The Somatic Anthropocene:

Body, Interoception, and Planetary Crisis

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Abstract

The Anthropocene has a body. Billions of sedentary, screen-mediated, nature-deprived bodies do not only suffer planetary crisis. They may also help mediate it through a feedback loop linking somatic dysregulation, compensatory consumption, and ecological extraction. This article introduces the Somatic Anthropocene: a conceptual model in which bodily dysregulation may mediate and amplify ecological crisis. Sedentary, digital, urban, and chemically altered environments may reduce movement, sleep quality, metabolic stability, interoceptive awareness, subjective well-being, nature connectedness, and embodied ecological care. These changes may increase vulnerability to compensatory consumption and growth-oriented economic systems, indirectly increasing material throughput and environmental pressure. Environmental degradation then feeds back into physical and mental health burdens, closing the loop. The article synthesizes evidence from embodied cognition, ecological psychology, interoception research, public health, youth mental health, well-being studies, environmental economics, and sustainability science. It reframes Generation Z and older Generation Alpha not as evidence of terminal somatic decline, but as early-warning cohorts in which multiple indicators of reduced somatic and psychosocial reserve appear to converge: mental-health burden, obesity, myopia, sleep disruption, low physical activity, loneliness, and digital overexposure. Finally, it proposes the Somatic Restitution Index (SRI), a preliminary framework for integrating bodily, psychological, ecological, and consumption-related indicators into sustainability assessment. The SRI is presented not as a replacement for GDP, but as a complementary multidimensional profile requiring validation through longitudinal and intervention studies. The paper also identifies pseudo-restitution—the commodified simulation of bodily repair through wellness, quantified-self, or digital-mindfulness systems—as a key validity risk for the SRI, and outlines intervention-based designs for testing whether somatic restitution can causally reduce compensatory consumption and strengthen ecological behaviour.

Keywords: Somatic Anthropocene; embodiment; interoception; nature connectedness; subjective well-being; compensatory consumption; Generation Z; Generation Alpha; public health; sustainability; Somatic Restitution Index; body ecology crisis; loneliness paradox; somatic political ecology

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Highlights

- The Anthropocene is reframed as not only a crisis of carbon, capital, and technology, but also a crisis of embodied mediation.
- Somatic dysregulation is proposed as a possible mediator and amplifier, not as a monocausal explanation of ecological crisis.
- Subjective and eudaimonic well-being are introduced as missing mediators between bodily dysregulation and compensatory consumption.
- Generation Z and older Generation Alpha are treated as early-warning cohorts showing reduced somatic and psychosocial reserve.
- A Somatic Restitution Index (SRI) is proposed as a complementary sustainability and public-health multidimensional profile requiring empirical validation.
- The article situates itself within and extends embodied political ecology toward a new research frontier: *somatic political ecology*.

Contents

1 Introduction: The Missing Body in Anthropocene Theory

1.1 The Anthropocene beyond carbon and GDP

The Anthropocene has been framed as an epoch in which human activity has become a dominant force shaping Earth-system processes (Crutzen & Stoermer, 2000; Steffen et al., 2007, 2015). Its most visible indicators are atmospheric carbon dioxide, biodiversity loss, land-use change, ocean acidification, nitrogen and phosphorus loading, chemical pollution, and the acceleration of socio-economic metabolism after the mid-twentieth century (Richardson et al., 2023; Rockström et al., 2009). In parallel, political economy has interpreted ecological crisis through capitalism, colonial extraction, fossil-fuel dependency, growth imperatives, unequal consumption, and global supply chains (Hickel, 2020; Kallis, 2011; Moore, 2017).

These frameworks are indispensable. They explain much of the material causality of ecological crisis and prevent simplistic blame of "humanity" as a single agent. Yet they often leave underdeveloped a crucial question: what kind of embodied subject participates in, desires, tolerates, or resists ecological destruction? In many Anthropocene narratives, the human appears as an abstract unit: *Homo economicus*, consumer, citizen, demographic mass, labour force, or technological species. The body enters mainly as a victim of pollution, heat, malnutrition, or disease, not as a mediator through which environments become meaningful and values become actionable.

This article situates itself within an emerging tradition of **embodied political ecology** (Doshi, 2017; Hayes-Conroy & Hayes-Conroy, 2013; Kinkaid, 2019; Truelove, 2024), which has examined the body as a site of sensory experience, labour, and political struggle in localized agrarian and urban contexts. Yet existing work remains predominantly qualitative, ethnographic, and place-based, focusing on taste, smell, disease, and social reproduction. The Somatic Anthropocene extends this tradition in three directions: first, by scaling the body from the local field or slum to the planetary system; second, by introducing interoceptive, metabolic, and neurobiological mechanisms previously underexamined in political ecology; and third, by proposing a psychometric and epidemiological framework (the SRI) that makes somatic mediation measurable across populations. In doing so, it opens a research frontier that may be termed **somatic political ecology**—the study of planetary-scale feedback loops between bodily dysregulation, economic systems, and Earth-system processes. For the philosophical and phenomenological grounding of this framework, including the concepts of embodied orientation and somatic restitution, see the companion essay *Axial Consciousness and the Somatic Anthropocene* (Lick, 2026, companion essay, §§ 2–3).

This article argues that Anthropocene theory needs a somatic dimension. The body is not only the biological substrate that suffers ecological crisis. It is also the medium through which humans perceive affordances, regulate affect, experience sufficiency, develop nature connectedness, and form habits of consumption or restraint.

1.1.1 Relation to existing frameworks

The Somatic Anthropocene is not proposed as a replacement for existing frameworks in global health, sustainability science, political ecology, or environmental humanities. It is better understood as a bridging framework that adds a specific missing layer: the bodily mediation of ecological perception, well-being, consumption, and material throughput.

First, the framework is adjacent to *One Health*, which emphasizes the interdependence of human, animal, and ecosystem health, especially in relation to zoonoses, antimicrobial resistance, food systems, and environmental contamination (World Health Organization, 2026). The Somatic Anthropocene shares this integrative orientation but shifts the analytical focus from cross-species disease ecology to the embodied conditions through which human populations become more or less vulnerable to compensatory consumption, digital dependence, and ecological disengagement.

Second, it is closely related to *Planetary Health*, which frames human health as inseparable from the state of Earth systems in the Anthropocene (Gupta et al., 2024; Rockström et al., 2023; Whitmee et al., 2015). Planetary Health asks how environmental degradation harms human health; the Somatic Anthropocene asks a complementary question: how bodily dysregulation may mediate the psychological and behavioural pathways through which ecological degradation is tolerated, amplified, or resisted.

Third, the framework overlaps with *syndemic theory*. Syndemic approaches examine interacting epidemics that cluster under conditions of inequality and mutually intensify health burdens (Horton, 2020; Singer et al., 2017). The Lancet Commission on the Global Syndemic, for example, linked obesity, undernutrition, and climate change through shared systemic drivers (Swinburn et al., 2019). The Somatic Anthropocene builds on this insight but extends it beyond disease clustering toward a feedback loop linking somatic dysregulation, reduced well-being, compensatory consumption, material throughput, and ecological degradation.

Fourth, the framework is informed by research on *social metabolism* and *socio-economic metabolism*, which studies the material and energetic flows through which societies appropriate, transform, consume, and excrete biophysical resources (Fischer-Kowalski, 1998; Fischer-Kowalski & Haberl, 2007; Haberl et al., 2019). The Somatic Anthropocene does not replace metabolic analysis of material throughput. Rather, it asks how bodily states, affective demand, and compensatory consumption may become behavioural mediators of these biophysical flows.

Fifth, the framework has conceptual affinities with *affect theory*, especially work on affective atmospheres, attachment, ordinary intensities, and forms of desire that organize everyday life below explicit cognition (Berlant, 2011; Massumi, 2002; Stewart, 2007). The term "affective background" should therefore not be read only as an individual mood state. It names the embodied field through which sufficiency, deficit, fatigue, desire, and compensation become socially organized.

Finally, the Somatic Anthropocene extends *embodied political ecology*, which has already shown that bodies are material, sensory, affective, and political sites of environmental inequality (Doshi, 2017; Hayes-Conroy & Hayes-Conroy, 2013; Kinkaid, 2019; Truelove, 2024). Its specific contribution is to scale this insight from local and ethnographic settings toward a planetary, epidemiological, and psychometric research programme. In this sense, somatic political ecology can be defined as the study of feedback loops between bodily dysregulation, political-economic systems, and Earth-system processes.

A compact comparison with adjacent frameworks is provided in Supplementary Table A1.

1.2 Definition of the Somatic Anthropocene

This article defines the Somatic Anthropocene as follows:

Definition.

The Somatic Anthropocene is a conceptual framework proposing that bodily dysregulation may amplify ecological crisis by weakening interoception, well-being, nature connectedness, and embodied ecological care, thereby increasing vulnerability to compensatory consumption.

This article does not claim that bodily dysregulation is the origin of ecological crisis. Rather, it proposes that bodily conditions may mediate and amplify existing political-economic, technological, and environmental drivers by shaping well-being, self-regulation, nature connectedness, and vulnerability to compensatory consumption. Bodily dysregulation is theorized as a *permissive factor*. It may lower the threshold for compensatory consumption and amplify existing political-economic drivers, but it is not a *sufficient cause* of ecological crisis. Capitalist accumulation, colonial extraction, fossil-fuel dependency, and platform attention economies remain independent structural drivers; somatic mediation operates as a feedback loop *within* these structures, not as their origin.

This definition is intentionally cautious. It does not claim that the body is the sole cause of ecological crisis. It does not replace fossil fuels, capitalism, colonial histories, institutional incentives, or technological infrastructures as explanatory variables.

The somatic burden is distributed unevenly by gender. Women's bodies may bear disproportionate allostatic load through unpaid reproductive labour, the "motherhood penalty," and gendered medical discrimination, making gendered care and reproductive labour important sites of biopolitical governance (Federici, 2012; Rose, 2007). These gendered somatic conditions do not replace class or colonial analysis but operate as intersecting amplifiers within the feedback loop.

The model can be summarized as a feedback loop (Figure 1). The loop operates as follows:

1. Technological, sedentary, urban, and chemically altered environments.
2. Somatic dysregulation: low movement, poor sleep, metabolic stress, pain, sensory narrowing, and reduced outdoor exposure.
3. Reduced interoceptive awareness and bodily self-regulation.
4. Reduced subjective/eudaimonic well-being and weakened nature connectedness.
5. Increased vulnerability to compensatory consumption.
6. Increased material throughput and ecological pressure.
7. Environmental degradation: pollution, climate stress, biodiversity loss, heat, toxic exposure, and reduced access to restorative environments.
8. Further physical and mental health burden, feeding back into somatic dysregulation.

1.3 Relation to the companion essay

This article is the scientific-conceptual part of a two-part research project. It develops the Somatic Anthropocene as a cautious interdisciplinary model, drawing on public health, embodied cognition, interoception research, well-being studies, sustainability science, and political ecology. Its task is to define the feedback loop, classify the evidential status of its claims, and propose the Somatic Restitution Index (SRI) as a preliminary multidimensional research framework.

A companion essay, *Axial Consciousness and the Somatic Anthropocene*, published simultaneously, provides the philosophical and phenomenological interpretation of the same framework. It develops concepts such as embodied orientation, embodied ecological relation, somatic restitution, somatic justice, and a speculative fertility-related signal. These concepts are not treated here as empirical conclusions. They are theoretical extensions operating mainly at levels L4–L5 of evidential support.

Table 1 summarizes the division of labour between the two texts.

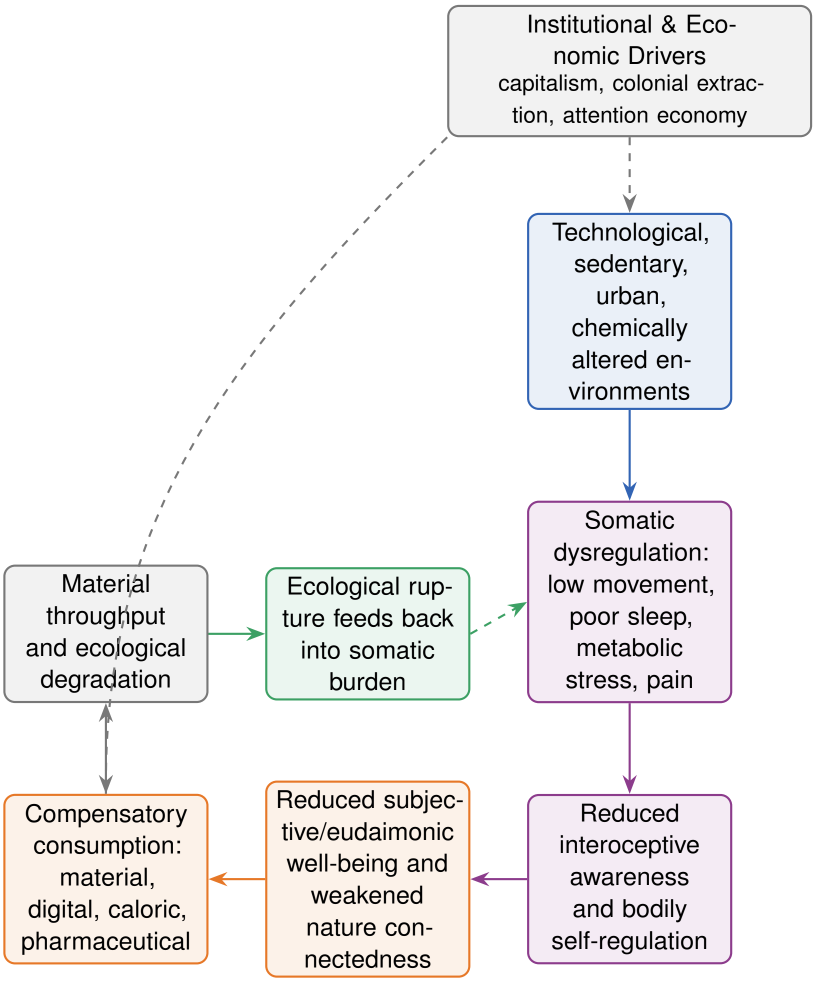


Figure 1: The Somatic Anthropocene feedback loop. *Note*: Institutional and economic drivers (capitalism, colonial extraction, attention economy) operate as parallel structural forces that synergize with somatic mediation; they are not depicted as upstream causes in a unilinear causal chain. The palette distinguishes civilizational drivers, somatic dysregulation, compensatory mechanisms, planetary extraction, and ecological feedback.

Table 1: Division of labour between the article and the companion essay.

Dimension	**Main article: empirical-conceptual framework**	**Companion essay: philosophical interpretation**
Primary function	Develops the Somatic Anthropocene as an interdisciplinary research model.	Interprets the Somatic Anthropocene through embodied orientation and ecological embeddedness.
Central question	How may bodily dysregulation mediate and amplify ecological crisis through well-being, interoception, nature connectedness, and compensatory consumption?	How might ecological, gravitational, interoceptive, and relational grounding shape lived experience and ecological care?
Main concepts	Somatic Anthropocene; somatic dysregulation; compensatory consumption; nature connectedness; subjective and eudaimonic well-being; Somatic Restitution Index.	Embodied orientation; embodied ecological relation; somatic restitution; body as embedded in biospheric processes; somatic justice; a speculative fertility-related signal.
Methodological status	Narrative conceptual synthesis with explicit evidence classification and preliminary operationalisation.	Philosophical and phenomenological companion essay; theoretical synthesis and speculative extension.
Evidential range	Primarily L1–L4, with speculative notes clearly marked.	Primarily L4–L5; concepts are offered as philosophical interpretations rather than empirical conclusions.
Role of the SRI	Proposed as a complementary public-health and sustainability profile requiring empirical validation.	Interpreted as a philosophical reading of the bodily conditions for ecological care.
Risk managed by separation	Avoids overextending empirical claims into metaphysical conclusions.	Avoids presenting philosophical interpretation as direct empirical evidence.

1.4 Scope and boundary conditions

Boundary condition.

The framework has eight boundary conditions.
First, it is not monocausal. Second, it is not anti-technology. Third, it is not romantic primitivism. Fourth, it is not a systematic review, but a narrative conceptual synthesis.
Fifth, the framework separates its scientific-conceptual argument from broader philosophical extensions concerning embodied orientation, embodied ecological relation, and disembodiment.
Sixth, the framework does not claim that somatic dysregulation operates independently of capitalism, colonial extraction, fossil-fuel dependency, or institutional power. It argues instead that these forces operate through bodies, and that bodily conditions are an undertheorized mediating layer.
Seventh, the framework does not assume normative or able-bodied embodiment. References to bipedalism, upright posture, and locomotion in § 3.5 describe species-level evolutionary predispositions, not physical ideals. Somatic restitution and the Somatic Restitution Index must accommodate disabled, aging, neurodivergent, and differently embodied populations without moral ranking.
Eighth, AI companions and algorithmic sociality are treated as emerging environmental variables. Their effects on somatic regulation, loneliness, attachment, and compensatory consumption require further longitudinal study (see § 5.3).

1.5 Alternative explanations and counter-evidence

The Somatic Anthropocene hypothesis must be tested against alternative explanations and counter-evidence. First, high consumption can co-occur with high well-being: several Scandinavian nations combine high GDP with high life satisfaction and relatively low compensatory consumption, suggesting that institutional design (welfare, labour protection, digital regulation) may moderate the somatic–consumption link. Second, low consumption does not guarantee somatic integrity: populations in low-income countries may experience severe somatic stress from physical labour, pollution, heat, and infectious disease without high material throughput. Third, education and income remain powerful independent predictors of health and consumption that may override or interact with somatic variables. The framework therefore treats somatic mediation as *conditional*, not universal, and invites research on institutional moderators.

Against somatic determinism. A further risk is that the framework could be misread as claiming that tired, dysregulated bodies *cause* overconsumption, thereby biologizing a political-economic process. We explicitly reject this reading. Somatic dysregulation is not an independent engine of capital accumulation or overconsumption; it is a *permissive* and *amplifying* condition within wider economic, institutional, and platform-driven pressures. Transnational marketing, labour precarity, housing unaffordability, and extractive supply chains remain primary drivers. The Somatic Anthropocene adds that chronic sleep deprivation, sedentarism, and interoceptive depletion may make these structural drivers more behaviourally effective. The body is a site of *mediation*, not a site of *origination*.

1.5.1 Intersectional boundary conditions

A fourth layer of boundary conditions concerns intersectionality. Somatic dysregulation does not operate uniformly across populations. Race, class, gender, caste, and colonial history structure both exposure to environmental risk and access to restorative environments (for the theoretical foundations, see Federici, 2012; Fraser, 2016). Working-class bodies, racialized bodies, and bodies in the Global South often bear disproportionate loads of chemical exposure, heat stress, and physical labour while having reduced access to green space, sleep security, and nutritious food. The Somatic Anthropocene framework therefore anticipates that the somatic–consumption loop will be *moderated* by inequality: populations under structural stress may experience somatic dysregulation without the compensatory consumption typical of high-income sedentary cohorts, because resource constraints block the consumption pathway while amplifying the health burden. Conversely, affluent populations may experience high compensatory consumption with relatively lower chemical and heat exposure. The SRI must be designed to capture these intersecting gradients rather than imposing a single somatic norm. Intersectional analysis also requires distinguishing exposure from restoration. Working-class, racialized, caste-marginalized, rural, agrarian, informal-settlement, and climate-exposed populations may spend substantial time outdoors or in direct contact with land, water, heat, or weather, yet this contact may be extractive rather than restorative when it occurs under conditions of labour coercion, pollution, unsafe infrastructure, or environmental risk.

