

The Process Behind the Origin of Symptoms That are Medically Unexplained

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Abstract

Medically Unexplained Symptoms are somatic complaints that lack a physiological explanation thus imposing a challenge on the biomedical model. This is due to a missed communication or significant alteration in the bi-directional relationship of the body and mind. The essential aspect of this body-mind relationship i.e., the process of interoception is explored and its importance is highlighted as how an alteration in the process can lead to a lack in the homeostasis of the body. The aim of the paper is to explore the aspects of the interoceptive process as a health promotive agent in the treatment of medically unexplained symptoms. The results highlight the need for research in the mechanism behind medically unexplained symptoms and interoception also the necessary interventions required for providing effective treatments in order to avoid such symptoms.

Keywords: medically unexplained symptoms, interoception, health promotion, body-mind relationship

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Symptoms lacking a physical basis are termed as “medically unexplained symptoms”. It is commonly used to describe the pain and discomfort reported by patients of these symptoms. (Marks & Hunter, 2015). Medically unexplained symptoms constitute fatigue; shortness of breath; chest pain; back, joint, and head pain; chronic pain; faint feeling; heart palpitations; stomach problems such as pain, bloated feel, diarrhoea, and constipation; collapsing, fits, weakness, paralysis, numbness, tingling, and several such symptoms. (Bolton & Attard, 2015).

Medically unexplained symptoms regardless of being commonly found has not been much researched due to which there is no reliable statistic to refer. The limited research has pointed towards a need for awareness in order to deal with these symptoms effectively. These symptoms may or may not co-exist with multiple disorders, hence fall under the somatic symptom disorder criterion of the DSM-5 which suggests that regardless of any medical explanation the individual’s suffering is still considered.

Indian research claims medically unexplained symptoms to be the reason behind loss of productivity and major economic burden on healthcare also as a major public health concern (Koola & Kuttichira, 2012). These symptoms reveal problems in the healthcare system causing significant disability, poor quality of life, clinical frustration due to an inability to provide concrete evidence on the cause leading to ethical dilemmas due to costly investigations, often patients of these symptoms are neglected in out-patient settings explaining the lack of structure in the management strategy and also a lack of investigation in prevalence of these symptoms in India (Baitha.et.al, 2019). Another concern with the management of these symptoms arises when there is no immediate follow up on these symptoms due to lack of availability of integrative treatment in one place concluding

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psychotherapy and pharmacotherapy which resolves to a lack in assurance from the practitioner leading to patient dissatisfaction (Menon.et.al, 2016).

To have a holistic understanding in order to decipher the cause of these symptoms, the mind-body integration plays a crucial role. The mind and the body work together impacting each other. (Bolton & Attard, 2015). The bodily conditions impact cognitive functioning producing sensory inputs which translate to perceptual content. (Shapiro, 2018). Damasio's research talks about how bodily signatures (physiological processes) get involved within different environmental contexts responsible for several behavioral outcomes. (Worall, 2018).

An Insightful exploration of this mind-body sync leads to the study of interoception, which not only explains this integration but also shows the roots that lead to medically unexplained symptoms.

Interoception is a relatively new term gaining popularity in academic literature and as of yet consensus on its meaning has not been established. Research has been able to establish its understanding of interoception. "Interoception involves the bi-directional communication between bodily sensation and multiple levels of cortical oversight, a process by which information about invisible internal physiological states are communicated to cognitive centers in the brain to support physical and emotional well-being, including an effective response to stress via emotional awareness and regulation"(Craig, 2003; Critchley and Garfinkel, 2017; as cited in Price & Hooven, 2018).

Once in a lifetime, at least one-third of the population experiences medically unexplained symptoms. Persistent medically unexplained symptoms is developed by 3 to 10% of the general population (Flasinski.et.al,2020).

This Paper aims to explore the cause behind medically unexplained symptoms and to also present the process of interoception as an effective health promoting agent against medically unexplained symptoms. The paper not only shows how the interpretation errors in interoception lead to symptoms but also attempts to present how it can be used in a beneficial way. The paper integrates the bi-directional relationship of the body and mind in medically unexplained symptoms through analysing the physiological facets embracing the body aspect and then the subjective and metacognitive aspects of the mind, in an attempt to understand the process of interoception better in order to project effective implementation towards interventions for the symptoms.

