

# The Conscious Body: Organs as Attractor-Based Minds

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June 2026 | [fantasyattractor.com](https://fantasyattractor.com)

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## Abstract

The standard view holds that only the brain generates consciousness. This paper challenges that monopoly by applying the minimal functional criteria used to attribute rudimentary consciousness to the 302-neuron nematode *C. elegans* to the body's own complex, intrinsically innervated organs. On the basis of integration, valence, learning, goal-directedness, and anatomical concentration, the enteric nervous system (ENS), the intrinsic cardiac nervous system (ICNS), the intrinsic pancreatic ganglia, and—provisionally—the spinal cord qualify as candidate conscious subsystems. We do not assert that these organs are conscious. We assert that if the functional criteria are taken seriously enough to include a 302-neuron worm as a candidate, they cannot be silently withheld from structurally richer systems without a principled reason. We argue that the brain is not the sole generator of consciousness but the regulator of a federation of semi-autonomous organ-level attractors. We provide testable predictions, sketch the coupling mechanisms that bind local attractors into a unified self, outline clinical implications, and identify open problems including inter-attractor conflict and the phenomenal gap. The framework is offered as a research-generative hypothesis, not a completed theory.

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# 1. Introduction: The Brain's Unexamined Monopoly

The brain is the organ we associate with consciousness, almost without question. Yet the body contains other complex neural networks. The enteric nervous system (ENS) comprises 200–600 million neurons, operates semi-autonomously, learns, and remembers. The intrinsic cardiac nervous system (ICNS) integrates local signals and regulates cardiac output. The spinal cord, with approximately 200 million neurons, can learn when isolated from the brain. The intrinsic pancreatic ganglia coordinate metabolic homeostasis. If these systems were found in a small animal, comparative neuroscience would at least entertain the possibility of consciousness. Because they are inside us, they are dismissed as mere infrastructure.

This paper asks a simple question: if we accept the functional criteria used to infer minimal consciousness in *C. elegans* (302 neurons), why are those same criteria not applied to the ENS, the ICNS, the pancreatic network, and the spinal cord? The question is not *Are these organs conscious?* but *Why are they excluded a priori?*

We do not claim to solve the hard problem of consciousness. We adopt the same pragmatic strategy used throughout comparative neuroscience: observable functional properties—integration, valence, learning, goal-directedness, and anatomical concentration—are treated as operational proxies for consciousness. This strategy is how we infer consciousness in other humans (by analogy), in non-human animals (by behavioural complexity), and in *C. elegans* (by measurable learning and integration). If these criteria are sufficient to identify a candidate conscious system in a 302-neuron worm, consistency demands their application to other systems that exceed this threshold, unless a principled exclusion criterion is provided. That exclusion criterion has not been articulated.

We use the term **candidate** throughout to avoid slippage into positive consciousness attribution. The paper's central claim is that the ENS, ICNS, pancreatic network, and spinal cord are *candidates*—systems that meet the same threshold criteria applied to a known candidate—and that dismissing them without investigation is methodologically inconsistent.

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## 2. The Attractor Framework as Conceptual Scaffolding

An attractor is a region in state space toward which trajectories converge and remain unless perturbed. A candidate conscious attractor possesses five functional properties:

1. **Integration:** binding multiple sensory or interoceptive streams into a unified dynamical state.
2. **Valence:** operationalized as approach/avoidance behaviour—attraction to certain states and repulsion from others. We do not claim that behavioural valence entails phenomenal valence. We claim only that it is the same behavioural proxy used for *C. elegans* and other simple organisms. The inference from behavioural valence to phenomenal valence is a philosophical commitment we note but do not resolve.
3. **Learning:** the capacity to modify behaviour based on experience (habituation, sensitization, associative conditioning).
4. **Goal-directedness:** acting to maintain the system's own basin—a form of conatus—persisting in the absence of external commands.
5. **Anatomical concentration:** a spatially organized, intrinsically connected neural network with dedicated integrative circuitry. This fifth criterion distinguishes concentrated neural attractors (ENS, ICNS,

pancreatic ganglia) from diffuse, non-neural systems (immune system) and from infrastructure networks that lack a defined integrative centre. For the spinal cord, as discussed in Section 4.4, we apply this criterion with qualification.