Table 2: Intersectional moderation of the Somatic Anthropocene feedback loop

Loop mechanism	**Class**	**Race / caste / coloniality**	**Gender / care burden**
Somatic dysregulation	High chemical exposure + low green-space access; physical labour without recovery infrastructure.	Racialized segregation concentrates toxic sites, reduces sleep security, and limits park access.	Unpaid reproductive labour and "motherhood penalty" deplete allostatic reserve; medical gaslighting delays care.
Compensatory consumption	Income constraints block consumption pathway; dysregulation amplifies health burden without material outlet.	Predatory marketing of ultra-processed foods and payday credit in marginalized neighbourhoods.	Gendered targeting of wellness commodities and convenience goods; time poverty may drive outsourced care consumption.
Ecological degradation / health burden	Working-class communities bear disproportionate heat, pollution, and flood risk.	Environmental racism and slow violence concentrate infrastructure in sacrifice zones (Nixon, 2011; Pulido, 2017).	Care work exposes women to climate stress and pollution; fertility intentions constrained by housing precarity.

2 Method: Narrative Conceptual Synthesis

2.1 Literature domains

This article draws on ten domains: (1) Anthropocene and planetary-boundary research; (2) One Health and Planetary Health; (3) syndemic theory and the Global Syndemic literature; (4) social metabolism and socio-economic metabolism; (5) embodied cognition, enactivism, and ecological psychology; (6) interoception, homeostatic feeling, affective neuroscience, and autonomic regulation; (7) nature connectedness, body image, self-compassion, and pro-environmental behaviour; (8) public-health research on sedentary behaviour, physical activity, sleep, obesity, myopia, youth mental health, loneliness, and digital exposure; (9) subjective well-being, eudaimonia, affect theory, materialism, voluntary simplicity, sufficiency, and compensatory consumption; and (10) sustainability economics, including GDP critique, degrowth, post-growth, doughnut economics, and material throughput.

2.2 Evidence classification

Each link in the model should be read according to its level of evidential support. Table 3 provides the interpretive key.

Table 3: Evidence levels used in the Somatic Anthropocene

Evidence level	Meaning	Use in this article
L1 Established empirical evidence	Supported by multiple empirical studies, official data, or strong disciplinary consensus.	Sedentary behaviour and health risk; physical activity and health; environmental degradation and health burden; consumption and material throughput.
L2 Correlational association	Supported by cross-sectional, observational, or survey-based association.	Interoception and nature connectedness; climate concern and fertility intentions; materialism and well-being; screen time and mental health.
L3 Mechanistic plausibility	Supported by biological, psychological, or behavioural mechanisms but not yet confirmed as a full causal chain.	Sleep displacement; reduced outdoor exposure; compensatory consumption after reduced well-being; altered reward-sensitivity hypotheses; sleep/circadian disruption and reproductive health; environmental reproductive burden.
L4 Theoretical synthesis	A proposed integration of multiple literatures requiring validation.	The full Somatic Anthropocene loop; the SRI as a multidimensional profile; somatic political ecology; perceived reproductive viability as an integrated research construct.
L5 Speculative extension	Philosophical interpretation or speculative extension beyond current empirical evidence.	Companion-essay concepts such as embodied orientation and disembodiment critique; speculative interpretation of fertility decline as a population-level viability signal; other philosophical extensions.

Because this is a narrative conceptual synthesis rather than a systematic review, source selection prioritized relevance to model construction. This creates a risk of confirmation bias. To mitigate this, the article (a) explicitly distinguishes evidence levels (L1–L5, Table 3); (b) includes alternative explanations in § 1.5 and

§ 8.6; and (c) maps every major claim to its evidential status in Appendix 9. The methodological approach aligns with scoping review conventions (Arksey & O'Malley, 2005): purposive, iterative, and designed for model construction rather than exhaustive coverage.

3 The Body as Ecological Mediator

3.1 Embodied cognition and ecological psychology

Classical cognitive science often treated cognition as internal computation performed by a brain that receives inputs and produces outputs. Embodied and enactive approaches challenged this picture. Ecological psychology argues that perception is directed toward affordances: possibilities for action offered by the environment to an organism (Gibson, 1979). Enactivism similarly holds that cognition arises through sensorimotor coupling between organism and world (Chemero, 2009; Thompson, 2007; Varela et al., 1991).

In this perspective, the body is not an inert container of a mind. It is the active medium through which the world becomes meaningful. A slope is perceived as climbable or dangerous in relation to legs, balance, fatigue, age, skill, and expectation. A forest is not only a visual scene; it is a field of smells, textures, sounds, gradients, temperatures, and possible movements. Ecological value is therefore not generated by abstract cognition alone; it may be partly shaped by embodied interaction, interoceptive awareness, and repeated contact with living environments.

The Somatic Anthropocene extends this insight to planetary theory as a mediating pathway rather than a metaphysical conclusion. If ecological value is partly shaped by embodied interaction, then environments that reduce movement, outdoor exposure, sensory variation, and interoceptive awareness may weaken some psychological and behavioural conditions for ecological care.

3.2 Interoception and homeostatic feeling

Interoception refers to the sensing of internal bodily states, including heartbeat, respiration, visceral sensations, temperature, pain, hunger, and autonomic arousal (Craig, 2002; Khalsa et al., 2018). Affective neuroscience has argued that emotions and values are grounded in homeostatic regulation and bodily feeling (A. Damasio, 2018; A. R. Damasio, 1994).

If values depend partly on bodily feeling, then chronic dysregulation may alter the affective background of everyday life. Poor sleep, low activity, chronic pain, obesity, loneliness, and digital overstimulation are not only individual symptoms. They may change what feels desirable, intolerable, rewarding, or sufficient.

This claim should not be read as biological determinism. Institutions, culture, poverty, inequality, advertising, and political structures shape desire. However, these forces operate through bodies. A person who is exhausted, lonely, inflamed, sleep-deprived, sedentary, and digitally overstimulated may be differently positioned toward consumption than a person who is rested, socially connected, physically active, and regularly exposed to restorative environments.

Neurobiological markers. Recent affective neuroscience suggests two possible bridges between interoception and ecological disposition. First, heart-rate variability (HRV)—a peripheral index of autonomic flexibility—correlates with interoceptive accuracy and emotional regulation (established empirical evidence, L1; Khalsa et al., 2018; Thayer & Lane, 2009). Low HRV may mark allostatic overload and reduced capacity for emotional regulation relevant to prosocial and ecological concern. Clinically, reduced resting HRV (for example, SDNN values in the lower population quartile) correlates with diminished interoceptive accuracy, elevated inflammatory tone, and impaired prefrontal regulation of emotional responses (Khalsa et al., 2018; Thayer & Lane, 2009). This makes HRV a candidate biomarker for the SRI interoception domain, alongside self-report scales. Second, the default mode network (DMN) appears to narrow under chronic digital stress and sleep disruption toward ego-centric, survival-oriented self-referential processing, whereas states of high interoceptive quiet (rest, nature immersion, slow breathing) are associated with a more expansive DMN configuration linked to existential and ecological cognition (Brewer et al., 2011; theoretical synthesis, L4). These findings suggest that the Somatic Restitution Index (§ 7) could incorporate HRV as an objective biomarker of the interoceptive domain, and that interoceptive restoration may support ecocentric rather than narrowly egocentric valuation. For the phenomenological grounding of interoception as embodied orientation, see the companion essay (Lick, 2026, § 3.3).

3.3 Nature connectedness and pro-environmental behaviour

Nature connectedness has been associated with pro-environmental behaviour and well-being in multiple studies (Mayer & Frantz, 2004; Whitburn et al., 2020). Although the causal direction remains complex, the association is theoretically important: people who experience themselves as connected to nature are more likely to act in ways that protect it.

Recent work also suggests links between interoceptive awareness and nature connectedness. Swami et al. (2026), in the largest cross-national study to date ($N = 50\,363$, 58 nations, 36 languages), reported evidence consistent with an indirect association between nature contact and life satisfaction through positive body image—the felt sense of bodily agency, functionality, and appreciation. Self-compassion emerged as the strongest mediator ($\beta = 0.31$, $p < .001$). The model was invariant across sex, age, and language, replicating in 53 of 58 countries. This finding is consistent with one component of the Somatic Anthropocene framework: the hypothesis that nature contact and well-being are mediated partly through embodied self-experience.

Where cultural contexts diverge—as in five of fifty-eight nations (India/Hindi, Brazil, Taiwan, Pakistan, Latvia) where the model showed non-invariance—the pathway may be moderated by urban density, inequality, or differing cultural scripts of embodiment. The Somatic Anthropocene framework explicitly anticipates such moderation (see § 6.12). These non-invariant cases function as *stress tests* for the model: they indicate that the nature–body–well-being link is not universal but is conditioned by structural and cultural variables that must be integrated into future SRI operationalisation.

3.4 From body awareness to ecological value

The central claim of this section is not that a single bodily variable directly predicts or explains ecological behaviour. Rather, the claim is that ecological value may be partly shaped by embodied interaction, interoceptive awareness, and repeated contact with living environments. The loss of daily bodily contact with living environments may reduce the felt salience of ecological destruction. In this sense, bodily conditions may mediate how Earth-system changes become culturally meaningful and behaviourally actionable.

3.5 Evolutionary architecture of the somatic subject

[This section operates at the level of established empirical evidence (L1) and theoretical synthesis (L4).]

Human bipedalism was a major anatomical shift in mammalian evolution. The transition to habitual upright walking, occurring approximately 4–6 million years ago, restructured the entire axial skeleton: the spine became S-shaped, the pelvis shortened and broadened, the foramen magnum shifted ventrally, and the lower limbs elongated (Lovejoy, 1988). These changes created biomechanical vulnerabilities that modern sedentary environments intensify.

These evolutionary constraints describe population-level predispositions, not normative physical ideals. The term “mismatch” refers to a discordance between evolved environmental expectations and contemporary environmental design, not to individual biological deficiency or able-bodied normativity.

The lumbar spine, in particular, bears the mechanical cost of bipedalism. Intravital pressure measurements demonstrate that the intervertebral disc experiences pressures of 100–140 kg/cm^2 during quiet standing, rising to 150–190 kg/cm^2 during walking, and exceeding 220 kg/cm^2 during loaded flexion (Nachemson & Elfstrom, 1970). Prolonged sitting—the defining posture of the digital knowledge worker—generates disc pressures of 140–150 kg/cm^2, approaching those of heavy lifting and exceeding those of upright locomotion (Wilke et al., 1999). The seated position becomes biomechanically harmful when maintained for 8–12 hours daily, partly because spinal discs depend on movement for nutritional diffusion.

The cervical spine faces a complementary load in the digital age. The “text neck” posture—head tilted forward at 45–60 degrees to view a smartphone—multiplies the effective weight of the head on the cervical vertebrae from approximately 5 kg to 20–27 kg, generating compressive forces comparable to carrying a seven-year-old child on the neck for several hours daily (Hansraj, 2014). This adds cervical strain to the lumbar burden of prolonged sitting.

The obstetric dilemma compounds this vulnerability. Bipedalism narrowed the pelvic outlet while encephalisation expanded fetal cranial dimensions, creating an evolutionary trade-off resolved through premature neurological birth and prolonged postnatal dependence (Rosenberg & Trevathan, 2002). The human infant is born with only 25% of its adult brain volume, making the first years of life a period of extreme neuroplastic somatic coupling with the environment. This evolutionary legacy suggests that the developing body expects mechanical, vestibular, and proprioceptive input. Their systematic absence—as in indoor, seated, digitally mediated childhood—may represent a major developmental mismatch (Gluckman & Hanson, 2016; Lieberman, 2013).

In the Somatic Anthropocene framework, these evolutionary constraints are not deterministic. They are predispositions: the human body is predisposed to suffer under sustained hypodynamia, not because it is poorly designed, but because it was designed for movement variability that industrial and digital environments have progressively eliminated. The axial skeleton—spine, pelvis, lower limbs, and cervical complex—is a key site of this vulnerability. For the philosophical interpretation of the axial body as the ground of consciousness, see the companion essay (Lick, 2026, § 3).

3.6 Non-normative embodiment and the Somatic Anthropocene

Evolutionary mismatch describes population-level predispositions, not normative physical ideals. Wheelchair users may exhibit high nature connectedness despite low standard motor metrics; blind users may experience ecological embeddedness through acoustic and haptic channels. The SRI must avoid ableist normativity in the Motor integrity domain. Furthermore, in low-income and marginalized communities, somatic dysregulation includes heat stress, pollution exposure, and physical labour—factors not reducible to screen time (Nixon, 2011; Pulido, 2017).

4 The Sedentary Rupture: First-Order Somatic Dysregulation

4.1 Sedentary behaviour and evolutionary mismatch

Human physiology evolved under conditions of substantial movement variability: walking, carrying, climbing, squatting, manipulating, foraging, and navigating complex terrain. Modern environments increasingly replace this variability with prolonged sitting, mechanized transport, indoor labour, and screen-based leisure. Evolutionary medicine describes such mismatches as conditions in which bodies adapted to one range of environments are exposed to radically different ones (Gluckman & Hanson, 2016; Lieberman, 2013).

Sedentary behaviour has been associated with cardiometabolic risk, musculoskeletal problems, and all-cause mortality, even when some physical activity is present (Biswas et al., 2015; Ekelund et al., 2016). The Somatic Anthropocene does not need to claim that sitting is the root of ecological crisis. It is sufficient to observe that sedentary environments can reduce physical vitality, outdoor exposure, sleep quality, and embodied engagement with the non-built world.

4.2 Developmental mismatch and reduced sensorimotor input

[This section operates at the level of established empirical evidence (L1) and theoretical synthesis (L4).]

The post-industrial economy has normalized a new daily pattern: 8–12 hours seated before a screen while performing intensive cognitive work. Neurobiological data indicate that this regime is associated with reduced cerebral blood flow, insulin resistance, and chronic neuroinflammation, which are linked to deterioration rather than improvement of executive function (Falck et al., 2017). The prefrontal cortex may operate under cognitive strain against a background of metabolic deficit.

Sleep deprivation amplifies this profile. Functional neuroimaging shows that sleep loss hyperactivates the ventral striatum and weakens medial prefrontal deactivation, creating a fast-dopamine bias toward immediate, low-effort rewards (Gujar et al., 2011). Concurrently, the dorsolateral prefrontal cortex loses capacity to integrate health-related signals, leading to systematic preference for calorie-dense options even when risks are consciously recognized (Greer et al., 2013).

When mechanical, vestibular, and proprioceptive input are reduced, the body may receive fewer of the signals that support mature sensorimotor function. The result may be a pattern of dissociated cognitive stress: high mental demand with low somatic support. The mind is active but deprived of somatic support; the body is present but deprived of agency. This pattern may increase anxiety, burnout, and compensatory dependence on products or platforms.

AI companions and algorithmic sociality may add a relational vector to this developmental mismatch; because the evidence is still emerging, the claim is treated separately as a provisional boundary condition in § 5.3.

This regime is not only a set of individual choices. It is also shaped by institutions and infrastructures. Contemporary governance treats the body as a productive unit whose value is measured by cognitive output and consumption input, not by somatic integrity. The sedentary workplace, the standardized school chair, and 24-hour digital availability are not neutral. They organize labour around bodies with reduced movement, recovery, and ecological contact. The companion essay develops the philosophical implications of arrested somatic development under digital sedentarism (Lick, 2026, § 5).

4.3 The Industrial Interlude: three waves of hypodynamia

The sedentary rupture is not a single event. It is a cumulative process across three technological waves. The Neolithic Revolution introduced chronic sitting through agriculture and settlement; the Industrial Revolution intensified it through mechanised labour; and the Digital Revolution intensifies it by reducing the residual motor variability that industrial life still preserved.

During the nineteenth and early twentieth centuries, the factory system imposed prolonged static postures—twelve-hour shifts at looms, benches, and assembly lines—that compressed the lumbar spine and desensitised interoception no less severely than the modern office chair. Yet the industrial worker retained several residual channels of organism–environment coupling: pedestrian commute, physical domestic labour, and predominantly outdoor leisure. The industrial body was hypodynamic during labour but not during life.

The digital revolution has eliminated these residuals. The contemporary knowledge worker sits for eight hours at the office, commutes by automobile (also seated), and spends leisure time in the same chair before a screen. The transition from industrial to digital hypodynamia is therefore qualitative: it removes many of the everyday movements that once interrupted sitting.

This historical layering has methodological implications. Studies that compare predigital generations with digital natives often attribute all observed differences to screen time alone. Yet older cohorts were already shaped by earlier sedentary transitions. The digital generation does not inherit a "natural" body suddenly corrupted by screens. It inherits a body already shaped by agricultural, industrial, and post-industrial sedentary environments. Digital environments may represent a further intensification of long-standing sedentary trends by reducing residual forms of everyday movement, outdoor exposure, and sensorimotor variability that persisted in agricultural and industrial life. Apparent epidemiological accelerations in younger cohorts should therefore be interpreted as possible nonlinear intensifications rather than as evidence of terminal reduced somatic reserve.

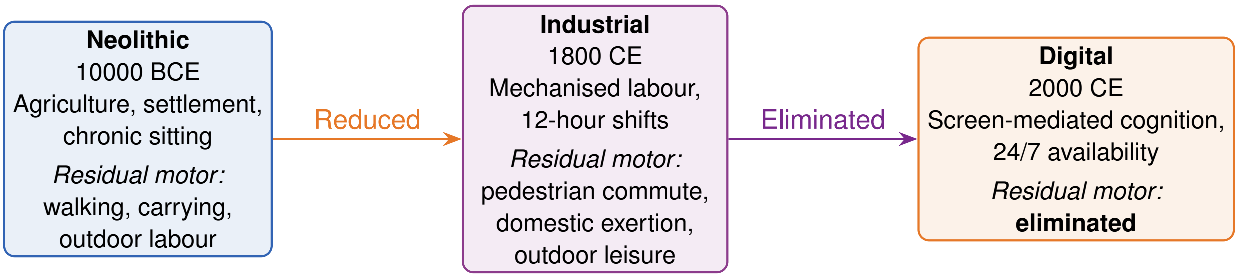


Figure 2: The three waves of sedentarisation and the progressive reduction of residual motor variability. The Digital wave may intensify earlier sedentary transitions by reducing residual forms of everyday motor variability.

4.4 Chemical and endocrine disruption

The modern body also faces chemical exposures that compound the effects of sedentarism. Endocrine-disrupting chemicals (EDCs)—including bisphenol A (BPA), phthalates, per- and polyfluoroalkyl substances (PFAS), and persistent organic pollutants—permeate food packaging, drinking water, household dust, and consumer products (Grandjean & Landrigan, 2014; Trasande, 2017). These compounds interfere with hormonal signalling at doses previously considered safe, producing non-monotonic dose–response curves that confound traditional toxicological thresholds.

Microplastics are another emerging exposure. Particles $<5\ \mu$m have been detected in human placenta, blood, and deep lung tissue, with unknown but potentially significant inflammatory and endocrine consequences (Landrigan et al., 2023). The Minderoo-Monaco Commission estimates that plastic production has risen from 2 million tonnes in 1950 to 460 million tonnes in 2022, with the human body now serving as a sink for polymer-associated chemicals including plasticisers, flame retardants, and heavy metals. In the Somatic Anthropocene framework, microplastic accumulation is not only a toxicological issue. It also shows how the technosphere enters bodily tissue.

The Developmental Origins of Health and Disease (DOHaD) framework is consistent with the claim that early-life chemical exposure may programme metabolic trajectories decades in advance (Heindel et al., 2017). Prenatal exposure to BPA and phthalates predicts childhood obesity, insulin resistance, and neurobehavioural disorders. PFAS accumulation—now detectable in 99% of the US population—correlates with reduced vaccine efficacy, thyroid dysfunction, and gestational diabetes. The somatic cost of the Anthropocene may therefore begin during gestation and early childhood.

These chemical stressors interact synergistically with sedentary behaviour, sleep disruption, and ultraprocessed diets to shape what can be termed the Anthropocene metabolic phenotype: chronic low-grade inflammation, insulin resistance, leptin dysregulation, and impaired glucocorticoid feedback. This phenotype is not only a medical problem. It is a somatic condition that alters affective tone, energy budgets, and the capacity for sustained attention—thereby increasing vulnerability to the compensatory consumption loop detailed in § 5. Chemical exposure is therefore not separate from sedentary rupture. It may be its biochemical complement.

