

FLOW HIJACKED

BODY BEFORE THOUGHT

Interoception, Allostasis and the Predictive Self

A long-form evidence-locked lecture on how bodily sensing, prediction, precision and regulation shape the reachable field of thought, emotion and action.

Epistemic status. Empirical findings, supported interpretations, formal transfers and original Flow Hijacked hypotheses are separated throughout. *Interoceptive Attractor Capture* is a proposed, falsifiable synthesis - not an established clinical mechanism.

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Educational scientific lecture · Not diagnosis, individualized treatment, or emergency guidance

HOW TO READ THIS LECTURE

Scope, evidence grammar and clinical boundary

This lecture is a deep revision and expansion of the earlier Flow Hijacked embodied-state-space work. The earlier move was to place physiology inside the state. The present lecture goes further: it asks how internal sensing, predictive regulation, precision weighting, social coupling and whole-body signaling can change the transitions available to the system. The scientific burden is to distinguish what is directly shown from what is inferred across literatures.

Evidence grammar

Empirical result - what a study directly reports.

Supported interpretation - a cross-study synthesis bounded by heterogeneity.

Flow Hijacked synthesis - integration through the project's dynamical lens.

Formal transfer - imported mathematics used only within its stated boundary.

New hypothesis - a falsifiable proposal not established by current evidence.

Scientific guardrail - a popular or tempting claim the lecture deliberately limits.

Clinical boundary. This is psychoeducation and a research synthesis. It does not diagnose a person, interpret an individual's bodily sensations, advise medication changes, prescribe exposure, breathing, fasting, exercise, vagus stimulation or any other treatment, or replace medical or psychological assessment. Acute chest pain, severe shortness of breath, neurological change, severe withdrawal, suicidality or other emergencies require appropriate real-world care rather than a computational explanation.

Research boundary. The selected 100-source portfolio favors major frameworks, systematic reviews, mechanistic studies and recent frontier work. Citation influence does not equal certainty. Animal mechanisms are not silently promoted into human clinical claims, and association is not written as causation.

CENTRAL PROPOSITION

The body is part of the geometry of possibility

A person does not first exist as a mind and then acquire a body state. Thought, perception and action emerge inside an organism whose heart, lungs, gut, immune system, endocrine state, pain, temperature and energy are already changing. The body therefore does not sit beneath cognition as background. It helps determine which actions feel affordable, which sensations become salient, which predictions are trusted and which futures remain reachable.

The cautious claim is already strong: internal bodily signals interact with emotion, attention, motivation, self-experience and psychiatric symptoms. The stronger Flow Hijacked claim is that loss of flexibility can sometimes be described as a contraction of embodied state-space, in which a limited set of predictions, precision assignments and regulatory policies becomes mutually self-reinforcing. That claim is reserved for the final part and must compete against simpler models.

Core sentence The body is not the background of consciousness. It is one of the conditions that determines where consciousness can move.

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Narrative dependency Body signal → anatomy → anticipatory control → predictive inference → precision → emotion/self → stress and diagnosis → addiction and relationship → immune/metabolic expansion → treatment → contradiction chamber → testable Flow Hijacked synthesis.

PART 01

Before Thought - The Body Is Already Acting

A familiar sequence begins before language. The chest tightens, breathing shifts, the gut contracts, the eyes search, the muscles prepare, and only then does a sentence arrive: something is wrong. The order is not always this clean, and conscious interpretation can also change physiology. Still, the central correction is important. Human experience is not produced by a mind that first decides what the world means and then instructs a passive body to follow. Brain, body and environment are already exchanging signals while the story is being formed.

This lecture begins from that temporal fact. It asks what becomes visible when bodily regulation is treated as part of cognition rather than as a downstream consequence of cognition. The answer reaches from heart and lungs to gut, immune system, endocrine state, pain, fatigue, attachment, craving and psychiatric symptoms. The aim is neither to reduce the mind to physiology nor to romanticize bodily intuition. It is to describe a coupled predictive system whose job is to remain viable while acting in an uncertain world.

What this part must establish

- **01** Before the Sentence
- **02** Regulation Before Representation
- **03** The Organising Question

The human problem comes first. Mathematics enters only where it makes a claim more precise or more falsifiable.

01

Before the Sentence

SUPPORTED INTERPRETATION

Imagine waking at 04:17 with no obvious thought in mind. Before any explanation is available, the body may already be different: respiratory depth has changed, the heart is more forceful, skin conductance is higher, muscle tone is increased, or a visceral sensation has crossed the threshold of awareness. A thought may then organize these signals into a narrative. Sometimes that narrative is accurate. Sometimes it is one possible explanation among several. The important point is that cognition and physiology are temporally interwoven.

Classic accounts often separated sensation from interpretation. Contemporary interoceptive science makes that border harder to draw. Ascending bodily signals are processed through brainstem, sub-cortical and cortical systems while descending predictions and autonomic commands alter the body that will be sensed next. Perception is therefore not simply a report about a finished physiological event. It participates in a loop that helps create the next state.

For Flow Hijacked, this changes the unit of analysis. The relevant trajectory is not a thought moving through an abstract cognitive space. It is an embodied trajectory in which respiration, cardiovascular state, energy, inflammatory signals, memory, appraisal, action and social context can alter one another. A person may know only the late, reportable part of that trajectory. The body has often been participating for seconds, minutes, or much longer.

Evidence boundary Temporal precedence does not prove that bodily change causes a later thought. Reciprocal causation and common causes remain possible.

Evidence anchors: R01-R05, R10, R14-R18

Core sentence The first conscious sentence is often not the first event in the system.

02

Regulation Before Representation

SUPPORTED INTERPRETATION

The nervous system did not evolve primarily to write accurate descriptions of internal organs. It evolved within organisms that had to keep temperature, oxygen, glucose, blood pressure, hydration and tissue integrity within survivable ranges while moving, feeding, avoiding danger and reproducing. Representation serves regulation. A useful internal model is one that helps the organism act before errors become catastrophic.

This is why the distinction between homeostasis and allostasis matters. A purely reactive controller waits for deviation and then corrects it. Biological regulation is often anticipatory. Heart rate rises before a sprint has depleted oxygen. Salivation and insulin responses can begin before nutrients have been absorbed. Stress systems mobilize before injury has occurred. Social context can change the cost assigned to a task before the task begins. The organism is constantly estimating what it will need next.

That anticipatory structure complicates everyday language about symptoms. A racing heart can be an error to correct, a useful preparation, or an expected consequence of action. Fatigue can signal depleted reserve, inflammation, sleep loss, learned expectation, or a protective policy that limits further expenditure. No single bodily signal carries its meaning alone. Meaning emerges from the relation between present state, predicted demand, context and action.

Evidence boundary Allostasis is a broad regulatory framework, not a claim that every bodily change is centrally predicted or consciously represented.

Evidence anchors: R21-R25, R35, R40

Core sentence A body is regulated not only for the present it has, but for the future it expects.

03

The Organising Question

FLOW HIJACKED SYNTHESIS

The organising question of this lecture is deliberately narrower than a grand theory of mind: how does a flexible brain-body system become progressively constrained into a smaller repertoire of bodily predictions, regulatory actions and reachable states? That question can be asked in panic, depression, trauma, addiction, chronic pain and ordinary stress without assuming that all of these conditions share one cause.

Flow Hijacked already treats mental suffering as changes in accessibility: some states become easy to enter, others difficult to reach, and recovery may require more than suppressing symptoms. The embodied extension asks whether accessibility is partly governed by bodily prediction and control. A threat state is not only a belief about danger; it includes autonomic preparation and altered sampling of the world. A depressive state is not only negative content; it may include altered effort valuation, fatigue, sleep disruption and inflammatory or metabolic signals. Craving is not merely desire; it can be a prediction that one action will rapidly change an aversive internal state.

The lecture therefore moves from anatomy to inference, from inference to psychopathology, and only then to the new hypothesis. The hypothesis must earn its place. It will be rejected if simpler accounts explain the same observations with fewer assumptions.

Evidence boundary The Flow Hijacked synthesis is an integration across literatures; it is not a validated diagnostic model.

Evidence anchors: R29-R40, R41-R66

Core sentence The question is not only what state the person is in, but how many other states remain reachable.

PART 02

The Hidden Sense - What Interoception Really Is

Interoception is often introduced as the sense of the internal body. That definition is useful and incomplete. It can imply a single channel, like vision turned inward, when the actual system is heterogeneous. Cardiac, respiratory, gastrointestinal, metabolic, thermal, nociceptive, immune and endocrine information travel through different receptors and pathways, on different timescales, and are not equally accessible to consciousness. The scientific problem is therefore not one hidden sense but a family of sensing, integration and control processes.

The field has also learned to distrust a single score. A person may be accurate at discriminating one cardiac signal and poor at a respiratory task. Self-reported bodily awareness can improve without laboratory discrimination improving. Attention, confidence and metacognitive calibration are separable. This multidimensionality is not an inconvenience to remove; it is part of the phenomenon.

What this part must establish

- **04** Many Internal Channels, No Single Dashboard
- **05** Accuracy, Sensibility, Attention and Metacognition
- **06** Cross-Modal Interoception

The hidden sense becomes scientifically useful only after it is broken into the processes and channels that actually carry information.

04

Many Internal Channels, No Single Dashboard

EMPIRICAL RESULT

The body sends information through several distinct routes. Mechanical stretch, blood gases, nutrient availability, osmolarity, temperature, inflammatory mediators, visceral pressure and tissue damage are transduced by different receptor families. Some signals travel rapidly through peripheral nerves. Others reach the brain through hormonal or immune pathways. Some are rhythmic, such as cardiac and respiratory cycles; others change slowly, such as inflammatory tone or energy reserve.

Conscious experience samples only a fraction of this traffic. Most regulation occurs without a verbal report. The fact that a person cannot feel a cytokine concentration does not make immune signaling irrelevant to experience. Conversely, feeling a bodily sensation vividly does not guarantee that the inferred cause is correct. Interoception therefore includes more than awareness. It includes the nervous system's sensing, integration, interpretation and regulation of internal physiological conditions.

This broader definition prevents a common error in mental-health discourse: treating the body as a collection of feelings that become useful only when consciously noticed. Internal sensing is already shaping arousal, action selection, attention and learning before explicit awareness. The phenomenology of the body is important, but it sits inside a larger regulatory architecture.

Evidence boundary The boundary of interoception remains debated; some classifications treat pain, temperature or proprioception differently.

Evidence anchors: [R01-R10](#), [R14-R20](#)

Core sentence Interoception is not a dashboard of feelings. It is a distributed control architecture with a conscious surface.

05

Accuracy, Sensibility, Attention and Metacognition

EMPIRICAL RESULT

Early work often relied heavily on heartbeat-counting tasks and spoke of interoceptive accuracy as though it were a stable trait. That simplification has not survived well. Performance can be influenced by prior knowledge of heart rate, beliefs about one's body, task strategy and the sensory channel being tested. Newer psychophysical paradigms estimate discrimination thresholds, uncertainty and metacognitive confidence more directly.

