Dedication

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Relationship Between Interoceptive Awareness, Mindfulness, and Somatization: Examining Competing Perspectives

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Abstract

Historically, a high focus on somatic experiences, i.e., bodily signals, was conceptualized negatively, as it was associated with hypervigilance and maladaptive somatic checking behaviors. However, with the emergence of research evidence supporting the clinical utility of mindfulness, scholars have questioned the notion that high somatic focus is inherently problematic. The present study investigated two competing theories of somatization, in which one suggests that high interoceptive awareness leads to somatization (cognitive behavioral model, CBM), while the other claims instead that low interoceptive awareness leads to somatization (predictive framework). The goal of this study was to examine the relationships between interoceptive awareness, mindfulness, and somatization, with the intent of exploring the evidence for both theories of somatization. Participants provided data regarding their sensory and affective tendencies toward somatization, levels of interoceptive awareness, levels of mindfulness, the degree to which they endorsed cognitive distortions and the extent to which they avoid unpleasant experiences. Evidence was found for both theoretical frameworks of somatization. The clinical implications for conceptualizing those two theories as complementary, rather than competing or conflicting, are discussed. This study has potential implications for how to better encompass individual differences and enhance treatment outcomes. To conclude, the limitations of the current study and ideals for future research directions are discussed.

Keywords: somatization, interoception, mindfulness, avoidance, cognitive distortion, top-down process, bottom-up process, hypervigilance, CBM, predictive theories

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Relationship Between Interoceptive Awareness, Mindfulness and Somatization: Examining Competing Perspectives

The "mind-body problem" refers to the historical interdisciplinary debate on the issue of specifying the relationship between mental and bodily processes. While it is intuitive that the mind is intrinsically connected to the brain, it is not always clear how electrical and chemical signals create complex qualitative and phenomenological perceptual experiences. The mind-body debate is a philosophical issue in nature, since there are no ways in which current scientific methods can completely solve the problem. Dualists would argue that the mind and body have a causal relationship, thus implying a clear separation between them. However, on the other hand, with advances in psychology and neuroscience, great insights were made in support of a materialistic view, in which mental activity is seen as nothing more than neural activity, thus not making clear distinctions between the mind and body. With that in mind, this study will explore the different ways in which the mind could interfere with bodily signals, leading to somatization.

The fifth edition of the *Diagnostic and Statistical Manual of Mental Disorders* (5th ed.; DSM–5; American Psychiatric Association, 2013) replaced what was formerly categorized as "somatoform disorders," which emphasized the absence of organic causes in somatic symptoms, with the class of psychological disorders that is now known as "somatic symptom and related disorders." This new categorization emphasizes experiencing distressing somatic symptoms and/or concerns about potential symptoms leading to maladaptive thoughts, feelings, and behaviors (Leigh, 2014). It is worth noting that the new diagnostic criteria do not explicitly discuss the etiology of such symptoms (except for conversion disorder). That said, Kellner (1990) defines somatization as physical complaints without an organic cause accompanied by

abnormal cognitive, emotional, and behavioral reactions, or excessive responses to existing physical symptoms (e.g., shortness of breath) due to known organic causes. These significant diagnostic changes were made to better reflect the current scientific knowledge of the complex interface between psychological and biological functioning. They represent a continued distancing from the outdated notion of Descartes' mind-body dualism, in which mental and physical health were thought to have clear boundaries.

Somatic symptoms and related disorders are characterized by experiences of physical symptoms and/or neurological conditions that may or may not be medically or organically explainable. These symptoms cause excessive or disproportionate responses including distressing thoughts, feelings, and behaviors leading to impairments in occupational, academic, affective, or social functioning. These disorders in this category are somatic symptom disorder, illness anxiety disorder, conversion disorder (also known as functional neurological symptom disorder), factitious disorder (also called Munchausen's syndrome) and factitious disorder imposed on another. This category also includes a diagnosis of psychological factors affecting other medical conditions. An individual diagnosed with somatic symptom disorder overfocuses on physical symptoms (e.g., pain) to an extent that it leads to distress and functional impairment. In contrast, those with illness anxiety disorder find themselves consumed with the possibility of developing a serious illness, despite no, or very mild, physical symptoms. This is closest to how many people conceptualize hypochondriasis. Individuals with conversion disorder manifest serious neurological symptoms (e.g., blindness or paralysis) that cannot be explained by known neurological illnesses or other medical conditions. These individuals are not thought to be consciously (i.e., intentionally) faking their symptoms. Conversely, individuals with factitious

disorder or factitious disorder imposed on another are deliberately faking or inducing symptoms in themselves or in another person in their care (e.g., their child), respectively, for secondary gains.

Current Treatments

Recommended Intervention. Cognitive Behavior Therapy (CBT) is a structured, collaborative, empirically based psychological treatment in which clinicians provide a range of cognitive and behavioral interventions. It is a time-limited and goal-directed psychotherapy with the ultimate aim of teaching patients how to apply and incorporate the skills and techniques into their lives post therapy termination. CBT is a skill focused therapy which includes the use of assigned homework in between sessions. CBT is based on the cognitive model theory, which does not consider a precipitating event as the direct cause of how we feel and behave. That is, situations or other people's behaviors do not directly cause our emotions or behaviors. If that were the case, we would all respond to the same situations with the same affective and behavioral responses. Instead, according to this model, we create interpretations of life events (i.e., our beliefs and thoughts), which will influence how we feel and, in turn, our actions (Beck & Beck, 1995). By not implying a deterministic view of causality, the cognitive model acknowledges that while situations (including other people) do influence our responses, there are other processes that also have an impact and those other factors could be under our control. In this model, it is considered more efficient to focus on what *can* be changed, rather than ruminating about things outside of our control.

Catastrophic beliefs and a dysfunctional perception of one's own condition and physical symptoms have been shown to significantly increase severity of the symptoms themselves and

decrease levels of functionality in various social situations (Petrie & Moss-Morris, 1995), consequently reducing quality of life. It is consistent then that CBT was found to be a somewhat effective treatment for somatic symptoms and related disorders (Speckens, et al., 1995; Sumathipala, et al., 2000; Kleinstäuber et al., 2011; Bouman, 2014; Newby et al., 2018) because the therapy specifically targets maladaptive beliefs through cognitive restructuring. CBT is the current recommended treatment for somatic symptoms and related disorders because it was shown to be the most effective treatment when compared to optimized medical care and other psychotherapies. However, overall, the efficacy of CBT for this class of disorders is still modest.

Alternative Interventions. Acknowledging CBT's weak to moderate results in treating somatic symptoms and related disorders, a growing body of research is emerging to assess the efficacy of other evidence-based psychological treatments for these disorders. In many traditional therapies, including the various adaptations of CBT, patient progress and responsiveness to therapy is determined by an observable reduction in symptoms, typically based on results of standard psychological assessment measures. With this approach, the goal of therapy is thus symptom reduction. Alternatively, some researchers have proposed that the focus of therapy should be redirected to maximize quality of life and functioning, rather than symptom reduction specifically. Due to the psychogenic suffering underlying those somatic symptoms, symptom reduction might be an inherent consequence of an enhanced quality of life and functioning, instead of the goal. After all, in addition to reported symptoms, it is common for patients with somatic symptoms and related disorders to engage in high levels of avoidance, since they commonly view their private experiences as unmanageable (Sayyar et al., 2019),

which restricts their lives and, thus, impacts quality of life, as well as further reinforcing or worsening of symptoms.

Acceptance and Commitment Therapy (ACT) is a third generation cognitive and behavior therapy based on the Relational Frame Theory (RFT). The latter assumes the normality of cognitive processes underlying psychopathology, shifting the focus from eliminating them to contextually reducing their importance by refocusing and increasing the functional importance of other cognitive activity (Hayes et al., 2012). One of the primary goals of ACT is to increase psychological flexibility by creating a separation between the self and thoughts, which in turn prevents avoidant behaviors. ACT therapists teach techniques such as cognitive defusion to help people learn how to observe their thoughts without becoming caught up in them. This is used to help people learn how to manage unpleasant thoughts and feelings, without the need to engage in maladaptive avoidance. ACT's creator, Steven Hayes, argues that "unfortunately, attempts to avoid uncomfortable private events tend to increase their functional importance […] and thus tend to narrow the range of behaviors that are possible since many behaviors might evoke these feared private events" (Hayes et al., 2009, p. 7). In other words, avoidance isn't effective since, despite providing relief in the short-term, it constrains one's life in the long term, which prevents the individual from overcoming their fear, making it worse over time.

There is evidence that therapies that promote psychological flexibility and cognitive defusion, by minimizing the use of maladaptive behaviors such as experiential avoidance and increasing mindfulness, acceptance, and tolerance to uncomfortable feelings and sensations, are also effective treatments for somatic symptoms and related disorders (Eilenberg et al., 2015; Sutar et al., 2016; van Ravesteijn, 2016).

Cullingham et al. (2020) examined the relationship between psychological inflexibility and somatization in participants with nonepileptic attack disorder (NEAD). The researchers stated that though CBT is the current recommended treatment for NEAD, its focus on symptom reduction has been shown to be only effective for some. Other patients fail to experience successful remission in symptomatology through CBT. Therefore, it raises the question of whether focusing on symptom reduction is the most effective strategy or whether it is time to strive for alternative therapeutic goals, such as acceptance, recovery of functioning, and enhanced quality of life, especially for chronic conditions. Furthermore, Cope et al.'s (2017) study comparing the efficacy of ACT and CBT in treating the same condition (NEAD) concluded that they both have similar outcomes. However, ACT has additional advantages because it is not designed to focus on challenging dysfunctional beliefs. This means that patients who are uncomfortable or even in denial about the possibility of having a psychological disorder, due to mental health stigma and prejudice, may be less likely to drop out from ACT treatment (Cope et al., 2017).

