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Interoceptive Sensitivity, Emotional Empathy, and Alexithymia in Irritable Bowel Syndrome: A Research Protocol

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Abstract

The brain and gut are deeply interconnected both anatomically and functionally. Irritable Bowel Syndrome (IBS) is a chronic gastrointestinal disorder characterized by changes in bowel movements and chronic intestinal pain. Despite IBS being associated with increased interoceptive sensitivity and emotional distress, the relationship between IBS and empathy is not fully understood. This study aims to investigate whether individuals with IBS exhibit differences in emotional empathy and emotional processing compared to individuals without IBS, and whether heightened empathy exacerbates IBS symptoms through increased sensitivity to both internal gastrointestinal signals and external emotional cues. Participants will complete a behavioural empathy task involving emotionally salient film clips depicting social interactions. They will report their own emotional experiences and infer those of the characters, while physiological responses and eye tracking data are recorded. Self-report measures of empathy and interoceptive awareness will also be administered. Group differences and associations between empathy, interoceptive awareness, and symptom severity will be examined using appropriate statistical analyses. It is expected that individuals with IBS will demonstrate heightened emotional empathy and reactivity compared to controls, with stronger associations between interoceptive awareness and empathic distress. Predicted findings would support a bidirectional relationship between IBS and empathy, whereby IBS-related bodily sensitivity amplifies emotional attunement, and increased empathy worsens gastrointestinal symptoms. Conversely, a lack of association would suggest distinct processing mechanisms for empathy and direct emotional experience. This study seeks to advance an integrated model of IBS as a digestive disorder with significant affective and neurological dimensions. Results may inform future research on emotion-based intervention aimed at reducing both empathic distress and gastrointestinal symptoms, contributing to more holistic treatment approaches.

Keywords: irritable bowel syndrome; empathy; brain-gut axis; interoception; alexithymia; emotional processing; psychophysiology; eye tracking; affective neuroscience

Introduction

Irritable Bowel Syndrome (IBS) is a complex brain-gut disorder characterized by chronic intestinal pain and altered bowel movements (constipation and/or diarrhea) [1]. Beyond physical symptoms, individuals with IBS face substantial psychosocial burdens. Elevated rates of anxiety, depression, and stress are common, often driven by the unpredictability and uncontrollability of symptoms [2, 3, 4, 5, 6]. This can create a vicious cycle, where anticipatory anxiety exacerbates symptom flare-ups, suggesting dysregulation of stress pathways in IBS [3, 4]. Despite its high prevalence, effective treatment options remain limited, leaving many patients struggling without adequate relief.

The gastrointestinal tract operates as a kind of "second brain" [7]. This highly innervated and emotionally attuned system both receives and sends emotional signals via the brain-gut axis, allowing emotional states to influence gastrointestinal functioning and vice versa [7]. This is evident in IBS, where gastrointestinal symptoms often worsen in response to psychological distress [3, 5, 9]. Individuals with IBS frequently report heightened sensitivity to emotions such as stress, anger, or sadness, which can intensify gastrointestinal symptoms even when these emotions are unrelated to the gut itself [3, 5, 9, 10]. The enteric nervous system, embedded in the gut wall, interacts closely with the central nervous system, meaning that emotions experienced by the brain are also processed somatically in the gut [7, 10]. For individuals with high emotional sensitivity, this can mean that stress, whether originating from issues pertaining to themselves or from close others, can manifest physically as gastrointestinal discomfort or symptom flare-ups. Conversely, individuals who struggle to identify or regulate their emotional states, referred to as alexithymia, may also experience unexplained symptom exacerbation, without recognizing the emotional origins of their distress [1, 4, 5, 6, 10]. In both cases, the emotional brain and the gut brain are in continuous, bidirectional communication, and dysregulation in one domain can lead to dysregulation in the other [7] (Figure 1).

