

Review Article

Does the MEM Model Explain the "Hard Problem" of Phenomenal Consciousness?

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This article addresses David Chalmers's hard problem of consciousness by asking why information processing is accompanied by a subjective 'what it is like'. Its point of departure is the distinction between intelligence and phenomenal consciousness: the achievements of contemporary artificial intelligence show that reasoning, planning, language, and the accurate description of emotions do not yet constitute evidence of feeling. The Motivated Emotional Mind (MEM) model extends Recurrent Processing Theory by integrating the receptor grounding of sensory modalities, interoception, homeostatic-allostatic regulation, semi-hierarchical representations called semblions, and re-entrant processing. According to MEM's central hypothesis, a phenomenal state is a dynamic, integrated biophysical configuration in which historically grounded sensory content is selected, recurrently stabilised, and coupled to the central representation of the organism's current state. Sensory maps determine the modal quality of experience, whereas interoception gives it bodily-affective and organism-centred anchoring. Semblions link sensory contents with memory, action, and regulatory significance. The mechanism of secondary perception explains how the top-down reinstatement of configurations in lower sensory maps can confer a phenomenal character on memories, mental images, dreams, and hallucinations. MEM thereby distinguishes unconscious feedforward processing from conscious reconstruction, as well as basic qualia from their subsequent recognition and description. On an identity-theoretic account, an appropriately organised biophysical state does not produce a separate quale but is the experience itself, apprehended from first- and third-person perspectives. The hard problem is thus reformulated as an empirical question concerning the necessary and sufficient conditions of phenomenality. The article proposes tests involving disruption of re-entry and interoceptive coupling, formalisation of semblion dynamics, and the construction of embodied artificial systems. MEM is presented as a falsifiable research programme whose full assessment requires experimental confirmation. It also addresses the modal, knowledge, zombie, and inverted-spectrum objections by combining MEM with the phenomenal concept strategy, and it

compares MEM with the affective neuroscience of Panksepp and Solms in order to delimit the model's originality and empirical commitments.

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1. Introduction: From Cognitive Functions to 'What It Is Like'

Chalmers^[1] called those problems of consciousness that concern the explanation of functions 'easy': discriminating stimuli, integrating information, directing attention, controlling behaviour, producing verbal reports, and using data in reasoning. The term 'easy' does not mean that these problems are technically simple. It means only that we know the kind of explanation we seek: a computational, neuronal, or functional mechanism that performs the operation in question. The hard problem arises when we ask why the performance of these functions is accompanied by experience: the redness of red, the painfulness of pain, a taste, a smell, fear, pleasure, or the presence of one's own body.

The distinction between function and experience has a long history. Turing^[2] proposed replacing the unproductive question 'Can machines think?' with an operational investigation of their behaviour in the imitation game. He did not claim that successfully imitating a human being proves the existence of experience; rather, he showed that linguistic and reasoning abilities can be assessed without first resolving the metaphysics of mind. Newell and Simon^[3] formulated the physical symbol system hypothesis, according to which the manipulation of appropriately organised symbols is necessary and sufficient for general intelligent action. Fodor^[4] developed a computational conception of mental representation, while Marr^[5] distinguished the levels of the computational problem, the algorithm, and physical implementation. Legg and Hutter^[6], in turn, proposed a general definition of intelligence as the ability to achieve goals across a wide range of environments. The common message of these works is not that the brain is simply a computer, but that information processing, inference, and planning can be described independently of the question of phenomenal feeling.

Contemporary artificial intelligence has given this programme experimental force. GPT-4 achieved very high scores on professional and academic tests and combined text analysis with image analysis^[7]. GPT-4o processes text, images, and speech within a single system, conducting spoken dialogue with latency approaching that of natural conversation and recognising elements of visual scenes^[8]. Gemini 1.5 demonstrated the ability to work with very long multimodal contexts encompassing documents, audio

recordings, and video^[9]. AlphaGeometry combined a neural model with a symbolic deduction engine and solved 25 of 30 Olympiad geometry problems, approaching the average performance of a gold medallist^[10]. Its successor, AlphaGeometry2, surpassed the average gold-medallist level in 2025 on an expanded set of geometry problems^[11]. Robotic systems are increasingly capable of integrating language, vision, and action. Gemini Robotics, a vision-language-action model, performs complex manipulations, responds to novel instructions, objects, and environments, and can be adapted to different robotic embodiments^[12].

These results justify describing such systems as intelligent in an operational sense. They can learn regularities, transfer knowledge, select means appropriate to an end, solve novel tasks, correct their responses, and communicate reasons. They perform many activities for which humans draw on intelligence. It does not follow that machine intelligence is identical to human intelligence. Human intelligence develops within a single organism through continuous sensorimotor, social, and emotional learning; it is constrained by bodily needs, autobiographical memory, vulnerability to damage, and the organism's own regulatory goals. The intelligence of contemporary models, by contrast, is distributed across training data, architecture, external tools, and user instructions. It may exceed human intelligence in memory breadth and computational speed while remaining less reliable in extended tasks, online learning, the sustained maintenance of goals, and physical action in changing environments. These differences concern the organisation of intelligence, however, and do not yet determine whether it is accompanied by phenomenal consciousness (PC), as it is in humans.

The aim of this paper is not to present the complete Motivated Emotional Mind (MEM) model, which was set out in the book *Reductive Model of the Conscious Mind*^[13] and in a series of subsequent publications. Many important elements of MEM theory are therefore presented here in abbreviated form. A detailed account of the semi-hierarchical architecture of memory and of the formation and association of neuronal representations is provided in the aforementioned book. The relationship between distributed representations and concept cells is described in Galus^[14]. The identity of mental and neuronal states and their causal efficacy are developed by Galus^{[15][16]}. The formation of words, metaphors, and abstract and mathematical concepts is discussed by Galus^{[17][18]}. The mechanism of secondary perception and the receptor grounding of qualia are presented in Galus^[19], a complete physicalist proposal in Galus^[20], and a model of thinking, planning, and response inhibition through higher-order associations in Galus^[21]. The mechanisms, processes, and functions of MEM invoked in the following sections should be read as

pointers to these more extensive treatments, rather than as insufficiently described or unsupported assertions.

This concise description of the model will serve as the theoretical core for discussing whether MEM can explain what phenomenal states are and how and why a biological system not only processes information but also feels it. MEM extends Lamme's Recurrent Processing Theory by adding embodiment, interoception, homeostatic valuation, hierarchical representations called semblions, and a mechanism of secondary perception. Justifying so strong a thesis requires a proper understanding of the word 'explains': MEM does not provide a deductive proof that every possible form of consciousness must have its architecture. It instead proposes a physical mechanism and an identity of states which, if confirmed, remove the need to postulate an additional transition from physical states to psychological experiencing and feeling.

2. Machine Intelligence and the Appearance of Phenomenality

The most compelling reason for separating intelligence from feeling is that machines perform an increasing range of cognitive tasks without providing independent evidence that they possess feelings. Language models conduct extended conversations, explain concepts, analyse arguments, recognise irony, intentions, and false beliefs, generate images, and describe scenes. In a study by Strachan et al.^[22], GPT-4 matched or exceeded human performance on several theory-of-mind tasks, although it displayed characteristic weaknesses in recognising faux pas. This result demonstrates advanced reasoning about other agents' mental states, but it does not show that the model possesses the same mechanism of social-propositional understanding as a human being.

Tasks concerning emotions are even more striking. Schlegel, Sommer, and Mortillaro^[23] found that six language models gave correct answers to approximately 81% of items, on average, across five ability-based emotional-intelligence tests, compared with human averages of approximately 56% in validation studies. The models accurately identified regulatory strategies, predicted the protagonists' likely emotions, and generated new items of a quality comparable to materials prepared by psychologists. In medicine, chatbot responses have sometimes been rated as more empathetic than physicians' shorter answers, although the result depended on the material, criteria, and method of assessment^{[24][25]}. Such achievements encourage anthropomorphism: if a system names subtle feelings, responds tactfully, and adjusts its tone, it is easy to conclude that it too must feel something.

This conclusion is unwarranted. Emotional competence can mean at least three different things: recognising linguistic and expressive patterns associated with emotions, predicting human behaviour, and actually experiencing an affective state. The first two can be tested externally; the third requires a theory linking the organisation of a system to phenomenality. An LLM can correctly complete the sentence 'The loss of a loved one usually causes...' by exploiting the statistical and semantic structure of its data, just as it can describe the taste of a fruit without tasting it. Fluent use of first-person expressions such as 'I am sorry' and 'I am afraid' is part of learned conversation and does not constitute an introspective report unless we know the mechanism that generates the reported experience.

The most extensive analysis of indicators of consciousness in AI, undertaken by Butlin and a large team of researchers^[26], did not judge any of the contemporary systems examined to be conscious, although the authors identified no fundamental technical barrier that would prevent future systems from satisfying their neuroscience-derived criteria. This is a cautious position: it does not prove that machine consciousness does not exist, but it rejects inferences based solely on linguistic fluency. From the standpoint of MEM, the crucial deficiency of typical LLMs is not so much an 'insufficient number of parameters' as a lack of embodiment, and hence the absence of an organism whose state has intrinsic value for the system and which possesses accessible regulatory variables. Such systems lack rich interoception and the recurrent reinstatement of contents in receptor-grounded sensory maps.

