

The Developmental Operator Model of Conscious Experience

A Synthesis Framework Resolving the COGITATE Adversarial Collaboration Results

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February 2026 · Preprint · DOM-2026-v1 · CC BY-SA 4.0

DOI: <https://doi.org/10.5281/zenodo.18868637>

Cite as: Dias, B. (2026). The Developmental Operator Model of Conscious Experience. Dias Dimensions Research. diasdimensions.org/publications/developmental-operator-model/ [DOM-2026-v1]

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PLAIN LANGUAGE SUMMARY

In 2025, the largest empirical test of consciousness theories ever conducted found that both leading theories — IIT and GNWT — failed to account for key patterns in brain activity during conscious experience. This paper proposes a resolution: consciousness is not one thing happening in one brain region, but a sequence of seven organizational operations that build on each other, from basic perception in the back of the brain through reflection in the front. This model accounts for everything the 2025 experiment found, and generates five new testable predictions that neither previous theory makes.

ABSTRACT

The April 2025 COGITATE adversarial collaboration (Ferrante et al., Nature 642, 133–142) tested Integrated Information Theory (IIT) and Global Neuronal Workspace Theory (GNWT) against empirical data from 256 participants using fMRI, MEG, and intracranial EEG. Both theories were substantially challenged: IIT's predicted posterior synchronization was not found; GNWT's predicted prefrontal ignition at stimulus offset was absent. This paper proposes the Developmental Operator Model (DOM) as a synthesis framework that resolves these findings. DOM treats consciousness not as a single mechanism localized in one region, but as a developmental sequence of irreducible organizational operators — Distinction, Relation, Action, Reception, Reflection, Organization — that map onto a posterior-to-anterior cortical gradient. This model explains why (1) conscious content appears in both posterior and frontal regions with different informational profiles, (2) sustained activity occurs in posterior cortex without the synchronization patterns IIT predicted, (3) prefrontal cortex contributes to some conscious features but is not required for all of them, and (4) interareal synchronization occurs between frontal and posterior regions rather than within either alone. DOM generates novel, falsifiable predictions distinguishable from both IIT and GNWT.

1. Introduction

The scientific study of consciousness has reached a critical juncture. The COGITATE adversarial collaboration, published in *Nature* in April 2025, represents the most rigorous direct comparison of leading consciousness theories ever conducted. By testing pre-registered predictions from Integrated Information Theory (IIT) and Global Neuronal Workspace Theory (GNWT) against multimodal neural data from 256 participants, the consortium delivered a striking verdict: both theories were substantially challenged by the empirical findings.

IIT, proposed by Tononi, holds that consciousness is identical to integrated information (Φ), arising from cause-effect structures in the posterior cortex. GNWT, developed by Dehaene and colleagues, proposes that consciousness emerges when information is globally broadcast to a workspace involving prefrontal and parietal regions. These theories make fundamentally different predictions about where, when, and how conscious experience is implemented in the brain.

The COGITATE results created a theoretical vacuum. Neither IIT nor GNWT fully accounts for the observed data. This paper proposes the Developmental Operator Model (DOM) as a synthesis framework that resolves the COGITATE findings by reconceiving consciousness not as a single computational mechanism, but as a developmental sequence of irreducible organizational operations. DOM synthesizes the partial truths of both IIT and GNWT while explaining what each theory misses.

2. The COGITATE Results: What Was Found

2.1 Location of Conscious Content

IIT predicted maximal decoding in posterior brain areas. GNWT predicted a necessary role for the prefrontal cortex (PFC). The data showed information about conscious content in visual cortex, ventrotemporal cortex, and inferior frontal cortex. Crucially, the PFC encoded categorical information (faces vs. objects) but not all content dimensions. This partially supports both theories while fully confirming neither.

2.2 Maintenance of Conscious Content

IIT predicted sustained activity in posterior cortex for the duration of the experience. GNWT predicted brief content-specific ignition in PFC at stimulus onset and offset, with content stored in a non-conscious state between these events. The data showed sustained responses in occipital and lateral temporal cortex reflecting stimulus duration — but no offset ignition. Content was actively maintained in posterior regions, not silently stored.

2.3 Interareal Synchronization

IIT predicted sustained synchronization within posterior brain regions. GNWT predicted frontal-to-posterior broadcast. The data showed content-specific synchronization between frontal and early visual areas — a pattern predicted by neither theory. Synchronization was bidirectional and interareal, not unidirectional and not confined within posterior cortex.