The Physiological Aspect

The brain depends on the physiological state of the body in two contexts – the physiological and the informational context. In the physiological context, the brain needs apt conditions for systematic biological functioning. In the informational context, the brain receives and responds to active feedback of afferent visceral signals that shape its operational functioning- this is classical interoception which is the encoding and representation of internal bodily signals reporting the body's physiology. (Critchley & Harrison, 2013). In the context of medically unexplained symptoms when the mind perceives danger, the body receives signals through the nerves and chemicals in the blood from the brain which get the body ready for action by increasing oxygen intake and gearing up the muscles. (Bolton & Attard, 2015). Alongside the environmental factors, an increase in sensitization of the peripheral stimuli is speculated to partially be responsible for triggering and the maintenance of medically unexplained symptoms (Ruschil, et.al, 2021).

Garfinkel in one of his studies explains that poor interoceptive respiratory accuracy was associated with a high anxiety score (Garfinkel.et.al,2016). This explains an important

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aspect of experiencing shortness of breath when a person is extremely anxious. A change in the normal breathing pattern causes shortness of breath in panic attacks and anxiety (Meuret & Ritz, 2010). Conscious perception of the discrepancies within the body could result in several health benefits.

In the cardiovascular system, stress has a severe effect on our body which creates disruptions in several systems as it increases, an awareness in the interoceptive signals the body provides in response to stress such as fatigue can be corrected to save oneself from further damage such as, chest pain arises as a comorbid condition to fatigue in the case of the chronic illness of Myocarditis and this can eventually lead to several serious heart conditions (Spencer.et.al,2018; Railton, 2020). Spencer. et.al, 2018 and Critchley & Garfinkel, 2017 Findings from clinical science research explain the role of psychological influences on gut microbiota. The most common medically unexplained symptoms are pain in the back, joint, head, chest and in different body parts or disturbances in organ functions such as gastrointestinal problems inducing fatigue and respiratory problems leading to exhaustion. Having an additional physical illness precipitate and maintains these symptoms. (Guney.et.al, 2019). In the treatment process, Motivational Interviewing could help in adapting to a healthier approach in their beliefs towards the symptoms. (Heijmans.et.al, 2011).

Interoception is influential in the perception of pain due to the information received from the pain-inducing stimuli by the central nervous system (Craig, 2015). In a review article in 2016 interoception plays an important role in chronic pain conditions, findings revealed that altered interoception correlated with chronic pain conditions, patients with chronic pain exhibited lower Interoceptive accuracy as compared to the healthy population (Lernia. et.al, 2016). The endocrine and immune systems aid in homeostasis or allostatic control and according to a study imbalance in these systems is linked to Interoceptive

dysregulation in depression (Harrison. et.al, 2009). Medically unexplained symptoms and functional somatic syndromes are often a result of disturbed homeostasis and faulty processing of information through the body. (Rosendal. et.al, 2004).

The Subjective Aspect

The subjective experience defines the understanding of the physiological state of an individual. Medically unexplained symptoms are a result of an imbalance within the body which do not seem to have a physical cause, through a conscious exploration of the internal sense in the body could provide insight into understanding the body-mind sync better.

Interoception can be seen as a predecessor to emotion response, this plays a role in survival providing a window to emotional experience and provides insight on emotional regulation (Price & Hooven,2018). Though medically unexplained symptoms occur wherein there is a disproportion in the internal pattern of signals, among several other discrepancies- there is a disturbance in the subjective awareness and the temporoparietal cortices appear dysfunctional. (Spence,2006).