Historically, the difficulty of explaining qualia has favoured dualism. Descartes separated thinking substance from extended substance, leaving the problem of their interaction unresolved^[27]. Chalmers^[1]^[28] now defends naturalistic property dualism: phenomenal facts do not follow logically from physical facts, although they may be connected to them by psychophysical laws. Panpsychism distributes rudimentary forms of experience among the fundamental constituents of reality, but confronts the problem of combining them into a single subject. Quantum theories such as Orch-OR are not necessarily forms of substance dualism, but they invoke mechanisms whose sufficiency for phenomenal experience remains contested. These positions share the assumption that ordinary neuronal processing cannot be identical to feeling. MEM challenges precisely this assumption: not every form of processing is phenomenal, but, as argued below, certain receptor-grounded and recurrently reinstated biophysical states may be experiences themselves rather than merely their causes or correlates.

3. From Interoception to Feeling: The Regulatory Core of Phenomenality

A natural starting point for analysing phenomenal states is the sensing of one's own organism through interoception (rather than sensations supplied by the external senses, or exteroception). Homeostasis comprises processes that maintain vital variables within ranges compatible with continued functioning: temperature, blood pressure and composition, glucose levels, oxygenation, hydration, acid-base balance, and tissue integrity. Allostasis extends this regulation by incorporating prediction: the organism changes its parameters before a demand arises, mobilises energy, regulates circulation, and prepares context-dependent behaviour. Interoception encompasses the detection, transmission, and central representation of signals from the organs, blood vessels, immune system, smooth muscles, and the body's chemical milieu.

The examples are elementary but illustrative. Decreased osmolarity and fluid volume initiate thirst-related processes; changes in glucose concentration, gut hormones, and visceral signals influence hunger and satiety; chemoreceptors respond to CO₂ and O₂ levels, and mechanoreceptors to the distension of the lungs, stomach, and blood vessels. Nociception signals potential or actual damage, although pain is not a simple copy of nociceptor activity. These systems operate largely unconsciously. Only some complex configurations are integrated, recognised, and felt as breathlessness, palpitations, nausea, tension, hunger, fatigue, pain, calmness, or pleasure, that is, as different classes of phenomenal feeling.

This account continues the James-Lange perceptual theory of emotion. James^[29] and Lange^[30] reversed the commonsense causal order: we do not tremble solely because a conscious feeling of fear has already arisen; experiencing bodily changes helps constitute what we call fear. It would nevertheless be unwarranted to identify every emotion with a unique and invariant pattern of peripheral responses. Contemporary evidence supports a weaker but well-founded core of the theory: interoception is an important component of emotional experience, operating together with appraisal, memory, and context^{[31][32]}. Most emotional episodes and many affective states are accompanied by a complex, multidimensional, and partly overlapping profile of bodily changes and their interoceptive representation, which is linked to memory, situational appraisal, and cognitive representations^{[33][34][35]}. Early affective responses may occur without conscious and elaborate cognitive appraisal. The conscious recognition, differentiation, and naming of emotions, however, depend on integrating bodily signals

with information about the situation. This process is implemented by distributed cortical-subcortical systems, including the insula, cingulate cortex, amygdala, thalamus, and prefrontal regions, rather than exclusively by the cortex's 'cognitive layers'. fMRI studies have shown cooperation between representations of bodily state and appraisals of emotional state, together with partially shared involvement of the anterior insula^[36].

Experiments that manipulate bodily signals rather than merely measuring correlations are especially important. Hsueh et al.^[37] used optogenetic stimulation to accelerate the heart rate of mice. Tachycardia was not unconditionally aversive in itself, but intensified anxiety-like behaviour in a risky environment. The finding supports a two-factor interpretation: a bodily signal increases affective readiness, but its significance depends on the situation. Damasio and Damasio^[38] regard homeostatic feelings as a central component of the biology of consciousness because they relate mental contents to a particular living owner. MEM follows a similar path but situates feelings within a broader architecture of memory, action, and re-entry. A still closer comparison is provided by the affective neuroscience of Panksepp^{[39][40]} and Solms^{[41][42]}, which assigns constitutive importance to evolutionarily ancient homeostatic-affective systems; Section 9 examines both the convergence and the remaining differences.

Can one therefore logically assert that 'there is no feeling without sensors'? In a broad sense, the claim appears true: for the system to discriminate one of its states, there must be a process sensitive to the relevant difference. If a new organ or molecular mechanism were discovered that supplied a signal about the state of the body, we would call it a sensor or a component of a sensory system. Any process that contributes to experience could be called a detector after the fact. We avoid tautology by assigning neuroscience, psychology, and biophysics the task of determining where the sensor is located, what it detects, and when its activity is sufficient for the system to feel the states monitored by that process.

This raises the question of whether ongoing stimulation of peripheral receptors is necessary for every experience. Phantom pain is felt in a non-existent limb; direct electrical stimulation of the brain can elicit bodily and emotional feelings; and imagining a threat can produce tension and fear in the absence of a current external stimulus^{[43][44]}. In post-amputation phantom pain, surviving sensory-nerve fragments, neuromas, and the cell bodies of primary afferent neurons in the dorsal root ganglia may generate spontaneous ectopic discharges. These impulses travel along former sensory pathways to preserved somatotopic representations and may be experienced as originating in the missing limb. Evidence includes recordings of activity in transected nerves, the suppression of phantom pain by blocking nerves or dorsal root ganglia, and the induction of somatotopic phantom sensations through electrical

stimulation of surviving afferent fibres^{[45][46][47][48][49]}. It is also reasonable to posit a dynamic peripheral-central loop in which peripheral ectopic impulses, spinal sensitisation, preserved limb maps, and re-entrant brain activity sustain one another.

This does not refute receptor grounding. It shows that grounding can be historical and structural, and can operate through preserved sensory pathways: the brain reinstates a configuration shaped by the prior cooperation of receptors, the body, and action; in some cases, pathological impulses arising in former afferent neurons can reactivate that configuration. A more accurate thesis is therefore that phenomenal quality requires the realisation or reinstatement of a state in a detection-sensory system whose organisation was shaped by the discrimination of external stimuli or internal states. Receptors are necessary for the emergence and calibration of a modality, but they need not be activated on every occasion of recall, hallucination, or phantom pain.

Not every activation of a receptor or interoceptor becomes a conscious feeling. In MEM, a phenomenal feeling arises when stimulation produces a sufficiently strong, extensive, coherent, and enduring configuration of activity in lower sensory or interoceptive fields; when this configuration is neither extinguished nor masked; when it activates the corresponding semblion through feedforward processing; and when it is subsequently reinstated and stabilised by re-entrant processing. In direct perception, this process remains initiated and constrained by current receptor signals, whereas in memory, imagination, dreaming, or hallucination, the configuration may be reconstructed top-down in maps previously shaped by sensory experience. This is what distinguishes unconscious homeostatic monitoring from felt hunger, unconscious circulatory modulation from conscious palpitations, and nociception from pain.

If a state organised in this way reaches the level of conscious perception, its modality-specific realisation is, according to the MEM identity hypothesis, the phenomenal feeling itself, rather than merely information about that feeling. All sensory states that satisfy these conditions are therefore consciously felt, although most ongoing receptor activity does not meet them. MEM does not assume that phenomenal consciousness is an all-or-none property or that human consciousness is its sole standard. A minimal episode may be brief, weakly integrated, and restricted to a single modality; the richness of experience increases with the receptor repertoire, the depth of the hierarchy, the reach of reconstruction, the number of associations, and the ability to relate content to the organism's state. The consciousness of a shrimp, a bird, an octopus, and a human may therefore differ in both content and dynamics. An open set of possible sensors does not make the theory arbitrary: the relation among the physical

discrimination of change, a learned modal map, recognition, re-entry, and the regulatory significance of the state for the system remains invariant.

4. From Action to Quale: The Associative Attribution of Sensory Meaning

In MEM, direct perception begins with transduction. Receptors convert physical or chemical differences into bioelectrical and biochemical activity. The pattern is mapped in lower sensory fields, after which a feedforward sweep (FFS) propagates it towards higher layers. Successive stages extract features, compare them with stored patterns, categorise them, and select the representation that best matches the current configuration. MEM calls these multilevel representations *semblions*. They may integrate exteroceptive, interoceptive, mnemonic, motor, and symbolic components^{[13][14][15][21]}. A *semblion* is neither a single neuron, nor a local 'address' of a concept, nor a label for arbitrary integration. It is a learning-generated fragment of an overlapping, semi-hierarchical network: lower sub-*semblions* retain modality-specific features, while higher levels combine them into representations of objects, actions, events, words, ideas, and models. The same neuron or sub-*semblion* may participate in many larger structures, allowing knowledge to be compressed and reused. Ascending connections support recognition and generalisation, lateral connections support association, and descending connections support reconstruction. Dynamic *semblions* also make it possible to preserve the order of events and phonemes. This architecture, together with the rules governing its learning and co-activation, is described more fully in Galus and Starzyk^[13] and Galus^{[50][14][18]}.