Mindfulness-based cognitive therapy (MBCT) integrates both cognitive and mindfulness techniques as part of the intervention. One study on its efficacy for somatoform disorders found that it was more effective than CBT alone because the latter focuses on identifying unhealthy thought patterns, and clients tend to be hesitant to go to talk therapy to treat a condition that feels so physical to them (van Ravesteijn, 2016). Overall, MBCT was found to be higher than CBT in treatment satisfaction and adherence. While the CBT control group had slightly higher scores in health status and physical functioning, the MBCT group showed higher levels of mental and social functioning (van Ravesteijn, 2016).

Theories of Somatization

The current literature suggests two opposing, well-supported frameworks for understanding these disorders: a cognitive behavioral model (CBM) or a predictive perspective. A commonality in both theories is that the development and maintenance of somatic symptoms and related disorders are associated with abnormal interoceptive perception. Interoceptive perception is one's awareness of internal physical sensations, such as organ functions, as well as the sympathetic activity of the autonomic nervous system related to emotions.

Development. These two frameworks disagree, on the other hand, on the nature of such interoceptive abnormalities. Based on the cognitive model of panic disorder, the cognitive behavioral model (CBM) suggests that the individual notices minor somatic symptoms due to somatic hypervigilance, and over focuses their attention to these symptoms, through selective attention allocation, and then interprets the sensations in a negative way (Witthöft, 2020). In line with this framework, people cognitively process these symptoms by worrying through catastrophic cognitions, thereby amplifying, and exaggerating the symptoms themselves, through a bottom-up process.

Conversely, a prediction framework is based on principles of predictive processing and active inference, as well as the Bayesian brain hypothesis. Thus, it conceptualizes somatization as an "active, constructional, and hypothesis-driven" process in which expectations modulate perception, in accordance with the principle of minimization of error (Witthöft, 2020). That said, it assumes somatization to be a top-down process, in which somatic sensory information do not even need to be present, since sensation perception can arise without any afferent input. This claim is backed up by the perception of phantom limbs and neuropathic pain, for instance.

Moreover, predictive theories of somatization are based on the idea that somatization, despite maybe initially depending on *prior* experience (so that a symptom memory is consolidated), eventually becomes less reliant on *current* sensory input, and increasingly more reliant on predictions and expectations (Witthöft et al., 2020).

Maintenance. In both perspectives, the disorders are thought to be maintained by dysfunctional behaviors, such as avoidance, checking behaviors and social withdrawal, which, in turn, increases distress and frequency of symptoms. However, the cognitive behavioral model (CBM) argues that the nature of avoidance is external, in which individuals avoid social situations and activities and become too focused and consumed with checking behaviors. Predictive theories, on the other hand, suggest that experiential avoidance is the main contributor to the maintenance of symptoms, claiming that attempts to avoid attending to physical complaints in turn increases their functional value. Note that the theories have divergent conceptualizations on the nature of the interoceptive attention: too many checking behaviors (CBM) as opposed to experiential avoidance of somatic experiences, or not checking enough (predictive framework).

In summary, while the CBM predicts that higher interoceptive awareness leads to somatization, the predictive model assumes that a less detailed sensory process and, therefore, lower interoceptive accuracy, lead to somatization.

Current evidence.

The cognitive behavior model (CBM) draws insights from research in the fields of behavioral and cognitive psychology. It stems from the idea that though our internal systems are constantly active, some people can be prone to sensitivity to those minor sensations that are

usually unconscious for most other people. This may occur through hypervigilance, selective attention biases to painful stimuli, catastrophizing the experience, and experiencing pain-related anxiety. According to Lautenbacher et al. (2010), these processes lead to the development or physical health complaints, or the maintenance or exacerbation of existing conditions.

Predictive theories of somatization, on the other hand, have their roots in the psychoanalytic notion of conversion. From Sigmund Freud's work, conversion occurs when psychological phenomena (e.g., stress, anxiety, or trauma) fail to be adequately processed, and are instead converted into physical symptoms that symbolize an unconscious intrapsychic conflict. Since this idea of unconscious forces cannot be empirically studied, scholars now argue for a top-down process, in which *neurological* phenomena influence physical experiences. Psychological phenomena arise from neural activity, in accordance with a materialistic view on the mind-body problem, which is the perspective that is largely endorsed by science today. That said, psychological phenomena are indeed capable of affecting physical experiences. In other words, psychological conflicts are indeed correlated with somatization, but likely through more indirect ways than Freud's original conceptualization of conversion.

That said, within a predictive framework, it has been proposed that somatization might be a manifestation of unacknowledged emotions. Supportive evidence for this includes research findings that people who experience depressive episodes, anger, hostility, and anxiety are more likely to experience somatization (Kellner, 1990). Such results make sense, acknowledging that interoceptive awareness is closely related to the physiological activity from emotions.

Another perspective within the same framework is that somatization is a result of a form of pathological learning/ memory. Non-associative and associative learning, such as sensitization

and classical conditioning, respectively, could also explain somatization through a predictive lens: repeated exposure to a painful stimulus while high in arousal sensitizes people to subsequent exposures. Due to sensitization, classical conditioning is facilitated because the experience is more salient each time. That said, conditioned stimuli associated with such experiences may eventually be enough to activate the pain memory, even in the absence of a current painful stimulus. With that in mind, Icenhour et al. (2017) found changes in neural activity and visceral stimulation during anticipation (expected due to a conditioned cue) because of prior conditioning. Moreover, recent studies on the cytoarchitecture of an interoceptive predictive processing framework suggests that perceptual processes related to the somatosensory modality are affected by top-down influences more often than other sensory modalities, such as sight (Witthöft et al., 2020).

While there is circumstantial evidence to support each theory, there are only a few studies assessing both concurrently, aiming at finding support for one of the theories. Moreover, those few studies reflect inconclusive or mixed results. Schaefer et al. (2012) found no differences in interoceptive accuracy between participants with somatoform disorders and the control group, in line with previous findings (Mussgay et al., 1999). These findings do not support either theory. Witthöft et al. (2020), on the other hand, found a weak to medium negative association with cardiac symptoms and cardiac interoceptive accuracy, supporting the predictive theory. However, these results were limited to heart activity and showed small effects. Nevertheless, it is in accordance with other studies looking at cardiac interoceptive accuracy and somatization (Herbert et al., 2011; Schaefer, Egloff, & Witthöft, 2012), suggesting a less precise and hence a

more biased sensation of body processes associated with higher somatic symptom distress (particularly in the cardiorespiratory system).

Conceptualizing Interoceptive Awareness

Earlier conceptualizations of interoceptive awareness considered individuals' attentional focus on physical sensations as a maladaptive manifestation of anxiety, depression, and, ultimately, somatization. This perspective closely associates interoceptive awareness with hypervigilance, and it is consistent with the cognitive behavioral model. In fact, screening for the number and perceptual intensity of physical symptoms have been used as markers to measure anxiety and somatization in several studies and in clinical settings.

Recently, with the increasing popularity of mindfulness in the psychological literature and the accumulating evidence on its effectiveness for managing various psychological symptoms, the perspectives of somatic awareness are shifting. A core aspect of mindfulness is non-judgmental, present-focused awareness of internal experiences. This suggests that in some cases, heightened somatic awareness could have beneficial outcomes. In consideration of that, several current evidence-based psychotherapies (e.g., Acceptance and Commitment Therapy and Mindfulness-Based Cognitive Therapy) now incorporate a large focus on mindfulness, deliberately aiming at enhancing somatic awareness. It is important to reiterate though that these therapies specifically train individuals on non-judgmental acceptance of their experiences.

The CBM presumes that high interoceptive awareness is maladaptive because it leads to hypervigilance. The predictive framework conversely is based on the idea that low interoceptive awareness leads to somatization occurring through top-down processes overriding bottom-up processes. Similarly, allocating attention towards an immediate experience appears to be

adaptive, whereas an abstract ruminative self-focus later appears to be maladaptive. In examining their basic premise, these theories seem in direct opposition. One way of clarifying these contradictory views is by identifying the different sub-components of interoceptive awareness.

Therefore, Mehling et al. (2012) defines body/interoceptive awareness as the combination of both the sensory perception produced by the body's internal physiological changes due to processes like pain, emotion, and movement; as well as one's appraisal of the awareness of such experiences. The latter tend to be influenced by attitudes, beliefs, and one's social and cultural context. Put simply, interoceptive awareness is the perceptual process of not only sensing, but also evaluating internal bodily signals. This definition led to the creation of a new measurement of interoceptive awareness, the Multidimensional Assessment of Interoceptive Awareness (MAIA), with subscales that measure those different components of the concept.

Other researchers have added on to Mehling's conceptualization and argued for a three-dimensional model. Garfinkel et al. (2015) validated three distinct constructs of interoception: accuracy, sensibility, and awareness. Interoceptive accuracy refers to the degree to which one's perceptions are objectively close to reality; interoceptive sensibility refers to the perception of one's subjective experiences closely related to their emotional sensibility; and interoceptive awareness refers to a metacognitive process in which the individual is aware of both of the objective (interoceptive accuracy) and subjective (interoceptive sensibility), which is what the MAIA is intended to measure.