5 Civilizational Escalation

5.1 Subjective well-being as the missing mediator

5.1.1 Body, health, and happiness

Subjective well-being includes affective well-being, evaluative life satisfaction, and eudaimonic meaning (Diener, 1984; Ryan & Deci, 2001). Health and happiness are bidirectionally related: better physical and mental health supports well-being, while higher well-being is associated with healthier behaviours, lower stress, and better long-term outcomes (Pressman & Cohen, 2005; Steptoe, 2019).

This literature helps solve a weakness in earlier versions of the Somatic Anthropocene model. The body does not need to be portrayed as directly producing ecological extraction. Instead, somatic dysregulation may reduce well-being and sufficiency, which may increase compensatory consumption.

5.1.2 Three dimensions of well-being

Hedonic well-being (pleasure/pain, affect) is grounded in homeostatic feeling (A. Damasio, 2018). When the body is chronically dysregulated, the affective background shifts toward diffuse deficit. This is the first bridge to compensatory behaviour.

Eudaimonic well-being (meaning, vitality, rootedness) is the key construct for the Somatic Anthropocene. Eudaimonia is not simply "happiness" but the sense of fullness, self-realisation, and connectedness. Its loss under somatic dysregulation explains why material improvement fails to compensate for deficit—the Easterlin paradox (Easterlin, 1974; Kahneman & Deaton, 2010).

Sufficiency is the least studied but most relevant dimension: the felt sense of "enough." Work on voluntary simplicity shows that people with high eudaimonic well-being are less vulnerable to consumerism (Brown & Kasser, 2005; Kasser, 2016).

5.1.3 The Global Flourishing Study

The Global Flourishing Study (VanderWeele et al., 2025), covering 202,000 participants across 22 countries in *Nature Mental Health*, reports a historically unprecedented finding: young adults aged 18–29 now "flourish" less than adults aged 60–70. In 18 of 22 countries studied, younger adults reported significantly lower scores on purpose, relationships, and meaning—the first reversal of the age–well-being gradient in measured history. In these data, youth no longer appears as the peak of measured flourishing. This finding is consistent with the possibility that younger cohorts are experiencing a population-scale deficit in meaning, relationship quality, and subjective flourishing, although the study does not by itself identify somatic dysregulation as the cause.

5.2 The loneliness paradox: connected infrastructure, isolated bodies

The loneliness paradox of Generation Z and Alpha may be partly structured by the digital condition. Social media platforms offer connection as signal while reducing many bodily features of connection: co-presence, facial feedback, voice, touch, timing, and shared space. What remains is social performance without social nutrition.

Data from Cigna (2023) indicate that 80% of Gen Z felt lonely in the past twelve months, compared with 45% of Boomers. Gen Z is described as "the loneliest and least resilient demographic group currently living" (as reported in a commercial survey; Cigna 2023). Yet 95% of teenagers own smartphones and 45% are online constantly (Pew Research Center, 2023). More technologically connected, yet often more socially isolated.

Some clinical and addiction-oriented models interpret compulsive digital use through reward-sensitivity mechanisms, although direct neurobiological evidence in ordinary social-media users remains limited. In this interpretation, slower embodied rewards such as walking, conversation, silence, or nature contact may become less immediately salient than high-intensity digital stimuli, increasing the likelihood of repeated digital compensation (Lembke, 2021). Platform design may further reinforce this loop by monetizing attention, emotional arousal, and repeated engagement (Roberts et al., 2025). This reward-sensitivity architecture may be further reinforced by platform attention economies that use algorithmic variable-reward schedules; the proposed neurobiological and political-economic mechanisms of this loop are developed in § 5.2.1.

In this framework, loneliness is not only a psychological variable. It is a form of somatic dysregulation that adds a feedback contour to the main loop: isolation → digital compensation → further somatic dysregulation → deeper isolation.

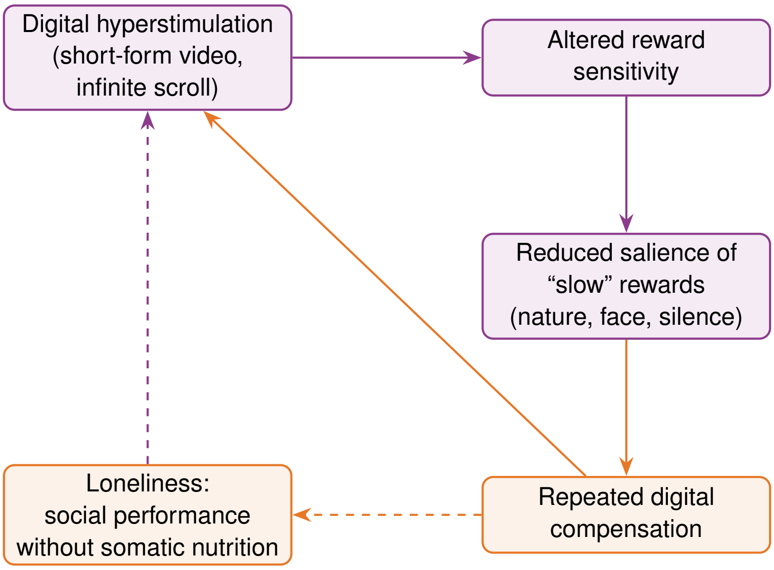


Figure 3: The digital–reward–loneliness loop: a self-reinforcing cycle in which digital compensation deepens the somatic isolation it promises to relieve.

5.2.1 The dopaminergic loop of platform capitalism

Boundary condition

This section synthesizes behavioural neuroscience and platform studies. It does not claim direct in-vivo neurochemical measurement of dopamine release in ordinary users, but constructs a mechanistically plausible model based on established reward-circuitry principles.

The loneliness paradox described above is not only a psychological deficit; it may also be monetised through what this article terms the *dopaminergic loop of platform capitalism* (mechanistic plausibility, L3; see also Lembke, 2021; Roberts et al., 2025; Zuboff, 2019). Social-media platforms and short-form video architectures deploy algorithmic variable-reward schedules functionally analogous to operant conditioning, but scaled to population-level engagement. Each scroll, notification, and variable content burst may provide short reward pulses that momentarily mask the tonic interoceptive deficit produced by sedentary, socially depleted environments.

Short-form video platforms (TikTok, Reels, Shorts) intensify this architecture through micro-temporal reward pacing: content intervals of 15–60 seconds prevent habituation and sustain maximal anticipatory arousal (Y. Zhang et al., 2023). Neuroimaging studies are consistent with the possibility that rapid stimulus switching may narrow prefrontal regulatory control while amplifying limbic reactivity. At the population level, this may support an attentional phenotype more oriented toward consumption than contemplation. The cost is not only psychological. It may also reshape the reward–effort gradient: slow embodied rewards (walking, conversation, craft) become cognitively “expensive” relative to the zero-friction digital alternative.

The body seeks homeostatic satiety—rest, co-regulation, sensory grounding—yet the interface maintains the organism in a state of perpetual anticipatory arousal. This pattern may be reinforced by platform business models that monetize attention, arousal, and repeated engagement. Attention extraction may therefore become a form of bodily extraction, substituting rapid digital reward for slower rewards such as movement, face-to-face synchrony, and nature contact. The result is a self-reinforcing cycle in which somatic dysregulation increases platform dependency, and platform dependency deepens somatic dysregulation, amplifying the compensatory consumption pathway detailed in § 5.4.

Population-scale evidence identifies smartphone use before bedtime as the strongest predictor of short sleep duration among adolescents, surpassing television and computer use (Hysing et al., 2015). The device may therefore contribute to sleep loss while also offering a short-term reward that compensates for fatigue: it disrupts melatonin while simultaneously providing the phasic dopaminergic bursts that the sleep-deprived brain craves, closing a self-reinforcing loop between somatic dysregulation and platform dependency.

Preliminary quasi-experimental evidence is consistent with this displacement mechanism. Myers and Hooper (2026) exploit the 2007–2011 AT&T iPhone exclusivity in the United States—a period during which iPhone access was determined by county-level AT&T mobile broadband coverage—to estimate the effect of smartphone diffusion on birth rates. Synthetic difference-in-differences and entropy-balanced Poisson event studies imply that iPhone access reduced births by 4.5–8.0% at ages 15–19 and 3.2–6.6% at ages 20–24, with null placebo effects on Verizon and Sprint coverage. Time-use data show that minutes per day with friends present fell by 69% among U.S. adolescents aged 15–19 between 2003 and 2024, while time alone rose by 26%. The smartphone may function not only as a competing activity, but also as an always-available alternative to in-person time, engineered to sustain attention through variable reward schedules that displace the peer interactions in which sexual and social encounters form (Myers & Hooper, 2026). However, it is crucial to note that this evidence relies on a preliminary working paper. While the quasi-experimental design is robust, peer-reviewed replication is required before definitive causal weight can be assigned to this specific digital-displacement mechanism.

5.3 AI companions and algorithmic sociality

An emerging boundary condition concerns AI companions and algorithmic sociality. Digital platforms no longer organize attention only through feeds, notifications, and recommendation systems. Increasingly, they also simulate relational presence through conversational agents, emotionally responsive interfaces, personalized companions, synthetic intimacy, and always-available forms of interaction. These systems may become part of the everyday environment through which loneliness, attachment, self-regulation, attention, and compensatory consumption are mediated.

This subsection is necessarily provisional. The long-term effects of AI companions remain insufficiently studied, especially across age, gender, disability, class, culture, and developmental stage. AI companions may provide benefits in some contexts, including emotional support, accessibility, language practice, care navigation, social rehearsal, or reduced isolation. The concern is not AI companionship as such. It is the possibility that these systems may reorganize relational life and alter embodied regulation, interoception, sleep, attention, and consumption patterns. Early evidence is mixed and preliminary: longitudinal language analysis has reported increased loneliness and depression signals alongside deepening AI relational focus, while preregistered experiments suggest that AI companions may reduce loneliness momentarily without necessarily building cumulative social capital (De Freitas et al., 2025; Yuan et al., 2026).

From the perspective of the Somatic Anthropocene, the key question is whether algorithmic sociality functions as a restorative support, a compensatory substitute, or an amplifier of dysregulation. A restorative use would support real-world connection, self-regulation, reflection, access to care, and reduced isolation without replacing embodied relational life. A compensatory use would provide short-term relief from loneliness, boredom, anxiety, or exhaustion while leaving the underlying conditions of isolation, sedentary life, sleep disruption, and digital dependence unchanged. An amplifying use would intensify attachment to screen-mediated environments, increase time online, reduce sleep, reinforce emotional dependency, or generate new pathways for commercial targeting.

The relevant distinction is not simply between "human" and "artificial" interaction. Rather, the distinction concerns whether algorithmic sociality expands or contracts the user's embodied and ecological world. It may expand the world when it helps users seek support, move, rest, learn, regulate stress, reconnect with others, or engage with their physical environment. It may contract the world when it replaces embodied reciprocity with continuous on-demand responsiveness, converts distress into engagement, or turns loneliness into a monetizable interface.

AI companions may also affect interoception and self-regulation. Conversational systems can encourage users to name emotions, track bodily states, reflect on stress, and adopt healthier routines. However, they may also shift regulation outward toward always-available digital reassurance. If the user increasingly relies on algorithmic response rather than bodily awareness, social support, sleep, movement, or environmental change, the system may become part of a compensatory loop. This possibility remains a hypothesis requiring empirical validation.

Algorithmic sociality is also relevant to consumption. Emotionally adaptive systems may eventually connect companionship, recommendation, advertising, entertainment, therapy-like interaction, and commerce. In such cases, loneliness and dysregulation could become pathways into highly personalized consumption. This would extend platform capitalism from attention capture toward affective and relational capture. The Somatic Anthropocene framework should therefore treat AI companions not only as communication tools, but also as possible infrastructures of affective regulation and consumption mediation.

Table 4 summarizes candidate pathways through which AI companions and algorithmic sociality may interact with the Somatic Anthropocene feedback loop.

Table 4: AI companions and algorithmic sociality as emerging variables in the Somatic Anthropocene framework.

Domain	Potential restorative pathway	Potential dysregulating or compensatory pathway
Loneliness and social support	May provide temporary support, social rehearsal, accessibility assistance, or care navigation.	May substitute for embodied reciprocity, deepen isolation, or make loneliness commercially capturable.
Interoception and self-regulation	May help users name emotions, notice bodily signals, and develop regulation practices.	May externalize regulation into constant digital reassurance and reduce tolerance for silence, boredom, or bodily discomfort.
Attention and sleep	May support routines, reminders, and reflection when used deliberately.	May extend screen time, evening device use, notification dependence, and sleep displacement.
Attachment and intimacy	May provide low-risk relational practice or support for socially isolated users.	May produce asymmetrical attachment to systems that simulate availability without reciprocal vulnerability.
Consumption mediation	May reduce impulsive consumption by supporting reflection and self-regulation.	May connect affective distress to personalized recommendations, subscriptions, entertainment, or commercial targeting.
Ecological salience	May encourage outdoor activity, environmental education, and embodied practices.	May further relocate experience into screen-mediated interaction and reduce direct contact with living environments.

Future research should examine whether AI companions are associated with changes in loneliness, sleep, screen time, interoceptive awareness, social connectedness, compensatory consumption, and nature connectedness. Particular attention should be given to adolescents, older adults, disabled users, socially isolated populations, and people using AI companions for emotional support. The central empirical question is not whether algorithmic sociality is good or bad in general, but under what conditions it supports somatic restitution, and under what conditions it becomes part of the compensatory loop.

5.4 Reduced well-being and compensatory consumption

Materialism is consistently associated with lower personal well-being (Dittmar et al., 2014; Kasser, 2016). Emotional eating, retail therapy, excessive social-media use, gambling-like digital mechanics, and compulsive shopping can be understood as compensatory behaviours that may seek external reward when internal regulation and meaning are depleted. Somatic dysregulation is treated here as a permissive and amplifying condition that may increase vulnerability to compensatory consumption under existing economic, institutional, and platform-driven pressures.

Experimental evidence confirms sleep deprivation as a specific amplifier of caloric compensation. In a randomized simulated-supermarket trial, one night of total sleep deprivation increased food purchases by 9% in calories and 18% in grams, with marked preference for high-fat items (Chapman et al., 2013). This nutritional vector operates through the same mesolimbic circuitry as digital rewards, indicating that compensatory consumption is a dual metabolic–digital cascade (Greer et al., 2013).

The evidence here is mixed in causal direction. It is possible that low well-being increases materialism; that materialism reduces well-being; and that both are shaped by inequality, advertising, social comparison, loneliness, debt, or family stress. The Somatic Anthropocene model therefore treats compensatory consumption as a plausible mediator, not as a fully established causal driver.

5.5 Voluntary simplicity and sufficiency

Voluntary simplicity and sufficiency-oriented lifestyles are associated in several studies with higher well-being and lower consumption, though the literature is heterogeneous and culturally specific (Brown & Kasser, 2005; Kasser, 2016). These findings are important because they suggest that reduced consumption need not imply reduced flourishing. Under some conditions, lower material throughput can coincide with higher subjective and eudaimonic well-being.

This point distinguishes somatic restitution from austerity. The goal is not deprivation, but the restoration of internal, relational, and ecological sources of well-being that reduce dependence on compensatory consumption.

5.6 From somatic deficit to growth demand

Somatic dysregulation does not create growth-oriented capitalism. Rather, it may function as a *permissive condition*: a population-level somatic state that can make individuals and communities more susceptible to compensatory consumption engineered by food systems, platforms, and fossil-fuel infrastructures (Zuboff, 2019). The causal arrow does not run simply from biology to economy. Institutions shape environments that may produce somatic outcomes, and those bodily states may make market mechanisms more effective. The framework therefore treats bodily dysregulation as a *mediator* and *amplifier* within political economy, not as its substitute.

A more defensible version of the Somatic Anthropocene hypothesis is therefore: Somatic dysregulation may reduce interoceptive and subjective well-being, increasing vulnerability to compensatory consumption. Growth-oriented economic systems can exploit and amplify this vulnerability. The resulting material throughput contributes to ecological degradation, which then feeds back into bodily and mental health burden.

The pharmaceutical loop illustrates this process. The 504–588% increase in adolescent GLP-1 prescriptions

(2020–2023) coincides with the financialization of metabolic management: synthetic royalties, priority review vouchers, and portfolio structures treat chronic pharmacological dependence as a revenue stream decoupled from therapeutic outcome (Kesselheim et al., 2016; Lee et al., 2024; Lo, 2012). The synthetic royalty "follows" the drug in perpetuity, permanently embedding cost in price regardless of patient ability to pay.

Restitution as commodity. It is important to distinguish structural restitution from its commodified substitute. The wellness industry, quantified-self technologies, and corporate mindfulness programmes increasingly convert somatic repair into data commodities and human-capital optimisation. An SRI-based policy must therefore guard against financialising the body anew: restitution fails if it becomes merely another metric for insurance risk, productivity enhancement, or platform engagement.

5.7 The political economy of insufficiency

A further implication is that somatic restitution may conflict with some growth-oriented business models. Attention platforms, ultra-processed food systems, wellness markets, and parts of the pharmaceutical economy do not simply satisfy pre-existing needs; they often profit from states of fatigue, loneliness, dysregulation, boredom, anxiety, and low interoceptive clarity. The chronically insufficient subject is economically valuable because distress can be converted into engagement, craving, purchasing, subscription, treatment, or self-optimisation. In this sense, the Somatic Anthropocene is not only a public-health problem but also a political-economic one: certain markets are structurally aligned with the perpetuation of somatic deficit.

This does not imply intentional conspiracy or monocausal blame. Rather, it identifies an incentive structure. A population that sleeps poorly, moves little, feels lonely, and lacks non-material sources of sufficiency is more available to compensatory markets. Conversely, a population with stronger sleep, movement, social connection, interoceptive awareness, and ecological contact may be less dependent on fast-reward consumption. Somatic restitution therefore threatens not only unhealthy behaviours but also the demand conditions on which some forms of platform, food, wellness, and pharmaceutical growth depend.

For this reason, policy proposals such as active-transport infrastructure, outdoor schooling, right-to-disconnect laws, sleep-compatible work schedules, and restrictions on manipulative digital design should not be framed as pleasant lifestyle additions. They are interventions into the political economy of insufficiency. Their purpose is to reduce the structural production of unmet bodily and affective needs that are otherwise converted into material throughput.

5.8 Somatic accumulation by design

Three mechanisms engineer the somatic deficit for extraction. First, food engineering: ultra-processed products hijack homeostatic reward circuits through optimised form–flavour–texture profiles (Gearhardt et al., 2011; Monteiro et al., 2019). Second, platform architecture: infinite scroll, push notifications, and variable reward schedules create phasic dopaminergic debt not incidentally but as a business model (Han, 2015; Roberts et al., 2025; Williams, 2018). Third, urban design: automotive dependency eliminates the residual motor variability that industrial workers once retained through pedestrian commuting (Norton, 2021).

5.9 Technosolutionism and disembodiment: a boundary note

Some forms of technosolutionist discourse approach ecological crisis primarily as a problem of optimization, substitution, and infrastructural redesign. Such approaches can be valuable when they contribute to decarbonization, medical care, ecological monitoring, accessibility, or the restoration of bodily agency. The Somatic Anthropocene framework is therefore not anti-technology. Its concern is narrower: technological imaginaries that treat the body primarily as a replaceable interface rather than as a mediator of ecological relation.

Disembodied technosolutionist imaginaries, including disembodiment and substrate-independent cognition, are not evaluated empirically in this article. They are discussed in the companion essay *Axial Consciousness and the Somatic Anthropocene* as possible extreme forms of somatic alienation (Lick, 2026, § 6.2–6.4). The present article restricts itself to a more modest claim: sustainability discourse should not marginalize embodiment, interoception, mortality, sensory contact, and ecological embeddedness. These are not incidental features of human life. They may be among the bodily conditions through which ecological care, sufficiency, and non-compensatory well-being become possible.

