A Cognitive Science Analysis of Somatic Experiencing®: Evaluating the SIBAM Framework Through Embodied Cognition and Interoceptive Inference

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***Abstract*—Body-based trauma therapies have gained clinical traction in recent years, but many lack grounding in the theoretical frameworks of cognitive science. This paper asks: to what extent can Peter Levine's SIBAM framework (Sensation, Image, Behavior, Affect, Meaning) in Somatic Experiencing® be understood as a cognitively coherent model of bottom-up processing when analyzed through embodied cognition and interoceptive inference? Through a literature review synthesizing 14 sources across clinical SE literature, computational neuroscience, embodied cognition, and cognitive behavioral therapy, I find that SIBAM's five channels map onto established cognitive science constructs, particularly interoceptive processing, somatic markers, and active inference. However, SE's claim to "bottom-up" processing is complicated by predictive coding, which describes neural processing as fundamentally bidirectional. The central tension resolves when "bottom-up" is understood not as an architectural claim about how the brain computes, but as a therapeutic strategy that shifts precision-weighting toward interoceptive prediction errors, allowing body signals to update rigid, trauma-related priors. This reinterpretation positions SE and CBT as complementary interventions targeting different levels of the same predictive hierarchy. Future empirical work should test whether SE produces measurable changes in interoceptive accuracy and precision-weighting.**

Keywords: somatic experiencing, SIBAM, embodied cognition, interoception, interoceptive inference, bottom-up processing, cognitive behavioral therapy

I. Introduction

Trauma-related disorders are a significant public health concern. People who suffer from traumatic experiences often show impaired cognitive functioning due to the intensity of the negative affect they experience in trauma-related situations [1]. This impairment poses a problem for cognitive, language-based interventions, which require substantial cognitive processing to be effective. Exposure-based interventions frequently used in cognitive behavioral therapy (CBT) also face challenges, including high dropout rates due to the confrontational nature of the intervention [1]. These limitations have motivated growing interest in body-based therapeutic approaches that do not rely primarily on verbal cognitive processing.

One approach is Somatic Experiencing® (SE), a body-oriented trauma therapy developed by Peter Levine. SE treats post-traumatic symptoms by changing the interoceptive and proprioceptive sensations associated with the traumatic experience [1], [2]. Rather than targeting cognitions or deliberately re-exposing clients to traumatic memories, SE directs attention to internal body sensations and facilitates the completion of interrupted defensive responses [3]. Levine systematized this approach through the SIBAM model, which identifies five interacting channels of experience: Sensation, Image, Behavior, Affect, and Meaning [4]. He describes SIBAM as "the essence of 'bottom-up,' sensorimotor processing," positioning it explicitly against the top-down logic of cognitive therapies [4].

From a cognitive science perspective, this claim raises an important question. The dominant framework in the field, what Thagard calls the Computational-Representational Understanding of Mind (CRUM), holds that "thinking can best be understood in terms of representational structures in the mind and computational procedures that operate on those structures" [5]. Thagard himself acknowledges that this framework has underemphasized the role of bodies and physical environments in shaping cognition, a challenge he argues should be met by expanding and supplementing CRUM rather than abandoning it [5]. At the same time, Damasio's somatic marker hypothesis established that bodily signals play a central role in emotional experience and decision-making, showing that feelings are "the direct perception of a specific landscape: that of the body" [6]. More recently, Seth's framework of interoceptive inference proposes that emotional experience arises from the brain's actively inferred generative models of the causes of interoceptive signals [7]. Seth and Friston extend this through the concept of "circular causality," where descending predictions about bodily states and ascending interoceptive signals continuously interact in a closed loop [8].

These developments in embodied cognition and interoceptive inference provide the analytical tools to evaluate SE's theoretical claims. This paper asks:

To what extent can Peter Levine's SIBAM framework in Somatic Experiencing be understood as a cognitively coherent model of bottom-up processing when analyzed through the lens of embodied cognition and interoceptive inference?

It is important to note that this is not a clinical efficacy question. The goal is not to evaluate whether SE works, but whether its conceptual architecture maps onto or extends existing cognitive science constructs regarding body-mind integration.

