From Motor Feedback to the Vacuum Net

Rodney Cotterill's Sensorimotor Theory of Cognition and Its Possible Relation to the Vacuum.Net Theory

Abstract

Rodney M. J. Cotterill's 2001 paper, *Cooperation of the basal ganglia, cerebellum, sensory cerebrum and hippocampus: possible implications for cognition, consciousness, intelligence and creativity*, develops a strikingly non-standard account of cognition. Rather than treating consciousness as something generated primarily by sensory processing in the cerebral cortex, Cotterill places movement, bodily feedback, recurrent signaling and environmental interaction at the centre of the explanation. His proposal is explicitly "back-to-front": cognition begins with an organism probing its environment through movement, while consciousness emerges when the organism can use feedback from its own activity to anticipate and modify subsequent action. [?]

The Vacuum.Net theory begins from a very different domain—fundamental physics—but contains a structural principle that makes an unexpected comparison possible. Its primitive is a single continuous strand; persistent structures arise through phase closure, while tension and throughflow characterize configurations that are not simply static objects. The theory explicitly treats the net as the vacuum itself rather than as something embedded in an independently existing space. (Hans Konstapel Blogs) [?]

The central thesis of this essay is therefore not that Cotterill anticipated Vacuum.Net, nor that Cotterill's neuroscience constitutes evidence for Vacuum.Net. Rather, the two theories can be placed in a common structural framework:

continuous process → interaction → feedback → recurrent closure → persistence → memory → prediction → controlled continuation.

Cotterill describes this sequence biologically. Vacuum.Net describes an analogous architecture at a more fundamental structural level. The interesting scientific question is whether the correspondence can eventually be made mathematical rather than merely conceptual.

1. The importance of Cotterill's starting point

Cotterill's paper begins with an unusually fundamental question: what does possession of a brain actually do for an animal?

His answer is not simply that the brain processes sensory information. Instead, he argues that the entire nervous system should be understood in relation to the organism's capacity to move. Muscular contraction is, in his formulation, the nervous system's externally directed product, and neural pathways ultimately converge on movement-mediating areas. [?]

This produces a reversal of the conventional information-processing picture.

The conventional sequence is approximately:

world → sensory input → brain → decision → action.

Cotterill proposes something closer to:

action → environmental consequence → sensory feedback → modification of subsequent action.

The distinction is fundamental. In the second formulation, the organism is not merely a passive receiver of information. It actively generates the conditions under which new information becomes available.

This is already visible in his treatment of very simple organisms. He argues that the basic behavioral strategy of living organisms may be continuous self-paced probing of the environment. Cognition is consequently connected not primarily to sensory input but to the organism's motor activity. ?

This point is particularly important for the comparison with Vacuum.Net.

Vacuum.Net likewise does not begin with objects receiving externally supplied information. It begins with a continuous substrate and asks what structures can persist within that substrate through their own internal relational organization. The fundamental question is therefore not simply “what exists?” but “what configuration can maintain itself?”

That is a surprisingly close change of viewpoint.

2. Cotterill's organism as a closed dynamical system

The most important feature of Cotterill's model is the feedback loop between organism and environment.

The organism produces movement. Movement changes the organism's relationship with the environment. The changed environment generates sensory consequences. Those consequences are fed back into the organism and influence the next movement.

Thus the organism is not represented by a one-way causal chain but by a loop:

organism → action → environment → feedback → organism.

Cotterill explicitly describes this as a continuation of the ancient biological strategy of “probe-by-movement.” Even organisms without nervous systems can be regarded as probing their environment by changing their state and responding to the resulting conditions. With increasing neural complexity, the same basic strategy becomes more sophisticated. ?

This is where the comparison with Vacuum.Net becomes productive.

Vacuum.Net begins with one continuous strand and a closure principle. What persists is not an independently existing object placed inside a pre-existing space. Persistence arises from the internal organization of the strand itself. The theory describes the net as the vacuum, rather than as an object located in vacuum. (Hans Konstapel Blogs) ?

In both cases, therefore, the fundamental entity is relational rather than object-like.

