The Human as Throughflow Closure

One Model, Seven Variables, and a Mapping onto the Sciences of the Human

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What this paper offers

Every science of the human has its own vocabulary, and the vocabularies do not talk to each other. Biochemistry has metabolism and turnover. Medicine has stress, allostatic load and recovery. Psychology has traits, affect and emotional inertia. Sleep science has sleep pressure. Sociology has cohesion and co-regulation. Each discipline has measured something real. None of them can state what the others measured.

This paper does two things. First, it derives a minimal formal model of the human being from a single physical picture — one strand, woven into a net, carrying tension. The model has seven variables and six explicitly labelled choices, and it obliges five falsifiable predictions. Second, it maps the model onto the existing vocabularies, term by term, with the status of each correspondence stated: exact, partial, or empty. The result is not a rival theory. It is a common coordinate system in which quantities already measured in separate fields turn out to be the same seven variables — and in which several standing school differences become decidable experiments.

The paper is self-contained. Every equation and every step is in the text. No reference needs to be consulted to follow the argument.

Provenance and method

The base model (Section 1) is Konstapel's Vacuum.Net theory, condensed to its minimum. The projection onto the human being (Sections 2–5) was constructed independently by the AI co-author from that base model alone, and was then subjected to seven rounds of adversarial mathematical stress testing by an independent AI reviewer, over eight editions. The test log is part of the record: a normalisation error, a hidden single-mode assumption, an incorrect duty-cycle balance, a non-regular statistics problem, and several definitional gaps were found and repaired in successive editions; one reviewer finding was rejected on the record as based on a stale copy. Every statement below carries one of five statuses: **base** (assumed), **derived**, **conditionally derived**, **chosen** (a model choice, named and attackable), or **testable** (an obligatory prediction). The choices are exactly the places where the model can die, and the failure map from test to choice is given in Section 6.

1. The Base Model

The vacuum is not empty. It is one strand, woven into a net. Eight definitions and one postulate carry everything that follows.

Definition 1 (strand). There is one 1-dimensional continuum, parameterised by arc length $s \in \mathbb{R}$. Nothing else exists; space is not an input.

Definition 2 (contact). A contact is a pair (s, s'), $s \neq s'$, that is identified — the strand touching itself. The contact set turns the strand into a graph G: strand segments as edges, contacts as nodes.

Definition 3 (winding). A winding is a cycle in G — a closed walk alternating strand segments and contacts — that persists under the dynamics. Its characteristic number n is defined on the strand's own order: the contacts of the cycle are chords on the parameterised strand; two chords (s_1, s_1') and (s_2, s_2') interleave iff $s_1 < s_2 < s_1' < s_2'$; n is the number of interleaving chord pairs. No embedding is needed — only the arc-length order of Definition 1. n is conserved under pattern-preserving relay (Section 3), not under the full dynamics. A thing is a winding whose pattern keeps coming back. Nothing more.

Definition 4 (net). The net is G itself. Meshes are the cycle space of G; knots are windings.

Definition 5 (tension). One scalar field $\chi(s, t) \geq 0$ lives on the strand. Its total is conserved: $d/dt \int \chi \, ds = 0$.

Postulate (the only dynamics). Tension redistributes along the strand and across contacts, toward equalisation:

$$\partial\chi/\partial t = \partial/\partial s \left(\varkappa \, \partial\chi/\partial s \right) + \Sigma_{(s,s')} \eta_{ss'} \left(\chi(s') - \chi(s) \right) \quad (1)$$

Diffusion on a graph. $\varkappa$ and η are the only material quantities.

Definition 6 (the four states, operational). For any region W, states are assigned on the plane $(\bar{\chi}_W, d\bar{\chi}_W/dt)$ by a preregistered protocol: fix a rate band $\varepsilon > 0$ and thresholds $\theta_{low} < \theta_{high}$ before measurement. **Loading**: $d\bar{\chi}/dt > \varepsilon$. **Discharge**: $d\bar{\chi}/dt < -\varepsilon$. **Holding**: $|d\bar{\chi}/dt| \leq \varepsilon$ and $\bar{\chi} \geq \theta_{high}$. **Rest**: $|d\bar{\chi}/dt| \leq \varepsilon$ and $\bar{\chi} \leq \theta_{low}$. Every measured point receives exactly one label. A single load step produces only loading → holding; the full four-state traversal requires a load-on/load-off protocol.

Definition 7 (memory). Contact formation is not uniform: the probability of a new contact rises with local winding density. New cycles form on existing cycles. The old carries the new. This layers the graph without prescribing a count of layers.