Taking account of the mind's influence over the body, the discrepancies can be altered. Cognition comprises a range of subjective experiences such as moods and emotions, metacognition, and bodily sensations. The Feelings as information Theory explains that this range of subjective experiences plays a role in judgment, assuming that people look up to feelings as informative. (Schwarz, 2012). In a study conducted on the mapping of subjective feelings, it was found that each feeling is characterized by a combination of interoceptive and exteroceptive information, evaluated concerning emotional states. The structure is at a mental and embodied level. (Nummenmaa.et.al, 2018). Acceptance and a cognitive appraisal are beneficial in the short-term regulation of symptom annoyance in the case of patients with

medically unexplained symptoms. (Kleinstaubert.al, 2019). Emotions are driven by their physiological root causes, the amygdala in the brain is responsible for emotions and each emotion is a product of certain biological processes such as happiness is caused by pleasant sensations from the body which is a reaction to biochemical substances such as serotonin, dopamine, and oxytocin moving through the blood along with electrical signals complementing the complex physiology of the brain (Blue, 2017). Hormones associated with aggression are testosterone and serotonin and the brain processes these emotions in a form of a physiological pattern formed through experiences. (Jhangiani.et.al, 2014). Happiness is proposed as a healing factor from the risk of medically unexplained symptoms. (Bando, 2018).

Medically unexplained symptoms were reported to be caused by affective influences on symptom processing leading to unpleasantness and further triggered by negative affect. (Constantinou.et.al, 2014). Affect is inherent to the perceptual process. A review on affect differentiates perception of body sensations from physiological changes that how gradually these sensations become independent from the physiological changes such as in anxiety and how this difference leads to medically unexplained symptoms (Peterson. et.al, 2015). Medically unexplained symptoms are considered within a cognitive-perceptual framework precipitating from biases in interoceptive information processing, negative emotions can be one of the sources of this bias, research findings have implicated mood-congruency as the underlying mechanism which refers to the hypothesis contemplating the role of negative emotions activating affectively congruent symptom representations in memory. (Constantinou, 2018). Without understanding the importance of this sense, the outcome of discrepancies in the body's equilibrium would be difficult to manage as distortions in

accurately identifying interoceptive signals have been linked to somatoform disorders (Schaefer. et.al, 2012).

The Metacognitive Aspect

Metacognition in simple words means thinking about thinking. This aspect further describes the physiological and the subjective aspects deriving the source of medically unexplained symptoms.

Symptom attention and increasing attribution processes are the cognitive factors reported to contribute to different medically unexplained symptoms. These symptoms are maintained by negative illness perceptions and attentional biases towards threats. (Guo.et.al, 2019). Youngsters with well-developed interoception use both logic and emotions as their response to the environment, those who lack interoception have difficulties in dealing with situations and do not understand the appropriate response to the situation, this prolonged may lead to emotional meltdowns, overload, anxiety, and depression. (Goodall, 2019). Medically unexplained symptoms are an outcome of distortions in bodily consciousness or control which result from an over-activation of the symptom representations in memory. (Brown, 2006).

Alterations in interoception play a significant role in symptom development and maintenance. The cognitive facet of interoception namely self-regulation is affected in patients with somatoform disorder and major depressive disorder. Highlighting the need of including specifically targeted mindfulness-based interventions. (Flasinski.et.al, 2018). Interoceptive awareness and self-regulation majorly contribute to psychosomatic competence which refers to the basic competence in the body maintaining the body's equilibrium. The results conclude that interoceptive awareness and conscious body-related self-regulation

together contribute to a basic competence of the body in homeostatic/allostatic control. (Fazekas.et.al, 2020). Allostasis is reported to be the basis behind the mechanism of interoception. Allostasis is the process of maintaining homeostasis through the adaptive mechanisms in the body. (Zsoldos & Ebmeier, 2016). Research on fatigue highlighted the performance of interoceptive-allostatic circuitry as monitored by a metacognitive layer that updates beliefs about the brain's capacity to successfully regulate bodily states (allostatic self-efficacy), fatigue occurred in a lack of sequential responses to the interoceptive experience and the metacognitive diagnosis stating a low allostatic self-efficacy. (Stephan.et.al, 2016).

