

PERSPECTIVE ARTICLE

Somatosensory amplification: Conceptual structure, neurobiological foundations, and clinical implications

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Abstract

Somatosensory amplification (SSA) is a cognitive-emotional construct defined as the tendency to perceive normal physiological sensations as unusually intense, disturbing, and threatening. Originally introduced by Barsky *et al.*, SSA involves heightened attention to bodily sensations, catastrophic interpretations, and exaggerated emotional responses. This tendency is closely linked with various psychiatric disorders, including anxiety disorders, somatic symptom disorder, panic disorder, and health anxiety. SSA is also conceptually related to constructs such as interoception, somatization, and bodily awareness, although it remains distinct in its emphasis on cognitive-affective distortion. Neuroimaging studies suggest that SSA is associated with hyperactivation in brain regions responsible for somatic awareness and emotion regulation, such as the insula and anterior cingulate cortex. The SSA scale is the most commonly used tool to assess SSA, although complementary methods like heartbeat detection tasks and attentional bias paradigms are also employed. Therapeutically, cognitive-behavioral therapy, mindfulness-based interventions, and attention training programs have shown promise in reducing SSA levels. This review emphasizes the importance of SSA as a transdiagnostic mechanism that bridges bodily, emotional, and cognitive domains, with implications for both research and clinical practice. Future studies should further investigate SSA's neurobiological basis and develop targeted interventions to address this amplifying tendency in diverse clinical populations.

***Corresponding author:**Zuhal Koc Apaydin
(zuhalapaydin@karabuk.edu.tr)**Citation:** Apaydin ZK.Somatosensory amplification:
Conceptual structure,
neurobiological foundations, and
clinical implications. *J Clin Basic
Psychosom.* 2026;4(3):025260047.
doi: 10.36922/JCBP025260047**Received:** June 24, 2025**Revised:** July 22, 2025**Accepted:** July 24, 2025**Published online:** August 8, 2025**Copyright:** © 2025 Author(s).This is an Open-Access article
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affiliations.**Keywords:** Somatosensory amplification; Interoception; Health anxiety; Somatization; Cognitive-behavioral therapy; Mindfulness; Neurobiology; Transdiagnostic model

1. Introduction

Somatosensory amplification (SSA) is a tendency characterized by heightened attention to internal bodily sensations and the perception of these sensations as unusually intense and threatening. The concept was first defined by Barsky and Wyshak (1990), who described it as a cognitive-emotional pattern marked by persistent focus on bodily sensations, a tendency toward catastrophizing, and increased emotional reactivity to these sensations.¹ While it is common for individuals to occasionally notice signals from their bodies in daily life, individuals with high SSA levels tend to focus excessively on such sensations and often interpret physiologically normal signals as distressing

or abnormal.² Body awareness has been identified as the strongest predictor of SSA, followed by anxiety and subjective symptoms, which together contribute to a stress response.²

Despite its clinical relevance, SSA remains an underrecognized and underutilized construct in psychiatric research and practice. It plays a critical role in the development and persistence of psychosomatic symptoms, health anxiety, and functional somatic syndromes, yet is rarely assessed or addressed directly in clinical settings.³ Moreover, SSA provides a transdiagnostic framework that transcends traditional psychiatric classifications,⁴ making it highly valuable in understanding symptom severity, treatment resistance, and quality of life across various mental disorders.

The unique nature of SSA suggests that it is associated not only with psychological processes but also with cognitive, sensory, and neurobiological mechanisms.^{5,6} However, research focusing on these dimensions is still limited, and current knowledge has not been fully translated into clinical practice. In this context, exploring the theoretical foundations and neurobiological underpinnings of SSA will contribute to a more comprehensive and applicable understanding of the construct.