A useful distinction separates what a person can detect, what they believe about their bodily ability, where they direct attention, how confident they are, and how well confidence tracks performance. These dimensions can dissociate. Someone can attend intensely to bodily signals while interpreting them poorly. Another person can be physiologically accurate but distrust the signal. A third may report high body awareness because they notice discomfort frequently rather than because they discriminate internal changes precisely.

This matters clinically. A treatment that increases attention to the body is not automatically beneficial. In panic, somatic symptom disorders or some trauma presentations, more attention without better contextual interpretation can intensify distress. The target may be calibration and flexible use of information rather than maximal sensitivity.

Evidence boundary No single laboratory task establishes a person's global interoceptive ability, and self-report should not be treated as an objective physiological measure.

Evidence anchors: R05-R08, R54, R97-R99

Core sentence Better interoception does not mean feeling more. It means using bodily information more appropriately for the context.

06

Cross-Modal Interoception

SUPPORTED INTERPRETATION

The term interoception can tempt us to assume that someone who senses the heart accurately will also sense breathing, gastric distension or temperature accurately. Large psychophysical studies challenge that assumption. Performance across cardiac and respiratory tasks can be weakly related or unrelated, suggesting that interoceptive ability is at least partly channel-specific.

That finding is conceptually useful. It implies that the internal body is not represented by one master gauge. Different bodily systems have different noise properties, receptor densities, temporal structures and learned meanings. A person with asthma may develop unusually detailed respiratory expectations without comparable cardiac sensitivity. Someone with an eating disorder may show altered gastrointestinal inference while performing normally on another modality. Chronic pain can reorganize attention around nociception without producing a general increase in internal accuracy.

Flow Hijacked therefore treats the embodied state as a vector rather than a scalar. The state includes multiple physiological dimensions whose reliability and influence can change independently. This also means that intervention should be modality-aware. A breathing exercise, cardiac biofeedback and gastrointestinal exposure are not interchangeable simply because all are 'body based.' They perturb different loops.

Evidence boundary Evidence for cross-modal independence is growing but task reliability remains an active methodological problem.

Evidence anchors: R07-R09, R57, R97-R100

Core sentence There is no single volume knob for the inner body.

PART 03

How the Body Reaches the Brain

The phrase 'brain-body connection' is too vague to do scientific work. The body reaches the brain through named receptors, nerves, brainstem nuclei, hormonal routes and immune signals. The brain reaches the body through autonomic, endocrine, motor and behavioral outputs. Between these directions lie local reflexes that can regulate an organ before cortical awareness is relevant. The architecture is therefore nested rather than linear.

A useful map begins in the periphery, travels through vagal and spinal afferents to the nucleus of the solitary tract, parabrachial complex, hypothalamus and thalamic systems, and continues into insular, cingulate and somatosensory cortices. But no single path is the interoceptive pathway. Organ systems differ, and immune and metabolic information often travel through multiple channels at once.

What this part must establish

- **07** Vagal and Spinal Afferents
- **08** Brainstem to Insula
- **09** Rhythms That Gate Perception

Anatomy replaces the vague phrase mind-body connection with a set of testable routes, delays, feedback loops and control points.

07

Vagal and Spinal Afferents

EMPIRICAL RESULT

The vagus nerve is central to many visceral functions, but popular accounts often turn it into a universal cable of calm. Anatomically, vagal afferents carry diverse information from thoracic and abdominal organs. Spinal afferents also carry visceral signals, including information relevant to pain, distension, temperature and metabolic state. Different organs and receptor populations therefore contribute to interoception through partially distinct routes.

Recent genetic and anatomical work has sharpened this picture. Vagal sensory neurons can be divided into subtypes tuned to features such as stretch, nutrients and chemical signals. Gastrointestinal mechanosensation involves specialized receptors rather than a generic 'gut feeling.' Spinal pathways contribute to energy regulation and visceral state in ways that a vagus-only account would miss.

This matters because interventions do not act on an undifferentiated autonomic system. A meal, inflammation, slow breathing, exercise and transcutaneous vagus stimulation alter different combinations of peripheral and central signals. Their effects can converge, but convergence is not identity. Flow Hijacked therefore treats the body as a set of coupled channels whose joint state matters more than any single fashionable pathway.

Evidence boundary Vagal anatomy does not justify using vagal tone as a synonym for safety, regulation, resilience or social engagement.

Evidence anchors: R09-R10, R81, R88-R90, R94

Core sentence The vagus matters greatly. It does not explain the body by itself.

08

Brainstem to Insula

EMPIRICAL RESULT

Many visceral afferents first enter central processing in the brainstem. The nucleus of the solitary tract integrates cardiorespiratory and visceral information and projects into broader autonomic and motivational systems. The parabrachial complex contributes to aversive, respiratory, thermal and homeostatic processing. Hypothalamic systems coordinate endocrine, autonomic and behavioral responses relevant to energy, temperature, stress and reproduction.

Cortically, the insula is repeatedly implicated in interoceptive attention, subjective feeling and integration with salience. Yet the insula should not be called the brain's interoceptive center. It is heterogeneous along posterior-anterior gradients, strongly connected to cingulate, somatosensory, limbic and executive systems, and participates in functions far beyond bodily sensing. The anterior cingulate similarly links action, effort, autonomic regulation and control rather than serving one isolated function.

The scientific advantage of this network view is that bodily state can influence cognition through several routes. A signal may change arousal at the brainstem level, action readiness through hypothalamic and cingulate systems, and conscious feeling through cortical integration. No single node needs to contain the final meaning.

Evidence boundary Regional activation is not a diagnostic fingerprint. Insula or cingulate involvement does not establish a unique psychological process.

Evidence anchors: R10-R13, R17, R38

Core sentence Interoception is implemented by circuits, not by a single inner-body module.

09

Rhythms That Gate Perception

SUPPORTED INTERPRETATION

The heart, lungs and stomach are rhythmic organs, and the brain does not receive their signals as a steady stream. Cardiac systole and diastole change baroreceptor input. Breathing organizes mechanical, chemical and neural rhythms. Gastric slow waves can couple with large-scale brain activity. These cycles can modulate perception, attention, motor readiness and emotional processing.

This adds a temporal dimension to the embodied state. The same external stimulus can be processed differently depending on when it arrives relative to an internal cycle. Such effects are usually small and context-dependent, but they undermine the idea that cognition runs on a clock independent of physiology. A brain state has a bodily phase structure.

For Flow Hijacked, the implication is not that every symptom can be timed to a heartbeat. It is that state-space should include phase and timescale. Fast cardiorespiratory rhythms, intermediate arousal dynamics and slow inflammatory or metabolic changes can all shape transitions. A system may appear stable when averaged over minutes while containing short windows of heightened susceptibility or opportunity.

Evidence boundary Cardiac, respiratory and gastric phase effects are real research domains, but effect sizes and generalizability vary across tasks.

Evidence anchors: R13-R18, R97-R100

Core sentence The body does not merely change the level of a state; its rhythms can change when transitions are easiest.

PART 04

Homeostasis Was Not Enough - Enter Allostasis

Homeostasis remains foundational: living systems must keep critical variables within viable limits. But an organism that only corrects deviations after they happen would often be too slow. Allostasis names the anticipatory organization of regulation across changing demands. It shifts the question from 'what value should remain constant?' to 'what pattern of regulation best prepares the organism for what is coming?'

This predictive logic brings cost into the model. Mobilization is useful and expensive. Sleep deprivation can temporarily preserve performance while consuming reserve. Cortisol, inflammation and sympathetic activation are not simply toxic processes; they can be adaptive responses whose repeated or poorly terminated use carries a price. The key scientific task is to distinguish adaptive deployment from chronic overuse.

What this part must establish

- **10** Predictive Regulation
- **11** Allostatic Load
- **12** Energy, Effort and Reserve

Allostasis gives the lecture its first bridge from physiology to lived possibility: the future is anticipated in the body before it is narrated in language.

10

Predictive Regulation

SUPPORTED INTERPRETATION

Allostatic regulation can be understood as control under uncertainty. The organism estimates future demand and acts before the regulated variable reaches a dangerous boundary. This is obvious in movement: cardiovascular and respiratory systems prepare for effort as action begins. It is also visible in anticipatory endocrine and metabolic responses, learned stress reactions and context-dependent autonomic adjustments.

The advantage of prediction is speed. The cost is that predictions can be wrong. A system calibrated in a dangerous environment may mobilize early because false negatives are costly. In a safer environment the same policy can look excessive, but it may remain statistically sensible given the organism's learned history. This is one reason to avoid moral language about 'overreacting.' The reaction may be an old solution operating under new boundary conditions.

Flow Hijacked uses this idea to connect history with present physiology. The body does not only carry damage from the past; it carries learned control policies. Some of those policies remain flexible. Others become rigid enough that current evidence struggles to update them.

Evidence boundary Predictive regulation is a systems-level interpretation; not every anticipatory response requires a detailed cortical generative model.

Evidence anchors: [R21-R25](#), [R35](#), [R37-R40](#)

Core sentence What looks excessive in the present may be a prediction policy that once minimized a different kind of error.

11

Allostatic Load

EMPIRICAL RESULT

Allostatic load describes the cumulative burden associated with repeated or inefficient adaptation. It is not one biomarker. Research has used combinations of cardiovascular, metabolic, endocrine, inflammatory and anthropometric measures to estimate multisystem wear. The construct has been influential precisely because chronic stress does not respect organ boundaries.

The idea is often simplified into 'stress damages the body.' A more faithful reading is that adaptive mediators have trade-offs. Increased glucose availability, immune mobilization, vigilance or vascular tone can be useful in the short term. Problems arise when the response is repeated too often, remains active too long, fails to activate when needed, or is poorly coordinated with other systems. Social and material environments influence this process by changing the frequency and controllability of demands.

In the present lecture, allostatic load will remain distinct from the new Flow Hijacked concept. Load concerns cumulative biological cost. Attractor capture concerns loss of state-transition flexibility. They may interact, but neither is reducible to the other.

Evidence boundary Allostatic-load indices vary across studies and should not be treated as a universal clinical score for an individual.

Evidence anchors: R22-R24, R35, R40

Core sentence Cost and flexibility are related questions, not the same question.

12

Energy, Effort and Reserve

FLOW HIJACKED SYNTHESIS

Every action has a physiological budget. Standing, focusing, talking, exploring and inhibiting impulses require coordinated activity across neural, autonomic and metabolic systems. Subjective effort is therefore not merely an attitude toward work. It is an inference about the cost and expected value of mobilization under current bodily conditions.

This becomes especially important in depression, inflammatory states, chronic pain and fatigue. Reduced activity can be maladaptive in one context and protective in another. A person with genuinely depleted reserve may experience an action as expensive because it is expensive. Another person may carry a learned expectation of cost that persists after physiology has improved. In practice these mechanisms can coexist and reinforce one another.

Flow Hijacked therefore avoids the false choice between 'biological fatigue' and 'psychological avoidance.' Both are descriptions at different levels of a coupled control problem. The relevant questions are how much reserve exists, what the system predicts action will cost, what reward it expects, and whether small actions generate corrective evidence or further depletion.