For Cotterill:

organism = an ongoing relation between internal state, action and environment.

For Vacuum.Net:

physical object = an ongoing configuration of the underlying strand.

This gives the first correspondence:

Cotterill: organismal closure

Vacuum.Net: topological/phase closure

They are not identical concepts. Cotterill's closure is dynamical and biological; Vacuum.Net's closure is structural and physical. But both reject the idea that persistence requires an isolated, static object.

3. From stimulus-response to throughflow

The strongest conceptual bridge is the transition from stimulus-response to continuous throughflow.

A classical reflex can be represented approximately as:

stimulus → response.

Cotterill argues that this is inadequate for complex organisms. A sophisticated organism must retain information about the trajectory through which it has arrived at its present condition. In his discussion of muscular “hyperspace,” the relevant state is not simply the present stimulus but the recent path through possible movements. [?]

This has a direct structural analogue in Vacuum.Net.

A static point does not contain a history.

A trajectory does.

A configuration of the net is therefore better understood as a process than as an isolated object. Its current condition depends upon the way the strand has been wound, crossed, stretched and brought into its present configuration.

The Vacuum.Net formulation consequently gives us a possible physical vocabulary for Cotterill's biological argument:

Cotterill	Vacuum.Net interpretation
movement	change of configuration
motor trajectory	path through configuration space

sensory feedback	information generated by changed configuration
recurrent neural pathway	local closure/return
persistent motor pattern	stable configuration
learned context	stored relational configuration
anticipation	continuation of an established trajectory
veto	resistance to an incompatible continuation
consciousness	internal access to the trajectory and its possible continuation

The last row is the most speculative and should not be treated as established science. But the structural mapping is sufficiently precise to deserve investigation.

4. Closure and persistence

The central physical idea of Vacuum.Net is that closure is not merely a geometrical curiosity. It is the selection mechanism.

The theory proposes that a configuration which returns to itself in phase can persist, while configurations that do not close disperse. The net therefore generates its own selection criterion: persistence is the consequence of closure rather than an externally imposed law. (Hans Konstapel Blogs) ?

Cotterill's biological argument contains a remarkably similar selection process.

An organism performs movements. Some movements produce useful consequences; others do not. Through feedback, correlations between movements and consequences become available for later use. The hippocampus, in his model, records correlations between motor sequences and the resulting sensory feedback, with later consolidation into longer-term memory. ?

The parallel can therefore be expressed as:

Vacuum.Net

configuration
→ interaction
→ closure
→ persistence

Cotterill

movement
→ environmental interaction
→ successful correlation
→ consolidation

This does not mean that biological learning literally obeys Vacuum.Net's topological equations. It means that both theories describe persistence as something earned by recurrent consistency.

That distinction matters.

In both frameworks, existence is associated with a pattern that survives its own dynamics.

5. Memory as retained closure

This may be the most promising point of contact.

Cotterill does not describe memory simply as the storage of sensory snapshots. He places the hippocampus in a system that records correlations between motor sequences and their resulting sensory consequences. The organism therefore stores relationships between:

what it did

and

what happened because it did it.

This is very different from the metaphor of memory as a filing cabinet.

Memory becomes a persistent relation.

That is strikingly compatible with the Vacuum.Net concept of a knot or closed configuration as an address. The Vacuum.Net theory describes stable structures as configurations of the underlying strand and associates the persistence of such configurations with closure. (Hans Konstapel Blogs)

One can therefore formulate a speculative common principle:

Memory is a dynamically maintained relation that has acquired sufficient closure to persist.

In Cotterill, the relation is neural and behavioral.

In Vacuum.Net, the fundamental relation is topological and physical.

The biological memory is consequently not proposed here as literally a Vacuum.Net knot. Rather, the knot provides a possible general abstraction:

a memory is a persistent relational configuration.

This formulation could potentially connect physics, neuroscience and information theory without assuming that they use identical mechanisms.

6. The crucial role of feedback

Cotterill places extraordinary importance on feedback.