This boundary note is included to clarify the scope of the present argument. The Somatic Anthropocene does not reject technological intervention; it distinguishes between technologies that restore embodied agency and imaginaries that bypass the body altogether. A sustainability transition that treats the body as obsolete may reproduce the very somatic disconnection that the transition needs to overcome.

6 Generation Z–Alpha as Early-Warning Cohorts

6.1 Methodological caution: cohorts versus age groups

Generation Z is commonly defined as those born approximately between 1997 and 2012, and Generation Alpha as those born approximately between 2013 and 2025. However, most epidemiological data are age-based rather than generation-based. Therefore, this article treats Gen Z and older Alpha as overlapping early-warning cohorts, not as cleanly separated biological units. A second limitation concerns geography: much of the available evidence comes from high-income countries. Global claims must remain tentative.

6.2 School as somatic infrastructure

If Generation Z and older Generation Alpha are treated as early-warning cohorts, then the school environment deserves specific attention as a formative somatic infrastructure. Schools do not only transmit knowledge. They organize children's movement, posture, attention, sleep rhythms, outdoor exposure, social interaction, food environments, and digital habits. In this sense, the classroom, timetable, schoolyard, transport route, screen policy, and homework regime all participate in the production of bodily conditions that may later shape well-being, self-regulation, nature connectedness, and vulnerability to compensatory consumption.

This claim should not be read as an argument that schools are the primary cause of youth somatic or psychological burden. Family structure, housing, income, digital platforms, neighbourhood safety, food systems, climate stress, and broader political-economic conditions remain crucial. Rather, schools are important because they are one of the few institutions that structure the daily bodily life of almost all children across long developmental periods. For this reason, even modest changes in school design may have population-level significance.

The standard school day often combines prolonged sitting, limited outdoor time, high cognitive demand, artificial lighting, digital work, time pressure, and restricted spontaneous movement. Physical education, while important, may not fully compensate for a wider institutional architecture of immobility if the rest of the day remains sedentary. From the perspective of the Somatic Anthropocene, the question is therefore not only whether children receive enough exercise, but whether the school environment supports continuous sensorimotor variation, interoceptive awareness, social regulation, rest, and contact with living environments.

Schooling also interacts with sleep and circadian regulation. Early start times, homework load, commuting time, evening screen use, and academic pressure may contribute to sleep restriction, especially among adolescents. Because sleep is linked to affective regulation, metabolic health, attention, and reward sensitivity, school schedules should be understood as part of the broader somatic ecology of youth development rather than as a purely administrative matter.

The school environment also shapes children's ecological perception. Access to schoolyards, trees, gardens, walking routes, outdoor learning, weather exposure, and unstructured play may influence whether nature is experienced as a living field of affordances or as an abstract topic in the curriculum. Environmental education may be less effective when ecological knowledge is delivered to bodies that spend most of the day seated indoors and mediated by screens. A somatic approach to education would therefore connect ecological literacy with movement, sensory contact, outdoor experience, and embodied care.

This perspective suggests the need for a *somatic curriculum*: not a separate subject, but a cross-cutting design principle for schooling. Such a curriculum would include movement-rich classrooms, outdoor learning, sleep education, digital hygiene, breathing and interoceptive practices, access to green and blue space, active transport, healthy food environments, and non-competitive forms of bodily literacy. Its purpose would not be to moralize children's bodies or impose able-bodied norms, but to create conditions in which diverse bodies can regulate, attend, relate, and recover.

Table 5 summarizes candidate school-level domains relevant to the Somatic Anthropocene framework.

Table 5: School as somatic infrastructure: candidate domains for future research and policy design.

Domain	School-level condition	Relevance to the Somatic Anthropocene framework
Movement ecology	Classroom movement, active breaks, physical education, active transport, standing or flexible learning environments.	May reduce sedentary exposure and support sensorimotor development, metabolic regulation, and attentional recovery.
Posture and furniture	Desk design, chair duration, ergonomic variation, floor-based or flexible seating options.	May influence musculoskeletal load, comfort, breathing patterns, and bodily awareness during learning.
Outdoor exposure	Recess quality, outdoor learning, school gardens, tree cover, shade, blue/green space access.	May support nature connectedness, sensory variation, thermal adaptation, and ecological salience.
Sleep and circadian support	School start times, homework load, evening digital demands, light exposure, adolescent sleep education.	May influence affective regulation, reward sensitivity, cognitive performance, and metabolic health.
Digital environment	Screen duration, device policies, notification exposure, platform-mediated homework, digital breaks.	May affect attention, sleep, posture, social interaction, and vulnerability to platform-driven reward loops.
Food environment	Meal timing, nutritional quality, ultra-processed food exposure, hydration access.	May influence metabolic stability, energy regulation, mood, and compensatory consumption patterns.
Social regulation	Bullying prevention, cooperative play, non-commercial social space, teacher-student relational climate.	May reduce loneliness, stress burden, and reliance on digital or material compensation.
Inclusive embodiment	Adapted movement opportunities, disability access, neurodiversity-sensitive environments, non-competitive bodily literacy.	Prevents somatic interventions from becoming able-bodied norms or moralized body ranking.

Future research should test whether school-level somatic conditions are associated with indicators such as sleep quality, physical activity, interoceptive awareness, well-being, loneliness, nature connectedness, screen exposure, food behaviour, and ecological attitudes. Such research would help distinguish individual-level behavioural factors from institutional conditions that structure bodily development. If supported, school design could become a key intervention point for somatic restitution, public health, and sustainability education.

6.3 Gendered somatic load

The Z–Alpha profile is not gender-neutral. Women's bodies carry disproportionate allostatic load through menstrual–sleep synchronization, unpaid care labour, and medical gaslighting (Federici, 2012). Adolescent obesity is associated with elevated PCOS risk (14.7-fold for severe obesity) and oligospermia (–2.4% total sperm count per 5 BMI units), potentially seeding reproductive dysfunction before fertility intentions form; mobile-phone exposure reviews raise additional sperm-parameter concerns (Adams et al., 2014; Assefa, 2025; X. Zhang et al., 2024).

6.4 Mental health and flourishing

Youth mental-health data show substantial concern. International agencies estimate that a significant share of adolescents live with mental disorders, especially anxiety, depression, and behavioural disorders. Many high-income countries report rising anxiety and depressive symptoms among adolescents and young adults, although diagnostic practices, help-seeking, reporting norms, and pandemic effects complicate trend interpretation.

Large well-being studies confirm that young adults in most surveyed countries now report lower flourishing, meaning, and relational satisfaction than older cohorts—a historically unprecedented reversal (VanderWeele et al., 2025). Depression among children aged 6–12 rose 27% between 2016 and 2021, with projections indicating a further 33% increase by 2032. Suicidal ideation exceeds 10% in adolescent samples, and 70% of schoolchildren reported loneliness during the pandemic period. These findings support the view that Gen Z and older Alpha may be experiencing reduced psychosocial reserve.

6.5 Physical health: obesity, activity, sleep, and metabolic risk

Child and adolescent obesity has increased dramatically across recent decades (NCD Risk Factor Collaboration, 2024). This trend reflects food environments, marketing, inequality, urban design, reduced activity, sleep disruption, and globalized ultra-processed diets. Physical inactivity remains another major concern: many adolescents in high-income countries do not meet recommended daily activity levels. Sleep disruption is also widespread and may interact with screen use, stress, school schedules, and social media. Together, obesity, low activity, and poor sleep form a somatic-risk cluster relevant to the Somatic Anthropocene framework.

6.6 The pharmaceutical loop: metabolic compensation as signal

The rise of pharmacological intervention in childhood metabolic dysregulation may constitute both medical progress and a measurable signal of growing adolescent metabolic risk. In the United States, dispensing of GLP-1 receptor agonists to adolescents aged 12–17 increased by 504–588% between 2020 and 2023, with monthly prescriptions climbing from approximately 8,700 to over 60,000 (Centers for Disease Control and Prevention, 2025; Lee et al., 2024). Exposures reported to poison control centres increased by 1,568.8% among 12–17-year-olds from 2021 to 2024.

The rapid pharmacological response to adolescent metabolic risk illustrates how downstream medical systems may become entangled with upstream environmental and behavioural conditions. This should not be read as a critique of treatment for individuals: GLP-1 receptor agonists and related therapies may represent genuine therapeutic advances for adolescents with obesity-related comorbidities. The point is structural rather than moral: pharmacological treatment may expand while the environmental conditions producing metabolic burden—sedentary routines, sleep disruption, food environments, stress, and reduced outdoor activity—remain insufficiently addressed.

6.7 Myopia and sensory ecology

Myopia has increased substantially among children and adolescents, particularly in East Asia, with global projections indicating continued growth (Liang et al., 2025). Contributing factors include near work, educational pressure, reduced outdoor light exposure, and possibly screen use. Myopia is not simply an eye condition in this framework; it is a marker of altered sensory ecology. Children increasingly develop in environments of indoor near-focus rather than outdoor far-focus.

6.8 Screen time: correlations, mediators, and confounders

Screen time is often associated with anxiety, depression, ADHD symptoms, sleep problems, and lower well-being. However, most evidence is correlational and subject to confounding by poverty, unsafe neighbourhoods, family conflict, parental mental health, and lack of outdoor spaces. Reverse causality is also possible. Policy recommendations should focus not only on reducing screen hours, but also on improving sleep, movement, outdoor access, content quality, social support, and family stability.

6.9 East Asia as a concentrated signal

South Korea may be read as a high-intensity case in which several variables relevant to the Somatic Anthropocene hypothesis co-occur: low fertility, high myopia prevalence, dense urbanization, educational pressure, long working hours, and digital saturation. Three variables converge at notable levels:

- **Fertility:** TFR 0.72 (2023), the lowest national rate ever recorded.
- **Myopia:** 80–90% among schoolchildren, the highest globally.
- **Digital saturation:** Highest per-capita screen time and fastest 5G/AI adoption.

Few high-income contexts combine these variables at such notable levels, making South Korea useful for hypothesis generation rather than causal confirmation. Fertility should be interpreted here as a demographic, cultural, and economic stress indicator, not as direct evidence of somatic dysregulation. Caution is required: correlation is not causation, and cultural specificities (education pressure, Confucian family structure, urban density, gendered labour markets) are strong independent predictors that may dominate over somatic mechanisms. Nevertheless, the convergence is theoretically informative.

Feminist political economy note. Fertility decline is not interpreted as biological failure of the species, nor as a call for pronatalist policy. It is read as a biosocial signal that the conditions of reproduction—including housing, care infrastructure, gender equity, and somatic viability—have become structurally hostile. This reading situates fertility within the framework of *reproductive justice* (Ross & Solinger, 2017): the right to have children, not have children, and parent in safe conditions. Somatic stressors may deplete the embodied energy required for care work, but they do not replace the political-economic analysis of gendered labour, housing precarity, and welfare-state retrenchment (Federici, 2012; Fraser, 2016).

6.10 The compounded deficit cluster

Sleep, physical activity, and loneliness do not only add up; they may interact synergistically. Sleep restriction ($<$7 hours in Gen Z vs. 8–9 recommended) impairs emotional regulation, increasing interpersonal conflict and social withdrawal. Hypodynamia reduces serotonin and BDNF, elevating depression risk and subsequent isolation. Loneliness may drive compensatory scrolling, which can displace sleep. The result is not three separate problems but a single somatic cluster with multiple phenotypic expressions.

6.11 The convergence signal: six indicators, one pattern

The Anthropocene has typically been measured in parts per million, species lost, and degrees of warming. The Somatic Anthropocene proposes a complementary focus: bodily, psychosocial, and population-level stress indicators across younger cohorts and their wider developmental context. Six indicators now converge in a pattern relevant to the hypothesis:

1. **Fertility:** Global TFR falling toward 1.8; multiple nations below 1.0. This is a population-level demographic context rather than an attribute of Generation Alpha.
2. **Mental health:** Depression among 6–12-year-olds rose 27% between 2016–2021; suicidal ideation exceeds 10% in adolescent samples.
3. **Physical health:** UNICEF (2024) projects that by 2050 children will face 8-fold greater exposure to extreme heat waves compared with 2020 baselines (UNICEF, 2024).
4. **Loneliness:** 65% of Gen Z report loneliness on two or more dimensions, versus 32% of Boomers (Cigna, 2023).
5. **Reproductive endocrinology:** childhood obesity peaks at ages 6–12 (9.4% prevalence), preceding puberty and establishing insulin-resistant trajectories toward PCOS and oligospermia that will register in demographic data only after a 15–20-year lag (X. Zhang et al., 2024).
6. **Provisional digital–fertility link:** A preliminary NBER working paper exploits the U.S. AT&T iPhone monopoly (2007–2011) as a natural experiment and estimates a 4.5–8.0% decline in teen births associated with smartphone access, with null placebo effects on non-iPhone carriers; peer-reviewed replication is required before this mechanism is assigned definitive causal weight (Myers & Hooper, 2026).

These indicators should not be interpreted as proof of collapse or of a single causal mechanism. They are better read as a convergence of developmental stress signals consistent with the Somatic Anthropocene hypothesis and should be tested through longitudinal, cross-cultural and intervention-based research. Whether this trajectory is reversible depends on structural interventions in schooling, urban design, digital regulation, and food systems.

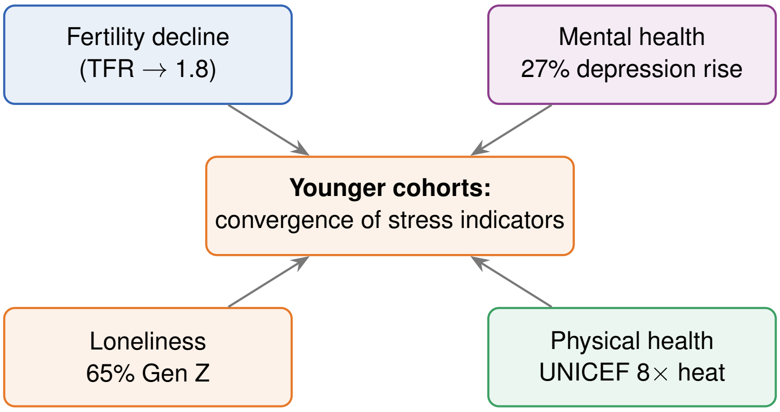


Figure 4: The Convergence Signal: four developmental and population-level indicators relevant to the Somatic Anthropocene hypothesis. The diagram is heuristic and does not imply a single causal mechanism.

6.12 HIC and LMIC variations

These cohorts should not be interpreted as evidence of terminal somatic decline. They are treated here as early-warning cohorts in which multiple indicators of reduced somatic and psychosocial reserve appear to converge. The Z–Alpha profile is not globally uniform. High-income countries often show high screen penetration, high diagnosis rates, high loneliness reporting, and strong monitoring systems. Low- and middle-income countries may show lower screen exposure in rural areas but rapid urban transitions, rising obesity, air pollution, and unequal access to healthcare. In some LMIC regions, children may retain higher physical activity while facing stronger pollution, heat, infectious disease, or food insecurity.

In the most comprehensive exposome study to date in sub-Saharan Africa, Sieber et al. (2026) found that household-level markers of urbanization—mobile phone ownership, electricity access, and proximity to roads—were the strongest predictors of hospital visits in a cohort of 17,145 Mozambican children under five, even after adjustment for healthcare access. While the directionality is partially confounded by differential care-seeking (hospital visits reflect both morbidity and access), the pattern is consistent with the Somatic Anthropocene framework: technological modernity co-occurs with higher early-life morbidity burden at the population level. Notably, paternal absence—affecting 47% of the cohort—emerged as the most "protective" factor against hospital visits, suggesting that structural family dissolution may attenuate healthcare utilization in contexts where formal systems are already strained. This counterintuitive finding should therefore be interpreted not as a biological or structural benefit of family dissolution, but as a methodological reflection of differential healthcare utilization, where paternal absence may correlate with altered household resource allocation, deeper informal maternal support networks, or distinct care-seeking thresholds in resource-constrained environments.

The Somatic Anthropocene should not impose a single Western digital narrative on the world. It should model multiple pathways: sedentary affluence, urban pollution, food-system transition, climate stress, digital leapfrogging, and data scarcity. The framework explicitly anticipates such moderation.

Comparative matrix. HIC contexts show sedentary affluence and high screen penetration; LMIC contexts show urban pollution, food-system transition, and climate stress; digital-leapfrogging contexts (India, Nigeria, Indonesia) show rapid mobile adoption without preceding motor infrastructure. Somatic restitution must include non-Western practices—communal farming, traditional body techniques, religious fasting—as valid regulatory modalities (Escobar, 1998; Leff, 2015).

6.13 LMIC case studies: India, Brazil, and the non-invariance stress test

The cross-national non-invariance observed by Swami et al. (2026) in India (Hindi-speaking sample) and Brazil provides a critical stress test for the Somatic Anthropocene framework. In these contexts, the pathway from nature contact to life satisfaction through positive body image and self-compassion did not replicate invariantly. This divergence is theoretically informative rather than falsifying: it suggests that in highly unequal, densely urbanised, or culturally distinct embodiment regimes, the somatic mediation of ecological value may operate through different mechanisms.

India. Rapid urbanisation, caste-based environmental segregation, and gendered restrictions on outdoor mobility mean that "nature contact" is not uniformly accessible or uniformly interpreted across social strata. For Dalit and Adivasi populations, outdoor labour may be coerced rather than restorative; for upper-caste urban women, park access may be constrained by safety concerns. The Somatic Anthropocene framework must therefore distinguish between *voluntary* nature contact (restorative) and *involuntary* environmental exposure (extractive). The SRI should incorporate measures of environmental justice and coerced labour when applied in such contexts. Furthermore, somatic political ecology in these contexts must account for "extractive hyperextension"—where somatic dysregulation is driven not by sedentary screen time, but by severe physical labour, heat stress, and toxic agricultural exposure, leading to an entirely different allostatic profile that current high-income models fail to capture.

Brazil. Favela residents often experience high nature contact (steep terrain, informal green spaces) alongside high violence exposure, poor sanitation, and chemical contamination. The somatic state produced by such environments is not simply "low nature contact" but *ambivalent ecological embeddedness*: the body is simultaneously in nature and under threat. This suggests that the SRI domain "nature contact" must be disaggregated into *quality of contact* (restorative vs. hazardous) and *agency of contact* (chosen vs. imposed) in LMIC operationalisations.

These cases suggest that the Somatic Anthropocene framework should not be treated as a high-income universal, but as a *scalable heuristic* requiring local calibration. The companion essay develops the philosophical implications of such cultural variation for embodied orientation (Lick, 2026, § 7.3).

7 The Somatic Restitution Index

7.1 Why existing sustainability indicators are incomplete

GDP, HDI, GPI, planetary boundaries, and doughnut economics provide essential information. Yet they rarely measure the bodily conditions that allow people to experience sufficiency, nature connectedness, and non-compensatory well-being. A society can score well on certain economic indicators while producing sedentary, lonely, sleep-deprived, anxious, and ecologically disconnected citizens (Raworth, 2017).

7.2 SRI domains

The Somatic Restitution Index (SRI) is proposed as a preliminary framework, not a validated index. It should be developed through psychometric testing, epidemiological validation, and cross-cultural piloting. The SRI is explicitly designed as a **multidimensional profile** (radar diagram) rather than a single scalar score. A scalar SRI would risk oversimplification, moral ranking of populations, and cultural imposition. The eight domains are intended to be read jointly: a society may score low on motor integrity but high on nature contact, or high on eudaimonia but high on compensatory consumption. Only longitudinal validation can determine whether a composite scalar is theoretically justified. Table 6 presents eight preliminary domains.