Evidence boundary The lecture does not infer individual energy metabolism from subjective fatigue, nor does it frame fatigue as a single computational error.

Evidence anchors: R32, R40, R64-R66

Core sentence Agency depends partly on what the system believes it can afford – and partly on what it can actually afford.

PART 05

The Predictive Body - The Brain Does Not Wait for the Signal

Predictive processing gives allostasis a computational language. Instead of treating perception as a one-way reconstruction from sensory data, it models perception as inference under uncertainty. Prior expectations meet incoming evidence; prediction errors update beliefs according to how reliable each source is estimated to be. In interoception, the object being inferred is not only an external cause but the changing condition of the organism itself.

The crucial move is that prediction is tied to action. If the system predicts that blood pressure, oxygen availability or social safety will need to change, it can act to make the prediction come true. Perception and regulation therefore meet inside the same loop. The body becomes both the object of inference and one of the means by which inference is resolved.

What this part must establish

- **13** Generative Models of the Body
- **14** Prediction Error Is Not Enough
- **15** Active Inference - Acting to Change the Evidence

Predictive processing is used here as a disciplined computational scaffold, not as an explanation that wins automatically whenever a phenomenon is complex.

13

Generative Models of the Body

FORMAL TRANSFER

A generative model represents hypotheses about hidden causes that could have produced current sensory input. In interoception, those hidden causes include physiological states such as cardiac load, respiratory demand, gastric distension, temperature or inflammatory condition. The model need not be consciously accessible. It is a formal description of how expectations can constrain interpretation.

A simple observation model can be written as bodily sensation s_t arising from a hidden physiological state x_t plus noise. The system maintains a belief about x_t and updates that belief when sensation differs from prediction. The important scientific point is not the exact equation but the separation between the state itself, the noisy measurement of that state, and the belief about it.

This separation immediately explains why feeling can diverge from physiology without implying that either side is unreal. Two people can occupy similar physiological states while holding different priors, attending to different channels, or assigning different reliability to the same sensation. Conversely, similar subjective reports can arise from different physiological configurations. A symptom is therefore not a transparent readout of one hidden variable.

$$s_t = g(x_t) + \omega_t, \quad p(x_t | s_t) \propto p(s_t | x_t) p(x_t)$$

Evidence boundary Generative models are explanatory abstractions. The brain is not assumed to store explicit probability tables corresponding to the equations.

Evidence anchors: R25-R31, R36-R39

Core sentence The body that is felt is neither pure physiology nor pure belief. It is physiology interpreted through an uncertain model.

14

Prediction Error Is Not Enough

FORMAL TRANSFER

Prediction error is often described as the engine of learning: the difference between what was expected and what was sensed. But a large error should not always force an update. A signal may be noisy, transient, corrupted by movement, or known to be unreliable. Bayesian and predictive-processing models therefore introduce precision, the expected reliability of a signal or belief.

This matters enormously for interoception because internal signals are noisy and context-dependent. A heartbeat during exercise should not have the same meaning as the same heartbeat while sitting still. Breathlessness at altitude, fever during infection and gastric fullness after a large meal each have context that changes interpretation. The system must estimate not only what the signal says but how much weight it deserves.

Precision is therefore a candidate control variable linking arousal, attention and learning. Increasing precision can make a weak error influential; decreasing it can allow a strong sensation to be treated as noise. In a flexible system these weights change with context. In a rigid system the weighting policy itself may become part of the problem.

$$\Delta\mu_t \propto \Pi_t \varepsilon_t, \quad \varepsilon_t = s_t - \hat{s}_t$$

Evidence boundary Precision is a formal parameter whose neurobiological implementation is distributed and task-dependent; it should not be equated with one neurotransmitter or one region.

Evidence anchors: R26-R34, R36

Core sentence A prediction error changes the model only to the extent that the system believes the error deserves to be trusted.

15

Active Inference - Acting to Change the Evidence

SUPPORTED INTERPRETATION

An organism can reduce prediction error in two broad ways. It can change its belief to fit the sensory evidence, or it can act so that sensory evidence moves toward the predicted state. The latter is the logic of active inference. If the body is predicted to require more oxygen, respiration can increase. If an aversive internal state is expected to end after a familiar behavior, that behavior can become strongly selected.

This framework is especially useful for understanding why regulation and perception cannot be cleanly separated. A person who leaves a crowded room may reduce threat-related bodily signals, which then confirms that leaving was an effective policy. Someone who repeatedly uses alcohol to terminate tension may learn not only that alcohol is rewarding, but that a particular action reliably converts one internal state into another. Avoidance and relief can therefore train bodily expectations as well as overt habits.

Flow Hijacked takes from active inference the idea that action changes the evidence available to the next inference. This will become central to Interoceptive Attractor Capture: a system may gradually produce conditions that confirm the very model driving its actions.

Evidence boundary Active inference is one computational framework among several. Similar behavioral loops can be modeled using reinforcement learning, control theory or associative learning.

Evidence anchors: R25-R31, R37

Core sentence A nervous system does not only predict the body. Through action, it helps build the body it will sense next.

PART 06

Precision - Which Signal Deserves to Be Believed?

Precision is where the literature becomes especially relevant to psychiatry. Recent transdiagnostic work suggests that difficulty may lie not simply in sensing the body inaccurately, but in failing to adjust the relative weight assigned to bodily evidence when conditions change. That is a different kind of deficit. It is a problem of calibration and flexibility rather than a permanently weak or permanently strong inner signal.

This part therefore treats precision as a moving quantity. Attention, arousal, context and prior learning can all alter how much a signal matters. Healthy regulation requires the ability to change that weighting rather than maximize it.

What this part must establish

- **16** Adaptive Precision
- **17** Hypervigilance and Underweighting Can Coexist
- **18** Precision as a Target of Learning

Precision gives the lecture a candidate mechanism for flexibility. The next question is how bodily inference becomes emotion and selfhood rather than remaining a technical control problem.

16

Adaptive Precision

EMPIRICAL RESULT

In computational interoception tasks, healthy participants can alter how strongly they rely on afferent cardiac information when experimental conditions increase the reliability of that information. Transdiagnostic psychiatric samples have shown a reduced ability to make this adjustment. The finding has been reported across depression, anxiety, eating and substance-use disorders and then examined in a larger replication and extension.

The result does not mean that every person with a psychiatric diagnosis has the same precision abnormality. Group effects overlap, tasks are simplified compared with real life, and interoception is multidimensional. Yet the pattern is conceptually valuable because it moves the field away from a static deficit account. A person can be reasonably accurate under one condition and fail when the environment demands reweighting.

This is exactly the kind of variable a dynamical framework needs. Flexibility can fail even when average performance looks normal. The scientifically interesting question becomes how rapidly, appropriately and reversibly precision changes after perturbation.

Evidence boundary The task-based precision parameter is not a general clinical biomarker and should not be generalized to every interoceptive channel.

Evidence anchors: R33-R34, R53-R57

Core sentence The deeper failure may be not sensing too little or too much, but changing trust too slowly.

17

Hypervigilance and Underweighting Can Coexist

SUPPORTED INTERPRETATION

Clinical language often creates a false opposition between hyperawareness and disconnection. Trauma survivors may report intense bodily alarm in one situation and numbness or dissociation in another. People with panic may monitor the heart closely while misestimating what a change means. Depression can include both intrusive bodily discomfort and reduced confidence in bodily guidance. These patterns are not contradictory if different channels and contexts receive different precision.

A hierarchical model allows high precision at one level and low precision at another. The system may strongly expect danger while treating moment-to-moment safety signals as unreliable. It may notice arousal intensely but distrust signals of hunger, fatigue or satisfaction. It may alternate between amplification and suppression depending on context.

This matters for intervention. The aim cannot simply be 'increase interoception' or 'reduce interoception.' The more precise question is which signal, at what level, in what context, with what confidence, and to what regulatory end. That is slower language, but it prevents treatment from becoming a generic instruction to listen to the body.

Evidence boundary Clinical heterogeneity is substantial; the same symptom label can arise from different combinations of attention, precision, prior expectation and physiology.

Evidence anchors: R41-R57

Core sentence A person can be too certain about one bodily story and too uncertain about another at the same time.

18

Precision as a Target of Learning

EMERGING EVIDENCE

A particularly important frontier is whether precision itself can be trained. Recent experimental work suggests that interoceptive training can alter computational estimates of how bodily evidence is weighted, and that this change may track reductions in anxiety more closely than a simple accuracy score. If replicated, such findings would support a treatment model based on recalibration rather than on sensitivity alone.

The implication is subtle. Exposure to bodily sensations may work partly because the person learns a new mapping between signal, context and consequence. Breathing exercises may help not because slow breathing is universally therapeutic, but because they create controlled perturbations in which respiratory sensations become more predictable and less catastrophic. Biofeedback may be useful when it improves calibration rather than merely producing a preferred number on a screen.

Flow Hijacked treats this as a promising bridge between computational parameters and clinical change, not as settled mechanism. The strongest test would show that a measured change in precision precedes, mediates and predicts durable improvement beyond nonspecific factors.

Evidence boundary Evidence that precision change causally mediates clinical recovery is emerging and not yet sufficient for broad treatment claims.

Evidence anchors: R34, R91-R95, R98-R100

Core sentence The therapeutic target may be the ability to reweight evidence, not the ability to feel every signal more strongly.

PART 07

Before Emotion Has a Name

A bodily state is not an emotion by itself. Increased heart rate can accompany fear, anger, exercise, excitement, fever or caffeine. What becomes consciously felt depends on context, learned categories, attention, memory and the actions currently available. Interoception therefore participates in emotion without reducing emotion to physiology.

This part follows the transformation from bodily signal to affective meaning. It also asks why emotional language sometimes fails. If the person can feel that something is happening but cannot organize the sensation into a differentiated concept, action selection becomes harder. The body may be loud while meaning remains vague.

What this part must establish

- **19** Affect Is Embodied but Not Reducible
- **20** Alexithymia and Emotional Granularity
- **21** From Feeling to Action

Before an emotion receives a name, bodily prediction has already changed the field of possible action. Naming can help, but naming is not the whole mechanism.

19

Affect Is Embodied but Not Reducible

SUPPORTED INTERPRETATION

Affective neuroscience has repeatedly implicated interoceptive and autonomic systems in emotion, but the evidence does not support one-to-one mappings between individual emotions and fixed bodily signatures. Bodily changes contribute to intensity, action readiness and valence, while cortical and contextual systems shape interpretation. The result is an embodied construction rather than a simple readout.

This middle position matters. Saying that emotion is 'in the body' can be as misleading as saying that emotion is 'in the head.' Fear involves threat appraisal, memory, sensory processing, autonomic mobilization and action. Shame includes bodily heat, social prediction, self-model and imagined evaluation by others. Craving includes visceral anticipation, learned reward, withdrawal, memory and opportunity.

Flow Hijacked therefore uses affect as a field variable: a summary of what the current state affords and demands. Affect can bias attention toward certain trajectories before explicit reasoning catches up. It helps explain why a person may know intellectually that something is safe while still inhabiting a body organized for avoidance.