Definition 8 (property = state). Every observable of a winding W has the form $O(W) = f(N_W ; \chi_{env})$: the full contact pattern N_W — of which n is one derived quantity — and the surrounding tension. Nothing else may enter. All kinetic parameters below $(\mu, \lambda, \nu, r, \eta)$ are **instantaneous** state functions of (N_W, χ_{env}), never free constants — fixed for an individual only as long as N remains within one identity class.

No universal constants, no fixed layer count, no background. Everything below comes from these nine statements or is marked as a choice.

2. The Closed Winding and Its One Time

Take a connected subgraph $W \subset G$ containing cycles, capacity $C_W = \int_W ds$, mean tension $\bar{\chi}_W \equiv (1/C_W)\int_W \chi \, ds$. Integrating (1) over W, interior contact terms cancel pairwise; only boundary contacts b survive:

$C_W \cdot d\bar{\chi}_W/dt = \Sigma_b \eta_b (\chi_b^{ext} - \chi(s_b, t))$ (2a, exact)

Approximation A (fast internal equalisation): $\chi(s_b, t) \approx \bar{\chi}_W(t)$, giving

$d\bar{\chi}_W/dt = (1/C_W) \Sigma_b \eta_b (\chi_b^{ext} - \bar{\chi}_W)$. (2)

A network generically has many relaxation modes; one exponential is not automatic. Hence:

Choice 1 (retention, spectral form). With $1/\tau_{exch} = \Sigma_b \eta_b / C_W$ the exchange rate and λ_{int} the slowest purely internal rate (the interior spectral gap), define $\varrho \equiv \lambda_{int} \cdot \tau_{exch}$. **$\varrho \gg 1$ is the definition of an inside.** The reduction logic: large internal gap → under Approximation A the internal state collapses to one collective variable $\bar{\chi}_W$ after a transient $\sim 1/\lambda_{int}$ → the external model (2) is a one-pole relaxation. With several boundary contacts, equilibrium is $\bar{\chi}_\infty = \Sigma \eta_b \chi_b^{ext} / \Sigma \eta_b$. Under this reduction, a step change gives

$\bar{\chi}_W(t) = \bar{\chi}_\infty + (\bar{\chi}_0 - \bar{\chi}_\infty) e^{\{-t/\tau_W\}}, \tau_W = C_W / \Sigma_b \eta_b$. (4, conditionally derived)

Every winding satisfying the spectral condition has one characteristic time: capacity over boundary conductance. Holding is not a metaphor; it is a relaxation time, measurable by step response. Whether humans are such windings is exactly test T1.

3. The Throughflow Closure: Life, Maintenance, Window

A closed winding by itself relaxes to its surroundings and is done. Three labelled laws change that.

Choice 2 (re-lay law). Contacts decay at rate λ when idle; contact formation follows the local gradient at rate $\mu \cdot J$, with J the current through the winding.

The identity pattern. Define formally $N(W) = [C(W), <]_{\cong}$ — the chord structure with the strand-order-induced ordering, up to interleaving-preserving isomorphism. A **realisation** is the currently maintained contact set within that class. A re-lay event is **pattern-preserving** when the replacement lands in the same chord class; then n is conserved by construction — maintenance replaces material, not structure. Re-lay outside the class changes N. **$C_{min}(N)$** is the smallest sub-realisation that still closes every defining cycle of the pattern.

Choice 2c (drift and repair). Under load, a fraction of re-lay events lands outside the class: the realisation drifts from N at rate νJ. Drift is repaired during equalisation phases (boundary conductance down, $J \approx 0$) at rate r. Stationarity of the pattern deviation fixes the rest fraction:

$(1-f) \cdot \nu J = f \cdot r \Longrightarrow f = \nu J / (\nu J + r)$ (7, derived)

— linear only at low load, saturating toward 1. Maintenance under this duty cycle:

$C_W^*(J) = \mu r J / [\lambda(\nu J + r)] \to \mu r/(\lambda\nu)$ as $J \to \infty$ (5′, derived)

with $dC^*/dJ = \mu r^2/[\lambda(\nu J+r)^2] > 0$. **A winding on a gradient maintains its own contact pattern — up to a ceiling set by its own repair capacity. That is the definition of life in this model: not a substance, but a closure in throughflow that re-lays itself.** It costs current ($J \to 0 \Longrightarrow C \to 0$), it self-repairs, and its maintenance saturates.

Choice 2b (environment). The sustaining gradient is finite: $C_{env} \cdot d(\Delta\chi)/dt = R - J$, with $J = \eta_W \Delta\chi$. R is not creation of tension; it is inflow from the remainder of the globally conserved net.