The remainder of this paper is organized as follows. Section II describes the literature review design, including the search process and how my approach evolved. Section III presents the results organized around four themes: SIBAM's alignment with cognitive science constructs, the complications introduced by predictive processing, a proposed resolution through precision-weighting, and a comparison between SE and CBT through this lens. Section IV discusses the implications of these findings. Section V concludes with a summary of key insights and future directions. Section VI addresses limitations and specific proposals for future research.

II. Literature Review Design

My interest in this topic began with a personal observation. In my experience with traditional cognitive therapies, which focus on linguistic and symbolic restructuring of thoughts, I found that there is a ceiling to the amount of change that can occur through abstract reasoning alone. When the nervous system is in a state of high arousal, thinking about the problem often fails to resolve the underlying physiological state. This led me to Somatic Experiencing, and I wanted to understand whether its body-first approach had a solid foundation in cognitive science or operated outside the field's established frameworks.

I began the review by reading Levine's two foundational books: *Waking the Tiger* [2] and *In an Unspoken Voice* [4]. These gave me the clinical and theoretical foundation for SE and introduced the SIBAM model. From there, I moved to Payne, Levine, and Crane-Godreau's peer-reviewed article [3], which is the most systematic articulation of SE in the academic literature. This paper explicitly frames SE as using "bottom-up processing" and cites researchers like Craig and Damasio, who pointed me toward the interoceptive inference literature.

I searched for sources using the Georgia Tech Library, Brown University Library, Google Scholar, and PubMed. My primary search terms were "somatic experiencing," "somatic markers," "proprioception," and "interoception." I followed citation chains from Payne et al. [3] to identify the key interoceptive inference papers by Seth [7] and Seth and Friston [8]. I also identified Craig [9], Critchley and Garfinkel [10], and the Khalsa et al. consensus paper [11] through this process. For the CBT contrast, I used Beck's textbook [12], and for the broader cognitive science framework, I drew on Thagard's course textbook [5] and Damasio [6]. Brooks [13] was included because it was a course reading on embodied cognition and offered an important reference point for anti-representational approaches.

I organized my notes with a consistent structure for each source: an overview or summary, key quotes, and a section on conceptual connections to the research question. This made it easier to compare sources later and to identify where authors agreed, disagreed, or were talking past each other.

My approach changed in two significant ways during the review. First, I originally planned to organize the results by mapping each SIBAM channel one by one to a corresponding cognitive science concept. This seemed straightforward at first: Sensation maps to interoception, Image maps to mental imagery, and so on. But as I read Seth [7] and Seth and Friston [8], I encountered the concept of precision-weighting and the Bayesian brain framework, which complicated the picture. Predictive processing describes perception as fundamentally bidirectional rather than bottom-up. This meant I could not simply validate SE's "bottom-up" claim at face value. I had to grapple with the tension between SE's framing and what contemporary computational neuroscience actually says about processing direction. The results section reflects this shift: rather than a channel-by-channel mapping, I organized the findings around the broader question of whether SE's bottom-up model is coherent and how the tension with predictive processing can be resolved.

Second, I initially considered including Porges's polyvagal theory, which is cited frequently in the SE literature. Yet, the scope of that work was too large to explore adequately alongside the interoceptive inference framework, so I narrowed my focus to 14 sources organized into four thematic clusters: (1) SE and SIBAM, (2) interoception and predictive processing, (3) foundational embodied cognition, and (4) cognitive science framework and contrast.

III. Results

A. SIBAM as a Multi-Channel Model of Embodied Experience

SIBAM's five channels find meaningful parallels in established cognitive science constructs. The Sensation channel, which Levine defines as interoceptive and proprioceptive awareness arising from within the body [4], aligns directly with Craig's redefinition of interoception as "the sense of the physiological condition of the entire body" [9]. Craig mapped the ascending interoceptive pathway from lamina I neurons through the brainstem and thalamus to the insular cortex. Building on Sherrington's earlier concept of a sense of "the material me," Craig argues that this interoceptive system provides a foundation for subjective feelings, emotion, and self-awareness [9]. This provides neuroanatomical grounding for Levine's claim that "physical sensations are the very foundation of human consciousness" [4].