Evidence boundary The lecture does not endorse a unique peripheral signature for each emotion or claim that cognition merely labels pre-existing bodily states.

Evidence anchors: R05, R12-R14, R27-R28

Core sentence Emotion is embodied meaning: physiology interpreted inside a history, context and field of possible action.

20

Alexithymia and Emotional Granularity

SUPPORTED INTERPRETATION

Alexithymia describes difficulty identifying and describing feelings, and it cuts across diagnostic categories. It has been linked to interoceptive processes, but the relationship is not simple. A person can experience strong undifferentiated arousal without accurately identifying its source. Language, conceptual knowledge and social learning also influence emotional differentiation.

Emotional granularity matters because regulation depends on representation. 'Bad' is a poor control signal. Fear, grief, shame, anger, exhaustion, hunger and loneliness invite different actions. When many bodily states collapse into one undifferentiated distress category, the regulatory repertoire can narrow. The fastest familiar relief policy may win simply because the system does not distinguish what kind of problem is present.

This offers a bridge to addiction and self-regulation. Learning to identify bodily-emotional states may increase the number of available responses, but only if labeling is tied to context and action rather than becoming another monitoring ritual. Precision, concept and policy must change together.

Evidence boundary Alexithymia is not equivalent to poor interoception, and self-report measures can confound emotional vocabulary with bodily accuracy.

Evidence anchors: [R41](#), [R49](#), [R67](#)

Core sentence When every internal difficulty feels like the same emergency, the same emergency solution becomes easier to repeat.

21

From Feeling to Action

FLOW HIJACKED SYNTHESIS

The functional purpose of affect is not only to be experienced. It helps organize action. Pleasant and unpleasant states alter approach, withdrawal, persistence and learning. Interoceptive predictions contribute to this process by estimating what actions will do to the body and what bodily costs those actions will require.

A person deciding whether to enter a social room, take a walk, begin a difficult task or resist a craving is implicitly solving an embodied control problem. How much energy is available? How threatening is uncertainty? What relief is expected from avoidance? How quickly can the system recover if the action goes badly? These variables are rarely conscious in formal form, yet they shape choice.

Flow Hijacked therefore links emotion to reachability. A state feels different partly because different actions become available from within it. Recovery is not merely changing emotional valence; it can mean restoring actions that had become prohibitively costly or invisible.

Evidence boundary The language of reachability is a Flow Hijacked formalization, not a validated clinical metric of emotion.

Evidence anchors: [R24-R32](#), [R37-R40](#)

Core sentence Feelings matter partly because they redraw the map of what the person can do next.

PART 08

The Body and the Self - Why I Feel Like Me

The self is not a single object in the brain. It is a layered construction involving memory, agency, body ownership, perspective, social identity and continuity through time. Interoception contributes one unusually persistent stream: the ongoing condition of the organism from which every external perception is encountered.

Cardiac, respiratory and gastric signals influence perceptual timing and bodily self-consciousness. The evidence does not justify claiming that interoception creates the self alone. It does suggest that the felt continuity of being an embodied subject depends partly on how internal and external signals are integrated.

What this part must establish

- **22** Bodily Self-Consciousness
- **23** Agency as Predicted Control
- **24** Continuity Across Time

Embodiment deepens the Flow Hijacked notion of selfhood: identity is not a fixed state but a trajectory whose bodily constraints and affordances change over time.

22

Bodily Self-Consciousness

SUPPORTED INTERPRETATION

Experimental illusions show that body ownership and self-location can be altered by manipulating visual, tactile and proprioceptive information. Interoceptive signals add another layer. Synchrony between visual events and the heartbeat can change self-related processing, and insular or multisensory regions participate in integrating these streams.

The philosophical temptation is to declare that the self is simply interoception. The scientific evidence does not support that shortcut. People retain identity across large physiological changes, and autobiographical, social and conceptual processes clearly matter. A better claim is that selfhood is scaffolded by recurrent bodily information that helps anchor perspective to a living organism.

This anchoring becomes clinically relevant in depersonalization, dissociation and some trauma states, where people describe feeling unreal, detached or absent from the body. Such experiences should not be reduced to one interoceptive mechanism, but altered integration between bodily signals and higher-order self-models is a plausible component worth testing.

Evidence boundary Bodily self-consciousness is multisensory; interoception is one contributor among vision, touch, proprioception, vestibular signals, memory and social cognition.

Evidence anchors: R13-R15, R50-R52

Core sentence The self is not located in the body, but every self must continuously negotiate being a body.

23

Agency as Predicted Control

FLOW HIJACKED SYNTHESIS

Agency depends on more than initiating movement. It includes the expectation that an action can change a state in a reliable direction. When the link between action and bodily consequence becomes uncertain, helplessness can emerge even if motor capacity remains intact. Conversely, a small action that reliably changes internal state can become disproportionately valuable.

This is one reason substances, compulsions and avoidance can become compelling. They often provide fast, predictable state transitions. Their long-term cost may be enormous, but the short-term control signal is clear. Healthy agency requires more than the absence of compulsion; it requires alternative actions that can change the system with sufficient reliability to compete.

Flow Hijacked calls this controllability within embodied state-space. The variable is not subjective confidence alone. It includes actual environmental affordances, physiological reserve and learned action-outcome structure. Recovery can therefore involve both changing beliefs and constructing conditions in which effective action genuinely becomes possible.

Evidence boundary The control-theoretic language is explanatory; individual agency cannot be inferred from one physiological or computational measure.

Evidence anchors: R25, R32, R37, R65-R66

Core sentence Agency grows when the system can predict that more than one action is capable of moving it.

24

Continuity Across Time

SUPPORTED INTERPRETATION

The body carries continuity through rhythms and slower processes. Circadian phase, sleep debt, inflammatory state, menstrual or endocrine changes, training status, pain and metabolic reserve create a history that is present before autobiographical memory is consulted. The same person can therefore encounter the same environment from meaningfully different embodied starting points.

This temporal continuity complicates trait language. Someone may appear 'anxious' after sustained sleep loss, stimulant use or illness and very different after recovery. A person with chronic pain may develop stable anticipatory patterns because the body has supplied repeated evidence of cost. Interceptive models should therefore include history-dependent state, not merely momentary sensation.

For the later attractor model, this is essential. Attractors are not personality labels. They are recurrent dynamical tendencies produced by a system with memory. The system can change, but its past influences which transitions are easiest today.

Evidence boundary History dependence does not imply permanence. Biological and learned processes operate on multiple reversible and irreversible timescales.

Evidence anchors: R13, R23-R24, R35, R39-R40

Core sentence The body gives the present a history before the mind tells the story of that history.

PART 09

When Adaptation Becomes the Problem

A regulatory response can be adaptive and still become costly when its duration, frequency or context changes. This is one of the central lessons of stress biology. Mobilization, vigilance, inflammatory signaling, analgesia, avoidance and energy conservation can all protect the organism under some conditions. Pathology often appears not because the response is intrinsically wrong, but because the system cannot disengage, recalibrate, or recruit an alternative response when circumstances change.

This part brings together chronic stress, developmental adversity, allostatic load and the Flow Hijacked idea of narrowing. The scientific discipline is to avoid saying that adversity is simply 'stored in the body.' What persists are measurable changes in learning, physiology, appraisal and control, with substantial variation between people.

What this part must establish

- **25** Stress as Coordinated Mobilization
- **26** Developmental Calibration
- **27** Why the Response Persists After the Context Changes

The body can remember without storing a literal narrative: history can persist as changed thresholds, learned policies and altered transition probabilities.

25

Stress as Coordinated Mobilization

SUPPORTED INTERPRETATION

Stress is not a single hormone and not a synonym for distress. It is coordinated adaptation to demands that threaten or challenge current regulation. Sympathetic activity, the HPA axis, immune signaling, attention, memory and behavior can all participate. The exact response depends on controllability, predictability, social context, developmental history and the nature of the stressor.

This multivariate view explains why the same person may show different stress signatures across tasks. Cortisol may rise without a dramatic subjective response; heart rate may increase while another autonomic measure barely changes. Average group differences can conceal meaningful temporal structure. Recovery time may matter more than peak amplitude.

Flow Hijacked therefore asks four questions about a stress response: how easily it begins, how strongly it amplifies, how long it persists, and how reliably the system returns. These are dynamical properties rather than moral judgments. A system built for survival can be highly effective at entering threat and still be impaired in leaving it.

Evidence boundary No single biomarker defines stress or safety. Cortisol, HRV and inflammatory markers each index limited components of a larger response.

Evidence anchors: [R22-R24](#), [R35](#), [R40](#), [R52](#)

Core sentence A stress system can be powerful at mobilization and weak at return.

26

Developmental Calibration

SUPPORTED INTERPRETATION

Early environments influence the developing regulation of stress, attention, attachment and bodily expectation. Adversity does not write one deterministic program into the nervous system. It changes probabilities. Development is plastic, and similar experiences can lead to different outcomes depending on timing, genetics, relationships, later environment and the meaning of the experience.

An adaptation-based view is useful here. A child in an unpredictable environment may benefit from rapid threat detection, strong sensitivity to caregiver availability, or short time horizons. Those calibrations can later mismatch a safer environment. The adult may experience the response as irrational even though it emerged from a history in which waiting for more evidence was costly.

Interoception adds a bodily dimension to developmental calibration. Repeated patterns of feeding, soothing, touch, illness, pain and caregiver response help shape expectations about what internal sensations mean and whether distress can be changed. This does not reduce attachment to physiology. It shows how relational history can enter the statistics of bodily control.

Evidence boundary Developmental effects are probabilistic, not destiny; retrospective adversity measures and causal inference have important limitations.

Evidence anchors: R67-R77

Core sentence A nervous system learns the cost of uncertainty from the environments in which it had to survive uncertainty.

27

Why the Response Persists After the Context Changes

FLOW HIJACKED SYNTHESIS

A learned policy does not disappear merely because the original environment is gone. If the policy repeatedly prevented feared outcomes, the system may have received little evidence about what would have happened without it. Avoidance is a classic example. Leaving a situation reduces arousal quickly, which reinforces leaving and prevents corrective learning about staying.

The same logic can operate physiologically. Hyperventilation, muscle bracing, checking, substance use or withdrawal can change internal state in ways that make the next episode easier to interpret through the same model. The response begins to participate in maintaining the evidence for itself.

This is the first clear step toward Interoceptive Attractor Capture. Persistence is not mysterious memory hidden in tissue. It can arise from coupled learning loops in which prediction alters action, action alters physiology, physiology alters sensation, and sensation updates prediction. History is carried forward by the dynamics of the present.

Evidence boundary The attractor interpretation is a Flow Hijacked synthesis. Individual symptoms can persist for many reasons not captured by this loop.

Evidence anchors: R24-R31, R41-R57

Core sentence The past survives when present-day regulation keeps recreating the conditions under which the old model remains plausible.

PART 10

One Body, Many Diagnoses

Interoceptive alterations appear across many psychiatric and neurological conditions. That trans-diagnostic reach is scientifically interesting and easy to abuse. If the same construct is found everywhere, it can become too vague to explain anything. The task is therefore to specify which component is altered, in which modality, under which task, and how strongly the evidence supports the claim.