Table 6: Preliminary domains for a Somatic Restitution Index

Domain	Possible indicators	Purpose
Postural and motor integrity	Sitting time; daily steps; moderate-to-vigorous physical activity; mobility; musculoskeletal pain.	Measures movement variability and basic bodily capacity.
Interoceptive awareness	Continuous heart-rate variability (HRV) monitoring as a primary objective biomarker to counter self-report bias; validated interoception scales; breath awareness; body-awareness questionnaires.	Assesses bodily self-regulation and internal sensing; autonomic flexibility.
Nature contact	Daily outdoor time; access to green/blue space; unstructured nature exposure.	Measures embodied ecological coupling.
Sleep and circadian stability	Sleep duration; insomnia symptoms; bedtime screen use; regularity.	Captures recovery and temporal regulation.
Subjective well-being	Life satisfaction; positive affect; negative affect.	Measures affective and evaluative well-being.
Eudaimonic meaning and social connection	Purpose; flourishing; loneliness; relationship quality.	Captures non-material sources of sufficiency.
Compensatory consumption	Compensatory consumption risk; materialist values; emotional spending; platform-mediated consumption risk; digital attention economy exposure; emotionally adaptive platforms; AI companions; algorithmic sociality; synthetic intimacy where these shape sleep, attention, loneliness, self-regulation, or compensatory consumption.	Connects bodily and behavioural variables to ecological pressure; captures algorithmic and affective amplification of consumption.
Ecological footprint	Individual/household carbon, water, and material footprints.	Links somatic conditions to planetary pressure.

The pseudo-restitution trap. A central methodological risk for the SRI is that contemporary wellness, quantified-self, and digital-mindfulness industries may simulate restitution without producing measurable autonomic, behavioural, or ecological change. A population may report higher subjective well-being because it uses mindfulness applications, wearable feedback loops, AI companions, or gamified self-care platforms, while showing little improvement in sleep stability, HRV, movement variability, face-to-face social connection, or compensatory consumption. The SRI must therefore not rely on self-report alone. Its validity depends on a dual-layer structure: subjective indicators should be interpreted alongside objective and behavioural measures such as continuous HRV, actigraphy, sleep regularity, outdoor exposure, platform use, impulsive purchasing, and material footprint. Without this safeguard, the SRI may measure digital wellness literacy, social desirability, or access to self-optimisation products rather than genuine somatic restitution. Appendix C develops related operationalisation safeguards for objective biomarkers and pseudo-restitution risk. For implications for policy and future validation, see Sections 8 and 8.7.

7.3 SRI Ethics Charter: preventing misuse

Before any operationalisation or scoring is proposed, the ethical boundaries of the Somatic Restitution Index must be made explicit. The SRI is not a diagnostic tool, not a measure of personal worth, not a ranking of bodies, and not a behavioural compliance instrument. It is proposed as a preliminary multidimensional research profile for examining the bodily, psychological, environmental, and infrastructural conditions that may support or undermine somatic regulation and ecological care.

The main ethical risk is that a tool designed to reveal structural and environmental conditions could be misused to blame individuals for dysregulation produced by work regimes, poverty, housing insecurity, unsafe neighbourhoods, digital platforms, pollution, disability exclusion, climate stress, or lack of access to restorative environments. The SRI must therefore distinguish individual-level indicators from contextual indicators of somatic commons. Low scores in any domain should be interpreted as signals of unmet conditions, not as evidence of weak discipline, poor character, moral failure, or defective embodiment.

A second risk is able-bodied normativity. The SRI must not assume that bodily restitution means athletic performance, normative posture, unaided mobility, weight optimization, productivity, or compliance with a single model of health. Disabled, aging, neurodivergent, chronically ill, and differently embodied people must be included in the design and interpretation of the instrument. The purpose is to identify conditions that support bodily regulation and ecological relation across diverse forms of embodiment, not to impose a single bodily ideal.

A third risk is surveillance. Because SRI domains may include sleep, movement, screen exposure, geolocation, environmental conditions, or wearable data, any pilot use must follow strict principles of informed consent, data minimization, voluntary participation, anonymization, and participant control over sensitive information. Wearable, smartphone, or geospatial data should be optional and should never be required in contexts where participants may feel coerced by schools, employers, insurers, platforms, or state institutions.

A fourth risk is institutional misuse. Schools, employers, insurers, governments, or platforms could misuse SRI-like measures to individualize responsibility, optimize productivity, price risk, discipline behaviour, or justify exclusion. To prevent this, the SRI should be used only for research, public-health planning, environmental assessment, and participatory policy design. It should not be used to evaluate employability, insurance eligibility, academic performance, social deservingness, or personal compliance.

The ethical use of the SRI should therefore follow five principles:

1. **Non-stigmatization:** SRI results must never label individuals as deficient, unhealthy, unfit, or less worthy.
2. **Structural interpretation:** low domain scores should be interpreted in relation to environmental, economic, institutional, and social constraints.

3. **Embodiment diversity:** the instrument must be adaptable to disabled, aging, neurodivergent, chronically ill, and differently embodied populations.
4. **Data protection:** sensitive bodily, digital, and location data must be minimized, anonymized, voluntary, and ethically governed.
5. **Restorative purpose:** the SRI should guide improvements in shared conditions of bodily regulation, not discipline individual behaviour.

For these reasons, the SRI should be interpreted as a research and policy-support framework. Its purpose is to identify where somatic restitution is structurally supported or structurally blocked. It should help shift attention from individual lifestyle blame toward the shared conditions that make sleep, movement, interoception, nature contact, social connection, and ecological care more or less possible.

Only after these ethical constraints are made explicit can a draft item pool be proposed. The following module is therefore illustrative and provisional.

7.4 Draft SRI questionnaire module

A draft SRI questionnaire module is provided in Supplementary Appendix 9. It is not a validated instrument and should not be used for diagnosis, ranking, individual evaluation, or policy scoring. It is included only as a preliminary item pool for future pilot research.

The module covers movement and sedentary pattern, sleep and recovery, interoception and bodily self-regulation, nature contact and environmental exposure, digital exposure and attentional load, subjective and eudaimonic well-being, social regulation, compensatory consumption vulnerability, ecological salience, and contextual somatic commons. All items require cognitive interviewing, accessibility review, translation testing, reliability analysis, factor analysis, measurement-invariance testing, cultural adaptation, and ethical review before any research or policy use.

Only after these validation steps could the SRI be developed into a reliable multidimensional profile. It should not be collapsed prematurely into a single score.

7.5 Radar diagram: current vs. restitution target

Figure 5 presents an illustrative radar diagram of the eight SRI domains. Two polygons are shown: a hypothetical "current OECD average" profile and a "restitution target" profile. The diagram is explicitly speculative and intended to guide instrument development rather than represent measured data.

7.6 Pilot hypotheses

The SRI should generate falsifiable hypotheses. Examples include:

1. Higher daily nature contact will predict higher nature connectedness and lower perceived stress, controlling for income and urban density.
2. School-based interventions combining outdoor time, movement, and sleep education will improve selected SRI subdomains compared with standard health education.
3. Higher interoceptive awareness and eudaimonic well-being will predict lower materialist value orientation and lower compensatory consumption, controlling for income.
4. Urban green-space access will moderate the association between screen time and youth mental health symptoms.
5. Improvements in SRI subdomains will predict reduced healthcare burden and improved well-being over longitudinal follow-up.
6. The association between screen time and youth mental health symptoms will be stronger in countries with weaker labour protections and longer working hours (parental absence as moderator).

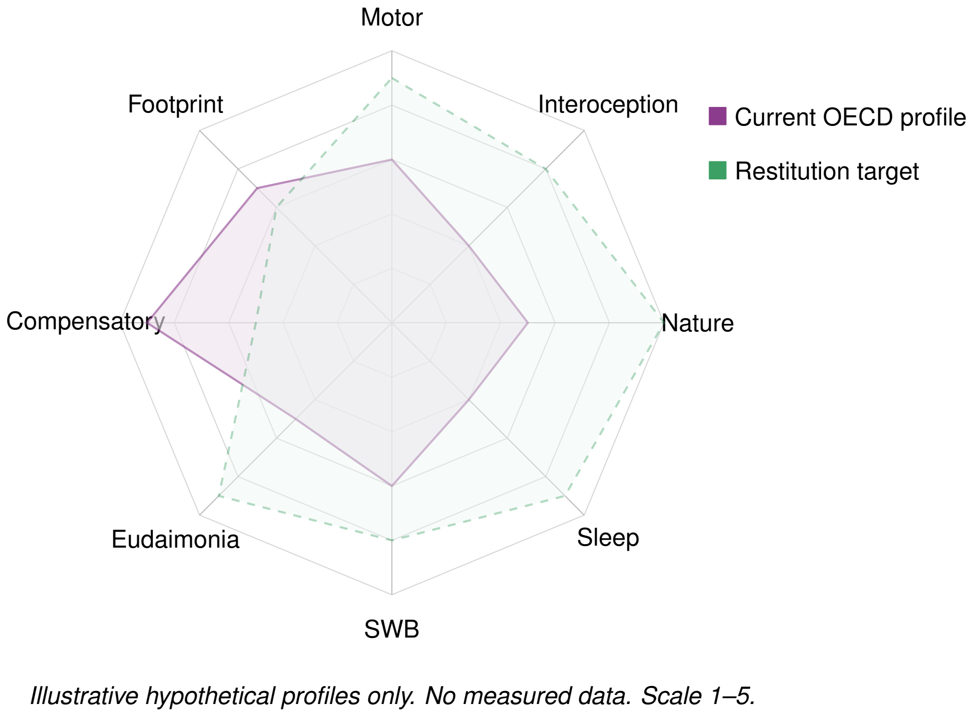


Figure 5: Illustrative radar diagram of the SRI across eight domains. The restitution target shows lower compensatory consumption and ecological footprint alongside higher somatic and well-being scores.

7. Urban green-space access will moderate the screen time–mental health link more strongly in high-inequality neighbourhoods than in low-inequality neighbourhoods.

7.7 Operationalisation with existing datasets

To avoid the critique of theoretical abstraction, the preliminary SRI could be operationalised and tested using existing large-scale datasets, while still requiring dedicated validation:

- **NHANES (USA):** metabolic, postural, and sleep indicators.
- **COMPASS / IPEN (Europe/Australia):** GPS-monitored nature contact, physical activity, and built-environment exposure.
- **ESS / Eurobarometer (Europe):** well-being, materialism, consumption, and social-connection modules.
- **UK Biobank:** accelerometry ($N > 100{,}000$), environmental exposures, mental health phenotypes.
- **HBSC (Health Behaviour in School-aged Children):** adolescent sleep, activity, screen time, well-being across 50 countries.
- **Gallup World Poll:** life evaluation, affect, purpose (can be linked to national environmental indicators).

7.8 Limitations of the SRI

The SRI risks becoming another technocratic dashboard unless it is developed carefully. It must avoid moralizing individual bodies, blaming the poor for structural conditions, or imposing high-income cultural assumptions on diverse societies. It should be used to evaluate institutions and environments, not only to rank individuals or nations. The SRI must not be used to stigmatize individuals or nations as "somatically deficient." Its proper use is institutional: evaluating whether schools, workplaces, urban plans, and digital policies produce or restore somatic integrity. Future SRI development should distinguish individual somatic indicators from contextual indicators of somatic commons, so that bodily dysregulation is not misattributed to individual choice when it is produced by shared environmental, labour, digital, or infrastructural conditions. The draft questionnaire module included here is illustrative only and requires psychometric validation, accessibility review, cultural adaptation, and ethical oversight before any research or policy use.

7.9 Illustrative pilot calculation

For illustrative purposes only, a provisional SRI domain profile is provided in Supplementary Table SS5. The values are hypothetical and do not represent computed national scores. The example is included only to show how future validation studies might display multidimensional SRI domains without collapsing them into a single ranking.

This illustration should not be read as a validated comparison of countries. The SRI is designed to be interpreted as a domain profile, not as a league table.

8 Discussion

8.1 Theoretical contribution

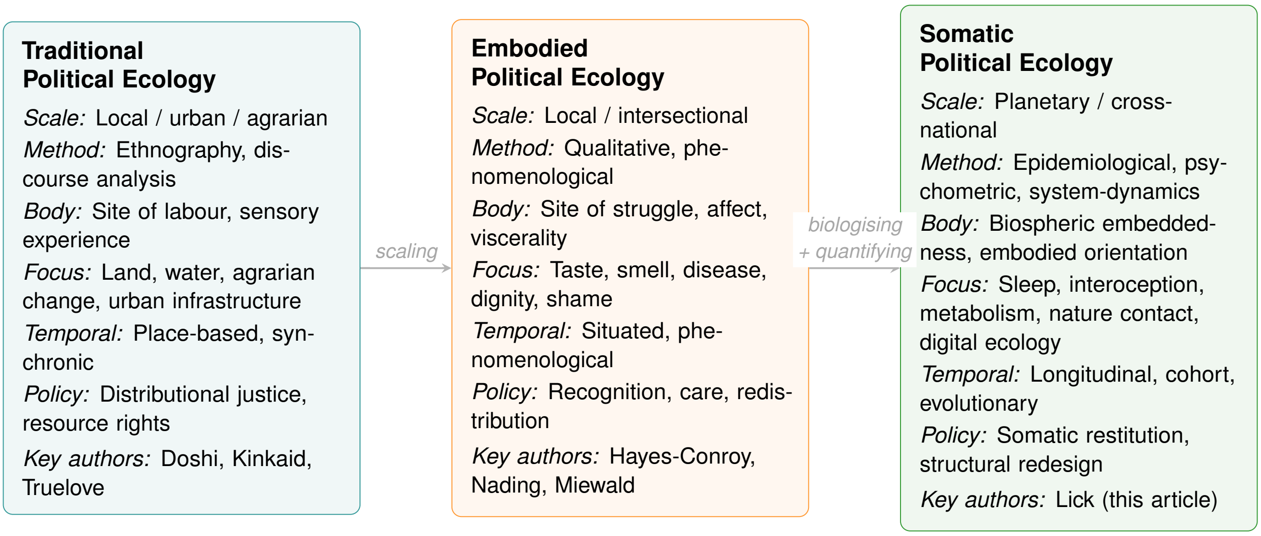


Figure 6: Three political ecologies compared. The trajectory from traditional to somatic political ecology involves a scale shift (local → planetary), a method shift (ethnographic → epidemiological), and a body shift (site of struggle → biospheric embeddedness). The diagram is heuristic and does not imply teleological progression; all three modes coexist and complement one another.

The Somatic Anthropocene makes three theoretical contributions. **First**, to Anthropocene theory, by introducing the body as a mediator rather than merely a victim of ecological crisis. **Second**, to public health and sustainability science, by proposing the SRI as a composite framework linking bodily, psychological, and ecological indicators. **Third**, to political ecology, by extending the embodied tradition from local, qualitative, and intersectional analysis (Doshi, 2017; Kinkaid, 2019) to planetary, epidemiological, and system-dynamics research—thereby founding **somatic political ecology** as a distinct subfield concerned with the political economy of metabolic, interoceptive, and sensory mediation.

8.2 Public-health implications

Public health can become ecological policy. Interventions that increase safe outdoor play, active transport, sleep regularity, movement-rich schools, green-space access, social connection, and body awareness may also reduce compensatory consumption and strengthen ecological care. Such interventions should be structural rather than moralistic: urban design, school schedules, labour policy, food environments, and digital regulation matter more than individual willpower. Examples include Finland's school-based outdoor play mandates, the Netherlands' cycling infrastructure as active-transport default, France's 2017 labour law protecting workers' "right to disconnect" from digital communication, and Barcelona's "superblock" urban redesign reducing traffic and increasing green space. Additional structural measures include: sleep-protective digital regulation (elimination of infinite scroll, disabling nocturnal push notifications, delayed school start times aligned with adolescent circadian biology); food-system reform (school meal standards based on the NOVA classification, EDC regulation under REACH); labour policy (four-day week, movement breaks, ergonomic standards); and pharmaceutical transparency (mandatory disclosure of synthetic royalty terms, conditions on public R&D funding to prevent subsequent financialization). Table S8 (Appendix Appendix C.5) maps these interventions to SRI domains and evidence levels.

8.3 Somatic commons: shared conditions for bodily and ecological regulation

The Somatic Anthropocene framework also implies a shift from individual health behaviour to shared bodily infrastructure. Many conditions that support somatic regulation are not produced by individuals alone. Sleep security, breathable air, walkable streets, accessible green space, quiet environments, safe social contact, thermal comfort, time sovereignty, and freedom from continuous digital intrusion are collectively shaped. They function as what may be termed *somatic commons*: shared social, environmental, temporal, and infrastructural conditions that enable bodily regulation, ecological perception, and reduced dependence on compensatory consumption.

Somatic commons is proposed here as a theoretical extension, not as an established empirical category. It translates the Somatic Anthropocene from a model of individual dysregulation into a political-ecological question: which institutions, urban forms, labour regimes, school systems, digital platforms, and environmental policies protect or degrade the bodily conditions under which ecological care becomes psychologically and behaviourally possible?

This shift matters because many lifestyle recommendations place responsibility on individuals while leaving dysregulating environments intact. Advising movement, sleep, nature contact, or digital restraint is insufficient if work schedules, housing precarity, platform design, unsafe streets, heat exposure, noise pollution, and lack of accessible green space make such practices difficult or structurally unavailable. Somatic restitution therefore requires not only individual behavioural change, but also the protection and redesign of shared conditions that make bodily self-regulation feasible.

Table 7 summarizes key domains of the proposed somatic commons and their relevance to the Somatic Anthropocene feedback loop.

Table 7: Proposed domains of somatic commons and their relevance to the Somatic Anthropocene framework.

Domain	Shared condition	Relevance to the feedback loop
Sleep security	Predictable rest time, reduced night-shift burden, low noise exposure, protection from 24/7 work availability.	Supports affective regulation, metabolic stability, interoceptive awareness, and reduced vulnerability to compensatory consumption.
Breathable air	Low particulate pollution, healthy indoor air, reduced toxic exposure, ventilation standards.	Reduces physiological stress burden and supports respiratory, cognitive, and autonomic regulation.
Walkability and movement	Safe pedestrian infrastructure, active transport, accessible public space, reduced sedentary design.	Increases daily sensorimotor engagement and reduces first-order somatic dysregulation.
Accessible green and blue space	Equitable access to parks, trees, water, shade, biodiversity, and restorative outdoor environments.	Supports nature connectedness, well-being, thermal regulation, and ecological salience.
Quiet and attentional space	Protection from chronic noise, notification overload, advertising saturation, and continuous digital interruption.	Supports attentional recovery, interoceptive awareness, sleep, and reduced platform-driven consumption.
Time sovereignty	Sufficient non-work time, care time, recovery time, and freedom from constant productivity demands.	Makes somatic restitution behaviourally possible and reduces reliance on convenience-based compensatory consumption.
Social and relational infrastructure	Safe public gathering spaces, community ties, non-commercial sociality, intergenerational contact.	Reduces loneliness and may buffer digital pseudo-attachment, affective distress, and compensatory consumption.
Thermal and climate protection	Shade, cooling infrastructure, heat-resilient housing, flood protection, climate adaptation.	Reduces climate-related somatic burden and prevents ecological degradation from feeding back into bodily dysregulation.

The somatic commons concept also clarifies why the framework must be interpreted through inequality. Affluent populations may be able to purchase private substitutes for damaged commons: air conditioning, wellness services, private green space, fitness infrastructure, organic food, sleep technologies, and retreat environments. Low-income, racialized, disabled, aging, and climate-exposed populations are more likely to depend on public or shared infrastructures and therefore bear greater harm when these commons are degraded. The erosion of somatic commons is thus not only a public-health issue, but also a distributive and political-ecological issue.

For this reason, future operationalisation of the Somatic Restitution Index should include not only individual-level indicators such as sleep, movement, interoception, well-being, and nature contact, but also contextual indicators of somatic commons. Candidate measures may include neighbourhood walkability, green-space accessibility, heat exposure, air quality, noise burden, work-time insecurity, digital exposure, and access to non-commercial social infrastructure. These variables would allow the SRI to distinguish between individual somatic behaviour and the shared conditions that make such behaviour possible.