The motor system cannot operate intelligently if it only knows what movement it intends to perform. It must also receive information about what is actually happening. He argues that meaningful adjustment of movement requires information about the current values and rates of change of muscular variables. [?]

This leads to a crucial statement in his theory:

without feedback from the body, anticipation would be impossible.

His broader argument is that attention must be active rather than passive. The system has to continuously integrate present sensory information with information about its immediately preceding activity. [?]

Vacuum.Net can be interpreted as making a comparable claim at the structural level.

A perfectly static configuration contains no dynamics.

A purely unconstrained dynamic contains no stable identity.

A persistent entity therefore requires both:

structure

and

process.

The current formulation of Vacuum.Net explicitly distinguishes structural and process aspects, describing the theory in terms of closure, address, topology and memory on one side, and dynamics and tension on the other. (Hans Konstapel Blogs) [?]

This produces a potentially useful correspondence:

Cotterill's feedback = the biological expression of the coexistence of structure and process.

The organism must preserve enough structure to recognize itself while remaining dynamic enough to interact with its environment.

7. Tension and incomplete closure

This is where the comparison becomes more ambitious.

Vacuum.Net does not define reality merely as a collection of closed knots. Its current formulation emphasizes the importance of tension and throughflow. A configuration can be structurally persistent while still containing an unresolved difference or dynamical remainder. The theory describes this as part of the reason that physical processes continue rather than simply terminating in perfect equilibrium. (Hans Konstapel Blogs) [?]

Cotterill's organism has an analogous property.

An organism at complete equilibrium would have no reason to move.

Movement occurs because the organism is not simply in equilibrium with its environment. It has needs, internal states, expectations and discrepancies. Those discrepancies generate activity. Cotterill describes the organism's drive as depending upon its needs and available internal resources; when the drive exceeds a threshold, movement occurs. [?]

Thus:

no tension → no movement

and

no unresolved dynamical difference → no throughflow.

This is not a trivial analogy. It suggests a possible general principle:

Persistent systems remain dynamically active because persistence does not imply perfect equilibrium.

The knot remains identifiable while the process continues through it.

That would provide a natural conceptual bridge between “stable structure” and “living process.”

8. Consciousness as prediction rather than reception

Cotterill's theory becomes particularly interesting when he addresses consciousness.

He explicitly rejects the idea that consciousness is simply the passive registration of sensory input. His “back-to-front theory” places motor planning before conscious awareness. Consciousness becomes relevant when an already activated motor system can anticipate the consequences of an action and influence whether that action continues. [?]

His proposed mechanism is essentially:

possible action → simulated consequence → evaluation → continuation or veto.

He gives the example of a child learning to walk. Earlier attempts produce sensory consequences; successful and unsuccessful patterns become available as memory; later attempts can therefore be evaluated against anticipated consequences. Consciousness performs a “watch-dog” function during the consolidation of new motor patterns. [?]

This provides a much more precise connection to Vacuum.Net than the vague statement that “consciousness is energy.”

The proposed relation would instead be:

consciousness = an organism's ability to operate upon the continuation of its own dynamical pattern.

In Vacuum.Net terminology, one could ask whether consciousness corresponds to a system that does not merely occupy a configuration but has internal access to alternative continuations of that configuration.

That would turn consciousness from a mysterious additional substance into a property of recursive dynamical organization.

This remains a hypothesis. Cotterill does not formulate it in Vacuum.Net terms, and Vacuum.Net does not currently derive consciousness mathematically. But the two frameworks meet at the concept of **self-referential continuation**.

9. The importance of the motor areas

Cotterill's anatomy reinforces this interpretation.

His proposed architecture involves the sensory cerebrum, basal ganglia, cerebellum, hippocampus, thalamus, anterior cingulate and motor-related cortical regions. These components do not simply form a hierarchy in which sensory information rises toward a central processor. They participate in reciprocal pathways. ?

In his summary diagram, the premotor system is influenced by different sources performing different functions. The superior colliculus selects a suitable sequence, the basal ganglia permit its execution, and the cerebellum permits its continuation. The hippocampus records correlations between motor sequences and sensory feedback. ?