Based on this conceptualization, there are notable conceptual and functional similarities or overlaps between interoceptive awareness and mindfulness. Indeed, greater dispositional mindfulness has been previously linked with greater interoceptive awareness, and both of these

concepts are associated with psychological well-being (Hanley et al., 2017). In fact, mindfulness interventions such as Acceptance and Commitment Therapy (ACT) and Mindfulness-Based Stress Reduction (MBSR) tend to focus on promoting awareness of somatic sensations, since it is thought to be one of the primary mechanisms of positive change in mindfulness interventions. Indeed, MBSR was found to increase 5 out of 8 dimensions of interoceptive awareness measured by the MAIA (Bornemann et al., 2015).

However, despite highly intertwined attentional processes, interoceptive awareness and mindfulness are distinct processes. While interoceptive awareness is conceptualized with a focus only on somatic experiences, mindfulness refers to attention directed to any type of activity (exteroception, interoception, and cognitions). Additionally, mindfulness focuses on a non-evaluative stance, while interoceptive awareness does not necessarily distinguish between a non-judgmental or an anxiety-driven attentional style.

These conflicting approaches on how to conceptualize such concepts are the basis for the competing nature of both perspectives on somatization. Therefore, the goal of this study is to assess both theories (CBM and Predictive framework), aiming at finding evidence for both, and, thus, further advocate for a complementary, rather than opposing view, in order to better account for the complexity of human nature and individual differences.

Hypotheses:

1. H1: Low interoceptive awareness will be correlated with a higher tendency towards somatization.
2. H2: Conversely, high interoceptive awareness will be correlated with a higher tendency towards somatization.

3. H3: Mindfulness will be negatively correlated with tendency towards somatization.
4. H4: Experiential avoidance will be positively correlated with tendency towards somatization.
5. H5: High endorsement of somatic cognitive distortions will be positively correlated with tendency towards somatization.

Methods

Participants

The researchers recruited participants online through Amazon Mechanical Turk (mTurk) during March 2022. All participants were at least 18 years old and lived in the United States of America (USA). After starting with 229 participants who consented to participate (17 individuals opened the survey, but did not consent), we eliminated the data of seven participants who failed either of two attention checks (one open-ended question and one forced-choice multiple-choice question). The final sample consisted of 222 participants. Acknowledging that the purpose of this study was to assess tendencies towards somatization, rather than psychopathology specifically, we did not prescreen to either explicitly include or exclude those diagnosed with somatic symptoms and related disorders. Therefore, our sample could range to include individuals who experience no or subclinical levels of somatization to those with diagnosed psychopathology.

Procedure

The online questionnaire began with the informed consent form. Participants who consented to participate then provided some demographic information (e.g., race/ethnicity, highest level of education obtained, etc.). Subsequently, participants answered questions

regarding commonly experienced physical symptoms and their associated emotions; cognitive distortions associated with those somatic experiences; the degree to which they are aware of their internal feelings and sensations; the degree to which they avoid unpleasant experiences; as well as the degree to which they observe, note, describe, act with intentionality, judge, and react to things around them. The online questionnaire ended with debriefing participants about the purpose of the study, providing them contact information for the researchers, and thanking them for their participation.

Measures

Demographics

Participants answered questions about their age, gender identity, race/ethnicity, level of education, and whether they have been diagnosed with a chronic health condition.

Symptom Checklist-90 (SCL-90)

The Symptom Checklist-90 (SCL-90) (Derogatis & Unger, 2010) questionnaire was developed to assess several psychological domains, including somatic symptoms and somatization. It was created in accordance with diagnostic criteria in the Diagnostic and Statistical Manual of Mental Disorders, 5th edition (DSM 5), and its clinical utility, reliability and validity have been empirically supported. The SCL-90 is a 90-item self-report measure assessing several dimensions. For this study, we used only the 12 items from the somatic subscale (all items that were correlated with somatization). Participants could indicate the degree to which they have been recently bothered by various somatic symptoms on a Likert scale ranging from 1

(*not at all*) to 5 (*extremely*). The scores are then summed with higher scores suggesting a greater tendency towards somatization.

The Whiteley-7 Scale

The Whiteley-7 Scale (Fink et al., 1999) was designed to quickly screen for somatization as a brief 7-item self-report questionnaire, with two sub-scales assessing illness conviction and worrying. Participants answered "yes" or "no" to questions assessing whether they often worry about somatic symptoms or potential illness. The summed scores could range from 0 to 7, with higher scores suggesting higher tendency for somatization. The Whiteley-7 Scale was found to have an acceptable psychometric profile.

Five Facets Mindfulness Questionnaire (FFMQ)

The Five Facets Mindfulness Questionnaire (FFMQ) (Baer et al., 2008) was developed to measure mindfulness through an exploratory factor analysis. The 39-item FFMQ has five subscales: observing, describing, acting with awareness, non judging, and nonreactivity. Observing refers to how we perceive internal and external stimuli by staying present and avoiding distraction; Describing means one's ability to name or label their experiences; Acting with awareness is related to staying focused on a task, rather than acting it mindlessly (on auto-pilot) or being distracted; Nonjudging is one's ability to stay neutral, without evaluating their experiences; Finally, nonreactivity refers to a detachment from and disengagement with thoughts and emotions, being associated with acceptance. Various aspects of mindfulness are measured on a Likert scale ranging from 1 (*never or very rarely true*) to 5 (*very often or always*

true). Summed scores range from 39 to 195, with higher scores suggesting a higher level of mindfulness. Its construct validity has been empirically supported.

Experiential Avoidance Scale (BEAQ)

The Brief Experiential Avoidance Questionnaire (BEAQ) (Gámez et al., 2014) consists of 15 items assessing tendencies toward avoiding unpleasant experiences, including unpleasant feelings, sensations, emotions, situations, and memories. Participants responded on a Likert scale ranging from 1 (*strongly disagree*) to 6 (*strongly agree*). High scores suggest higher degrees of experiential avoidance. The BEAQ was developed from the 62-item Multidimensional Experiential Avoidance Questionnaire (MEAQ) due to practical clinical and research utility, and it has demonstrated good internal reliability. It predicts avoidance, psychopathology (extreme), and quality of life (restrain), but it was found to be distinct from neuroticism and negative affectivity.

Somatic CEQ-R

The Cognitive Errors Questionnaire-Revised (CEQ-R) (Moss-Morris & Petrie, 1997) uses specific scenarios to first illustrate and then measure endorsement of specific cognitive distortions, such as overgeneralization, selective abstraction, catastrophizing, and personification. It contains two subscales: General CEQ-R, regarding cognitive biases in everyday life, and Somatic CEQ-R, regarding cognitive biases related to somatic experiences. While both subscales presented high internal consistency and good test-retest reliability, further investigation showed the somatic scale to be more associated with self and symptom focusing. That said, only the 9-item somatic subscale was used for the purposes of this study. After reading illustrations of the

cognitive distortions, participants could indicate their likelihood of endorsing that distortion on a Likert scale ranging from 1 (*almost exactly like I would think*) to 5 (*not at all like I would think*). Lower scores suggest higher levels of cognitive errors. That said, we reversed scored all items for smoother analysis.

Multidimensional Assessment of Interoceptive Awareness (MAIA)

The Multidimensional Assessment of Interoceptive Awareness (MAIA) (Mehling et al., 2012) measures interoceptive awareness, with acceptable psychometric properties. Because interoceptive awareness has been associated with both positive (mindfulness) and negative (hypervigilance) practices in previous literature, the MAIA subscales are able to measure interoceptive awareness in both regards. There are 8 subscales: noticing, not-distracting, not-worrying, attention regulation, emotional awareness, self-regulation, body listening, and trusting. The core five domains from interoceptive awareness are measured in those subscales: general awareness of somatic sensations, emotional and attentional responses to bodily sensations, attention regulation capacity, awareness of mind-body integration, and tendency to trust somatic feelings. Participants indicated how true various statements (e.g., "When I am tense, I notice where the tension is located in my body.") were for them on a Likert scale ranging from 1 (*never*) to 5 (*always*). Higher scores suggest higher awareness of internal states and sensations.

Results

Participants were 222 American adults. The mean age was 43. 122 participants identified their gender as female; 97 as male; and 2 as non-binary. One participant did not identify a

gender. Regarding the most common racial/ethnic identifications, 75.7% of the sample identified as White or Caucasian, 8.6% as Black or African American, 7.2% as Asian/Asian-American, and 2.3% as Hispanic American/Latinx. Overall, the sample was highly educated, with 65% having at least a bachelor's degree.

Given that the focus of this study is experiences of somatization, we included a question in which participants could report whether they had been diagnosed with a chronic health condition. Because a substantial number of participants (41.4%) responded in the affirmative, independent sample t-tests were conducted to examine whether there were any statistically significant differences in somatization based on diagnosis status. The mean scores of reported somatic symptoms were 12.25 (SD = 9.75) and 5.79 (SD = 7.14) for diagnosed and undiagnosed participants, respectively. The mean scores of health anxiety (i.e., excessive worry about somatic complaints) were 3.93 (SD = 2.17) and 1.42 (SD = 1.90) for diagnosed and undiagnosed participants, respectively. Compared to the 130 participants who did not report having diagnosed chronic health conditions, the 92 participants who did report such diagnoses also reported statistically significantly more somatic symptoms $t(157.14) = -5.41$, $p < .001$, $d = -.78$, and more health anxiety $t(179.16) = -8.95$, $p < .001$, $d = -1.25$.