The concept of somatic commons therefore extends the policy relevance of the Somatic Anthropocene. If bodily dysregulation mediates ecological perception, well-being, and compensatory consumption, then protecting the shared conditions of bodily regulation becomes part of sustainability policy. Public health, urban design, labour policy, digital regulation, education, and climate adaptation should be understood not as separate domains, but as interconnected infrastructures of somatic and ecological resilience.

8.4 Sustainability implications

Sustainability policy often focuses on energy transition, carbon pricing, conservation, circular economy, and technological innovation. These remain essential. The Somatic Anthropocene suggests that they should be complemented by policies that restore embodied well-being. A society of exhausted, lonely, sedentary, anxious, and overstimulated people may remain vulnerable to high-consumption compensation even if its energy systems become renewable.

8.5 Pseudo-restitution and the politics of measurement

The SRI should be treated not only as a measurement proposal, but also as a warning against a predictable policy failure: the substitution of measurable wellness activity for somatic restitution. In high-income digital environments, institutions may respond to bodily dysregulation by offering mindfulness subscriptions, resilience apps, wearable dashboards, or corporate wellness modules while leaving the underlying conditions of sleep loss, immobility, social isolation, food engineering, and platform dependence intact. Such interventions may improve reported coping or perceived self-management without altering the structural production of dysregulation.

This creates a risk of pseudo-restitution. If sustainability and public-health systems measure only subjective wellness, engagement with wellness tools, or participation in self-care programmes, they may mistake adaptation to harmful environments for recovery from them. For this reason, SRI validation should require convergence between subjective indicators, objective biomarkers, behavioural measures, and contextual measures of the somatic commons. A valid restitution profile should show not only improved self-report, but also improvements in autonomic regulation, sleep stability, movement agency, nature contact quality, social connection, reduced compensatory consumption, and lower ecological footprint.

Pseudo-restitution is therefore not merely a measurement problem; it is also a political-economic risk, because the same industries that profit from dysregulation may also sell commodified forms of repair.

8.6 Limitations

The model has several limitations:

1. Many links are correlational rather than causal.
2. Evidence is biased toward high-income countries.
3. Generational categories are imprecise.
4. SRI indicators require validation.
5. The model risks overextending biological explanations into political economy if not carefully bounded.

6. Cross-cultural differences in body, nature, happiness, and consumption must be respected.
7. The model does not yet specify the causal weight of specific political-economic mechanisms (e.g., corporate marketing, labour precarity, housing policy) relative to somatic variables.
8. The model does not yet fully integrate the neurobiological cascade from sleep deprivation through metabolic dysfunction to reproductive endocrinology; this pathway is supported by preliminary evidence (Gujar et al., 2011) but requires longitudinal cohort confirmation before causal weight can be assigned. The discussion of AI companions and algorithmic sociality is provisional. Current evidence is still emerging, and future studies should avoid both technological moral panic and uncritical optimism.
9. The causal evidence on smartphone-driven fertility decline (Myers & Hooper, 2026) is drawn from an NBER working paper and has not yet completed peer review; its inclusion here is provisional and its estimates should be treated as quasi-experimental rather than fully established.

The fertility discussion remains hypothesis-generating: perceived reproductive viability is proposed as a candidate construct, not as a validated explanation of fertility decline, and should be tested against established demographic, economic, gender, cultural, and policy explanations.

Future work should integrate institutional and political-economic mediators into the feedback loop.

8.7 Future research

Future research should proceed along five lines.

First, longitudinal studies should test whether movement, sleep, interoception, nature contact, well-being, compensatory consumption, and ecological behaviour form measurable pathways over time. Second, intervention studies should examine whether somatic restitution changes not only health outcomes, but also materialist values, consumption patterns, and ecological behaviour. Third, institutional studies should test whether schools, workplaces, digital platforms, and urban environments function as somatic infrastructures that either restore or degrade bodily regulation. Fourth, cross-cultural studies should examine how the somatic–consumption pathway varies across high-income, low-income, urban, rural, and climate-exposed contexts. Fifth, SRI validation should proceed through cognitive interviewing, pilot testing, reliability analysis, factor analysis, measurement-invariance testing, and participatory review with disabled, aging, neurodivergent, chronically ill, low-income, and climate-exposed populations.

Research should also integrate political-economic variables into the Somatic Anthropocene loop, including corporate food marketing, platform monetization, labour precarity, housing density and cost, and digital labour policy. Cross-national designs are needed to test whether the somatic–consumption link is moderated by welfare-state generosity, digital regulation, and urban planning traditions.

8.8 Critical causal tests

The most important empirical test of the Somatic Anthropocene hypothesis is not whether bodily dysregulation correlates with ecological attitudes or consumption, but whether somatic restitution changes behaviour under controlled or quasi-controlled conditions. A critical research design would be a randomized or cluster-randomized longitudinal intervention in which one group receives a six-month structural restitution intervention—sleep extension, movement-rich schooling or workplace redesign, reduced evening screen exposure, outdoor time, and interoceptive training—while a comparison group receives standard wellness information or no structural intervention. Outcomes should be measured before, during, and after the intervention.

Primary outcomes should include both somatic and behavioural variables: HRV, actigraphy-derived sleep regularity, sedentary time, nature contact, interoceptive awareness, subjective and eudaimonic well-being, loneliness, platform use, impulsive purchasing, emotional spending, dietary choice in a simulated or real purchasing task, and household material or carbon footprint where feasible. Experimental tasks such as simulated supermarkets, delay-discounting paradigms, social-media craving measures, or ecological-choice tasks could test whether improved bodily regulation reduces susceptibility to fast-reward consumption. Such a design would not prove the entire feedback loop, but it would provide stronger causal evidence for the proposed bridge between somatic restitution, compensatory consumption, and ecological behaviour.

A second design would use natural experiments: school start-time reforms, right-to-disconnect policies, active-transport infrastructure, green-schoolyard interventions, or workplace mobility reforms. These cases could test whether institutional changes that improve sleep, movement, and nature contact also shift consumption patterns, well-being, and ecological salience. Together, randomized interventions and natural experiments would move the framework from plausible mediation toward testable causal pathways.

Subcultural practices of somatic resistance may also be studied, but their efficacy relative to institutional redesign remains empirically unexplored.

Perceived reproductive viability is discussed separately in § 8.7 as a speculative and hypothesis-generating extension of the framework.

A provisional research roadmap is provided in Supplementary Table S6. It outlines pilot validation, school-based interventions, longitudinal cohort studies, cross-national comparisons, and eventual integration with sustainability metrics.

8.9 Speculative theoretical note: fertility, perceived reproductive viability, and somatic cost

Fertility decline should not be treated as evidence of somatic collapse. Low and declining fertility rates are shaped by multiple well-established factors, including education, gender equality, contraception, delayed partnership formation, housing costs, labour-market insecurity, urbanization, changing values, reproductive autonomy, childcare systems, and policy context. The Somatic Anthropocene framework does not replace these explanations. It adds one supplementary question: whether some fertility decline may also reflect perceived changes in the bodily, ecological, psychological, digital, and social viability of reproduction.

This question can be framed through the concept of *perceived reproductive viability*. The term refers to the perceived feasibility of having and raising children in a given organism–environment context. It includes income, housing, childcare, partnership stability, and policy support, but also bodily reserve, sleep security, stress load, climate stability, environmental safety, social support, digital ecology, and confidence in the future habitability of the world. Perceived reproductive viability is therefore not only biological. It is a psychosomatic and socio-ecological judgement about whether one has enough bodily, relational, environmental, temporal, and future-oriented capacity to sustain new life.

One pathway concerns climate anxiety and reproductive decision-making. Research on eco-reproductive concerns suggests that some individuals already factor climate change, ecological degradation, and anticipated future suffering into reproductive choices (Dillarstone et al., 2023; Schneider-Mayerson, 2022; Schneider-Mayerson & Leong, 2020). Recent European evidence also suggests that climate concern or environmental uncertainty may be associated with lower fertility intentions in some contexts, although findings remain context-dependent and should not be treated as universal (Bastianelli, 2025; Puglisi et al., 2025). These studies do not show that climate anxiety is the primary driver of fertility decline. They indicate only that reproductive intention can be shaped by perceived planetary insecurity, anticipated child vulnerability, ethical concern, and diminished confidence in the future.

A second pathway concerns the *allostatic load of parenting*. Parenting is not only an economic cost; it is also a physiological and temporal demand. Pregnancy, birth, infant care, night waking, caregiving stress, time poverty, and chronic sleep disruption all place demands on the body. Sleep quality, circadian stability, and stress regulation are relevant to reproductive health and parenting processes (Lateef & Akintubosun, 2020; McEwen & Karatsoreos, 2015; McQuillan et al., 2019, 2022; Zhong et al., 2022). Where adults already experience high allostatic load from work intensity, digital overload, poor sleep, loneliness, metabolic strain, housing insecurity, pollution, and climate stress, the anticipated cost of parenting may be experienced not only as financially high but as physiologically overwhelming.

A third pathway concerns environmental reproductive burden. Heat exposure, air pollution, endocrine-disrupting chemicals, PFAS, obesity, sleep disruption, and metabolic stress have all been examined in relation to reproductive health, fecundability, pregnancy outcomes, or semen parameters (Carré et al., 2017; Hajdu, 2024; Lahimer et al., 2023; Wang et al., 2023). These factors should not be conflated with fertility intentions, but they are relevant to the bodily ecology of reproduction. They suggest that the reproductive body is one site where environmental degradation, toxic exposure, sleep disruption, and metabolic dysregulation may converge.

A fourth pathway concerns digitalization. Digital technologies may affect fertility in divergent ways. Some forms of digital access may support fertility by enabling remote work, flexible scheduling, social support, and care coordination (Billari et al., 2019). Other forms may reduce perceived reproductive viability by intensifying screen-mediated life, sleep displacement, loneliness, dating-market instability, social comparison, algorithmically mediated lifestyle expectations, or anxiety about parenting standards. A recent quasi-experimental working paper on the U.S. rollout of the iPhone suggests that smartphone diffusion may have reduced births among younger cohorts by displacing in-person interaction and partnered sex, although this finding requires peer-reviewed replication and should be treated cautiously (Myers & Hooper, 2026). The relationship between digitalization and fertility should therefore be treated as ambiguous and context-dependent.

Together, these pathways suggest that fertility decline may be read not only as a demographic outcome, but also as a possible population-level signal of perceived organism–environment viability. This signal is not reducible to biology, economics, climate anxiety, digital life, or individual preference alone. It emerges at the intersection of bodily reserve, ecological confidence, social support, reproductive autonomy, gendered care burden, digital mediation, and expectations about the future.

For this reason, the article proposes *perceived reproductive viability* as a candidate construct for future research. It could be operationalised through survey items assessing whether individuals feel that their body, time, finances, environment, relationships, climate future, digital life, and social support are sufficient to sustain parenting. Such research should distinguish between fertility desire, fertility intention, reproductive anxiety, ecological concern, perceived parental burden, biological fecundability, reproductive autonomy, and actual reproductive outcomes.

The evidential status of this section remains mixed. The links between sleep, stress, metabolic health, pollution, heat, and reproductive health have varying degrees of empirical support. The links between climate concern and reproductive intention are emerging but context-dependent. The links between digitalization, algorithmic sociality, intimacy, and fertility remain especially provisional. The integrated claim that declining fertility partly reflects perceived reproductive viability should therefore be treated as L4 theoretical synthesis, supported by some L3 mechanistic plausibility and some L5 speculative extension. It is proposed as a research agenda, not as a settled conclusion.

A detailed pathway table for perceived reproductive viability is provided in Supplementary Table S7.

8.10 Defining somatic political ecology

The Somatic Anthropocene opens a research frontier at the intersection of planetary health, affective neuroscience, and political economy—a field that may be termed **somatic political ecology**. This section offers a provisional definition to guide future disciplinary development.

Definition: Somatic political ecology.

Somatic political ecology is the study of planetary-scale feedback loops between bodily dysregulation, economic systems, and Earth-system processes. It treats the body neither as a purely biological substrate nor as a passive victim of environmental injustice, but as deeply embedded in biospheric processes and studyable through measurable variables such as movement, sleep, interoception, nature contact, well-being, and health burden. In this framing, ecological value may be partly shaped by embodied interaction, interoceptive awareness, and repeated contact with living environments, while remaining politically contested and institutionally mediated. Its methods are mixed: epidemiological, psychometric, ethnographic, and phenomenological. Its ethical commitment is to somatic restitution—the redesign of institutions, environments, and technologies to restore bodily conditions that may support ecological care—rather than to individual health optimisation or biological normativity.

Somatic political ecology extends embodied political ecology (Doshi, 2017; Kinkaid, 2019) in three directions: (1) *scale*, from the local field or slum to the planetary system and its population-level biomarkers; (2) *mechanism*, from sensory ethnography to interoceptive neuroscience, evolutionary morphology, and endocrine toxicology; and (3) *measurement*, from thick qualitative description to multidimensional psychometric profiles (the SRI) capable of tracking bodily states as planetary forces. It does not replace the ethnographic richness of existing embodied political ecology; it complements it with tools for detecting population-scale somatic mediation and its feedback into ecological crisis.

The companion essay *Axial Consciousness and the Somatic Anthropocene* provides the philosophical interpretation of these tools: a phenomenological account of why bodily restoration may matter, and why the disembodied technosolutionist imaginary may risk reproducing the alienation it claims to solve (Lick, 2026, § 6).

9 Conclusion

The Anthropocene is not only a crisis of carbon, capital, and technology. It may also involve an underexamined embodied dimension: the bodily conditions through which ecological value, sufficiency, and care become psychologically and behaviourally salient. Bodies that cannot move freely, sleep deeply, sense themselves, encounter living environments, or generate non-compensatory well-being may become more vulnerable to consumption-driven systems. Restoring bodily movement, interoceptive awareness, nature contact, sleep, social connection, and sufficiency should therefore be investigated as part of ecological policy.

The Somatic Anthropocene should therefore be read as a hypothesis-generating research framework. It invites empirical testing of whether bodily dysregulation, interoceptive depletion, reduced well-being, weakened nature connectedness, and compensatory consumption form measurable pathways within broader political-economic and ecological systems. If validated, this framework would not replace existing explanations of the Anthropocene, but would add a missing somatic layer to public health, sustainability science, and political ecology.

The Somatic Anthropocene thus opens a research frontier at the intersection of planetary health, affective neuroscience, and political economy—a field that may be termed **somatic political ecology**. Its task is not to replace the ethnographic richness of embodied political ecology, but to complement it with epidemiological, cross-national, and psychometric tools capable of testing whether and how bodily states mediate ecological perception, consumption, and care. For the philosophical and phenomenological interpretation of this research frontier, see the companion essay *Axial Consciousness and the Somatic Anthropocene* (Lick, 2026).

If the Somatic Anthropocene hypothesis is even partially correct, then excluding somatic indicators from sustainability metrics is a systematic blind spot. Carbon accounting, circular-economy policy, and planetary-boundary governance remain indispensable, but they do not measure whether people possess the bodily and social conditions required for sufficiency, ecological salience, and non-compensatory well-being. We therefore propose that public-health agencies, sustainability researchers, national statistical offices, and international organisations begin piloting SRI modules within the next five years, initially as exploratory supplements to existing well-being, health, and environmental indicators. The cost of inaction would not be merely medical. It would be ecological: a society may decarbonise parts of its infrastructure while leaving intact the somatic deficit that drives compensatory consumption and weakens embodied ecological care.

Acknowledgements. This draft was developed as a conceptual revision of an earlier manuscript on the Somatic Anthropocene. Further expert review is needed in public health, epidemiology, environmental psychology, sustainability science, and psychometrics. The companion essay *Axial Consciousness and the Somatic Anthropocene* is published simultaneously as a separate working paper.

A Supplementary Material: Full Claim–Evidence Status Table

This table maps every major empirical claim in the main text to its evidential level (L1–L5), primary source(s), and location in the manuscript. It is intended for reviewers and readers who wish to verify the epistemic status of specific assertions without re-reading the full text.

Table S1: Full claim–evidence status table

Claim	Level	Primary source(s)	Section
Sedentary behaviour increases cardiometabolic risk and all-cause mortality, independent of physical activity.	L1	Biswas et al. (2015); Ekelund et al. (2016)	§ 4.1
Physical inactivity in adolescence predicts adult metabolic trajectories.	L1	NCD Risk Factor Collaboration (2024)	§ 6.5
Global child/adolescent obesity has risen dramatically since 1990.	L1	NCD Risk Factor Collaboration (2024)	§ 6.5
Environmental degradation (pollution, heat, biodiversity loss) imposes measurable health burdens.	L1	WHO; UNICEF	§ 1.2
High-income countries have disproportionate carbon and material footprints.	L1	Hickel (2020); Rockström et al. (2009)	§ 1.5
GDP correlates poorly with well-being above moderate income thresholds (Easterlin paradox).	L1	Easterlin (1974); Kahneman and Deaton (2010)	§ 5.6
Materialism is consistently associated with lower personal well-being.	L1	Dittmar et al. (2014); Kasser (2016)	§ 5
Nature connectedness predicts pro-environmental behaviour.	L1	Mayer and Frantz (2004); Whitburn et al. (2020)	§ 3.3
Interoception refers to sensing of internal bodily states and is linked to emotional regulation.	L1	Craig (2002); Khalsa et al. (2018)	§ 3.2
Myopia prevalence is rising globally, especially in East Asia.	L1	Liang et al. (2025)	§ 6.7
Cervical spine load increases nonlinearly with forward head tilt during smartphone use.	L1	Hansraj (2014)	§ 3.5
Screen time correlates with anxiety, depression, sleep problems, and lower well-being in youth.	L2	Multiple meta-analyses; see § 6.8 caveat	§ 6.8
Interoceptive awareness correlates with nature connectedness.	L2	Swami et al. (2026)	§ 3.3
Nature contact is associated with life satisfaction through positive body image in a mediation model.	L2	Swami et al. (2026); $N = 50{,}363$, 58 nations	§ 3.3
Self-compassion mediates nature–well-being link ($\beta = 0.31$).	L2	Swami et al. (2026)	§ 3.3
Fertility decline correlates with development, urbanisation, and female education.	L2	UN World Population Prospects (2024)	§ 8.9

Table S1 – continued from previous page

Claim	Level	Primary source(s)	Section
Young adults (18–29) now report lower flourishing than older cohorts in 18/22 countries.	L2	VanderWeele et al. (2025); $N = 202{,}000$	§ 6.4
Gen Z loneliness (80% past 12 months) exceeds Boomer rates (45%).	L2	Cigna U.S. Loneliness Index (2023)	§ 5.2
GLP-1 prescriptions for adolescents rose 504–588% (2020–2023).	L2	Lee et al. (2024); CDC MMWR (2025)	§ 6.6
Urbanisation markers (mobile phones, electricity) predict paediatric hospital visits in LMIC.	L2	Sieber et al. (2026); $N = 17{,}145$, Mozambique	§ 6.12
Voluntary simplicity correlates with higher well-being and lower consumption.	L2	Brown and Kasser (2005)	§ 5
Short-form video use is associated with altered reward sensitivity and depressive symptoms.	L2	Y. Zhang et al. (2023)	§ 5.2.1
Sleep displacement by screens may impair emotional regulation and related neurobiological processes.	L3	Mechanistic literature; see § 6.8	§ 6.8
Reduced outdoor exposure narrows sensory ecology and proprioceptive calibration.	L3	Ecological psychology theory; Gibson (1979)	§ 6.7
Compensatory consumption follows reduced well-being (direction mixed).	L3	Dittmar et al. (2014); Kasser (2016)	§ 5
Altered reward sensitivity may contribute to compulsive scrolling.	L3	Lembke (2021); Roberts et al. (2025)	§ 6.8
Chemical EDC exposure may influence metabolic trajectories via DOHaD mechanisms.	L3	Grandjean and Landrigan (2014); Heindel et al. (2017)	§ 4.4
Microplastics and polymer-associated chemicals have been detected in human tissue, with possible inflammatory consequences.	L3	Landrigan et al. (2023)	§ 4.4
Corporate food marketing and platform design as institutional drivers of somatic dysregulation.	L3	Mechanistic literature; see § 5.6	§ 5.6
Scandinavian welfare states as moderators of somatic–consumption link.	L3	Comparative welfare literature	§ 1.5
Intersectional gradients (race, class, caste, gender) moderate somatic–ecological pathways.	L3	Federici (2012); Fraser (2016)	§ 1.5.1
The full Somatic Anthropocene feedback loop (8 links) operates as described.	L4	Theoretical synthesis of 7 literatures	§ 1.2
The SRI is proposed as a preliminary multidimensional profile for sustainability assessment.	L4	Proposed framework; requires validation	§ 7.2

Table S1 – continued from previous page

Claim	Level	Primary source(s)	Section
Pseudo-restitution may cause subjective wellness indicators to overstate genuine autonomic or behavioural restitution.	L4	Theoretical synthesis; wellness/quantified-self/platform capitalism literature; requires validation	§§ 7.2, 8.5
Developmental mismatch explains reduced sensorimotor input under digital sedentarism.	L4	Evolutionary morphology + neurobiology synthesis	§ 4.2
Three waves of sedentarisation may help interpret nonlinear intensifications in younger cohorts.	L4	Historical + epidemiological synthesis	§ 4.3
Somatic political ecology as extension of embodied political ecology.	L4	Kinkaid (2019); Doshi (2017)	§ 8.1
LMIC case studies (India, Brazil) suggest cultural non-invariance and environmental justice gradients.	L4	Theoretical synthesis; Swami et al. (2026)	§ 6.13
Fertility decline may be explored as a complex biosocial phenomenon in which somatic stressors interact with economic and cultural variables.	L4/L5	Somatic Anthropocene hypothesis	§ 8.9
Somatic restitution may reduce vulnerability to compensatory consumption and improve ecological salience.	L4/L5	Somatic Anthropocene hypothesis; future intervention studies required	§§ 8.8, 9
Embodied orientation and transhumanism critique.	L5	Philosophical extension; companion essay	§ 5.9

Note. Claims marked L2 are supported by robust correlational data but may be subject to reverse causality or unmeasured confounders. The article explicitly flags these limitations in the main text. Claims marked L4/L5 are theoretical syntheses or speculative extensions requiring empirical validation.