The attractor vocabulary is applied conceptually, not formally, in this paper. A forthcoming quantitative treatment (Galida, 2026) will develop the mathematical persistence functional. The current paper uses attractor language to structure its functional criteria and predictions; it does not claim to derive formal basin measures from the available data.

**Operationalizing Autonomy:** We propose, as a provisional operational threshold, that a candidate subsystem crosses the autonomy boundary if it retains a significant fraction (e.g.,  $\geq 50\%$ ) of its normal functional repertoire following complete extrinsic denervation or isolation. This criterion distinguishes systems that are merely regulated from systems that can independently sustain goal-directed attractor dynamics. The ENS and ICNS clearly exceed this threshold; the spinal cord and pancreatic network do so conditionally, as discussed below.

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### 3. The Conditional Argument and Its Stipulated Baseline

The nematode *C. elegans* possesses exactly 302 neurons. Its connectome is fully mapped. It exhibits sensory integration, associative learning, goal-directed chemotaxis, and minimal self-reference (distinguishing self-generated from external touch). Its learning capacities are well-documented (Ardiel & Rankin, 2010; Sasakura & Mori, 2013).

We stipulate—we do not establish—that *C. elegans* is a

candidate for minimal consciousness on the basis of these functional criteria. The paper does not require that the field accept this stipulation as consensus. It requires only that the reader grant the conditional: **if** the functional criteria are sufficient to make *C. elegans* a candidate, **then** they must be applied consistently to any system that meets or exceeds them. Those who reject the conditional may ignore the remainder of the argument, but they must then explain what additional criterion excludes the ENS, ICNS, pancreatic network, and spinal cord while admitting *C. elegans*.

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## 4. Candidate Organs

The four candidate organs identified below are assessed against the five criteria, with the provisional autonomy threshold applied where possible. We differentiate their evidential strength clearly.

### 4.1 The Enteric Nervous System (ENS)

The ENS is the strongest candidate. Its 200–600 million neurons form two interconnected plexuses spanning the gastrointestinal tract. It meets all five criteria:

- **Integration:** continuously integrates mechanical, chemical, and hormonal signals to coordinate peristalsis, secretion, and blood flow.
- **Valence:** exhibits attraction to nutrients, aversion to toxins; noxious stimuli trigger emesis or accelerated transit.
- **Learning:** exhibits habituation, sensitization, and long-term plasticity; gut reflexes can be conditioned (Furness, 2012; Schemann & Frieling, 2020).
- **Goal-directedness:** actively propels food and maintains digestive homeostasis independently of the brain;

peristalsis persists after vagotomy—well above the 50% autonomy threshold.

- **Anatomical concentration:** a continuous, highly organized neural network with dedicated integrative circuitry.

## 4.2 The Intrinsic Cardiac Nervous System (ICNS)

The ICNS (14,000–43,000 neurons) is a moderate candidate. Its neuron count is only 46–143 times the *C. elegans* threshold, a narrower margin than the ENS. It meets the criteria, but with less evidential richness:

- **Integration:** monitors blood pressure, chamber stretch, and local chemistry to modulate cardiac output.
- **Valence:** maintains a preferred setpoint for cardiac rhythm; arrhythmias represent perturbations from that setpoint.
- **Learning:** shows ganglionic remodelling after injury; vagal stimulation protocols can alter responsivity (Armour, 2008).
- **Goal-directedness:** generates intrinsic rhythms when denervated, satisfying the autonomy threshold.
- **Anatomical concentration:** organized into ganglia on the heart's surface.

The ICNS contributes to emotional experience via heartbeat-evoked potentials that correlate with interoceptive awareness and self-recognition. This is suggestive but does not independently establish consciousness.

## 4.3 The Intrinsic Pancreatic Network

The pancreatic network is the most provisional candidate. Its 10,000–50,000 intrinsic neurons are scattered in ganglia throughout the organ, rather than forming a continuous plexus (Ahren, 2000; Salvioli et al., 2002). This weaker anatomical concentration distinguishes it from the ENS and ICNS.