Aspects involved in the Process of Interoception

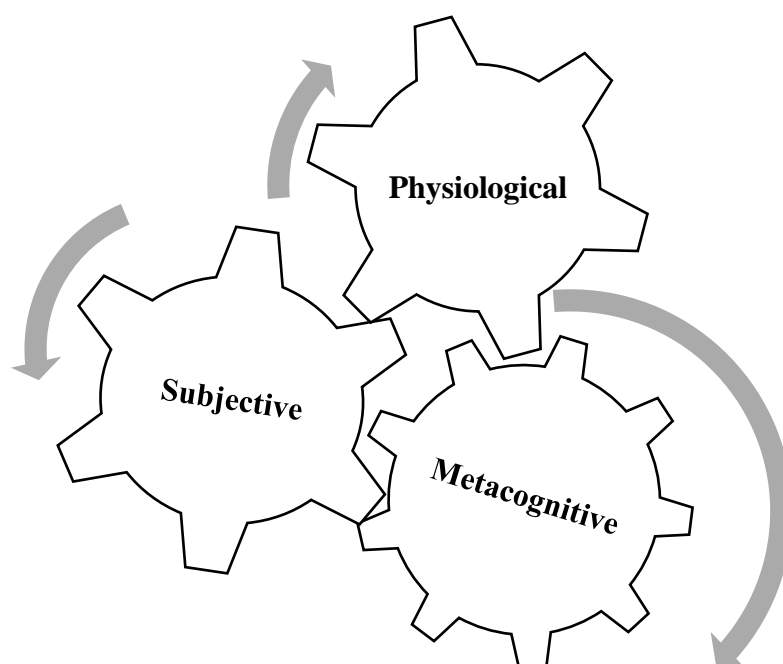


Figure 1: Aspects of Interoception that act as Health Promotive Agents

Since medically unexplained symptoms do not have a direct explanation onto its origin, including a dearth of research of these symptoms, the paper presents the process of interoception through it's physiological, subjective and metacognitive dimensions understanding and highlighting not only the origin of medically unexplained symptoms but

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also the importance of creating awareness on interoception. The application of this awareness will not only initiate a plan for a well-designed treatment process but will also lead to several insights on the body mind relationship.

The urgent need for research in medically unexplained symptoms can be qualified from the paucity in research in these symptoms alone. The research in these symptoms is only accounted when involved in another research. Most of the research in this paper was found along with the studies of interoception, this also highlights the fact that interoception can provide basis onto further research on the subject. This concludes a holistic approach on interventions towards these symptoms considering the bi-directional relationship of the body and mind and to make better policies towards a cost-effective treatment of these symptoms.

References

- Baitha, U., Deb, K. S., Ranjan, P., Mukherjee, A., Baudhh, N. K., Kaloiya, G. S., Kumar, A., & Jadon, R. S. (2019). *Estimated prevalence of medically unexplained physical symptoms in the medicine outpatient department of a tertiary care hospital in India*. General hospital psychiatry. Retrieved January 27, 2022, from <https://pubmed.ncbi.nlm.nih.gov/31710858/>
- Bando, H. (2018). *Management for Medically Unexplained Symptoms (MUS) in Primary Care Medicine*. iomcworld.org. <https://www.iomcworld.org/open-access/management-for-medically-unexplained-symptoms-mus-in-primarycare-medicine-2167-1079-1000307.pdf>.
- Blue, M. (2017, July 5). *Happiness is just Biology*. Impakter. <https://impakter.com/happiness-just-biology/>
- Bolton, & Attard. (2015). *Medically unexplained symptoms*. RC PSYCH ROYAL COLLEGE OF PSYCHIATRISTS. Retrieved January 27, 2022, from <https://www.rcpsych.ac.uk/mental-health/problems-disorders/medically-unexplained-symptoms>
- Brown, R. J. (2006, October 30). *Medically unexplained symptoms: A new model*. Psychiatry. Retrieved January 27, 2022, from <https://www.sciencedirect.com/science/article/abs/pii/S1476179306701975>.
- Constantinou, Bergh, Omer, Diest, Ilse, Bogaerts, & Katleen. (2014). *Affective processing of interoceptive information in persons with medically unexplained symptoms*. LIBISnet. Retrieved January 27, 2022, from <https://limo.libis.be/primo->
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explore/fulldisplay?docid=LIRIAS1791374&context=L&vid=Lirias&search_scope=Lirias&tab=default_tab&lang=en_US&fromSitemap=1

