watson et al., 1988) is a 20-item measure wherein participants identify emotions or affective states (e.g., excited, upset) they are currently experiencing, as well as the intensity of these states. An additional item, "disgusted," was included in the PANAS in order to assess the experience of disgust, totaling 21 items. Each item is rated on a 5-point Likert-type scale from 1 ("very slightly or not at all") to 5 ("extremely"), and two subscales of positive and negative affect are yielded ("disgusted" was included in the negative affect subscale). Only the negative affect subscale was used in the current study. Regarding internal consistency, the PANAS is able to reliably measure general, trait-level affect (α_{pos} = .88; α_{neg} = .87) as well as in-the-moment, state affect (α_{pos} = .89; α_{neg} = .85; Watson et al., 1988). Further, the positive affect subscale is negatively correlated with psychopathology, while the negative affect scale is positively correlated with depression, demonstrating convergent and divergent validity among a college student sample (Watson et al., 1988). Additionally, the inverse relationship of positive and negative affect under stressful or aversive states has been implicated among chronic health populations (Davis et al., 2004), which is demonstrated by the lack of relationship between the two subscales in a sample of individuals with chronic kidney disease (de Sousa et al., 2016). Across the four inductions, internal

consistencies for the negative affect subscale ranged from poor ($\alpha_{neutral}$ = .67), adequate ($\alpha_{disgust}$ = .78), to good ($\alpha_{anxiety, sadness}$ = .86). See Appendix J for the PANAS.

State Emotion Regulation Strategies

The Strategies Questionnaire (SQ) is a 4-item measure that assesses in-the-moment use of emotion regulation strategies that was developed for use in a previously published study (Ehring et al., 2010). Items are measured on a Likert-type scale from 0 ("strongly disagree") to 6 ("strongly agree"). The SQ assesses the degree to which an individual engages in suppression and/or reappraisal as a way to regulate emotions during an experimental paradigm, and as such, is designed to be administered prior to and following an experimental trial. In the study the SQ was created for, the suppression and reappraisal items had good (α = .84) and adequate (α = .70) internal consistency, respectively (Ehring et al., 2010). In the current study the SQ was used to assess use of emotion regulation strategies in the experimental paradigm. Across emotion inductions, the suppression ($\alpha_{neutral}$ = .76, $\alpha_{anxiety}$ = .94, $\alpha_{sadness}$ = .88, $\alpha_{disgust}$ = .85) and reappraisal ($\alpha_{neutral}$ = .69, $\alpha_{anxiety}$ = .85, $\alpha_{sadness}$ = .89, $\alpha_{disgust}$ = .79) subscales evidenced poor to excellent internal consistency. See Appendix K for the SQ.

State Emotion Regulation Abilities

The State Difficulties in Emotion Regulation Scale (S-DERS; Lavender et al., 2017) is a 21-item self-report questionnaire developed to measure difficulties in emotion regulation across repeated assessment over brief periods of time. Respondents answer items on a 5-point Likert-type scale from 1 ("not at all") to 5 ("completely"), with higher scores indicating poor ability to regulate emotions at the moment of assessment. The S-DERS is comprised of the total score and four subscales reflecting nonacceptance of current emotions (nonacceptance), difficulties regulating emotional and behavioral responses in the moment (modulate), limited awareness of

current emotions (awareness), and limited understanding of current emotional experiences (clarity). Overall, the S-DERS demonstrates good internal consistency ($\alpha = .86$), while the four subscales range from poor (clarity; $\alpha = .65$), acceptable (awareness; $\alpha = .79$), good (modulate; $\alpha = .85$), and excellent (nonacceptance; $\alpha = .92$). Lavender and colleagues (2017) attest that because the clarity scale is comprised of only two items and that the two items are moderately correlated ($r = .48$, $p < .001$), the internal consistency should be considered acceptable. Additionally, the S-DERS is highly correlated with the trait DERS (Gratz & Roemer, 2004) as well as experimental measures of emotional reactivity (Lavender et al., 2017). The S-DERS was utilized in the current study to identify difficulties modulating and identifying one's emotions during an experimental paradigm. The total score evidenced good internal consistency across inductions ($\alpha_{anxiety,\ disgust} = .83$, $\alpha_{neutral,\ sadness} = .84$). See Appendix L for the S-DERS.

Current Distress

The Subjective Units of Distress Scale (SUDS; Wolpe, 1958) is a brief assessment of the severity of an individual's level of emotional discomfort or distress in a given situation. Distress is rated from 0 ("no distress") to 10 ("most severe distress ever experienced"). An initial SUDS rating is typically established as the baseline level of distress in a particular situation and is periodically reassessed to monitor changes in distress (McCabe, 2015; Wolpe, 1958). SUDS ratings are highly correlated with measures of state negative affect including anxiety and depression (McCabe, 2015). In the current study, SUDS was used as an assessment of current distress or discomfort following emotion inductions.

Manipulation Check and Mood Induction Questions

Participants responded to manipulation check questions through a Qualtrics survey. In addition, individual PANAS items (i.e., nervous, upset, disgusted) served as induction-congruent

manipulation checks for each emotion induction. Open-ended questions assessed participants' perception of the purpose of each task, and then yes/no and multiple choice (e.g., not at all, a little, moderately, very much) questions assessed the intensity of participants' typical reactions to anxiety-, sadness-, and disgust- eliciting stimuli. Regarding the anxiety induction, questions assessed the believability of the speech deception and typical emotional response to having to give a speech. Sadness induction items asked about familiarity with the show *This Is Us* and sadness following film clips depicting death, while the disgust induction inquired about watching disgusting videos (e.g., pimple popping, botched surgery television shows). See Appendix M for a full list of the manipulation check items.

Modifications Due to Coronavirus Disease 2019 (COVID-19)

A priori power analyses using G*Power version 3.1 (Erdfelder et al., 1996; Faul et al., 2009) were conducted to determine the necessary sample size to be fully powered to test all hypotheses. The power analysis revealed that 78 participants would be needed to achieve a medium to large effect ($d \geq .65$) and adequate power ($1 - \beta = 0.8$). Data collection began at the start of the Fall 2020 semester. However, the ongoing COVID-19 pandemic disrupted data recruitment through the Psychology Department's research pool (Sona Systems). Multiple efforts were made to increase enrollment in the study, such as increasing the number of experimenter time slots, sending regular reminder emails, and adding a raffle wherein participants had a 10% chance of being selected to receive a $25 Amazon gift card. However, these efforts did not substantially increase enrollment.

Prior to the Spring 2021 semester, a survey-only study option was added to Sona Systems (in addition to the original study) that was open to all students (vs. invitation only) to complete online through Qualtrics. This new study included the aforementioned self-report battery of

baseline measures. In an additional effort to enroll participants, this online survey was also available to students participating in a university-wide survey panel managed by the University's Office of Institutional Research, Effectiveness, and Planning (IREP). Students aged 18 years or older were eligible for the online survey, and the eligibility criteria relating to the presence or absence of gastrointestinal symptoms were not applied to participants recruited through these mechanisms. After participants completed this online study, those eligible for the experimental protocol as described above (see "Eligibility and Recruitment") were able to enroll to receive additional credit (Sona Systems) or as a volunteer (IREP). Of note, no participants recruited through IREP elected to participate in the experimental study procedures. Accordingly, questionnaire (hypotheses 1 and 2) and experimental data (hypotheses 3 and 4) were handled separately. In light of these changes, hypotheses 1 and 2 were updated to reflect these continuous data as follows:

1. Depression, anxiety, and stress would be significantly positively associated with gastrointestinal symptoms.
2. Heightened emotional responsivity, difficulties understanding emotions, and greater physiological sensation awareness would be significantly positively associated with gastrointestinal symptoms.

Procedure

Self-Report Online Study Procedures

Sona Systems and IREP participants provided informed consent and completed the battery of baseline questionaries online through Qualtrics, which included the demographic and medical questionnaire, GSRS, DASS-21, EIS-R, TAS-20, ERQ, DERS, VSI, and BPQ-SF. Sona

Systems participants received course credit for their participation in the study. Participation in the IREP survey panel was voluntary and no incentive was provided.

Experimental Session Procedures

There were no differences in the procedures for the FGID and control group. Given the occurrence of COVID-19 at the time of data collection, the experimental portion of the study was conducted over the Zoom videoconferencing platform. An experimenter reviewed consent procedures and individuals provided informed consent. Next, participants were oriented to SUDS, instructed how to rate SUDS, and asked for their typical (i.e., baseline) SUDS. Participants then watched a video of a nature scene, which served as a control induction. Then, participants completed the baseline battery of self-report questionnaires through Qualtrics (i.e., demographic and medical questionnaire, GSRS, DASS-21, EIS-R, TAS-20, ERQ, DERS, VSI, and BPQ-SF). Participants who had previously completed these measures through the survey-only study option did not complete them again. Next, participants completed the series of three emotion inductions designed to elicit anxiety, disgust, and sadness. Each induction lasted approximately three minutes, with a minimum 3-minute distraction period (i.e., nature videos) between trials and following the final trial. The order of trials was counterbalanced across participants to decrease the potential for order effects. To achieve this, the sample was divided into thirds, with each third completing the three emotion induction trials in a different order. Each participant number corresponded with the trial order *a priori*.

To induce anxiety, a speech anticipation task was used. Deception was used to lead participants to believe that they may have to present a speech and that a coin flip would determine whether or not they would present the speech. In reality, the coin flip was rigged, and no participants were asked to complete a speech task. The anticipation of presenting a speech has

been shown to elicit a significant anxiety response, such as increased physiological arousal and subjective anxiety (Macatee et al., 2017; Waugh et al., 2010). In the current study, participants were told that they would receive three minutes to prepare a speech on the topic "Why are you a good friend?", which has been successful at inducing anxious response in previous studies (Macatee et al., 2017; Waugh et al., 2010). Participants were told that two virtual coin flips would determine if and when they would be presenting their speech, and if selected to present, that the speech would be recorded for later evaluation on its clarity, coherence, and persuasiveness. The first coin flip followed the 3-minute anticipation period, and participants were told that it would determine if they would present the speech immediately or wait for the second coin flip following completion of a short battery of questionnaires, which would determine whether they gave the speech at that time or not at all. In line with the deception, all participants received the feedback that they would not give the speech immediately, and after completing the experimental questionnaires, were again told that they would not be giving the speech. Altogether, participants anticipated giving the speech for approximately five minutes. A 5-minute speech anticipation period demonstrates a robust influence on stress response, and is suggested to be the most ideal amount of time (Labuschagne et al., 2019). Additionally, digital or virtual administration of speech tasks designed to elicit anxiety is sufficient in producing comparable levels of cortisol response as in-person administration, particularly for individuals under the age of 25 (Helminen et al., 2019).

To induce sadness, participants viewed a 3-minute film clip that addressed themes of loss and grief. Reviews suggest that using film clips depicting themes of loss can be a potent elicitor of sadness (Gross & Levenson, 1995; Joseph et al., 2020). However, the majority of clips used to induce sadness originated in the 1980s and 1990s; therefore, in attempt to increase the salience of

these clips to current undergraduate students, a survey of sad movie themes and examples of specific movies was provided to a group of nine undergraduate research assistants who rated how sad each theme and movie would make them. Based on the survey results, a scene from the television program *This Is Us* depicting the loss of a loved one was chosen as the sadness induction. Prior to the film clip, a brief 30-second introduction summarized the plot of the television show, as providing context has been shown to amplify the emotional impact (Palomba & Stegagno, 1993).

To induce disgust, participants viewed a 3-minute compilation of disgusting video clips. The video clips featured disgusting videos that correspond with the various facets of disgust (Rozin et al., 2008) such as autopsy and surgery scenes, maggot infestations, vomiting, and consuming unusual food (i.e., insects).

Following each induction, participants completed the experimental questionnaires (i.e., SUDS, PANAS, SQ, S-DERS). Completion of each induction was followed by the 3-minute distraction task to allow for return to baseline SUDS. After the distraction, participants again provided their SUDS rating and if distress had not yet returned to their baseline, they continued to watch the nature video for another three minutes. Lastly, the manipulation checks and mood induction questions were administered.

After study procedures were completed, participants were debriefed about the purpose of the study, and participants were informed that they were provided with false information pertaining to the possibility of delivering a speech task. All participants provided informed consent a second time after they were debriefed on this deception and were credited for their participation.

Data Analysis

Data Cleaning Procedures

All statistical analyses were conducted using SPSS version 26. Alpha was set at $p < .05$. Due to the novel and exploratory nature of the current study, hypotheses 3 and 4 were considered the primary analyses. Data obtained through the baseline survey battery and experimental protocol were separately screened for accuracy errors, missing data, outliers, and assumptions including non-normality, skewness, and kurtosis. Participants missing more than 5% of their data were removed. Missing data were imputed using linear trend at point regression for those missing fewer than 5% data, which takes the scale average within and item average across participants. Tukey's outlier labeling rule (Hoaglin et al., 1986) identified three outliers in the survey sample and three outliers in the experimental sample. However, the outliers were not removed or altered given that this is a novel pilot study and the full range of emotional and physiological functioning within this population is not yet understood.

Of the 370 original survey participants, 30 were removed for not having completed the primary gastrointestinal symptom measure (GSRS), 28 were removed for missing more than 5% of their data, and 21 were removed for failing an attention check. Three participants were missing one item on the EIS-R due to experimenter error, and the single missing item was imputed for each participant using the previously described imputation procedures. All data met assumptions of normality, multicollinearity, linearity, homogeneity, and homoscedasticity. The final sample consisted of 291 participants, 52 of which participated in the experimental protocol. Of these 52 experimental participants, 53.8% ($n = 28$) were classified in the FGID group and 46.2% ($n = 24$) were classified in the control group.

Preliminary Analyses and Sample Characteristics

Demographic variables were examined to identify potential between-group differences in those with and without FGID symptoms. Given the low frequency of racial minorities in the sample, race was collapsed into White and non-White. Descriptive statistics were conducted for each variable to characterize the sample and responses to the emotion inductions. Responses to the manipulation checks and potential between-group differences were evaluated.

Examination of Hypotheses 1 and 2

Pearson correlations were used to test hypotheses 1 and 2 in the full sample of participants ($N = 291$). Specifically, these analyses tested the associations between gastrointestinal symptoms (GSRS) and 1) depression, anxiety, and stress (DASS-21; hypothesis 1); and 2) emotional and physiological responsivity and awareness (EIS-R, TAS-20, ERQ Reappraisal, ERQ Suppression, DERS, VSI, and BPQ-SF; hypothesis 2).

Examination of Hypothesis 3

Hypothesis 3 was tested in the experimental sample ($n = 52$). Negative emotion differentiation was characterized by variability in affective experience throughout the emotion inductions. Prior literature has used the PANAS to calculate the degree to which individuals are able to adequately distinguish emotional or affective states (Edwards & Wupperman, 2017; Pond et al., 2012). Standard deviations were calculated between negative emotions across emotion induction trials (anxiety, sadness, and disgust) for each participant. Higher scores are interpreted as little difficulty in differentiating negative emotions relative to lower scores that indicate greater difficulty differentiating negative emotions (de Sousa et al., 2016).

To examine group differences in emotion differentiation during emotion inductions, an independent samples *t*-test was computed with group status (FGID, control) entered as the independent variable and negative emotion differentiation entered as the dependent variable.

Examination of Hypothesis 4

Hypothesis 4 was tested in the experimental sample (n = 52). To test hypothesis 4, a series of 2 (Condition: FGID, control) X 4 (Induction: neutral, anxiety, sadness, disgust) mixed factorial ANOVAs were computed, with SUDS, SQ suppression, SQ reappraisal, and S-DERS from each induction entered as the dependent variables in each respective model. Post-hoc planned contrasts were used to examine interaction effects, while pairwise comparisons examined main effects.

CHAPTER 3

RESULTS

Preliminary Data Analysis

Across FGID and control groups, there were no significant differences in sex ($X^2 = 1.84$, $p = .18$), age ($t = -1.35$ (49), $p = .18$), or race ($X^2 = 0.81$, $p = .37$). Experimental participants were counterbalanced to one of three induction orders: A (anxiety, sadness, disgust), B (disgust, anxiety, sadness), or C (sadness, disgust, anxiety). Participants were relatively evenly counterbalanced across the three induction orders (34.6%, 32.7%, and 32.7%, respectively).

Manipulation checks were employed to assess differences across groups in SUDS, negative affect, and manipulation-congruent emotions following each induction. Regarding the anxiety induction, 21.2% of participants reported not believing the speech task deception (yes/no response choice); therefore, additional information was examined to evaluate how believability affected distress and negative affect. Results revealed no significant differences between those who reported believing and not believing the deception in SUDS ($t = 0.94$ (50), $p = .35$), negative affect ($t = 0.33$ (16.09), $p = .75$), or nervousness ($t = 1.12$ (50), $p = .27$) following the anxiety induction. Given this consistent pattern of findings, it appears that the speech anticipation task was successful in eliciting distress and anxiety regardless of deception believability.

Regarding the clip of the television program used for the sadness induction, 30.8% of participants had seen the television program before and 19.2% of participants had seen the

specific episode depicted in the sadness induction. There were no significant differences in SUDS (t = -0.21 (50), p = .84; t = 0.48 (14), p = .69), negative affect (t = 0.60 (50), p = .55); t = 1.85 (14), p = .09), or feeling upset (t = .39 = (50), p = .70; t = 1.85 (14), p = .09) between participants who had seen the show and/or the exact episode and those who had not, respectively. Therefore, participants' prior knowledge of the television program did not appear to significantly affect experience of sadness or related distress during the sadness induction.

Lastly, 48.1% of participants reported typically watching disgusting videos but did not evidence differences in SUDS (t = -0.56 (50), p = .57), negative affect (t = -1.50 (50), p = .14), or disgust (t = 0.75 (50), p = .46) following the disgust induction, relative to those who did not watch disgusting videos. Therefore, participants' previous exposure to disgusting stimuli did not appear to significantly affect experience of disgust or related distress during the disgust induction. Based on these data, all data were included in primary study analyses given that external factors did not appear to differentially affect participants' responses to the anxiety, sadness, and disgust inductions.

Participant Characteristics

Across the entire sample, most participants had never been diagnosed with a gastrointestinal disorder (91.8%, n = 267), while 4.5% (n = 13) self-reported having been diagnosed with IBS and 3.7% (n = 11) an organic gastrointestinal condition (e.g., GERD, lactose intolerance). Of the 14.8% (n = 43) of the sample that had reported seeking medical attention for gastrointestinal problems, 15.5% saw a general practitioner, 7.6% saw a specialist, and 1.7% saw a mental health provider. Regarding behavior aimed to reduce or prevent gut symptoms, participants reported avoiding specific foods (65.3%), avoiding eating prior to an event or activity (54.0%), and purposely eating small portions of food (50.2%). Regarding

psychopathological characteristics, the average levels of depression (M = 8.73, SD = 9.82), anxiety (M = 7.40, SD = 8.29), and stress (M = 10.95, SD = 9.36) across the sample were within the normal range. See Table 1 for additional participant demographic and gastrointestinal characteristics, as well as clinical cutoffs regarding emotional difficulties.

Among the participants who completed the experimental procedures, the structure of the FGID and control groups were as expected, with those in the FGID group endorsing higher gastrointestinal symptoms (M = 2.54, SD = 1.05) and visceral sensitivity (M = 25.93, SD = 20.12) than the control group (M_{GSRS} = 1.45, SD_{GSRS} = 0.56; M_{VSI} = 7.29, SD_{VSI} = 11.08). See Table 2 for means and standard deviations of psychological and physiological trait characteristics across FGID and control groups.

Examination of Study Hypotheses

Relationship Between Gastrointestinal Distress and Emotional and Physiological Characteristics (Hypotheses 1 and 2)

Psychopathology. In concordance with hypothesis 1, significant positive correlations were observed between gastrointestinal distress and depression (r = .31, p < .001), anxiety (r = .47, p < .001), and stress (r = .52, p < .001). See Table 3 for zero-order correlations and descriptive statistics.

Emotional and Physiological Reactivity. Partially supporting hypothesis 2, significant positive correlations were observed between gastrointestinal distress and emotion intensity, alexithymia, emotion regulation abilities, visceral sensitivity, and body awareness and ANS reactivity (rs = .20 – .69, ps < .001). Stronger correlations were observed for the physiological reactivity variables as compared to the emotional reactivity variables. Inconsistent with

hypothesis 2, there were no significant correlations between gastrointestinal distress and reappraisal or suppression (*p*s > .30).

Group Differences in Negative Emotion Differentiation Across Inductions (Hypothesis 3)

Standard deviation of negative affect during the three emotion inductions was on average 0.93 (*SD* = 0.39) and ranged from 0 to 1.65 (see Table 4 for negative affect means and standard deviations across groups following each induction). Unexpectedly, there was not a significant difference across the FGID and control groups in negative emotion differentiation, t (50) = 1.47, p = .15. Therefore, hypothesis 3 was not supported.

Group Differences in Emotional Characteristics Across Inductions (Hypothesis 4)

Distress. Participants' SUDS were examined across each of the four induction trials (neutral, anxiety, sadness, disgust) and two groups (FGID, control). Mauchly's test (p = .01) indicated assumptions of sphericity were not met, therefore a Huynh-Feldt correction (ε > .75) was used. There was not a significant interaction of induction by group on SUDS, F(2.78,139.12) = 0.28, p = .83 (see Table 5 for post-hoc planned contrasts for each dependent variable). However, there was a significant within-subjects main effect of induction (F[2.78,139.12] = 36.12, η^2 = .42, p < .001). SUDS following the anxiety, sadness, and disgust inductions were significantly higher than SUDS following the neutral induction, and SUDS following the anxiety and disgust inductions were significantly higher than SUDS following the sadness induction (all *p*s < .001; see Table 4 for means and standard deviations for each dependent variable). There was no statistical difference in SUDS between the anxiety and disgust inductions. There was not a significant difference in SUDS across the FGID and control groups, F(1,50) = 0.34, p = .56.

Emotion Regulation Abilities. Participants' state-level emotion regulation abilities were examined across each of the four inductions (neutral, anxiety, sadness, disgust) and two groups (FGID, control). Mauchly's test ($p < .001$) indicated assumptions of sphericity were not met, therefore a Huynh-Feldt correction ($\varepsilon > .75$) was used. There was not a significant interaction of induction by group on emotion regulation abilities, $F(2.44,122.00) = 1.94$, $p = .14$, nor were there significant main effects of induction ($F[2.44,122.00] = 1.03$, $p = .37$) or group ($F[1,50] = 1.84$, $p = .18$).

Emotion Regulation Strategies. Participants' state-level emotion regulation strategies were examined across each of the four inductions (neutral, anxiety, sadness, disgust) and two groups (FGID, control). Participants' use of cognitive reappraisal and suppression were each examined separately. Regarding cognitive reappraisal, Mauchly's test ($p = .06$) indicated that assumptions were met. There was not a significant interaction of induction by group on use of cognitive reappraisal, $F(3,150) = 1.35$, $p = .26$, nor were there significant main effects of induction ($F[3,150] = 2.03$, $p = .11$) or group ($F[1,50] = 0.22$, $p = .64$). Regarding suppression, Mauchly's test ($p = .73$) indicated that assumptions were met. There was not a significant interaction of induction by group on use of suppression, $F(3,150) = 0.06$, $p = .98$, nor were there significant main effects of induction ($F[3,150] = 1.19$, $p = .32$) or group ($F[1,50] = 0.57$, $p = .45$). Overall, hypothesis 4 was not supported.

CHAPTER 4

DISCUSSION

Although individuals with FGID symptoms are known to experience heightened emotional responsivity (Drossman, 2016; Fournier et al., 2018), the empirical literature examining these associations is sparse. The current study aimed to deepen this knowledge by examining trait and state emotional and physiological responses in the context of gastrointestinal distress. With regard to the characterization of FGID symptoms in the current sample, gastrointestinal symptoms were generally less severe than in clinical patients with emotional and/or functional gastrointestinal disorders (Grzesiak et al., 2014; Simrén et al., 2018); yet, gut symptoms commonly affected participants' routine and eating behaviors. Nearly one-third of participants avoided eating at restaurants, approximately one in five avoided sex and exercise, and although avoiding specific food items (e.g., dairy) may be adaptive in some cases, over half of the sample did so to prevent gut symptom exacerbation. These findings are consistent with studies suggesting FGIDs and related impairment are common among samples of college students (up to 26.9%; Goyal et al., 2020; Jiang et al., 2019) and are comparable to the general population (Chang, 2004).