Supplementary Table A1: Relationship to adjacent frameworks

Supplementary Table A1: Relationship between the Somatic Anthropocene and adjacent frameworks.

Framework	**Primary focus**	**Somatic Anthropocene contribution**
One Health	Interdependence of human, animal, and ecosystem health; zoonoses, antimicrobial resistance, food systems, and environmental contamination.	Shifts attention toward bodily dysregulation as a mediator of well-being, consumption, and ecological care.
Planetary Health	Human health under Earth-system degradation and planetary-boundary transgression.	Adds behavioural and interoceptive pathways through which bodily states may mediate ecological perception and compensatory consumption.
Syndemic theory	Interacting epidemics clustered by inequality and social conditions.	Extends clustered-burden thinking into a feedback loop linking somatic dysregulation, consumption, material throughput, and ecological degradation.
Global Syndemic	Obesity, undernutrition, and climate change as interacting pandemics with shared systemic drivers.	Reframes obesity, loneliness, sleep loss, digital exposure, and low well-being as a broader somatic deficit cluster.
Social metabolism	Material and energy flows between society and nature.	Adds affective and bodily mediation to the analysis of material throughput and consumption demand.
Affect theory	Pre-cognitive intensities, atmospheres, attachments, and ordinary affective life.	Provides language for affective background, sufficiency, deficit, desire, and compensatory consumption.
Embodied political ecology	Body as material, sensory, affective, and political site of environmental inequality.	Scales embodied analysis from local ethnographic cases to planetary, epidemiological, and psychometric research.

B Supplementary Material: Generational Indicator Tables

These tables present selected generational indicators used to construct the early-warning cohort argument in § 6 of the main text. Values marked with an asterisk (*) are projections or interpolations based on trend extrapolation; all other values are drawn from the cited sources. Values are not predictions but heuristic illustrations of trajectory continuation under current structural conditions. Actual Generation Alpha outcomes will depend on structural interventions in schooling, urban design, digital regulation, and food environments.

Method of extrapolation

Values marked with an asterisk (*) in Tables S2–S4 are derived from linear trend continuation of observed empirical data, not from predictive modelling. They assume no structural intervention—such as policy changes in schooling, urban design, digital regulation, or food environments—and therefore illustrate trajectory continuation under current conditions rather than forecasting probable outcomes. The extrapolation is intentionally conservative: it does not account for non-linear inflections, technological shocks, pandemic effects, or behavioural tipping points. These values are heuristic devices intended to guide hypothesis generation and policy urgency; they should not be cited as predictions or used to stigmatise younger cohorts.

Table S2: Core Somatic Indicators by Generation

Table S2: Core somatic indicators across generations. MVPA = moderate-to-vigorous physical activity.

Indicator	**Gen X**	**Millennials**	**Gen Z**	**Gen Alpha**
Birth years	1965–1980	1981–1996	1997–2012	2013–2025
Empirical data				
Daily outdoor time (hours)	2.5–3.0	1.5–2.0	0.5–1.0	—
Age at first smartphone (years)	18–22	12–14	8–10	—
Daily screen time, leisure (hours)	1.5–2.5	3.0–5.0	6.0–9.0	—
Sleep duration, adolescents (hours)	7.5–8.5	7.0–8.0	6.0–7.0	—
Meeting MVPA guidelines (%)	45–55	30–40	15–25	—
Obesity prevalence, childhood (%)	5–8	10–15	18–22	—
Myopia prevalence, adolescents (%)	20–30	35–50	50–65	—
Heuristic extrapolations (*)				
Daily outdoor time (hours)	—	—	—	0.3–0.5*
Daily screen time, leisure (hours)	—	—	—	7.0–10.0*
Sleep duration, adolescents (hours)	—	—	—	6.0–7.0*
Meeting MVPA guidelines (%)	—	—	—	$<$15*
Obesity prevalence, childhood (%)	—	—	—	20–25*
Myopia prevalence, adolescents (%)	—	—	—	60–80*

Sources: NCD Risk Factor Collaboration (2024); Liang et al. (2025); various national report cards. Projections (*) assume linear continuation of observed trends without structural intervention.

Table S3: Mental Health and Digital Ecology Indicators

Sources: Cigna (2023); Pew (2023); national health surveys. Gen Alpha values (*) are heuristic continuation scenarios based on Gen Z trajectories and accelerated digital exposure. They are not predictions and should not be cited as empirical estimates. Their purpose is to illustrate a possible worsening trajectory under current structural conditions without intervention.

Table S3: Mental health and digital ecology indicators.

Indicator	**Gen X**	**Millennials**	**Gen Z**	**Gen Alpha**
Empirical data				
Self-reported loneliness, past year (%)	30–35	40–45	65–80	—
Major depression, lifetime (%)	15–20	20–25	25–30	—
Anxiety disorders, lifetime (%)	10–15	15–20	25–30	—
ADHD diagnosis, childhood (%)	3–5	5–8	8–12	—
Suicidal ideation, adolescents (%)	8–12	12–15	18–22	—
Social media platforms used (count)	0–2	2–4	4–6	—
Heuristic extrapolations (*)				
Self-reported loneliness, past year (%)	—	—	—	75–85*
Major depression, lifetime (%)	—	—	—	30–35*
Anxiety disorders, lifetime (%)	—	—	—	30–35*
ADHD diagnosis, childhood (%)	—	—	—	12–16*
Suicidal ideation, adolescents (%)	—	—	—	20–25*
Social media platforms used (count)	—	—	—	5–7*

Table S4: Fertility and digital penetration indicators.

Indicator	**Gen X**	**Millennials**	**Gen Z**	**Gen Alpha**
Empirical data				
Expected lifetime TFR (children/woman)	2.0–2.2	1.7–1.9	1.3–1.6*	—
Age at first childbirth (years)	24–26	27–30	30–33*	—
Internet penetration at age 10 (%)	<5	20–40	80–95	—
Smartphone ownership at age 10 (%)	<1	10–20	60–75	—
Heuristic extrapolations (*)				
Expected lifetime TFR (children/woman)	—	—	—	1.0–1.4*
Age at first childbirth (years)	—	—	—	32–35*
Internet penetration at age 10 (%)	—	—	—	95–100
Smartphone ownership at age 10 (%)	—	—	—	80–95*

Table S4: Fertility and Digital Penetration

Sources: UN World Population Prospects (2024) medium-variant. TFR projections (*) based on trend extrapolation.

Cautionary note. Table S4 is used as a heuristic illustration of demographic and digital trajectories, not as evidence that digital penetration or somatic dysregulation causes fertility decline. Fertility trends are multi-causal and must be interpreted through demographic transition, reproductive autonomy, gender equality, housing, labour markets, policy context, climate concern, digital life, and perceived reproductive viability. Values marked with an asterisk remain extrapolations and should not be cited as predictions.

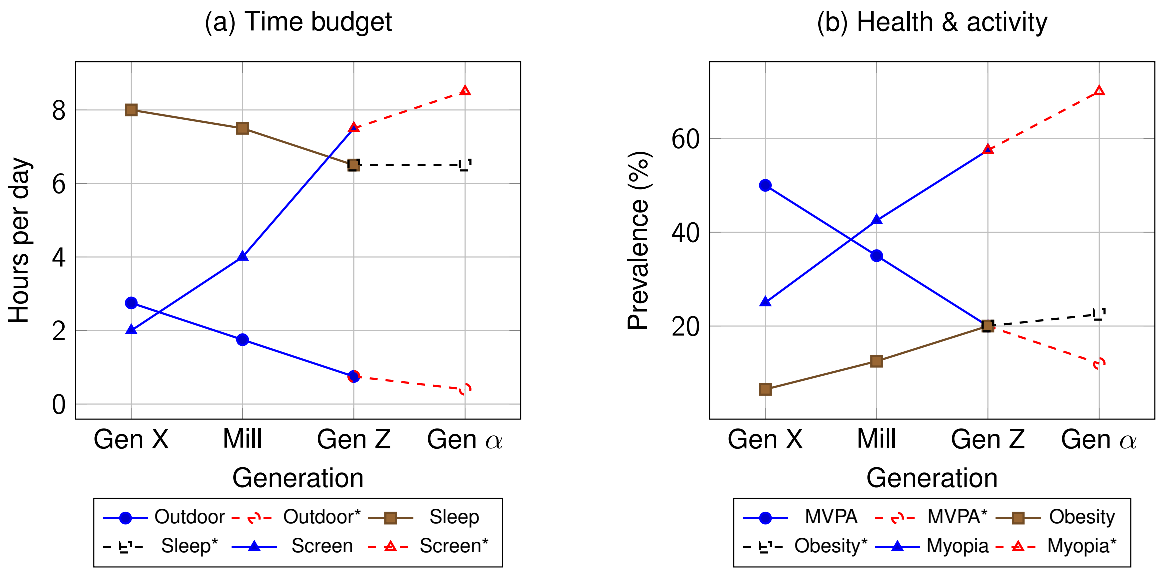


Figure 7: Generation-level trajectories of core somatic indicators (Table S2). Solid lines with filled markers: empirical data. Dashed lines with open markers: heuristic projections for Generation Alpha. Sources: NCD Risk Factor Collaboration (2024); Liang et al. (2025); national report cards.

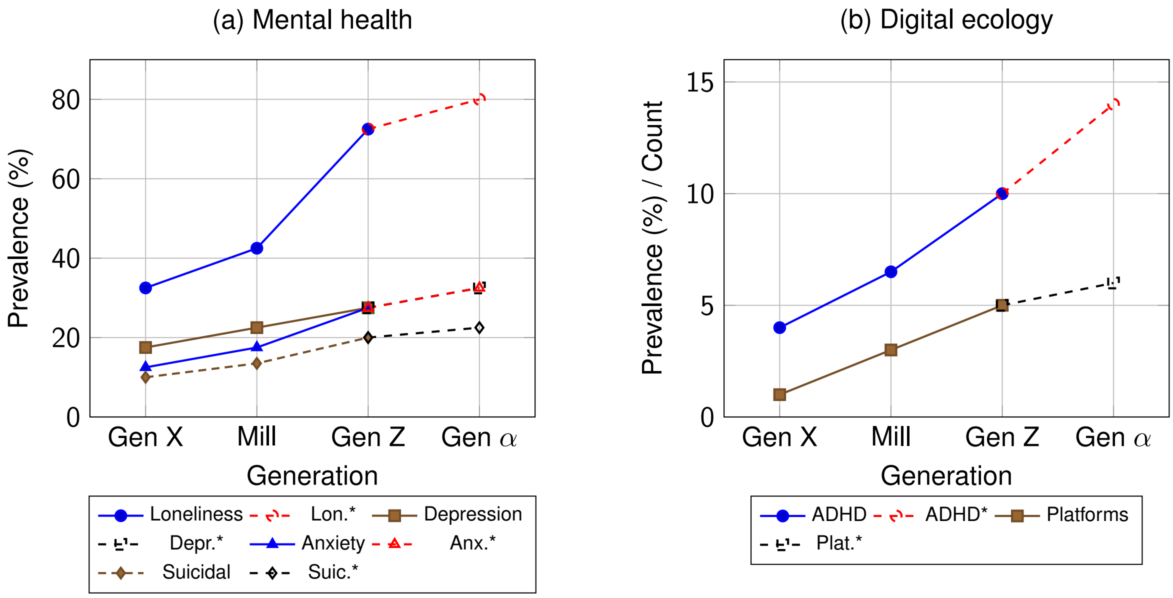


Figure 8: Generation-level trajectories of mental health and digital ecology indicators (Table S3). Solid lines with filled markers indicate empirical generational values. Dashed lines with open markers indicate heuristic Generation Alpha continuation scenarios under current structural conditions, not predictions.

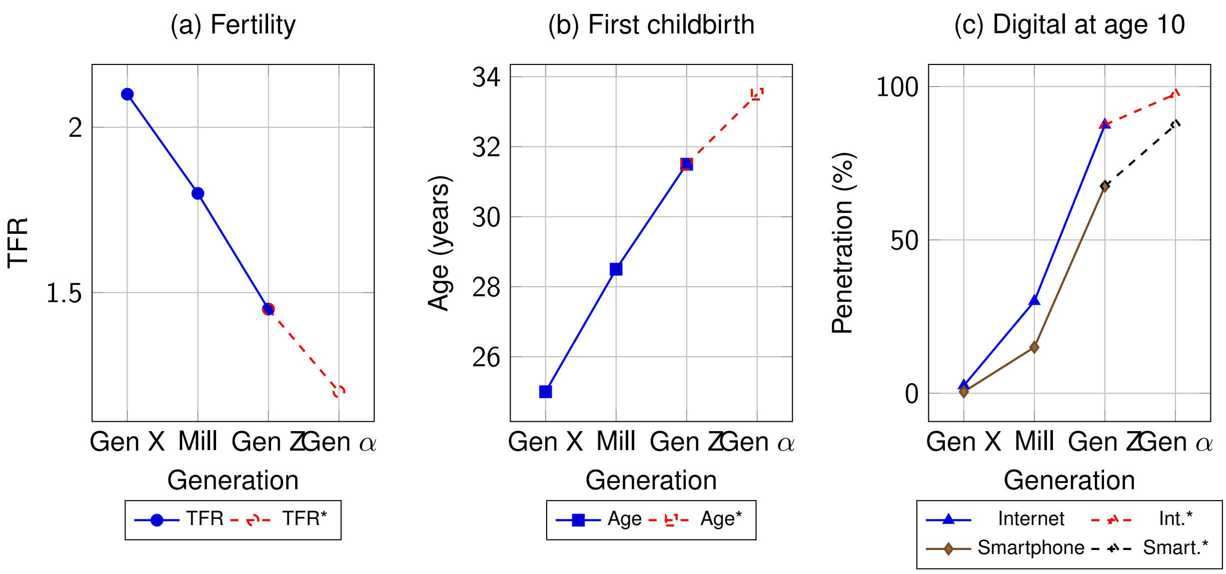


Figure 9: Generation-level trajectories of fertility and digital penetration (Table S4). Solid lines: empirical; dashed: projected. Sources: UN World Population Prospects (2024); Pew (2023).

C Supplementary Material: Methodological and Operationalisation Notes

Appendix C.1 Search Strategy

This conceptual synthesis employed a purposive, iterative literature search across seven domains (see § 7.2 of the main text). The search was not systematic in the PRISMA sense; it was designed for model construction rather than exhaustive coverage, aligning with scoping review conventions (Arksey & O'Malley, 2005). The following eight keyword clusters were used in combinations across PubMed, PsycINFO, Web of Science, Scopus, and Google Scholar:

1. Anthropocene / planetary boundaries: "Anthropocene", "planetary boundaries", "great acceleration", "Earth system", "degrowth", "doughnut economics"
2. Embodied cognition / enactivism: "embodied cognition", "enactivism", "ecological psychology", "affordances", "sensorimotor coupling", "extended mind"
3. Interoception / homeostasis: "interoception", "homeostatic feeling", "visceral sensing", "body awareness", "cardiac perception", "gut–brain axis"
4. Nature connectedness: "nature connectedness", "nature relatedness", "biophilia", "pro-environmental behaviour", "outdoor exposure", "green space"
5. Sedentary behaviour / public health: "sedentary behaviour", "physical inactivity", "sitting time", "screen time", "sleep disruption", "obesity", "myopia", "youth mental health"
6. Well-being / consumption: "subjective well-being", "eudaimonia", "materialism", "compensatory consumption", "voluntary simplicity", "emotional eating", "retail therapy"
7. Generation Z / Alpha: "Generation Z", "Generation Alpha", "adolescent mental health", "loneliness epidemic", "digital natives", "social media addiction"
8. Sustainability / economics: "GPI", "Genuine Progress Indicator", "degrowth", "post-growth", "sustainability indicators", "well-being economy"

Date range: 1970–2026, with priority given to meta-analyses, systematic reviews, and large-scale cohort studies published after 2010. Grey literature (WHO, UNICEF, UN, CDC, national statistics) was included where peer-reviewed data were unavailable for LMIC contexts.

No PRISMA protocol was followed; the search was purposive and designed for model construction rather than exhaustive coverage. The following flowchart describes the process:

- 8 keyword clusters → 5 bibliographic databases (PubMed, PsycINFO, Web of Science, Scopus, Google Scholar)
- Iterative snowballing from seminal papers identified in initial search
- Grey literature (WHO, UNICEF, UN, CDC, national statistics) where peer-reviewed data were unavailable for LMIC contexts
- Source selection prioritized relevance to model construction over exhaustive coverage

Appendix C.2 Inclusion and Exclusion Criteria

Inclusion criteria:

- Peer-reviewed empirical studies, systematic reviews, meta-analyses, or official statistical reports
- English-language publications (with exceptions for globally significant non-English sources with English abstracts)
- Human subjects or population-level data
- Relevance to at least one link in the Somatic Anthropocene feedback loop

Exclusion criteria:

- Purely theoretical philosophical papers without empirical grounding (unless used for L5 speculative sections)
- Single-case studies or small-sample ($N < 50$) interventions without replication
- Industry-funded research on product efficacy (e.g., pharmaceutical trials for specific brands)
- Pre-1970 historical sources except for foundational theoretical works (e.g., Gibson 1979)

Risk of bias: Because this is a conceptual synthesis rather than a systematic review, source selection prioritized relevance to model construction. This creates a risk of confirmation bias. To mitigate this, the article explicitly distinguishes evidence levels (L1–L5, Table 3) and includes alternative explanations (capitalist accumulation, fossil fuels, inequality, colonial extraction) in § 1.5 and § 8.6 of the main text.

Supplementary SRI draft questionnaire module

The following item pool is illustrative and provisional. It is not a validated instrument and should not be used for diagnosis, ranking, individual evaluation, or policy scoring.