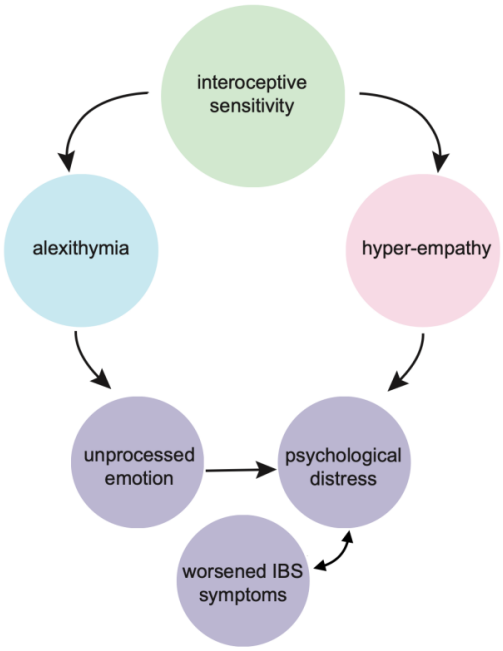

Figure 1. Conceptual model of the bidirectional relationship between empathy and IBS symptoms. This schematic illustrates the hypothesized feedback loop in which differences in empathic processing contribute to psychological distress, which may worsen IBS symptoms. In turn, chronic IBS symptoms may influence emotional sensitivity and empathy. Illustrated using BioRender.

Emerging research suggests a connection between interoceptive sensitivity, the ability to perceive internal bodily signals, and emotional empathy [1, 2, 8, 9, 10, 11, 12]. Individuals who are more attuned to their internal states may also be more responsive to the emotional states of others, a link that has been observed in both behavioral and neuroimaging studies [2, 8, 9, 10, 13]. This suggests that disruptions in interoception, as seen in IBS, may influence not only how individuals experience their own emotions, but also how they process and respond to the emotions of others [3, 4, 9, 13]. Despite this theoretical overlap, few studies have directly investigated emotional empathy in the context of IBS. To our knowledge, no research has systematically examined whether individuals with IBS differ in their empathic profiles or how these differences might relate to symptom expression and social well-being. Addressing this gap is important not only for understanding the lived experience of those with IBS but also for identifying effective targets for intervention that move beyond traditional symptom management.

Figure 2. Hypothesized empathy continuum in relation to IBS. This cartoon illustrates a proposed continuum of emotional empathy, with alexithymia on one end and hyper-empathy on the other. Individuals with IBS are hypothesized to fall at either extreme, while control participants are expected to cluster near the center. Illustrated using Adobe Illustrator.

Given the emotional toll of IBS, this exploratory study investigates how the condition may relate to interpersonal functioning, with a specific focus on emotional empathy. We hypothesize that individuals with IBS may exhibit heightened sensitivity to both internal bodily signals and external emotional cues, placing them at opposite ends of the empathy spectrum, either displaying hyper-attunement to others' emotions or experiencing emotional disconnection, such as alexithymia (Figure 2). These extremes may offer insight into how emotional processing influences gut health. By identifying distinct affective profiles in IBS, this research may highlight new pathways for treatment that integrate both emotional and physiological dimensions of the disorder.

Methods

Participants

We performed a power analysis (α = .05, 80% power) and determined that 120 participants were required to properly account for within-participant variability. Additionally, we chose to only select participants whom were assigned female sex at birth, between the ages of 20 and 45. The participants will be divided equally into two groups: (1) an IBS group and (2) a control group. The IBS group will consist of individuals with a formal diagnosis of Irritable Bowel Syndrome or who meet established clinical criteria based on validated self-report screening tools. The control group will consist of individuals with no history of chronic gastrointestinal conditions or frequent gastrointestinal symptoms.

This age range was selected to minimize physiological variability due to aging and hormonal transitions, and the female-only sample reflects both the higher prevalence of IBS in biological females and their greater susceptibility to mood disorders such as anxiety and depression, which are relevant to the brain-gut connection. Moreover, the choice of participants being assigned female sex at birth is to account for the unique hormonal fluctuations and menstrual cycles they possess. These variations can influence gastrointestinal and emotional processes, thus they will be accounted for by collecting menstrual cycle data. Including a matched control group will allow for direct comparison of empathy, alexithymia, and interoceptive functioning between individuals with and without chronic gastrointestinal symptoms.