This is a distributed closure architecture.

There is no single “consciousness box.”

Instead, consciousness is proposed to emerge from the interaction of multiple recurrent subsystems.

This is compatible with the Vacuum.Net intuition that an entity is not defined by one location but by the organization of relationships throughout a network.

The relevant object is therefore not:

neuron A

but:

the closed route connecting many elements.

That is an important conceptual shift.

10. Oscillation and recurrent structure

Cotterill also discusses gamma-band oscillations and synchronization. He points to evidence that oscillatory activity involves not merely isolated cortical regions but interactions between distributed areas and thalamic structures. ?

The paper also discusses reciprocal cortical projections and argues that dynamic correlations can be captured through these interacting pathways. Learning can modify both forward and reverse-directed connections, with different directions potentially serving different forms of learning. [?]

This is especially relevant to Vacuum.Net because a closed network is fundamentally a dynamical object.

The analogy can be stated cautiously:

neural oscillation is not necessarily closure, but oscillation can be a dynamical signature of recurrent organization.

If Vacuum.Net is correct that stable physical structures depend upon recurrent closure, then biological systems might be expected to exploit recurrent dynamics extensively wherever stable information must be maintained.

That prediction is not yet sufficient to validate Vacuum.Net. Recurrent neural dynamics are already well established independently of the theory. What Vacuum.Net could potentially add is a deeper structural explanation for why recurrence is so ubiquitous in systems capable of maintaining identity and memory.

11. Cotterill's “back-to-front” theory and the Vacuum.Net direction of causality

The deepest philosophical similarity may be found in the direction of explanation.

Cotterill asks us to stop explaining cognition from input toward output. Instead, he proposes beginning with output and asking what internal machinery is necessary to control it. He explicitly argues that the output of a machine can reveal its internal organization more clearly than its input. [?]

Vacuum.Net makes a comparable methodological move.

Instead of starting with elementary particles and assuming the space, fields and constants in which they exist, it starts with the primitive structure and asks what persistent structures must follow from it. The theory describes itself as a re-derivation rather than an additional physical theory. (Hans Konstapel Blogs) [?]

The shared methodological principle is:

Do not begin by assuming the entities you are trying to explain. Begin with the process that makes those entities possible.

For Cotterill:

movement → feedback → cognition → consciousness.

For Vacuum.Net:

strand → crossing → closure → persistent configuration.

The two chains operate at different explanatory levels, but they have the same direction: from process to entity.

12. The body as an address

Cotterill makes another unusually strong claim: cognition is fundamentally related to the body.

He argues that even organisms without nervous systems can be described as monitoring their own bodily state. He consequently proposes that consciousness may be an elaboration of the same basic principle—monitoring of the body by the body through the nervous system. [?]

This has a striking correspondence with the Vacuum.Net concept of address.

In the current Vacuum.Net formulation, a thing is characterized by its location within the network of relations rather than by an externally assigned identifier. The theory describes “everything has its number in the maze” as a consequence of the winding structure. (Hans Konstapel Blogs) [?]

Applied conceptually to biology:

the organism is its own reference frame.

Its sensory information is not information “in general.” It is information relative to the organism's current state and location in its own dynamical history.

This is precisely what makes Cotterill's theory interesting from the Vacuum.Net perspective.

There is no view from nowhere.

There is only information available from a particular configuration.

That is close to the Vacuum.Net principle that knowledge is always read from an address within the net rather than from an external absolute position. (Hans Konstapel Blogs) [?]

13. From biological memory to physical address

The strongest synthesis can now be formulated.

Suppose the following hierarchy is valid:

Level 1 — Strand

There is a continuous substrate.

Level 2 — Configuration

The substrate folds, crosses and develops local structure.

Level 3 — Closure

Some configurations return consistently upon themselves.

Level 4 — Persistence

Closed configurations survive longer than non-closed configurations.

Level 5 — History

Persistent configurations interact and acquire dynamical histories.

Level 6 — Memory

Some histories become stabilized as reproducible configurations.