Steady state: $J^* = R$ — sustainable throughflow is capped by the environment's recharge, transient exceedance runs on the depleting reservoir.

The window (derived from the above). Closure requires $C_W^* \geq C_{min}(N)$:

1. **Constitution:** $\mu r > \lambda\nu C_{min}(N)$ — whether this winding can live at all, a property of N before any environment.
2. **Lower edge:** $J_{min} = \lambda C_{min} \cdot r / (\mu r - \lambda\nu C_{min})$ — below it the pattern decays through threshold.
3. **Upper edge (environmental, steady-state):** sustained $J \leq R$.

Life exists in a sustainable steady-state window, with performance saturating at r/ν before any edge.

4. The Tower and the Human

Choice 3 (closure operator). $K(\{W_i\})$ = a subgraph connecting the W_i with cycles over them as wholes and $\varrho \gg 1$. Definition 7 lets K repeat: W^0 = smallest stable cycle, $W^{(k+1)} = K(\{W^{(k)}\})$. The level count is not postulated.

Lemma (derived). Capacity adds; closure internalises contacts (strands between constituents cease to be boundary), with side condition $0 < \eta_{int} < \Sigma C_i/\tau_i$. Hence $\tau_S = \Sigma C_i/(\Sigma C_i/\tau_i - \eta_{int}) > \Sigma C_i/(\Sigma C_i/\tau_i)$: the super-closure's time lies above the capacity-weighted **harmonic mean** of its constituents' times, growing with internalisation. This does *not* give $\tau_S > \max \tau_i$.

Choice 3b (scale separation). K is admissible only when $\tau_S \geq \sigma \cdot \max_i \tau_i$, $\sigma > 1$. The strict ordering of time scales through the tower is chosen, not derived — and T4 tests it.

Definition (human). A human is a throughflow closure of depth m in the tower: spectral condition, window, and 3b hold at level m, over constituents satisfying them at m−1. In short: **human = closure + spectral condition + window + 3b.** Stated plainly: the human scale is not derived from the base model alone — one chosen temporal selection criterion is part of the definition, and it is testable.

Current science names the lower levels cells and molecules. This construction needs neither name: what sits at m−1 is an implementation detail of deeper winding. Every statement about the human uses four quantities:

- **N** — the identity pattern. Discrete. The blueprint.
- $\bar{\chi}$ — the mean tension. How the person is doing.
- $\boldsymbol{\tau}$ — the retention time. How long the person holds.
- **J** — the throughflow. What the holding costs.

5. Derived Properties

Identity. Realisations are continually replaced; what persists is N, the class. Total material turnover with persistent identity — a paradox in the substance picture — is here Definition 3: the thing *is* the pattern that keeps being re-laid into the same class.

Origin. A new closure is laid on the strand of two existing closures (Definition 7): N_{new} inherits substructure from both carriers, plus the tension state of the moment of knotting. Heredity and moment of origin are two components of one invariant.

Perception. Boundary conductances are state functions $\eta_b = \eta(\chi_b)$: an outside pattern modulates inflow, and stands as a state change inside W after $\sim 1/\lambda_{int}$. Perception is outside tension walking in along one's own contacts. **No representation step: the correlation is the contact.**

Action. The same equation reversed: W sets a disturbance into the mesh; whether it persists depends on phase overlap with the mesh state. Selection by fitting; no causal arrow.

Simultaneous cycles. The four-state traversal runs at every tower level with its own τ, separated by $\geq \sigma$: one human carries several loading–discharge cycles at once, at separated tempi.

Rest. The duty cycle (7) makes rest periodically necessary, fraction $f = \nu J/(\nu J + r)$.

Death. The spectral or window condition fails; J collapses, the realisation decays, χ redistributes into the mesh. N does not vanish — a pattern once laid is strand history. It only ceases to re-lay itself.

6. What the Model Obliges (T1–T5)

T1 — One-pole response (tests Choice 1). Load step; record $\bar{\chi}(t)$ at known noise σ_{noise}. Fit nested models M1: $A + B_1 e^{-t/\tau_1}$ against Mk: $A + \Sigma_i B_i e^{-t/\tau_i}$, Mk containing M1 at $B_2 = \ldots = B_k = 0$. Exponential selection is **non-regular** (parameters of absent modes vanish under the null): use a preregistered bootstrap likelihood-ratio, AICc/BIC with declared threshold, or explicit equivalent — not an asymptotic F-test. Preregister the minimal detectable second mode ($B_2/B_1 \geq \beta_{min}$; τ-separation band) and the excluded transient. **Falsification runs in two steps:** a reproducible slow second mode above the floor falsifies the one-pole *reduction*; by declared convention that invalidates the human closure under Choice 1. It does not by itself falsify the spectral-gap hypothesis — attribution requires the separate check that the mode is internal and slow.