All participants must have normal or corrected-to-normal vision, be fluent in English or French, and be free from major neurological, cardiovascular, or autoimmune conditions. Additional exclusion criteria include pregnancy, known hormonal disorders, irregular sleep patterns, and use of psychotropic medication (with the exception of stable SSRI use, which will be documented and statistically controlled) active IBD, uncontrolled thyroid, chronic migraine, fibromyalgia. Height and weight will also be collected to calculate body mass index (BMI), as it may impact gut health and will be controlled for in analyses. Participants will be screened using a health history questionnaire prior to enrollment.

On the day of participation, participants will be instructed to avoid taking caffeine and nicotine to avoid any noise within the physiological data. Moreover, upon participant arrival, they will be instructed to sit quietly and breathe for 10 minutes before commencing the task, to ensure their heart rate, skin conductance, and respiration are at baseline.

All participants will be run at the same time of day (9AM-12PM) to maintain a high degree of standardization between the participants.

Questionnaires

Validated self-report measures will assess IBS (Rome IV for inclusion, IBS-SSS for severity), empathy (IRI), anxiety (Visceral Sensitivity Index), depression (HADS), alexithymia (TAS-20), interoception (MAIA-2), early life adversity (CTQ), and exploratory autism spectrum traits using a brief questionnaire (SRS-A).

Figure 3. Task figure. Participants will watch an emotionally salient clip, then report how they feel, and finally report how they think the individual in the clip felt. In the illustration, the participant is demonstrating an empathic response to the individual in the clip. Throughout the task their eye movements and physiological measures will be taken. Illustrated using BioRender.

Task

Participants will complete a behavioral empathy task designed to measure emotional empathy in a naturalistic context. The task involves viewing emotionally salient film clips depicting social interactions, during which the participant will report their own emotional experience and infer that of the characters (Figure 3). This approach will facilitate the assessment of empathy within a more realistic social scenario.

While the participant is completing the task, physiological data will be collected to assess embodied empathic responses. Measures will include electrocardiography (ECG) to evaluate heart rate variability, electrodermal activity (EDA) will capture autonomic arousal, and respiration, collected via a respiratory belt, will detect changes in breathing. Lastly, eye-tracking will be used to examine gaze patterns and attention to emotional cues throughout the task. This data will provide converging evidence for the presence and intensity of empathic engagement, even in participants with potential deficits in emotional awareness.

Procedure

To reduce participant fatigue and optimize data quality, the study will be conducted over multiple sessions scheduled on separate days. In the initial session, participants will complete self-report questionnaires assessing empathy, alexithymia, interoception, anxiety, depression, and early life adversity using validated measures. Demographics, including menstrual cycle information will also be collected.

Given the relevance of gastrointestinal health and body physiology in brain-gut interactions, participants' weight and height will also be collected to calculate body mass index (BMI), as this may influence gut health and will be considered in data analyses.

If needed, questionnaires can be split over multiple sessions to reduce cognitive load and ensure participant comfort. Lastly, the empathy task will take place on its own day to ensure the participants' full attention is available. The exact scheduling will be adjusted based on pilot testing and participant feedback.

Data Analysis

Descriptive statistics will be calculated for all measures, including emotional empathy scores, alexithymia, gut symptom severity, and early life adversity (ELA). This will help us understand the overall patterns in our data, such as average scores and degree of variability across participants.

Next, we will check for simple relationships between key variables. Specifically, we will use Pearson correlation analyses to explore whether emotional empathy, alexithymia, and ELA are related to gut symptom severity. This will provide an initial assessment of how strongly specific physiological traits are associated with traditional IBS symptoms.

Regression analysis will be used to test the main hypothesis. This will allow us to see whether empathy and alexithymia predict gut symptom severity even when ELA is taken into account. By including ELA as a control variable in the model, we can assess whether the relationship between emotional sensitivity and gut symptoms remains significant beyond the influence of past trauma.

Finally, we will explore whether participants at either extreme of the empathy spectrum (very high empathy or very high alexithymia) show greater psychological distress and IBS symptom severity. This can be done by grouping participants based on their empathy or alexithymia scores and comparing their symptom levels, using group comparisons or nonlinear regression techniques if appropriate.