Level 7 — Prediction

A system can use those stabilized configurations to estimate possible continuations.

Level 8 — Conscious control

The system can evaluate possible continuations and modify the trajectory.

Cotterill essentially starts at Levels 5–8.

Vacuum.Net attempts to provide an explanation beginning at Levels 1–4.

The research question is therefore whether the two descriptions can be joined:

Vacuum.Net supplies the physical architecture of persistence.
Cotterill supplies the biological architecture of recursive control.

That is a much more interesting proposition than saying that Vacuum.Net "explains consciousness."

It does not—at least not yet.

It potentially supplies a lower-level structural language into which a theory such as Cotterill's could be translated.

14. The role of the basal ganglia and cerebellum

Cotterill's treatment of the basal ganglia and cerebellum is particularly compatible with this framework.

He describes both as mechanisms that can prevent motor signals from reaching the threshold required for overt movement. In effect, they act as veto or permission systems. ?

This produces an interesting interpretation.

A biological system does not simply generate all possible actions. It continuously restricts possible continuations.

In mathematical language, the organism moves through a space of possible states but only some transitions are permitted.

That is structurally similar to a constrained network.

Vacuum.Net likewise does not describe arbitrary configurations as equally persistent. Closure acts as a selection rule. The physically relevant question becomes:

which transitions preserve the conditions required for persistence?

Thus the basal ganglia/cerebellar veto mechanism might be regarded as the biological analogue of a constraint on allowable continuation.

Again, this is a mapping, not an established identity.

But it suggests a formal program:

Define the neural state space, identify its transition constraints, and ask whether stable behavioral patterns correspond mathematically to attractors or closures in the same formal class as Vacuum.Net configurations.

That would be experimentally and mathematically meaningful.

15. Intelligence and creativity

Cotterill extends his model beyond consciousness.

He proposes that intelligence can be understood as the ability to consolidate individual motor elements into more complex patterns. Creativity then emerges through competition between possible patterns, with novel correlations providing new candidates. ?

His discussion of creativity is based on a race-to-threshold mechanism. Competing signals converge on premotor and supplementary motor areas, while attention and other brain structures influence which candidate reaches the relevant threshold. ?

This can again be expressed in Vacuum.Net language.

A creative event would not necessarily require creation from nothing.

It could instead be:

existing structures → recombination → new configuration → temporary instability → successful closure → persistence.