2. Theoretical framework

Initially introduced by Barsky *et al.* to explain the underlying mechanisms of hypochondriasis and somatization processes,⁷ the concept of SSA refers to an individual's tendency to perceive normal physiological sensations from the body as more intense, disturbing, and threatening than they actually are. This condition is characterized as a cognitive-emotional process involving three key components: heightened awareness of sensory stimuli, catastrophic interpretations of these sensations, and increased emotional reactivity.¹

According to Barsky's *et al.* model, SSA consists of three core components:

- (i) Attentional focus: The excessive and abnormal focusing of attention on internal bodily sensations
- (ii) Catastrophic interpretation: The tendency to interpret these sensations as signs of serious illness
- (iii) Increased emotional reactivity: The emergence of anxiety, fear, and distress in response to the perceived threat, which in turn amplifies bodily sensations.^{5,7}

This model suggests that SSA is not merely a psychological trait but rather a dynamic structure interacting with attentional processes, cognitive distortions, and emotional regulation systems. In this regard, SSA is considered a foundational construct for psychophysiological and neurocognitive research.

3. Neurobiological mechanisms

Recent neuroimaging studies have demonstrated that SSA is not solely associated with cognitive and emotional processes but is also linked to structural and functional mechanisms at the level of the central nervous system. One of the core features of SSA—heightened attention to bodily sensations and threat perception—has been found to involve brain regions such as the insula, anterior cingulate cortex, and the somatosensory cortex.^{8,9}

Functional neuroimaging studies have shown that focused attention on emotional stimuli and bodily states leads to increased activation in the right insula and the primary somatosensory cortex (S1).⁹ These areas play a critical role in both interoceptive awareness and emotional processing. Similarly, sustained attention to spontaneous sensations has been associated with enhanced activation in the primary somatosensory areas (Brodmann areas 3a/3b), superior parietal cortex, and anterior cingulate gyrus. This pattern suggests that bodily representations are modulated by top-down cognitive control mechanisms.¹⁰

Recent neurobiological models further propose that SSA is embedded in a broader interoceptive-attentional system.^{8,11} The posterior insula is implicated in the processing of raw bodily sensations, while the anterior insula integrates these signals with emotional and cognitive representations, contributing to the perception of threat.^{12,13} The anterior cingulate cortex is thought to support sustained attention and conflict monitoring, especially when individuals focus intensely on bodily states.¹⁴ Moreover, altered patterns of activity in the Default Mode Network—including regions such as the medial prefrontal cortex and posterior cingulate cortex—may reflect increased self-referential and bodily-focused processing in individuals with elevated SSA,¹⁵ consistent with a ruminative and threat-oriented cognitive style.

A more recent and integrative perspective proposes that SSA is not limited to symptom awareness but also encompasses processes related to the bodily perception of external threats. This conceptual extension, termed somatic threat amplification, refers to individuals perceiving both their current bodily sensations and anticipated future symptoms as threatening.² Within this framework, SSA should be considered not only in relation to interoception and symptom perception but also as a broader neurocognitive construct interwoven with health-related anxiety, symptom expectations, and fear-based cognitive schemas.

Taken together, these findings support the notion that SSA is a multidimensional construct, shaped by the dynamic interaction between neurobiological, cognitive,

sensory, and affective systems, rather than being solely a psychological tendency.

4. Conceptual distinctions, related constructs, and psychiatric comorbidities

Although SSA overlaps conceptually with various psychological and psychiatric constructs, it remains a distinct phenomenon with unique features. SSA is frequently discussed alongside concepts such as interoception, somatization, and health anxiety, which may lead to confusion or conflation.^{1,2,16} Interoception refers to the ability to perceive internal bodily signals, such as heartbeat or gastrointestinal activity.¹⁷ While heightened interoceptive sensitivity may serve neutral or even adaptive functions,¹⁷ SSA is characterized by the interpretation of such signals as threatening, distressing, and exaggerated.² Individuals with high SSA levels tend to report increased anxiety and pain symptoms,² whereas those with high interoceptive awareness often display fewer anxiety symptoms due to better emotion regulation capacities.¹⁸ Thus, SSA not only pertains to the awareness of bodily sensations but also reflects the cognitive and emotional distortions that shape their interpretation.²