Expected Results

Based on the literature, we expect that the IBS cohort will score higher on measures of interoception, anxiety, depression, and land on either extreme of the empathy scale when compared to controls [1, 2, 9, 10]. We expect that the higher interoceptive awareness will be strongly correlated with emotional empathy, in that individuals who have heightened interoceptive awareness will also be more likely to pick up on empathic cues from external sources. This will in turn be presented as higher physiological readouts during the empathy task, namely with a higher heart rate, skin conductance, and increased respiration during emotionally salient film clips.

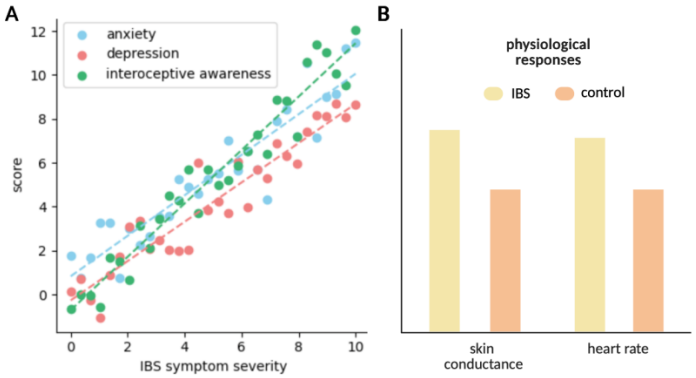

Figure 4. Cartoon of hypothesized results. (A) This schematic illustrates the expected positive correlations between IBS symptom severity and psychological variables, including anxiety, depression, and interoceptive awareness. (B) A bar graph representing predicted group differences in physiological reactivity during the empathy task. Individuals with IBS are expected to show higher heart rate, skin conductance, and respiration rates compared to controls in response to emotionally salient film clips. Generated through Python.

Discussion

The expected results suggest IBS patients have a lower threshold for internal bodily signals and external emotional cues [3, 5, 9, 14, 15]. The lower threshold for external emotional cues has important implications, namely that the empathic cues IBS patients detect could lead to flare-ups in their symptoms. Previous work has demonstrated that emotions elicit a full-body experience, with the central nervous system transmitting information to the enteric nervous system in the gut [7, 8, 10, 14, 15]. For example,

when someone experiences fear, the emotion is mirrored with stereotypical responses in the gut [7]. For those with IBS, this response can further lead to IBS flare-ups. This has further implications when one considers embodied empathy and how these empathic responses could relate to the symptom profiles of IBS patients. Simply put, the emotional states of others could impact IBS symptoms.

If IBS patients are shown to have heightened empathy profiles or impairments interpreting emotional stimuli (alexithymia), the embodied empathy endured by IBS patients can therefore be associated with increased symptom flare-ups. This would require future research that looks at the social interactions of IBS patients in differing emotional contexts and monitoring their IBS symptoms.

Furthermore, the potential connection between IBS flare-ups and embodied empathy opens doors to treatment options focused on the importance of cognitive restructuring surrounding gut sensory experiences and aiding the patients in combating their association of certain foods, experiences, and gut sensations with IBS symptoms. Coaching individuals to recognize the origin of their gut sensations can aid in reducing flare-ups in the future, since they could learn to recognize the flare-ups result from stress, rather than a consequence of the food that was consumed.

Additionally, empathy research suggests prescribing emotion regulation interventions for those who struggle with empathic distress, as we believe many IBS patients do [11, 12]. The idea being that some flare-ups could be a result of emotion processing difficulties and, should the individual learn to self-regulate, the empathic responses may become less severe and not translate into symptom presentation [3, 4, 6, 11, 12]. Through this idea, it is possible to view symptoms and emotions acting in a cycle, with strong emotions maintaining symptoms. In a similar light, compassion-based therapy could assist individuals in managing their emotions and therefore their symptom presentation [11, 12]. By aiding patients in recognizing their symptoms are not their fault and that they do not need to feel shame surrounding their experiences, they will be successfully regulating their emotions and potentially their symptoms.

Considering the strong implications of emotions within the brain-gut axis, we assert the recognition of IBS as not only a brain-gut disorder, but a brain-gut-emotion disorder. By recognizing the strong importance of emotions in this axis, it highlights the necessity for patients to learn emotion regulation skills, participate in compassion-based therapy, and cognitive restructuring. In addition, this recognition is important for the progression of research on this topic in recognizing the role affective neuroscience plays for the diagnosis, prevention, and treatment of IBS.