Consistent with FGID presentations among other university (Dong et al., 2013; Goyal et al., 2020; Jiang et al., 2019) and clinical samples (Lee et al., 2017), study participants with FGID symptoms experienced more symptoms of depression, anxiety, and stress relative to healthy controls. However, the FGID group reported overall normal to mild levels of symptoms, with

only a minority endorsing clinically significant symptoms of depression (14.8%), anxiety (18.5%), and stress (3.7%). In contrast, levels of depression and anxiety among FGID populations are typically much higher, with severity scores falling between means observed in psychiatric populations and healthy control groups (Çakmak et al., 2018; Drossman, 1999; Hartono et al., 2012). Although convenience samples such as college students may serve as a more easily accessible proxy population to FGID patients, future studies may consider over-selecting for more severe gut and emotional symptoms to more accurately represent patient populations.

Despite the generally low level of gut and emotional distress in the current sample, FGID symptoms evidenced a small association with depression and moderate associations with anxiety and stress symptoms. This finding supports hypothesis 1 and the broader link between gut and emotional symptoms. These associations may reflect the integral role of the ANS and HPA axis in the reciprocal link between psychopathology, particularly stress and anxiety, and alterations in motility and visceral signaling, which together contribute to FGIDs (Elsenbruch et al., 2010; Fukudo et al., 1998; Geeraerts et al., 2005; Van Oudenhove & Aziz, 2013; Van Oudenhove et al., 2016). Chronic stress is also a major risk factor for depression; therefore, depression is linked to HPA axis excitation through the experience of stress (Saveanu & Nemeroff, 2012). In a related vein, recent reviews have implicated dysbiosis of the gut microbiome in the etiology of anxiety and depression by way of proinflammatory bacteria (Rivet-Noor & Gaultier, 2020; Simpson et al., 2021). Stress may be responsible for alterations in the microbiota, which has direct ties to depression (Rivet-Noor & Gaultier, 2020) and gut pain (Mayer et al., 2014). In turn, gut inflammation is thought to disrupt the HPA axis causing increased release of cortisol and triggering the above-mentioned process (Rivet-Noor & Gaultier, 2020; Simpson et al., 2021).

Incorporating the gut microbiome into future work examining the links between emotions and the gastrointestinal tract is important for developing a complete understanding of these associations.

Consistent with ties to emotional distress, FGID symptoms evidenced small associations with heightened emotion intensity, alexithymia, and greater difficulties regulating emotions, which provides support for hypothesis 2. Through the HPA axis, deficits in the processing and expression of emotions as well as emotional hyperreactivity may contribute to heightened visceral perception and chronic gut symptoms (Aldao et al., 2010; Carrozzino & Porcelli, 2018; Fournier et al., 2018; Panayiotou et al., 2021). Therefore, emotion-related deficits may serve as an amplifier of distress contributing to somatic and visceral sensitivities through excitation of the HPA axis, but additional work is needed to test this hypothesis. Contrary to hypothesis 2, the tendency to use reappraisal and suppression was not associated with gut symptoms. Given the low levels of emotional distress and gastrointestinal symptoms reported by the FGID group, the selection of emotion regulation strategies may not be as salient to this group relative to clinical populations. Among clinical FGID samples, research has shown connections between the selection of emotion regulation strategies and gastrointestinal symptoms. For instance, behavioral avoidance of gastrointestinal symptoms contributes to worse gut symptom severity (Bonnert et al., 2018), whereas positive emotion regulation strategies such as mindfulness have been found to ameliorate gut symptoms (Aucoin et al., 2014; Mazaheri, 2015). Additional empirical work examining the role of emotion regulation strategies among patients with FGIDs experiencing higher levels of emotional distress is warranted to truly understand these associations.

Robust associations were observed between gastrointestinal symptoms and broad awareness of visceral (i.e., internal organs) and somatic (i.e., skin, muscles, soft tissue) sensations, which provides further support for hypothesis 2. Through alteration of gut motility and CNS signaling, visceral sensitivity contributes to both gastrointestinal symptoms (Simrén et al., 2018) and stress (Mertz, 2003). In a vicious cycle, stress reciprocally contributes to visceral sensitivity in those with FGIDs. More broadly, ANS reactivity associated with the ENS (i.e., the gut; Cabrera et al., 2018) is particularly relevant to FGID symptoms compared to reactivity in the upper body cavity (e.g., esophagus), which is linked with autonomic inhibition of the parasympathetic nervous system. Taken together with the current literature, these correlational findings implicate physiological reactivity and sensitivity in the gut as having a robut influence on FGID symptoms.

Inconsistent with hypothesis 3, the findings revealed those with FGID symptoms did not differ in their ability to differentiate negative emotions following emotion-provoking stimuli relative to healthy peers. Greater ability to differentiate negative emotions is associated with more effective selection of emotion regulation strategies (and decreased problematic behavior; e.g., substance use) and improved emotion regulation abilities (Barrett et al., 2001; Kalokerinos et al., 2019; Kashdan et al., 2015). Given that those with FGIDs are hypothesized to be vulnerable to negative emotion and exhibit poor emotion regulation relative to healthy peers (Fournier et al., 2018), it is unexpected that the FGID group was not worse at differentiating emotions. Notably, low levels of emotion differentiation were observed in both groups across emotion inductions. Adolescents exhibit poor emotion differentiation (Nook et al., 2018); therefore, it is possible that participants, who were on average 19 years of age, may have struggled to distinguish discrete emotions during emotion inductions. College students overall

may lack the ability to differentiate discrete emotions when encountering multiple emotion-provoking stimuli, making them an inopportune group to test this hypothesis. Examining emotion differentiation abilities among adult populations experiencing FGIDs would shed light on an important skill that may buffer, or contribute to, detrimental consequences of negative affect (Smidt & Suvak, 2015).

With regard to hypothesis 4, distress, emotion regulation strategies, and emotion regulation abilities did not differ between the FGID and control groups across emotion inductions, which is contrary to the burgeoning literature in this area (Cheng et al., 2000; Fournier et al., 2018; Jones et al., 2006; Mazaheri, 2015; Stanculete et al., 2015). Of note, SUDS during the emotion inductions were generally low, ranging from 1.18 to 4.29 (out of 10) in the FGID group; yet, these data are comparable to outcomes observed in previous studies using clinical analogue samples (e.g., 2.42 – 4.83; Cloutier et al., 2019; Franklin et al., 2012; Schatten et al., 2015). Chronic or heightened levels of distress may be more salient to FGID presentations than short-term, acute emotional distress; therefore, the current sample of individuals experiencing low levels of distress would not be ideal for detecting such emotional differences. Future research is needed to further evaluate relevant mood induction paradigms in this population and identify circumstances under which it is possible to detect differences in laboratory-induced emotions between individuals with FGID symptoms and healthy controls. For instance, prolonged emotion induction paradigms or idiographic mood inductions, such as participant-selected video or music clips or recitation of an emotionally salient autobiographical event, may be necessary for evoking complex emotional responses, such as processes of psychopathology and emotion regulation (Ellard et al., 2012; Kuo et al., 2014).

It is possible that alexithymia has a more precise relationship with FGIDs than emotion regulation, an arguably broader construct that alexithymia may be encompassed within (Panayiotou et al., 2021), potentially explaining the null results of hypothesis 4. Notably, the FGID group reported clinical levels of dispositional alexithymia at two times the rate of the control group, a finding consistent with the current literature (Porcelli et al., 1999, 2004; Portincasa et al., 2003). Alexithymia is posited to be a somatosensory amplifier associated with deficits in cognitive-emotional processing and increased sensitivity towards physical sensations (see Kano & Fukudo, 2013). Those high in alexithymia experience hyperinteroceptive arousal, especially when physiologically or emotionally stimulated, such that objectively low stimulation is attended to and experienced as intensely painful (Kano & Fukudo, 2013). This somatosensory amplification process may partially explain FGIDs, in that there is no biochemical or structural abnormality, yet, typical gut sensations are experienced as painful. One potential but understudied pathway linking alexithymia to illnesses such as FGIDs is common third variables (Lumley et al., 2008), and although the mechanism is still unknown, studies implicate emotion regulation system deficits and activation of the ANS and HPA axis (Kano et al., 2018; Kano & Fukudo, 2013). There is need to understand the unique, yet inextricable roles of alexithymia and emotion regulation in activation of the HPA axis and other excitatory systems in the body that may affect the brain-gut axis.

In addition to hypothesis-specific explanations, factors associated with the study sample and methodology may have also contributed to the null findings of hypotheses 3 and 4. First, the FGID group was not necessarily diagnosed with FGIDs, and participants generally experienced little gastrointestinal and emotional distress. Given the high co-occurrence of psychopathology and FGIDs observed in clinical samples (Elsenbruch et al., 2010; Hillila & Farkkila, 2004; Lee et

al., 2009; Van Oudenhove et al., 2016; Wu, 2012), this sample may not be an appropriate proxy population with which to understand FGIDs and the disruption of the brain-gut axis more broadly. Secondly, the emotion inductions may not have been sufficient elicitors of anxiety, sadness, and disgust. One main effect of induction on SUDS emerged, such that the anxiety and disgust inductions elicited a greater level of distress than the sadness induction, and that all three emotion inductions were associated with greater distress than the neutral induction. However, this difference in distress was not seen across groups, nor were there differences among state-level emotion regulation strategies or abilities, suggesting that the inductions may not have been salient to this sample. Lastly, the robustness of inductions may have been weakened by the remote administration, such that completing the study in participants' home environment may have led to lower distress than might be seen in a laboratory setting (see "Videoconferencing Considerations" section below for more considerations of remote administration).

Limitations

These results should be interpreted in the context of several limitations. First, the specificity and sensitivity of the eligibility screening is unclear. In some cases, the screening may have been over-restrictive (e.g., excluded people with co-occurring organic gastrointestinal disorders and FGIDs), while in other cases it may have been under-restrictive by not effectively identifying participants with organic disorders (e.g., not reporting organic disorders at screening but subsequently reporting such disorders). More generally, the inclusion criteria may have contributed to issues in group composition given that there are no strict guidelines on how to categorize GSRS responses. Participants included in the FGID group did not necessarily have FGIDs, but rather, endorsed at least one moderate to very severe gut symptom. This may have resulted in average levels of minor to mild gastrointestinal symptoms, which are lower than other

student (Chen et al., 2021) and clinical samples (Porcelli et al., 2020). Nevertheless, this classification is consistent with previous studies that have used college student samples (Norton et al., 1999; Vivier et al., 2020), which examine gut sensations on a continuum of severity rather than dichotomously due to frequent fluctuations in severity. Although it may be prudent to recruit persons diagnosed with FGIDs for future work, understanding the impact of emotional reactivity in gastrointestinal distress among college samples is important as students are vulnerable to both emotional distress (Auerbach et al., 2016, 2018) and functionally impairing gut sensations (Chen et al., 2021; Dong et al., 2013; Gulewitsch et al., 2011; Zvolensky et al., 2018).

Second, the sample was primarily young (M_{age} = 20.59), White (82.5%), female (72.5%) college students. Although certain characteristics are reflective of those observed in FGID patients, greater heterogeneity in demographic characteristics is needed to fully understand this population. For instance, college students remain an important target population as approximately one-third of students experience at least one mild to moderate gastrointestinal symptom at a given time (Vivier et al., 2020). Yet, expanding the age range is essential as FGIDs occur across the lifespan, with different disorders peaking at different times (i.e., childhood vs. adulthood) and in concurrence with life events (e.g., pregnancy; Houghton et al., 2016). FGIDs are also more common among females relative to males (Sperber et al., 2021), with one study suggesting women experience IBS at a rate of 53% to 82% times greater than men (Card et al., 2014). This imbalance may be partially due to societal expectations of women (e.g., bodily function is shameful) and attractiveness standards (e.g., bloating contributing to body image difficulties), both of which result in the experience of greater gut pain and emotional duress (Houghton et al., 2016; Longstreth & Wolde-Tsadik, 1993). The complete pathophysiology

underlying higher prevalence in women is unknown, but it is likely multifaceted and may include several factors such as autonomic and immune dysregulation, health care seeking behaviors, and genetic predispositions (Houghton et al., 2016). Lastly, as FGIDs are prevalent across the world (Sperber et al., 2012, 2021) and different cultures (Francisconi et al., 2016), future studies should take care to enroll ethnically diverse samples.

Third, while hypotheses 3 and 4 were tested with an experimental design, the survey data are cross-sectional and temporal assumptions are precluded. To further strengthen the methodology, future studies may consider building upon the current design by incorporating a longitudinal component to assess long-term associations between FGID and emotional symptoms. Given the frequency of gut sensations in college students (Vivier et al., 2020), recruiting at-risk students and following them throughout college may present opportunities to understand the trajectory of gastrointestinal and emotional symptoms by identifying risk and protective factors. As a fourth limitation, the study relied on retrospective self-report measures to assess emotional responding and presence and severity of FGID symptoms. Despite the ANS being integral to the brain-gut axis, the psychophysiology literature is underdeveloped in the context of FGIDs. Psychophysiological assessments (e.g., facial expression analysis, electrodermal activity, heart rate variability) could be incorporated in future work to further characterize emotional responding in this population. Additionally, utilization of medical providers, hospital records, or clinical interviews to verify FGID symptoms would more closely approximate FGID patients.

Fifth, the emotion inductions may not have been potent enough to elicit an adequate amount of distress across participants. Although the anxiety induction used in this study has been previously validated (Macatee et al., 2017; Waugh et al., 2010), a recent review indicated that

virtual administrations, evidencing moderate effect sizes, are not as effective at eliciting stress as in-person administrations (Helminen et al., 2019). Additionally, while the sadness and disgust inductions were based on prior research (Al-Shawaf et al., 2019; Gross & Levenson, 1995; Joseph et al., 2020; Stark et al., 2005), the psychometric properties regarding the ability to evoke desired emotional responses have not been previously studied. Although there are existing validated film clips that serve as sadness inductions, the most commonly used films premiered between the years of 1979 and 1998 (Joseph et al., 2020), and most college students in the 2020 – 2021 academic year (i.e., the period data collection occurred) were born after these films premiered. Consequently, these film clips may not be as relevant to current and upcoming generations of college students. Furthermore, in addition to the limited availability of suitable emotion inductions, no studies have examined nor validated emotional inductions within a FGID sample. In order to understand emotional responsivity as it relates to FGIDs, standardization and validation efforts are needed for these instruments within FGID samples to identify stimuli that are effective elicitors of discrete emotions.

Lastly, the COVID-19 pandemic caused disruptions to recruitment of study participants, resulting in the experimental sample being underpowered (n = 52, relative to the sample size of 78 that experimental hypotheses were powered for). Due to the underpowered nature of the experimental sample, hypotheses 3 and 4 should be interpreted cautiously. However, as the relationship between power and sample size is asymptotic (Field, 2018), it is possible that the sample may be sufficiently powered to detect significant results. It is always a possibility that, regardless of issues with power, null results accurately reflect reality in that there truly are not associations between study variables. In addition to affecting recruitment, the pandemic may have also altered typical responding. A multitude of articles suggest that the COVID-19

pandemic has altered mental health globally (e.g., Alzueta et al., 2021; Vindegaard & Benros, 2020; Wang et al., 2020a), and notably, among college students (Husky et al., 2020; Wang et al., 2020b). Recent data collected from this university suggests that nearly 80% of undergraduate students relocated to their family homes due to COVID-19-related closures (Dixon et al., in press). As many participants likely completed study procedures in their home environment, these data may not capture typical responding and therefore it is unclear how findings may generalize to other time periods (i.e., responding prior to the pandemic). Overall, it is difficult to know how the pandemic may have altered participant responding in psychological studies such as this one.

Videoconferencing Considerations

Social distancing guidelines during the pandemic demanded that data collection occur in a novel, virtual environment. Thus, the experimental procedures of this study were conducted via the videoconferencing platform, Zoom Video Communications Inc. (Zoom), representing a novel contribution to the empirical literature. Inherent to any new methodology, there are yet to be published (and peer-reviewed) guidelines on best practices for empirical data collection via videoconference. Zoom adaptations to the experimental design were based primarily on published qualitative literature and American Psychological Association-sponsored recommendations (Archibald et al., 2019; Gray et al., 2020; Lourenco & Tasimi, 2020; Su & Ceci, 2021; Wood, 2021).

In our experience and established through the literature, there are advantages and disadvantages to conducting research via Zoom, as well as important considerations that are unique to conducting research remotely. The first benefit of using videoconferencing technology in research is that it can provide access to typically hard to reach populations (e.g., rural; Lourenco & Tasimi, 2020), and participants can access the study from anywhere, such as their

family homes. This is particularly relevant in Mississippi, and in this sample, one-fourth of participants who completed the experimental procedures reported being from rural locations. Second, methodologies that emphasize the viewing of stimuli may be a good fit for online data collection, especially data collection that is conducted to inform future in-person studies (Wood, 2021). Virtual study sessions may be advantageous for identifying and addressing methodological issues in the pilot phase before dedicating more time and resources to recruit in-person participants.

Although remote methods may allow typically underrepresented persons access to participate in research, it also limits individuals with poor or no internet connection from participating, particularly Black and Latinx populations (Lourenco & Tasimi, 2020). In this study, data collection via Zoom may have restricted participation to students physically located on campus or in family homes with access to internet (e.g., suburban or urban locations) and/or necessary equipment (i.e., computers with audio and video capability). A second limitation to using Zoom is the lack of control over the study environment. Many participants completed the study from their dorm room with roommates present, while others were in public spaces (e.g., library). These environments inherently introduce more confounds (e.g., distractions, presence of other people) but may also represent a more ecologically valid environment relative to a typical laboratory setting. Lastly, online or remote studies that are not theoretically related to online or virtual behavior may lack generalizability to in-person behaviors (Wood, 2021). Participants' responses to emotion-evoking stimuli delivered via Zoom may not be representative of their in-person behavioral or affective responding. Despite these limitations, data collected in the current study may provide a preliminary understanding of emotional and physiological responding of

students with FGID symptoms relative to healthy controls, and the context for identifying methodological modifications for future in-person studies.

Researchers must carefully consider whether samples used in remote research are accurate representations of the target population of interest and not artifacts of remote data collection (Wood, 2021). *A priori* methodological considerations must be put into place such as attention and manipulation checks to screen out inaccurate responding and individuals who may not belong to the target population, respectively. It is also prudent to compare responding to that of in-person studies to understand how well remote designs capture in-person phenomena. Regarding the current study, much of the current emotion induction literature focuses on physiological responses (e.g., heart rate variability, cortisol, electrodermal responding) associated with emotion-provoking stimuli rather than the affective responses measured in the current study, making responses difficult to compare. Regarding emotion variables, relative to a sample of depressed and never-depressed participants, participants in the current study evidenced greater use of suppression and reappraisal in response to emotion inductions (Ehring et al., 2010). Notably, Ehring and colleagues (2010) averaged responses following a series of emotion inductions *and* following a rest period, rather than only after inductions as in the current study, making this impossible to compare responses to the current study. There are no known studies utilizing emotion inductions among individuals with FGIDs to provide context for in-person responding within this population. In sum, Zoom provides access to populations that would otherwise not be accessible and the opportunity to fine-tune the design of studies for in-person data collection, but it is crucial to assess whether findings are comparable to published in-person studies.

Future Directions

Although the primary study hypotheses resulted in null findings, the current study provides a novel contribution to the FGID literature, particularly through its methodology, and underscores the need for future in-person experimental studies to uncover the relationship between emotion processes and the gut. Researchers may consider inducing a wider range of emotions to further understand which discrete emotions impact FGID symptoms. Additionally, it would be prudent to understand the associations between gastrointestinal symptoms, emotion dysregulation, and alexithymia. For instance, instructing participants with FGID symptoms to use either suppression or reappraisal during emotion inductions (e.g., Ehring et al., 2010) may facilitate understanding of how specific emotion regulation strategies (e.g., avoidance) influence gut sensations. Alexithymia is thought to arise from deficits in emotion regulation, although there is contrasting evidence for which components of the emotion regulation process are associated with alexithymia (e.g., perception vs. regulation of emotions; van der Velde et al., 2015). Behavioral tasks (e.g., emotion inductions, vignettes, computer tasks) and use of psychophysiological equipment to measure and differentiate emotion regulation and alexithymia may shed light on how these emotion constructs differentially impact individuals with FGID symptoms.

Equally important is developing a more thorough understanding of physiological responding and sensitivity among individuals with FGIDs. Beyond its role in the stress response (Fichna & Storr, 2012), the ANS has wide-reaching effects throughout the body including visceral responses to CNS activity (Tougas, 2000) and differential responding to emotional stimuli (Kreibig, 2010). Future work may attempt to elucidate which components of the ANS are responsible for contributing to gut symptoms, and how these associations reciprocally affect

emotional responding. Researchers could attempt to induce gut responding through physiological or psychological stressor tasks while measuring sympathetic (e.g., cardiovascular, electrodermal, respiratory activity) and parasympathetic (e.g., heart rate variability) activity.

As more information about disorders of the brain-gut axis is unveiled, we become closer to refining intervention and identifying clinical implications for this vulnerable population. Due to the heterogeneous nature and relatively unknown pathophysiological mechanisms of FGIDs, pharmaceuticals used to treat these conditions are limited and only moderately effective (Craig & Quigley, 2011). Further, FGID patients frequently report dissatisfaction with and perceived invalidation from health care providers because of the poorly understood and functional nature of FGIDs (Chang et al., 2006). Considering FGIDs are viewed through a biopsychosocial lens and co-occur frequently with emotional disorders (Drossman et al., 2002), psychological interventions may be an effective alternative. Burgeoning literature suggests emotion awareness and regulation may improve both gastrointestinal and psychological symptoms (Doroui et al., 2017; Thakur et al., 2013). Such transdiagnostic interventions contribute to reduction in gastrointestinal symptoms through increases in cognitive reappraisal and reductions in emotional suppression and behavioral avoidance (Bonnert et al., 2018; Mazaheri et al., 2014; Mohsenabadi et al., 2018). Thus, changes in emotion regulation may be a critical component of intervention for FGID symptoms. Clinical case studies are warranted to provide more empirical support for existing evidence-based psychological interventions for FGIDs and to inform the next phases of clinical research, including the implementation of randomized controlled trials. As with emotional disorders (Donker et al., 2009) and other chronic pain conditions (Salvetti et al., 2012), it would also be pertinent for investigators to identify whether providing psychoeducation

regarding the interplay of emotions, behavior, and the gut may serve as a standalone treatment for FGIDs.

Conclusions

The current study examined the role of emotion processes in FGIDs using a novel experimental design, wherein a series of emotion inductions were administered through a videoconferencing platform. Although the results do not indicate that there are differences in distress or emotion differentiation or regulation across those with and without FGID symptoms, they do suggest that heightened affective and physiological reactivity are correlated with gastrointestinal distress. Results also show that gut symptoms are relatively common among college students, a population that is vulnerable to emotional duress (Auerbach et al., 2016, 2018). Given the link between emotions and the gut, college students experiencing psychological distress are potentially at risk for developing gut sensitivities. Future studies are needed to examine specific emotional-behavioral factors that may confer risk for developing or worsening gut symptoms, as well as investigating whether individuals with FGIDs have trouble identifying, differentiating, and modulating emotions relative to their healthy counterparts.