A similar distinction exists between SSA and somatization. Somatization refers to the expression of psychological distress through physical symptoms in the absence of a clear organic cause.^{19,20} It can be viewed as a defense mechanism, wherein overwhelming emotions such as stress or anxiety are externalized through bodily complaints.²¹ In contrast, SSA focuses not on the emergence of symptoms per se, but rather on how bodily sensations are perceived and interpreted.² Individuals with high SSA levels are inclined to interpret physiologically normal bodily sensations (e.g., stomach rumbling, heart palpitations) as threatening and show a heightened attentional focus on them. Over time, this pattern may lead to increased health concerns and hypersensitivity to somatic symptoms. Indeed, individuals with high anxiety sensitivity may exhibit autonomic arousal and defensive physiological reactions when anticipating interoceptive threats such as hyperventilation.²² Notably, such responses may persist even after the threat has subsided, indicating prolonged sensitivity to bodily sensations.²² Interestingly, SSA is not necessarily associated with increased physiological accuracy. For example, Mailloux and Brener²³ found that individuals who could more accurately detect their heartbeats actually scored lower on SSA measures, suggesting that SSA is more closely linked to the interpretation of sensations and the associated cognitive-emotional response patterns rather than physiological sensitivity itself.

SSA is also closely related to health anxiety (hypochondriasis).¹⁶ Individuals with health anxiety tend to interpret bodily signals as indicators of serious illness.²⁴ SSA provides a cognitive-affective framework for understanding this interpretative process, including attentional focus on bodily sensations, their threat-related misinterpretation, and heightened emotional reactivity.²⁵ However, SSA does not always result in clinical levels of health anxiety; it can also be observed in non-clinical populations and may interact with other psychopathological structures.

Patients with schizophrenia often exhibit disturbances in the perception and representation of bodily states, including coenesthetic hallucinations and hypochondriacal delusions, suggesting a potential link between SSA and positive psychotic symptoms.^{26,27} Structural and functional neuroimaging studies have revealed abnormalities in the insular cortex, supporting the notion that altered interoception and SSA may contribute to the neurobiological basis of psychotic manifestations in schizophrenia.^{28,29}

Indeed, SSA has been examined in relation to several psychiatric disorders. Beyond its conceptual overlaps with interoception, somatization, and health anxiety, SSA has been found to be associated with anxiety disorders, major depression, somatic symptom disorder, irritable bowel syndrome, and fibromyalgia.^{16,30-33} A common feature across these disorders is the exaggerated perception of internal sensations, which exacerbates psychological distress. Understanding SSA's role in these clinical presentations can offer valuable insights for both diagnostic and therapeutic decision-making. For instance, in individuals with high SSA, symptom-focused treatment approaches may prove insufficient. Instead, therapies aimed at modifying attentional focus and addressing cognitive distortions may be more effective.

5. Measurement of SSA: Scales and methods

The most commonly used tool for assessing SSA is the SSA scale (SSAS), developed by Barsky *et al.* (1990). This scale aims to evaluate individuals' sensitivity to internal bodily sensations and their tendency to perceive such sensations as threatening or disturbing. The original version of the SSAS consists of 10 items rated on a 5-point Likert-type scale, where higher scores indicate greater levels of SSA.⁷