Pattern matching itself may remain unconscious. An organism recognises a stimulus in the functional sense if it initiates an appropriate response, but it need not experience the stimulus phenomenally. Sensory quality arises in the lower, modality-specific part of the representation, whereas recognition and propositional knowledge are associated with higher layers. A crucial distinction must therefore be maintained: the quale of red is neither the name 'red' nor a judgement about wavelength. It is the mode of discriminating a particular configuration in a receptor-grounded visual map. Fear is not merely the proposition 'the situation is dangerous', but the felt interoceptive component associated with that appraisal.

'Perception as the Essence of Phenomenal Consciousness'^[19] describes the formation of qualia through closure of the perception-action-outcome loop. A system touches, moves, grasps, avoids, or consumes an

object. Its receptors register not only the object's initial properties but also the consequences of the response. Interoception signals whether those consequences improved or worsened the regulatory state. Repetition, or a single biologically powerful coincidence, binds the sensory pattern to the motor outcome and its affective value. Slipperiness is thus not an abstract coefficient of friction; it is a discriminable configuration of touch, slippage, muscle tension, failed grip correction, and consequences for the goal of action. Sourness, pungency, warmth, weight, and pain acquire a similarly embodied content.

It does not follow that affect constitutes the entirety of exteroceptive quality. Colour remains a quality of a visual configuration, and pitch a quality of an auditory configuration. Affect gives them organism-centred significance: it indicates whether an object is beneficial, threatening, desirable, neutral, or requires further exploration. In a particular episode, visual redness may be linked to the taste of ripe fruit, a threat signal, the memory of a flag, or aesthetic pleasure, but these associations are not what makes it red. MEM preserves the distinction between modal content and valuation while explaining their conjunction within a single semblion.

The learning of such associations has a material basis. Long-term synaptic potentiation, dendritic-spine remodelling, changes in postsynaptic receptors, astrocytic regulation, and modifications of gene expression are among the best-documented candidate mechanisms of memory and plasticity^{[51][52][53][54]}. Galus advances further, although less firmly established, hypotheses concerning the consolidation of patterns through ion-channel protein conformations, ephaptic coupling, and extensive neuron-astrocyte memory within a neuroelectrodynamic framework^{[55][56][15]}. A weaker assumption is sufficient for MEM: through biophysical association, co-occurring sensory, interoceptive, and motor pathways durably alter the probability of their joint reactivation.

The process can be presented in six steps. First, a sensor discriminates an event. Second, the FFS constructs a multilevel representation, compares it with memory patterns, and enables recognition^[13]. Third, a response changes the organism-environment relation. Fourth, exteroception and proprioception register its outcome, while interoception registers the change in well-being. Fifth, plasticity binds these components into a representation of the event and, at the highest cognitive levels, into a model of reality. Sixth, re-entry stabilises the selected configuration and makes it available again for recognition through secondary perception. This cycle produces a state that is simultaneously discriminable at the sensory level, meaningful to the organism, and capable of influencing future action.

In MEM, binding the components of a percept is not reducible to the passive registration of co-occurring activations. The outcomes of action, registered by exteroception, proprioception, and interoception, influence the consolidation, strength, and subsequent accessibility of representational pathways. An object is thereby represented not only as a recognisable configuration of features but also as a source of possible actions and their anticipated consequences for the organism. The representation thus acquires functional and organism-centred meaning.

Linguistic concepts can arise on the same basis. A semblion representing a sequence of sounds, a graphic inscription, or a gesture becomes associated with the multimodal semblion of an object, action, property, or relation. Subsequent processes of categorisation, generalisation, information compression, and analogy-finding enable the formation of metaphors, abstract concepts, and mathematical constructs. The transition from sensations and percepts to language and models of reality is developed in detail in Galus^{[17][18]}, whereas its relation to motivated learning, thinking, goal-setting, and action is discussed by Galus^[21], Starzyk^[57], and Starzyk et al.^[58].

Does this account explain the quale, or merely the functions it performs? The answer depends on the ontology adopted. If one expects an additional psychophysical law explaining how neuronal activity is 'transformed' into the non-material quality of red, every physicalist model will appear incomplete. MEM rejects, however, the very assumption that such a transformation must occur. According to the proposed identity hypothesis^[15], a recognised, receptor-grounded, and recurrently stabilised biophysical configuration does not become an experience only through some transition mechanism; it is that experience, immanently apprehended from the first-person perspective. The explanation therefore consists in identifying why the configuration has a particular modality, which sensory differences it encodes, how it was shaped and calibrated through sensorimotor experience, and why it became associated with a particular value for the organism. When we see a blue sky, we not only distinguish its colour from other colours but also attribute it to a particular object or region of the scene, apprehend its spatial relations, and may activate related memories, associations, and affective responses. The quale of blue is not, however, the sum of those judgements and associations. It is the modality-specific mode in which a recognised configuration is realised within a receptor-grounded and recurrently activated visual system.

Within this ontology, no additional non-physical phenomenal component is required. What remains necessary is empirical evidence that the processes identified by MEM are indeed necessary or sufficient for particular forms of experience.

5. Secondary Perception: What Is the Source of Phenomenal Memories, Mental Images, Dreams, and Hallucinations?

Classical theories of perception have focused primarily on the relation between a current stimulus and experience. Pautz^[59] classifies the possible positions as sense-datum theory, internal physical-state theory, representationalism, and naïve realism. Naïve realism emphasises the direct presence of the object in experience. Representationalism explains experience in terms of the content of an internal representation. Sense-datum theories posit qualitative data as the immediate objects of awareness, whereas physicalist positions identify experience with a state of the nervous system. Each of these approaches encounters the problem of experiences that occur without a corresponding object of perception: dreams, memories, hallucinations, and voluntary imagery.

Recurrent Processing Theory correctly identified that conscious vision depends not only on unidirectional flow from the retina towards higher regions, but also on recurrent activity among visual areas^{[60][61]}. The mere fact of recurrence does not, however, explain what makes a process phenomenal. MEM supplements RPT with the hypothesis of secondary perception. Activation of a higher layer of a semblion, whether by a word, intention, memory, dream, or hypothesis, propagates backwards to lower sensory and interoceptive maps. The reinstated configuration then enters another feedforward cycle, is recognised anew, and may recruit the associated affect. What is remembered is therefore not merely a declaration in semantic memory; it may reacquire an appearance, sound, touch, and emotional tone.

Secondary perception is not simply another name for feedback. The distinctive feature of MEM's proposal is that it identifies the entire causal cycle. Activation at a higher level of a semblion does not merely modulate an earlier field; it reinstates a modally specific configuration of activations in lower maps. This configuration then becomes the input to a new feedforward pass, is recognised again, and may reactivate the associated affect. Only the sequence of top-down activation, reconstruction, and renewed recognition constitutes secondary perception. A single mechanism can thus encompass recall, imagination, dreaming, hallucination, inner speech, and the emotional simulation of the future. The detailed argument distinguishing this procedure from the general concept of feedback is presented in Galus^{[16][19][21]}.

Visual imagery provides substantial evidence. Activity patterns during perception and imagery partially overlap; information about the content of an imagined object can be decoded from early visual cortex,

and information flow during reconstruction from memory reverses the direction typical of perception^[62]^[63]. Dijkstra's review^[64] indicates that early visual cortex is particularly associated with fine, spatially precise details of imagery, whereas higher-level regions represent more invariant and semantic content. Not all acts of imagery engage V1 to the same extent; its contribution depends on vividness, the task, and the required resolution. The evidence therefore supports re-entry, but not the simplistic thesis of a single 'screen' of consciousness.

Secondary perception also encompasses affective states. Imagining a threat may increase heart rate, skin conductance, and muscle tension. Remembering a person may reinstate their face and voice while simultaneously restoring a sense of safety, shame, or longing. In MEM, this involves a double reconstruction. Descending activity reinstates sensory maps but may also elicit an autonomic bodily response, whose consequences are read anew by interoception. Emotional imagery is therefore not merely an 'image of an emotion'. It is a loop in which a representation of a situation modifies the body, the body supplies a new signal, and the system secondarily feels the consequence of its own simulation.

This architecture also explains planning. Deviations from allostasis generate priority and motivation. Higher layers can withhold an automatic response, reconstruct possible scenarios, and anticipate their consequences at two levels: propositional and affective. The first answers the question 'What is likely to happen?'; the second, 'How will this outcome affect the system?' Intuition may consist partly in the rapid, weakly verbalisable reinstatement of an associated affective profile before the detailed grounds are presented in inner speech. This does not prove that every intuition has such a mechanism, but MEM offers a way of linking 'good-bad' appraisals to a concrete history of embodied learning.