LIST OF REFERENCES

LIST OF REFERENCES

Aldao, A., Nolen-Hoeksema, S., & Schweizer, S. (2010). Emotion-regulation strategies across psychopathology: A meta-analytic review. *Clinical Psychology Review*, *30*(2), 217–237. https://doi.org/10.1016/j.cpr.2009.11.004

Al-Shawaf, L., Lewis, D. M. G., Ghossainy, M. E., & Buss, D. M. (2019). Experimentally inducing disgust reduces desire for short-term mating. *Evolutionary Psychological Science*, *5*(3), 267–275. https://doi.org/10.1007/s40806-018-0179-z

Alzueta, E., Perrin, P., Baker, F. C., Caffarra, S., Ramos-Usuga, D., Yuksel, D., & Arango-Lasprilla, J. C. (2021). How the COVID-19 pandemic has changed our lives: A study of psychological correlates across 59 countries. *Journal of Clinical Psychology*, *77*(3), 556–570. https://doi.org/10.1002/jclp.23082

Amstadter, A. (2008). Emotion regulation and anxiety disorders. *Journal of Anxiety Disorders*, *22*(2), 211–221. https://doi.org/10.1016/j.janxdis.2007.02.004

Ananthakrishnan, A. N., McGinley, E. L., & Binion, D. G. (2008). Excess hospitalisation burden associated with Clostridium difficile in patients with inflammatory bowel disease. *Gut*, *57*(2), 205–210. https://doi.org/10.1136/gut.2007.128231

Archibald, M. M., Ambagtsheer, R. C., Casey, M. G., & Lawless, M. (2019). Using Zoom videoconferencing for qualitative data collection: Perceptions and experiences of researchers and participants. *International Journal of Qualitative Methods*, *18*, 1–8. https://doi.org/10.1177/1609406919874596

Aucoin, M., Lalonde-Parsi, M.-J., & Cooley, K. (2014). Mindfulness-based therapies in the treatment of functional gastrointestinal disorders: A meta-analysis. *Evidence-Based Complementary and Alternative Medicine, 2014*(140724), 1–11. https://doi.org/10.1155/2014/140724

Aue, T., Hoeppli, M.-E., Piguet, C., Sterpenich, V., & Vuilleumier, P. (2013). Visual avoidance in phobia: Particularities in neural activity, autonomic responding, and cognitive risk evaluations. *Frontiers in Human Neuroscience*, *7*(194). https://doi.org/10.3389/fnhum.2013.00194

Auerbach, R. P., Alonso, J., Axinn, W. G., Cuijpers, P., Ebert, D. D., Green, J. G., Hwang, I., Kessler, R. C., Liu, H., Mortier, P., Nock, M. K., Pinder-Amaker, S., Sampson, N. A., Aguilar-Gaxiola, S., Al-Hamzawi, A., Andrade, L. H., Benjet, C., Caldas-de-Almeida, J. M., Demyttenaere, K., … Bruffaerts, R. (2016). Mental disorders among college students in the World Health Organization World Mental Health Surveys. *Psychological Medicine*, *46*(14), 2955–2970. https://doi.org/10.1017/S0033291716001665

Auerbach, R. P., Mortier, P., Bruffaerts, R., Alonso, J., Benjet, C., Cuijpers, P., Demyttenaere, K., Ebert, D. D., Green, J. G., Hasking, P., Murray, E., Nock, M. K., Pinder-Amaker, S., Sampson, N. A., Stein, D. J., Vilagut, G., Zaslavsky, A. M., Kessler, R. C., & WHO WMH-ICS Collaborators. (2018). WHO World Mental Health Surveys International College Student Project: Prevalence and distribution of mental disorders. *Journal of Abnormal Psychology*, *127*(7), 623–638. https://doi.org/10.1037/abn0000362

Aziz, Q., Doré, J., Emmanuel, A., Guarner, F., & Quigley, E. M. M. (2013). Gut microbiota and gastrointestinal health: Current concepts and future directions. *Neurogastroenterology & Motility*, *25*(1), 4–15. https://doi.org/10.1111/nmo.12046

Aziz, Q., Fass, R., Gyawali, C. P., Miwa, H., Pandolfino, J. E., & Zerbib, F. (2016). Esophageal Disorders. *Gastroenterology*, *150*(6), 1368–1379. https://doi.org/10.1053/j.gastro.2016.02.012

Bachorowski, J.-A., & Braaten, E. B. (1994). Emotional intensity: Measurement and theoretical implications. *Personality and Individual Differences*, *17*(2), 191–199. https://doi.org/10.1016/0191-8869(94)90025-6

Baer, R. A., Peters, J. R., Eisenlohr-Moul, T. A., Geiger, P. J., & Sauer, S. E. (2012). Emotion-related cognitive processes in borderline personality disorder: A review of the empirical literature. *Clinical Psychology Review*, *32*(5), 359–369. https://doi.org/10.1016/j.cpr.2012.03.002

Bagby, R. M., Parker, J. D. A., & Taylor, G. J. (1994). The twenty-item Toronto Alexithymia scale—I. Item selection and cross-validation of the factor structure. *Journal of Psychosomatic Research*, *38*(1), 23–32. https://doi.org/10.1016/0022-3999(94)90005-1

Bagby, R. M., Taylor, G. J., & Parker, J. D. A. (1994). The twenty-item Toronto Alexithymia scale—II. Convergent, discriminant, and concurrent validity. *Journal of Psychosomatic Research*, *38*(1), 33–40. https://doi.org/10.1016/0022-3999(94)90006-X

Barrett, L. F., Gross, J., Christensen, T. C., & Benvenuto, M. (2001). Knowing what you're feeling and knowing what to do about it: Mapping the relation between emotion differentiation and emotion regulation. *Cognition & Emotion*, *15*(6), 713–724. https://doi.org/10.1080/02699930143000239

Barton, J. R., & Ferguson, A. (1990). Clinical features, morbidity and mortality of Scottish children with inflammatory bowel disease. *QJM: An International Journal of Medicine*, *75*(2), 423–439. https://doi.org/10.1093/oxfordjournals.qjmed.a068452

Beck, K. D., Jiao, X., Pang, K. C. H., & Servatius, R. J. (2010). Vulnerability factors in anxiety determined through differences in active-avoidance behavior. *Progress in Neuro-Psychopharmacology and Biological Psychiatry*, *34*(6), 852–860. https://doi.org/10.1016/j.pnpbp.2010.03.036

Bennett, E. J., Tennant, C. C., Piesse, C., Badcock, C.-A., & Kellow, J. E. (1998). Level of chronic life stress predicts clinical outcome in irritable bowel syndrome. *Gut*, *43*(2), 256–261. https://doi.org/10.1136/gut.43.2.256

Berg, D. F., Bahadursingh, A. M., Kaminski, D. L., & Longo, W. E. (2002). Acute surgical emergencies in inflammatory bowel disease. *The American Journal of Surgery*, *184*(1), 45–51. https://doi.org/10.1016/S0002-9610(02)00879-6

Bisgaard, H., Li, N., Bonnelykke, K., Chawes, B. L. K., Skov, T., Paludan-Müller, G., Stokholm, J., Smith, B., & Krogfelt, K. A. (2011). Reduced diversity of the intestinal microbiota during infancy is associated with increased risk of allergic disease at school age. *Journal of Allergy and Clinical Immunology*, *128*(3), 646-652.e5. https://doi.org/10.1016/j.jaci.2011.04.060

Boeckxstaens, G., Camilleri, M., Sifrim, D., Houghton, L. A., Elsenbruch, S., Lindberg, G., Azpiroz, F., & Parkman, H. P. (2016). Fundamentals of neurogastroenterology: Physiology/motility – Sensation. *Gastroenterology*, *150*(6), 1292-1304.e2. https://doi.org/10.1053/j.gastro.2016.02.030

Bonnert, M., Olén, O., Bjureberg, J., Lalouni, M., Hedman-Lagerlöf, E., Serlachius, E., & Ljótsson, B. (2018). The role of avoidance behavior in the treatment of adolescents with irritable bowel syndrome: A mediation analysis. *Behaviour Research and Therapy*, *105*, 27–35. https://doi.org/10.1016/j.brat.2018.03.006

Bradette, M., Delvaux, M., Staumont, G., Fioramonti, J., Bueno, L., & Frexinos, J. (1994). Evaluation of colonic sensory thresholds in IBS patients using a barostat. *Digestive Diseases and Sciences*, *39*(3), 449–457. https://doi.org/10.1007/BF02088327

Bradford, K., Shih, W., Videlock, E. J., Presson, A. P., Naliboff, B. D., Mayer, E. A., & Chang, L. (2012). Association between early adverse life events and irritable bowel syndrome. *Clinical Gastroenterology and Hepatology*, *10*(4), 385-390.e3. https://doi.org/10.1016/j.cgh.2011.12.018

Brandt, C. P., Gonzalez, A., Grover, K. W., & Zvolensky, M. J. (2013). The relation between emotional dysregulation and anxiety and depressive symptoms, pain-related anxiety, and HIV-symptom distress among adults with HIV/AIDS. *Journal of Psychopathology and Behavioral Assessment*, *35*(2), 197–204. https://doi.org/10.1007/s10862-012-9329-y

Braveman, P., & Gottlieb, L. (2014). The social determinants of health: It's time to consider the causes of the causes. *Public Health Reports*, *129*(1_suppl2), 19–31. https://doi.org/10.1177/00333549141291S206

Briere, J., Hodges, M., & Godbout, N. (2010). Traumatic stress, affect dysregulation, and dysfunctional avoidance: A structural equation model. *Journal of Traumatic Stress*, *23*(6), 767–774. https://doi.org/10.1002/jts.20578

Brockmeyer, T., Bents, H., Holtforth, M. G., Pfeiffer, N., Herzog, W., & Friederich, H.-C. (2012). Specific emotion regulation impairments in major depression and anorexia nervosa. *Psychiatry Research*, *200*(2–3), 550–553. https://doi.org/10.1016/j.psychres.2012.07.009

Butler, M. I., Cryan, J. F., & Dinan, T. G. (2019). Man and the microbiome: A new theory of everything? *Annual Review of Clinical Psychology*, *15*, 371–398.

Cabrera, A., Kolacz, J., Pailhez, G., Bulbena-Cabre, A., Bulbena, A., & Porges, S. W. (2018). Assessing body awareness and autonomic reactivity: Factor structure and psychometric properties of the Body Perception Questionnaire-Short Form (BPQ-SF). *International Journal of Methods in Psychiatric Research*, *27*(2), e1596. https://doi.org/10.1002/mpr.1596

Çakmak, B. B., Özkula, G., Işıklı, S., Özkan Göncüoğlu, İ., Öcal, S., Altınöz, A. E., & Taşkıntuna, N. (2018). Anxiety, depression, and anger in functional gastrointestinal disorders: A cross-sectional observational study. *Psychiatry Research*, *268*, 368–372. https://doi.org/10.1016/j.psychres.2018.06.046

Callister, L. C. (2003). Cultural influences on pain perceptions and behaviors. *Home Health Care Management & Practice*, *15*(3), 207–211. https://doi.org/10.1177/1084822302250687

Cannon, W. B. (1927). The James-Lange theory of emotions: A critical examination and an alternative theory. *The American Journal of Psychology*, *39*, 106–124. https://doi.org/10.2307/1422695

Carabotti, M., Scirocco, A., Maselli, M. A., & Severi, C. (2015). The gut-brain axis: Interactions between enteric microbiota, central and enteric nervous systems. *Annals of Gastroenterology*, *28*(2), 203–209.

Card, T., Canavan, C., & West, J. (2014). The epidemiology of irritable bowel syndrome. *Clinical Epidemiology*, *6*, 71–80. https://doi.org/10.2147/CLEP.S40245

Carrozzino, D., & Porcelli, P. (2018). Alexithymia in gastroenterology and hepatology: A systematic review. *Frontiers in Psychology*, *9*. https://doi.org/10.3389/fpsyg.2018.00470

Carver, C. S., & Blaney, P. H. (1977). Perceived arousal, focus of attention, and avoidance behavior. *Journal of Abnormal Psychology*, *86*(2), 154–162. https://doi.org/10.1037/0021-843X.86.2.154

Cebra, J. J. (1999). Influences of microbiota on intestinal immune system development. *The American Journal of Clinical Nutrition*, *69*(5), 1046s–1051s. https://doi.org/10.1093/ajcn/69.5.1046s

Chang, L. (2004). Review article: Epidemiology and quality of life in functional gastrointestinal disorders. *Alimentary Pharmacology and Therapeutics*, *20*(s7), 31–39. https://doi.org/10.1111/j.1365-2036.2004.02183.x

Chang, L., Toner, B. B., Fukudo, S., Guthrie, E., Locke, G. R., Norton, N. J., & Sperber, A. D. (2006). Gender, age, society, culture, and the patient's perspective in the functional gastrointestinal disorders. *Gastroenterology*, *130*(5), 1435–1446. https://doi.org/10.1053/j.gastro.2005.09.071

Charmandari, E., Tsigos, C., & Chrousos, G. (2005). Endocrinology of the stress response. *Annual Review of Physiology*, *67*(1), 259–284. https://doi.org/10.1146/annurev.physiol.67.040403.120816

Chen, H.-H., Hung, C.-H., Kao, A.-W., & Hsieh, H.-F. (2021). Exploring quality of life, stress, and risk factors associated with irritable bowel syndrome for female university students in Taiwan. *International Journal of Environmental Research and Public Health*, *18*(8), 3888. https://doi.org/10.3390/ijerph18083888

Cheng, C., Hui, W., & Lam, S. (2000). Perceptual style and behavioral pattern of individuals with functional gastrointestinal disorders. *Health Psychology*, *19*(2), 146–154. https://doi.org/10.1037//0278-6133.19.2.146

Claesson, M. J., Jeffery, I. B., Conde, S., Power, S. E., O'Connor, E. M., Cusack, S., Harris, H. M. B., Coakley, M., Lakshminarayanan, B., O'Sullivan, O., Fitzgerald, G. F., Deane, J., O'Connor, M., Harnedy, N., O'Connor, K., O'Mahony, D., van Sinderen, D., Wallace, M., Brennan, L., … O'Toole, P. W. (2012). Gut microbiota composition correlates with diet and health in the elderly. *Nature*, *488*(7410), 178–184. https://doi.org/10.1038/nature11319

Clarke, G., Cryan, J. F., Dinan, T. G., & Quigley, E. M. (2012). Review article: Probiotics for the treatment of irritable bowel syndrome - focus on lactic acid bacteria. *Alimentary Pharmacology & Therapeutics*, *35*(4), 403–413. https://doi.org/10.1111/j.1365-2036.2011.04965.x

Cloutier, R. M., Blumenthal, H., Trim, R. S., Douglas, M. E., & Anderson, K. G. (2019). Real-time social stress response and subsequent alcohol use initiation among female adolescents. *Psychology of Addictive Behaviors*, *33*(3), 254–265. https://doi.org/10.1037/adb0000454

Cotton, P. B., Elta, G. H., Carter, C. R., Pasricha, P. J., & Corazziari, E. S. (2016). Gallbladder and sphincter of oddi disorders. *Gastroenterology*, *150*(6), 1420-1429.e2. https://doi.org/10.1053/j.gastro.2016.02.033

Craig, O. F., & Quigley, E. M. M. (2011). Current and emerging therapies for the management of functional gastrointestinal disorders. *Therapeutic Advances in Chronic Disease*, *2*(2), 87–99. https://doi.org/10.1177/2040622310389507

Craske, M. G., Kircanski, K., Zelikowsky, M., Mystkowski, J., Chowdhury, N., & Baker, A. (2008). Optimizing inhibitory learning during exposure therapy. *Behaviour Research and Therapy*, *46*(1), 5–27. https://doi.org/10.1016/j.brat.2007.10.003

Craske, M. G., Treanor, M., Conway, C. C., Zbozinek, T., & Vervliet, B. (2014). Maximizing exposure therapy: An inhibitory learning approach. *Behaviour Research and Therapy*, *58*, 10–23. https://doi.org/10.1016/j.brat.2014.04.006

Cryan, J. F., & Dinan, T. G. (2012). Mind-altering microorganisms: The impact of the gut microbiota on brain and behaviour. *Nature Reviews Neuroscience*, *13*(10), 701–712. https://doi.org/10.1038/nrn3346

Cryan, J. F., & O'Mahony, S. M. (2011). The microbiome-gut-brain axis: From bowel to behavior. *Neurogastroenterology & Motility*, *23*(3), 187–192. https://doi.org/10.1111/j.1365-2982.2010.01664.x

Davidson, R. J. (1984). Affect, cognition, and hemispheric specialization. In C. E. Izard, J. Kagan, & R. B. Zajonc (Eds.), *Emotions, cognition, and behavior* (pp. 320–365). CUP Archive.

Davis, M. C., Zautra, A. J., & Smith, B. W. (2004). Chronic pain, stress, and the dynamics of affective differentiation. *Journal of Personality*, *72*(6), 1133–1160. https://doi.org/10.1111/j.1467-6494.2004.00293.x

Dent, J., El-Serag, H. B., Wallander, M. A., & Johansson, S. (2005). Epidemiology of gastro-oesophageal reflux disease: A systematic review. *Gut*, *54*(5), 710–717. https://doi.org/10.1136/gut.2004.051821

de Sousa, L. M. M., Marques-Vieira, C. M. A., Severino, S. S. P., Rosado, J. L. P., & José, H. M. G. (2016). Validation of the Positive and Negative Affect Schedule in people with chronic kidney disease. *Texto & Contexto - Enfermagem*, *25*(4). https://doi.org/10.1590/0104-07072016005610015

Dickhaus, B., Mayer, E. A., Firooz, N., Stains, J., Conde, F., Olivas, T. I., Fass, R., Chang, L., Mayer, M., & Naliboff, B. D. (2003). Irritable bowel syndrome patients show enhanced modulation of visceral perception by auditory stress. *The American Journal of Gastroenterology*, *98*(1), 135–143.

Dimenäs, E., Glise, H., Hallerbäck, B., Hernqvist, H., Svedlund, J., & Wiklund, I. (1995). Well-being and gastrointestinal symptoms among patients referred to endoscopy owing to suspected duodenal ulcer. *Scandinavian Journal of Gastroenterology*, *30*(11), 1046–1052. https://doi.org/10.3109/00365529509101605

Dixon, L. J., Witcraft, S. M., & Schadegg, M. J. (in press). COVID-19 anxiety and mental health among university students in the early stages of the U.S. outbreak. *Journal of American College Health*.

Dong, Y.-Y., Chen, F.-X., Yu, Y.-B., Du, C., Qi, Q.-Q., Liu, H., & Li, Y.-Q. (2013). A school-based study with Rome III criteria on the prevalence of functional gastrointestinal disorders in Chinese college and university students. *PLoS ONE*, *8*(1), e54183. https://doi.org/10.1371/journal.pone.0054183

Donker, T., Griffiths, K. M., Cuijpers, P., & Christensen, H. (2009). Psychoeducation for depression, anxiety and psychological distress: A meta-analysis. *BMC Medicine*, *7*(1), 79–87. https://doi.org/10.1186/1741-7015-7-79

Doroui, N., Sadeghi, K., Foroughi, A. A., Ahmadi, S. M., & Fard, A. A. P. (2017). The efficacy of emotion regulation skills in patients with irritable bowel syndrome: Reduction of psychopathological symptoms, emotion regulation problems and improvement in quality of life: A case series. *International Journal of Applied Behavioral Sciences*, *4*(3), 54–64. https://doi.org/10.22037/ijabs.v4i3.19901

Drossman, D. A. (1999). Do psychosocial factors define symptom severity and patient status in irritable bowel syndrome? *The American Journal of Medicine*, *107*(5), 41–50. https://doi.org/10.1016/S0002-9343(99)00081-9

Drossman, D. A. (2011). Abuse, trauma, and GI illness: Is there a link? *American Journal of Gastroenterology*, *106*(1), 14–25. https://doi.org/10.1038/ajg.2010.453

Drossman, D. A. (2016). Functional gastrointestinal disorders: History, pathophysiology, clinical features, and Rome IV. *Gastroenterology*, *150*(6), 1262-1279.e2. https://doi.org/10.1053/j.gastro.2016.02.032

Drossman, D. A., Camilleri, M., Mayer, E. A., & Whitehead, W. E. (2002). AGA technical review on irritable bowel syndrome. *Gastroenterology*, *123*(6), 2108–2131. https://doi.org/10.1053/gast.2002.37095

Drossman, D. A., & Hasler, W. L. (2016). Rome IV—functional GI disorders: Disorders of gut-brain interaction. *Gastroenterology*, *150*(6), 1257–1261. https://doi.org/10.1053/j.gastro.2016.03.035

Drossman, D. A., Li, Z., Andruzzi, E., Temple, R. D., Talley, N. J., Grant Thompson, W., Whitehead, W. E., Janssens, J., Funch-Jensen, P., Corazziari, E., Richter, J. E., & Koch, G. G. (1993). U. S. Householder survey of functional gastrointestinal disorders: Prevalence, sociodemography, and health impact. *Digestive Diseases and Sciences*, *38*(9), 1569–1580. https://doi.org/10.1007/BF01303162

Drossman, D. A., Li, Z., Leserman, J., Toomey, T., & Hu, Y. (1996). Health status by gastrointestinal diagnosis and abuse history. *Gastroenterology*, *110*(4), 999–1007. https://doi.org/10.1053/gast.1996.v110.pm8613034

Edwards, E. R., & Wupperman, P. (2017). Emotion regulation mediates effects of alexithymia and emotion differentiation on impulsive aggressive behavior. *Deviant Behavior*, *38*(10), 1160–1171. https://doi.org/10.1080/01639625.2016.1241066

Ehring, T., Tuschen-Caffier, B., Schnülle, J., Fischer, S., & Gross, J. J. (2010). Emotion regulation and vulnerability to depression: Spontaneous versus instructed use of emotion suppression and reappraisal. *Emotion*, *10*(4), 563–572. https://doi.org/10.1037/a0019010

Ekman, P., Levenson, R., & Friesen, W. (1983). Autonomic nervous system activity distinguishes among emotions. *Science*, *221*(4616), 1208–1210. https://doi.org/10.1126/science.6612338

Ellard, K. K., Farchione, T. J., & Barlow, D. H. (2012). Relative effectiveness of emotion induction procedures and the role of personal relevance in a clinical sample: A comparison of film, images, and music. *Journal of Psychopathology and Behavioral Assessment*, *34*(2), 232–243. https://doi.org/10.1007/s10862-011-9271-4

Elsenbruch, S., Rosenberger, C., Enck, P., Forsting, M., Schedlowski, M., & Gizewski, E. R. (2010). Affective disturbances modulate the neural processing of visceral pain stimuli in irritable bowel syndrome: An fMRI study. *Gut*, *59*(4), 489–495. https://doi.org/10.1136/gut.2008.175000

Erdfelder, E., Faul, F., & Buchner, A. (1996). *G*Power* (Version 3) [Computer software].

Farrokhyar, F., Marshall, J. K., Easterbrook, B., & Irvine, J. E. (2006). Functional gastrointestinal disorders and mood disorders in patients with inactive inflammatory bowel disease: Prevalence and impact on health. *Inflammatory Bowel Diseases*, *12*(1), 38–46. https://doi.org/10.1097/01.MIB.0000195391.49762.89

Faul, F., Erdfelder, E., Buchner, A., & Lang, A.-G. (2009). Statistical power analyses using G*Power 3.1: Tests for correlation and regression analyses. *Behavior Research Methods*, *41*(4), 1149–1160. https://doi.org/10.3758/BRM.41.4.1149

Fichna, J., & Storr, M. A. (2012). Brain-gut interactions in IBS. *Frontiers in Pharmacology*, *3*. https://doi.org/10.3389/fphar.2012.00127

Field, A. P. (2018). *Discovering statistics using IBM SPSS statistics* (5th edition, North American edition). Sage Publications Inc.