This part does not propose interoception as a hidden common cause of mental illness. It uses it as a cross-cutting dimension that can interact differently with threat, reward, mood, compulsion, pain and psychosis.

What this part must establish

- **28** Anxiety and Panic - When Bodily Change Becomes Evidence of Threat
- **29** Depression - Energy, Effort and the Shrinking Field
- **30** Trauma, Dissociation, Psychosis and Functional Symptoms

Interoception becomes useful in psychiatry only when the exact failure mode is specified. Otherwise it risks becoming a fashionable label attached to every symptom.

28

Anxiety and Panic - When Bodily Change Becomes Evidence of Threat

SUPPORTED INTERPRETATION

Panic provides one of the clearest demonstrations of why bodily prediction matters. Changes in heart rate, breathing, dizziness or gastrointestinal sensation can become objects of threat appraisal. Attention amplifies their salience, catastrophic expectation changes their meaning, and escape or safety behaviors can reinforce the association. Respiratory manipulations and interoceptive exposure are clinically relevant precisely because the feared stimulus can be internal.

Yet panic should not be reduced to 'misreading the body.' Carbon dioxide sensitivity, autonomic physiology, learned fear, context and broader anxiety vulnerability all contribute. Some people experience intense bodily symptoms without panic, while others panic in the absence of dramatic measured physiology. The model must therefore contain both sensation and interpretation.

Flow Hijacked frames panic as a high-gain loop in which ordinary or transient bodily deviations become unusually potent state-transition triggers. Treatment can work by changing the meaning, predicted consequence and action policy around those sensations rather than trying to eliminate bodily variability.

Evidence boundary Bodily arousal is not inherently pathological, and panic cannot be diagnosed from interoceptive performance or autonomic measures.

Evidence anchors: R42-R44, R53, R99

Core sentence Panic is not the presence of bodily change. It is a learned regime in which bodily change can become a privileged route into danger.

29

Depression - Energy, Effort and the Shrinking Field

SUPPORTED INTERPRETATION

Depression often includes changes in appetite, sleep, pain, psychomotor activity, fatigue and effort. These features make it difficult to sustain a purely cognitive account. Interoceptive and allostatic models propose that altered estimates of bodily state and available resources may contribute to anhedonia, reduced action and the sense that ordinary tasks cost too much.

The evidence remains heterogeneous. Depression is not one physiological subtype, and inflammatory or metabolic findings apply more strongly to some groups than others. Insular differences are reported in neuroimaging, but they are neither specific nor diagnostic. What is robust is the clinical fact that mood, body and action are coupled.

Flow Hijacked connects this to future compression. If action is predicted to be costly and unlikely to change the state, fewer actions are sampled. With fewer actions, fewer rewards and corrective outcomes occur. The future then contains less evidence of possibility. The loop can be cognitive, social and physiological at once.

Evidence boundary The lecture does not claim that depression is caused by low energy, inflammation or interoceptive error; these are heterogeneous contributors and candidate mechanisms.

Evidence anchors: R32, R35, R43-R46, R55-R56, R65-R66

Core sentence Depression can narrow the future partly by making movement feel biologically and computationally expensive.

30

Trauma, Dissociation, Psychosis and Functional Symptoms

SUPPORTED INTERPRETATION

Trauma-related conditions expose the limits of simple 'more or less interoception' stories. Hyperarousal can coexist with numbness. Dissociation can involve detachment from bodily signals while threat systems remain active. Functional neurological symptoms can involve altered expectations and sensorimotor inference without symptoms being voluntary or imaginary. Psychosis research increasingly examines how internal bodily priors interact with broader disturbances of inference and self-experience.

These literatures are less mature than panic research and should be treated accordingly. Scoping reviews in PTSD identify promising patterns but substantial methodological heterogeneity. Schizophrenia findings differ by symptom domain and task. Functional neurological disorder has strong evidence for altered attention, prediction and agency, but no single computational model explains all presentations.

The Flow Hijacked contribution is therefore not unification by declaration. It is a common question: where does the system place precision, which sensations become state-transition triggers, and how much flexibility remains when context changes?

Evidence boundary Transdiagnostic similarity does not erase diagnosis-specific mechanisms, developmental pathways or treatment evidence.

Evidence anchors: R49-R60

Core sentence A shared dynamical question can connect disorders without pretending they are the same disorder.

PART 11

Craving - When Regulation Becomes Compulsion

Addiction is often described through reward, habit and compulsion. Interoception adds a missing layer: substances and behaviors can become tools for changing the internal body. Alcohol can reduce tension, opioids can alter pain and distress, nicotine can change arousal and concentration, stimulants can change energy, and repetitive behaviors can terminate uncertainty. The regulatory effect may be immediate even when the long-term consequences are devastating.

Craving can therefore be understood partly as a prediction about a state transition. The organism expects that one policy will change the body quickly and reliably. Repetition strengthens that policy while alternative routes may become less available.

What this part must establish

- **31** Craving Is a Bodily Prediction
- **32** Negative Reinforcement and Relief Learning
- **33** Recovery as Repertoire Expansion

Addiction offers the clearest example of why the body cannot be treated as background. A policy can capture behavior precisely because it is so effective at changing embodied state in the short term.

31

Craving Is a Bodily Prediction

SUPPORTED INTERPRETATION

Craving is not merely a thought about pleasure. It often includes visceral urgency, tension, salivation, restlessness, pain, dysphoria or a felt sense that the current state must end. Cues can trigger these changes before deliberate decision-making. The insula has been repeatedly implicated in craving and interoceptive aspects of addiction, while broader cortico-striatal, salience and stress systems contribute to learning and action.

Predictive coding offers one way to organize these observations. A cue can evoke an expected bodily state and the expected relief associated with use. If the prediction is precise, competing evidence may have little influence. The person may fully know the long-term cost while the short-term embodied policy remains dominant.

This helps explain why education alone rarely resolves addiction. The problem is not ignorance of consequences. It is that one action has become disproportionately reliable at moving the system from an aversive state to a less aversive one.

Evidence boundary Interoceptive models complement rather than replace reward learning, habit, stress, social context and pharmacology in addiction.

Evidence anchors: R45-R46, R61-R66

Core sentence Craving becomes powerful when the body predicts not only reward, but rapid exit from the state it is in.

32

Negative Reinforcement and Relief Learning

SUPPORTED INTERPRETATION

Many addictive trajectories shift over time from pursuit of positive reward toward avoidance of withdrawal, stress or dysphoria. This negative-reinforcement process is fundamentally regulatory: behavior is strengthened because it removes an aversive state. Repeated relief can teach the system that discomfort is intolerable unless the familiar policy is enacted.

The learning problem becomes self-reinforcing. Withdrawal and stress increase the value of the substance; substance use temporarily reduces those states; repeated use then contributes to future withdrawal and altered stress regulation. The body supplies both the problem and the evidence that the learned solution works.

Flow Hijacked interprets this as policy compression. The person may still possess other coping strategies conceptually, but their transition probability under high distress becomes very low. Recovery requires making alternatives not merely imaginable but competitive under the bodily conditions in which use is most likely.

Evidence boundary Negative reinforcement is prominent in many addictions but does not describe every stage, substance or person.

Evidence anchors: R45-R46, R63-R66

Core sentence A policy becomes compulsive when it remains the only action the system trusts at the moment trust matters most.

33

Recovery as Repertoire Expansion

FLOW HIJACKED SYNTHESIS

A useful recovery metric is not simply days without a substance. Abstinence can be essential, but dynamical recovery also asks whether the person has regained multiple ways to move through distress, boredom, social pain, fatigue and craving. The regulatory repertoire includes relationships, sleep, exercise, treatment, medication where appropriate, meaning, delay, distraction, acceptance and direct problem-solving.

These alternatives are not equivalent. Some work only at low arousal, some require another person, and some take too long to compete with a substance that changes state within minutes. Recovery therefore involves engineering accessibility. A strategy that exists in a workbook but cannot be reached during craving is not yet part of the effective repertoire.

This is where interoception connects to agency. The person learns that bodily urgency can rise and fall without dictating one action, and that other actions can alter state. That learning changes the geometry of choice.

Evidence boundary Regulatory-repertoire language is a Flow Hijacked construct; it is not a validated addiction outcome scale.

Evidence anchors: R45-R46, R93-R96

Core sentence Recovery strengthens when the body learns that there is more than one way out.

PART 12

The Borrowed Body - Regulation Is Learned Between People

No human begins as an isolated self-regulating unit. Feeding, temperature, sleep, distress and arousal are initially managed within caregiver-infant systems. Touch, voice, gaze, movement and predictability become part of the environment in which bodily sensations acquire meaning. Later, relationships can continue to change appraisal, effort, pain, autonomic response and the accessibility of action.

This part links Body Before Thought to The Borrowed Nervous System without collapsing the two lectures. The scientific claim is modest and strong: social context can alter regulation. The stronger claim – that another person can change the geometry of reachable states – remains a Flow Hijacked synthesis that must be tested against simpler explanations.

What this part must establish

- **34** Co-Regulation Before Self-Regulation
- **35** Social Context Changes Cost
- **36** Synchrony Without Mysticism

The body is social without becoming owned by other people. Healthy co-regulation should widen agency, not concentrate all regulation in one relationship.

34

Co-Regulation Before Self-Regulation

SUPPORTED INTERPRETATION

Infants depend on caregivers for regulation in a literal sense: feeding, warmth, protection and soothing are externally supported. Through repeated interaction, the child also learns patterns linking internal states with external responses. Hunger can predict feeding; distress can predict contact; arousal can predict soothing or, in less stable environments, uncertainty. These regularities become part of developmental learning.

Affective touch is one pathway among many. C-tactile afferents respond preferentially to gentle stroking in particular ranges, and social touch can influence stress and pain. But touch is not universally safe or desirable; its meaning depends on consent, relationship, culture, history and context. Voice, timing, predictability and shared action also matter.

For interoception, the key idea is that bodily inference develops inside relationships. The child is not only learning 'what do I feel?' but also 'what happens when I feel this, and can the state change?'

Evidence boundary Co-regulation should never be used to justify forced touch, dependency, surveillance or the claim that one person can directly control another's nervous system.

Evidence anchors: R67-R77

Core sentence The earliest lesson of bodily regulation is often relational: this state can change, and I do not always have to change it alone.

35

Social Context Changes Cost

SUPPORTED INTERPRETATION

Social Baseline Theory and related work propose that the brain often assumes access to social resources when estimating effort and threat. Familiar support can alter responses to pain, stress and challenge. This does not mean that company always calms physiology. The effect depends on who is present, the history of the relationship, the task and whether support itself creates evaluation or obligation.

The important variable may be cost rather than comfort. A difficult action can become more reachable when another person provides information, physical help, witness, safety or shared responsibility. Conversely, a hostile or unpredictable relationship can increase vigilance and narrow the field of action even when the external task is unchanged.

Body Before Thought adds an interoceptive layer: social context can change how bodily signals are interpreted and how much mobilization an action appears to require. The same heartbeat before a medical procedure, public speech or difficult conversation may carry a different meaning in the presence of a trusted person.