Associations at the highest, cognitive level need not merely reinforce the first available response. They may inhibit its execution, maintain a goal in an active state, and activate alternative scenario semblions. Their predicted outcomes are reconstructed both propositionally and sensorily-affectively, and are then compared with current needs and knowledge. From this perspective, thinking can be described as a controlled sequence of semblion activation, reconstruction, and selection; inner speech is one instrument of this sequence, not its immaterial vehicle. Creativity arises through linking distant sub-semblions, transferring relational structure between domains, and motivationally selecting a novel configuration. The mechanism of response inhibition, planning, and the phenomenal aspect of thought is developed in Galus^[21], and the neuronal basis of metaphor and analogy in Galus^{[17][18]}.

6. Does MEM Really Solve the 'Hard Problem'?

Three standards of explanation must first be distinguished. A correlational explanation identifies the activity of a particular region that accompanies a given experience. A mechanistic explanation sets out the elements, their organisation, and the process that produces a system's capacity. A constitutive explanation specifies what a particular state is. In consciousness research, merely identifying a neural correlate does not remove the 'hard problem'. MEM aspires to the latter two standards: it describes the mechanism of receptor grounding, valuation, and re-entry, and then identifies selected states of that mechanism with phenomenal experience.

These standards clarify what a defensible identity theory must accomplish. It must identify the material state that is a feeling, explain the differentiation of sensory qualities, and show why a complete third-person description does not replace first-person realisation. This is the challenge posed by the explanatory gap^[65], Kripke's modal argument, Jackson's knowledge argument, and the thought experiments involving zombies and the inverted spectrum. MEM offers a constitutive answer: the phenomenal 'what it is like' is a specific, receptor-grounded brain-body configuration, recognised within associative memory, recurrently reinstated, and coupled with interoception. Receptor stimulation initiates this organisation; conscious experience requires its discrimination and incorporation into multicyclic perception.

Kripke^[66] observes that, if 'pain' and 'C-fibre stimulation' are rigid designators, a true identity between them should be necessary, although pain without such stimulation appears conceivable. MEM's candidate is the complete configuration comprising nociceptors and interoceptors, sensory pathways and maps, recognition, recurrence, and the organism's regulatory state^[15]. Conceiving pain without 'C-fibres' may therefore reflect an unduly narrow physical description rather than a separation of experience from its complete realiser. Chalmers's physical zombie would have to duplicate this dynamic as well; attributing an absence of experience to it would presuppose the falsity of identity. An inverted spectrum with identical behaviour remains possible when receptors, maps, or learning histories differ. If all relevant material configurations are identical, the assumption of different qualia again becomes a premise rather than the conclusion of the argument^[28].

The knowledge argument maintains that Mary, despite knowing every physical fact about colour vision, learns for the first time what red looks like^[67]. The phenomenal concept strategy explains this novelty as the acquisition of a distinctive mode of access to the same physical property. Loar^[68] describes a

recognitional concept acquired through experience, whereas Papineau^[69] proposes a concept employing a sensory or imaginative template. Their use of the word concept therefore includes a non-verbal capacity to recognise or recall a type of experience. This makes it possible to defend physicalism against the inference that an epistemic difference establishes ontological dualism.

The phenomenal concept strategy does not, however, specify the mechanism: where the pattern is stored, how current stimulation is compared with it, or how the modal quality of a memory is restored. In MEM, a concept is a compressed representation available for categorisation, reasoning, and association with a word, and therefore belongs to access consciousness. A quale is a felt sensory state that may precede language and developed conceptualisation. This distinction preserves Loar's and Papineau's insight concerning two modes of access while assigning a specific biophysical realisation to recognition and recall. It also addresses the objection that 'phenomenal concepts' merely relocate the explanatory gap to a special form of cognitive access^[70].

A stimulus acting on exteroceptors, proprioceptors, or interoceptors produces transduction and a distinctive spatiotemporal configuration of activity in lower sensory fields. This receptor-grounded configuration provides the basis of elementary quality, while its modality depends on the type of sensors, pathways, and maps involved. The ascending Fast Feedforward Sweep (FFS) compares the configuration across successive layers with patterns consolidated during learning. Repeated co-activations form semblions: multilayered representations linking sensory features, categories, context, value, and possible responses. Competition among activated semblions selects the pattern that best matches the current signal^{[13][15][16]}. A quale arises as the recognised, felt modal state; differences among qualia correspond to differences among stimulations and their consolidated configurations.

Categorisation and generalisation compress the multidimensional percept. A higher layer may contain a small neuronal population functioning as an index to a distributed semblion; it does not 'store' the entire image or quale. Connecting this index with a word semblion permits the percept to be named and used in reasoning. The construction of these representations, the relation between distributed and sparse coding, and the neuronal realisation of words are developed more fully by Galus^{[14][18]}.

Signals from higher layers subsequently return to intermediate and sensory layers. Re-entry reinstates the modal components of the selected semblion, supplements the percept with memory content, and supplies input to another FFS. Repeated cycles constitute secondary perception: a mechanism for recognising a current stimulus, remembering, and imagining through renewed activation of receptor-

shaped maps. A memory is therefore a reconstruction, and its vividness depends on the depth and fidelity of reactivation. Descending activity may simultaneously reactivate interoceptive representations, allowing the percept to acquire beneficial, harmful, or ambivalent value. Interoception realises feelings and affective states, while its learned associations with exteroceptive content co-constitute the complete experience and influence response selection. FFS, re-entry, secondary perception, and the relations among perceptual, executive, and reporting consciousness are developed in earlier MEM publications^[15]
^{[16][19][20][21]}.

Mary's case can now be described without positing a separate phenomenal property. Before leaving the room, her knowledge is realised by semblions of theories, propositions, and models of colour vision. She lacks not another proposition about red but the actual stimulation of the relevant modality. Her first exposure to red elicits a new relative pattern of cone activation and activity in subsequent components of the visual pathway. FFS recognises the difference, learning consolidates or modifies a semblion, and re-entry permits the quality to be reinstated later in memory and imagination. Mary associates the new state with the already familiar word 'red'. She thereby acquires a new quale, a new sensory discrimination, and new mnemonic capacities; she does not discover an additional non-physical property. The epistemic novelty is acquaintance through realisation: for the first time, the system enters a state that it had previously represented only symbolically.

A stimulus, transduction, and neural activity can be described verbally or mathematically with increasing precision. Such a description cannot convey the feeling to someone who has never realised the relevant configuration. Names, physical magnitudes, and causal relations define the conditions of stimulation; the quality of the experience can be communicated only indirectly, by comparison with experiences already known to the recipient. Metaphors and analogies can reactivate similar semblions only in a recipient with the appropriate sensory history. This difference can be expressed as $D(B) \neq B$: the symbolic description of a biophysical state is a different material operation from the state itself. It does not follow that $B \neq Q$. The MEM thesis is $B = Q$: the appropriately organised receptor, neural, and interoceptive configuration is the feeling, rather than its cause or its representation.

MEM thus strengthens identity theory by replacing a general 'capacity to recognise and recall' with a sequence of processes open to investigation. Its adequacy will be decided by evidence showing whether the proposed components are necessary and jointly sufficient, and whether differences among qualia systematically correspond to differences in receptors, maps, recurrence, and interoception. Identity so formulated is an empirical hypothesis rather than a conceptual declaration. The gap between description

and experience remains a difference in realisation and route of access; it does not by itself establish an ontological gap.

This account remains subject to four connected requirements.

First, the sensory claim must be specified precisely enough to be falsifiable: for each proposed feeling, the relevant physical variable, receptor or central detector, target map, recurrent pathway, and predicted consequence of disruption should be identified. The concept of a sensor would lose explanatory force if it were extended to every neuronal activation. Box 1 illustrates the required decomposition for the apparently simple experience of grasping a slippery object.

Three principal classes of sensors cooperate when a slippery object is grasped. Exteroceptors and proprioceptors enable the detection of slippage and correction of grip force, whereas interoceptors provide information about effort and the state of the organism.

1. Exteroceptors-detect the object and its slippage

- Mechanoreceptors in the skin of the hand and fingers register pressure, texture, skin stretch, vibration, and microslippage of the object.
- Retinal photoreceptors provide information about the object's position and movement.
- Thermoreceptors and nociceptors signal its temperature, excessive pressure, or the possibility of skin damage.

Slipperiness is not detected by a single specialised receptor but is recognised from combined information about friction, vibration, skin stretch, and displacement of the pressure field.

2. Proprioceptors-provide information about hand position and the force produced

- Muscle spindles signal muscle length and the rate at which it changes.
- Golgi tendon organs provide information about muscle tension and grip force.
- Joint receptors and mechanoreceptors in deep tissues specify the positions of the fingers and wrist and the direction of the forces acting upon them.

3. Interoceptors-provide information about the state of the organism

- Group III and IV muscle afferents signal effort, fatigue, and metabolic changes.
- Baroreceptors, chemoreceptors, and receptors in the respiratory and circulatory systems provide information about changes in pressure, breathing, and autonomic arousal.

Their contribution increases when the object is heavy, the grip is maintained for a long time, or the situation is accompanied by emotional tension.