Foa, E. B., & Kozak, M. J. (1986). Emotional processing of fear: Exposure to corrective information. *Psychological Bulletin*, *99*(1), 20–35. https://doi.org/10.1037/0033-2909.99.1.20

Fournier, A., Mondillon, L., Dantzer, C., Gauchez, A. S., Ducros, V., Mathieu, N., Faure, P., Canini, F., Bonaz, B., & Pellissier, S. (2018). Emotional overactivity in patients with irritable bowel syndrome. *Neurogastroenterology & Motility*, *30*(10), e13387. https://doi.org/10.1111/nmo.13387

Fox, H. C., Hong, K. A., & Sinha, R. (2008). Difficulties in emotion regulation and impulse control in recently abstinent alcoholics compared with social drinkers. *Addictive Behaviors*, *33*(2), 388–394. https://doi.org/10.1016/j.addbeh.2007.10.002

Francisconi, C. F., Sperber, A. D., Fang, X., Fukudo, S., Gerson, M.-J., Kang, J.-Y., & Schmulson, M. (2016). Multicultural aspects in functional gastrointestinal disorders (FGIDs). *Gastroenterology*, *150*(6), 1344-1354.e2. https://doi.org/10.1053/j.gastro.2016.02.013

Franklin, J. C., Aaron, R. V., Arthur, M. S., Shorkey, S. P., & Prinstein, M. J. (2012). Nonsuicidal self-injury and diminished pain perception: The role of emotion

dysregulation. *Comprehensive Psychiatry*, *53*(6), 691–700. https://doi.org/10.1016/j.comppsych.2011.11.008

Fujiwara, Y., Higuchi, K., Watanabe, Y., Shiba, M., Watanabe, T., Tominaga, K., Oshitani, N., Matsumoto, T., Nishikawa, H., & Arakawa, T. (2005). Prevalence of gastroesophageal reflux disease and gastroesophageal reflux disease symptoms in Japan. *Journal of Gastroenterology and Hepatology*, *20*(1), 26–29. https://doi.org/10.1111/j.1440-1746.2004.03521.x

Fukudo, S., Nomura, T., & Hongo, M. (1998). Impact of corticotropin-releasing hormone on gastrointestinal motility and adrenocorticotropic hormone in normal controls and patients with irritable bowel syndrome. *Gut*, *42*(6), 845–849. https://doi.org/10.1136/gut.42.6.845

Geeraerts, B., Vandenberghe, J., Van Oudenhove, L., Gregory, L. J., Aziz, Q., DuPont, P., Demyttenaere, K., Janssens, J., & Tack, J. (2005). Influence of experimentally induced anxiety on gastric sensorimotor function in humans. *Gastroenterology*, *129*(5), 1437–1444. https://doi.org/10.1053/j.gastro.2005.08.020

Gerson, C. D., Gerson, M., Awad, R. A., Chowdhury, A., Dancey, C., Poitras, P., Porcelli, P., Sperber, A., & Wang, W. (2008). Irritable bowel syndrome: An international study of symptoms in eight countries. *European Journal of Gastroenterology & Hepatology*, *20*(7), 659–667. https://doi.org/10.1097/MEG.0b013e3282f53a24

Geuens, M., & de Pelsmacker, P. (2002). Validity and reliability of scores on the reduced Emotional Intensity Scale. *Educational and Psychological Measurement*, *62*(2), 299–315. https://doi.org/10.1177/0013164402062002007

Gilchrist, P. T., Vrinceanu, T., Béland, S., Bacon, S. L., & Ditto, B. (2016). Disgust stimuli reduce heart rate but do not contribute to vasovagal symptoms. *Journal of Behavior*

Therapy and Experimental Psychiatry, *51*, 116–122. https://doi.org/10.1016/j.jbtep.2016.01.005

Goyal, O., Nohria, S., Dhaliwal, A. S., Goyal, P., Soni, R. K., Chhina, R. S., & Sood, A. (2020). Prevalence, overlap, and risk factors for Rome IV functional gastrointestinal disorders among college students in northern India. *Indian Journal of Gastroenterology*, ePub ahead of print. https://doi.org/10.1007/s12664-020-01106-y

Gratz, K. L. (2007). Targeting emotion dysregulation in the treatment of self-injury. *Journal of Clinical Psychology*, *63*(11), 1091–1103. https://doi.org/10.1002/jclp.20417

Gratz, K. L., Dixon, L. J., Kiel, E. J., & Tull, M. T. (2018). Emotion regulation: Theoretical models, associated outcomes and recent advances. In V. Zeigler-Hill & T. Shackelford, *The SAGE handbook of personality and individual differences: Volume III: Applications of personality and individual differences* (pp. 63–89). SAGE Publications Ltd. https://doi.org/10.4135/9781526451248.n3

Gratz, K. L., & Roemer, L. (2004). Multidimensional assessment of emotion regulation and dysregulation: Development, factor structure, and initial validation of the Difficulties in Emotion Regulation Scale. *Journal of Psychopathology and Behavioral Assessment*, *26*(1), 41–54. https://doi.org/10.1007/s10862-008-9102-4

Gratz, K. L., Tull, M. T., Matusiewicz, A. M., Breetz, A. A., & Lejuez, C. W. (2013). Multimodal examination of emotion regulation difficulties as a function of co-occurring avoidant personality disorder among women with borderline personality disorder. *Personality Disorders: Theory, Research, and Treatment*, *4*(4), 304–314. https://doi.org/10.1037/per0000020

Gray, L. M., Wong-Wylie, G., Rempel, G. R., & Cook, K. (2020). Expanding qualitative research interviewing strategies: Zoom video communications. *The Qualitative Report*, *25*(5), 1292–1301.

Gross, J. J. (1998). The emerging field of emotion regulation: An integrative review. *Review of General Psychology*, *2*(3), 271–299. https://doi.org/10.1037/1089-2680.2.3.271

Gross, J. J. (2015a). Emotion regulation: Current status and future prospects. *Psychological Inquiry*, *26*(1), 1–26. https://doi.org/10.1080/1047840X.2014.940781

Gross, J. J. (2015b). The extended process model of emotion regulation: Elaborations, applications, and future directions. *Psychological Inquiry*, *26*(1), 130–137. https://doi.org/10.1080/1047840X.2015.989751

Gross, J. J., & John, O. P. (2003). Individual differences in two emotion regulation processes: Implications for affect, relationships, and well-being. *Journal of Personality and Social Psychology*, *85*(2), 348–362. https://doi.org/10.1037/0022-3514.85.2.348

Gross, J. J., & Levenson, R. W. (1995). Emotion elicitation using films. *Cognition & Emotion*, *9*(1), 87–108. https://doi.org/10.1080/02699939508408966

Gross, J. J., & Levenson, R. W. (1997). Hiding feelings: The acute effects of inhibiting negative and positive emotion. *Journal of Abnormal Psychology*, *106*(1), 95–103. https://doi.org/10.1037/0021-843X.106.1.95

Gross, J. J., Sheppes, G., & Urry, H. L. (2011). Emotion generation and emotion regulation: A distinction we should make (carefully). *Cognition & Emotion*, *25*(5), 765–781. https://doi.org/10.1080/02699931.2011.555753

Grzesiak, M., Beszłej, J. A., Mulak, A., Szechiński, M., Szewczuk-Bogusławska, M., Waszczuk, E., Kantorska, M., & Frydecka, D. (2014). The lifetime prevalence of anxiety disorders

among patients with irritable bowel syndrome. *Advances in Clinical and Experimental Medicine: Official Organ Wroclaw Medical University*, *23*(6), 987–992. https://doi.org/10.17219/acem/37356

Guarner, F., & Malagelada, J.-R. (2003). Gut flora in health and disease. *The Lancet*, *361*(9356), 512–519. https://doi.org/10.1016/S0140-6736(03)12489-0

Gulewitsch, M. D., Enck, P., Hautzinger, M., & Schlarb, A. A. (2011). Irritable bowel syndrome symptoms among German students: Prevalence, characteristics, and associations to somatic complaints, sleep, quality of life, and childhood abdominal pain. *European Journal of Gastroenterology & Hepatology*, *23*(4), 311–316. https://doi.org/10.1097/MEG.0b013e3283457b1e

Gwee, K.-A., Lu, C.-L., & Ghoshal, U. C. (2009). Epidemiology of irritable bowel syndrome in Asia: Something old, something new, something borrowed. *Journal of Gastroenterology and Hepatology*, *24*(10), 1601–1607. https://doi.org/10.1111/j.1440-1746.2009.05984.x

Hansen, C. H. F., Nielsen, D. S., Kverka, M., Zakostelska, Z., Klimesova, K., Hudcovic, T., Tlaskalova-Hogenova, H., & Hansen, A. K. (2012). Patterns of early gut colonization shape future immune responses of the host. *PLoS ONE*, *7*(3), e34043. https://doi.org/10.1371/journal.pone.0034043

Hartono, J. L., Mahadeva, S., & Goh, K.-L. (2012). Anxiety and depression in various functional gastrointestinal disorders: Do differences exist? *Journal of Digestive Diseases*, *13*(5), 252–257. https://doi.org/10.1111/j.1751-2980.2012.00581.x

Hazlett-Stevens, H., Craske, M. G., Mayer, E. A., Chang, L., & Naliboff, B. D. (2003). Prevalence of irritable bowel syndrome among university students. *Journal of*

Psychosomatic Research, *55*(6), 501–505. https://doi.org/10.1016/S0022-3999(03)00019-9

Helminen, E. C., Morton, M. L., Wang, Q., & Felver, J. C. (2019). A meta-analysis of cortisol reactivity to the Trier Social Stress Test in virtual environments. *Psychoneuroendocrinology*, *110*, 104437. https://doi.org/10.1016/j.psyneuen.2019.104437

Hillila, M. T., & Farkkila, M. A. (2004). Prevalence of irritable bowel syndrome according to different diagnostic criteria in a non-selected adult population. *Alimentary Pharmacology and Therapeutics*, *20*(3), 339–345. https://doi.org/10.1111/j.1365-2036.2004.02034.x

Hoaglin, D. C., Iglewicz, B., & Tukey, J. W. (1986). Performance of some resistant rules for outlier labeling. *Journal of the American Statistical Association*, *81*(396), 991–999. https://doi.org/10.1080/01621459.1986.10478363

Hollister, E. B., Gao, C., & Versalovic, J. (2014). Compositional and functional features of the gastrointestinal microbiome and their effects on human health. *Gastroenterology*, *146*(6), 1449–1458. https://doi.org/10.1053/j.gastro.2014.01.052

Hong, R. Y. (2007). Worry and rumination: Differential associations with anxious and depressive symptoms and coping behavior. *Behaviour Research and Therapy*, *45*(2), 277–290. https://doi.org/10.1016/j.brat.2006.03.006

Hooper, L. V., Midtvedt, T., & Gordon, J. I. (2002). How host-microbial interactions shape the nutrient environment of the mammalian intestine. *Annual Review of Nutrition*, *22*(1), 283–307. https://doi.org/10.1146/annurev.nutr.22.011602.092259

Houghton, L. A., Heitkemper, M., Crowell, M. D., Emmanuel, A., Halpert, A., McRoberts, J. A., & Toner, B. (2016). Age, gender, and women's health and the patient. *Gastroenterology*, *150*(6), 1332-1343.e4. https://doi.org/10.1053/j.gastro.2016.02.017

Hua, J., Le Scanff, C., Larue, J., José, F., Martin, J.-C., Devillers, L., & Filaire, E. (2014). Global stress response during a social stress test: Impact of alexithymia and its subfactors. *Psychoneuroendocrinology*, *50*, 53–61. https://doi.org/10.1016/j.psyneuen.2014.08.003

Hunt, M. G., Ertel, E., Coello, J. A., & Rodriguez, L. (2014). Development and validation of the GI-Cognitions Questionnaire. *Cognitive Therapy and Research*, *38*(4), 472–482. https://doi.org/10.1007/s10608-014-9607-y

Hunt, M. G., Milonova, M., & Moshier, S. (2009). Catastrophizing the consequences of gastrointestinal symptoms in irritable bowel syndrome. *Journal of Cognitive Psychotherapy*, *23*(2), 160–173. https://doi.org/10.1891/0889-8391.23.2.160

Husky, M. M., Kovess-Masfety, V., & Swendsen, J. D. (2020). Stress and anxiety among university students in France during Covid-19 mandatory confinement. *Comprehensive Psychiatry*, *102*, 152191. https://doi.org/10.1016/j.comppsych.2020.152191

Iverson, K. M., Follette, V. M., Pistorello, J., & Fruzzetti, A. E. (2012). An investigation of experiential avoidance, emotion dysregulation, and distress tolerance in young adult outpatients with borderline personality disorder symptoms. *Personality Disorders: Theory, Research, and Treatment*, *3*(4), 415–422. https://doi.org/10.1037/a0023703

James, W. (1884). What is emotion? *Mind*, *9*, 188–205.

Jiang, C., Xu, Y., Sharma, S., Zhang, L., Wang, H., Song, J., Qian, W., Bai, T., & Hou, X. (2019). Psychosocial factors associated with irritable bowel syndrome development in

Chinese college freshmen. *Journal of Neurogastroenterology and Motility*, *25*(2), 233–240. https://doi.org/10.5056/jnm18028

Jones, M., Wessinger, S., & Crowell, M. (2006). Coping Strategies and Interpersonal Support in Patients With Irritable Bowel Syndrome and Inflammatory Bowel Disease. *Clinical Gastroenterology and Hepatology*, *4*(4), 474–481. https://doi.org/10.1016/j.cgh.2005.12.012

Joseph, D. L., Chan, M. Y., Heintzelman, S. J., Tay, L., Diener, E., & Scotney, V. S. (2020). The manipulation of affect: A meta-analysis of affect induction procedures. *Psychological Bulletin*, *146*(4), 355–375. https://doi.org/10.1037/bul0000224

Jung, H., Choung, R. S., Locke, G. R., Schleck, C. D., Zinsmeister, A. R., Szarka, L. A., Mullan, B., & Talley, N. J. (2009). The incidence, prevalence, and outcomes of patients with gastroparesis in Olmsted county, Minnesota, from 1996 to 2006. *Gastroenterology*, *136*(4), 1225–1233. https://doi.org/10.1053/j.gastro.2008.12.047

Kalokerinos, E. K., Erbas, Y., Ceulemans, E., & Kuppens, P. (2019). Differentiate to regulate: Low negative emotion differentiation is associated with ineffective use but not selection of emotion-regulation strategies. *Psychological Science*, *30*(6), 863–879. https://doi.org/10.1177/0956797619838763

Kano, M., Endo, Y., & Fukudo, S. (2018). Association between alexithymia and functional gastrointestinal disorders. *Frontiers in Psychology*, *9*. https://doi.org/10.3389/fpsyg.2018.00599

Kano, M., & Fukudo, S. (2013). The alexithymic brain: The neural pathways linking alexithymia to physical disorders. *BioPsychoSocial Medicine*, *7*(1), 1–9. https://doi.org/10.1186/1751-0759-7-1

Kashdan, T. B., Barrett, L. F., & McKnight, P. E. (2015). Unpacking emotion differentiation: Transforming unpleasant experience by perceiving distinctions in negativity. *Current Directions in Psychological Science*, *24*(1), 10–16. https://doi.org/10.1177/0963721414550708

Keefer, L., Drossman, D. A., Guthrie, E., Simrén, M., Tillisch, K., Olden, K., & Whorwell, P. J. (2016). Centrally mediated disorders of gastrointestinal pain. *Gastroenterology*, *150*(6), 1408–1419. https://doi.org/10.1053/j.gastro.2016.02.034

Kessler, R. C., Petukhova, M., Sampson, N. A., Zaslavsky, A. M., & Wittchen, H.-U. (2012). Twelve-month and lifetime prevalence and lifetime morbid risk of anxiety and mood disorders in the United States. *International Journal of Methods in Psychiatric Research*, *21*(3), 169–184. https://doi.org/10.1002/mpr.1359

Kindt, S., van Oudenhove, L., Broekaert, D., Kasran, A., Ceuppens, j. l., Bossuyt, X., Fischler, B., & Tack, J. (2009). Immune dysfunction in patients with functional gastrointestinal disorders. *Neurogastroenterology & Motility*, *21*(4), 389–398. https://doi.org/10.1111/j.1365-2982.2008.01220.x

Kökönyei, G., Urbán, R., Reinhardt, M., Józan, A., & Demetrovics, Z. (2014). The Difficulties in Emotion Regulation Scale: Factor structure in chronic pain patients. *Journal of Clinical Psychology*, *70*(6), 589–600. https://doi.org/10.1002/jclp.22036

Koloski, N. A., Jones, M., Kalantar, J., Weltman, M., Zaguirre, J., & Talley, N. J. (2012). The brain–gut pathway in functional gastrointestinal disorders is bidirectional: A 12-year prospective population-based study. *Gut*, *61*(9), 1284–1290. https://doi.org/10.1136/gutjnl-2011-300474

Kragel, P. A., & LaBar, K. S. (2013). Multivariate pattern classification reveals autonomic and experiential representations of discrete emotions. *Emotion*, *13*(4), 681–690. https://doi.org/10.1037/a0031820

Kreibig, S. D. (2010). Autonomic nervous system activity in emotion: A review. *Biological Psychology*, *84*(3), 394–421. https://doi.org/10.1016/j.biopsycho.2010.03.010

Kulich, K. R., Madisch, A., Pacini, F., Piqué, J. M., Regula, J., Van Rensburg, C. J., Újszászy, L., Carlsson, J., Halling, K., & Wiklund, I. K. (2008). Reliability and validity of the Gastrointestinal Symptom Rating Scale (GSRS) and Quality of Life in Reflux and Dyspepsia (QOLRAD) questionnaire in dyspepsia: A six-country study. *Health and Quality of Life Outcomes*, *6*(1), 12. https://doi.org/10.1186/1477-7525-6-12

Kuo, J. R., Neacsiu, A. D., Fitzpatrick, S., & MacDonald, D. E. (2014). A methodological examination of emotion inductions in borderline personality disorder: A comparison of standardized versus idiographic stimuli. *Journal of Psychopathology and Behavioral Assessment*, *36*(1), 155–164. https://doi.org/10.1007/s10862-013-9378-x

Labus, J. S., Bolus, R., Chang, L., Wiklund, I., Naesdal, J., Mayer, E. A., & Naliboff, B. D. (2004). The Visceral Sensitivity Index: Development and validation of a gastrointestinal symptom-specific anxiety scale. *Alimentary Pharmacology and Therapeutics*, *20*(1), 89–97. https://doi.org/10.1111/j.1365-2036.2004.02007.x

Labus, J. S., Mayer, E. A., Chang, L., Bolus, R., & Naliboff, B. D. (2007). The central role of gastrointestinal-specific anxiety in irritable bowel syndrome: Further validation of the Visceral Sensitivity Index. *Psychosomatic Medicine*, *69*(1), 89. https://doi.org/10.1097/PSY.0b013e31802e2f24

Labuschagne, I., Grace, C., Rendell, P., Terrett, G., & Heinrichs, M. (2019). An introductory guide to conducting the Trier Social Stress Test. *Neuroscience & Biobehavioral Reviews*, *107*, 686–695. https://doi.org/10.1016/j.neubiorev.2019.09.032

Lackner, J. M., & Gurtman, M. B. (2004). Pain catastrophizing and interpersonal problems: A circumplex analysis of the communal coping model. *Pain*, *110*(3), 597–604. https://doi.org/10.1016/j.pain.2004.04.011

Lackner, J. M., & Quigley, B. M. (2005). Pain catastrophizing mediates the relationship between worry and pain suffering in patients with irritable bowel syndrome. *Behaviour Research and Therapy*, *43*(7), 943–957. https://doi.org/10.1016/j.brat.2004.06.018

Lacy, B. E., Mearin, F., Chang, L., Chey, W. D., Lembo, A. J., Simren, M., & Spiller, R. (2016). Bowel disorders. *Gastroenterology*, *150*(6), 1393-1407.e5. https://doi.org/10.1053/j.gastro.2016.02.031

Lam, S., Dickerson, S. S., Zoccola, P. M., & Zaldivar, F. (2009). Emotion regulation and cortisol reactivity to a social-evaluative speech task. *Psychoneuroendocrinology*, *34*(9), 1355–1362. https://doi.org/10.1016/j.psyneuen.2009.04.006

Lang, P. J. (1979). A bio-informational theory of emotional imagery. *Psychophysiology*, *16*(6), 495–512. https://doi.org/10.1111/j.1469-8986.1979.tb01511.x

Lange, C. G. (1922). *The emotions* (I. A. Haupt, Ed.). Williams & Wilkins.

Larsen, J. K., Brand, N., Bermond, B., & Hijman, R. (2003). Cognitive and emotional characteristics of alexithymia. *Journal of Psychosomatic Research*, *54*(6), 533–541. https://doi.org/10.1016/S0022-3999(02)00466-X

Lavender, J. M., Tull, M. T., DiLillo, D., Messman-Moore, T., & Gratz, K. L. (2017). Development and validation of a state-based measure of emotion dysregulation: The

State Difficulties in Emotion Regulation Scale (S-DERS). *Assessment*, *24*(2), 197–209. https://doi.org/10.1177/1073191115601218

LeDoux, J. E. (1984). Cognition and emotion: Processing functions and brain systems. In M. S. Gazzaniga (Ed.), *Handbook of cognitive neuroscience* (pp. 357–368). Springer US. https://doi.org/10.1007/978-1-4899-2177-2_17

LeDoux, J. E., Moscarello, J., Sears, R., & Campese, V. (2017). The birth, death and resurrection of avoidance: A reconceptualization of a troubled paradigm. *Molecular Psychiatry*, *22*(1), 24–36. https://doi.org/10.1038/mp.2016.166

Lee, C., Doo, E., Choi, J. M., Jang, S., Ryu, H.-S., Lee, J. Y., Oh, J. H., Park, J. H., Kim, Y. S., & Brain-Gut Axis Research Group of Korean Society of Neurogastroenterology and Motility. (2017). The increased level of depression and anxiety in irritable bowel syndrome patients compared with healthy controls: Systematic review and meta-analysis. *Journal of Neurogastroenterology and Motility*, *23*(3), 349–362. https://doi.org/10.5056/jnm16220

Lee, S., Wu, J., Ma, Y. L., Tsang, A., Guo, W.-J., & Sung, J. (2009). Irritable bowel syndrome is strongly associated with generalized anxiety disorder: A community study. *Alimentary Pharmacology & Therapeutics*, *30*(6), 643–651. https://doi.org/10.1111/j.1365-2036.2009.04074.x

Lembo, T., Naliboff, B., Munakata, J., Fullerton, S., Saba, L., Tung, S., Schmulson, M., & Mayer, E. A. (1999). Symptoms and visceral perception in patients with pain-predominant irritable bowel syndrome. *American Journal of Gastroenterology*, *94*(5), 1320–1326. https://doi.org/10.1111/j.1572-0241.1999.01009.x

Lench, H. C., Flores, S. A., & Bench, S. W. (2011). Discrete emotions predict changes in cognition, judgment, experience, behavior, and physiology: A meta-analysis of experimental emotion elicitations. *Psychological Bulletin*, *137*(5), 834–855. https://doi.org/10.1037/a0024244

Levenson, R. W., Lwi, S. J., Brown, C. L., Ford, B. Q., Otero, M. C., & Verstaen, A. (2017). Emotion. In J. T. Cacioppo, L. G. Tassinary, & G. G. Berntson (Eds.), *Handbook of psychophysiology* (4th ed., pp. 444–464). Cambridge University Press.

Levy, R. L., Jones, K. R., Whitehead, W. E., Feld, S. I., Talley, N. J., & Corey, L. A. (2001). Irritable bowel syndrome in twins: Heredity and social learning both contribute to etiology. *Gastroenterology*, *121*(4), 799–804. https://doi.org/10.1053/gast.2001.27995

Levy, R. L., Olden, K. W., Naliboff, B. D., Bradley, L. A., Francisconi, C., Drossman, D. A., & Creed, F. (2006). Psychosocial aspects of the functional gastrointestinal disorders. *Gastroenterology*, *130*(5), 1447–1458. https://doi.org/10.1053/j.gastro.2005.11.057

Levy, R. L., Whitehead, W. E., Korff, M. R., & Feld, A. D. (2000). Intergenerational transmission of gastrointestinal illness behavior. *The American Journal of Gastroenterology*, *95*(2), 451–456. https://doi.org/10.1111/j.1572-0241.2000.01766.x

Levy, R. L., Whitehead, W. E., Walker, L. S., Von Korff, M., Feld, A. D., Garner, M., & Christie, D. (2004). Increased somatic complaints and health-care utilization in children: Effects of parent IBS status and parent response to gastrointestinal symptoms. *The American Journal of Gastroenterology*, *99*(12), 2442–2451. https://doi.org/10.1111/j.1572-0241.2004.40478.x

Loas, G., Corcos, M., Stephan, P., Pellet, J., Bizouard, P., Venisse, J. L., Perez-Diaz, F., Guelfi, J. D., & Jeammet, P. (2001). Factorial structure of the 20-item Toronto Alexithymia

Scale: Confirmatory factorial analyses in nonclinical and clinical samples. *Journal of Psychosomatic Research*, *50*(5), 255–261. https://doi.org/10.1016/S0022-3999(01)00197-0

Lohiniemi, S., Mäki, M., Kaukinen, K., & Collin, P. (2000). Gastrointestinal Symptoms Rating Scale in coeliac disease patients on wheat starch-based gluten-free diets. *Scandinavian Journal of Gastroenterology*, *35*(9), 947–949. https://doi.org/10.1080/003655200750023002

Longstreth, G. F., & Wolde-Tsadik, G. (1993). Irritable bowel-type symptoms in HMO examinees: Prevalence, demographics, and clinical correlates. *Digestive Diseases and Sciences*, *38*(9), 1581–1589. https://doi.org/10.1007/BF01303163

Lourenco, S. F., & Tasimi, A. (2020). No participant left behind: Conducting science during covid-19. *Trends in Cognitive Sciences*, *24*(8), 583–584. https://doi.org/10.1016/j.tics.2020.05.003

Lovell, R. M., & Ford, A. C. (2012). Global prevalence of and risk factors for irritable bowel syndrome: A Meta-analysis. *Clinical Gastroenterology and Hepatology*, *10*(7), 712-721.e4. https://doi.org/10.1016/j.cgh.2012.02.029

Lovibond, P. F., & Lovibond, S. H. (1995). The structure of negative emotional states: Comparison of the Depression Anxiety Stress Scales (DASS) with the Beck Depression and Anxiety Inventories. *Behaviour Research and Therapy*, *33*(3), 335–343. https://doi.org/10.1016/0005-7967(94)00075-U

Lumley, M. A., Beyer, J., & Radcliffe, A. (2008). Alexithymia and physical health problems: A critique of potential pathways and a research agenda. In A. J. J. M. Vingerhoets, I.