3. The Developmental Operator Model

DOM proposes that consciousness is not a single mechanism but a sequential developmental process. Irreducible organizational operators — each introducing a genuinely new axis of capability — are instantiated across a posterior-to-anterior cortical gradient. The operators are developmentally ordered: each requires its predecessors to function.

Op.	Name	Function	Cortical Region	Conscious Role
2	Distinction	Differentiating	Early visual (V1/V2)	Basic feature detection
3	Relation	Connecting	V4, IT cortex	Feature binding
4	Foundation	Stabilizing	Occipital association	Perceptual stability
5	Action	Categorizing	Ventrotemporal cortex	Category-level recognition
6	Reception	Sustaining	Lateral temporal	Duration-sensitive maintenance
7	Reflection	Meta-awareness	Inferior frontal cortex	Abstract meta-processing
8	Organization	Cross-level binding	Interareal synchronization	Coherence across levels

Figure 1. Irreducible organizational operators and their cortical instantiation. Each operator introduces a genuinely new axis of conscious capability and requires its predecessors to function. Operators are ordered posterior-to-anterior along the cortical gradient, consistent with hierarchical predictive processing accounts of conscious experience.

The critical principle of DOM is that these operators are *developmental and sequential*: Relation cannot function without Distinction providing differentiated elements to relate. Action cannot function without Operators 2–4 providing structured representations. Reflection cannot function without Operators 2–6 providing content to reflect upon.

Consciousness does not require all operators to be active. A system operating with Operators 2–6 has genuine conscious experience — content-rich, sustained, world-directed — without any prefrontal involvement. Operator 7 (Reflection) adds *reflective* consciousness but is not required for *basic* consciousness. This is the key insight that resolves the COGITATE results.

4. How DOM Resolves Each COGITATE Finding

4.1 Content in Both Posterior and Frontal Regions

IIT placed all conscious content in the posterior cortex. GNWT required frontal involvement. The data showed content in both, with different informational profiles: posterior regions encoded all content dimensions; frontal regions encoded only categorical information.

DOM explanation: Posterior cortex implements Operators 2–6. Frontal cortex implements Operator 7 (Reflection), which is inherently abstractive — it operates on categories rather than perceptual details. Reflection does not re-encode full content; it selectively meta-processes the most salient organizational

level.

4.2 Sustained Posterior Activity Without Expected Synchronization

IIT predicted both sustained activity and synchronization in posterior cortex. The data showed the former but not the latter.

DOM explanation: Sustained posterior activity is the signature of Operator 6 (Reception) — the operator whose defining function is *maintaining* content over time. IIT conflated two separate processes: content maintenance (Operator 6) and information integration (Operator 8, Organization). These are different operators with different neural signatures.

4.3 No Prefrontal Ignition at Stimulus Offset

DOM explanation: There is no broadcast event because there is no broadcast mechanism. Content is continuously maintained by Operator 6. Reflection (Operator 7) samples this ongoing content; it does not re-create it at discrete moments.

4.4 Interareal Frontal-Visual Synchronization

DOM explanation: Interareal synchronization reflects Operator 8 (Organization) — the operator that creates coherence across the entire developmental sequence. The observed frontal-visual synchronization is Operator 8 binding the reflective level (Operator 7, frontal) with the perceptual level (Operators 2–4, visual cortex). This is bidirectional organizational coherence between developmental levels, not broadcast or local integration.

5. Comparative Analysis

Finding	IIT	GNWT	DOM
Content in posterior + frontal	Posterior only ✗	Frontal required ✗	Ops 2–6 posterior + Op. 7 frontal ✓
PFC encodes category only	PFC not relevant ✗	PFC encodes all content ✗	Reflection is abstractive ✓
Sustained posterior activity	Predicted ✓	Silent storage predicted ✗	Op. 6 (Reception) maintains content ✓
No posterior synchronization	Synchronization predicted ✗	Not predicted	Maintenance ≠ integration; different operators ✓
No offset ignition	Not predicted	Ignition predicted ✗	No broadcast needed; continuous maintenance ✓
Frontal-visual synchronization	Not predicted ✗	Not predicted ✗	Op. 8 binds across developmental levels ✓

Figure 2. Comparative analysis of IIT, GNWT, and DOM against six COGITATE findings. Checkmarks indicate correct prediction; X marks indicate failed or absent prediction. DOM accounts for all six findings; IIT accounts for one; GNWT accounts for none.