Evidence boundary Social buffering is heterogeneous and cannot be reduced to HRV, oxytocin or one attachment style.

Evidence anchors: R72-R80

Core sentence Another person can change the cost of a transition without taking the transition for us.

36

Synchrony Without Mysticism

EMPIRICAL RESULT

Interpersonal physiological and neural synchrony has become a popular research topic. Dyads can show time-linked changes in heart rate, skin conductance, movement or neural activity during interaction. But synchrony is not automatically evidence of empathy, safety or healthy attachment. Shared stimuli, movement and task structure can create synchrony without direct mutual regulation, and high synchrony can sometimes accompany shared distress.

The methodological lesson is essential. Live interaction increases ecological validity while making causal identification harder. Who influenced whom? Did both participants respond to the same event? Did behavior mediate physiology? Did the measure capture stable coupling or coincidental co-fluctuation?

Flow Hijacked treats synchrony as a possible signature of coupling, never as proof of its meaning. The stronger scientific question is whether interaction changes transition dynamics in a way that persists, generalizes and preserves agency after the interaction ends.

Evidence boundary Synchrony is descriptive unless experimental design identifies direction, mechanism and functional consequence.

Evidence anchors: R74-R77

Core sentence Moving together is not the same as regulating well together.

PART 13

Beyond the Nervous System - Gut, Metabolism and Immunoception

Interoception is wider than neural sensation. The gut contains mechanosensory, chemosensory and endocrine systems that communicate with peripheral nerves and the brain. Immune mediators can alter motivation, fatigue, temperature and social behavior. Metabolic organs signal nutrient availability and energetic state. These pathways are increasingly studied with cell-type-specific tools that move the field beyond slogans about the 'gut-brain axis.'

This frontier is scientifically exciting and particularly vulnerable to hype. Microbiome findings are often associative, heterogeneous and sensitive to diet, medication, geography and analytic choices. Inflammation is relevant to subsets of psychiatric illness but is not a universal cause. The aim is to show how whole-body signaling expands the model without pretending that one peripheral pathway explains the mind.

What this part must establish

- **37** The Gut Is a Sensory Organ
- **38** Immunoception
- **39** Microbiome: Signal, Not Oracle

The body is an ecosystem of interacting regulatory systems. The challenge is to expand the map without turning every peripheral signal into a new master explanation.

37

The Gut Is a Sensory Organ

EMPIRICAL RESULT

The gastrointestinal tract continuously detects stretch, nutrients, osmolarity, microbial products and chemical composition. Mechanosensory neurons and enteroendocrine cells convert these features into neural and hormonal signals. Vagal afferents transmit some of this information, while spinal pathways contribute other forms of visceral sensing. The result is a distributed sensory system rather than a passive digestive tube.

Recent work identifying PIEZO2-dependent mechanosensation and specialized vagal populations illustrates the growing resolution of the field. The brain can receive information about fullness, nutrient content and internal chemical conditions without those signals becoming explicit conscious sensations. These signals influence feeding, reward and autonomic control.

For psychiatry, the correct inference is not that the gut causes mood. It is that internal state estimation includes a large gastrointestinal component that can interact with stress, eating behavior, medication and illness. The gut is one source of evidence in the embodied control problem.

Evidence boundary Mechanistic animal findings require careful translation to human subjective experience and psychiatric outcomes.

Evidence anchors: R78-R90

Core sentence The gut matters because it is part of the body's sensing architecture, not because it is a second brain with a single message.

38

Immunoception

EMERGING EVIDENCE

Immune activity changes behavior. Infection can produce fatigue, social withdrawal, reduced appetite, altered sleep and slowed movement – a coordinated sickness response rather than a collection of unrelated symptoms. Cytokines and other immune mediators signal through humoral, neural and cellular routes. Recent work has begun to map how vagal sensory neurons represent specific cytokine-related signals and how insular systems participate in immune regulation.

The term immunoception captures this bidirectional relationship: the nervous system senses aspects of immune state and can influence immune function. That does not mean conscious awareness directly reads inflammation, nor that mental intention can freely control immunity. The relevant loops operate across autonomic, endocrine and behavioral channels.

Flow Hijacked uses immunoception to enlarge the state vector. A person's accessible behavior can narrow during inflammation because energy allocation and motivational systems change. The resulting withdrawal may be adaptive during acute illness and harmful when persistent inflammation or learned expectations continue after the original trigger.

Evidence boundary Immune mechanisms explain only subsets of psychiatric symptoms; biomarkers such as CRP are nonspecific and should not be used as stand-alone psychiatric explanations.

Evidence anchors: R20, R82-R87

Core sentence Immune state can change the geometry of action without becoming the single cause of the mind.

39

Microbiome: Signal, Not Oracle

SCIENTIFIC GUARDRAIL

The microbiota-gut-brain literature has established plausible bidirectional routes involving metabolites, immune signaling, vagal pathways, endocrine mechanisms and diet. Animal models provide strong mechanistic evidence that microbes can influence behavior and neural development. Human studies are increasingly sophisticated, including imaging and intervention work, but effect sizes, causal direction and reproducibility remain uneven.

This is exactly the kind of field in which public enthusiasm can outrun evidence. A microbial profile is not a psychiatric diagnosis. Probiotics are not interchangeable, and effects from germ-free mice cannot be translated directly into claims about treating depression. Medication, diet, age, geography, antibiotics and sequencing methods all influence findings.

The lecture therefore uses the microbiome as an example of disciplined systems thinking. A body-brain model should be open to new peripheral signals while remaining resistant to monocausal stories. Complexity is not permission to believe everything; it increases the burden of identification.

Evidence boundary Microbiome associations should be separated from causal intervention evidence, and psychiatric claims require independent replication in humans.

Evidence anchors: [R78-R83](#), [R86-R90](#)

Core sentence A whole-body model becomes weaker, not stronger, when every correlation is promoted to a mechanism.

PART 14

Can the Body Learn Again? - Recalibration and Treatment

If bodily prediction can become rigid, treatment should be able to restore flexibility. That proposition sounds obvious and is harder to prove than it appears. Many interventions change symptoms without changing measured interoception. Others change self-reported body awareness without improving laboratory accuracy. The clinical question is therefore not whether a treatment is 'body based,' but which component of the loop it changes and whether that change matters to outcome.

The evidence base includes interoceptive exposure, breathing interventions, mindfulness, biofeedback, exercise, neurofeedback and vagal stimulation. Some have strong indications for specific conditions; others remain experimental. This part organizes them by function rather than by branding.

What this part must establish

- **40** Exposure as Updating
- **41** Breathing, Biofeedback and Mindfulness
- **42** Neuromodulation and Interoceptive Technologies

Treatment is best understood as recalibration across multiple levels: signal, interpretation, policy, environment and social field.

40

Exposure as Updating

SUPPORTED INTERPRETATION

Interoceptive exposure deliberately evokes feared bodily sensations in a controlled context. In panic treatment, exercises such as spinning, hyperventilation or physical exertion can create sensations that have been associated with danger. Repeated exposure without catastrophe can update expectations about what the sensations mean and whether they require escape.

From a predictive perspective, exposure creates informative prediction errors. But learning is not guaranteed by mere repetition. If the person attributes safety entirely to a ritual, therapist presence or emergency escape route, the old model may remain intact. Context variation and expectancy violation therefore matter.

The Flow Hijacked lens is simple: successful exposure should reduce the probability that a bodily perturbation triggers the same narrow state transition. It should increase the number of states and actions that remain reachable while arousal is present.

Evidence boundary Exposure should be condition-specific and clinically guided where appropriate; deliberately provoking symptoms is not a universal self-help strategy.

Evidence anchors: R42, R91, R94-R95

Core sentence The goal is not to eliminate arousal. It is to make arousal compatible with more than one future.

41

Breathing, Biofeedback and Mindfulness

SUPPORTED INTERPRETATION

Slow-paced breathing can alter cardiorespiratory coupling, baroreflex engagement and subjective arousal. HRV biofeedback uses physiological feedback to train aspects of autonomic regulation. Mindfulness practices often increase reported interoceptive awareness and can change attention to bodily sensations. These effects are real enough to study and heterogeneous enough to resist a single mechanism story.

A useful distinction separates changing the signal from changing the interpretation of the signal. Breathing directly changes respiratory chemistry and cardiovascular dynamics. Biofeedback makes selected physiological information visible. Mindfulness may alter attentional stance and reactivity. A person can benefit through one route without becoming globally 'more regulated.'

The strongest public-health message is modest: practices can be useful tools, but no breathing pattern resets the nervous system permanently, and HRV is not a meter of psychological safety. Clinical benefit depends on indication, adherence, context and the broader treatment plan.

Evidence boundary Mindfulness, breathwork and HRV interventions vary substantially; adverse effects and contraindications should not be erased by wellness marketing.

Evidence anchors: R91-R96

Core sentence Regulation training is valuable when it increases flexibility, not when it turns one preferred physiological state into a new obligation.

42

Neuromodulation and Interoceptive Technologies

EMERGING EVIDENCE

Neurofeedback, vagus nerve stimulation, transcutaneous auricular stimulation and immersive interoceptive technologies create new ways to perturb brain-body loops. Real-time fMRI neurofeedback can train modulation of insular activity during interoceptive attention. Vagal stimulation can alter autonomic and central responses, and experimental studies are examining effects on prediction-error processing.

These technologies are important because they allow stronger causal tests than passive observation. If changing a pathway predictably changes perception, learning or symptoms, mechanistic confidence increases. Yet device enthusiasm can repeat the same mistake seen with supplements or microbiome claims: a plausible target is not equivalent to proven clinical efficacy.

Flow Hijacked therefore treats neurotechnology as an experimental lever. Its value is not that electricity or feedback is inherently more scientific than psychotherapy. Its value is that controlled perturbation can reveal which parts of the system are actually capable of shifting transition dynamics.

Evidence boundary Mechanistic target engagement, symptom benefit, durability and regulatory approval are separate questions and must be reported separately.

Evidence anchors: R91-R95, R100

Core sentence A good intervention is not defined by how directly it touches the nervous system, but by whether it restores useful control without creating new rigidity.

PART 15

The Nervous-System Regulation Myth

The language of nervous-system regulation has entered public culture. Some of it is helpful: it gives people a non-moral vocabulary for stress, arousal and recovery. Some of it has become scientifically careless. Complex autonomic systems are reduced to 'fight or flight versus safety,' HRV becomes a universal score, the vagus nerve becomes a reset button, and every uncomfortable state is labeled dysregulation.

This part is a contradiction chamber. The lecture audits its own attractive claims and deliberately identifies what the evidence does not support. Scientific restraint is not a weakening of the message. It is what keeps a useful systems framework from turning into another wellness myth.

What this part must establish

- **43** Calm Is Not the Goal
- **44** The Vagus Is Not a Safety Meter
- **45** Trauma Is Not Literally Stored in the Body

The strongest public message is not that everyone needs to regulate harder. It is that flexible systems need permission to mobilize, recover and vary.