The Affect channel, which in SIBAM encompasses both categorical emotions and the broader "felt sense," corresponds to what both Damasio and Seth describe as the experiential dimension of body-state processing. Damasio argued that feelings are "the direct perception of a specific landscape: that of the body" [6], and that somatic markers, the bodily signals associated with emotional experience, guide decision-making before conscious deliberation. In his Iowa Gambling Task experiments, normal subjects developed anticipatory skin conductance responses before choosing from disadvantageous decks. At the same time, patients with prefrontal damage

showed no such anticipatory signals and made catastrophically poor decisions [6]. Seth later formalized this insight computationally, proposing that emotional experience arises from "actively-inferred generative models of the causes of interoceptive afferents" [7]. In both accounts, affect is not a separate cognitive module but something that emerges from the brain's processing of body signals. This supports SIBAM's positioning of Affect as arising from Sensation rather than from cognition.

The Behavior channel, which captures observable motor patterns and action tendencies, maps onto what Seth and Friston describe as active inference: the process by which predictions are fulfilled not by updating beliefs but by performing actions that change the body or environment [8]. This is relevant because SE's theory of trauma centers on incomplete defensive responses. Kuhfuß et al. summarize that "in the traumatic situation, people are unable to complete the initiated psychological and physiological defensive reaction (e.g. prolonged freeze instead of fight or flight)" and that this leads to persistent dysregulation of the nervous system [1]. A central SE technique, biological completion, involves facilitating the completion of these thwarted responses through body awareness [3]. In predictive processing terms, completing a defensive action generates proprioceptive prediction errors that signal "threat resolved," allowing the generative model to update.

The Image channel (sensory impressions internalized as memory) and the Meaning channel (cognitive labels, beliefs, narratives) correspond to higher-level representational processes. Levine is clear that Meaning is the last channel to emerge in therapeutic processing: "Meanings are the labels we attach to the totality of experience, that is, to the combined elements of sensation, image, behavior, and affect" [4]. This ordering is significant because it aligns with Thagard's observation that emotions depend on "interaction between bodily signals and cognitive appraisals" [5], but with the important difference that SE treats cognitive appraisal as consequent rather than causal.

Taken together, SIBAM can be understood as what Thagard prescribes when he argues that CRUM "needs to be expanded and supplemented to encompass the body and the world" [5]. SIBAM expands the standard representational toolkit by adding body-based channels (Sensation, proprioception, interoception). It supplements computational procedures with biological and physiological processes. Nonetheless, it does not abandon representation entirely, since Image and Meaning are still present. This positions SIBAM within mainstream cognitive science rather than outside it.

B. The "Bottom-Up" Claim: Complications from Predictive Processing

SE explicitly claims to use bottom-up processing. Payne, Levine, and Crane-Godreau state that "SE differs from cognitive therapies in that its major interventional strategy involves bottom-up processing by directing the client's attention to internal sensations, both visceral (interoception) and musculoskeletal (proprioception and kinesthesis), rather than primarily cognitive or emotional experiences" [3]. Levine describes this as a reversal of the Cartesian hierarchy: "rather than being the hierarchical, top-dog commander in chief, our thoughts are a complex elaboration of what we do and how we feel" [4].

However, contemporary computational neuroscience complicates this framing. Seth writes that "the concept of PC [predictive coding] overturns classical notions of perception as a largely 'bottom-up' process of evidence accumulation or feature detection, proposing instead that top-down predictive signals specify perceptual content" [7]. In the predictive coding framework, perception at every level involves both ascending prediction errors (mismatches between what the brain expects and what it receives) and descending predictions (the brain's best guesses about the causes of sensory input). These two streams interact continuously.

Seth and Friston make this explicit through the concept of circular causality: "there is a circular causality, where neuronally encoded predictions about bodily states engage autonomic reflexes through active inference, while interoceptive signals inform and update these predictions" [8]. The Khalsa et al. consensus paper, representing the collective view of leading interoception researchers, confirms that "inference and control of bodily states form a closed loop" [11]. Critchley and Garfinkel similarly describe "reverberating causality" in interoceptive processing [10].