- **Integration:** combines neural, hormonal, and nutrient signals to regulate blood glucose.
- **Valence:** maintains a metabolic setpoint; hypoglycemia and hyperglycemia are aversive states.
- **Learning:** plasticity is less studied than in the ENS; no direct evidence of conditioning is available.
- **Goal-directedness:** coordinates endocrine and exocrine output to maintain glucose homeostasis; whether this function persists at  $\geq 50\%$  of normal repertoire after complete extrinsic denervation is not yet established. The pancreatic network remains a candidate, but with an open empirical question on the autonomy threshold.
- **Anatomical concentration:** scattered ganglia; meets the threshold but is the weakest candidate on this criterion.

#### 4.4 The Spinal Cord (Provisional Candidate)

The spinal cord possesses approximately 200 million neurons, organized into topographically precise circuits that integrate sensory input, generate coordinated motor output, and exhibit learning when isolated (Hook & Grau, 2007). By the five functional criteria, it qualifies. However, under normal physiological conditions, its activity is tightly coupled to descending commands, and independent behavioural generation is rarely observed. After complete spinal cord injury, the isolated cord reorganizes and can generate complex, goal-directed responses. Whether such reorganization achieves the  $\geq 50\%$  autonomy threshold is an empirical question; we provisionally include the spinal cord as a candidate with lower confidence, identifying it as the ideal test case for refining the autonomy criterion.

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## **5. The Brain as Regulator: Mechanisms of Coupling**

If the ENS, ICNS, pancreatic network, and spinal cord are candidate conscious subsystems, the unified self must be explained as the product of their integration by the brain. We propose that the brain couples, modulates, and aligns local attractors through four mechanisms, each supported by established physiology.

### **5.1 Vagal Afferent Signalling**

The vagus nerve provides the primary bidirectional communication channel between the brain and the viscera. Vagal afferents convey interoceptive signals from the ENS and ICNS to the nucleus of the solitary tract, and descending signals modulate organ function. Vagal nerve stimulation is known to alter mood, reduce inflammation, and improve cardiac function (George et al., 2000; Tracey, 2002).

### **5.2 Humoral Signalling**

Circulating hormones (cortisol, adrenaline, insulin, glucagon) and immune mediators (cytokines) provide a slower, diffuse coupling channel. These signals alter the global attractor's landscape by shifting the metabolic and inflammatory context. Sickness behaviour—fatigue, anhedonia, social withdrawal—is a well-documented example of immune-to-brain signalling that temporarily reconfigures the global attractor (Dantzer et al., 2008).

### **5.3 Rhythmic Entrainment**

The brain entrains peripheral rhythms to its own oscillations. Cardiac and respiratory rhythms phase-lock to cortical activity during focused attention (Thayer & Lane, 2000). Slow-wave sleep entrains glymphatic clearance (Xie et al., 2013). The brain sets a rhythm, and the organs—each with their

own intrinsic oscillators—tend to follow. This resonance is not command; it is coupling by shared frequency.

#### **5.4 Predictive Processing and Attractor Coupling**

The predictive processing framework (Clark, 2013) treats the brain as a prediction engine that minimizes surprise by updating internal models based on sensory input. We suggest that this framework extends naturally to interoception: the brain maintains predictions about the states of the body's organs, and each organ generates its own predictions about local conditions. The alignment of these nested predictive models is functionally analogous to attractor coupling, in that both involve the progressive alignment of internal states toward a shared equilibrium. Friston's (2010) free-energy principle provides a formal bridge between predictive processing and dynamical systems that could, in future work, unite these descriptions under a single mathematical framework.

#### **5.5 Relationship to Competing Theories of Consciousness**

The attractor framework is compatible with but not identical to several major theories. Integrated Information Theory (IIT; Tononi, 2008) holds that consciousness is a function of the amount of integrated information a system generates. The attractor framework shares IIT's emphasis on integration but does not require the computation of  $\Phi$ , which remains technically infeasible for most organ systems. Global Workspace Theory (GWT; Baars, 1988; Dehaene, 2011) posits that consciousness arises when information is broadcast within a global workspace. Under GWT, many peripheral attractors would be considered unconscious because they lack access to a central workspace. The attractor framework allows for phenomenal consciousness without global access, a position consistent with the possibility that the ENS may have experiences that never enter cortical awareness. Higher-Order Theories (HOTs) require meta-representation—the capacity to

represent one's own states—which, if correct, would likely exclude all candidate organs except the brain. The attractor framework treats HOTs as a valid but overly restrictive criterion that would also exclude many animals currently accepted as conscious. The framework does not seek to refute these theories but to generate testable predictions that can be compared with theirs, advancing the debate through empirical competition.