To reiterate the study hypotheses, it was expected that scoring either low or high on interoceptive awareness would be correlated with a higher tendency towards somatization. Additionally, mindfulness was predicted to be negatively correlated with somatization. Conversely, experiential avoidance and high endorsement of somatic cognitive distortions would be positively correlated with somatization (H1 and H2). Additionally, mindfulness was expected

to be positively correlated to somatization (H3). Conversely, experiential avoidance would be positively correlated with somatization (H4). Similarly, high endorsement of cognitive distortions would also be positively correlated with somatization (H5).

Somatization was measured with two different scales assessing distinct aspects of it: the experience of physical symptoms (Somatic SCL-90) and excessive health anxiety associated with such symptoms (Whiteley-7). A Pearson product-moment correlation coefficient computed of the two measures indicated that, as would be expected, they are moderately positively correlated, $r(220)= .44$, $p =.00$, suggesting that the more somatic symptoms participants reported, the greater their health anxiety about those symptoms.

H1 – H2: Somatization and Interoceptive Awareness

Interoceptive awareness was measured with the MAIA subscales, which assess eight different aspects of it: Noticing, Not Distracting, Not Worrying, Attention Regulation, Emotional Awareness, Self-Regulation, Body Listening, and Trusting. Noticing refers to the awareness of physical stimuli; Not Distracting reflects whether someone tends to use distraction to avoid uncomfortable physical sensations; Not Worrying reflects whether people are prone to experiencing emotional distress with somatic feelings; Attention Regulation refers to the ability to maintain controlled focus on the body; Emotional Awareness is about one's understanding of the connection between bodily and affective states; Self-Regulation refers to one's ability to focus on the body in order to regulate their emotions; Body Listening is the ability to actively attend to somatic experiences for psychological insights. Lastly, Trusting refers to the degree to which one experiences their body as safe and trustworthy.

Taken together, hypotheses 1 and 2 reflect a predicted quadratic relationship between overall interoceptive awareness and tendency towards somatization, such that both overly low and overly high interoceptive awareness would be associated with more somatization. To test these hypotheses, we conducted two polynomial regressions to assess the relationships between interoceptive awareness (defined as the total of all MAIA subscale scores) and both somatic symptoms (Somatic SCL-90) and health anxiety (Whiteley-7). The polynomial regression analysis between the Somatic SCL-90 and MAIA scores suggests that interoceptive awareness accounts for an insignificant amount of the variance in the number of somatic symptoms people report experiencing. Interoceptive awareness did not significantly, reliably predict somatic symptoms using either a linear (R^2 =.00, $F(1, 220) = .20$, $p = .66$) or quadratic (R^2 =.01, $F(2, 219) = .99$, $p = .19$) model.

The second polynomial regression was to assess the relationship between interoceptive awareness and health anxiety (Whiteley-7). While the linear model was significant (R^2 =.03, $F(1, 220) = 6.59$, $p = .01$), the hypothesized quadratic model was not significant (R^2 =.04, $F(2, 219) = 4.81$, $p = .09$). With the linear model, participants' overall interoceptive awareness predicted somatization as defined here by reported health anxiety ($\beta = -.17$, $p = .01$). For every 1-point increase in interoceptive awareness, a .17 unit decrease in health anxiety is predicted.

Additionally, Pearson product-moment correlation coefficients were computed between overall interoceptive awareness and somatization. There was a non-significant relationship between general interoceptive awareness and number of physical symptoms reported. However, overall interoceptive awareness was found to be weakly, negatively correlated with health anxiety, $r(220)=-.17$, $p=.01$. This suggests that the more interoceptive awareness participants

reported (i.e., the more aware they were of their internal sensations), the less health anxiety they tended to report.

In order to further investigate these unexpected findings, we conducted exploratory post-hoc analyses on the specific components of interoceptive awareness, which were measured by the different MAIA subscales, and their relationships with somatization. Pearson product-moment correlation coefficients were calculated to examine whether the eight different aspects of interoceptive awareness have varying relationships with somatization. The data are reported in Table 1.

Table 1
Relationship Between Interoceptive Awareness and Somatization

MAIA Subscale	Somatic SCL-90	Whiteley-7
Noticing	.20**	.20**
Not Distracting	-.12	-.05
Not Worrying	-.18**	-.48**
Attention Regulation	-.02	-.15*
Emotional Awareness	.03	.048
Self-regulation	-.05	-.14*
Body Listening	.17*	.06
Trusting	-.21**	-.34**
Total (sum of subscales)	-.03	-.17*

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

The MAIA Noticing subscale was positively correlated with both the reporting of physical symptoms and health anxiety. The more participants were aware of somatic stimuli, the more somatic symptoms they reported and the more health anxiety they reported. Conversely, the Not Worrying subscale was negatively correlated with both the reporting of physical symptoms and health anxiety. This means that the less participants tended to worry or get emotionally reactive due to uncomfortable physical stimuli, the less physical symptoms, and the less health anxiety they tended to report. It is important to highlight that this subscale was only weakly correlated with the reporting of somatic symptoms, but moderately to strongly correlated with health anxiety.

Similarly, the MAIA Trusting subscale was found to be negatively correlated with both the number of physical symptoms reported and health anxiety levels. The more participants felt safe in their own bodies, the fewer somatic symptoms, and the lower health anxiety they reported, with a stronger relationship for the latter. In other words, one's trust in their body is associated with less overall somatization.

Interestingly, the Body Listening subscale was weakly, positively correlated with the reporting of somatic complaints, but not significantly correlated with health anxiety at all. In other words, the higher one's ability to attend to bodily signals for psychological insight, the more physical symptoms reported, without necessarily feeling anxious about said symptoms. On the other hand, the Attention Regulation and Self-Regulation subscales were both found to be only negatively correlated with the levels of reported health anxiety, but not the number of somatic complaints, contrary to what one may intuitively expect. In other words, the higher the

ability to focus and sustain attention to the body, as well as the subsequent ability to regulate psychological distress by attending to the body, the more health anxiety reported.

Finally, the MAIA Not Distracting and Emotional Awareness subscales were the only subscales for which there were no statistically significant correlations with either reports of somatic symptoms or health anxiety. Therefore, there was surprisingly no evidence of significant relationships between somatization and distracting oneself to avoid uncomfortable physical sensations or awareness of the connection between somatic and emotional experiences.

H3: Somatization and Mindfulness

Mindfulness was measured with the FFMQ subscales which assess five different components of mindfulness: observation, description, acting with awareness, non-judging, and non-reactivity. Pearson product-moment correlation coefficients were computed to investigate the relationship between mindfulness and somatization. Contrary to expectations, both the number of physical symptoms reported, $r(220) = .25$, $p = .00$; and health anxiety, $r(220) = .22$, $p = .00$, were positively, though weakly, correlated with general mindfulness. In other words, contrary to the third hypothesis, the more overall mindfulness participants endorsed, the greater their tendency toward somatization. To better understand this unexpected finding, subsequent Pearson product-moment correlation coefficients were computed to examine whether the five specific aspects of mindfulness have varying relationships with somatization. These data are reported in Table 2.

Table 2
Relationship Between Mindfulness and Somatization

FFMQ Subscale	Somatic SCL-90	Whiteley-7
Observation	.45**	.41**
Description	.28**	.13
Acting With Awareness	-.47**	-.32**
Non Judging	-.32**	-.24**
Nonreactivity	.43**	.28**
Total (sum)	.25**	.22**

**. Correlation is significant at the 0.01 level (2-tailed).

The FFMQ Observation subscale was positively correlated with both the reporting of physical symptoms and health anxiety. The more participants reported noticing internal and external stimuli, the more physical health symptoms they reported and the more health anxiety they also reported. While the Description subscale was positively correlated with reported number of physical complaints, there was no statistically significant relationship between this aspect of mindfulness and reported health anxiety. The more participants were able to verbally describe and label their cognitions and emotions, the more physical health complaints they tended to report. However, there was no significant relationship between that ability and how overly anxious or preoccupied participants felt about their physical health.

Contrary to what one may intuitively expect, Nonreactivity was positively correlated with both the number of physical symptoms reported and health anxiety levels. The more individuals actively accepted and detached themselves from their experiences (less reactive), the more physical symptoms complaints and the higher anxiety levels they tend to report. Acting with

awareness was negatively correlated with both the number of physical symptoms and health anxiety reported. In other words, the greater participants' ability to stay focused on a task (as opposed to acting mindlessly or being distracted), the less physical health complaints and the less health anxiety they tended to report.

The Nonjudging facet, an essential component of mindfulness, was negatively correlated with both the number of physical symptoms reported and health anxiety levels. In other words, the more participants were able to access their thoughts, emotions, beliefs, and situations without judging them, the less somatic symptoms and health anxiety they reported.

In summary, mindfulness, when measured as an overall construct, was weakly associated with somatization. However, when further investigating its facets, Observation, Description and Nonreactivity were positively correlated with tendency towards somatization, while Acting with Awareness and Nonjudging were negatively correlated with somatization.

H4: Somatization and Experiential Avoidance

Pearson product-moment correlation coefficients were also computed to investigate the relationships between somatization and experiential avoidance. The data support the fourth hypothesis that experiential avoidance is positively associated with tendency toward somatization. It was found to be significantly positively correlated with both the number of physical symptoms reported, $r(220)=.41$, $p=.00$, and health anxiety levels, $r(220)=.34$, $p=.00$. In other words, the more someone strives to avoid unpleasant experiences, the more likely they are to engage in somatization.