T2 — The window (tests Choices 2/2b/2c). Constitutional condition, closed-form lower edge, environmental steady-state upper edge. The first two are functions of N: per person, calibratable, stable while N holds. A sustainable upper edge that does not track the environment attacks 2b specifically.

T3 — Rest fraction (tests Choice 2c). $f = \nu J/(\nu J + r)$: linear onset with per-person slope ν/r, saturating shape. The *shape* is the test. Protocol requirement: ν, r are instantaneous state functions; the prediction holds while N stays within one identity class — class constancy is monitored, and a drifting ν/r with class change is boundary failure, not falsification.

T4 — Separated simultaneous time scales (tests Choice 3b). Cycles at distinct tempi must coexist, orderable by tower level, ratio $\geq \sigma$ between adjacent levels.

T5 — The tower above the human (tests Choice 3). K applied to humans yields genuine closures with $1 \ll \varrho_{group} < \varrho_{human}$: pair, family, group — more weakly held than their members, same mathematics. Measurable: shared $\bar{\chi}$ dynamics of a pair under a step load on one member — a joint slow mode absent for uncoupled individuals.

Failure map: T1 → Choice 1; T2 → 2/2b/2c; T3 → 2c; T4 → 3b; T5 → 3.

7. The Mapping onto the Human Sciences

Φ maps model terms to discipline terms; each entry carries its status: **exact** (same quantity, other name), **partial** (overlap, difference stated — hence testable), **empty** (no preimage; the refusal is a claim).

Biochemistry and cell biology

Model	Discipline	Status
Throughflow	Metabolism; dissipative structure; **autopoiesis** (Maturana & Varela)	Exact — autopoiesis is the closure without equations; this model adds (5′), the window, the
Class vs. realisation	**Dynamic state of body constituents** (Schoenheimer)	Exact — material replaced, form persists, measured in 1942.
μJ, λ	Anabolism, catabolism	Exact in role; linear form is Choice 2.
r	Autophagy, DNA repair,	Partial — mechanisms vs. one aggregate rate.

Physiology and medicine

Model	Discipline	Status
$\bar{\chi}$	Stress level (**Selye**); allostatic state; arousal	Exact in role.
Accumulated	**Allostatic load**	Exact — wear of sustained load, named clinically.
τ	Recovery time; return-to-baseline; HRV	Exact — medicine measures τ daily.
J_min	Disuse atrophy; "use it	Exact, derived.
Ceiling r/ν	Overtraining; chronic	Partial — damage reading vs. duty-cycle saturation; T3
Constitution μr > λνC_min(N)	Physiological reserve; frailty threshold	Partial — measured capacity vs. derived from N.
Homeostasis	The one-pole relaxation (4)	Exact, conditionally — homeostasis is what a $\varrho \gg 1$ winding does; T1 tests whether humans are such

Neuroscience

Model	Discipline	Status
One-pole reduction	Neural mass / mean-field	Exact in method — the spectral condition is the shared licence.
Four	Integrate-and-fire	Exact at unit level; the whole-person claim is T4's content.
Perception as inflow	**Direct perception**	Exact — no representation step; the correlation is the contact.
Perception as inflow	Predictive processing	Partial — they keep an internal model that runs ahead; this model has none. The overlap is forward sensitivity of state to input.
Action as	Affordance	Exact.

Psychology

Model	Discipline	Status

N	Temperament; traits	Partial — traits are the statistics; N is the structure they estimate.
$\bar{\chi}$	Affect; mood	Exact in role.
τ	**Emotional inertia** (affect dynamics)	Exact — the AR(1) coefficient of mood *is* e^{−Δt/τ}; psychology has measured τ_W for two decades under another name. High
Window	Yerkes–Dodson	Partial — inverted U vs. window-plus-flat-ceiling;
f(J)	Recovery–stress balance; burnout as	Exact in role; the saturating form is the testable addition.
Identity through	Ship of Theseus; narrative identity	Exact resolution: identity = class.