This creates a genuine tension with SE's claims. If processing is always bidirectional, then calling SE "bottom-up" in a strict computational sense is inaccurate. Top-down predictions are always present, even when a therapist directs a client's attention to bodily sensations. The brain does not stop generating predictions just because the therapeutic focus shifts to the body.

C. Resolving the Tension: "Bottom-Up" as Therapeutic Strategy

The tension dissolves when we distinguish between two different uses of "bottom-up." One is as a description of computational architecture, which is what predictive processing addresses. The other is as a description of a therapeutic strategy, which is what SE is actually doing in practice.

In predictive processing, a key concept is precision-weighting. Not all prediction errors have equal influence on updating the brain's generative model. Prediction errors are associated with precisions, which determine their influence on subsequent hierarchical processing [7]. Seth describes attention as "the optimization of precision weighting, balancing the relative influence of prediction errors and prior expectations on perceptual inference" [7]. High-precision prediction errors get privileged access to higher levels of the hierarchy and can update high-level expectations [8]. Low-precision errors are effectively ignored.

This concept provides a computational account of what SE does therapeutically. When SE directs a client's attention to bodily sensations, it increases the precision of interoceptive

prediction errors. These high-precision body signals then propagate up the hierarchy and can update maladaptive priors that have been maintained by trauma. SE's emphasis on "bottom-up" processing is, in computational terms, a strategy for shifting precision-weighting toward interoceptive signals and away from rigid top-down predictions.

Several SE techniques map naturally onto this interpretation. Titration, the principle of approaching trauma "drop by drop" rather than all at once [3], functions as a gradual increase in precision on difficult interoceptive signals, preventing the system from being overwhelmed. Pendulation, the back-and-forth oscillation between activation and calm [2], can be understood as oscillating precision between states. Resourcing, establishing positive embodied experiences before approaching charged material [3], corresponds to building positive interoceptive priors. And Levine's warning against "premature cognition," imposing cognitive meaning too early in the therapeutic process [4], maps onto preventing over-weighted top-down predictions from suppressing body signals before they can be processed.

Biological completion also fits this framework. When a client completes a previously interrupted defensive response through body awareness and motor engagement, this generates proprioceptive feedback that signals successful action [3]. In active inference terms, the body changes to match the prediction of safety, generating prediction errors that update the generative model. The system can then reset to adaptive homeostatic regulation, which, as Seth and Friston argue, is the fundamental purpose of interoceptive inference [8].

This reinterpretation preserves SE's core clinical insight, that starting with the body is therapeutically important, while grounding it in a computationally precise framework. The "bottom-up" emphasis is not wrong; it is just imprecise. What SE actually does is shift precision-weighting within a bidirectional system, and this is a coherent and well-motivated therapeutic strategy.

D. SE and CBT: Complementary Levels of the Predictive Hierarchy

The traditional framing places SE and CBT in opposition. CBT's cognitive model proposes that "dysfunctional thinking (which influences the client's mood and behavior) is common to all psychological disturbances" [12]. The causal sequence runs from situation to automatic thoughts to emotional, behavioral, and physiological reactions [12]. Beck writes that "it's not a situation in and of itself that determines what people feel and do but rather how individuals construe a situation" [12]. In this model, body sensations are signals of emotions, which are themselves signals of cognitions. The therapeutic direction is top-down: change thoughts and feelings, and physiology follows.

SE inverts this. Levine argues that "we can't change our feelings and sensations with our thoughts, but our feelings can change our thoughts" [14]. The therapeutic sequence runs from Sensation through Affect to Meaning, with cognition emerging last rather than driving the process [4]. The two approaches seem to contradict each other directly.

Yet through the lens of predictive processing, this apparent contradiction resolves. Both CBT and SE operate within the same hierarchical generative model. They simply target different levels of that hierarchy. CBT works at the level of explicit, verbally accessible predictions. It targets automatic thoughts and core beliefs, which in computational terms are high-level priors that can be brought to conscious awareness and evaluated through reasoning [12]. SE works at the level of interoceptive prediction errors and implicit procedural priors. It targets body signals and subcortical defensive responses that are not readily accessible through verbal cognition [3].