43

Calm Is Not the Goal

FLOW HIJACKED SYNTHESIS

A nervous system that could only remain calm would be dangerously inflexible. Healthy life requires mobilization during exercise, alarm during genuine threat, focused arousal during performance, sympathetic activation during standing and cardiovascular adjustment during heat, illness or exertion. Regulation is therefore not the suppression of activation. It is context-sensitive deployment and recovery.

This distinction changes therapeutic language. Telling a person that every increase in heart rate means dysregulation can create new fear of normal physiology. Labeling anger or excitement as a nervous-system failure can pathologize useful states. A better question is whether the state fits the situation, whether it can change when the situation changes, and whether the person retains meaningful choice within it.

Flow Hijacked defines flexibility as the central value. Calm may be one reachable state among many. The aim is not a flat line; it is a wider and more navigable state-space.

Evidence boundary There is no single physiological pattern that defines psychological regulation across people and contexts.

Evidence anchors: [R15-R18](#), [R21-R24](#), [R91-R96](#)

Core sentence Health is not permanent calm. Health is appropriate movement and reliable return.

44

The Vagus Is Not a Safety Meter

SCIENTIFIC GUARDRAIL

Vagal pathways are anatomically and clinically important, but popular discourse often assigns them meanings they cannot bear. HRV is influenced by respiration, posture, age, fitness, medication, sleep, recording length and many other factors. Different HRV metrics capture different properties. A low value in one recording does not prove trauma, danger or poor emotional regulation.

Likewise, the autonomic nervous system is not a simple seesaw between one sympathetic and one parasympathetic mode. Sympathetic and parasympathetic outputs can co-activate or vary across organs. Local reflexes and central networks add further complexity. Useful simplified diagrams should therefore be labeled as simplifications rather than presented as anatomy.

The Flow Hijacked rule is strict: no one-number nervous system. Measures can be valuable, especially longitudinally and within controlled tasks, but meaning depends on context.

Evidence boundary The lecture does not use polyvagal categories as established diagnostic states and does not infer felt safety directly from HRV.

Evidence anchors: R09-R18, R73-R76, R93

Core sentence A physiological metric becomes misleading when it is asked to answer a psychological question it was never designed to answer.

45

Trauma Is Not Literally Stored in the Body

SCIENTIFIC GUARDRAIL

The phrase 'the body keeps the score' captures an important clinical truth: trauma can have enduring bodily consequences. Sleep, autonomic reactivity, pain, startle, immune function, posture and sensory processing can all change. The problem begins when metaphor is converted into literal storage language, as though a traumatic memory exists in muscle or fascia waiting to be released.

Current evidence supports distributed memory, learned prediction, autonomic conditioning, endocrine and immune changes, and altered sensory processing. These mechanisms are already powerful. They do not require a hidden somatic archive. Body-based treatments may help through attention, exposure, movement, safety learning, social interaction or physiological regulation without validating a literal storage theory.

Flow Hijacked therefore keeps the metaphor but repairs the mechanism. History can become embodied because it changes how the present system responds. That is enough to explain persistence without inventing an anatomically unsupported container for trauma.

Evidence boundary Persistent bodily consequences of trauma are real; the caution concerns literalized storage claims, not the legitimacy of embodied symptoms.

Evidence anchors: R50-R52, R67-R77

Core sentence The body can carry history as altered dynamics without storing the past as a hidden object.

PART 16

Flow Hijacked Novel Concept - Interoceptive Attractor Capture

The lecture now has enough machinery to make a stronger proposal. Interoceptive Attractor Capture is a Flow Hijacked hypothesis about how bodily prediction, precision and regulatory action can become mutually self-reinforcing over time. It does not claim that psychiatric disorders are attractors in a literal measured landscape. It proposes a testable dynamical description of lost flexibility.

The key move is to define health not by one preferred state but by the size and accessibility of the regulatory repertoire. A flexible system can mobilize, rest, explore, withdraw, connect, focus and recover as context requires. Capture occurs when a restricted set of predictions, bodily states and policies becomes increasingly easy to re-enter and increasingly difficult to leave.

What this part must establish

- **46** The Coupled Model
- **47** Regulatory Repertoire Compression and Hysteresis
- **48** Falsification, Measurement and Recovery

A healthy nervous system is not a calm nervous system. It is a system with somewhere else to go.

46

The Coupled Model

NEW HYPOTHESIS

Let the embodied state be $x_t = (b_t, n_t, e_t, a_t)$, containing bodily physiology, neural configuration, environment and regulatory action. Let μ_t represent predictions, Π_t precision and π_t the policy currently governing regulation. The next state depends on all of these variables and on their history.

In a flexible system, a context change produces appropriate changes in prediction, precision and policy. In capture, context sensitivity falls. Threat priors may remain high after danger ends; bodily signals that contradict the threat model may receive low weight; avoidance or substance use may remain the dominant policy because they have repeatedly changed state quickly.

The hypothesis is not that one basin explains everything. It is that repeated reciprocal loops can narrow transition options. Prediction changes action. Action changes physiology. Physiology changes sensation. Sensation then supplies evidence for the next prediction. A model can become partially self-evidencing because the organism's own regulatory behavior changes the evidence it will later observe.

$$x_{t+1} = F(x_t, \mu_t, \Pi_t, \pi_t, e_t), \quad \mu_t \rightarrow \pi_t \rightarrow b_{t+1} \rightarrow s_{t+1} \rightarrow \mu_{t+1}$$

Evidence boundary Interoceptive Attractor Capture is a proposed Flow Hijacked model. Attractor depth, basin geometry and precision rigidity have not been directly measured as a unified clinical construct.

Evidence anchors: R25-R40, R41-R66

Core sentence Capture begins when a prediction does not merely interpret the state but helps recreate the state that makes the prediction look right.

47

Regulatory Repertoire Compression and Hysteresis

NEW HYPOTHESIS

A flexible system has many usable policies. The relevant quantity is not simply how many strategies a person can name, but how many remain accessible under the state in which they are needed. We can represent this effective repertoire by a distribution over policies. As one policy dominates and others become rarely reachable, the entropy of the repertoire falls.

Capture also predicts hysteresis. The conditions required to enter a state need not equal the conditions required to leave it. A severe stressor may initiate a threat regime, but once learning, sleep disruption, avoidance and bodily sensitization reinforce one another, much smaller cues may sustain it. In addition, an intense period of use can create a regime in which minor distress later triggers a highly practiced relief policy.

This is different from allostatic load. Load asks how much adaptation costs. Capture asks how many transitions remain available. A person could have high biological cost but retain flexibility, or lose flexibility before substantial cumulative damage is measurable.

$$H(R) = - \sum_i p_i \log p_i, \quad |\Omega_{\text{accessible}}| \downarrow$$

Evidence boundary Policy entropy and hysteresis are formal hypotheses. They require operational definitions and longitudinal perturbation data before clinical use.

Evidence anchors: R33-R40, R45-R66

Core sentence The central pathology is not a bad state. It is the shrinking number of ways to leave it.

48

Falsification, Measurement and Recovery

NEW HYPOTHESIS

A novel concept is useful only if it can fail. Interoceptive Attractor Capture predicts measurable signatures: reduced context-dependent precision updating, longer dwell time in particular physiological-neural states, slower recovery after perturbation, greater hysteresis, lower diversity of effective regulatory policies and reduced transition entropy. These signatures should correlate with impairment better than average arousal alone if the model is informative.

The strongest studies would combine ambulatory physiology, ecological momentary assessment, behavioral tasks and repeated perturbations. They would test whether treatment changes transition structure before symptom scores improve, and whether regained flexibility predicts durable recovery. The model should also compete against simpler alternatives such as trait anxiety, symptom severity, medication effects and general behavioral inflexibility.

Recovery is then defined as restoration of accessible state-space. A person does not need to remain calm, positive or symptom-free. The system becomes healthier when more appropriate states and actions can be reached, when perturbations no longer dictate one trajectory, and when return becomes easier without dependence on one regulator.

$$\text{Recovery} \Rightarrow |\Omega_{\text{accessible}}| \uparrow, \quad T_{\text{return}} \downarrow, \quad H(R) \uparrow$$

Evidence boundary The proposed measures are a research program, not established clinical endpoints. Failure to outperform simpler models should lead to revision or rejection of the concept.

Evidence anchors: R33-R40, R91-R100

Core sentence Recovery is not simply leaving a bad state. It is regaining somewhere else to go.

EVIDENCE CONTRACT

What the lecture claims - and what it refuses to claim

The lecture uses a hierarchy of claims rather than a hierarchy of rhetorical confidence. Direct experimental findings retain their task, species, population and time scale. Reviews and meta-analyses can support cross-study interpretation but do not erase heterogeneity. Computational parameters are not reified into hidden substances. Neural correlates are not diagnostic tests. Mechanistic animal work is used to clarify possible routes, not to certify human subjective mechanisms.

The Flow Hijacked formalism is intentionally detachable from the evidence beneath it. If Interceptive Attractor Capture fails empirical tests, the anatomy, psychophysics, clinical reviews and intervention evidence remain intact. This is a design requirement. A novel synthesis should be allowed to fail without taking established evidence with it.

Falsification standard The novel model must predict something beyond symptom severity or general inflexibility: context-sensitive precision updating, transition diversity, dwell time, perturbation recovery, hysteresis, or policy accessibility. If these variables do not improve explanation or prediction, the model should be simplified or rejected.

METHODS AND INTEGRITY NOTE

How the evidence was selected

The research review was organized around six high-yield streams: foundations and measurement; brain-body circuitry; allostasis and predictive control; computational precision; transdiagnostic psychopathology and addiction; development, social regulation, immune-metabolic signaling and intervention. The final portfolio below is deliberately selective. It is not a claim that exactly one hundred papers exhaust the field. It is a compact evidence spine chosen to make the lecture auditable while preserving room for frontier work.

Older publications remain when they define a construct, method or canonical mechanism that current research still uses. Recent work from 2024-2026 is included when it changes resolution, supplies replication, introduces stronger causal perturbation or exposes an important limitation. Preprints and emerging studies are treated as frontier evidence rather than promoted to the same status as replicated peer-reviewed results.

Figures and equations in this lecture are explanatory reconstructions. No equation is a diagnostic model of an individual. State-space, entropy, basin depth and hysteresis are used only with explicit boundaries. The novel Flow Hijacked sections are labeled so that a reader can remove them and still retain the established scientific lecture.