Psychiatry and clinical science

Model	Discipline	Status
ϱ falling toward 1;	**Critical slowing down** (Scheffer); dynamical	Exact — already measured before depression onset and in frailty.
Class	"Not the same person" after	Partial — the phrase gets a formal referent.
Disease entity	—	**Empty.** The model has states and class changes, no entities a person has; a label maps at most onto a region

Sleep science and chronobiology

Model	Discipline	Status
Rest phase	Sleep: sensory gating,	Exact in role.
f = νJ/(νJ+r)	**Process S** (Borbély): sleep	Exact in structure — found empirically forty years earlier. The model's addition: the pressure rate is load-dependent (νJ), not merely
Simultaneous	Ultradian/ circadian/	Exact in role; the ordering is T4's addition.

Genetics, development, gerontology

Model	Discipline	Status
Inherited substructure	Genotype; heritability	Partial — the molecular channel is one realisation of the statement, not its definition.
Origin-state in N	Developmental programming (Barker); season-of-birth effects	Partial — the mark is placed in the invariant itself.
Rising τ with	Loss of resilience as frailty marker	Exact — already a dynamical indicator.
Un-repaired drift over life	Ageing as damage accumulation	Exact in role — the lifetime integral of drift that repair did not close.

Social science and economics

Model	Discipline	Status

1 ≪ ϱ_group <	Cohesion; entitativity; family systems	Exact in role — the group is a real closure, more weakly held.
Joint slow mode (T5)	**Co-regulation**; physiological synchrony (partners, parent–	Exact — the synchrony literature measures the T5 observable.
Group	**Collective effervescence**	Exact in role — boundary down, internal
Lost boundary	Loneliness as health risk	Exact, derived — no separate mechanism needed.
Spectral condition +	**Near-decomposability** (Simon 1962)	Exact — Simon's architecture-of-complexity argument *is* Choices 1 and 3b; this model adds the
Throughflow closure	The firm as going concern; bankruptcy = window exit	Exact in role.
R	Carrying capacity; sustainable yield; debt-financed exceedance =	Exact in role.
Un-repaired	Technical debt; deferred	Exact in role.

The empty set — terms the model refuses

Representation (no internal copy: the correlation is the contact). **Cause between separate things** (one strand admits no arrow between two substances; constitutive relations and selection by fitting instead). **The isolated subject** (ϱ ≫ 1 defines an inside, never a separateness). **The disease entity** (states and class changes, no things a person has). Each refusal is a claim, and each is load-bearing in the tests.

8. What the Mapping Shows

Read column-wise, one point emerges. The sciences of the human have each measured a piece of the closure: Schoenheimer the class/realisation split, Selye and McEwen the state and the drift, Borbély the duty cycle, affect dynamics the retention time, Gibson the contact, Simon the tower, Durkheim the group repair, the resilience literature the approach of ϱ to 1. None had the others' pieces, because each vocabulary stops at its discipline's boundary. The model is not a rival to any of them. It is the coordinate system in which their measured quantities are the same seven variables — and in which standing school differences (Yerkes–Dodson's decline vs. the flat ceiling; Process S time-based vs. load-based; predictive processing's internal model vs. Gibson's contact) become decidable experiments instead of positions.

Simon's 1962 argument deserves separate mention: near-decomposability — hierarchy with separated time scales as the survivable form of complexity — is the strongest existing motivation for the two choices (1 and 3b) that the stress tests identified as the model's most exposed assumptions. What Simon argued, T1 and T4 now test.

9. Status Ledger

Base: Definitions 1–8 and the postulate (Konstapel, Vacuum.Net). **Derived:** (2a) exact; (2) under Approximation A; (7); (5′) with monotonicity and ceiling; the window's constitutional condition and lower edge in closed form; the tower lemma with its side condition; Section 5. **Conditionally derived:** (4), valid iff ϱ ≫ 1 — whether humans qualify is T1; conservation of n under pattern-preserving re-lay, with νJ its violation rate. **Chosen — the places to attack:** the spectral gap as the definition of an inside (1); the linear re-lay law (2); the reservoir equation (2b); the linear drift law

(2c); the operator K (3); scale separation $\sigma > 1$ (3b). **Testable:** T1–T5 with the failure map. **Open:** the count of tower levels; the form of N for an actual human; nonlinear re-lay and drift laws; whether 3b can be derived from a physical selection principle; the coupling algebra for two humans becoming one mesh; and the next document — T1–T5 as preregistrable protocols with measurement variables, controls, null hypotheses, decision rules and exact falsification conditions.

10. Invitation

The model is deliberately small: seven variables, six named choices, five tests. Each discipline in Section 7 already owns a measurement tradition that touches one of the tests — affect dynamics for T1, occupational and sleep research for T3, synchrony research for T5, resilience indicators for the approach to closure failure. The authors invite exactly the confrontation the paper is built for: preregistered protocols, existing data re-read in the common coordinates, and the six choices attacked where the failure map says they are exposed.

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