Constantinou. (2018, January 1). *Negative affect and medically unexplained symptoms:*

Semantic scholar. undefined. Retrieved January 27, 2022, from

<https://www.semanticscholar.org/paper/Negative-Affect-and-Medically-Unexplained-Symptoms-Constantinou/7607e5a61adb352220528469a1469b5e9e362811>

Craig, A. D. (2015). *How do you feel? An interoceptive moment with your neurobiological self.* Princeton University Press.

Craig, A. D. (B. (2003, July 11). *Interoception: The sense of the physiological condition of*

the body. Current Opinion in Neurobiology. Retrieved January 27, 2022, from

<https://www.sciencedirect.com/science/article/abs/pii/S0959438803000904?via%3DiHub>

Critchley, H. D., & Garfinkel, S. N. (2017, April 23). *Interoception and emotion.* Current

Opinion in Psychology. Retrieved January 27, 2022, from

<https://www.sciencedirect.com/science/article/pii/S2352250X17300106>

Critchley, H. D., & Harrison, N. A. (2013). *Visceral influences on brain and behavior.*

Neuron. Retrieved January 27, 2022, from <https://pubmed.ncbi.nlm.nih.gov/23439117/>

Fazekas, C., Avian, A., Noehrer, R., Matzer, F., Vajda, C., Hannich, H., & Neubauer, A.

(2020, May 19). *Interoceptive awareness and self-regulation contribute to*

psychosomatic competence as measured by a new inventory. SpringerLink. Retrieved

January 27, 2022, from <https://link.springer.com/article/10.1007/s00508-020-01670-5>

Flasinski, T., Dierolf, A. M., Rost, S., Lutz, A. P. C., Voderholzer, U., Koch, S., Bach, M., Asenstorfer, C., Münch, E. E., Mertens, V.-C., Vögele, C., & Schulz, A. (2020, August 7). *Altered interoceptive awareness in high habitual symptom reporters and patients with somatoform disorders*. *Frontiers*. Retrieved January 27, 2022, from <https://www.frontiersin.org/articles/10.3389/fpsyg.2020.01859/full>

Flasinski, T., Dierolf, A., Voderholzer, U., Koch, S., Bach, M., Asenstorfer, C., Lutz, A., Rost, S., Vögele, C., & Schulz, A. (2018, January 1). *Sensing your body: Interoceptive awareness and medically unexplained symptoms: Semantic scholar*. undefined. Retrieved January 27, 2022, from <https://www.semanticscholar.org/paper/Sensing-Your-Body%3A-Interoceptive-Awareness-and-Flasinski-Dierolf/3366be47113a4b18df11f3b1b535702b31d1d798>

Garfinkel, S. N., Manassei, M. F., Fletcher, G. H., Bosch, Y., Critchley, H. D., & Engels, M. (2016). *Interoceptive dimensions across cardiac and respiratory axes*. *Philosophical transactions of the Royal Society of London. Series B, Biological sciences*. Retrieved January 27, 2022, from <https://pubmed.ncbi.nlm.nih.gov/28080971/>

Goodall. (2019). *Ready to learn Interoception Kit - South Australia*. Retrieved January 27, 2022, from <https://www.education.sa.gov.au/sites/default/files/ready-to-learn-interoception-kit.pdf>

Guney, Z., Sattel, H., Witthoft, M., & Henningsen, P. (2019, June 7). *Emotion regulation in patients with somatic symptom and related disorders: A systematic review*. *PloS one*. Retrieved January 27, 2022, from <https://pubmed.ncbi.nlm.nih.gov/31173599/>