H5: Somatization and Cognitive Distortions

Finally, Pearson product-moment correlation coefficients were also calculated to investigate the relationships between somatization and cognitive errors and biases. The findings support the last hypothesis that high endorsement of somatic cognitive distortions is positively correlated with tendency towards somatization. Endorsement of somatic cognitive biases and errors was found to be positively correlated with both the number of physical symptoms reported, $r(220)=.36$, $p=.00$, and health anxiety levels, $r(220)=.36$, $p=.00$. In other words, participants with greater tendency towards engaging in common cognitive distortion, also tended to experience more somatization.

Discussion

Somatization and Interoceptive Awareness

Both intuitively and based on findings from previous research, we expected to find a relationship between interoceptive awareness and tendency towards somatization. The exact nature of the relationship based on the previously reviewed research, is however, less clear. Being excessively aware of (i.e., consumed with) interoceptive activity was historically associated with hypervigilance and, therefore, seen as having an overall negative impact on well-being. However, with the emergence of research on mindfulness, which advocates for and promotes interoceptive awareness, scholars had questioned that idea. The benefits of mindfulness for psychological and physical well-being are well established. That said, it could be hypothesized that mindfulness is effective in reducing somatization due to enhanced quality of life, in general. However, due to their common somatic nature, it is more possible that

mindfulness acts on somatization through more direct ways: enhancing people's awareness of bottom-up processes, thus making them less likely to be overridden by top-down signals.

Because of that interesting relationship, we had hypothesized that interoceptive awareness and somatization would have a quadratic relationship; both overly low and overly high levels of interoceptive awareness were expected to be associated with a higher tendency towards experiencing somatization. However, the obtained results did not support our prediction of this quadratic relationship.

One contributing factor might be the fact that unintentionally, almost half of our sample reported that they had diagnosed chronic physical health illnesses. Examples of these illnesses could be chronic pain, arthritis, multiple sclerosis, fibromyalgia, sciatica, irritable bowel syndrome, endometriosis, lupus, or any number of other chronic health conditions that can cause varying levels of distress and functional impairment. Given their experiences of living with such persistent health difficulties, it is not surprising that we found evidence that these participants did report statistically significantly more somatic symptoms and health anxiety. One implication is that we may have had less diversity than intended in our sample. As stated earlier, we intended to include a broad range of experiences, from those who do not experience much somatization to those who may even qualify to diagnoses of somatic symptom and related disorders. In other words, we intended to assess tendency towards somatization in the general population, rather than in a clinical population or specifically in a population of those living with chronic physical illnesses. Perhaps the hypothesized quadratic relationship between interoceptive awareness and somatization could be supported with a more diverse sample, as opposed to a sample with almost half of the participants scoring towards the higher end of somatization.

Another explanation could be this study's own limitation, in assessing interoceptive awareness as conceptualized by the MAIA scale: one's self-report based metacognitive perception of being consciously aware of both objective and subjective aspects of somatic experiences. In other words, this study did not differentiate between interoceptive accuracy and interoceptive sensibility, since the former would need more objective methods of measurement (i.e., measuring participants heart rate). However, it is possible that interoceptive accuracy would yield stronger results when assessing its relationship with somatization because it might better encompass the nature of the interoceptive abnormality agreed upon by both investigated theories, rather than interoceptive awareness as a general concept. Future research should assess the relationship between somatization and interoceptive accuracy specifically to further investigate such abnormality.

However, the findings still suggest an interesting relationship between interoceptive awareness and somatization. The data suggest that the relationship between different specific components of interoceptive awareness and somatization may be more important than interoceptive awareness considered as an overall concept. Acknowledging Mehling's (2012) new conceptualization of interoceptive awareness, it is a combination of both sensory experience and one's evaluations of them. That said, the different components of interoceptive awareness were found to have inverse relationships with somatization, which could explain the weak association between the overall score and tendency towards somatization.

The researchers' intentions when developing the MAIA subscales were so higher scores in every subscale reflected higher awareness. This led to two subscales conceptualized in the negative, "Not Worrying" and "Not Distracting" composed of items that would be reverse

scored. Example items include, “When I feel physical pain, I become upset.” and “I ignore physical tension or discomfort until they become more severe.” One could argue that the nature of the evaluation process does not predict awareness, since interoceptive awareness does not necessarily distinguish between a nonjudgmental or an anxiety-driven attentional style. In other words, one isn’t necessarily less aware of somatic symptoms when worried. The opposite might also be true, in which, because they are worried, they are more aware of it, since anxiety leads to hypervigilance. That said, in my opinion, the sum of MAIA subscale scores as a whole may be less useful for interpretative purposes. Therefore, the MAIA may be best interpreted by each specific subscales, as many other scholars have done. If this study were replicated, it would be done in this fashion with specific a priori hypotheses made regarding the relationships between specific subscales and somatization.

Our results suggest that too much awareness of physical stimuli (MAIA Noticing subscale) is associated with higher tendency towards somatization, manifested as both the experience of more physical symptoms and more health anxiety. This finding supports the cognitive behavioral model (CBM) of somatization, since it argues that increased attention to bodily signals could lead to hypervigilance and selective attention. This could then lead to more consciously experienced physical symptoms, as well as a high likelihood of responding to those symptoms with worry and catastrophic beliefs, leading to higher health anxiety.

Similarly, the MAIA subscale Body Listening was associated with a greater number of physical symptoms experienced, but without significantly higher anxiety. In other words, the ability to actively attend to somatic experiences for psychological insight was also associated with reporting more somatic symptoms. However, it was only associated with the sensory, but

not affective (i.e., worrying, overreactivity), aspect of somatization. People who would score high on Body Listening are those that in trying to understand how they feel about a situation or what behavior might be beneficial to them, they intentionally attend to internal cues like their breathing or heart rate. It is not surprising then that individuals with this tendency are also likely to notice more somatic sensations (e.g., “a lump in your throat” or “pains in lower back”) as measured on the Somatic SCL-90. Their observation of these symptoms was not directly connected to an overreaction to the symptoms.

We also found that the ability to feel safe in one’s body (MAIA Body Trusting subscale) and the ability to not worry about uncomfortable sensations (MAIA Not Worrying subscale) were associated with less somatization, both the sensory and the affective components. These findings could support either theory, depending how they are interpreted. They could be in line with the predictive framework, which states that psychological phenomena (in this case worrying and not trusting) can produce not only an affective, but also a sensory experience due to expectations. However, they could also support the CBM, since psychological phenomenon could intensify existing physical symptoms.

Similarly, the abilities to focus attention to somatic sensations (MAIA Attention Regulation subscale) and subsequently regulate psychological distress by sustaining such attention (MAIA Self-Regulation subscale) were found to be associated with less somatization. However, no statistically significant associations were found between the sensory aspect of somatization. Rather, such abilities were only related to its affective component, with those abilities being associated with less health anxiety. These findings are in line with the predictive framework, indicating that more attention to the body and using the body’s signals to regulate

one's psychological state may lead to a more detailed sensory experience that is harder to be overridden by emotional states or memory (top-down processes)

Somatization and Mindfulness

Contrary to the third hypothesis, mindfulness was found to be associated with higher tendency towards somatization, initially somewhat supporting the cognitive behavior model (CBM). However, since it was an unexpected finding and a weak correlation, we decided to investigate if the five different components of mindfulness (observation, description, acting with awareness, non-judging, non-reactivity) have differing relationships with somatization, as it did in the case of interoceptive awareness, described above.

The findings suggest that our ability to observe our experiences by staying present and without distracting ourselves (FFQM Observing subscale) is associated with increased somatization, with increases in both the reporting of physical complaints and health anxiety. These results are in support of the cognitive behavioral model (CBM), since it suggests that distraction, and not mindful engagement, is associated with less somatization due to decreased hypervigilance.

One's ability to describe and label their experiences (FFQM Describing subscale) was also found to be associated with increased somatization. However, it was only associated with the experience of more physical symptoms, without a negative affective component. As theorized earlier when explaining similar results between the MAIA subscale Body Listening and somatization, this finding could be explained by the fact that by labeling experiences they come into conscious awareness and become more salient. However, that label is not inherently

neither more positive nor more negative. That said, we could become more aware of physical stimuli, but not be necessarily cognitively negatively reactive (i.e., anxious) to those stimuli. Such results make sense since description entails noticing, reflecting a higher number of physical symptoms reported, but without an emotional reaction associated with it. With that in mind, such finding also supports the cognitive behavioral model (CBM).

The Non-Reactivity component of mindfulness is about our ability to detach from unpleasant emotions and thoughts. Someone who scores high on this subscale is able to acknowledge the existence of these negative thoughts and emotions without reacting to them. Given this conceptualization, it was thus surprising that Non-Reactivity was associated with more somatization, specifically that it was associated with both more reports of physical symptoms and more negative affective reactions to the symptoms. The latter relationship, that a better ability to not react to negative emotions and thoughts was significantly associated with increased health anxiety, was most surprising. It could be the case that very high scores in the Non-Reactivity subscale suggest levels of denials. If that were the case, these findings would be aligned with the predictive framework, with unacknowledged thoughts and emotions leading to somatization. Further research is needed to determine if that is actually the case and why, or if it was due to a methodological issue.

On the other hand, the ability to stay focused on a task without being distracted or operating on “autopilot” (FFQM Act with Awareness subscale) was associated with decreased sensory and affective somatization. This finding suggests that behaving purposefully decreases the likelihood of over focusing and overreacting to unimportant stimuli, in this case physical sensations, supporting a cognitive behavioral model (CBM). Distraction of bottom-up, afferent

sensory stimuli through intentional focus on an activity is associated with decreased somatization.