4. How grip correction proceeds

Cutaneous receptors detect microslippage, and the motor system automatically increases the force exerted by the finger muscles. Proprioceptors assess the effectiveness of the correction, vision and touch confirm that the object has been stabilised, and interoception signals effort, fatigue, and the significance of the situation for the organism.

Box 1.

In MEM, this episode comprises the joint activation of tactile and slip representations, the proprioceptive representation of hand position and force, and the interoceptive appraisal of effort and risk. Repeated attempts shape procedural memory and associate the sensory configuration with successful corrections of grip. Slipperiness is consequently felt through the organised activity of the relevant sensors and maps, understood through recognition of the learned semblion, and used in action through its coupling to cognitive and motor structures.

Second, the empirical problem of sufficiency remains distinct from the modal objection. The foregoing analysis blocks the inference from conceivability to metaphysical possibility, but it does not by itself prove that the MEM configuration is sufficient. That claim requires convergent evidence from selective interventions, dissociations, cross-species comparisons, and ultimately constructive tests in artificial systems. A functional imitator lacking receptor-grounded maps, endogenous regulation, and the relevant recurrent dynamics would test functionalism rather than the stronger MEM identity hypothesis.

Third, the model must provide measurable criteria for the unity of experience. At any moment, many sensory maps and visceral signals are active. MEM proposes that an episode is formed by co-active and partly overlapping semblions that share sub-semblions, occupy a common temporal window, compete for maintenance, and are related to the current model of the body and its regulatory state. Lateral and descending connections bind components from different modalities, while re-entry stabilises the selected coalition long enough to affect subsequent recognition and action. The architecture is developed in Galus and Starzyk^[13] and Galus^{[14][21]}, its thresholds, timescale, and neuronal boundaries remain empirical questions.

Fourth, discrepancies between information processing and experience provide critical tests. Blindsight, agnosia, anosognosia, aphantasia, phantom pain, anaesthesia, emotional dissociation, and interoceptive error can dissociate transduction, recognition, reconstruction, valuation, and report. They should therefore reveal which component is responsible for the loss, preservation, or distortion of a particular phenomenal aspect.

Does MEM, then, really solve the hard problem? It offers a solution in the constitutive and reductive sense, conditional on the physicalist identity hypothesis and on the empirical adequacy of the proposed architecture. A phenomenal state and its corresponding biophysical configuration are one state, not two states related as cause and effect^{[71][72][73][74]}. The phenomenal concept strategy explains why this identity is not disclosed by a priori reflection, while MEM specifies the receptor-grounded and recurrent

configuration proposed to realise particular qualities. The account is not an ontology-neutral proof, and its necessity and sufficiency remain to be tested. It nevertheless closes the alleged transition from a physical process to an additional quale: if $B = Q$, no further transformation or causal production is required. In this precise sense, the title of this section states a research hypothesis with determinate empirical commitments rather than a verbal reassertion of identity.

7. Where Are Images Reinstated? From Higher Areas through V1 and the LGN to the Limits of Speculation

A graded reconstruction model is the most plausible. Higher regions store or reactivate more abstract, invariant properties of an object; V2-V4 may suffice for coarse shape, categorical colour, and relations among parts. When a task requires location, contour, size, and fine detail, the contribution of early visual cortex increases. Dijkstra^[64] summarises the evidence as follows: during imagery, the early visual cortex (EVC), including V1 and adjacent fields, represents details in a manner similar to perception, but it is not active in every mental image and is not itself sufficient to explain conscious visualisation.

There is also evidence of LGN activation during imagery together with V1^[75]. The LGN receives extensive cortical feedback, and its responses are modulated by attention and task demands. This supports the hypothesis that, in particularly vivid or precise imagery, reconstruction may extend to the LGN-V1 system^{[20][21]}. It does not, however, justify treating the LGN as an established 'screen' on which an image is displayed. Activation may reflect arousal, selection, expectation, or modulation of information flow rather than the complete reconstruction of a pixel-like scene.

Specific tests are possible. The vividness and content of imagery should be compared after selective disruption of V1, higher visual areas, and corticothalamic connections; laminar fMRI, MEG, and effective-connectivity methods should be used to track the direction of information flow; researchers should test whether demands for fine detail shift reconstruction towards lower fields; and they should examine whether LGN modulation predicts subjective vividness over and above cortical activity.

8. What Is Phenomenal Consciousness Objectively?

Phenomenal consciousness pertains to a system, agent, or organism that responds purposefully to signals from its environment. Let us define the purposiveness of its responses as satisfying the condition of being an intentional entity in Brentano's sense. A wholly unconscious entity will not possess

phenomenal consciousness either. Phenomenal consciousness is a property of a system consisting in its capacity to feel phenomenal states during primary or secondary perception. In light of the preceding sections, let us attempt to define what a phenomenal state is.

MEM definition of a phenomenal state:

A phenomenal state is a dynamic, integrated biophysical state of the whole embodied system in which sensor-grounded modal content is recurrently stabilised and coupled with a suprathreshold interoceptive configuration representing the system's current regulatory state. The modal content may be elicited by an external stimulus, arise within the system, or be reconstructed top-down through recurrent processing.

Exegesis:

1. **The bearer of a phenomenal state is the whole embodied system.** In a biological system, the state pertains to the organism as a whole, rather than merely to the brain or to a central information-processing structure. The brain is indispensable to its integration, but the represented bodily and regulatory condition is partly determined by processes occurring throughout the organism.
2. **A whole-system state is dynamic.** It is determined by the momentary states and interactions of the system's components and changes continuously over time. This does not mean that every component contributes equally or directly to every phenomenal episode. The phenomenal state is constituted by the causally integrated configuration specified in the definition, while the remaining physical state of the system provides its enabling and regulatory conditions.
3. **Sensor-grounded modal content is a physical, modality-specific component of this configuration.** It is not a proposition, semantic description, or internally observed image. Its modal character depends on the organisation of the relevant receptors or internal detectors, sensory pathways, and sensory maps. Different configurations constitute different sensory qualities.
4. **Sensor grounding does not require current peripheral stimulation in every phenomenal episode.** In direct perception, modal content is initiated by ongoing exteroceptive, proprioceptive, nociceptive, or interoceptive transduction. In imagery, memory, dreaming, hallucination, and phenomenal thought, a previously formed sensory configuration may be reinstated centrally. It remains sensor-grounded because the reactivated pathways and maps were shaped by sensory transduction and learning.
5. **Not every signal generated by a sensor becomes part of phenomenal consciousness.** Most sensory and regulatory processing may remain unconscious. For sensory activity to enter a phenomenal state, the relevant configuration must be selected and recurrently stabilised while becoming

integrated with an appropriate interoceptive-regulatory configuration. Subpersonal discrimination of one activation pattern from another should be distinguished from conceptual recognition of an object. Object identification, categorisation, naming, and propositional report belong to further processing associated with access consciousness.

6. Interoceptive coupling means causal integration, not mere simultaneous occurrence.

Exteroceptive and proprioceptive signals may alter autonomic, endocrine, visceral, and motor states, which are registered by interoceptive pathways. Conversely, the current regulatory state influences the selection, persistence, valuation, and behavioural consequences of sensory content. The sensory and interoceptive components thereby form one integrated phenomenal episode.

7. “Suprathreshold” is an operational, not a phenomenally defined, condition. It does not mean “activity that is already felt”. It denotes an independently measurable configuration of interoceptive activity attaining sufficient amplitude, spatiotemporal coherence, and duration to form a central representation of the system’s regulatory state, enter recurrent integration with active sensory content, and influence subsequent regulation, learning, or action. The relevant thresholds remain to be determined experimentally.

8. The interoceptive configuration constitutes the bodily and affective aspect of the state. According to the MEM identity hypothesis, it does not merely inform the system about pleasure, discomfort, arousal, or tension and does not subsequently cause an additional feeling. Considered from the first-person perspective, this configuration is the bodily or affective feeling itself. Its occurrence does not require classification or naming as a particular emotion.

9. Bodily feelings are phenomenal states independently of their classification as emotions. Hunger, thirst, breathlessness, visceral discomfort, pain, burning, pleasure, and tension may derive their modal character principally from interoceptive, somatosensory, or nociceptive pathways. Pain should not, however, be equated with peripheral nociception alone: nociceptive processing may remain unconscious, whereas pain may persist or be reconstructed without current peripheral input, as in phantom pain.

10. Secondary perception explains reconstructed phenomenal content. In memory, imagery, dreaming, hallucination, and conscious thought, top-down re-entry reinstates sensor-shaped configurations in sensory fields. These configurations subsequently enter renewed feedforward processing and may reactivate associated interoceptive states. The resulting multicyclic process constitutes secondary perception. The three sources mentioned in the definition—external,

internal, and reconstructed—are therefore not mutually exclusive and may jointly contribute to one phenomenal episode.

11. **The integrated biophysical configuration is not the cause of a separate quale.** It is the phenomenal state itself, described from the third-person perspective as a configuration of material processes and experienced from the first-person perspective as a particular sensory or affective quality. A verbal or mathematical description can specify the stimulus and the corresponding physical configuration, but it does not instantiate that configuration in the recipient. The difference between description and experience is therefore a difference between describing and physically realising one state, not evidence for two ontologically distinct states.