Nyklíček, & J. Denollet (Eds.), *Emotion regulation: Conceptual and clinical issues* (pp. 43–68). Springer US. https://doi.org/10.1007/978-0-387-29986-0_4

Macatee, R. J., Albanese, B. J., Schmidt, N. B., & Cougle, J. R. (2017). Attention bias towards negative emotional information and its relationship with daily worry in the context of acute stress: An eye-tracking study. *Behaviour Research and Therapy*, *90*, 96–110. https://doi.org/10.1016/j.brat.2016.12.013

Manabe, N., Tanaka, T., Hata, J., Kusunoki, H., & Haruma, K. (2009). Pathophysiology underlying irritable bowel syndrome—From the viewpoint of dysfunction of autonomic nervous system activity. *Journal of Smooth Muscle Research*, *45*(1), 15–23. https://doi.org/10.1540/jsmr.45.15

Martin, M., & Chapman, S. C. E. (2010). Cognitive processing in putative functional gastrointestinal disorder: Rumination yields orientation to social threat not pain. *European Journal of Pain*, *14*(2), 207–213. https://doi.org/10.1016/j.ejpain.2009.04.008

Mattila, A. K., Salminen, J. K., Nummi, T., & Joukamaa, M. (2006). Age is strongly associated with alexithymia in the general population. *Journal of Psychosomatic Research*, *61*(5), 629–635. https://doi.org/10.1016/j.jpsychores.2006.04.013

Mayer, E. A., Naliboff, B. D., & Craig, A. D. B. (2006). Neuroimaging of the brain-gut axis: From basic understanding to treatment of functional GI disorders. *Gastroenterology*, *131*(6), 1925–1942. https://doi.org/10.1053/j.gastro.2006.10.026

Mayer, E. A., Savidge, T., & Shulman, R. J. (2014). Brain–gut microbiome interactions and functional bowel disorders. *Gastroenterology*, *146*(6), 1500–1512. https://doi.org/10.1053/j.gastro.2014.02.037

Mazaheri, M. (2015). Difficulties in emotion regulation and mindfulness in psychological and somatic symptoms of functional gastrointestinal disorders. *Iranian Journal of Psychiatry and Behavioral Sciences*, *9*(4). https://doi.org/10.17795/ijpbs-954

Mazaheri, M., Afshar, H., Weinland, S., Mohammadi, N., & Adibi, P. (2012). Alexithymia and functional gastrointestinal disorders (FGID). *Medical Archives*, *66*(1), 28. https://doi.org/10.5455/medarh.2012.66.28-32

Mazaheri, M., Mohammadi, N., Daghaghzadeh, H., & Afshar, H. (2014). The effectiveness of emotion regulation intervention on emotional problems and quality of life among patients with functional gastrointestinal disorders. *Govaresh*, *19*(2), 109–117.

McCabe, R. E. (2015). Subjective Units of Distress Scale. In I. Milosevic & R. E. McCabe (Eds.), *Phobias: The psychology of irrational fear* (pp. 361–362). ABC-CLIO, LLC.

Mertz, H. (2003). Review article: Visceral hypersensitivity. *Alimentary Pharmacology & Therapeutics*, *17*(5), 623–633. https://doi.org/10.1046/j.1365-2036.2003.01447.x

Mohsenabadi, H., Zanjani, Z., Shabani, M. J., & Arj, A. (2018). A randomized clinical trial of the Unified Protocol for Transdiagnostic treatment of emotional and gastrointestinal symptoms in patients with irritable bowel syndrome: Evaluating efficacy and mechanism of change. *Journal of Psychosomatic Research*, *113*, 8–15. https://doi.org/10.1016/j.jpsychores.2018.07.003

Morris-Yates, A., Talley, N. J., Boyce, P. M., Nandurkar, S., & Andrews, G. (1998). Evidence of a genetic contribution to functional bowel disorder. *The American Journal of Gastroenterology*, *93*(8), 1311–1317. https://doi.org/10.1016/S0002-9270(98)00321-9

Naliboff, B. D., Munakata, J., Fullerton, S., Gracely, R. H., Kodner, A., Harraf, F., & Mayer, E. A. (1997). Evidence for two distinct perceptual alterations in irritable bowel syndrome. *Gut*, *41*(4), 505–512.

Ng, S. C., Shi, H. Y., Hamidi, N., Underwood, F. E., Tang, W., Benchimol, E. I., Panaccione, R., Ghosh, S., Wu, J. C. Y., Chan, F. K. L., Sung, J. J. Y., & Kaplan, G. G. (2017). Worldwide incidence and prevalence of inflammatory bowel disease in the 21st century: A systematic review of population-based studies. *The Lancet*, *390*(10114), 2769–2778. https://doi.org/10.1016/S0140-6736(17)32448-0

Nook, E. C., Sasse, S. F., Lambert, H. K., McLaughlin, K. A., & Somerville, L. H. (2018). The nonlinear development of emotion differentiation: Granular emotional experience is low in adolescence. *Psychological Science*, *29*(8), 1346–1357. https://doi.org/10.1177/0956797618773357

Norton, G. R., Norton, P. J., Asmundson, G. J. G., Thompson, L. A., & Larsen, D. K. (1999). Neurotic butterflies in my stomach: The role of anxiety, anxiety sensitivity and depression in functional gastrointestinal disorders. *Journal of Psychosomatic Research*, *47*(3), 233–240. https://doi.org/10.1016/S0022-3999(99)00032-X

Norton, P. J., & Asmundson, G. J. G. (2003). Amending the fear-avoidance model of chronci pain: What is the role of physiological arousal? *Behavior Therapy*, *34*(1), 17–30. https://doi.org/10.1016/S0005-7894(03)80019-9

Oaten, M., Stevenson, R. J., & Case, T. I. (2009). Disgust as a disease-avoidance mechanism. *Psychological Bulletin*, *135*(2), 303–321. https://doi.org/10.1037/a0014823

Oh, V. Y. S., & Tong, E. M. W. (2020). Negative emotion differentiation and long-term physical health—The moderating role of neuroticism. *Health Psychology*, *39*(2), 127–136. https://doi.org/10.1037/hea0000809

Palomba, D., & Stegagno, L. (1993). Physiology, perceived emotion, and memory: Responding to film sequences. In N. Birbaumer & A. Öhman (Eds.), *The structure of emotion* (pp. 156–167). Hogrefe & Huber Publishers.

Panayiotou, G., Panteli, M., & Vlemincx, E. (2021). Adaptive and maladaptive emotion processing and regulation, and the case of alexithymia. *Cognition and Emotion*, *35*(3), 488–499. https://doi.org/10.1080/02699931.2019.1671322

Pandey, R., Saxena, P., & Dubey, A. (2011). Emotion regulation difficulties in alexithymia and mental health. *Europe's Journal of Psychology*, *7*(4), 604–623. https://doi.org/10.5964/ejop.v7i4.155

Panksepp, J. (1982). Toward a general psychobiological theory of emotions. *Behavioral and Brain Sciences*, *5*(3), 407–422. https://doi.org/10.1017/S0140525X00012759

Piche, T., Saint-Paul, M. C., Dainese, R., Marine-Barjoan, E., Iannelli, A., Montoya, M. L., Peyron, J. F., Czerucka, D., Cherikh, F., Filippi, J., Tran, A., & Hebuterne, X. (2007). Mast cells and cellularity of the colonic mucosa correlated with fatigue and depression in irritable bowel syndrome. *Gut*, *57*(4), 468–473. https://doi.org/10.1136/gut.2007.127068

Pohl, C., Hombach, A., & Kruis, W. (2000). Chronic inflammatory bowel disease and cancer. *Hepato-Gastroenterology*, *47*(31), 57–70.

Pond, R. S., Kashdan, T. B., DeWall, C. N., Savostyanova, A., Lambert, N. M., & Fincham, F. D. (2012). Emotion differentiation moderates aggressive tendencies in angry people: A daily diary analysis. *Emotion*, *12*(2), 326–337. https://doi.org/10.1037/a0025762

Porcelli, P., Affatati, V., Bellomo, A., De Carne, M., Todarello, O., & Taylor, G. J. (2004). Alexithymia and psychopathology in patients with psychiatric and functional gastrointestinal disorders. *Psychotherapy and Psychosomatics*, *73*(2), 84–91. https://doi.org/10.1159/000075539

Porcelli, P., De Carne, M., & Leandro, G. (2014). Alexithymia and gastrointestinal-specific anxiety in moderate to severe irritable bowel syndrome. *Comprehensive Psychiatry*, *55*(7), 1647–1653. https://doi.org/10.1016/j.comppsych.2014.05.022

Porcelli, P., De Carne, M., & Leandro, G. (2017). The role of alexithymia and gastrointestinal-specific anxiety as predictors of treatment outcome in irritable bowel syndrome. *Comprehensive Psychiatry*, *73*, 127–135. https://doi.org/10.1016/j.comppsych.2016.11.010

Porcelli, P., De Carne, M., & Leandro, G. (2020). Distinct associations of DSM-5 Somatic Symptom Disorder, the Diagnostic Criteria for Psychosomatic Research-Revised (DCPR-R) and symptom severity in patients with irritable bowel syndrome. *General Hospital Psychiatry*, *64*, 56–62. https://doi.org/10.1016/j.genhosppsych.2020.03.004

Porcelli, P., Michael Bagby, R., Taylor, G. J., De Carne, M., Leandro, G., & Todarello, O. (2003). Alexithymia as predictor of treatment outcome in patients with functional gastrointestinal disorders. *Psychosomatic Medicine*, *65*(5), 911–918. https://doi.org/10.1097/01.PSY.0000089064.13681.3B

Porcelli, P., Taylor, G. J., Bagby, R. M., & De Carne, M. (1999). Alexithymia and functional gastrointestinal disorders. *Psychotherapy and Psychosomatics*, *68*(5), 263–269. https://doi.org/10.1159/000012342

Portincasa, P., Moschetta, A., Baldassarre, G., Altomare, D. F., & Palasciano, G. (2003). Pan-enteric dysmotility, impaired quality of life and alexithymia in a large group of patients meeting *ROME* II criteria for irritable bowel syndrome. *World Journal of Gastroenterology*, *9*(10), 2293. https://doi.org/10.3748/wjg.v9.i10.2293

Posserud, I., Agerforz, P., Ekman, R., Björnsson, E. S., Abrahamsson, H., & Simrén, M. (2004). Altered visceral perceptual and neuroendocrine response in patients with irritable bowel syndrome during mental stress. *Gut*, *53*(8), 1102–1108. https://doi.org/10.1136/gut.2003.017962

Prkachin, K. M., Williams-Avery, R. M., Zwaal, C., & Mills, D. E. (1999). Cardiovascular changes during induced emotion: An application of Lang's theory of emotional imagery. *Journal of Psychosomatic Research*, *47*(3), 255–267. https://doi.org/10.1016/S0022-3999(99)00036-7

Quigley, E. M. M., Abdel-Hamid, H., Barbara, G., Bhatia, S. J., Boeckxstaens, G., De Giorgio, R., Delvaux, M., Drossman, D. A., Foxx-Orenstein, A. E., Guarner, F., Gwee, K., Harris, L. A., Hungin, A. P. S., Hunt, R. H., Kellow, J. E., Khalif, I. L., Kruis, W., Lindberg, G., Olano, C., … Tzeuton, C. (2012). A global perspective on irritable bowel syndrome: A consensus statement of the World Gastroenterology Organisation Summit Task Force on irritable bowel syndrome. *Journal of Clinical Gastroenterology*, *46*(5), 356–366. https://doi.org/10.1097/MCG.0b013e318247157c

Rao, M., & Gershon, M. D. (2016). The bowel and beyond: The enteric nervous system in neurological disorders. *Nature Reviews Gastroenterology & Hepatology*, *13*(9), 517–528. https://doi.org/10.1038/nrgastro.2016.107

Rao, S. S. C., Bharucha, A. E., Chiarioni, G., Felt-Bersma, R., Knowles, C., Malcolm, A., & Wald, A. (2016). Anorectal disorders. *Gastroenterology*, *150*(6), 1430-1442.e4. https://doi.org/10.1053/j.gastro.2016.02.009

Revicki, D. A., Wood, M., Wiklund, I. K., & Crawley, J. (1998). Reliability and validity of the Gastrointestinal Symptom Rating Scale in patients with gastroesophageal reflux disease. *Quality of Life Research*, *7*, 75–83.

Rivet-Noor, C., & Gaultier, A. (2020). The role of gut mucins in the etiology of depression. *Frontiers in Behavioral Neuroscience*, *14*, 592388. https://doi.org/10.3389/fnbeh.2020.592388

Roberts, N. A., Burleson, M. H., Weber, D. J., Larson, A., Sergeant, K., Devine, M. J., Vincelette, T. M., & Wang, N. C. (2012). Emotion in psychogenic nonepileptic seizures: Responses to affective pictures. *Epilepsy & Behavior*, *24*(1), 107–115. https://doi.org/10.1016/j.yebeh.2012.03.018

Roseman, I. J., Wiest, C., & Swartz, T. S. (1994). Phenomenology, behaviors, and goals differentiate discrete emotions. *Journal of Personality and Social Psychology*, *67*(2), 206–221. https://doi.org/10.1037/0022-3514.67.2.206

Rozin, P., Haidt, J., & McCauley, C. R. (2008). Disgust. In *Handbook of emotions, 3rd ed* (pp. 757–776). The Guilford Press.

Rutter, C. L., & Rutter, D. R. (2002). Illness representation, coping and outcome in irritable bowel syndrome (IBS). *British Journal of Health Psychology*, *7*(4), 377–391. https://doi.org/10.1348/135910702320645372

Sallis, J. F., Owen, N., & Fisher, E. (2015). Ecological models of health behavior. In K. Glantz, B. K. Rimer, & K. Viswanath (Eds.), *Health behavior and health education: Theory, reserach, and practice* (4th ed., pp. 465–485). John Wiley & Sons.

Salvetti, M. D., Cobelo, A., Vernalha, P. D., Vianna, C. I. D., Canarezi, L. C. C. C. C., & Calegare, R. G. L. (2012). Effects of a psychoeducational program for chronic pain management. *Revista Latino-Americana de Enfermagem*, *20*(5), 896–902. https://doi.org/10.1590/S0104-11692012000500011

Saveanu, R. V., & Nemeroff, C. B. (2012). Etiology of depression: Genetic and environmental factors. *Psychiatric Clinics of North America*, *35*(1), 51–71. https://doi.org/10.1016/j.psc.2011.12.001

Schachter, S., & Singer, J. (1962). Cognitive, social, and physiological determinants of emotional state. *Psychological Review*, *69*(5), 379–399. https://doi.org/10.1037/h0046234

Schatten, H. T., Andover, M. S., & Armey, M. F. (2015). The roles of social stress and decision-making in non-suicidal self-injury. *Psychiatry Research*, *229*(3), 983–991. https://doi.org/10.1016/j.psychres.2015.05.087

Simpson, C. A., Diaz-Arteche, C., Eliby, D., Schwartz, O. S., Simmons, J. G., & Cowan, C. S. M. (2021). The gut microbiota in anxiety and depression – A systematic review. *Clinical Psychology Review*, *83*, 101943. https://doi.org/10.1016/j.cpr.2020.101943

Simrén, M., Törnblom, H., Palsson, O. S., van Tilburg, M. A. L., Van Oudenhove, L., Tack, J., & Whitehead, W. E. (2018). Visceral hypersensitivity is associated with GI symptom severity in functional GI disorders: Consistent findings from five different patient cohorts. *Gut*, *67*(2), 255–262. https://doi.org/10.1136/gutjnl-2016-312361

Smidt, K. E., & Suvak, M. K. (2015). A brief, but nuanced, review of emotional granularity and emotion differentiation research. *Current Opinion in Psychology*, *3*, 48–51. https://doi.org/10.1016/j.copsyc.2015.02.007

Smyth, J. M., & Arigo, D. (2009). Recent evidence supports emotion-regulation interventions for improving health in at-risk and clinical populations. *Current Opinion in Psychiatry*, *22*(2), 205–210. https://doi.org/10.1097/YCO.0b013e3283252d6d

Sperber, A. D., Bangdiwala, S. I., Drossman, D. A., Ghoshal, U. C., Simren, M., Tack, J., Whitehead, W. E., Dumitrascu, D. L., Fang, X., Fukudo, S., Kellow, J., Okeke, E., Quigley, E. M. M., Schmulson, M., Whorwell, P., Archampong, T., Adibi, P., Andresen, V., Benninga, M. A., … Palsson, O. S. (2021). Worldwide prevalence and burden of functional gastrointestinal disorders, results of Rome foundation global study. *Gastroenterology*, *160*(1), 99-114.e3. https://doi.org/10.1053/j.gastro.2020.04.014

Sperber, A. D., Drossman, D. A., & Quigley, E. M. M. (2012). The global perspective on irritable bowel syndrome: A Rome Foundation–world gastroenterology organisation symposium. *American Journal of Gastroenterology*, *107*(11), 1602–1609. https://doi.org/10.1038/ajg.2012.106

Stanculete, M. F., Matu, S., Pojoga, C., & Dumitrascu, D. L. (2015). Coping strategies and irrational beliefs as mediators of the health-related quality of life impairments in irritable bowel syndrome. *Journal of Gastrointestinal and Liver Diseases*, *24*(2), 159–164. http://dx.doi.org/10.15403/jgld.2014.1121.242.strt

Stanghellini, V., Chan, F. K. L., Hasler, W. L., Malagelada, J. R., Suzuki, H., Tack, J., & Talley, N. J. (2016). Gastroduodenal disorders. *Gastroenterology*, *150*(6), 1380–1392. https://doi.org/10.1053/j.gastro.2016.02.011

Stark, R., Schienle, A., Sarlo, M., Palomba, D., Walter, B., & Vaitl, D. (2005). Influences of disgust sensitivity on hemodynamic responses towards a disgust-inducing film clip. *International Journal of Psychophysiology*, *57*(1), 61–67. https://doi.org/10.1016/j.ijpsycho.2005.01.010

Stilling, R. M., Dinan, T. G., & Cryan, J. F. (2014). Microbial genes, brain & behaviour—Epigenetic regulation of the gut-brain axis. *Genes, Brain and Behavior*, *13*(1), 69–86. https://doi.org/10.1111/gbb.12109

Su, I., & Ceci, S. J. (2021). "Zoom developmentalists": Home-based videoconferencing developmental research during COVID-19. *PsyArXiv*. https://doi.org/10.31234/osf.io/nvdy6

Sugawara, N., Sato, K., Takahashi, I., Satake, R., Fukuda, S., Nakaji, S., & Yasui-Furukori, N. (2017). Depressive symptoms and coping behaviors among individuals with irritable bowel syndrome in Japan. *Internal Medicine*, *56*(5), 493–498. https://doi.org/10.2169/internalmedicine.56.7695

Svaldi, J., Griepenstroh, J., Tuschen-Caffier, B., & Ehring, T. (2012). Emotion regulation deficits in eating disorders: A marker of eating pathology or general psychopathology? *Psychiatry Research*, *197*(1–2), 103–111. https://doi.org/10.1016/j.psychres.2011.11.009

Svedlund, J., Sjödin, I., & Dotevall, G. (1988). GSRS - A clinical rating scale for gastrointestinal symptoms in patients with irritable bowel syndrome and peptic ulcer disease. *Digestive Diseases and Sciences*, *33*(2), 129–134. https://doi.org/10.1007/BF01535722

Swart, M., Kortekaas, R., & Aleman, A. (2009). Dealing with feelings: Characterization of trait alexithymia on emotion regulation strategies and cognitive-emotional processing. *PLoS ONE*, *4*(6), e5751. https://doi.org/10.1371/journal.pone.0005751

Taylor, G. J., Bagby, R. M., & Parker, J. D. A. (1997). *Disorders of affect regulation: Alexithymia in medical and psychiatric illness*. Cambridge University Press.

Thakur, G. A., Sengupta, S. M., Grizenko, N., Schmitz, N., Pagé, V., & Joober, R. (2013). Maternal smoking during pregnancy and ADHD: A comprehensive clinical and neurocognitive characterization. *Nicotine & Tobacco Research*, *15*(1), 149–157. psyh. https://doi.org/10.1093/ntr/nts102

Thompson, W. G., Irvine, E. J., Pare, P., Ferrazzi, S., & Rance, L. (2002). Functional gastrointestinal disorders in Canada: First population-based survey using Rome II criteria with suggestions for improving the questionnaire. *Digestive Diseases and Sciences*, *47*(1), 225–235. https://doi.org/10.1023/A:1013208713670

Tillisch, K., Mayer, E. A., & Labus, J. S. (2011). Quantitative meta-analysis identifies brain regions activated during rectal distension in irritable bowel syndrome. *Gastroenterology*, *140*(1), 91–100. https://doi.org/10.1053/j.gastro.2010.07.053

Tolmunen, T., Heliste, M., Lehto, S. M., Hintikka, J., Honkalampi, K., & Kauhanen, J. (2011). Stability of alexithymia in the general population: An 11-year follow-up. *Comprehensive Psychiatry*, *52*(5), 536–541. https://doi.org/10.1016/j.comppsych.2010.09.007

Torkzadeh, F., Danesh, M., Mirbagher, L., Daghaghzadeh, H., & Emami, M. (2019). Relations between coping skills, symptom severity, psychological symptoms, and quality of life in patients with irritable bowel syndrome. *International Journal of Preventive Medicine*, *10*(1), 72. https://doi.org/10.4103/ijpvm.IJPVM_464_17

Tougas, G. (2000). The autonomic nervous system in functional bowel disorders. *Gut*, *47*(Suppl IV), 78iv–7880. https://doi.org/10.1136/gut.47.suppl_4.iv78

Tull, M. T., & Aldao, A. (2015). Editorial overview: New directions in the science of emotion regulation. *Current Opinion in Psychology*, *3*, 1–5. https://doi.org/10.1016/j.copsyc.2015.03.009

Tull, M. T., Barrett, H. M., McMillan, E. S., & Roemer, L. (2007). A preliminary investigation of the relationship between emotion regulation difficulties and posttraumatic stress symptoms. *Behavior Therapy*, *38*(3), 303–313. https://doi.org/10.1016/j.beth.2006.10.001

Vaccarino, A. L., Sills, T. L., Evans, K. R., & Kalali, A. H. (2009). Multiple pain complaints in patients with major depressive disorder. *Psychosomatic Medicine*, *71*(2), 159–162. https://doi.org/10.1097/PSY.0b013e3181906572

van der Velde, J., Gromann, P. M., Swart, M., Wiersma, D., de Haan, L., Bruggeman, R., Krabbendam, L., & Aleman, A. (2015). Alexithymia influences brain activation during emotion perception but not regulation. *Social Cognitive and Affective Neuroscience*, *10*(2), 285–293. https://doi.org/10.1093/scan/nsu056

Vanner, S. J., Greenwood-Van Meerveld, B., Mawe, G. M., Shea-Donohue, T., Verdu, E. F., Wood, J., & Grundy, D. (2016). Fundamentals of neurogastroenterology: Basic science. *Gastroenterology*, *150*(6), 1280–1291. https://doi.org/10.1053/j.gastro.2016.02.018

van Orshoven, N. P., Andriesse, G. I., van Schelven, L. J., Smout, A. J., Akkermans, L. M. A., & Oey, P. L. (2006). Subtle involvement of the parasympathetic nervous system in patients with irritable bowel syndrome. *Clinical Autonomic Research*, *16*(1), 33–39. https://doi.org/10.1007/s10286-006-0307-x

Van Oudenhove, L., & Aziz, Q. (2009). Recent insights on central processing and psychological processes in functional gastrointestinal disorders. *Digestive and Liver Disease*, *41*(11), 781–787. https://doi.org/10.1016/j.dld.2009.07.004

Van Oudenhove, L., & Aziz, Q. (2013). The role of psychosocial factors and psychiatric disorders in functional dyspepsia. *Nature Reviews Gastroenterology & Hepatology*, *10*, 158–167.