Similarly, the ability to be neutral and non-judgmental towards our experiences (FFQM Non-Judgmental subscale) was associated with less sensory and affective somatization. These results could be interpreted as supportive for both the prediction and cognitive behavioral models because they both acknowledge the influence and importance of cognitive biases. However, I would argue that the more important point here is that it isn't a matter of being either insufficiently or excessively focused on bodily signals, but actually about the nature of the evaluation of those signals and, consequently, the attentional style chosen for such focus.

Taken together, these findings suggest that somatization is not necessarily a function of the intensity of individuals' interoceptive awareness, but rather the nature of such attentional awareness. In sum, allocating non-evaluative attention towards an immediate experience appears to be adaptive, whereas an evaluative and ruminative self-focus attentional style later appears to be maladaptive.

Somatization and Experiential Avoidance

Experiential avoidance, which is the tendency to avoid uncomfortable experiences, was associated with increased somatization, experienced as in more physical symptoms and more health anxiety. This finding is in line with previous research that states that experiential avoidance is associated with lower levels of well-being and higher levels of psychopathology (e.g., Gámez et al., 2014). It also supports the predictive theory, which argues that a less detailed sensory experience (that could be due to fear and avoidance of physical stimuli) lead to top-down processes overriding bottom-up ones, and therefore the experience of somatization. The

cognitive behavior model (CBM) would argue that excessive checking behaviors, instead of avoidance, would lead to somatization (which also has some evidence). As with most things in psychological research, since we are dealing with complex human experiences, a combination/ middle ground of both opposing perspectives is probably the most adaptive.

Somatization and Cognitive Distortions

High endorsement of cognitive distortions and biases when interpreting somatic experiences was associated with increased somatization, experienced with both the affective and sensory aspects. These align with previous research and are aspects common to both the cognitive behavioral model (CBM) and predictive frameworks. Catastrophic interpretations of experiences are thought to exacerbate both the affective and sensory components of somatization according to both models.

General Discussion and Clinical Implications

These findings suggest that mindfulness and interoceptive training could be beneficial. Although noticing (MAIA) and observing (FFQM) were associated with increased somatization, due to hypervigilance, over time and with training focused specifically on non-judgmental evaluation, individuals could develop habituation overtime and may be able to develop other aspects on interoceptive awareness that promote less catastrophic interpretations. Eventually, somatization might decrease. Similarly, both theories suggest, as confirmed by our findings, that cognitive biases and errors when interpreting somatic symptoms are associated with increased affective and sensory somatization. With that in mind, cognitive restructuring, a common

Cognitive-Behavioral Therapy (CBT) strategy, could also be beneficial as a specific tool for reducing somatization.

Overall, viewing these two different theories, the predictive framework and the cognitive behavioral model, as complementary, rather than opposing frameworks, helps us better encompass the complexity of human nature, with clinical implications. For some people, the maladaptive (e.g., catastrophic) interpretation of accurate somatic sensations is the primary issue. In those cases, CBT may be the best treatment. On the other hand, other people may be experiencing bias difficulties due to low interoceptive perception accuracy. For them, Acceptance and Commitment Therapy (ACT) and other mindfulness-based interventions that aim to increase non-judgmental interoceptive observation and also its accuracy might be the best intervention.

Moreover, a combination treatment might be even more beneficial. If typical somatic sensations were repetitively associated with intense anxiety for a long period of time, those somatic sensations could serve as triggers after remission. That said, CBT as initial treatment aiming at symptom reduction, combined with ACT as an active maintenance treatment could be especially effective. This combined treatment approach would be tackling the different mechanisms that contribute to the development of somatic illnesses in different people, with the hope of more treatment efficacy than what is reflected in the current literature. Moreover, work with acceptance (ACT) seems especially important for residual symptom and everyday triggers (normal somatic sensations) after remission, in line with the current evidence supporting its combined use with other psychotherapies in the context of chronic depression (e.g., A-Tjak et al., 2021).

Limitations

An additional limitation worth considering was the sample demographics. The majority of the participants identified as White/Caucasian (75.7%) and highly educated (65%), which may limit some aspects of the study's generalizability. Moreover, as previously stated, the fact that 41.4% of the sample had a chronic health illness diagnosis might have also skewed the data. Furthermore, due to the nature of the topic, this was a correlational study, and the findings must be interpreted accordingly. That is, statements regarding causality or the direction of effects cannot be made. Finally, the subjective nature of self-report measures are prone to errors, so objective measurements (such as measuring interoceptive accuracy.

Future Research

Despite these stated limitations, this study contributes to the understanding of the complex relationships between somatization, mindfulness, and the different elements of interoceptive awareness. There are potential implications for how the field of psychology understands the connections between our cognitive processes and our physical experiences. Furthermore, there could also be implications for how the field treats those who experience somatic symptom disorders.

One direction for future research would be to measure interoceptive accuracy, rather than interoceptive awareness through self-report, by using measures to assess heart rate, perspiration, breathing, etc.. Future research may also explore potential mediators and moderators that could explain why somatization could be developed and/or maintained differently in each individual. In other words, are there certain factors that could explain why some individuals may better respond to CBT, while others see more symptom relief with ACT? Finally, another interesting

research direction would be to further explore the current research data by either excluding and/ or focusing exclusively on the individuals who had a chronic illness diagnosis. This could provide information on how somatization is experienced similarly or differently by individuals with such diagnoses and those without diagnosed conditions.

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Appendix

Online Study Questionnaire

Somatization & Interoceptive Awareness

Start of Block: Informed Consent Form

Q1
Exploring the Relationship Between Somatization and Interoceptive Awareness
Consent Form

1. **SUMMARY and KEY INFORMATION**

You are invited to participate in a research study about the relationship between psychological factors (e.g., stress) and physical health. Your participation is voluntary. You were selected as a possible participant because you are a member of Amazon.com's Mechanical Turk (MTurk). You must also be older than 18 years of age. As part of the study, you may experience some discomfort because you will answer questions regarding physical sensations that may bother you. This research, however, does not involve any risks greater than what you might experience in your everyday life while reading, hearing, or talking about medical or psychological topics in the media. You will receive $1 for your 30 minutes research participation. The study is being conducted by Caio Hummel Hohl, an undergraduate Psychology student at Drew University and his faculty sponsor Adijat Mustapha, Ph.D.

We ask that you read this document and ask any questions you may have before consenting to be in the study.

2. BACKGROUND

The purpose of this study is to better understand the mind and body connection, that is, how psychological factors such as stress or our thinking patterns can contribute to bodily sensations or physical health symptoms.

3. DURATION

This study should take no more than 30 minutes

4. PROCEDURES

As part of the study, you will answer questions regarding your medical history and physical health symptoms, your thoughts about somatic (bodily) sensations, and mindfulness, which is the ability to non-judgmentally engage with the present moment. You will also answer a few demographic questions. Although data collection will occur via a web-survey, you have the right to skip any questions that you would prefer not to answer.

5. RISKS/BENEFITS

This study involves minimal risk. As part of the study, you may experience some discomfort because you will answer questions regarding physical sensations that may bother you. This research, however, does not involve any risks greater than what you might experience in your everyday life while reading, hearing, or talking about medical or psychological topics in the media or in your social groups.

By participating in this study, you will gain first-hand knowledge of the methods that psychologists use to gain knowledge. You will also be compensated $1 for your 30-minute research participation. Moreover, the research will add to our understanding of the interaction between people's cognitions, emotions, physical sensations, and behaviors.

6. CONFIDENTIALITY

Although the survey will ask you to answer questions about yourself and your opinions (e.g., age, gender, and attitudes), this information will not allow anyone to know that you have participated in this study nor to identify your individual responses as your own. The researchers have taken all reasonable measures to protect your identity and responses. For example, the data is (TLS) encrypted (also known as HTTPS) and is stored on a password protected database. However, e-mail and the internet are not 100% secure, so it is also suggested that you clear your computer's cache and browser history to protect your privacy after completing the survey. After your participation, data will be stored on secure, password protected servers at Qualtrics.com. All data will be archived using secure servers for at least 5 years to ensure time for publication, and to meet requirements associated with publication by the American Psychological Association. Your data will only be reported combined with the data of all other participants as results in published scientific studies.

7. VOLUNTARY NATURE OF THE STUDY

Your decision whether to participate or not in this study will not affect your relations with Drew University. If you decide to participate in this study, you are free to withdraw from the study at any time and / or can skip any questions that you prefer not to answer. You may also redirect your browser at any time, and your responses will not be included in the data set.

8. CONTACTS AND QUESTIONS

After you complete the study, you will receive a statement that fully outlines the purpose of the study, its methods, as well the study hypothesis.

The researcher conducting this study is Caio Hummel Hohl. You may ask any questions you have right now by contacting the researcher at chummelhohl@drew.edu or his faculty advisor, Adijat Mustapha, Ph.D. at amustaph@drew.edu.

If you have questions or concerns regarding this study and would like to speak with someone other than the researcher, you may contact Christopher Medvecky, College of Liberal Arts Representative for the Institutional Review Board at cmedvecky@drew.edu.

9. STATEMENT OF CONSENT

Please verify the following: The procedures of this study have been explained to me and my questions have been addressed. I understand that my participation is voluntary and that I may withdraw at any time without penalty. If I have any concerns about my experience in this study (e.g., that I was treated unfairly or felt unnecessarily threatened), I may contact the Chair of the Drew Institutional Review Board regarding my concerns.