We can supplement this definition of the phenomenal state with the definition of phenomenal consciousness:

Phenomenal consciousness is the capacity of an embodied system to instantiate phenomenal states of the kind defined above; occurrent phenomenal consciousness consists in their temporally organized and continuously changing integration.

According to the identity hypothesis adopted in MEM, a suprathreshold configuration of interoceptive activation described from the third-person perspective and the corresponding feeling accessible from the first-person perspective are not two distinct phenomena, but two ways of apprehending the same material state. The phenomenal character of perception therefore consists in coupling sensor-grounded content to a suprathreshold interoceptive state which, on the MEM hypothesis, constitutes the bodily-affective aspect of the same integrated configuration.

The proposed explanation does not assume that the phenomenality of perception is derived from another phenomenal state of the same kind. MEM distinguishes the modal-sensory component from the bodily-affective component of experience. The former is grounded in the activity of the relevant receptors and sensory maps, while the latter is grounded in the current configuration of interoceptive processes representing the organism's regulatory state. A phenomenal state is identical not to either component considered in isolation, but to their dynamic, recurrently stabilised, and causally integrated configuration.

A sensory stimulus can be registered, distinguished from the background, compared with stored patterns, and implicitly classified before the subject is capable of consciously recognising its source or describing it propositionally. A sudden flash may therefore elicit an orienting or defensive response even

if the system has not yet identified its cause, colour, or situational significance. In this sense, the recognition required by MEM does not necessarily mean consciously naming the stimulus. At a minimum, it means functionally distinguishing it and matching it to existing patterns in a manner that enables a change in the system's behaviour or regulatory state.

Such implicit detection or categorisation should not, however, be equated with phenomenal experience. Prior to coupling with a suprathreshold interoceptive configuration, there is sensor-grounded modal content that may influence behaviour unconsciously. According to MEM's strong interoceptive hypothesis, a full phenomenal state arises when this content is recurrently stabilised and causally coupled to the organism's current regulatory state. This does not amount to mechanically adding together two already formed experiences. Phenomenal experience is a single systemic state whose different components account for distinct aspects of the experience.

According to the proposed identity hypothesis, this configuration does not cause a distinct, immaterial transition from neuronal processes to experience. The sensor-grounded, recurrently stabilised, and interoceptively coupled biophysical configuration is the phenomenal state itself, described from the third-person perspective as a material process and from the first-person perspective as the particular 'what it is like' of the experience.

9. MEM's Astonishing Hypothesis: Conditions for the Emergence of a Phenomenal State

Francis Crick's hypothesis, presented in *The Astonishing Hypothesis*^[76], was primarily a radically physicalist programme: thoughts, feelings, memory, the sense of identity, and other mental states were to be consequences of the organisation and activity of the material nervous system. This thesis removes the need to postulate a separate mental substance, but it does not by itself identify which states of the nervous system are phenomenal states or why only some neuronal processes have a particular 'what it is like'. It is at this point that MEM seeks to move from Crick's general physicalism to a mechanistic identity hypothesis by integrating the receptor grounding of content, the James-Lange perceptual tradition, interoception, and recurrent processing.

The contemporary work of Antonio and Hanna Damasio is a particularly important point of reference. Damasio and Damasio^{[38][77]} argue that a continuous stream of homeostatic feelings links mental contents to a particular organism and may constitute a fundamental component of consciousness.

Carvalho and Damasio^[78] further identify bidirectional interaction between the nervous system and non-neuronal processes within the body as the physiological basis of feelings. This converges with MEM's strong interoceptive hypothesis but is not identical to it. MEM additionally separates the source of the modal content of experience from its bodily-affective anchoring and specifies a mechanism for the re-entrant reinstatement of content in secondary perception. The modality of colour, tone, or touch is determined by the organisation of the relevant sensory maps, whereas interoception links that content to the organism's current state and interests.

The central hypothesis may be formulated as follows:

In a system with the MEM architecture, a phenomenal state arises when a modality-specific, historically receptor-grounded sensory or interoceptive configuration is currently realised, either bottom-up through receptor activation or top-down through reconstruction, is selected and recurrently stabilised, and simultaneously enters into dynamic coupling with the centrally represented homeostatic-allostatic state of the organism.

According to the MEM identity hypothesis, this integrated biophysical configuration neither causes an additional quale nor is 'transformed' into an experience; it is the phenomenal state itself, described from the third-person perspective as a material process and from the first-person perspective in terms of its particular "what-it-is-like" character.

1. **Modal grounding.** Each modality must possess a physical system that discriminates the relevant class of changes. In direct perception, the configuration is determined by current input from exteroceptors, proprioceptors, or interoceptors. In memory, imagery, dreaming, or hallucination, current activation of peripheral receptors is not necessary, but the reconstructed configuration remains historically grounded in maps shaped by previous receptor experience. Grounding explains why the activity of one system has a visual character and that of another an auditory, tactile, or visceral character; the semantic label 'red', 'pain', or 'bitter' does not itself create that modality.
2. **Selection and re-entry.** The mere detection of a stimulus, its preliminary categorisation, and even the initiation of an appropriate response may occur without consciousness. RPT associates the transition to conscious vision with recurrent activity among sensory regions^{[60][79][61]}. MEM adopts this distinction but gives it a more specific interpretation: the selected configuration is reinstated or maintained in the lower layers of a sensor-grounded semblion and may then again become the input to another feedforward pass. In secondary perception, the direction of initiation is the reverse

of that in direct perception, in agreement with findings concerning reconstruction from memory and mental imagery^{[63][64]}.

3. Interoceptive anchoring in the organism. Sensory content must be coupled to the system's current regulatory state. This does not mean that every consciously perceived colour or shape must be accompanied by a distinct named emotion or intense autonomic arousal. Damasio and Damasio^[38]^[77] note that, in addition to strong feelings of hunger, pain, thirst, or malaise, subtle continuous feelings are associated with maintaining life close to homeostatic equilibrium. In MEM terminology, such a tonic 'background state' may provide minimal organism-centred anchoring, whereas stronger homeostatic deviations or allostatic responses give experience more pronounced valence and motivational force. Research on brain networks indicates a large-scale system linking interoception with allostatic regulation^[80], while predictive models emphasise that interoceptive experience arises from bidirectional interaction between visceral signals and descending predictions^[81]. Evidence for the causal significance of bodily signals is supplied, among other studies, by the experiment of Hsueh et al.^[37], in which changing heart rate modulated anxiety-like behaviour depending on context.

4. Associative binding rather than mandatory conceptual categorisation. An active semblion may bind exteroceptive, proprioceptive, interoceptive, motor, and mnemonic components. A minimal quale does not require conscious recognition of its source, the assignment of a name, or a propositional description. One may feel an unfamiliar smell, unidentified pain, or indeterminate tension. Higher cognitive layers nevertheless become necessary for richer forms of consciousness: object identification, conscious comparison, self-knowledge, planning, inner speech, and report. MEM thereby distinguishes the conditions of a simple phenomenal state from those of access and reflective consciousness.

5. Causal integration with regulation and action. In MEM, a phenomenal state is not a passive addition to a computation. Because it is identified with a particular biophysical configuration, it participates in the same causal network as learning, action selection, regulation, and memory. This does not mean that every conscious content must immediately alter behaviour; a rapid feedforward response may precede conscious reconstruction. It does mean, however, that a felt state may influence subsequent choice, the consolidation of associations, response inhibition, and appraisal of predicted outcomes. The organism learns not only which object it recognised, but also what consequences its encounter with that object had for its state.

The hypothesis formulated in this way avoids several misunderstandings. First, the presence of sensors is not sufficient for consciousness: detection may be entirely unconscious. Second, MEM does not require a unique autonomic 'fingerprint' for each emotion; bodily profiles may overlap and depend on context. Third, the phenomenality of neutral perception does not require a separate emotion to arise; a continuous interoceptive background state may suffice, provided that it is dynamically coupled to the current content. Fourth, intelligence understood as problem-solving is not itself a condition of minimal feeling. Extensive learning, planning, and modelling of reality are, however, conditions of the complex consciousness characteristic of humans and many animals.

In direct perception, the full cycle can be represented as follows: receptor → lower modal map → feedforward processing and semblion selection → coupling with the current interoceptive state → re-entry and stabilisation → renewed recognition and possible correction of action. In secondary perception, the first component is replaced by top-down initiation: activity in a higher mnemonic or cognitive layer reconstructs an earlier configuration in sensory maps and, if sufficiently strong, may also elicit bodily responses whose consequences are again read interoceptively. A memory, mental image, dream, or hallucination may thereby possess a modal character similar to primary perception despite the absence of a current external stimulus.