Van Oudenhove, L., Levy, R. L., Crowell, M. D., Drossman, D. A., Halpert, A. D., Keefer, L., Lackner, J. M., Murphy, T. B., & Naliboff, B. D. (2016). Biopsychosocial aspects of functional gastrointestinal disorders: How central and environmental processes contribute to the development and expression of functional gastrointestinal disorders. *Gastroenterology*, *150*(6), 1355-1367.e2. https://doi.org/10.1053/j.gastro.2016.02.027

Vanuytsel, T., van Wanrooy, S., Vanheel, H., Vanormelingen, C., Verschueren, S., Houben, E., Salim Rasoel, S., Tóth, J., Holvoet, L., Farré, R., Van Oudenhove, L., Boeckxstaens, G., Verbeke, K., & Tack, J. (2014). Psychological stress and corticotropin-releasing hormone increase intestinal permeability in humans by a mast cell-dependent mechanism. *Gut*, *63*(8), 1293–1299. https://doi.org/10.1136/gutjnl-2013-305690

Vindegaard, N., & Benros, M. E. (2020). COVID-19 pandemic and mental health consequences: Systematic review of the current evidence. *Brain, Behavior, and Immunity*, *89*, 531–542. https://doi.org/10.1016/j.bbi.2020.05.048

Vivier, H., Ross, E. J., & Cassisi, J. E. (2020). Classification of gastrointestinal symptom patterns in young adults. *BMC Gastroenterology*, *20*(1), 326. https://doi.org/10.1186/s12876-020-01478-7

Vujanovic, A. A., Zvolensky, M. J., & Bernstein, A. (2008). The interactive effects of anxiety sensitivity and emotion dysregulation in predicting anxiety-related cognitive and affective symptoms. *Cognitive Therapy and Research*, *32*(6), 803–817. https://doi.org/10.1007/s10608-007-9148-8

Wang, C., Pan, R., Wan, X., Tan, Y., Xu, L., McIntyre, R. S., Choo, F. N., Tran, B., Ho, R., Sharma, V. K., & Ho, C. (2020a). A longitudinal study on the mental health of general population during the COVID-19 epidemic in China. *Brain, Behavior, and Immunity*, *87*, 40–48. https://doi.org/10.1016/j.bbi.2020.04.028

Wang, X., Hegde, S., Son, C., Keller, B., Smith, A., & Sasangohar, F. (2020b). Investigating mental health of US college students during the COVID-19 pandemic: Cross-sectional survey study. *Journal of Medical Internet Research*, *22*(9), e22817. https://doi.org/10.2196/22817

Watson, D., Clark, L. A., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: The PANAS scales. *Journal of Personality and Social Psychology*, *54*(6), 1063–1070. https://doi.org/10.1037/0022-3514.54.6.1063

Waugh, C. E., Panage, S., Mendes, W. B., & Gotlib, I. H. (2010). Cardiovascular and affective recovery from anticipatory threat. *Biological Psychology*, *84*(2), 169–175. https://doi.org/10.1016/j.biopsycho.2010.01.010

Weiss, N. H., Tull, M. T., Viana, A. G., Anestis, M. D., & Gratz, K. L. (2012). Impulsive behaviors as an emotion regulation strategy: Examining associations between PTSD, emotion dysregulation, and impulsive behaviors among substance dependent inpatients. *Journal of Anxiety Disorders*, *26*(3), 453–458. https://doi.org/10.1016/j.janxdis.2012.01.007

Wiklund, I. K., Fullerton, S., Hawkey, C. J., Jones, R. H., Longstreth, G. F., Mayer, E. A., Peacock, R. A., Wilson, I. K., & Naesdal, J. (2003). An irritable bowel syndrome-specific symptom questionnaire: Development and validation. *Scandinavian Journal of Gastroenterology*, *38*(9), 947–954. https://doi.org/10.1080/00365520310004209

Witte, J., Shivananda, S., Lennard-Jones, J. E., Beltrami, M., Politi, P., Bonanomi, A., Tsianos, E. V., Mouzas, I., Schulz, T. B., Monteiro, E., Clofent, J., Odes, S., Limonard, C. B., Stockbrügger, R. W., & Russel, M. G. (2000). Disease outcome in inflammatory bowel disease: Mortality, morbidity and therapeutic management of a 796-person inception cohort in the European Collaborative Study on Inflammatory Bowel Disease (EC-IBD). *Scandinavian Journal of Gastroenterology*, *35*(12), 1272–1277. https://doi.org/10.1080/003655200453610

Wolpe, J. (1958). *Psychotherapy by Reciprocal Inhibition*. Stanford University Press.

Wood, S. (2021, January 1). *Collecting behavioral data online: A brief guide for psychological scientists*. American Psychological Association. https://www.apa.org/science/leadership/students/collecting-behavioral-data

Wu, J. C. (2012). Psychological co-morbidity in functional gastrointestinal disorders: Epidemiology, mechanisms and management. *Journal of Neurogastroenterology and Motility*, *18*(1), 13–18. https://doi.org/10.5056/jnm.2012.18.1.13

Zola, I. K. (1966). Culture and symptoms—An analysis of patient's presenting complaints. *American Sociological Review*, *31*(5), 615. https://doi.org/10.2307/2091854

Zvolensky, M., Jardin, C., Farris, S. G., Kauffman, B., Bakhshaie, J., Garey, L., Manning, K., Rogers, A. H., & Mayorga, N. A. (2018). Gut interpretations: How difficulties in emotion regulation may help explain the relation of visceral sensitivity with depression and anxiety among young adults with gastrointestinal symptoms. *Psychology, Health & Medicine*, *23*(7), 840–845. https://doi.org/10.1080/13548506.2018.1455984

LIST OF APPENDICES

APPENDIX A: DEMOGRAPHICS AND MEDICAL QUESTIONNAIRE

1. With what gender do you identify?
    a. Male
    b. Female
    c. Transgender
    d. Non-binary
    e. Other
2. What was your sex at birth?
    a. Male
    b. Female
3. Age (Free response)
4. With what race do you identify?
    a. White/Caucasian
    b. Black/African American
    c. Native American/Alaska Native
    d. Asian/Pacific Islander
    e. Multiracial (specify)
    f. Other (specify)
    g. Prefer not to answer
5. With what ethnicity do you identify?
    a. Hispanic/Latinx
    b. Non-Hispanic/Latinx
6. Identify which best represents your housing situation:
    a. Dormitory
    b. Greek housing
    c. With friends or roommates in apartment/condominium/house
    d. With family in apartment/condominium/house
    e. Live alone
7. Are you employed?
    a. Yes, part-time (< 30 hours per week)
    b. Yes, full-time (≥ 30 hours per week)
    c. No
8. Are you a first-generation college student?
    a. Yes
    b. No
9. What location best describes where you were raised?
    a. Urban
    b. Rural
    c. Suburban
    d. Other (specify)
10. How do you self-identify?
    a. Gay
    b. Lesbian
    c. Bisexual
    d. Queer
    e. Questioning
    f. Heterosexual/Straight

g. Asexual
h. Other (specify)

11. Year in college
    a. Freshman (1st year)
    b. Sophomore (2nd year)
    c. Junior (3rd year)
    d. Senior (4th year)
    e. Other (specify)
12. What is your current height in inches? One-foot equals 12 inches. (free response)
13. What is your current weight in pounds? (free response)
14. About how often did you smoke cigarettes *in the past year*?
    a. Never
    b. One time
    c. Monthly or less
    d. 2-4 times a month
    e. 2-3 times a week
    f. 4 or more times a week
15. About how often did you use smokeless tobacco products (e-cigarettes (e.g., Juul), chewing tobacco) *in the past year*?
    a. Never
    b. One time
    c. Monthly or less
    d. 2-4 times a month
    e. 2-3 times a week
    f. 4 or more times a week
16. About how often did you use cannabis (i.e., marijuana) *in the past year*?
    a. Never
    b. One time
    c. Monthly or less
    d. 2-4 times a month
    e. 2-3 times a week
    f. 4 or more times a week
17. Have you seen any of the following *specifically* for gastrointestinal or stomach pain or discomfort? (multiple responses)
    a. General practitioner/family doctor
    b. Specialists (e.g., gastroenterologist)
    c. Complementary and alternative medicine
    d. Psychologist/Psychiatrist
    e. Other (specify)
18. Which of the following over the counter medications do you use to help alleviate gastrointestinal or stomach pains? (multiple responses)
    a. Antacids (e.g., Tums, Pepto-Bismol, milk of magnesia, Alka-Seltzer)
    b. Diuretics
    c. Laxatives (Metamucil, Dulcolax)
    d. Gas relief (e.g., Beano)
    e. Other (specify)

19. Which of the following dietary guidelines/diets do you follow? (multiple responses)
    a. Vegetarian
    b. Vegan
    c. Pescatarian
    d. FODMAP
    e. Gluten free
    f. Lactose free
    g. Keto
    h. Other (specify)

19a. How stringently do you follow these dietary guidelines/diets? (multiple responses)
    a. Every day
    b. Weekdays only
    c. Weekends only
    d. Specific times related to upcoming events (e.g., social event, sporting event)
    e. Other (specify)

20. Has a medical provider diagnosed you with any of the following? (multiple responses)
    a. Celiac disease
    b. Crohn's disease
    c. Ulcerative colitis
    d. Gastroesophageal reflux disease (GERD)
    e. Irritable bowel syndrome
    f. Gastroparesis
    g. Gastritis
    h. Diverticulitis
    i. Other (specify)

21. Do you have other, non-gastrointestinal medical conditions that may cause gastrointestinal distress, pain, or discomfort, such as endometriosis, or temporary illnesses that would cause gastrointestinal distress, such as the stomach flu? (free response).

22. Do you experience/are you currently experiencing gastrointestinal distress *as a result of menstruation* (e.g., cramping, bloating)?
    a. Yes
    b. No/I am male

23. Do you do any of the following to avoid gastrointestinal or stomach pain or discomfort? (multiple responses)
    a. Avoiding meals at certain times of day (specify)
    b. Avoiding or restricting intake of food
    c. Avoiding restaurants
    d. Avoiding certain foods (specify)
    e. Avoiding situations without easy access to a restroom
    f. Checking for location of bathrooms
    g. Relying on medications when traveling
    h. Avoiding public transportation
    i. Avoiding exercise (e.g., cardiovascular activities, lifting weights (squatting), abdominal exercises

APPENDIX B: GASTROINTESTINAL SYMPTOM RATING SCALE

Please read this first: This survey contains questions about how you have been feeling and what it has been like DURING THE PAST WEEK. Mark the choice that best applies to you and your situation. If you are female, please only consider gastrointestinal symptoms that occur when you are **NOT** menstruating. Response scale: (1) No discomfort at all. (2) Minor discomfort. (3) Mild discomfort. (4) Moderate discomfort. (5) Moderately severe discomfort. (6) Severe discomfort. (7) Very severe discomfort.

1. Have you been bothered by STOMACH ACHE OR PAIN during the past week? (Stomach ache refers to all kinds of aches or pains in your stomach or belly.)
2. Have you been bothered by HEARTBURN during the past week? (By heartburn we mean an unpleasant stinging or burning sensation in your chest.)
3. Have you been bothered by ACID REFLUX during the past week? (By acid reflux we mean regurgitation or flow of sour or bitter fluid into your mouth.)
4. Have you been bothered by HUNGER PAINS in the stomach or belly during the past week? (This hollow feeling in the stomach is associated with the need to eat between meals.)
5. Have you been bothered by NAUSEA during the past week? (By nausea we mean a feeling of wanting to throw up or vomit.)
6. Have you been bothered by RUMBLING in your stomach or belly during the past week? (Rumbling refers to vibrations or noise in the stomach.)
7. Has your stomach felt BLOATED during the past week? (Feeling bloated refers to swelling often associated with a sensation of gas or air in the stomach.)
8. Have you been bothered by BURPING during the past week? (Burping refers to bringing up air or gas through the mouth.)
9. Have you been bothered by PASSING GAS OR FLATUS during the past week? (Passing gas or flatus refers to the release of air or gas from the bowel.)
10. Have you been bothered by CONSTIPATION during the past week? (Constipation refers to a reduced ability to empty the bowels.)
11. Have you been bothered by DIARRHEA during the past week? (Diarrhea refers to a too frequent emptying of the bowels.)
12. Have you ever been bothered by LOOSE STOOLS during the past week? (If your stools have been alternately hard and loose, this question only refers to the extent you have been bothered by the stools being loose.)
13. Have you been bothered by HARD STOOLS during the past week? (If your stools have been alternately hard and loose, this question only refers to the extent you have been bothered by the stools being hard.)
14. Have you been bothered by an URGENT NEED TO HAVE A BOWEL MOVEMENT during the past week? (This urgent need to go to the toilet is often associated with a feeling that you are not in full control.)
15. When going to the toilet during the past week, have you had the FEELING OF NOT COMPLETELY EMPTYING YOUR BOWELS? (This feeling of incomplete emptying means that you still feel a need to pass more stool despite having exerted yourself to do so.)

APPENDIX C: DEPRESSION, ANXIETY, STRESS SCALE – 21

Please read each statement and choose the number which indicates how much the statement applied to you over the past week. There are no right or wrong answers. Do not spend too much time on any statement. The rating scale is as follows:

0 = Did not apply to me at all
1 = Applied to me some degree, or some of the time
2 = Applied to me a considerable degree, or a good part of the time
3 = Applied to me very much, or most of the time

_____ 1. I found it hard to wind down.
_____ 2. I was aware of dryness in my mouth.
_____ 3. I couldn't seem to experience any positive feeling at all.
_____ 4. I experience breathing difficulty (e.g., excessively rapid breathing, breathlessness in the absence of physical exertion).
_____ 5. I found it difficult to work up the initiative to do things.
_____ 6. I tended to over-react to situations.
_____ 7. I experienced trembling (e.g., in the hands).
_____ 8. I felt that I was using a lot of nervous energy.
_____ 9. I was worried about situations in which I might panic and make a fool of myself.
_____ 10. I felt that I had nothing to look forward to.
_____ 11. I found myself getting agitated.
_____ 12. I found it difficult to relax.
_____ 13. I felt down-hearted and blue.
_____ 14. I was intolerance of anything that kept me from getting on with what I was doing.
_____ 15. I felt I was close to panic.
_____ 16. I was unable to become enthusiastic about anything.
_____ 17. I felt I wasn't worth much as a person.
_____ 18. I felt that I was rather touchy.
_____ 19. I was aware of the action of my heart in the absence of physical exertion (e.g., sense of heart rate increase, heart missing a beat).
_____ 20. I felt scared without any good reason.
_____ 21. I felt that life was meaningless.

APPENDIX D: EMOTIONAL INTENSITY SCALE – REVISED

Imagine yourself in the following situations and then choose the answer that best describes how you usually feel.

1. Someone compliments me. I feel:
    a. It has little effect on me.
    b. Mildly pleased.
    c. Pleased.
    d. Very pleased.
    e. Ecstatic – on top of the world.
2. I am happy. I feel:
    a. It has little effect on me.
    b. Mildly happy.
    c. Happy.
    d. Extremely happy.
    e. Euphoric – so happy I could burst.
3. Someone I am very attracted to asks me out for coffee. I feel:
    a. Ecstatic – on top the world.
    b. Very thrilled.
    c. Thrilled.
    d. Mildly thrilled.
    e. It has little effect on me.
4. I am at a fun party. I feel:
    a. It has little effect on me.
    b. A little lighthearted.
    c. Lively.
    d. Very lively.
    e. So lively that I almost feel like a new person
5. Something wonderful happens to me. I feel:
    a. Extremely joyful – exuberant.
    b. Extremely glad.
    c. Glad.
    d. A little glad.
    e. It has little effect on me.
6. I have accomplished something valuable. I feel:
    a. It has little effect on me.
    b. A little satisfied.
    c. Satisfied.
    d. Very satisfied.
    e. So satisfied it's as if my entire life was worthwhile.
7. A person with whom I am involved prepares me a candlelight dinner. I feel:
    a. It has little effect on me.
    b. Slightly romantic.
    c. Romantic.
    d. Very romantic.
    e. So passionate nothing else matters.
8. I am involved in a romantic relationship. I feel:

a. So consumed with passion I can think of nothing else.
b. Very passionate.
c. Passionate.
d. Mildly passionate.
e. It has little effect on me.

9. Someone surprises me with a gift. I feel:
    a. It has little effect on me
    b. A little grateful
    c. Grateful
    d. Very grateful
    e. So grateful that I want to run out and buy them a gift in return
10. Something frustrates me. I feel:
    a. It has little effect on me.
    b. A little frustrated.
    c. Frustrated.
    d. Very frustrated.
    e. So extremely tense and frustrated that my muscles knot up.
11. I say or do something I should not have done. I feel:
    a. It has little effect on me.
    b. I twinge of guilt.
    c. Guilty.
    d. Very guilty.
    e. Extremely guilty.
12. Someone criticizes me. I feel:
    a. It has little effect on me.
    b. I am a bit taken aback.
    c. Upset.
    d. Very upset.
    e. So extremely upset I could cry.
13. I have an embarrassing experience. I feel:
    a. It has little effect on me.
    b. A little ill at ease.
    c. Embarrassed.
    d. Very embarrassed.
    e. So embarrassed I want to die.
14. Someone I know is rude to me. I feel:
    a. So incredibly hurt I could cry.
    b. Very hurt.
    c. Hurt.
    d. A little hurt.
    e. It has little effect on me.
15. I see a sad movie. I feel:
    a. So extremely sad that I feel like weeping.
    b. Very sad.
    c. Sad.
    d. A little sad.

e. It has little effect on me.

16. I am involved in a situation in which I must do well, such as an important exam or job interview. I feel:
    a. It has little effect on me.
    b. Slightly anxious.
    c. Anxious.
    d. Very anxious.
    e. So extremely anxious I can think of nothing else.
17. I am in an argument. I feel:
    a. It has little effect on me.
    b. Mildly angry.
    c. Angry.
    d. Very angry.
    e. So incredibly angry I find it difficult to remain composed.

APPENDIX E: TORONTO ALEXITHYMIA SCALE

Rate the following items from 1, *strongly disagree*, to 5, *strongly agree*.

1. I am often confused about what emotion I am feeling.
2. It is difficult for me to find the right words for my feelings.
3. I have physical sensations that even doctors don't understand.
4. I am able to describe my feelings easily.
5. I prefer to analyze problems rather than just describe them.
6. When I am upset, I don't know if I am sad, frightened, or angry.
7. I am often puzzled by sensations in my body.
8. I prefer to just let things happen rather than to understand why they turned out that way.
9. I have feelings that I can't quite identify.
10. Being in touch with emotions is essential.
11. I find it hard to describe how I feel about people.
12. People tell me to describe my feelings more.
13. I don't know what's going on inside me.
14. I often don't know why I am angry.
15. I prefer talking to people about their daily activities rather than their feelings.
16. I prefer to watch "light" entertainment shows rather than psychological dramas.
17. It is difficult for me to reveal my innermost feelings, even to close friends.
18. I can feel close to someone, even in moments of silence.
19. I find examination of my feelings useful in solving personal problems.
20. Looking for hidden meanings in movies or plays distracts from their enjoyment.

APPENDIX F: EMOTION REGULATION QUESTIONNAIRE

We would like to ask you some questions about your emotional life, in particular, how you control (that is, regulate and manage) your emotions. The questions below involve two distinct aspects of your emotional life. One is your emotional experience, or what you feel like inside. The other is your emotional expression, or how you show your emotions in the way you talk, gesture, or behave. Although some of the following questions may seem similar to one another, they differ in important ways. For each item, please answer using the following scale:

1 = strongly disagree ----- 2 ----- 3 ----- 4 = neutral ----- 5 ----- 6 ----- 7 = strongly agree

1. When I want to feel more *positive* emotion (such as joy or amusement), I *change what I'm thinking about*.
2. I keep my emotions to myself.
3. When I want to feel less *negative* emotion (such as sadness or anger), I *change what I'm thinking about*.
4. What I am feeling *positive* emotions, I am careful not to express them.
5. When I'm faced with a stressful situation, I make myself *think about it* in a way that helps me stay calm.
6. I control my emotions by *not expressing them*.
7. When I want to feel more *positive* emotion, I *change the way I'm thinking* about the situation.
8. I control my emotions by *changing the way I think* about the situation I'm in.
9. When I am feeling *negative* emotion, I make sure not to express them.
10. When I want to feel less *negative* emotion, I *change the way I'm thinking* about the situation.

APPENDIX G: DIFFICULTIES IN EMOTION REGULATION SCALE

Please indicate how often the following statements apply to you by filling in the appropriate numbered bubble from the scale below:

1=almost never (0-10%); 2=sometimes (11-35%); 3=about half the time (36-65%); 4=most of the time (66-90%); 5=almost always (91-100%).

	Almost never	Sometimes	About half the time	Most of the time	Almost always
1. I am clear about my feelings.	1	2	3	4	5
2. I pay attention to how I feel.	1	2	3	4	5
3. I experience my emotions as overwhelming and out of control.	1	2	3	4	5
4. I have no idea how I am feeling.	1	2	3	4	5
5. I have difficulty making sense out of my feelings.	1	2	3	4	5
6. I am attentive to my feelings.	1	2	3	4	5
7. I know exactly how I am feeling.	1	2	3	4	5
8. I care about what I am feeling.	1	2	3	4	5
9. I am confused about hwo I feel.	1	2	3	4	5
10. When I'm upset, I acknowledge my emotions.	1	2	3	4	5
11. When I'm upset, I become angry with myself for feeling that way.	1	2	3	4	5
12. When I'm upset, I become embarrassed for feeling that way.	1	2	3	4	5
13. When I'm uspet, I have difficulty getting work done.	1	2	3	4	5
14. When I'm upset, I become out of control.	1	2	3	4	5
15. When I'm uspet, I believe that I will remain that way for a long time.	1	2	3	4	5
16. When I'm upset, I believe that I'll end up feeling very depressed.	1	2	3	4	5

17. When I'm upset, I believe that my feelings are valid and important.	1	2	3	4	5
18. When I'm upset, I have difficulty focusing on other things.	1	2	3	4	5
19. When I'm upset, I feel out of control.	1	2	3	4	5
20. When I'm upset, I can still get things done.	1	2	3	4	5
21. When I'm upset, I feel ashamed with myself for feeling that way.	1	2	3	4	5
22. When I'm uspet, I know that I can find a way to eventually feel better.	1	2	3	4	5
23. When I'm uspet, I feel like I am weak.	1	2	3	4	5
24. When I'm upset, I feel like I can remain in control of my behaviors.	1	2	3	4	5
25. When I'm upset, I feel guilty for feeling that way.	1	2	3	4	5
26. When I'm upset, I have difficulty concentrating.	1	2	3	4	5
27. When I'm upset, I have difficulty controlling my behaviors.	1	2	3	4	5
28. When I'm upset, I believe that there is nothing I can do to make myself feel better.	1	2	3	4	5
29. When I'm upset, I become irritated with myself for feeling that way.	1	2	3	4	5
30. When I'm upset, I start to feel very bad about myself.	1	2	3	4	5
31. When I'm upset, I belive that wallowing in it is all I can do..	1	2	3	4	5
32. When I'm upset, I lose control over my behaviors.	1	2	3	4	5
33. When I'm upset, I have difficulty thinking about anything else.	1	2	3	4	5

34. When I'm upset, I take time to figure out what I'm really feeling.	1	2	3	4	5
35. When I'm upset, it takes me a logn time to feel better.	1	2	3	4	5
36. When I'm upset, emotions feel overwhelming.	1	2	3	4	5

APPENDIX H: VISCERAL SENSITIVITY INDEX

Below are statements that describe how some people respond to symptoms or discomfort in their belly or lower abdomen. These may include pain, diarrhea, constipation, bloating, or sense of urgency. Please answer "how strong you agree or disagree" with each of these statements, AS THEY RELATE TO YOU. Answer all of the statements as honestly and thoughtfully as you can.