The SSAS has been widely applied in clinical contexts, particularly in relation to psychosomatic disorders, health anxiety, and somatization.³⁴ Although the scale was introduced over three decades ago, its clinical relevance has arguably increased in recent years due to the rising

prevalence of health-related anxiety and medically unexplained somatic complaints. The persistence of these symptom profiles in modern psychiatric populations—often in the absence of clear organic pathology—highlights the continued applicability of the SSAS.³⁰ Furthermore, the scale provides a structured and quantifiable method for identifying individuals at risk of misinterpreting benign somatic signals, which can inform targeted psychological interventions. In this context, the current study's use of the SSAS not only allows for a standardized measurement of SSA but also facilitates a deeper understanding of the cognitive-emotional and interoceptive processes that underlie somatization in contemporary clinical settings.⁷ Therefore, re-evaluating and contextualizing the SSAS in light of present-day mental health challenges enhances the theoretical and empirical contribution of the current work. However, some researchers have pointed out that because the SSAS is based on subjective self-report, it may not measure the individual's physiological responses to sensations per se, but rather how these responses are cognitively appraised and emotionally evaluated. In this respect, the SSAS primarily reflects patterns of cognitive appraisal and emotional reaction rather than physiological sensitivity.³⁴

Experimental studies on SSA have also expanded measurement strategies. Notably, heartbeat detection tasks, which aim to assess interoceptive accuracy, are employed to explore the discrepancy between self-reported SSA and the individual's ability to accurately perceive physiological signals. However, empirical findings have shown inconsistent correlations between SSAS scores and performance on heartbeat detection tasks.¹⁵ These findings highlight the need to complement self-report measures with objective psychophysiological indicators in the assessment of SSA.

Recent measurement approaches have adopted a more comprehensive perspective, treating SSA not only as a tendency to perceive bodily sensations but also as a process shaped by how these sensations are appraised and the emotional responses they evoke. In this context, attentional bias paradigms (e.g., dot-probe tasks), threat perception tests, and neurocognitive methods such as electroencephalography (EEG) and functional magnetic resonance imaging (fMRI) have been increasingly used to analyze the underlying mechanisms of SSA in more depth.^{5,35}

6. Treatment approaches and interventions in SSA

In individuals with SSA, the tendency to interpret physiologically normal bodily sensations as exaggerated,

distressing, and threatening can gradually increase health-related concerns, disrupt daily functioning, and intensify various psychiatric symptoms. Consequently, treatment approaches targeting these cognitive-emotional patterns have gained prominence. Among these, cognitive behavioral therapy (CBT) stands out as the most widely used and empirically supported psychotherapy modality for addressing the maladaptive beliefs, catastrophic interpretations, and attentional biases associated with SSA.^{34,36}

CBT interventions are particularly effective in clinical conditions where SSA levels are high, such as health anxiety, somatic symptom disorder, and panic disorder. The therapeutic goal is to help patients interpret bodily sensations in a more functional and realistic manner.³⁷ Patients are informed that bodily sensations are often harmless and may be transiently triggered by stress and anxiety.³⁸ Cognitive restructuring, exposure techniques, and controlled attention training toward bodily sensations are key components of the treatment.³⁹ These strategies aim to interrupt the cycle of perceived threat and catastrophic misinterpretation that underlies SSA.

Another effective psychological approach in reducing SSA is mindfulness-based interventions.⁴⁰ Programs such as mindfulness-based stress reduction and mindfulness-based cognitive therapy help individuals to observe and accept bodily sensations non-judgmentally. This process reduces emotional reactivity and increases attentional flexibility.⁴¹⁻⁴³ Empirical studies have demonstrated the efficacy of mindfulness practices in alleviating health anxiety, fibromyalgia, and irritable bowel syndrome associated with SSA.^{44,45}

In addition, attention training programs aim to reduce the selective attention toward internal bodily sensations, which plays a central role in SSA.⁴⁶ These interventions encourage individuals to develop alternative attentional strategies that do not interpret bodily sensations as threatening. Techniques such as consciously redirecting attention away from internal cues or enhancing focus on external stimuli are used to weaken the underlying mechanism of hypervigilance. Experimental studies in this domain have shown that attention training can be effective in reducing SSA levels and associated anxiety symptoms.⁴⁷

7. Discussion and future directions

As discussed in previous sections, SSA has been associated with various psychiatric conditions, including anxiety disorders, somatic symptom disorder, panic disorder, and health anxiety.^{19,30,33} Thus, SSA is not limited to symptom perception alone but is also linked to multidimensional processes such as illness attitudes, body awareness, and emotional regulation capacity.