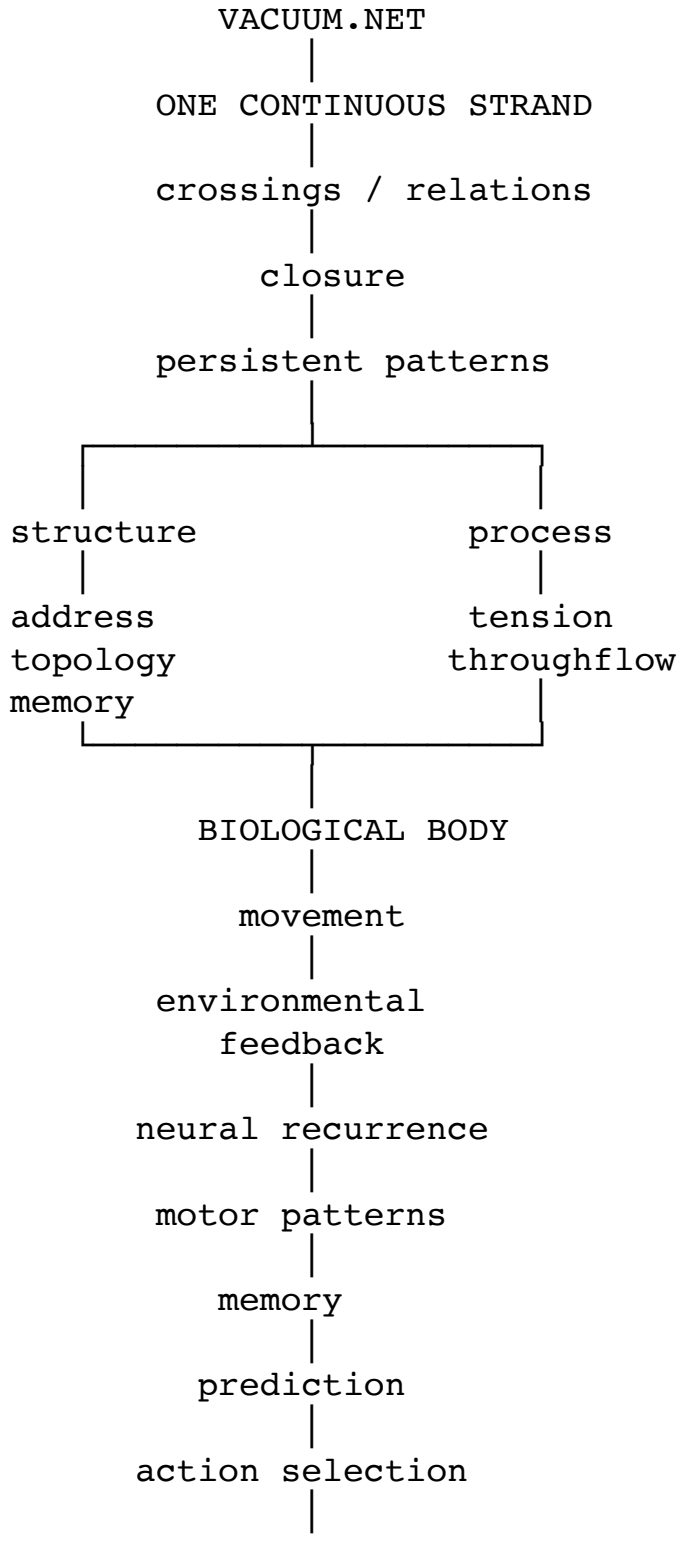
That is highly compatible with the general Vacuum.Net principle that new structure arises through transformations of an underlying continuous substrate.

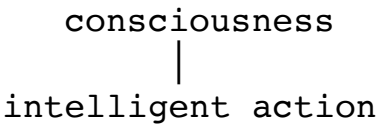
The key concept is therefore not “generation” but **reconfiguration**.

Creativity becomes the formation of a previously unavailable stable relation from existing components.

16. A possible unified model

The relationship can now be summarized in one conceptual diagram:





The central vertical axis is the important part.

The hypothesis is that the same abstract architecture appears at different scales:

continuous substrate → recurrent organization → persistence → history → prediction → controlled continuation.

17. What the comparison does not establish

The distinction between analogy and derivation must remain absolute.

Cotterill's paper does not mention Vacuum.Net. It predates it by approximately twenty-five years.

Nor does Cotterill establish that neural structures are topological knots in a physical vacuum. His claims are neurobiological and functional.

Conversely, the Vacuum.Net theory does not currently derive Cotterill's neural circuitry from its axioms.

The comparison therefore has three different levels of strength.

Established in Cotterill

Cotterill proposes that cognition is fundamentally related to movement, feedback, recurrent processing, prediction and the acquisition of context-specific motor patterns. ?

Established within the Vacuum.Net program

Vacuum.Net proposes a continuous strand, phase closure, persistent configurations, and a distinction between structural closure and dynamical tension/throughflow. (Hans Konstapel Blogs) ?

Open hypothesis

The biological processes described by Cotterill may be realizations, at a higher organizational level, of the same general closure/throughflow architecture proposed by Vacuum.Net.

That third statement is the scientifically interesting one.

It is also the one that requires actual work.

18. The experiment that would matter

The relationship should not remain a philosophical analogy.

A useful next step would be to construct a formal mapping.

Let a biological state be represented as:

B
(
t
)
=
{
M
(
t
)
,
S
(
t
)
,
H
(
t
)
,
P
(
t
)
}
B(t)=\{M(t),S(t),H(t),P(t)\}
where:

- M
  (
  t
)

  M(t)

  = motor state,
- S
  (
  t
)

  S(t)

  = sensory state,
- H
  (

t
)

H(t)

= retained history,

- P
(
t
)

P(t)

= predicted continuation.