This distinction matters especially for trauma. Payne et al. argue that trauma involves procedural memory encoded in the neostriatum rather than the hippocampus, and that this memory "is not accessible via thoughts or images but via physical sensation (proprioception and kinesthesis)" [3]. Kuhfuß et al. note that "cognitive, language-based interventions require a substantial amount of cognitive processing," which is precisely what trauma impairs [1]. If traumatic priors are procedurally encoded and cognitively inaccessible, then a therapeutic approach that targets explicit verbal beliefs will have limited reach. SE's emphasis on interoceptive and proprioceptive processing offers a pathway to update these implicit priors through the body.

Neither approach is computationally "pure." CBT's cognitive restructuring still involves body signals (clients notice physiological responses), and SE's body-based processing still involves cognition (the therapist uses verbal guidance to direct attention). The difference is in which level of the hierarchy each approach prioritizes as the entry point for change.

IV. Discussion

The central finding of this review is that SIBAM can be understood as a cognitively coherent model when its "bottom-up" emphasis is interpreted through control-oriented active interoceptive inference. The framework does not describe computational architecture, which is circular and bidirectional. Instead, it describes a therapeutic strategy that shifts precision-weighting toward interoceptive prediction errors, allowing body signals to update maladaptive priors that have been rigidified by trauma. This interpretation fits within what Thagard calls the "expanded and supplemented" version of CRUM [5], since it retains representational and computational processes while integrating body-based channels that mainstream cognitive science has historically underemphasized.

To make this concrete, consider what happens computationally during an SE session. A client who experienced a car accident may have developed rigid interoceptive priors: predictions that any acceleration of heart rate or tightness in the chest signals mortal danger. In daily life, these priors suppress the actual interoceptive signals. The client either avoids situations that activate the body (behavioral avoidance) or becomes overwhelmed when activation occurs (panic). The SE therapist guides the client's attention to subtle body sensations,

slowly increasing the precision of these interoceptive signals. Through titration, the activation is kept manageable. The client notices a trembling in the legs, an impulse to push away, and the beginning of a running motion. The therapist encourages the client to stay with these sensations and allow the motor sequence to unfold. As the defensive response completes through the body, proprioceptive feedback signals "threat resolved." The high-precision prediction errors propagate up the hierarchy and update the prior: an acceleration in heart rate no longer necessarily indicates danger. New meanings emerge spontaneously from this process, without the therapist ever having to challenge the client's beliefs verbally. This is what Payne et al. describe when they write that "cognitive restructuring happens much more easily as the CRN is restored to normal functioning" [3].

It is worth briefly situating SE relative to Brooks's anti-representational challenge to cognitive science. Brooks argued that "when we examine very simple level intelligence we find that explicit representations and models of the world simply get in the way" [13], proposing instead that intelligent behavior can emerge from parallel, layered perception-action systems without central representation. SE shares some of this orientation: it deprioritizes cognitive mediation and emphasizes direct sensorimotor engagement. Nevertheless, SE is not purely anti-representational. SIBAM explicitly includes the Image and Meaning channels, which involve certain representational processes. SE occupies a middle ground between Brooks's radical position and CBT's cognitive primacy. It insists on sensorimotor foundations while acknowledging that representational processes emerge from and are shaped by bottom-up processing.

This analysis also addresses the mechanism gap identified by Kuhfuß et al. [1]. Their scoping review found preliminary evidence for SE's effectiveness, with the strongest effects appearing in the most methodologically rigorous studies (Cohen's d = 1.26 for PTSD symptoms in the Brom et al. RCT). However, they described SE's mechanism simply as "changing the interoceptive and proprioceptive sensations" associated with trauma, without explaining how this leads to symptom reduction. The interoceptive inference framework provides that explanation: SE works by increasing precision on interoceptive prediction errors, which propagate up the predictive hierarchy and update the maladaptive generative model that maintains trauma symptoms.