○ I agree to participate, am at least 18 years old, AND do not have a current relation with Drew University (as a student or employee). By clicking this option, you are indicating your consent to participate. (4)

○ I do NOT agree to participate OR I am NOT at least 18 years old, OR I have a current relation with Drew University (as a student or employee). If you click this option, you are indicating that you do not consent to participate and will be redirected away from the study. (5)

End of Block: Informed Consent Form

Start of Block: Demographics Questionnaire

Q2 How old are you?

_____

Q3 What is your gender identity?

- ○ Male (1)
- ○ Female (2)
- ○ Non-binary (3)
- ○ Agender (4)
- ○ Other (8) _____

Q4 Please indicate which term(s) best describe your race/ethnicity [check all that apply]

- ☐ White or Caucasian (1)
- ☐ Hispanic American/Latinx (2)
- ☐ Black or African American (3)

- [ ] Asian/Asian American (4)
- [ ] Native American/American Indian or Alaskan Native (5)
- [ ] Biracial or Multiracial (6)
- [ ] Native Hawaiian or Pacific Islander (7)
- [ ] Race/ ethnicity not listed here (9)

_____

Q5 Please indicate your highest achieved level of education

- ○ Some high school (1)
- ○ High school (2)
- ○ Trade school (6)
- ○ Bachelor's degree (3)
- ○ Master's degree (4)
- ○ Ph.D. or higher (5)

Q6 Have you been diagnosed with a chronic health illness? Examples may include: chronic pain, arthritis, multiple sclerosis, fibromyalgia, sciatica, irritable bowel syndrome, endometriosis, or lupus.

- ○ Yes (1)
- ○ No (2)

End of Block: Demographics Questionnaire

Start of Block: SCL-90 (Somatization: Number of Symptoms)

Q7 Below is a list of problems and complaints that people sometimes have. Please read each one carefully.

For each concern, please indicate the frequency with which that problem has bothered or distressed you during the past week, including today.

	Not At All (1)	A Little Bit (2)	Moderately (3)	Quite a Bit (4)	Extremely (5)
Headaches (1)	○	○	○	○	○
Faintness or dizziness (62)	○	○	○	○	○
Nausea or upset stomach (63)	○	○	○	○	○
Soreness of your muscles (64)	○	○	○	○	○
Trouble getting your breath (65)	○	○	○	○	○

Hot or cold spells (66)	○	○	○	○	○
Pains in heart or chest (67)	○	○	○	○	○
Numbness or tingling in parts of your body (68)	○	○	○	○	○
A lump in your throat (69)	○	○	○	○	○
Feeling weak in parts of your body (70)	○	○	○	○	○
Heavy feelings in your arms or legs (71)	○	○	○	○	○
Pains in lower back (72)	○	○	○	○	○

End of Block: SCL-90 (Somatization: Number of Symptoms)

Start of Block: Attention Check - Open-Ended

Q8 Please write 2-3 sentences on your understanding of what the "mind-body connection" is?

_____

_____

_____

_____

_____

End of Block: Attention Check - Open-Ended

Start of Block: The Whiteley-7 Scale (Somatization: Health Anxiety)

Q9 For the following questions, please indicate the response that best describes what is generally true for you.

Q10 Do you worry a lot about your health?

- ○ No (1)
- ○ Yes (2)

Q11 Do you think there is something seriously wrong with your body?

- ○ No (1)
- ○ Yes (2)

Q12 Is it hard for you to believe a doctor when they tell you there is nothing to worry about?

- ○ No (1)

○ Yes (2)

Q13 Do you often worry about the possibility that you have a serious illness?

○ No (1)

○ Yes (2)

Q14 Are you bothered by many different pains and aches?

○ No (1)

○ Yes (2)

Q15 If a disease is brought to your attention (e.g., on TV, radio, the newspapers, or by someone you know), do you worry about getting it yourself?

○ No (1)

○ Yes (2)

Q16 Do you find that you are bothered by many different symptoms?

○ No (1)

○ Yes (2)

End of Block: The Whiteley-7 Scale (Somatization: Health Anxiety)

Start of Block: General Mindfulness 5 Facets Scale (FFMQ)

Q17 Please rate each of the following statements using the scale provided. Mark the number on the scale that best describes your own opinion of what is generally true for you.

	Never or very rarely true (1)	Rarely true (2)	Sometimes true (3)	Often true (4)	Very often or always true (5)
When I'm walking, I deliberately notice the sensations of my body moving. (1)	○	○	○	○	○
When I take a shower or bath, I stay alert to the sensations of water on my body. (2)	○	○	○	○	○
I notice how foods and drinks affect my thoughts, bodily sensations, and emotions. (3)	○	○	○	○	○

I pay attention to sensations, such as the wind in my hair or sun on my face. (4)	○	○	○	○	○
I pay attention to sounds, such as clocks ticking, birds chirping, or cars passing. (5)	○	○	○	○	○
I notice the smells and aromas of things. (6)	○	○	○	○	○
I notice visual elements in art or nature, such as colors, shapes, textures, or patterns of light and shadow. (7)	○	○	○	○	○
I pay attention to how my emotions affect my thoughts and behavior. (8)	○	○	○	○	○

I'm good at finding words to describe my feelings. (9)	○	○	○	○	○
I can easily put my beliefs, opinions, and expectations into words. (10)	○	○	○	○	○
It's hard for me to find the words to describe what I'm thinking. (11)	○	○	○	○	○
I have trouble thinking of the right words to express how I feel about things. (12)	○	○	○	○	○
When I have a sensation in my body, it's difficult for me to describe it because I can't find the right words. (13)	○	○	○	○	○
Even when I'm feeling terribly upset, I can find a way to	○	○	○	○	○

put it into words. (14)					
My natural tendency is to put my experiences into words. (15)	○	○	○	○	○
I can usually describe how I feel at the moment in considerable detail. (16)	○	○	○	○	○
When I do things, my mind wanders off and I'm easily distracted. (17)	○	○	○	○	○
I don't pay attention to what I'm doing because I'm daydreaming, worrying, or otherwise distracted. (18)	○	○	○	○	○
I am easily distracted. (19)	○	○	○	○	○

I find it difficult to stay focused on what's happening in the present. (20)	○	○	○	○	○
It seems I am "running on automatic" without much awareness of what I'm doing. (21)	○	○	○	○	○
I rush through activities without being really attentive to them. (22)	○	○	○	○	○
I do jobs or tasks automatically without being aware of what I'm doing. (23)	○	○	○	○	○
I find myself doing things without paying attention. (24)	○	○	○	○	○
I criticize myself for having irrational or inappropriate emotions. (25)	○	○	○	○	○

I tell myself I shouldn't be feeling the way I'm feeling. (26)	○	○	○	○	○
I believe some of my thoughts are abnormal or bad and I shouldn't think that way. (27)	○	○	○	○	○
I make judgments about whether my thoughts are good or bad. (28)	○	○	○	○	○
I tell myself that I shouldn't be thinking the way I'm thinking. (29)	○	○	○	○	○
I think some of my emotions are bad or inappropriate and I shouldn't feel them. (30)	○	○	○	○	○

When I have distressing thoughts or images, I judge myself as good or bad, depending what the thought/image is about. (31)	○	○	○	○	○
I disapprove of myself when I have irrational ideas. (32)	○	○	○	○	○
I perceive my feelings and emotions without having to react to them. (33)	○	○	○	○	○
I watch my feelings without getting lost in them. (34)	○	○	○	○	○
When I have distressing thoughts or images, I “step back” and am aware of the thought or image without getting taken over by it. (35)	○	○	○	○	○

In difficult situations, I can pause without immediately reacting. (36)	○	○	○	○	○
When I have distressing thoughts or images, I feel calm soon after. (37)	○	○	○	○	○
When I have distressing thoughts or images, I am able just to notice them without reacting. (38)	○	○	○	○	○
When I have distressing thoughts or images, I just notice them and let them go. (39)	○	○	○	○	○

End of Block: General Mindfulness 5 Facets Scale (FFMQ)

Start of Block: Experiential Avoidance Scale (BEAQ)

Q18 Please rate each of the following statements using the scale provided. Mark the number on the scale that best describes your own opinion of what is generally true for you.

	Strongly Disagree	Disagree	Somewhat Disagree	Somewhat Agree	Agree	Strongly Agree
	1	2	3	4	5	6
The key to a good life is never feeling any pain ()						
I’m quick to leave any situation that make me feel uneasy ()						
When unpleasant memories come to me, I try to put them out of my mind ()						
I feel disconnected from my emotions ()						
I won't do something until I absolutely have to ()						
Fear or anxiety won't stop me from doing important things ()						
I would give up a lot not to feel bad ()						
I rarely do things that there is a chance that it will upset me ()						
It is hard for me to know what I am feeling ()						
I try to put off unpleasant tasks for as long as possible ()						
I go out of my way to avoid uncomfortable situations ()						
One of my big goals is to be free from painful emotions ()						
I work hard to keep out upsetting feelings ()						
If I have any doubts about do something, I just won’t do it ()						
Pain always leads to suffering ()						

End of Block: Experiential Avoidance Scale (BEAQ)

Start of Block: Attention Check - Forced Choice

Q19 For this question, please select "often."

- Never (1)
- Rarely (2)
- Often (3)
- Every time (4)

End of Block: Attention Check - Forced Choice

Start of Block: Somatic CEQ-R (Somatic Cognitive Distortions)

Q20 Please read each of the following scenarios and rate them according to your own personal experiences.