Then define a recurrent transformation:

B
(
t
+
1
)
=
F
[
B
(
t
)
,
E
(
t
)
]
B(t+1)=F[B(t),E(t)]
where

E
(
t
)
E(t)
represents environmental interaction.

Cotterill's theory requires that

F
F
contain feedback from the organism's own preceding motor state.

The Vacuum.Net question would then be:

Can

F
F
be represented as a constrained evolution of a network configuration in which persistent behavioral states correspond to closed or approximately closed trajectories?

If the answer is yes, one could investigate whether the mathematical properties of those trajectories reproduce measurable features of learning, oscillation, memory consolidation or motor prediction.

That would turn the present conceptual relationship into a research programme.

19. Why Cotterill may be particularly important for Vacuum.Net

There is a broader reason this connection deserves attention.

Vacuum.Net is fundamentally a theory of persistence.

Cotterill is fundamentally developing a theory of how a living system maintains and modifies behavioral patterns through time.

These are different problems, but they share a question:

How can something remain identifiable while continuously changing?

A static object has identity but no history.

A completely unconstrained flow has history but no persistent identity.

Life requires both.

A human being is continuously replacing matter, changing neural states, moving through space and updating memories, yet remains identifiable as the same organism.

Cotterill explains this through recurrent body–brain–environment relations.

Vacuum.Net proposes that persistence itself is a consequence of closure in an underlying continuous net.

The possibility therefore emerges that **closure is the missing common abstraction between physical persistence and biological identity**.

20. Conclusion

Cotterill's 2001 theory and the Vacuum.Net theory originate from radically different research programmes. Cotterill is concerned with neurobiology, cognition, consciousness, motor control, memory and creativity. Vacuum.Net begins with a proposed physical primitive—a continuous strand—and a closure principle from which persistent structure is supposed to emerge.

Yet the two frameworks meet at a surprisingly precise conceptual point.

Cotterill argues that an organism is fundamentally an active system. It probes its environment through movement, receives feedback generated by that movement, records correlations between action and consequence, and uses those correlations to predict and control future action. Consciousness arises, in his proposal, when the system can operate upon the continuation of its own activity rather than merely respond to an external stimulus. ?

Vacuum.Net begins with a continuous substrate and asks why some configurations persist. Its answer is closure: a configuration that returns to itself can remain, while a configuration that cannot close disperses. Persistent structures therefore acquire identity through their internal relational organization. (Hans Konstapel Blogs) ?

The possible bridge is:

continuous process
→
feedback
→
recurrence
→
closure
→
persistence
→
memory
→
prediction
→
conscious control

$$\boxed{ \text{continuous process} \rightarrow \text{feedback} \rightarrow \text{recurrence} \rightarrow \text{closure} \rightarrow \text{persistence} \rightarrow \text{memory} \rightarrow \text{prediction} \rightarrow \text{conscious control} }$$

Cotterill gives empirical biological content to the right-hand side of this chain.

Vacuum.Net attempts to provide a fundamental structural explanation for the left-hand side.

The most consequential hypothesis is therefore not that “the brain is a vacuum net.” That would be too crude. The stronger proposition is that **the organization of living cognition may be an instance of a more general law of persistent self-referential structures**.

In that interpretation, a memory is a persistent relation; a learned behavior is a stabilized trajectory; consciousness is access to possible continuations of an ongoing trajectory; and an organism is a dynamically maintained closure rather than a static object.

Cotterill's final evolutionary claim is especially compatible with this reading: he proposes that the basic strategy of living systems has remained fundamentally one of self-paced probing of the

environment, while increasingly sophisticated neural structures allow increasingly complex forms of feedback, prediction and behavioral control. ?

Vacuum.Net can therefore be read as asking the next question below Cotterill:

If biological cognition is built from recurrent self-maintaining processes, what kind of physical substrate is capable of producing persistence, recurrence and closure in the first place?

That is the point at which the two theories genuinely touch.

And that is also where the analogy must end and the mathematics must begin.