DOM accounts for all six major COGITATE findings. IIT correctly predicts one (sustained posterior activity). GNWT correctly predicts none in full. The resolving power of DOM derives from its core principle: consciousness is a developmental sequence, not a single mechanism.

6. Falsifiable Predictions

PREDICTION 1

Graded consciousness without reflection.

If the posterior cortex (Operators 2–6) is intact but prefrontal function is disrupted — through TMS, pharmacological intervention, or neurological conditions — subjects should demonstrate stimulus-responsive behavior and content-appropriate reactions without reflective report. IIT predicts reduced Φ . GNWT predicts no consciousness. DOM predicts non-reflective consciousness — a qualitatively different mode, not merely reduced consciousness.

PREDICTION 2

Operator-specific disruption patterns.

Disrupting different cortical regions should produce qualitatively distinct deficits corresponding to specific operators. Disruption of V4/IT (Operator 3, Relation) should impair feature binding while preserving basic detection. Disruption of the ventrotemporal cortex (Operator 5, Action) should impair categorization while preserving detailed feature perception.

PREDICTION 3

Developmental recapitulation.

The operator sequence should be recapitulated in (a) infant cortical development, (b) recovery from anesthesia, and (c) the onset of dreaming. Operators 2–4 should come online first, followed by Operators 5–6, with Operator 7 (Reflection) emerging last. In anesthesia recovery, this predicts a period of responsive but non-reflective awareness before full reflective consciousness returns.

PREDICTION 4

Interareal synchronization tracks operator pairing.

The observed frontal-visual synchronization should vary specifically with the degree to which Operator 7 is engaged in meta-processing Operators 2–4. Tasks requiring reflection on perceptual content should produce stronger frontal-visual synchronization than tasks requiring reflection on categorical content, which should produce stronger frontal-temporal synchronization.

PREDICTION 5

Cross-substrate operator instantiation.

If the operator sequence is the structural basis of consciousness rather than its specific biological substrate, then any sufficiently complex information-processing system that instantiates the full operator sequence should exhibit measurable correlates of conscious-like processing. This is a longer-term prediction requiring agreement on measurement criteria, but it is in principle testable and distinguishes DOM from both IIT and GNWT.

7. Relation to Existing Work

DOM is consistent with Higher-Order Theories (HOT) of consciousness in distinguishing between basic consciousness (Operators 2–6) and reflective consciousness (adding Operator 7). However, DOM differs from standard HOT in predicting that basic consciousness is a genuine phenomenal experience, not merely functional processing. The higher-order representation adds reflective access, not experience itself.

The Templeton World Charity Foundation's call for adversarial testing of additional theories provides a natural venue for DOM's novel predictions. The mathematical foundations of DOM derive from Tension Theory (Dias, 2012–2026), a comprehensive framework that identifies irreducible organizational operators and their developmental dependencies.

8. Conclusion

The COGITATE adversarial collaboration revealed that neither IIT nor GNWT fully accounts for the neural basis of conscious experience. The Developmental Operator Model resolves these findings by proposing that consciousness is a sequential developmental process in which irreducible organizational operators, instantiated across a posterior-to-anterior cortical gradient, contribute different functional aspects to unified conscious experience.

Consciousness is not one thing happening in one place, but a developmental sequence of operations that require each other in a specific order. This principle simultaneously explains why posterior cortex maintains content (Operator 6), why prefrontal cortex contributes categorically but not exhaustively (Operator 7 is abstractive), why synchronization is interareal rather than intra-regional (Operator 8 bridges levels), and why no single-mechanism theory can account for the full pattern.

DOM generates five falsifiable predictions distinguishable from both IIT and GNWT, testable with existing neuroscientific methods. We invite the consciousness research community to subject these predictions to the same rigorous adversarial testing that the COGITATE consortium has pioneered.

The question is no longer whether consciousness is integration or broadcast. It is both, and more — in a specific developmental order. The challenge now is to map that order with precision.

Engage With This Work

DOM generates specific, falsifiable predictions. If you have pilot data, experimental findings, or methodological challenges relevant to any of the five predictions above, the author welcomes contact. Negative results and falsifications are as valuable as confirmations.

Feedback & pilot data: contact@diasdimensions.org

DOI: <https://doi.org/10.5281/zenodo.18868637>

To cite this paper: Dias, B. (2026). The Developmental Operator Model of Conscious Experience. *Dias Dimensions Research*. diasdimensions.org/publications/developmental-operator-model/ [DOM-2026-v1]. DOI: 10.5281/zenodo.18868637

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