0=strongly agree, 1=moderately agree, 2=mildly agree, 3=mildly disagree, 4=moderately disagree, 5=strongly disagree

1. I worry that whenever I eat during the day, bloating and distension in my belly will get worse.
2. I get anxious when I go to a new restaurant.
3. I often worry about problems in my belly.
4. I have a difficult time enjoying myself because I cannot get my mind off of discomfort in my belly.
5. I often fear that I won't be able to have a normal bowel movement.
6. Because of fear of developing abdominal discomfort, I seldom try new foods.
7. No matter what I eat, I will probably feel uncomfortable.
8. As soon as I feel abdominal discomfort I begin to worry and feel anxious.
9. When I enter a place I haven't been before, one of the first things I do is to look for a bathroom.
10. I am constantly aware of the feelings I have in my belly.
11. I often feel discomfort in my belly could be a sign of a serious illness.
12. As soon as I awake, I worry that I will have discomfort in my belly during the day.
13. When I feel discomfort in my belly, it frightens me.
14. In stressful situations, my belly bothers me a lot.
15. I constantly think about what is happening inside my belly.

APPENDIX I: BODY PERCEPTION QUESTIONNAIRE – SHORT FORM

I. Body Awareness

Please rate your awareness on each of the characteristics described below. Select the answer that most accurately describes you. (Scale: Never, Occasionally, Sometimes, Usually, Always)

During most situations I am aware of:

1. Swallowing frequently
2. An urge to cough to clear my throat
3. My mouth being dry
4. How fast I am breathing
5. Watering or tearing of my eyes
6. Noises associated with my digestion
7. A swelling of my body or parts of my body
8. An urge to defecate
9. Muscle tension in my arms and legs
10. A bloated feeling because of water retention
11. Muscle tension in my face
12. Goose bumps
13. Stomach and gut pains
14. Stomach distention or bloatedness
15. Palms sweating
16. Sweat on my forehead
17. Tremor in my lips
18. Sweat in my armpits
19. The temperature of my face (especially my ears)
20. Grinding my teeth
21. General jitteriness
22. The hair on the back of my neck “standing up”
23. Difficulty in focusing
24. An urge to swallow
25. How hard my heart is beating
26. Feeling constipated

II. Autonomic Nervous System Reactivity

The autonomic nervous system is the part of your nervous system that controls your cardiovascular respiratory, digestive, and temperature regulation systems. It is also involved in the experience and expression of emotions. The autonomic nervous system functions differently among people. This scale has been developed to measure how your autonomic nervous system reacts.

Please rate yourself on each of the statements below:

27. I have difficulty coordinating breathing and eating
28. When I am eating, I have difficulty talking
29. My heart often beats irregularly

30. When I eat, food feels dry and sticks to my mouth and throat
31. I feel shortness of breath
32. I have difficulty coordinating breathing with talking
33. When I eat, I have difficulty coordinating swallowing, chewing, and/or sucking with breathing
34. I have a persistent cough that interferes with my talking and eating
35. I gag from the saliva in my mouth
36. I have chest pains
37. I gag when I eat
38. When I talk, I often feel I should cough or swallow the saliva in my mouth
39. When I breathe, I feel like I cannot get enough oxygen
40. I have difficulty controlling my eyes
41. I feel like vomiting
42. I have 'sour' stomach
43. I am constipated
44. I have indigestion
45. After eating I have digestive problems
46. I have diarrhea

APPENDIX J: POSITIVE AND NEGATIVE AFFECT SCALE

This measure consists of a number of words and statements that describe different feelings and emotions. Please rate each word or statement using the scale below. Please rate each item based on how you are feeling right now, at this moment.

1	2	3	4	5
Very slightly or not at all	A little	Moderately	Quite a bit	Extremely

_____ interested
_____ distressed
_____ excited
_____ upset
_____ strong
_____ guilty
_____ scared
_____ hostile
_____ enthusiastic
_____ proud
_____ disgusted

_____ irritable
_____ alert
_____ ashamed
_____ inspired
_____ nervous
_____ determined
_____ attentive
_____ jittery
_____ active
_____ afraid

APPENDIX K: STRATEGIES QUESTIONNAIRE

Rate the following items on a scale from 0 (strongly disagree) to 6 (strongly agree).

1. I tried not to let my feelings show
2. I tried to suppress my emotions
3. I thought about the [stimulus] in a way that helps me to experience less emotion
4. I tried to adopt an unemotional attitude toward the [stimulus]

APPENDIX L: STATE – DIFFICULTIES IN EMOTION REGULATION QUESTIONNAIRE

Instructions: Please read each statement and indicate how much it applies to **YOUR EMOTIONS RIGHT NOW**.

1	2	3	4	5
Not at all	Somewhat	Moderately	Very much	Completely

_____ 1) I feel guilty for feeling this way.

_____ 2) I am paying attention to how I feel.

_____ 3) I feel out of control.

_____ 4) I am embarrassed for feeling this way.

_____ 5) I am feeling very bad about myself.

_____ 6) I am acknowledging my emotions.

_____ 7) I have no idea how I am feeling.

_____ 8) I feel ashamed with myself for feeling this way.

_____ 9) I am having difficulty doing the things I need to do right now.

_____ 10) I believe that I will continue feeling this way for a long time.

_____ 11) I care about what I am feeling.

_____ 12) I am angry with myself for feeling this way.

_____ 13) I am having difficulty controlling my behaviors.

_____ 14) I am confused about how I feel.

_____ 15) I believe that I am going to end up feeling very depressed.

_____ 16) I am taking time to figure out what I am really feeling.

_____ 17) My emotions feel out of control.

_____ 18) I am irritated with myself for feeling this way.

_____ 19) I believe that my feelings are valid and important.

_____ 20) I feel like I'm a weak person for feeling this way.

_____ 21) My emotions feel overwhelming.

APPENDIX M: MANIPULATION CHECK ITEMS

1. What do you believe the purpose of the three tasks was? (open ended)
2. What do you believe the intended emotion of the first task was? (open ended)
3. What do you believe the intended emotion of the second task was? (open ended)
4. What do you believe the intended emotion of the third task was? (open ended)
5. Do you typically watch videos that some people would find disgusting (e.g., pimple popping, botched surgery television shows)?
    a. Yes
    b. No
6. To what extent do you enjoy watching these videos or shows?
    a. Not at all
    b. A little
    c. Moderately
    d. Very much
7. To what extent do you experience disgust or get "grossed out" when watching these videos or shows?
    a. Not at all
    b. A little
    c. Moderately
    d. Very much
8. To what extend are you saddened by watching television shows that depict death such as the death of a spouse or loved one?
    a. Not at all
    b. A little
    c. Moderately
    d. Very much
9. Have you seen the television show *This Is Us*?
    a. Yes
    b. No
10. Do you like the television show *This Is Us*?
    a. Yes
    b. No
11. Have you seen the episode that was shown earlier?
    a. Yes, and I had the same reaction as the first time I saw it
    b. Yes, and I had a completely different reaction than the first time I saw it
    c. No
12. How did your reaction differ watching it this time? (open ended)
13. When having to give a speech, do you typically become anxious, nervous, or uncomfortable?
    a. Yes
    b. No
14. Did you believe that you would have to give the speech you prepared for?
    a. Yes
    b. No

LIST OF TABLES

Table 1. *Overall sample demographic, gastrointestinal, and clinical indicators of emotional characteristics (*N = *291*).

		n (%)
Age (*M* ± *SD*)		20.59 ± 5.50
Sex	Female	211 (72.5)
	Male	80 (27.5)
Race	White	240 (82.5)
	Black	28 (9.6)
	Multiracial	10 (3.4)
	Asian	9 (3.1)
	Other	3 (1.0)
	Preferred not to answer	1 (0.3)
Hispanic/Latinx		19 (6.5)
Year in college	Freshman	151 (51.9)
	Sophomore	57 (19.6)
	Junior	38 (13.1)
	Senior	29 (10.0)
	Other	16 (5.5)
First generation student		46 (15.8)
Self-reported GI diagnoses	Irritable bowel syndrome	13 (4.5)
	Gastroesophageal reflux disease	5 (1.7)
	Gastroparesis	1 (0.3)
	Celiac disease	1 (0.3)
	Other (e.g., lactose intolerance, leaky gut)	4 (1.2)
	Crohn's disease, ulcerative colitis, gastritis, and diverticulitis	0 (0.0)
Medical providers seen for GI distress	General practitioner	45 (15.5)
	Specialist (e.g., gastroenterologist)	22 (7.6)
	Mental health provider	5 (1.7)
	Other (e.g., emergency department)	2 (0.7)
OTC medication taken for GI distress	Antacids	83 (28.5)
	Laxatives	37 (12.7)
	Gas relief	26 (8.9)
	Diuretics	4 (1.4)
	Other (e.g., acetaminophen)	8 (2.7)
GI avoidance behaviors	Avoiding specific food	190 (65.3)
	Avoid eating before specific event/activity	157 (54.0)
	Eating small portions	146 (50.2)
	Avoiding eating certain times of day	123 (42.3)
	Checking for location of public restroom	58 (31.6)
	Carrying medication, food, or water	91 (31.3)
	Avoiding restaurants or eating outside of the home	91 (31.3)
	Relying on medication when traveling	65 (22.3)
	Avoiding sexual activity	59 (20.3)

	Avoiding situations without private restroom	58 (19.9)
	Avoiding exercise	54 (18.6)
	Avoiding public transportation	48 (16.5)
Depression	Normal	183 (62.9)
	Mild	25 (8.6)
	Moderate	48 (16.5)
	Severe	13 (4.5)
	Extremely Severe	22 (7.6)
Anxiety	Normal	177 (60.8)
	Mild	17 (5.8)
	Moderate	45 (15.5)
	Severe	23 (7.9)
	Extremely Severe	29 (10.0)
Stress	Normal	200 (68.7)
	Mild	31 (10.7)
	Moderate	31 (10.7)
	Severe	24 (8.2)
	Extremely Severe	5 (1.7)
Alexithymia	Clinical	63 (21.6)
	Sub-clinical	73 (25.1)

Note. GI = gastrointestinal; OTC = over-the-counter.

Table 2. *Means and standard deviations for trait characteristics between FGID and control participants (*n = *51).*

	FGID Group (*n* = 27) *M* (*SD*)	Control Group (*n* = 24) *M* (*SD*)
GI symptom severity	2.5 (1.1)	1.5 (0.6)
Depression	9.0 (9.8)	5.8 (8.1)
Normal[a]	19 (70.4)	19 (79.2)
Mild[a]	1 (3.7)	1 (4.2)
Moderate[a]	3 (11.1)	2 (8.3)
Severe-Extremely Severe[a]	4 (14.8)	2 (8.4)
Anxiety	8.4 (6.1)	2.8 (4.8)
Normal[a]	11 (40.7)	21 (87.5)
Mild[a]	4 (14.8)	1 (4.2)
Moderate[a]	7 (25.9)	1 (4.2)
Severe-Extremely Severe[a]	5 (18.5)	1 (4.2)
Stress	13.4 (6.7)	6.9 (8.1)
Normal[a]	15 (55.6)	19 (79.2)
Mild[a]	5 (18.5)	3 (12.5)
Moderate[a]	6 (22.2)	1 (4.2)
Severe-Extremely Severe[a]	1 (3.7)	1 (4.2)
Emotion Intensity	61.03 (5.95)	56.67 (8.91)
Alexithymia[a]	14 (51.9)	6 (25.0)
Reappraisal	29.19 (7.89)	28.04 (7.21)
Suppression	14.59 (5.27)	15.67 (5.82)
ER Difficulties[a]	15 (29.4)	12 (23.5)
Visceral Sensitivity	25.96 (20.12)	7.29 (11.08)
Body Awareness	15.19 (6.70)	8.83 (7.17)
ANS-Supra	4.04 (2.88)	2.63 (3.29)
ANS-Sub	3.48 (1.99)	1.33 (1.79)

Note. Alexithymia = sub-clinical and clinical levels included; ANS-Sub = autonomic nervous system reactivity in the subdiaphragmatic region; ANS-Supra = autonomic nervous system reactivity in the supradiaphragmatic region; ER = emotion regulation; GI = gastrointestinal.
[a]*n* (%)

Table 3. *Descriptive statistics and Pearson correlations of the relation between gastrointestinal symptoms and emotional and physiological symptoms (*N = *291).*

	GSRS	Mean (SD)	Observed Range	Possible Range
Hypothesis 1				
Depression	.305*	8.73 (9.82)	0 – 42	0 – 42
Anxiety	.468*	7.40 (8.29)	0 – 38	0 – 42
Stress	.518*	10.95 (9.33)	0 – 42	0 – 42
Hypothesis 2				
Emotion Intensity	.288*	58.65 (8.16)	32 – 85	17 – 85
Alexithymia	.204*	50.51 (11.76)	26 – 75	20 – 100
Reappraisal	-.007	27.17 (6.62)	6 – 41	6 – 42
Suppression	.061	15.36 (4.73)	4 – 28	4 – 28
ER Abilities	.310*	87.74 (26.10)	39 – 161	36 – 180
Visceral Sensitivity	.631*	15.22 (16.83)	0 – 75	0 – 75
Body Awareness	.487*	13.98 (7.85)	0 – 26	0 – 26
ANS-Supra	.463*	3.95 (3.94)	0 – 15	0 – 15
ANS-Sub	.692*	2.32 (2.07)	0 – 6	0 – 6

Note. ANS-Sub = autonomic nervous system reactivity in the subdiaphragmatic region; ANS-Supra = autonomic nervous system reactivity in the supradiaphragmatic region; ER = emotion regulation; GSRS = Gastrointestinal Symptom Rating Scale.
*$p < .001$

Table 4. *Means and standard deviations for induction-related emotional responding between FGID and control participants (*n = *52).*

	FGID Group (*n* = 28)				Control Group (*n* = 24)			
	Neutral	Anxiety	Sadness	Disgust	Neutral	Anxiety	Sadness	Disgust
SUDS	1.18 (1.44)	4.11 (2.39)	3.00 (1.94)	4.29 (2.61)	0.98 (1.42)	4.21 (2.50)	2.63 (1.56)	3.81 (2.36)
Negative Affect	13.04 (2.62)	20.39 (7.94)	16.68 (6.44)	17.57 (6.42)	11.83 (2.96)	16.54 (5.24)	14.50 (4.24)	16.96 (6.55)
State Reappraisal	3.43 (2.12)	4.36 (3.94)	3.75 (3.09)	3.68 (3.59)	4.33 (3.38)	4.75 (3.86)	2.88 (3.69)	4.63 (4.01)
State Suppression	4.64 (2.82)	4.54 (4.25)	3.86 (3.34)	3.86 (3.65)	3.88 (3.14)	4.17 (3.64)	3.25 (3.44)	3.42 (3.59)
State ER Difficulties	34.57 (7.53)	34.64 (8.27)	31.50 (5.82)	32.11 (5.72)	35.79 (9.68)	35.63 (9.68)	36.21 (10.10)	36.08 (9.77)

Note. ER = emotion regulation; FGID = functional gastrointestinal disorder; SUDS = subjective units of distress.

Table 5. *Post-hoc planned contrasts examining interaction effects of group (FGID, control) and induction (anxiety, sadness, disgust) relative to neutral induction (*n = *52).*

	Weighted SE	Pooled SE	MSE	*t*	df	*p*
SUDS	0.155	0.910	5.882			
C1				-0.316	1	.403
C2				0.183	1	.442
C3				0.286	1	.411
Reappraisal	0.155	2.696	17.420			
C1				0.312	1	.404
C2				1.084	1	.237
C3				-0.025	1	.492
Suppression	0.155	2.663	17.208			
C1				0.314	1	.403
C2				1.091	1	.236
C3				-0.026	1	.492
ER Difficulties	0.155	18.423	119.038			
C1				0.055	1	.482
C2				-0.813	1	.283
C3				-0.642	1	.318

Note. C1 = anxiety compared to neutral contrast; C2 = sadness compared to neutral contrast; C3 = disgust compared to neutral contrast; ER = emotion regulation; MSE = mean squared error; SE = standard error; SUDS = subjective units of distress.

VITA

Sara M. Witcraft, M.A.
Curriculum Vitae
Updated August 2021

Department of Psychology
302E Peabody Hall
P.O. Box 1848
University, MS 38677-1848

Email: sarawitcraft@gmail.com

EDUCATION

2021– **Predoctoral Psychology Residency/Internship (APA-Accredited)**
The Charleston Consortium (Medical University of South Carolina [MUSC] and Ralph H. Johnson Veterans Affairs Medical Center [VAMC]), Charleston, SC
Track: Adult Psychopathology
Research Preceptor: Daniel F. Gros, Ph.D.

2016– **Doctor of Philosophy, Clinical Psychology (expected 2022; APA-Accredited)**
University of Mississippi, University, MS
Dissertation (defended 8/25/2021): *Do individuals with functional gastrointestinal symptoms experience emotions differently? An examination of emotional responding during a series of emotion induction tasks* (Chair: Laura J. Dixon, Ph.D.)

2018 **Master of Arts, Clinical Psychology (APA-Accredited)**
University of Mississippi, University, MS
Thesis: *Nonmedical use of prescription drugs among young adults: An examination of anxiety sensitivity, distress tolerance, and emotion-driven impulse control difficulties* (Chair: Laura J. Dixon, Ph.D.)

2014 **Bachelor of Arts, Psychology, *Cum Laude***
University of Miami, Coral Gables, FL
Honors Thesis: *The relationship between traumatic life events and hoarding symptoms* (Chair: Kiara R. Timpano, Ph.D.)

PEER-REVIEWED PUBLICATIONS

*denotes mentored undergraduate student author

17. Dixon, L. J., **Witcraft, S. M.**, & Schadegg, M. J. (2021). COVID-19 anxiety and mental health among university students in the early stages of the U.S. pandemic. *Journal of American College Health*. Advance online publication. https://doi.org/10.1080/07448481.2021.1923504

16. Boullion, G. Q., **Witcraft, S. M.**, Schadegg, M. J., Perry, M. M., & Dixon, L. J. (2021). Emotion regulation difficulties and depression among individuals with dermatological and body dysmorphic concerns. *Journal of Nervous and Mental Disease, 209*(9)*,* 650-655. https://doi.org/10.1097/nmd.0000000000001355

15. **Witcraft, S. M.**, Dixon, L. J., Leukel, P., & Lee, A. A. (2021). Anxiety sensitivity and respiratory disease outcomes among individuals with chronic obstructive pulmonary disease. *General Hospital Psychiatry, 69,* 1-6. https://doi.org/10.1016/j.genhosppsych.2020.12.004

14. *Ellison, L., **Witcraft, S. M.**, & Dixon, L. J. (2021). Anxiety sensitivity and social anxiety in adults with psychodermatological symptoms. *Archives of Dermatological Research, 313,* 531-537. https://doi.org/10.1007/s00403-020-02130-w

13. **Witcraft, S. M.**, Wickenhauser, M. E., Maack, D. J., & Dixon, L. J. (2021). What sensitivities matter in dental anxiety? Investigating sensitivity to anxiety, pain, and disgust. *Psychology, Health & Medicine, 26*(3)*,* 313-321. https://doi.org/10.1080/13548506.2020.1781911

12. Smits, J. A. J., Pollack, M. H., Rosenfield, D., Otto, M. W., Dowd, S., Carpenter, J., Dutcher, C. D., Lewis, E. M., **Witcraft, S. M.**, Papini, S., Curtiss, J., Andrews, L., Kind, S., Conroy, K., & Hofmann, S. G. (2020). Dose timing of D-cycloserine to augment exposure therapy for social anxiety disorder: A randomized clinical trial. *JAMA Network Open, 3*(6)*,* e206777. https://doi.org/10.1001/jamanetworkopen.2020.6777

11. Niel, K., LaRosa, K. N., Klages, K. L., Merchant, T. E., Wise, M. S., **Witcraft, S. M.**, Hancock, D., Caples, M., Mandrell, B. N., & Crabtree, V. M. (2020). Actigraphy versus polysomnography to measure sleep in youth treated for craniopharyngioma. *Behavioral Sleep Medicine, 18*(5)*,* 589-597. https://doi.org/10.1080/15402002.2019.1635133

10. Carl, E., **Witcraft, S. M.**, Kauffman, B. Y., Gillespie, E. M., Becker, E. S., Cuijpers, P., Van Ameringen, M., Smits, J. A. J., & Powers, M. B. (2020). Psychological and pharmacological treatments for generalized anxiety disorder (GAD): A meta-analysis of randomized controlled trials. *Cognitive Behaviour Therapy, 49*(1)*,* 1-21. https://doi.org/10.1080/16506073.2018.1560358.

9. **Witcraft, S. M.**, Smith, C. V., Pollard, M. A., & Dixon, L. J. (2020). Is Greek affiliation a prescription for drug abuse? Examining misuse of prescription stimulants and downers in high school and college. *Journal of American College Health, 68*(7)*,* 678-682. https://doi.org/10.1080/07448481.2019.1623803

8. Hofmann, S. G., Papini, S., Carpenter, J. K., Otto, M. W., Rosenfield, D., Dutcher, C. D., Dowd, S., Lewis, M., **Witcraft, S. M.**, Pollack, M. H., & Smits, J. A. J. (2019). Effect of d-cycloserine on fear extinction training in adults with social anxiety disorder. *PLoS ONE,* 14(10)*,* e0223729. https://doi.org/10.1371/journal.pone.0223729

7. Asmundson, G. J. G., Thorisdottir, A. S., Roden-Foreman, J. W., Baird, S. O., **Witcraft, S. M.**, Stein, A. T., Smits, J. A. J., & Powers, M. B. (2019). A meta-analytic review of cognitive processing therapy for adults with posttraumatic stress disorder. *Cognitive Behaviour Therapy, 48*(1)*,* 1-14. https://doi.org/10.1080/16506073.2018.1522371

6. Dixon, L. J., **Witcraft, S. M.**, & Perry, M. M. (2019). How does anxiety affect adults with skin disease? Examining the indirect effect of anxiety symptoms on impairment through anxiety

sensitivity. *Cognitive Therapy and Research, 43*(1)*,* 14-23. https://doi.org/10.1007/s10608-018-9942-5

5. Vrijsen, J. N., Dainer-Best, J., **Witcraft, S. M.**, Papini, S., Hertel, P., Beevers, C. G., Becker, E. S., & Smits, J. A. J. (2019). Effect of Cognitive Bias Modification-Memory on depressive symptoms and autobiographical memory bias: Two independent studies in high-ruminating and dysphoric samples. *Cognition and Emotion, 33*(2)*,* 288-304. https://doi.org/10.1080/02699931.2018.1450225.

4. Carpenter, J. K., Andrews, L. A., **Witcraft, S. M.**, Powers, M. B., Smits, J. A. J., & Hofmann, S. G. (2018). Cognitive behavioral therapy for anxiety and related disorders: A meta-analysis of randomized placebo-controlled trials. *Depression and Anxiety, 35*(6)*,* 502-514. https://doi.org/10.1002/da.22728

3. Dixon, L. J., **Witcraft, S. M.**, McCowan, N. K., & Brodell, R. T. (2018). Stress and skin disease quality of life: The moderating role of anxiety sensitivity social concerns. *British Journal of Dermatology, 178*(4)*,* 951-957. https://doi.org/10.1111/bjd.16082

2. Davis, M. L., **Witcraft, S. M.**, Smits, J. A. J., Dowd, S., Pollack, M., Rosenfield, D., Otto, M., & Hofmann, S. G. (2016). D-cycloserine augmentation of exposure therapy: Review and new directions. *Quality in Primary Care, 24*(1*), 30-32.*

1. Shaw, A. M., **Witcraft, S. M.**, & Timpano, K. R. (2016). The relationship between traumatic life events and hoarding symptoms: A multi-method approach. *Cognitive Behaviour Therapy, 45*(1)*,* 49-59. https://doi.org/10.1080/16506073.2015.1101150

MANUSCRIPTS UNDER REVIEW

2. **Witcraft, S. M.**, Wickenhauser, M. E., Russell, K. M., Mandrell, B. N., Conklin, H. M., Merchant, T. E., & Crabtree, V. M. (2021). *Anxiety and mood are not related to disparate sleep profiles in youth with craniopharyngioma: A latent profile analysis*. Department of Psychology, St. Jude Children's Research Hospital.