## **5.6 Inter-Attractor Conflict: An Open Problem for the Federation Model**

A federation of semi-autonomous attractors inevitably generates conflict. Everyday clinical phenomena illustrate this: nausea during a cognitively demanding task (ENS and cortical attractors in tension), cardiac arrhythmia during emotional stress (ICNS and limbic system in conflict), hypoglycemic cognitive impairment (pancreatic and cortical attractors in opposition). The current paper does not propose a mechanism for conflict resolution beyond the brain's general regulatory role. Whether such conflicts are resolved by hierarchical dominance, temporal multiplexing, or some form of inter-attractor negotiation is an open question. We flag it as a priority for future theoretical development within the framework.

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## **6. The Alien Feeling and Clinical Dissociation**

When coupling between the global self and a local attractor falters, the experience can manifest as an “alien feeling”—the sense that an action or bodily state is “not mine.” This phenomenon is well-documented in alien hand syndrome (Della Sala et al., 1991) and in depersonalization disorder, where individuals report feeling detached from their own body and

mental processes (Sierra & David, 2011). We interpret these as temporary or chronic decoupling of a local attractor from the global workspace—exactly what the federation model would predict when integration fails.

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## 7. Testable Predictions

The framework generates five falsifiable predictions:

1. **ENS conditioning:** An isolated intestinal segment, exposed to a neutral stimulus paired with a non-nociceptive chemical infusion, will exhibit a conditioned motor or hormonal response.
  2. **ICNS plasticity:** Long-term heart rate variability biofeedback will produce persistent changes in baseline cardiac rhythms not fully mediated cortically.
  3. **Gut-directed therapy:** IBS patients receiving gut-directed biofeedback will show greater symptom improvement than those receiving standard CBT alone.
  4. **Pancreatic memory:** In a vagally denervated preparation, islet cell clusters exposed to repeated glucose perturbation will exhibit an anticipatory insulin response.
  5. **Spinal reorganization:** Complete spinal cord injury patients will develop complex, coordinated responses below the lesion beyond simple reflexes, consistent with a reorganizing local attractor.
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## 8. Future Directions: Approaching the

# Phenomenal Gap

The framework operates on behavioural and functional proxies for consciousness; it does not provide direct phenomenological access to organ-level experience. What evidence could begin to bridge this gap? We propose three directions. First, decoupling experiments that temporarily isolate a candidate organ (e.g., via selective pharmacologic blockade) and then probe the subject's subjective state could reveal whether the organ's local attractor contributes a distinct experiential component to the global self. Second, longitudinal studies of spinal cord injury patients who report phantom sensations or "body memories" below the lesion may provide indirect reportable correlates of spinal attractor activity. Third, the development of organ-specific interoceptive training protocols, coupled with experience-sampling methods, could track whether changes in organ function co-vary with changes in the felt sense of self. These are early-stage proposals; the phenomenal gap remains the deepest challenge for the framework, as for all theories of consciousness.

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## 9. Clinical Implications

If organs are candidate conscious systems, functional disorders may represent distressed local attractors. IBS may be a gut that has learned to react to benign stimuli as threats. Cardiac anxiety may reflect a perturbed ICNS state. These reframings suggest organ-directed therapies: gut-directed biofeedback, vagal stimulation, dietary protocols that calm the ENS. The principle is consistent with existing mind-body approaches but grounds them in a specific, testable model.

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## 10. Ethical Considerations

Candidate organs are not autonomous moral agents. Their interests are tied to the whole body's survival. Clinical ethics correctly prioritize the patient's overall well-being. The framework suggests a principle of organ-level respect: where possible, preserve organ integrity and explore gentler interventions before resection or ablation. This is holistic medicine, not radical ethics.

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## 11. Conclusion

The brain is not the body's sole candidate conscious organ. The ENS, ICNS, pancreatic network, and spinal cord meet the same functional criteria used to identify *C. elegans* as a candidate for minimal consciousness. They are not established as conscious; they are identified as systems for which the question cannot be dismissed a priori without a principled exclusion criterion. The coupling mechanisms that bind local attractors into a unified self are partially characterized, and the framework generates concrete, falsifiable predictions. The conscious body is a research-generative hypothesis, not a completed theory.

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