The following draft questionnaire module illustrates how selected SRI domains could be operationalised in future pilot research. It is not a validated instrument and should not be used for diagnosis, ranking, or individual evaluation. Items are proposed only as a preliminary item pool requiring cognitive interviewing, accessibility review, translation testing, reliability analysis, factor analysis, measurement-invariance testing, and ethical review. Unless otherwise specified, items may be answered on a 5-point Likert scale:

> 1 = strongly disagree; 2 = disagree; 3 = neither agree nor disagree; 4 = agree; 5 = strongly agree.

Some behavioural items may instead use frequency scales, such as:

> 1 = never or almost never; 2 = rarely; 3 = sometimes; 4 = often; 5 = very often.

Movement and sedentary pattern.

1. I have opportunities to move my body regularly during a typical day.
2. I spend long periods sitting or lying down without meaningful movement. *(reverse-coded)*
3. My daily environment makes walking, stretching, standing, or changing posture easy.
4. My work, study, or domestic responsibilities keep my body physically constrained for long periods. *(reverse-coded)*

Sleep and recovery.

1. I usually get enough sleep to feel physically and mentally restored.
2. My sleep is disrupted by stress, work, study, caregiving, noise, heat, or digital devices. *(reverse-coded)*
3. I have enough time for rest and recovery during a typical week.
4. My daily schedule supports a stable sleep rhythm.

Interoception and bodily self-regulation.

1. I can usually notice when my body is tense, tired, hungry, overstimulated, or in need of rest.
2. I often ignore bodily signals until they become difficult to manage. *(reverse-coded)*
3. I have practices or habits that help me regulate stress through the body, such as breathing, movement, rest, stretching, prayer, meditation, or quiet time.

4. I feel disconnected from my body during much of the day. *(reverse-coded)*

Nature contact and environmental exposure.

1. I have regular access to safe and restorative green or blue spaces.
2. Time outdoors usually helps me feel calmer, more present, or more connected.
3. My contact with outdoor environments is often stressful because of heat, pollution, danger, physical strain, or unsafe conditions. *(reverse-coded)*
4. I can choose when and how I spend time in natural or outdoor environments.

Digital exposure and attentional load.

1. Digital devices frequently interrupt my attention, rest, or social presence. *(reverse-coded)*
2. I often use screens late in the evening even when I feel tired. *(reverse-coded)*
3. I can create periods of the day without notifications, feeds, or digital demands.
4. My digital environment supports my well-being more than it drains it.

Subjective and eudaimonic well-being.

1. I generally feel that my life has meaning or direction.
2. I often feel emotionally depleted or unable to recover. *(reverse-coded)*
3. I feel capable of caring for myself, other people, and the world around me.
4. I often seek quick stimulation or consumption because I feel empty, stressed, or disconnected. *(reverse-coded)*

Social and relational regulation.

1. I have people or communities with whom I can feel safe, connected, and supported.
2. I often feel lonely even when I am digitally connected. *(reverse-coded)*
3. I have access to non-commercial spaces where I can spend time with others.
4. My daily life includes forms of social contact that help me regulate stress.

Compensatory consumption vulnerability.

1. When I feel tired, lonely, stressed, or overstimulated, I am more likely to buy, scroll, snack, stream, or consume in ways I later experience as unhelpful.
2. I often use consumption to compensate for lack of rest, connection, meaning, movement, or calm.
3. I feel able to meet many of my needs without relying on constant purchasing, digital stimulation, or convenience consumption. *(reverse-coded)*
4. My environment encourages quick consumption more than genuine recovery.

Ecological salience and care.

1. I feel that environmental degradation affects my body, health, or everyday life.
2. I feel emotionally or bodily connected to living environments such as air, water, soil, plants, animals, or local ecosystems.
3. Ecological problems often feel distant or abstract to me. *(reverse-coded)*
4. When I feel rested and regulated, I find it easier to care about environmental consequences.

Contextual somatic commons.

1. My neighbourhood or daily environment supports walking, resting, breathing clean air, and spending time outdoors.
2. My work, school, or caregiving responsibilities leave too little time for recovery. *(reverse-coded)*
3. I have access to quiet, safe, and non-commercial places for recovery or social connection.
4. Heat, noise, pollution, danger, or lack of infrastructure make bodily regulation difficult in my daily environment. *(reverse-coded)*

This draft module is intentionally multidimensional. It should not be collapsed prematurely into a single score. Future validation should test whether the items form distinct but related domains, whether domain scores are reliable across populations, and whether the instrument works equitably across gender, class, disability, age, culture, and urban/rural contexts. Qualitative feedback should be used to identify items that may be stigmatizing, culturally biased, inaccessible, or overly individualizing.

Crucially, the SRI must integrate objective biomarkers (such as continuous HRV monitoring) alongside subjective questionnaires. This dual-layer approach is necessary to mitigate the risk of "pseudo-restitution"—where populations report high subjective well-being simply because they are using gamified digital mindfulness applications that simulate restitution without facilitating genuine autonomic recovery.

Note. The Sleep and Compensatory consumption domains are mechanistically linked. Sleep deprivation weakens prefrontal control while sensitizing mesolimbic reward circuitry, creating a fast-dopamine bias that amplifies both digital engagement and hyperpalatable food intake (Chapman et al., 2013; Greer et al., 2013; Gujar et al., 2011). Longitudinal SRI validation should test this cross-domain pathway.

Supplementary Table: Hypothetical SRI pilot profiles

Table S5: Hypothetical SRI pilot profiles: OECD average, Finland, and South Korea (illustrative values only)

Domain (0–10 scale)	**OECD avg.**	**Finland**	**South Korea**
Motor integrity	3.2	4.8	2.9
Interoceptive awareness	2.8	3.9	2.4
Nature contact	2.5	4.2	1.8
Sleep stability	2.6	3.8	2.1
Subjective well-being	3.0	4.5	2.7
Eudaimonia / social connection	2.7	4.1	2.2
Compensatory consumption	6.8	4.5	7.2
Ecological footprint	7.5	5.8	6.9
Profile interpretation	High extraction, low restitution	Balanced restitution	High extraction, low restitution, extreme digital saturation

Note. Values are hypothetical and intended for heuristic purposes only. They should not be cited as empirical national estimates, rankings, or validated SRI scores. Finland is selected because it combines high welfare provision, school-based outdoor play mandates, and cycling infrastructure with moderate consumption. South Korea is selected as a high-intensity case of digital saturation and educational pressure (see § 6.9). The SRI is designed to be read as a profile, not a single score: a society may score high on motor integrity but high on compensatory consumption, requiring domain-specific policy responses rather than aggregate ranking.

Appendix C.3 SRI Operationalisation with Existing Datasets

The Somatic Restitution Index (SRI) is proposed as a preliminary framework requiring psychometric validation. However, each of its eight domains can be operationalised using existing large-scale epidemiological and social surveys. This section specifies the modules and variables that could constitute a pilot SRI instrument.

Appendix C.3.1 NHANES (National Health and Nutrition Examination Survey, USA)

- **Postural and motor integrity:** Objective accelerometry (ActiGraph) for daily steps and MVPA; self-reported sitting time; back pain module (MCQ)
- **Metabolic indicators:** Fasting glucose, HbA1c, lipid panel, BMI, waist circumference
- **Sleep:** Sleep disorders questionnaire (SLQ); self-reported sleep duration and quality

Appendix C.3.2 COMPASS / IPEN (International Physical Activity and Environment Network)

- **Nature contact:** GPS-monitored time in green/blue spaces; NEWS (Neighbourhood Environment Walkability Scale) access to parks
- **Motor integrity:** IPAQ (International Physical Activity Questionnaire) short form; objective GPS-tracked walking trips
- **Built environment:** Street connectivity, residential density, land-use mix (GIS-derived)

Appendix C.3.3 ESS / Eurobarometer (Europe)

- **Subjective well-being:** ESS Round 10 life satisfaction (0–10), happiness scale, WHO-5 well-being index
- **Eudaimonia:** ESS purpose in life, autonomy, competence, relatedness (BPNSF)
- **Materialism / consumption:** Eurobarometer 508 (2023) materialism module; ESS environmental behaviour items
- **Loneliness:** UCLA Loneliness Scale (short form) available in select ESS rounds

Appendix C.3.4 Additional datasets for cross-validation

- **UK Biobank:** Accelerometry ($N > 100{,}000$), environmental exposures, mental health phenotypes
- **HBSC (Health Behaviour in School-aged Children):** Adolescent sleep, activity, screen time, well-being across 50 countries
- **Gallup World Poll:** Life evaluation, affect, purpose (can be linked to national environmental indicators)

Appendix C.3.5 Proposed composite scoring

A pilot SRI composite could be constructed through the following steps:

1. Domain-specific z-scores calculated within each dataset (or harmonised across datasets using equipercentile linking)
2. Domain scores averaged to produce eight subdomain scores (range: 0–10, higher = more restitution)
3. Optional: weighted composite based on theoretical importance or local policy priorities
4. **Explicitly excluded:** geometric or arithmetic means across all eight domains without validation. The article presents the SRI as a profile (radar diagram) rather than a single scalar until longitudinal predictive validity is established.

Note. These operationalisations are illustrative. Cross-cultural measurement invariance, temporal stability, and predictive validity for ecological behaviour and health outcomes remain to be tested.

Appendix C.4 Supplementary research roadmap

Table S6 provides a provisional research roadmap for validating and extending the Somatic Anthropocene framework. It is intended as a planning tool, not as a completed research programme.

Table S6: Proposed research roadmap for the Somatic Anthropocene framework

Time horizon	Research priority	Key datasets / methods
1–2 years	Pilot SRI validation using existing survey data (NHANES, Eurobarometer, HBSC).	Harmonised z-scores; psychometric testing; cross-cultural measurement invariance.
2–3 years	School-based intervention trials measuring SRI subdomain changes.	Cluster-RCTs; accelerometry; validated interoception scales; nature-contact logs.
3–5 years	Longitudinal cohort studies linking somatic restitution to consumption and ecological behaviour.	UK Biobank; COMPASS/IPEN; linked commercial/carbon-footprint data.
5–7 years	Cross-national comparative designs testing welfare-state and digital-regulation moderation.	ESS; Gallup World Poll; OECD digital policy indicators; WHO mortality data.
7–10 years	Integration of SRI profiles with Earth-system models and planetary boundaries research.	Doughnut Economics metrics; IPCC scenario frameworks; subnational footprint data.
10+ years	Development of subcultural somatic-resistance metrics and bottom-up somatic restitution indices.	Ethnographic methods; wearable biomarkers; community-based participatory research.

Appendix C.5 Supplementary pathway table for perceived reproductive viability

Table S7 summarizes candidate pathways linking the Somatic Anthropocene framework to perceived reproductive viability. The table is heuristic and hypothesis-generating; it should not be read as evidence that fertility decline is caused by somatic dysregulation.

Table S7: Candidate pathways linking the Somatic Anthropocene framework to perceived reproductive viability.

Pathway	Mechanism	Research implication
Climate concern	Eco-anxiety, climate dread, ethical concern, anticipated child vulnerability, reduced confidence in future habitability.	Test associations between climate concern, reproductive anxiety, fertility desire, fertility intention, and postponement of childbearing.
Allostatic load of parenting	Anticipated sleep deprivation, caregiving stress, time poverty, cortisol dysregulation, and reduced bodily reserve.	Test whether sleep security, stress load, recovery capacity, and caregiving support predict perceived reproductive viability.
Environmental reproductive burden	Heat exposure, air pollution, endocrine disruption, PFAS exposure, metabolic strain, and toxic exposure affecting reproductive health.	Distinguish biological fecundability and pregnancy outcomes from fertility intentions and reproductive desire.
Digitalization and intimacy	Screen-mediated life, sleep displacement, dating-market changes, social comparison, algorithmic intimacy, and reduced embodied sociality.	Test whether digital overload, loneliness, and algorithmic sociality are associated with partnership formation, fertility intentions, and reproductive confidence.
Somatic commons	Housing, green space, walkability, quiet, social support, childcare, time sovereignty, and non-commercial community infrastructure.	Test whether shared conditions of bodily regulation increase perceived reproductive viability beyond income alone.

D Supplementary Material: Policy Intervention Mapping and Somatic Justice Matrix

Appendix D.1 Policy Intervention Mapping (Table S5)

Table S8 maps selected structural interventions to the SRI domains they target, alongside the evidence level for intervention efficacy and the primary geographical context of implementation. This table is intended to guide policy translation of the SRI framework and to identify gaps where intervention evidence remains weak or geographically concentrated.

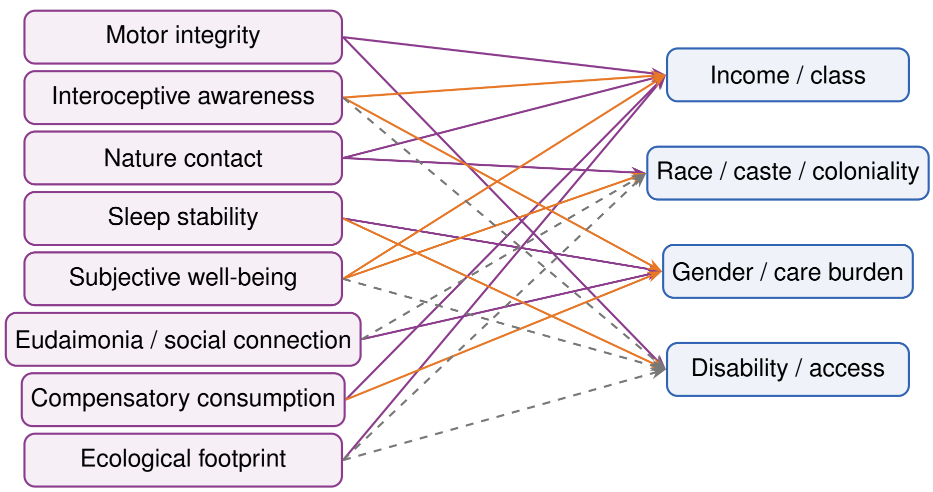
Note. Evidence levels refer to intervention efficacy (not underlying mechanism): L1 = RCT or strong quasi-experimental evidence; L2 = observational or natural-experiment evidence; L3 = theoretical or pilot evidence. The table is illustrative and not exhaustive.

Appendix D.2 Somatic Justice Matrix (Figure S6)

Figure 10 presents a heuristic matrix mapping the eight SRI domains against four axes of structural inequality. The matrix is intended to guide intersectional operationalisation of the SRI: it indicates which somatic domains are most likely to be moderated by income stratification, racialised/caste-based environmental segregation, gendered labour and care burdens, and disability-access barriers. The thickness and colour of connecting lines indicate hypothesised moderation strength (thick = strong, thin = moderate, dashed = context-dependent). This matrix is speculative and requires empirical testing in diverse national contexts.

Table S8: Policy intervention mapping: structural examples, targeted SRI domains, and evidence levels

Intervention	**Targeted SRI domains**	**Evidence level**	**Primary context**
School-based outdoor play mandates (Finland)	Motor integrity; Nature contact; Sleep stability	L2–L3	High-income (Nordic)
Cycling infrastructure as active-transport default (Netherlands)	Motor integrity; Nature contact; Ecological footprint	L2	High-income (Western Europe)
"Right to disconnect" labour law (France, 2017)	Sleep stability; Interoceptive awareness; Compensatory consumption (digital)	L3	High-income (EU)
Superblock urban redesign (Barcelona)	Motor integrity; Nature contact; Eudaimonia / social connection; Ecological footprint	L3	High-income (Southern Europe)
Green-space prescription programmes (UK, Scotland)	Nature contact; Subjective well-being; Motor integrity	L2–L3	High-income (Anglophone)
Sugar-sweetened beverage taxation (Mexico, UK)	Compensatory consumption; Metabolic indicators (adjacent)	L1–L2	Mixed income
Digital curfew and screen-time regulation (South Korea, China)	Sleep stability; Compensatory consumption; Interoceptive awareness	L3	East Asia
Community-based maternal/child health exposome monitoring (Mozambique)	Nature contact (quality); Chemical disruption; Motor integrity	L2–L3	Low-income (sub-Saharan Africa)



Heuristic matrix only. Line thickness denotes hypothesised moderation strength.

Figure 10: Somatic Justice Matrix: hypothesised intersections between SRI domains and axes of structural inequality. The matrix is intended to guide intersectional SRI operationalisation and to flag domains where cultural adaptation and justice-sensitive measurement are most urgently needed.

E Supplementary Material: Glossary of Neologisms

This glossary defines terms coined or repurposed in the Somatic Anthropocene framework. Definitions are provided to ensure consistent usage across the companion article and essay, and to facilitate interdisciplinary translation. Terms marked with an asterisk (*) are introduced in the companion essay *Axial Consciousness and the Somatic Anthropocene*.

Note. Sanskrit-derived terms (marked with *) are used as speculative conceptual bridges between phenomenology and contemporary toxicology/embryology; they are not offered as clinical, religious, or empirical conclusions. For full phenomenological development, see the companion essay (Lick, 2026).

Table S9: Glossary of neologisms and repurposed terms

Term	**Definition in the Somatic Anthropocene framework**
Somatic Anthropocene	The conceptual framework proposing that bodily dysregulation, reduced interoceptive awareness, weakened well-being, and diminished nature connectedness may amplify ecological crisis by increasing vulnerability to compensatory consumption and weakening embodied ecological care.
Somatic political ecology	The study of planetary-scale feedback loops between bodily dysregulation, economic systems, and Earth-system processes; treats the body as deeply embedded in biospheric processes and as a political field.
Somatic Restitution Index (SRI)	A preliminary multidimensional profile (not a scalar score) integrating eight domains—motor integrity, interoception, nature contact, sleep, subjective well-being, eudaimonia/social connection, compensatory consumption, and ecological footprint—for sustainability and public-health assessment.
Compensatory consumption	The behavioural tendency to seek external material, digital, caloric, or pharmaceutical rewards when internal regulation, meaning, and well-being are depleted.
Anthropocene metabolic phenotype	The population-level somatic condition shaped by synergistic chemical, sedentary, dietary, and sleep stressors: chronic low-grade inflammation, insulin resistance, leptin dysregulation, and impaired glucocorticoid feedback.
Digital–reward–loneliness loop	A self-reinforcing cycle in which digital compensation (scrolling, platform engagement) deepens the somatic isolation it promises to relieve, via altered reward sensitivity and reduced salience of slow embodied rewards.
Convergence signal	The co-occurrence of four population-level indicators (fertility decline, mental health deterioration, physical health decline, and loneliness) in younger cohorts, interpreted as a heuristic pattern consistent with the Somatic Anthropocene hypothesis.
Embodied orientation*	The embodied awareness of being situated through gravity, proprioception, interoception, social relation, and ecological embeddedness; a phenomenological companion-essay concept rather than an empirical conclusion.
Somatic restitution*	The recovery not only of health behaviours but of the bodily and environmental conditions that may support ecological care, embodied orientation, and ecological embeddedness.
Pseudo-restitution	The simulation or commodification of bodily repair through wellness, quantified-self, mindfulness, productivity, or algorithmic self-care systems without corresponding improvement in objective autonomic regulation, sleep, movement, social connection, reduced compensatory consumption, or ecological footprint.
Digital flattening*	The phenomenological attenuation of the axial field of consciousness by chronic screen-mediated, seated, horizontally oriented attention; the attenuation of embodied orientation into planar signal processing.
Sensorimotor neoteny*	A speculative metaphor (not a strict biological diagnosis) for arrested sensorimotor agency under digital and sedentary conditions; the condition of a somatically immature adult organism deprived of the ecological stimuli that support mature embodied self-regulation.
Viṣama (toxic accumulation)*	The systemic accumulation of endogenous and exogenous toxins (EDCs, microplastics, chronic inflammation) that alter metabolic phenotype and affective tone; the biochemical dimension of somatic dysregulation.

Data Availability Statement

No new empirical dataset was generated for this conceptual synthesis. The article draws on published literature and publicly documented datasets described in the supplementary material.

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