1. Loew, M., Russell, K. M., Tynes, B. L., Mandrell, B. N., **Witcraft, S. M.**, Schwartz, L. W., & Crabtree, V. M. (2021). *Sleep hygiene and sleep habits in pediatric patients with newly diagnosed cancer*. Department of Psychology, St. Jude Children's Research Hospital.

BOOK CHAPTERS

2. Dixon, L. J., & **Witcraft, S. M.** (2020). Anxiety and skin disease. In S. Richards (Volume Ed.) & L. M. Cohen (Series Ed.), *Wiley encyclopedia of health psychology, volume III: Clinical health and behavioral medicine* (1st ed., pp. 451–458)*.* John Wiley & Sons.

1. Davis, M. L., **Witcraft, S. M.**, Baird, S. O., & Smits, J. A. J. (2017). Learning principles in CBT. In S. G. Hofmann & G. J. G. Asmundson (Eds.), *The science of cognitive behavioral therapy* (1st ed., pp. 51–76). Academic Press.

GRANT EXPERIENCE

Misophonia Research Fund **Role: Research Assistant** **02/08/2021–07/23/2021**
Advancing the Characterization and Assessment of Misophonia through Laboratory and

Population-based Research
Health and Anxiety Research and Treatment Lab, University of Mississippi, University, MS
Principle Investigator: Laura J. Dixon, Ph.D.

1R34-MH099218-01A1 Role: Research Coordinator 08/15/2014–07/01/2016
National Institute of Mental Health
3/3 Dose Timing of D-Cycloserine to Augment CBT for Social Anxiety Disorder
Anxiety & Health Behaviors Lab, University of Texas-Austin, Austin, TX
Principle Investigator: Jasper A. J. Smits, Ph.D. (with Stefan G. Hofmann, Ph.D. & Mark H. Pollock, M.D.

AWARDS AND HONORS

2020	Graduate Research Achievement Award, University of Mississippi, Psychology Department
2019	Outstanding Paper Presentation Award, 9th Annual Graduate Research Symposium, University of Mississippi
2019	Graduate Student Council Travel Award ($300), University of Mississippi
2016–2020	Graduate Honors Fellowship ($3,000 per year), University of Mississippi
2016–2020	Psychology Department Travel Award ($400 per year), University of Mississippi
2014	B.A. Awarded *Cum Laude*, Departmental Honors in Psychology, University of Miami
2014	First Place, Research Creativity and Innovation Forum: Social Sciences Division, University of Miami
2013	Student Travel Scholarship, University of Miami
2013	College of Arts and Sciences Summer Program for Underrepresented Minorities and Women ($2,500), University of Miami
2013	Psychology Research Initiatives Mentorship Experience (PRIME) Summer Research Scholarship ($2,000), University of Miami
2010–2014	President's Honor Roll, Provost's Honor Roll, and Dean's List, All semesters, University of Miami

SYMPOSIA AND ORAL PRESENTATIONS

10. **Witcraft, S. M.**, & Dixon, L. J. (2020, November). Examining the mediating role of emotion regulation difficulties in behavioral avoidance of gastrointestinal symptoms. In L. Dixon & A. Lee (Chairs), *Extending the impact of cognitive and behavioral therapies through the integration of health outcomes: A closer look at emotion regulation processes* [Symposium]. Association for Behavioral and Cognitive Therapies 54th Annual Convention, Philadelphia, PA, United States.

9. Dixon, L. J., Schadegg, M. J., Boullion, G. Q., **Witcraft, S. M.**, & Perry, M. M. (2019, November). Obsessive-compulsive related disorders, emotion regulation, and quality of life in adults with skin disease. In J. McCann (Chair), *Change that matters: What, why, and how meaningful change happens in CBT for anxiety-related disorders* [Symposium]. Association for Behavioral and Cognitive Therapies 53rd Annual Convention, Atlanta, GA, United States.

8. **Witcraft, S. M.**, & Dixon, L. J. (2019, April). *Psychological sensitivities in dental anxiety: An examination of sensitivities to anxiety, disgust, and pain* [Data blitz]. University of Mississippi Psychological Research Day 6th Annual Meeting, University, MS, United States.

7. **Witcraft, S. M.**, & Dixon, L. J. (2019, March). *The role of emotion-driven impulsivity in inpatients with anxiety and prescription drug abuse* [Paper presentation].** University of Mississippi Graduate Student Council Research Symposium 9th Annual Meeting, University, MS, United States.
****This presentation received an award for being among the top three presentations in its category.**

6. Boullion, G. Q., Dixon, L. J., Perry, M. M., & **Witcraft, S. M.** (2018, November). Emotion regulation difficulties and depression among individuals with dermatological and body dysmorphic concerns. In B. Mathes & B. Summers (Chairs), *Recent advances in OC spectrum disorders: A transdiagnostic and translational perspective* [Symposium]. Association for Behavioral and Cognitive Therapies 52nd Convention, Washington, D.C., United States.

5. Vrijsen, J. N., Dainer-Best, J., **Witcraft, S. M.**, Papini, S., Müller, B., Hertel, P., Beevers, C. G., Becker, E. S., Tendolkar, I., & Smits, J. A. J. (2018, July). Retrieval-based memory bias modification for depression. In M. Weymar (Chair), *Current research and emerging directions in emotional memory: Evidence from healthy functioning, psychopathology, and interventions* [Symposium]. International Conference of the European Society for Cognitive and Affective Neuroscience 4th Annual Meeting, Leiden, The Netherlands.

4. **Witcraft, S. M.**, & Dixon, L. J. (2018, April 13). *Examining emotion regulation differences in prescription drug abusers and non-users* [Data blitz]. University of Mississippi Psychology Research Day 5th Annual Meeting, University, MS, United States.

3. Dixon, L. J., & **Witcraft, S. M.** (2017, November). Anxiety sensitivity and quality of life among adults with dermatological conditions. In L. Dixon (Chair), *Expanding the AS horizon: Recent advances in the study of anxiety sensitivity among individuals with medical conditions* [Symposium]. Association for Behavioral and Cognitive Therapies 51st Annual Meeting, San Diego, CA, United States.

2. **Witcraft, S. M.**, & Dixon, L. J. (2017, September). Prescription drug use and trait characteristics of psychopathology in an undergraduate sample. In M. Perry (Chair), *The age of anxiety: Exploring and assessing anxiety and its problematic health correlates* [Symposium]. Mississippi Psychological Association 68th Annual Conference, Biloxi, MS, United States.

1. **Witcraft, S. M.**, & Dixon, L. J. (2017, April). *Prescription opioid and anxiolytic use and trait characteristics of anxiety in an undergraduate sample* [Data blitz]. University of Mississippi Psychology Research Day 4th Annual Meeting, University, MS, United States.

POSTER PRESENTATIONS

*denotes mentored undergraduate student author

20. **Witcraft, S. M.**, *Niehaus, L. K., *Schruff, M. A., & Dixon, L. J. (2021, November). *Do gut reactions matter? How individuals with and without gastrointestinal symptoms respond to emotional stimuli* [Poster accepted for presentation]. Association for Behavioral and Cognitive Therapies 55th Annual Convention, New Orleans, LA, United States.

19. *Schruff, M. A., *Niehaus, L. K., **Witcraft, S. M.**, & Dixon, L. J. (2021, September 29 – October 1). *Emotion regulation strategies among those with gastrointestinal symptoms: Findings from an experimental study* [Poster accepted for presentation]. Mississippi Psychological Association 72nd Annual Conference, Biloxi, MS, United States.

18. **Witcraft, S. M.**, Dixon, L. J., & Lee, A. A. (2020, November). *Concerns about physical symptoms are associated with overuse of healthcare and short-acting medication among individuals with asthma* [Poster presentation]. Association for Behavioral and Cognitive Therapies 54th Annual Convention, Philadelphia, PA, United States.

17. **Witcraft, S. M.**, Schadegg, M. J., Boullion, G. Q., Perry, M. M., & Dixon, L. J. (2019, November). *What sensitivities matter in dental anxiety? Investigating sensitivity to anxiety, pain, and disgust* [Poster presentation]. Association for Behavioral and Cognitive Therapies 53rd Annual Convention, Atlanta, GA, United States.

16. Schadegg, M. J., **Witcraft, S. M.**, Perry, M. M., Boullion, G. Q., & Dixon, L. J. (2019, November). *An aggressive reaction to sound: The interactive effects of anxiety sensitivity and misophonia on facets of aggression* [Poster presentation]. Association for Behavioral and Cognitive Therapies 53rd Annual Convention, Atlanta, GA, United States.

15. Boullion, G. Q., Perry, M. P., **Witcraft, S. M.**, Schadegg, M. J., & Dixon, L. J. (2019, November). *Social anxiety and loneliness: The indirect effect of emotion regulation difficulties* [Poster presentation]. Association for Behavioral and Cognitive Therapies 53rd Annual Convention, Atlanta, GA, United States.

14. Perry, M. M., Boullion, G. Q., Schadegg, M. J., **Witcraft, S. M.**, & Dixon, L. J. (2019, November). *Examining interpersonal and intrapersonal emotion regulation, social anxiety, and aggression among college students* [Poster presentation]. Association for Behavioral and Cognitive Therapies 53rd Annual Convention, Atlanta, GA, United States.

13. LaRosa, K. N., Niel, K., Klages, K. L., Mandrell, B. N., Merchant, T. E., Wise, M. S., **Witcraft, S. M.**, Hancock, D., Caples, M., & Crabtree, V. M. (2019, June). *Comparison of actigraphy to polysomnography in the measurement of sleep in children treated for craniopharyngioma* [Poster presentation]. SLEEP 33rd Annual Meeting, San Antonio, TX, United States.

12. *Ellison, L., *York, M., **Witcraft, S. M.**, & Dixon, L. J. (2019, April). *It's not just "skin deep:" Social anxiety and anxiety sensitivity in adults with psychodermatological disorders* [Poster presentation]. University of Mississippi Psychological Research Day 6th Annual Meeting, University, MS, United States.

11. *Long, M. M., *Sappington, L. M., *Seale, N. M., **Witcraft, S. M.**, & Dixon, L. J. (2019, April). *Use of safety behaviors in predicting social anxiety in adults with dermatological conditions* [Poster presentation]. University of Mississippi Psychological Research Day 6th Annual Meeting, University, MS, United States.

10. **Witcraft, S. M.**, Perry, M. M., Boullion, G. Q., & Dixon, L. J. (2018, November). *The moderating role of anxiety sensitivity social concerns in stress and quality of life among adults with skin disease* [Poster presentation]. Association for Behavioral and Cognitive Therapies 52nd Annual Convention, Washington, D.C., United States.

9. Perry, M. M., Boullion, G. Q., **Witcraft, S. M.**, Viana, A., & Dixon, L. J. (2018, November). *The importance of a mother's perceived ability to regulate emotions in postpartum maternal quality of life and parenting distress* [Poster presentation]. Association for Behavioral and Cognitive Therapies 52nd Annual Convention, Washington, D.C., United States.

8. *Olson, S., **Witcraft, S. M.**, & Dixon, L. J. (2018, April 13). *Examination of dental anxiety in relation to anxiety sensitivity, pain sensitivity, and distress tolerance* [Poster presentation]. University of Mississippi Psychology Research Day 5th Annual Meeting, University, MS, United States.

7. *Cantrell, A. N., *Young, G. K., **Witcraft, S. M.**, & Dixon, L. J. (2018, April 13). *Prescription stimulants and polysubstance use among college students* [Poster presentation]. University of Mississippi Psychology Research Day 5th Annual Meeting, University, MS, United States.

6. **Witcraft, S. M.**, Dixon, L. J., Perry, M. M., Gratz, K. L., & Tull, M. T. (2017, November). *Correlates of nonmedical use of prescription drugs among patients with co-occurring anxiety and substance use disorders* [Poster presentation]. Association for Behavioral and Cognitive Therapies 51st Annual Convention, San Diego, CA, United States.

5. **Witcraft, S. M.**, Davis, M. L., Baird, S. O., & Smits, J. A. J. (2016, October). *Increased use of negative emotion words during public speaking exposures predicts greater decreases in social anxiety symptoms* [Poster presentation]. Association for Behavioral and Cognitive Therapies 50th Annual Convention, New York, NY, United States.

4. Baird, S. O., Davis, M. L., **Witcraft, S. M.**, & Smits, J. A. J. (2016, April). *Linguistic analysis as a correlate of fear activation and social anxiety change* [Poster presentation]. Anxiety and Depression Association of America 36th Annual Conference, Philadelphia, PA, United States.

3. **Witcraft, S. M.**, Powers, M. B., Gillespie, E. M., Kauffman, B. Y., Becker, E., Cuijpers, P., Van Ameringen, M. & Smits, J. A. J. (2015, November). *A meta-analysis of psychological and pharmacological treatments for generalized anxiety disorder (GAD)* [Poster presentation]. Association for Behavioral and Cognitive Therapies 49th Annual Convention, Chicago, IL, United States.

2. **Witcraft, S. M.**, Davis, M. L., Julian, K., Beard, C., Schmidt, N. B., Powers, M. B., & Smits, J. A. J. (2015, April). *Correlating attention bias to social anxiety symptom severity: A second look using Trial Level Bias Score* [Poster presentation]. Anxiety and Depression Association of America 35th Annual Conference, Miami, FL, United States.

1. **Witcraft, S. M.**, Shaw, A. M., Pedersen, E. J., & Timpano, K. R. (2013, October). *The relationship between traumatic life events and hoarding symptoms* [Poster presentation]. Society for Advancement of Chicano and Native Americans in Science 40th Annual Conference, San Antonio, TX, United States.

RESEARCH POSITIONS AND EMPLOYMENT

2016–2021 **Graduate Research Assistant**
Health and Anxiety Research and Treatment Lab, University of Mississippi, University, MS
Supervisor: Laura J. Dixon, Ph.D.

2017–2018 **Graduate Research Assistant**
Mississippi Contextual Psychology Lab, University of Mississippi, University, MS
Supervisors: Kelly G. Wilson, Ph.D. & K. Kate Kellum, Ph.D., BCBA-D

2017–2018 **Graduate Research Assistant**
St. Jude Children's Research Hospital, Department of Psychology, Memphis, TN

Supervisor: Valerie M. Crabtree, Ph.D.

2014–2016 **Project Coordinator**
Anxiety & Health Behaviors Lab, University of Texas-Austin, Austin, TX
Supervisors: Jasper A. J. Smits, Ph.D. & Mark B. Powers, Ph.D.

2012–2014 **Undergraduate Research Assistant**
Program for Anxiety, Stress, and OCD, University of Miami, Coral Gables, FL
Supervisor: Kiara R. Timpano, Ph.D.

2011–2012 **Undergraduate Research Assistant**
Schizophrenia Family Lab, University of Miami, Coral Gables, FL
Supervisor: Amy Weisman de Mamani, Ph.D.

CLINICAL EXPERIENCE

2021– **Predoctoral Resident/Intern**
The Charleston Consortium, Charleston, SC

Ralph H. Johnson VAMC, Mental Health Service Line
Rotation: Cognitive Behavioral Therapy Clinic for Emotional Disorders
Supervisor: Daniel F. Gros, Ph.D.

MUSC, Department of Psychiatry and Behavioral Sciences
Rotation: Sleep and Anxiety Treatment and Research Program
Supervisor: Allison K. Wilkerson, Ph.D.

Rotation: Women's Health and High Risk OB Clinic (February – July 2022)
Supervisor: Amber Jarnecke, Ph.D.

Rotation: Health and Wellness Institute (February – July 2022)
Supervisor: Alyssa A. Rheingold, Ph.D.

2020–2021 **Opioid Replacement Therapist**
Willow Pain and Wellness, Oxford, MS
Supervisor: John Young, Ph.D.

March–June 2020 **Outpatient Therapist**
Communicare, Lafayette County Office
Region 2 Community Mental Health Center, Oxford, MS
Supervisors: Dixie Church, M.A., LMFT & Scott Gustafson, Ph.D., ABPP

2019–2020 **Primary & Transition Residential Program Therapist**
Communicare's Chemical Dependency Unit: The Haven House
Region 2 Community Mental Health Center, Oxford, MS
Supervisors: Dixie Church, M.A., LMFT, Scott Gustafson, Ph.D., ABPP, & Terri Hall, LCSW

2019–2020 **Psychological Assessor**
Psychological Assessment Clinic, University of Mississippi, University, MS
Supervisor: Scott Gustafson, Ph.D., ABPP

2018–2019 **Therapist**
Education and Behavior Support, The Baddour Center, Senatobia, MS
Supervisor: Joshua C. Fulwiler, Ph.D. & Deborah McNamee, BCBA

2017–2018 **Dialectical Behavior Therapy Skills Group Co-Leader**
Psychological Services Center, University of Mississippi, University, MS
Supervisor: Laura J. Dixon, Ph.D.

2016–2021 **Graduate Therapist**
Psychological Services Center, University of Mississippi, University, MS
Supervisors: Laura J. Dixon, Ph.D., Alan M. Gross, Ph.D., Scott A. Gustafson, Ph.D., ABPP, & John Young, Ph.D.

2015–2016 **Clinical Interviewer & Assessor**
Anxiety & Health Behaviors Lab, University of Texas-Austin, Austin, TX
Supervisors: Jasper A. J. Smits, Ph.D. & Mark B. Powers, Ph.D.

2014–2016 **Protocol Therapist – Social Anxiety Disorder RCT**
Anxiety & Health Behaviors Lab, University of Texas-Austin, Austin, TX
Supervisor: Jasper A. J. Smits, Ph.D.

2014–2016 **Clinic Coordinator**
Anxiety & Stress Clinic, University of Texas-Austin, Austin, TX
Supervisors: Jasper A. J. Smits, Ph.D. & Mark B. Powers, Ph.D.

2013 **Group Facilitator for Self-Directed Cognitive Behavioral Therapy for Hoarding Disorder**
Program for Anxiety, Stress, and OCD, University of Miami, Coral Gables, FL
Supervisor: Kiara R. Timpano, Ph.D.

2011–2014 **Practicum Clinic Office Assistant**
Psychological Services Center, University of Miami, Coral Gables, FL
Supervisor: Saneya Tawfik, Ph.D.

TEACHING EXPERIENCE

2020–2021 **Instructor of Record**
University of Mississippi, University, MS
Course: Introduction to Psychology (online)

2017, 2020 **Teaching Assistant**
University of Mississippi, University, MS
Course: Abnormal Psychology (web-based)

2016–2018 **Guest Lecturer**
University of Mississippi, University, MS
Courses:
Introduction to Psychology, "Abnormal Psychology: Anxiety, Stress, and Depressive Disorders"

Abnormal Psychology, "Generalized Anxiety Disorder"; "Obsessive-Compulsive Spectrum Disorders"

MENTORING EXPERIENCE

2020–2021 **Mentor for Undergraduate Psychology Majors**
Department of Psychology, University of Mississippi, University, MS

2020–2021 **Graduate Student Peer Mentor**
Department of Psychology, University of Mississippi, University, MS

2017–2020 **Graduate Student Mentor: Undergraduate Honors Thesis Projects**
Health and Anxiety Research and Treatment Lab, University of Mississippi, University, MS
Through the screen: Examining peer relationships, social anxiety, loneliness, and social media in undergraduates
Lindsay Sappington, Defended: April 29, 2020

It's not just "skin deep": Social anxiety and anxiety sensitivity in adults with psychodermatological disorders
Lauren Ellison, Defended: May 2, 2019

Examination of dental distress and anxiety-related vulnerability factors
Sydney Olson, Defended: May 3, 2018

2017–2021 **Undergraduate Research Assistant Supervisor**
Health and Anxiety Research and Treatment Lab, University of Mississippi, University, MS

2014–2016 **Research Assistant Training Supervisor and Mentor**
Anxiety & Health Behaviors Lab, University of Texas-Austin, Austin, TX

2012–2014 **Undergraduate Student Peer Mentor**
Counseling Outreach and Peer Education, University of Miami, Coral Gables, FL

SERVICE AND ADMINISTRATIVE ROLES

2020 **Diversifying Psychology Day Panelist**
Department of Psychology, University of Mississippi, University, MS

2020–2021 **Assistant to Director of Undergraduate Studies**
Department of Psychology, University of Mississippi, University, MS

2019–2020 **Graduate Student Advisory Committee Member**
Department of Psychology, University of Mississippi, University, MS

2019–2020 **Communications Committee Member**
Department of Psychology, University of Mississippi, University, MS

2016–2021 **Website Design Coordinator**
Health and Anxiety Research and Treatment Lab, University of Mississippi, University, MS

2014–2016 **Website Design & Upkeep**

Anxiety & Health Behaviors Lab, Anxiety & Stress Clinic, University of Texas-Austin, Austin, TX

ATTENDED WORKSHOPS AND CLINICAL TRAININGS

09/2020 **Diversity, Equity, and Inclusion Training**
University of Mississippi, University, MS

05/2020 **Provider Training for Cognitive Behavioral Therapy of Insomnia (CBT-I)**, 6.5 hour Continuing Education training
Medical University of South Carolina

03/2020 **American Psychological Association Telepsychology Best Practice 101**, 8 hour Continuing Education training
American Psychological Association

02/2020 **Delis-Kaplan Executive Function System (D-KEFS) Workshop**
Psychological Assessment Clinic, University of Mississippi, University, MS
Instructor: Alexis K. Liberto, M.A.

02/2020 **Sexual Paraphilias and 'Kink-Aware Therapy'**
University of Mississippi, University, MS
Instructors: Sarah A. Bilsky, Ph.D. & Carrie V. Smith, Ph.D.

11/2019 **Functional Analysis in Process-based CBT**
Association for Behavioral and Cognitive Therapies Annual Convention, Atlanta, GA
Instructors: Stefan G. Hofmann, Ph.D. & Steven C. Hayes, Ph.D.

11/2019 **Dimensions and Diagnosis of Autism Spectrum Disorder**
University of Mississippi, University, MS
Instructor: Joshua C. Fulwiler, Ph.D.

05/2019 **Making Your Job Easier – Using Applied Behavior Analysis**
The Baddour Center, Senatobia, MS
Instructor: Molly Campbell Arana

05/2019 **Trauma Informed Care – Understanding How the Past can Affect Future Behavior**
The Baddour Center, Senatobia, MS
Instructor: Stephen Bell, Ph.D.

10/2018 **Introduction to Mediation, Moderation, and Conditional Process Analysis, two-day training workshop**
University of Mississippi, University, MS
Instructor: Andrew F. Hayes, Ph.D.

03/2016 **Exposure Therapy for Generalized Anxiety Disorder, specialized training**
Institute for Mental Health Research, University of Texas-Austin, Austin, TX
Instructor: Eni S. Becker, Ph.D.

09/2015 **Prolonged Exposure Therapy for PTSD, two-day training seminar**
Anxiety & Health Behaviors Lab, University of Texas-Austin, Austin, TX
Instructor: Mark B. Powers, Ph.D.

07/2015 **SCID-101 for DSM-IV Training Series**
Anxiety & Health Behaviors Lab, University of Texas-Austin, Austin, TX

AD HOC REVIEWING EXPERIENCES/ACTIVITIES

Behaviour Research and Therapy
Children's Health Care
Clinical Practice in Pediatric Psychology
Clinical Psychology Review

Cognitive Therapy and Research
Frontiers in Psychology
Journal of Clinical Sleep Medicine
Journal of Consulting and Clinical Psychology
Journal of Neuro-Oncology
Journal of Nervous and Mental Disease
Pediatrics
Sleep
Sleep Health: Journal of the National Sleep Foundation
Sleep Medicine
The Journal of General Psychology

PROFESSIONAL AFFILIATIONS

2015– Association for Behavioral and Cognitive Therapies