The MEM hypothesis therefore has clear empirical content. Selective disruption of recurrent reconstruction in lower maps should reduce the vividness and modal precision of experience while relatively preserving some semantic knowledge. Weakening interoceptive coupling should diminish the bodily sense of significance, valence, and motivational force of a percept even when stimulus recognition remains possible. The strongest version of the hypothesis predicts that, below a physiologically defined threshold of central interoceptive coupling, a full phenomenal state will not arise, although some unconscious sensory processing may persist. The value of this prediction lies precisely in its risk: if stable, rich phenomenal experience were found in the complete absence of an appropriate interoceptive representation and recurrent reconstruction, the strong version of MEM would require fundamental revision.

MEM similarly formulates conditions for testing artificial consciousness. A language-only LLM, however intelligent, does not satisfy these conditions merely because it describes emotions accurately. An artificial system would need its own regulatory variables, exteroceptors and interoceptors, modal maps shaped through sensorimotor learning, associative memory linking the outcomes of actions to its own state, and distinct feedforward and feedback pathways enabling reconstruction. If an artificial system

realised the same causal organisation and the relevant physical states, MEM predicts, in accordance with identity theory, that it would not merely be a functional imitator of feeling. It would be a candidate for possessing phenomenal states. This prediction does not eliminate the classical problem of other minds, but it makes the theory more demanding than a criterion based solely on behaviour or linguistic declarations.

MEM's 'astonishing hypothesis' is therefore stronger than Crick's general assertion that the mind is a function of the biological brain and more specific than the claim that emotions depend on the body. It integrates the receptor grounding of modal content, the interoceptive relation of that content to the organism's current state, and the recurrent maintenance and reinstatement of representations into a single constitutive hypothesis. Cognitive layers do not create the quale itself, but enable its recognition, contextualisation, and propositional description. MEM's response to the 'explanatory gap'^[65] is identity-theoretic: there is no additional stage at which a physical process produces a separate subjectivity; an appropriately organised biophysical state is a phenomenal state. This hypothesis is not protected from falsification by definition. As noted above, the strong version of MEM would be fundamentally undermined if stable and rich phenomenal experience were demonstrated in the simultaneous absence of an appropriate receptor-grounded modal representation, recurrent reconstruction, and central coupling to the interoceptively represented state of the organism. Determining whether the configuration identified by MEM is indeed necessary and sufficient for phenomenality therefore belongs to the programme of empirical research set out in the next section.

10. MEM's Position in the Debate Among Theories

MEM's claims concerning the identity of brain–body states and subjective first-person states extend beyond the conclusions reached by other established and prominent theories of the conscious mind. Let us identify the key similarities and differences among the claims advanced by these theories. The comparison should focus on what each theory regards as constitutive of experience. Shared mechanisms do not establish that the positions are identical, just as differences in terminology do not establish genuine theoretical competition. MEM can be understood as a proposal that integrates particular mechanisms and gives them an identity-theoretic interpretation. Its distinctiveness lies not in the discovery of feedback, memory, or embodiment as such, but in combining them into an account of a state that is itself proposed to constitute experience.

Recurrent Processing Theory (RPT) associates perceptual consciousness with recurrent processing, distinguishing it from the feedforward sweep (FFS) elicited by an incoming stimulus^[60]. MEM retains this point of departure but emphasizes the complete processing sequence: sensory reinstatement becomes the input to a subsequent FFS, activates further associations, and is coupled with interoception. The proposal thereby encompasses perception of the current stimulus, internal reconstruction, and affect. It would nevertheless be inaccurate to claim that RPT does not address context or phenomenality. The disagreement concerns whether a particular form of recurrence is sufficient and whether the additional relations postulated by MEM are necessary.

Global Neuronal Workspace Theory (GNWT) explains conscious access in terms of the global availability of representations. Dehaene and Changeux^[82] state that “conscious access occurs when incoming information is made globally available to multiple brain systems.” The model includes sustained recurrent processing, inhibition, and specific neuronal connections. MEM can interpret part of this integration as a consequence of the extensive interconnections among semblions. Its central question, however, is which sensory and interoceptive states are realized in this process. GNWT does not specify how global availability transforms neuronal representations into phenomenal experiences. The difference therefore concerns where the explanatory burden is placed, rather than a contrast between a biological theory and a purely abstract metaphor.

Higher-Order Theories (HOT) make the conscious character of a state dependent on an appropriate higher-order representation of that state^[83]. Such a representation need not take the form of an articulated sentence or a conscious reflection. MEM recognizes the importance of higher layers for recognition, but locates the basis of qualitative experience in sensory states involved in recurrent processing and coupled with interoceptive activity. A higher-order representation may help organize experience through its descending effects. In MEM, however, the mere presence of a higher-order representation does not replace the physical realization of the corresponding sensory quality.

Predictive approaches – predictive coding (PC), predictive processing (PP), and active inference (AI) – describe perception and regulation in terms of the reciprocal adjustment of signals and models of their causes. Seth and Friston^[84] extend this framework to interoception, feelings, and the embodied sense of self. These approaches are therefore not devoid of embodiment or affect. Here, “prediction” denotes a proposed mode of operation of a material system; it does not require a conscious subject that makes predictions. From the perspective of MEM, the fundamental question is which processes implementing such regulation are also felt states. The formal description of inference and the mechanism of secondary

perception may partly concern the same events. Their relationship should be established by mapping specific operations and predictions rather than by merely contrasting their respective terminologies.

Integrated Information Theory in its IIT 4.0 formulation identifies the quality of experience with a particular irreducible cause–effect structure of a system^[85]. It therefore does not reduce the problem to a single number measuring overall complexity. IIT constitutes a genuine alternative constitutive proposal and should be held to justificatory standards comparable to those applied to MEM. The difference lies in the criteria of identification: MEM assigns a distinctive role to sensory grounding, learning, and interoception, whereas the postulates of IIT have a more general scope. Determining which of these criteria better specifies the presence and structure of experience requires comparison of the theories' consequences.

Accounts of homeostatic feelings that are closest to MEM likewise treat the body as a constitutive element of feeling. Carvalho and Damasio^[78] relate the qualitative and subjective character of feelings to distinctive properties of the interoceptive system and to interactions between neuronal and non-neuronal processes. These ideas provide important foundations for a shared research programme rather than a competing challenge to MEM. The semblion model further develops the account of how feelings are connected with modality-specific contents, memory, and secondary perception. Agreement with this tradition alone does not, however, demonstrate that all of its hypotheses are already incorporated into MEM.

Affective neuroscience provides an even more direct test of MEM's originality. Panksepp's cross-species programme locates primary-process emotional feelings in evolutionarily ancient subcortical systems and treats the neural and experiential descriptions of these processes as aspects of the same brain-mind reality^{[39][40]}. Solms likewise argues that elemental consciousness is fundamentally affective: homeostatic deviations are registered as felt valence within upper-brainstem systems, whereas cortical mechanisms elaborate differentiated perceptual and cognitive contents^{[41][42]}. On this view, affect is not merely information later attached to an otherwise complete conscious percept. It is the primitive, organism-centred form of consciousness through which biological value is felt. This position is close to MEM's identification of centrally represented interoceptive–regulatory states with affective feeling, and it supports the claim that an account of consciousness which omits the living body's needs is incomplete.

The convergence also limits any claim of priority. MEM cannot be original merely in maintaining that homeostasis, affect, and subcortical bodily regulation are constitutive of consciousness rather than

external causes of it. Its distinctive proposal must instead be sought in the way it combines that insight with receptor-grounded modal maps, learned semi-hierarchical semblions, the distinction between a feedforward sweep and recurrent processing, and secondary perception as top-down reinstatement followed by renewed feedforward recognition. Panksepp provides a comparatively differentiated taxonomy of evolutionarily conserved emotional-action systems; Solms assigns explanatory primacy to an affective brainstem core and treats much cortical processing as intrinsically unconscious unless related to that core. MEM, by contrast, gives greater constitutive weight to modality-specific sensory realisation and to re-entry across distributed sensory, mnemonic, cognitive, and interoceptive levels. The models therefore overlap substantially without being interchangeable.

This comparison yields discriminating predictions. Evidence that a minimally differentiated but genuine conscious affect persists after extensive cortical loss would support the Panksepp-Solms emphasis and is compatible with MEM only if the remaining system still realises the required sensor-grounded and recurrent interoceptive configuration. Conversely, evidence that the phenomenal precision of a visual, auditory, or somatic quality systematically depends on recurrent reinstatement within the relevant modality-specific maps would favour MEM's additional architecture over an affective-core account alone. The strongest version of MEM also predicts that rich exteroceptive phenomenality cannot remain wholly detached from a centrally represented regulatory state. Affective neuroscience thus functions both as an important precursor and as a source of stringent tests: MEM's contribution is not the discovery that affect is embodied, but a more encompassing proposal about how affective ownership, modal quality, memory, recognition, and action become parts of one realised phenomenal state.

MEM's explanatory advantage lies in its capacity to encompass multiple phenomena within a single, coherent neurological and biophysical architecture and a unified account of the processes occurring within it. MEM shows how the same organization can account for modal differences, affective grounding, memory reconstruction, and the distinction between automatic responses and conscious experience. In this respect, its ambition extends beyond identifying a single correlate of consciousness. Assessing that ambition does not require dismissing the other theories as devoid of value; it requires determining what is added by this particular proposed configuration of mechanisms.