- Guo, D., Kleinstäuber, M., Johnson, M. H., & Sundram, F. (2019, March 6). *Evaluating commonalities across medically unexplained symptoms*. International journal of environmental research and public health. Retrieved January 27, 2022, from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6427368/>.
- Harrison, N. A., Brydon, L., Walker, C., Gray, M. A., Steptoe, A., Dolan, R. J., & Critchley, H. D. (2009, September 1). *Neural origins of human sickness in interoceptive responses to inflammation*. Biological psychiatry. Retrieved January 27, 2022, from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2885492/>.
- Heijmans, M., olde Hartman, T. C., van Weel-Baumgarten, E., Dowrick, C., Lucassen, P. L. B. J., & van Weel, C. (2011, March 2). *Experts' opinions on the management of medically unexplained symptoms in primary care. A qualitative analysis of narrative reviews and scientific editorials*. OUP Academic. Retrieved January 27, 2022, from <https://academic.oup.com/fampra/article/28/4/444/507755>.
- Jhangiani, D. R., Tarry, D. H., & Stangor, D. C. (2014, September 26). *The Biological and Emotional Causes of Aggression*. Principles of Social Psychology 1st International Edition. <https://opentextbc.ca/socialpsychology/chapter/the-biological-and-emotional-causes-of-aggression/>.
- Kleinstäuber, M., Allwang, C., Bailer, J., Berking, M., Brünahl, C., Erkip, M., Gitzen, H., Gollwitzer, M., Gottschalk, J.-M., Heider, J., Hermann, A., Lahmann, C., Löwe, B., Martin, A., Rau, J., Schröder, A., Schwabe, J., Schwarz, J., Stark, R., ... Rief, W. (2019, August 20). *Cognitive behaviour therapy complemented with emotion regulation training for patients with persistent physical symptoms: A randomised clinical trial*.

Psychotherapy and Psychosomatics. Retrieved January 28, 2022, from
<http://dx.doi.org/10.1159/000501621>

Koola, M. M., & Kuttichira, P. (2012). *Psychosocioeconomic study of Medically Unexplained Physical Symptoms*. Sage journals. Retrieved January 27, 2022, from
<https://journals.sagepub.com/doi/10.4103/0253-7176.101785>

Lernia, D. D., Serino, S., & Riva, G. (2016). *Pain in the body. altered interoception in chronic pain conditions: A systematic review*. Neuroscience and biobehavioral reviews. Retrieved January 27, 2022, from <https://pubmed.ncbi.nlm.nih.gov/27654341/>.

Marks, E. M., & Hunter, M. S. (2015, May). *Medically unexplained symptoms: An acceptable term?* British journal of pain. Retrieved January 27, 2022, from
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4616968/>.

Menon, V., Sarkar, S., & Thomas, S. (2016). *Establishing a psychosomatic clinic in a low resource setting: Process, challenges, and opportunities*. Journal of neurosciences in rural practice. Retrieved January 27, 2022, from
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4750324/>

Meuret, & Ritz. (2010, May 25). *Hyperventilation in panic disorder and asthma: empirical evidence and clinical strategies*. Europe PMC. Retrieved January 27, 2022, from
<https://europepmc.org/article/pmc/2937087>.

Nummenmaa, L., Hari, R., Hietanen, J. K., & Glerean, E. (2018, July 3). *Maps of subjective feelings*. Proceedings of the National Academy of Sciences of the United States of America. Retrieved January 27, 2022, from <https://pubmed.ncbi.nlm.nih.gov/30154159/>

Petersen, S., Von Leupoldt, A., & Van Den Bergh, O. (2015, September 17). *Interoception and the uneasiness of The mind: Affect as perceptual style*. *Frontiers*. Retrieved January 27, 2022, from <https://www.frontiersin.org/articles/10.3389/fpsyg.2015.01408/full>

Price, C. J., & Hooven, C. (2018, May 28). *Interoceptive awareness skills for emotion regulation: Theory and approach of mindful awareness in body-oriented therapy (MABT)*. *Frontiers*. Retrieved January 27, 2022, from <https://www.frontiersin.org/articles/10.3389/fpsyg.2018.00798/full>