RESEARCH PORTFOLIO

100 selected high-quality publications

- R01** Khalsa SS et al. Interoception and Mental Health: A Roadmap.
- R02** Chen WG et al. The Emerging Science of Interoception: Sensing, Integrating, Interpreting, and Regulating Signals within the Self.
- R03** Craig AD. How do you feel? Interoception: the sense of the physiological condition of the body.
- R04** Critchley HD, Wiens S, Rotshtein P, Ohman A, Dolan RJ. Neural systems supporting interoceptive awareness.
- R05** Critchley HD, Garfinkel SN. Interoception and emotion.
- R06** Garfinkel SN et al. Knowing your own heart: distinguishing interoceptive accuracy from interoceptive awareness.
- R07** Suksasilp C, Garfinkel SN. Towards a comprehensive assessment of interoception in a multi-dimensional framework.
- R08** Desmedt O, Luminet O, Walentynowicz M, Corneille O. The new measures of interoceptive accuracy: a systematic review and assessment.
- R09** Wang R, Chang RB. The Coding Logic of Interoception.
- R10** Sammons M et al. Brain-body physiology: local, reflex, and central communication.
- R11** Evrard HC. The Organization of the Primate Insular Cortex.
- R12** Menon V, Uddin LQ. Saliency, switching, attention and control: a network model of insula function.
- R13** Engelen T, Solca M, Tallon-Baudry C. Interoceptive rhythms in the brain.
- R14** Pace-Schott EF et al. Physiological feelings.
- R15** Skora L, Livermore JJA, Roelofs K. The functional role of cardiac activity in perception and action.
- R16** Silvani A et al. Brain-heart interactions: physiology and clinical implications.
- R17** Chan PYS, Lee LY, Davenport PW. Neural mechanisms of respiratory interoception.
- R18** Hsueh B et al. Cardiogenic control of affective behavioural state.
- R19** Klein AS et al. Fear balance is maintained by bodily feedback to the insular cortex in mice.
- R20** Harrison NA et al. Neural origins of human sickness in interoceptive responses to inflammation.
- R21** Sterling P. Allostasis: a model of predictive regulation.
- R22** McEwen BS, Stellar E. Stress and the individual: mechanisms leading to disease.
- R23** McEwen BS. Stress, adaptation, and disease: allostasis and allostatic load.
- R24** Peters A, McEwen BS, Friston K. Uncertainty and stress: why it causes diseases and how it is mastered by the brain.
- R25** Pezzulo G, Rigoli F, Friston K. Active inference, homeostatic regulation and adaptive behavioural control.
- R26** Seth AK, Friston KJ. Active interoceptive inference and the emotional brain.
- R27** Barrett LF, Simmons WK. Interoceptive predictions in the brain.
- R28** Barrett LF. The theory of constructed emotion: an active inference account of interoception and categorization.
- R29** Owens AP, Allen M, Ondobaka S, Friston K. Interoceptive inference: from computational neuroscience to clinic.
- R30** Paulus MP, Feinstein JS, Khalsa SS. An Active Inference Approach to Interoceptive Psychopathology.
- R31** Petzschnner FH, Weber LAE, Gard T, Stephan KE. Computational psychosomatics and computational psychiatry: toward a joint framework for differential diagnosis.
- R32** Stephan KE et al. Allostatic Self-efficacy: a metacognitive theory of dyshomeostasis-induced fatigue and depression.
- R33** Smith R et al. A Bayesian computational model reveals a failure to adapt interoceptive precision estimates across depression, anxiety, eating, and substance use disorders.
- R34** Lavalley CA et al. Transdiagnostic failure to adapt interoceptive precision estimates across affective, substance use, and eating disorders: replication and extension.
- R35** Santamaria-Garcia H et al. Allostatic interoceptive overload across psychiatric and neurological conditions.
- R36** Allen M, Levy AR, Parr T, Friston K. In the Body's Eye: the computational anatomy of interoceptive inference.
- R37** Sennesh E et al. Interoception as modeling, allostasis as control.
- R38** Katsumi Y et al. Allostasis as a core feature of hierarchical gradients in the human brain.
- R39** Ibanez A, Northoff G. Intrinsic timescales and predictive allostatic interoception in brain health and disease.
- R40** Bobba-Alves N, Juster RP, Picard M. The energetic cost of allostasis and allostatic load.
- R41** Brewer R, Murphy J, Bird G. Atypical interoception as a common risk factor for psychopathology: a review.
- R42** Saltafossi M, Heck D, Kluger DS, Varga S. Common threads: altered interoceptive processes across affective and anxiety disorders.
- R43** Jenkinson PM, Fotopoulou A, Ibanez A, Rossell SL. Interoception in anxiety, depression, and psychosis: a review.
- R44** Eggart M et al. Major depressive disorder is associated with impaired interoceptive accuracy: a systematic review.
- R45** Paulus MP. Interoceptive Processing in Substance Use Disorders: from neuroanatomy to computational models and predictive coding.
- R46** Im JJ et al. A Systematic Review of Interoception in Substance Use Disorders.
- R47** Khalsa SS, Berner LA, Anderson LM. Gastrointestinal Interoception in Eating Disorders: Charting a New Path.
- R48** Bragdon LB et al. Interoception and Obsessive-Compulsive Disorder: a review of current evidence and future directions.
- R49** Yao B, Thakkar KN. Interoception abnormalities in schizophrenia: review and integration with Bayesian accounts of psychosis.
- R50** Leech K, Stapleton P, Patching A. A roadmap to understanding interoceptive awareness and post-traumatic stress disorder: a scoping review.
- R51** Kearney BE, Lanius RA. The brain-body disconnect: a somatic sensory basis for trauma-related disorders.
- R52** Harricharan S, McKinnon MC, Lanius RA. How processing of internal and external sensory information shapes engagement with the world after trauma.
- R53** Smith R et al. Perceptual insensitivity to the modulation of interoceptive signals in depression, anxiety, and substance use disorders.
- R54** Critchley HD et al. Cardiac interoception in patients accessing secondary mental health services: a transdiagnostic study.

- R55** Hu L et al. Insular dysfunction of interoception in major depressive disorder: a neuroimaging perspective.
- R56** Hattori S et al. Insula-cerebellar functional connectivity associated with somatic symptoms in mood disorders.
- R57** Banellis L et al. Interoceptive ability is uncorrelated across respiratory and cardiac axes in a large-scale psychophysical study.
- R58** Hallett M et al. Functional neurological disorder: new subtypes and shared mechanisms.
- R59** Lowe B et al. Persistent physical symptoms: definition, genesis, and management.
- R60** Henningsen P et al. Persistent Physical Symptoms as Perceptual Dysregulation: a neuropsychobehavioral model and clinical implications.
- R61** Ashar YK et al. Effect of Pain Reprocessing Therapy vs Placebo and Usual Care for Patients With Chronic Back Pain.
- R62** Hashmi JA et al. Shape shifting pain: chronification of back pain shifts brain representation.
- R63** Borsook D et al. Reward deficiency and anti-reward in pain chronification.
- R64** Raizen DM et al. Beyond the symptom: the biology of fatigue.
- R65** Stover PJ et al. Neurobiology of eating behavior, nutrition, and health.
- R66** Uchida Y et al. Heterogeneous appetite patterns in depression: computational modeling of nutritional interoception, reward processing, and decision-making.
- R67** Murphy J, Brewer R, Catmur C, Bird G. Interoception and psychopathology: a developmental neuroscience perspective.
- R68** Filippetti ML. Being in Tune With Your Body: the emergence of interoceptive processing through caregiver-infant feeding interactions.
- R69** Montirosso R, McGlone F. The body comes first: embodied reparation and the co-creation of infant bodily-self.
- R70** Fotopoulou A, von Mohr M, Krahe C. Affective regulation through touch: homeostatic and allostatic mechanisms.
- R71** Crucianelli L, Filippetti ML. Developmental perspectives on interpersonal affective touch.
- R72** Schirmer A, Croy I, Ackerley R. What are C-tactile afferents and how do they relate to affective touch?
- R73** Morrison I. Keep Calm and Cuddle On: social touch as a stress buffer.
- R74** Puglisi N et al. Interactive synchrony and infants' vagal tone as an index of emotion regulation.
- R75** Hoehl S et al. A Developmental Framework of Interpersonal Neural Synchrony.
- R76** Coan JA, Sbarra DA. Social Baseline Theory: the social regulation of risk and effort.
- R77** Inagaki TK. Health neuroscience 2.0: integration with social, cognitive and affective neuroscience.
- R78** Cryan JF et al. The Microbiota-Gut-Brain Axis.
- R79** Mayer EA, Nance K, Chen S. The Gut-Brain Axis.
- R80** Bonaz B, Bazin T, Pellissier S. The Vagus Nerve at the Interface of the Microbiota-Gut-Brain Axis.
- R81** Rolls A. Immunoception: the insular cortex perspective.
- R82** Wheeler MA, Quintana FJ. The neuroimmune connectome in health and disease.
- R83** Huerta T et al. Neural representation of cytokines by vagal sensory neurons.
- R84** Chang H et al. Stress-sensitive neural circuits change the gut microbiome via duodenal glands.
- R85** Jameson KG et al. Select microbial metabolites in the small intestinal lumen regulate vagal activity via receptor-mediated signaling.
- R86** Servin-Vences MR et al. PIEZO2 in somatosensory neurons controls gastrointestinal transit.
- R87** Barton JR et al. Enteroendocrine cell regulation of the gut-brain axis.
- R88** Munzberg H, Berthoud HR, Neuhuber W. Sensory spinal interoceptive pathways and energy balance regulation.
- R89** Berthoud HR et al. Hepatic interoception in health and disease.
- R90** Heim N et al. Psychological interventions for interoception in mental health disorders: a systematic review of randomized controlled trials.
- R91** Schoeller F et al. Interoceptive technologies for psychiatric interventions: from diagnosis to clinical applications.
- R92** Lehrer PM, Gevirtz R. Heart rate variability biofeedback: how and why does it work?
- R93** Haruki Y et al. Real-time fMRI neurofeedback boosts heartbeat perception by modulating insula activation during interoceptive attention.
- R94** Ventura-Bort C, Weymar M. Transcutaneous auricular vagus nerve stimulation modulates interoceptive prediction-error processing and allostatic regulation.
- R95** Pinna T, Edwards DJ. A systematic review of associations between interoception, vagal tone, and emotional regulation.
- R96** Farb NAS et al. Interoception, contemplative practice, and health.
- R97** Laukkonen RE, Slagter HA. From many to none: meditation and the plasticity of the predictive mind.
- R98** Coll MP et al. Systematic review and meta-analysis of the relationship between heartbeat-evoked potential and interoception.
- R99** Nikolova N et al. The respiratory resistance sensitivity task: quantifying respiratory interoception and metacognition.
- R100** Legrand N et al. The heart rate discrimination task: estimating accuracy and precision of interoceptive beliefs.

CLOSING NOTE

The body is the ground of the possible

The body is not the enemy of thought and not a hidden oracle beneath it. It is the living system in which thought has to occur. Heartbeat, breath, gut, immune state, pain, fatigue, touch and social context can change the cost of action and the reliability of evidence without determining a person's fate.

The deepest correction is therefore simple. A healthy nervous system is not a system that has learned to remain calm. It is one that can mobilize when life requires mobilization, rest when rest is possible, tolerate uncertainty without one compulsory policy, use other people without surrendering agency, and return after perturbation.

Interoceptive Attractor Capture is offered as a research question inside that broader truth. If repeated prediction, precision and regulatory action can shrink the accessible repertoire, recovery should be visible not only as symptom reduction but as restored transition capacity. More states become reachable. More policies become usable. The same bodily signal stops dictating the same future.

A healthy nervous system is not a calm nervous system. It is a system with somewhere else to go.