11. A Programme for Empirically Testing the MEM Hypothesis

Once the conditions hypothesised to constitute a phenomenal state have been formulated, the next task is to separate them experimentally and test them independently. It is especially important to distinguish

correlation from necessity and sufficiency: the mere co-occurrence of sensory, interoceptive, or recurrent activity with conscious experience is insufficient to show that any of these processes constitutes that experience.

The first line of research should be a systematic mapping of internal sensation and its contribution to phenomenality. The classical five senses obscure the diversity of detectors for temperature, distension, pressure, chemical composition, immune state, energy balance, nociception, and visceral mechanics. Not every regulatory variable becomes conscious, and a 'one emotion-one receptor' relation should not be expected. Research should determine which configurations of interoceptive signals form central representations capable of entering a conscious systemic state, how they are bound to exteroceptive and proprioceptive contents, and what roles the insula, cingulate cortex, brainstem, PAG, thalamus, and somatosensory cortex play in this process. It would be particularly important to establish whether attenuation of particular interoceptive pathways reduces not only the valence and motivational force of perception but also its phenomenal presence.

The second line of research is the experimental separation of necessary and sufficient conditions. MEM predicts that selective disruption of recurrent reconstruction in lower sensory maps should reduce the vividness and modal precision of experience while relatively preserving some semantic knowledge and the capacity to classify the stimulus. Weakening interoceptive coupling should preserve some degree of external discrimination while diminishing the bodily sense of significance, valence, and motivational force of the percept. Disrupting higher cognitive layers may, in turn, preserve some modal qualities while eliminating recognition of their source, naming, or conscious report. Such double and triple dissociations would provide a much stronger test of MEM than merely demonstrating correlations between neuronal activity and consciousness.

The riskiest prediction of the strong interoceptive hypothesis concerns the boundary of sufficiency. MEM assumes that a full phenomenal state requires a recurrently stabilised, sensor-grounded biophysical configuration coupled to the centrally represented regulatory state of the organism. If rich and stable phenomenal experience could be demonstrated in the complete absence of such interoceptive coupling, the strong version of the theory would require revision. Likewise, preservation of full modal vividness despite the effective interruption of re-entry would undermine the proposed role of secondary perception.

The third line of research is the quantitative formalisation of semblions and re-entry dynamics. The semblion has already been described architecturally in terms of multiple levels, overlapping

representations, sub-semblions, lateral associations, competition, feedforward and feedback pathways, and the capacity to encode sequences in dynamic semblions^[13]. The next step should translate these properties into measurable parameters: the number and distribution of participating neurons, the duration of the active coalition, the delay between the top-down pass and renewed feedforward processing, the stabilisation threshold, the dependence of vividness on reconstruction depth, and the influence of allostatic signals on action selection. A mathematical model of MEM should yield quantitative predictions whose violation would provide grounds for rejecting particular elements of the theory.

The fourth line of research is the experimental implementation of an artificial system satisfying the conditions of MEM. An LLM alone is not an appropriate test because linguistic proficiency and the ability to describe emotions do not yet realise receptor grounding or the system's own organism-centred regulation. A more informative experiment would use an autonomous robot equipped with its own vulnerable resources, exteroceptors, proprioceptors, and interoceptors, a homeostatic-allostatic system, hierarchical sensorimotor memories, and separate feedforward and feedback pathways. Man, Damasio, and Neven^[86] showed that introducing artificial homeostasis can increase a system's adaptability under changing conditions. MEM would additionally require the system to learn the consequences of its own actions for its regulatory state, bind them to sensory representations, and recurrently reinstate both sensory and interoceptive states during planning.

Such a system would permit individual components of the architecture (interoception, re-entry, lower modal maps, associative memory, or homeostatic regulation) to be progressively disabled. One could then investigate whether the changes in learning, valence, motivation, reconstruction of experience, and behaviour predicted by MEM occur in accordance with the theory. This would not automatically solve the classical problem of other minds, because an external observer would still lack direct access to the artificial system's first-person experience. It would, however, make it possible to test whether realising the architecture postulated by MEM produces all the predicted causal consequences of phenomenality.

This programme changes the character of the problem of consciousness from a search for a single 'neural correlate' to the testing of a particular causal organisation. The most valuable experiments will be those that separate receptor grounding, modal reconstruction, interoception, recognition, report, and action. If the dependencies predicted by MEM prove robust under such manipulations, the identity hypothesis will receive much stronger support than can be supplied by the model's merely descriptive consistency with current neurobiological knowledge.

12. Conclusion

The development of contemporary artificial intelligence shows that access to information, reasoning, planning, language, image recognition, problem-solving, and accurate modelling of human emotions can attain a very high level without independent evidence of experience. This reinforces the distinction between intelligence and access consciousness, on the one hand, and phenomenal consciousness, on the other. At the same time, the distinction does not compel us to accept dualism. MEM identifies physical and functional properties absent from typical computational-linguistic systems: receptor-grounded sensory maps, interoceptive reference to the system's own regulatory state, learning in a closed perception-action-outcome loop, and re-entrant reinstatement of previously formed sensory states.

MEM's central thesis can be stated even more strongly. MEM does not explain how a biophysical process 'produces' a quale, because this formulation already assumes the existence of two different phenomena: a physical process and the experience that arises from it. Instead, MEM specifies what particular type of biophysical process is itself the quale and which conditions must be satisfied for such a state to be realised. According to the identity hypothesis, a sensor-grounded, modality-specific, selected, and recurrently stabilised biophysical configuration, coupled to the organism's current state, does not cause an additional phenomenal experience. It is that experience: described from the third-person perspective, it is a particular material state; from the first-person perspective, it is a particular 'what it is like': redness, pain, taste, tension, pleasure, or some other feeling.

On this account, the hard problem of consciousness is reformulated. We no longer ask how unconscious matter crosses an ontological boundary and produces something additional, namely subjective experience. We instead ask which material organisations and processes are phenomenal states, why they differ modally, and what conditions are necessary for their realisation. This is a problem of empirical identification, not a search for an unknown mechanism that transforms the physical into the mental. MEM treats phenomenality as a property of a single dynamic biophysical configuration in which receptor-grounded modal content, the current interoceptive-regulatory state, the associative organisation of semblions, and recurrent stabilisation form one causally integrated state of the system. The same architecture makes it possible to realise phenomenal content both in direct perception and, through the top-down reinstatement of previously formed sensory configurations, in memory, imagery, dreaming, or hallucination. From this perspective, a quale is a modality-specific manner of realising a particular sensory state, while its bodily-affective component results from coupling to the organism's

current state. Subsequent cognitive processes enable the experience to be recognised, categorised, and described, but do not create its basic phenomenal quality.

This position also offers a different perspective on the classical gap between first- and third-person descriptions. A description of a neuronal state is not the experience of that state, just as a description of metabolism is not metabolism. The difference between description and realisation need not, however, imply two kinds of reality. In MEM, the difference between first- and third-person access is epistemic, whereas the postulated identity is ontological: both descriptions refer to a single material state, thereby closing the so-called explanatory gap.

The phenomenal concept strategy makes this conclusion more precise. The epistemic gap is expected if phenomenal and physical concepts provide cognitively independent routes to the same property: one through the realisation or reinstatement of a sensorily and affectively grounded state, the other through public theoretical description. Kripkean apparent contingency, Mary's acquisition of a new phenomenal concept, and the conceivability of zombies or inverted spectra therefore do not by themselves establish an ontological gap. At the same time, this conceptual defence does not verify MEM's neural identity claim. It explains how that claim could be true despite its epistemic appearance; interventionist and comparative evidence must determine whether the configuration specified by MEM is in fact the relevant realiser.

This does not mean that MEM has been empirically confirmed. The most important unresolved question concerns the sufficient conditions of phenomenality. It must be shown whether receptor grounding, an appropriate organisation of representations, interoceptive coupling, and re-entry are not merely associated with conscious experience but actually constitute its necessary and sufficient conditions. The theory should be tested by selectively disrupting individual elements of this process, investigating dissociations between recognition and feeling, and examining how the vividness and modal accuracy of experience depend on the depth of sensory reconstruction and the strength of interoceptive coupling.

The claim that MEM solves the hard problem of consciousness must therefore be understood in a precise sense. The model does not propose a mechanism by which something non-phenomenal generates phenomenality. It rejects the need for such a mechanism and replaces it with an identity hypothesis: an appropriately organised biophysical state is a phenomenal state. The task of the theory is therefore to specify the architecture of that state, the conditions of its realisation, the manner in which qualia are differentiated, and its relations to memory, interoception, action, and secondary perception.

If these predictions are experimentally confirmed, the hard problem in its classical form will lose its fundamental premise. There will be no unexplained transition from matter to experience because there will not be two states between which such a transition could occur. What will remain is a properly scientific task: determining exactly which dynamic configurations of a material, embodied system are particular forms of feeling, and why their different organisation corresponds to different qualia. It is in this sense that MEM may provide a physicalist, mechanistic, and constitutive solution to the problem of phenomenal consciousness.

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