Nevertheless, SSA is still often treated as a secondary variable in many studies and remains an under-targeted domain in clinical interventions. Considering its close association with attentional processes, catastrophic thinking, and emotional reactivity,² SSA may be conceptualized as a transdiagnostic construct. Processes such as symptom-focused attention, impaired body awareness, and symptom catastrophizing—commonly observed in conditions such as health anxiety, depression, and post-traumatic stress disorder—may be interpreted through the lens of SSA. From this perspective, recognizing SSA as a transdiagnostic dimension may contribute to more integrative approaches in psychopathology models.

Future research should prioritize a deeper investigation of the neurobiological underpinnings of SSA. Functional neuroimaging techniques (e.g., fMRI, EEG) could be utilized to map brain activations related to attentional orientation, threat perception, and emotional processing in individuals with high SSA levels. Furthermore, exploring the causal relationships between SSA and processes such as interoception, somatic attentional bias, and affective regulation through longitudinal and experimental designs would enhance the construct's convergent and discriminant validity. Such studies would support the view of SSA not only as a measurable trait but also as a modifiable therapeutic target.

From a clinical perspective, taking into account our understanding of SSA in psychotherapy practices represents a promising avenue. While CBT, mindfulness-based approaches, and attention-focused interventions offer effective techniques for addressing SSA-related mechanisms, their direct effects on SSA have only been evaluated in a limited number of studies. Therefore, incorporating SSAS-specific modules into psychotherapeutic programs may enhance treatment efficacy and contribute to more personalized intervention planning. As a powerful conceptual tool for understanding the interplay between body, emotion, and cognition, SSAS warrants a more central position within transdiagnostic models and should be integrated into clinical decision-making processes. Such a shift could yield substantial benefits for academic literature and mental health services alike.

8. Conclusion

As a multilayered construct encompassing attentional focus, interpretative style, and emotional reactivity toward bodily sensations, SSA emerges as a potentially decisive mechanism in the symptom presentation and clinical course of various psychiatric disorders. Its association with anxiety disorders, somatic symptom disorder, health

anxiety, panic disorder, and depression highlights the need to conceptualize SSA not merely in diagnostic terms, but as a dynamic, process-oriented phenomenon. Consequently, SSA should be considered a critical component in both clinical assessment and treatment planning.

Contemporary literature suggests that SSA is associated not only with cognitive and emotional processes but also with underlying neurobiological mechanisms. Heightened attention to bodily sensations, perceived threat, and catastrophic thinking impacts not only mental health perceptions but also somatic health beliefs and healthcare-seeking behavior. Thus, SSA should be acknowledged and assessed not only in mental health services but also in primary care settings.

Future research should aim to further elucidate the transdiagnostic nature of SSA. This perspective would facilitate the identification of shared sensory, cognitive, and affective mechanisms across different psychiatric disorders and promote the development of common therapeutic targets. In particular, further investigation into the efficacy of CBT, mindfulness-based interventions, and attention training programs in modulating SSA would be valuable in enhancing psychotherapeutic strategies.

In summary, SSAS is a distinctive and important conceptual tool that should not be overlooked in either clinical practice or academic research. By serving as a bridge between bodily, emotional, and cognitive processes, SSAS supports a more holistic understanding of psychopathology and contributes to the development of personalized intervention strategies. Positioning SSA as a core component of transdiagnostic models—beyond the constraints of traditional diagnostic classifications—may yield meaningful advancements for both psychiatric research and mental health care systems.

Acknowledgments

None.

Funding

None.

Conflict of interest

The author declares no conflict of interest.

Author contributions

This is a single-authored article.

Ethics approval and consent to participate

Not applicable.

Consent for publication

Not applicable.

Availability of data

Not applicable.

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