Railton, D. (2020, January 20). *Chest pain: 26 causes, symptoms, and when to see a doctor*. *Medical News Today*. Retrieved January 27, 2022, from <https://www.medicalnewstoday.com/articles/321650>

Rosendal, M., Olesen, F., & Fink, P. (2004, December 30). *Management of medically unexplained symptoms*. *The BMJ*. Retrieved January 27, 2022, from https://www.bmj.com/content/330/7481/4?sort_by=field_highwire_a_epubdate_value&sort_order=DESC&items_per_page=10&page=1&panels_ajax_tab_tab=bmj_related_rapid_responses&panels_ajax_tab_trigger=rapid-responses

Ruschil, V., Mazurak, N., Hofmann, M., Loskutova, E., Enck, P., Freilinger, T., & Weimer, K. (2021, September 7). *Decreased autonomic reactivity and psychiatric comorbidities in neurological patients with medically unexplained sensory symptoms: A case-control study*. *Frontiers*. Retrieved January 27, 2022, from <https://www.frontiersin.org/articles/10.3389/fneur.2021.713391/full>

Schaefer, M., Egloff, B., & Witthoft, M. (2012). *Is interoceptive awareness really altered in somatoform disorders? testing competing theories with two paradigms of Heartbeat*

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- Perception*. Journal of abnormal psychology. Retrieved January 27, 2022, from <https://pubmed.ncbi.nlm.nih.gov/22642840/#:~:text=IA%20was%20reliably%20assessed%20with,IA%20in%20patients%20with%20SFDs>.
- Schwarz, N. (2012). *Feelings as information theory*. American Psychological Association. Retrieved January 27, 2022, from <https://psycnet.apa.org/record/2011-21800-014>
- Shapiro, L. A. (2018, July 6). *Flesh matters: The body in cognition*. Wiley Online Library. Retrieved January 27, 2022, from <https://onlinelibrary.wiley.com/doi/abs/10.1111/mila.12203>
- Spence, S. (2006, September). *All in the mind? the neural correlates of unexplained physical symptoms*. Research Gate. Retrieved January 27, 2022, from https://www.researchgate.net/publication/255620357_All_in_the_mind_The_neural_correlates_of_unexplained_physical_symptoms
- Spencer, N., Hibberd, T., & Travis, L. (2018, May 29). *'Second Brain' neurons keep colon moving*. ScienceDaily. Retrieved January 27, 2022, from <https://www.sciencedaily.com/releases/2018/05/180529132122.htm>
- Stephan, K. E., Manjaly, Z. M., Mathys, C. D., Weber, L. A. E., Paliwal, S., Gard, T., Tittgemeyer, M., Fleming, S. M., Haker, H., Seth, A. K., & Petzschner, F. H. (2016, January 1). *Allostatic self-efficacy: A metacognitive theory of dyshomeostasis-induced fatigue and depression*. Frontiers. Retrieved January 27, 2022, from <https://www.frontiersin.org/articles/10.3389/fnhum.2016.00550/full>
- Worrall, S. (2018, March 16). *Is there a mind-body connection, or do our brains work alone?* Science. Retrieved January 27, 2022, from [The Process Behind the Origin of Symptoms That are Medically Unexplained](#)

[https://www.nationalgeographic.com/science/article/why-the-brain-body-connection-is-more-important-than-we-](https://www.nationalgeographic.com/science/article/why-the-brain-body-connection-is-more-important-than-we-think#:~:text=Yes!,body%20and%20brain%20coordinate%20emotions)

[think#:~:text=Yes!,body%20and%20brain%20coordinate%20emotions.](https://www.nationalgeographic.com/science/article/why-the-brain-body-connection-is-more-important-than-we-think#:~:text=Yes!,body%20and%20brain%20coordinate%20emotions)

Zsoldos, E., & Ebmeier, K. P. (2016, June 3). *Aging and psychological stress*. *Stress: Concepts, Cognition, Emotion, and Behavior*. Retrieved January 27, 2022, from <https://www.sciencedirect.com/science/article/pii/B978012800951200039X>.