A practical implication is that CBT and SE may be complementary rather than competing approaches. If CBT targets explicit verbal priors and SE targets implicit procedural priors, then different clinical presentations may call for different entry points. Clients with identifiable cognitive distortions that are verbally accessible may benefit most from CBT methodologies. Clients whose trauma is encoded procedurally, whose symptoms are primarily somatic, or whose cognitive processing is impaired by high arousal may benefit from SE's body-first approach. Thagard's own position supports this kind of integration: he argues that "interaction is the right way of thinking about the relation between cognitive and physiological aspects of emotion" [5], and calls for "a neurocomputational theory that shows how your emotions can involve both judgments about how the current situation is affecting your goals and neurological assessments of your body's reaction to that situation" [5]. Interoceptive inference, applied to the SE-CBT comparison, begins to provide that integrative account.

V. Conclusion

This paper asked whether Peter Levine's SIBAM framework in Somatic Experiencing can be understood as a cognitively coherent model of bottom-up processing when analyzed through the lens of embodied cognition and interoceptive inference. The answer is a qualified yes. What I found most instructive through this review is that the apparent conflict between SE's clinical language and contemporary computational neuroscience is not a sign that one side is wrong. It is a sign that they are describing the same system at different levels of analysis. SIBAM's five channels map onto established constructs in interoceptive neuroscience, somatic marker theory, and predictive processing. Its "bottom-up" emphasis, while computationally imprecise as a description of neural architecture, is coherent as a therapeutic strategy: it functions by shifting precision-weighting toward interoceptive prediction errors, allowing body signals to update trauma-related priors within a fundamentally bidirectional system. The next step is to move from this theoretical alignment to empirical testing, which I outline in the following section alongside the limitations of this review.

VI. Limitations

This review has several important limitations. First, it is a theoretical analysis based on a literature review, not an empirical study. The proposed reinterpretation of SIBAM through interoceptive inference has not been tested experimentally. The alignment I describe between SE's clinical techniques and precision-weighting is conceptually motivated but remains speculative until empirically validated.

Second, the interoceptive inference framework remains largely theoretical. Seth acknowledges that "there is not yet any direct confirmatory evidence for interoceptive inference" [7], and Seth and Friston note that "direct empirical evidence for (or against) interoceptive predictions or prediction errors is still lacking" [8]. The Khalsa et al. consensus paper similarly states that "the empirical evidence for hierarchical Bayesian principles of interoception and homeostatic/allostatic control is indirect so far" [11]. Using one theoretical framework to evaluate another introduces a layer of uncertainty, since both may be incomplete or incorrect.

Third, the evidence base for SE remains preliminary. Of the ten quantitative studies reviewed by Kuhfuß et al. [1], only two used a randomized controlled trial design. The authors note that "there is only a very limited number of studies (n = 5) addressing the effectiveness of SE in the treatment of PTSD with sufficient scientific rigor" [1], and the overall study quality was mixed. While the strongest effects were observed

in the best-designed studies, this remains a small body of evidence compared to the extensive research supporting CBT.

Fourth, there is a risk of over-reading alignment when mapping a practitioner-derived clinical framework onto a computational one. SIBAM was developed through clinical observation, not through engagement with predictive processing or Bayesian inference. The fact that the two frameworks can be mapped onto each other does not necessarily mean they describe the same underlying processes. It is possible that the alignment I see says more about my framing than about the frameworks themselves.

Fifth, much of the foundational research in interoception has been conducted in laboratory settings with healthy participants, not in clinical populations with trauma histories. Whether the precision-weighting dynamics described by Seth and Friston operate the same way in trauma survivors is an open question. The existing literature also has demographic and cultural limitations that constrain generalizability.

Finally, SE's theoretical writings rely in part on MacLean's triune brain model and ethological observations from animal behavior [2], [4], both of which have been questioned in contemporary neuroscience. While my analysis focused on more current frameworks (interoceptive inference, predictive processing), the SE literature's own theoretical foundations are not uniformly up to date.

Given these limitations, future research should move from theoretical analysis to empirical testing. Specific directions include measuring changes in interoceptive accuracy (using heartbeat detection tasks or similar paradigms) before and after SE treatment, neuroimaging studies mapping SE techniques onto interoceptive circuitry in the insular and anterior cingulate cortices, and developing operational measures of precision-weighting that could be tracked across therapy sessions. Comparative studies examining SE and CBT through the shared lens of predictive processing could also clarify when each approach is most effective and whether combining them produces additive benefits.

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