However, should the results fail to show a relationship between empathy and IBS, this would suggest a fascinating distinction between directly experiencing emotional distress versus empathizing with others' emotions. Although current research has established that emotional states such as anger and sadness can exacerbate IBS symptoms, a null finding in this context may indicate that empathic processing engages distinct neural and physiological pathways that do not translate into gut-related symptomatology in the same way as first-hand emotional experiences. Such a result would not only contribute to the broader literature on empathy and emotion-processing networks but would also underscore the complexity of brain-gut communication, emphasizing the need for further investigation into the specific mechanisms that differentiate self-relevant emotional arousal from vicarious emotional experience.

Conclusions

Future Directions and Limitations

Future research should focus on longitudinal studies that investigate the impact of various therapeutic interventions (cognitive restructuring, emotion regulation, compassion-based therapy) on IBS symptoms. This research could inform future generations on the importance of emotions within the brain-gut axis and the treatment of various psychological and physiological illnesses.

Additionally, a potential area to investigate is the role of autism spectrum disorder (ASD) traits in the brain-gut-empathy relationship, given the overlap between alexithymia, empathy difficulties, and ASD [2, 11, 13]. Investigating these interactions in larger, more diverse samples may help elucidate distinct mechanisms underlying emotional processing in this population.

Furthermore, incorporating neuroimaging techniques may further clarify the neural mechanisms that underlie the proposed associations. Functional neuroimaging could examine whether individuals with IBS exhibit differential brain activation in regions implicated in interoception (insula), emotion regulation (prefrontal cortex), and empathy (anterior cingulate cortex, temporoparietal junction) during empathic or emotional tasks. Identifying distinct neural patterns associated with hyper-empathy or alexithymia could provide valuable insight into the brain-gut axis and guide personalized treatment approaches.

A key limitation of the present study is the inherent subjectivity of symptom reporting in disorders like IBS. Individuals may vary in how accurately or consistently they interpret and communicate internal discomfort, influenced by personality traits, emotional awareness, and past experiences. For example, those high in alexithymia may underreport symptoms due to difficulty identifying emotional or bodily states, while those high in emotional empathy may be more attuned to distress signals and thus report higher symptom intensity. Although the use of validated self-report tools aim to reduce variability, these individual differences remain an important consideration. Notably, this subjectivity is not just a limitation, it is central to the study's rationale. By examining empathy and alexithymia as potential moderators of symptom expression, the study seeks to better understand how perceptual and emotional traits shape the lived experience of IBS.

List of Abbreviations
ASD: autism spectrum disorder
BMI: body mass index
CRT: cognitive restructuring therapy
ECG: electrocardiography
EDA: electrodermal activity
ELA: early life adversity
fMRI: functional magnetic resonance imaging
IBS: irritable bowel syndrome
SSRI: selective serotonin-reuptake inhibitors

Conflicts of Interest
The author declares that they have no conflicts of interest.

Ethics Approval and/or Participant Consent
This work was a research proposal that examined previous studies and articles. Therefore, no approval or participant consent was required.

Authors' Contributions
EO: was responsible for the conceptualization, literature review, methodology, figure creation, and writing of the research proposal and manuscript. All aspects of the project were led and completed by EO.

Acknowledgements
I would like to sincerely thank my mentor, Courtney Ostromecki, for their guidance, feedback, and encouragement throughout the development of this proposal. Their support has been instrumental in strengthening this work.

Funding
This study was not funded.

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Article Information
Managing Editor: Jeremy Y. Ng
Peer Reviewers: Courtney Ostromecki, Arthur Tung
Article Dates: Received Jul 28 25; Accepted Sep 14 25; Published Nov 27 25

Citation
Please cite this article as follows:
Ozanick E. Interoceptive sensitivity, emotional empathy, and alexithymia in irritable bowel syndrome: A research protocol. URNCST Journal. 2025 Nov 27: 9(10). https://urncst.com/index.php/urncst/article/view/954
DOI Link: https://doi.org/10.26685/urncst.954