Q21 You and your partner went to a party the other day and you had a bad time because you felt very fuzzy headed and had to ask the host if you could lie down in the bedroom for half an hour. When your partner asks you to go to a party the following weekend, you think to yourself, "I don't want to go because I am going to have to lie down again."

- Almost exactly like I would think (6)
- A lot like I would think (7)
- Some-what like I would think (8)

- ○ A little like I would think (9)
- ○ Not at all like I would think (10)

Q22 A friend has just asked you to go out for a walk. You remembered how very fatigued and sore you felt after playing a game of tennis the other day and you think to yourself, "I guess there is no way I could hold up if I went out for a walk with him/her."

- ○ Almost exactly like I would think (6)
- ○ A lot like I would think (7)
- ○ Some-what like I would think (8)
- ○ A little like I would think (9)
- ○ Not at all like I would think (10)

Q23 You teach at a primary school. The last time it was your turn to stand and watch the children in the playground during lunch break, your muscles felt weak and ached for the rest of the afternoon. You notice that it is your turn again and think, "I have to watch those kids during break, I just know my body will hurt for the rest of the day."

- ○ Almost exactly like I would think (6)
- ○ A lot like I would think (7)
- ○ Some-what like I would think (8)

- ○ A little like I would think (9)
- ○ Not at all like I would think (10)

Q24 You have been feeling very weak and tired of late, but have continued to work. Although you got quite a bit done today, you finished work early because you were feeling particularly exhausted. You think to yourself, "What a terrible day. It seems like I can't get anything done."

- ○ Almost exactly like I would think (6)
- ○ A lot like I would think (7)
- ○ Some-what like I would think (8)
- ○ A little like I would think (9)
- ○ Not at all like I would think (10)

Q25 You and your family went to an afternoon rugby/football game. You enjoyed the first half of the match, but then you started to feel tired and your back was aching. You find yourself thinking, "What an awful way to spend an afternoon."

- ○ Almost exactly like I would think (6)
- ○ A lot like I would think (7)
- ○ Some-what like I would think (8)

- ○ A little like I would think (9)
- ○ Not at all like I would think (10)

Q26 You have just returned to your job after a sick leave during which you were recovering from yet another bout of flu. You worked hard all afternoon, but didn't finish everything you wanted to. You think to yourself, "Because of these recurring episodes of flu, I can't do my job."

- ○ Almost exactly like I would think (6)
- ○ A lot like I would think (7)
- ○ Some-what like I would think (8)
- ○ A little like I would think (9)
- ○ Not at all like I would think (10)

Q27 Recently your job has been so demanding that you have worked straight through your lunch hour. As a result you have been feeling increasingly fatigued and have had difficulties concentrating. Driving home from work, you think, "If l don't get some time to relax during the day, I am going to have a total collapse and be unable to work."

- ○ Almost exactly like I would think (6)
- ○ A lot like I would think (7)
- ○ Some-what like I would think (8)

- ○ A little like I would think (9)
- ○ Not at all like I would think (10)

Q28 You work at a job which requires some lifting and carrying of heavy boxes. The other day, you felt really weak and your muscles felt stiff and sore at the end of the day. Driving home from work, you find yourself thinking, "lf this keeps up I won't be able to work or even walk, and might land up permanently bedridden."

- ○ Almost exactly like I would think (6)
- ○ A lot like I would think (7)
- ○ Some-what like I would think (8)
- ○ A little like I would think (9)
- ○ Not at all like I would think (10)

Q29 Your favorite exercise is swimming. Even though you have been feeling very tired and your muscles feel sore after swimming, your doctor has urged you to keep up your exercise regime. Today when you were having your normal swim, your muscles started to ache before you were finished. You think to yourself, "Pretty soon, I won't be able to swim at all."

- ○ Almost exactly like I would think (6)
- ○ A lot like I would think (7)

○ Some-what like I would think (8)

○ A little like I would think (9)

○ Not at all like I would think (10)

End of Block: Somatic CEQ-R (Somatic Cognitive Distortions)

Start of Block: Multidimensional Assessment of Interoceptive Awareness (MAIA)

Q30 Please rate each of the following statements using the scale provided. Mark the response on the scale that best describes your own opinion of what is generally true for you.

	Never (1)	Rarely (2)	Sometimes (3)	Often (4)	Always (5)
When I am tense, I notice where the tension is located in my body. (1)	○	○	○	○	○
I notice when I am uncomfortable in my body. (2)	○	○	○	○	○
I notice where in my body I am comfortable. (3)	○	○	○	○	○
I notice changes in my breathing, such as whether it	○	○	○	○	○

slows down or speeds up. (8)					
When I feel physical pain, I become upset (9)	○	○	○	○	○
I start to worry that something is wrong if I feel any discomfort (10)	○	○	○	○	○
I can notice an unpleasant body sensation without worrying about it. (11)	○	○	○	○	○
I can stay calm and not worry when I have feelings of discomfort or pain. (12)	○	○	○	○	○
When I am in discomfort or pain I can’t get it out of my mind (13)	○	○	○	○	○
I listen for information from my body about my emotional state. (14)	○	○	○	○	○

When I am upset, I take time to explore how my body feels. (15)	○	○	○	○	○
I listen to my body to inform me about what to do. (16)	○	○	○	○	○
I do not notice physical tension or discomfort until they become more severe. (17)	○	○	○	○	○
I distract myself from sensations of discomfort. (18)	○	○	○	○	○
When I feel pain or discomfort, I try to power through it. (19)	○	○	○	○	○
I can pay attention to my breath without being distracted by things happening around me. (20)	○	○	○	○	○

I can maintain awareness of my inner bodily sensations even when there is a lot going on around me. (21)	○	○	○	○	○
When I am in conversation with someone, I can pay attention to my posture. (22)	○	○	○	○	○
I can return awareness to my body if I am distracted. (23)	○	○	○	○	○
I can refocus my attention from thinking to sensing my body. (24)	○	○	○	○	○
I can maintain awareness of my whole body even when a part of me is in pain or discomfort. (25)	○	○	○	○	○
I am able to consciously focus on my body as a whole. (26)	○	○	○	○	○

I notice how my body changes when I am angry. (27)	○	○	○	○	○
When something is wrong in my life I can feel it in my body. (28)	○	○	○	○	○
I notice that my body feels different after a peaceful experience. (29)	○	○	○	○	○
I notice that my breathing becomes free and easy when I feel comfortable. (30)	○	○	○	○	○
I notice how my body changes when I feel happy/joyful. (31)	○	○	○	○	○
When I feel overwhelmed I can find a calm place inside. (32)	○	○	○	○	○

When I bring awareness to my body I feel a sense of calm. (33)	○	○	○	○	○
I can use my breath to reduce tension. (34)	○	○	○	○	○
When I am caught up in thoughts, I can calm my mind by focusing on my body/breathing. (35)	○	○	○	○	○
I am at home in my body. (36)	○	○	○	○	○
I feel my body is a safe place. (37)	○	○	○	○	○
I trust my body sensations. (38)	○	○	○	○	○

End of Block: Multidimensional Assessment of Interoceptive Awareness (MAIA)

Start of Block: Debriefing Form

Q31

Exploring the Relationship Between Somatization and Interoceptive Awareness
Debriefing Form

1. PURPOSE OF THE STUDY

The purpose of this study is to explore what factors may contribute to somatization, which is the tendency to develop or intensely experience physical symptoms due to underlying psychological factors. We sought to assess two opposing theories of somatization from existing scientific literature. While the two theories both state that avoidance and cognitive biases account for the tendency towards somatization, previous research has highlighted the importance of interoceptive awareness (which is the ability to be conscious about bodily processes) in opposite ways: as beneficial (mindfulness) or as dysfunctional (hypervigilance). We were aiming to find evidence for both, in a complementary way, and further contribute to the understanding of the nature of the interoceptive awareness in such conditions.

2. METHODOLOGY

In this study you completed a questionnaire in which you were asked questions about your medical history, physical symptoms, somatic experiences, cognitions, mindfulness, interoceptive awareness, experiential avoidance, and lastly demographic questions.

3. ADDITIONAL RESOURCES

For more information on the topic of this research, you can read the following publications:

Sayyar Khesmakhi, S., Goli, F., Omidi, A., Eduard Scheidt, C., & Givehki, R. (2019). Effectiveness of acceptance and commitment therapy on psychosomatic symptoms and mindfulness in patients with psychosomatic disorders. Practice in Clinical Psychology, 7(2), 79-86.

van Ravesteijn, H. (2016). Mindfulness-based cognitive therapy for patients with somatoform disorders.Tijdschrift Voor Psychiatrie, 58(3), 198–206.

4. CONTACT INFORMATION

If you are interested in learning more about the research being conducted, or the results of the research of which you were a part, please do not hesitate to contact Adijat Mustapha, Ph. D., at amustaph@drew.edu In you wish to speak to someone other than the researcher, please contact the IRB chair (Chris Medvecky) at cmedvecky@drew.edu

Thank you for your help and participation in this study.

End of Block: Debriefing Form

Start of Block: MTurk Required PIN Information

Q32
Thank you for your participation!

Your PIN is: **4237HJKY**

If you completed the entire questionnaire, copy this code. Then, click next to complete the study. Finally, ENTER YOUR COPIED PIN INTO MTurk TO RECEIVE COMPENSATION.

End of Block: MTurk Required PIN Information