

Resource Perception, Comparison, and the Architecture of Human Cognition

Aram Cargill*

Change Challenge and the Adaption, Apex lab, Australia.

Correspondence

Aram Cargill, Change Challenge and the Adaption, Apex lab, Australia.

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INTRODUCTION

Fragmentation in Contemporary Models of Cognition and Regulation

Contemporary models of cognition have made significant advances in describing how the brain processes information, predicts outcomes, and adapts to environmental demands. However, much of this work remains distributed across separate domains, including cognitive psychology, neuroscience, behavioural economics, and systems theory, often treating cognition, emotion, and physiological regulation as partially independent processes.

This fragmentation creates a persistent conceptual gap. While individual mechanisms such as prediction, attention, learning, emotional processing, and executive function are increasingly well described, there remains less clarity regarding the higher-order organising principles that unify cognition in relation to internal physiological state, environmental demand, and behavioural output.

In recent decades, cognitive science has increasingly shifted away from viewing the brain as a passive information-processing system toward models that emphasise prediction, embodiment, adaptation, and environmental interaction. Predictive processing frameworks, for example, propose that the brain continuously generates and updates internal models of the world through ongoing comparison between expected and incoming sensory information [1,2]. Similarly, embodied and enactive approaches argue that cognition cannot be fully separated from the physiological and environmental conditions within which it occurs.

At the same time, growing evidence from behavioural economics and stress physiology suggests that cognitive performance is highly sensitive to perceived scarcity, physiological load, and regulatory state. Research exploring scarcity and decision-making has demonstrated that diminished perceived resources can significantly

narrow attentional bandwidth, reduce cognitive flexibility, impair executive function, and bias individuals toward shorter-term or more rigid forms of thinking [3]. These findings suggest that cognition is not merely influenced by informational content, but by the organism's broader assessment of energetic, environmental, and relational stability.

Related findings within affective neuroscience and stress physiology further demonstrate that chronic stress and dysregulation impair prefrontal cortical functioning, attentional control, emotional regulation, and behavioural flexibility [4,5]. Polyvagal Theory additionally proposes that the nervous system continuously evaluates conditions of safety and threat through processes of neuroception, influencing social engagement, defensive mobilisation, and physiological state regulation [6].

Despite these advances, many existing frameworks continue to isolate cognition from regulation, often treating thought, emotion, physiology, and behaviour as partially discrete domains rather than dynamically interacting systems. This separation may limit the ability of current models to fully account for why cognition changes so significantly under stress, uncertainty, overload, or perceived constraint.

A recurring observation across neuroscience, psychology, and behavioural science is that cognitive complexity often diminishes under conditions of increased stress or reduced perceived capacity. Under physiological or psychological load, individuals frequently demonstrate reduced tolerance for ambiguity, increased threat sensitivity, attentional narrowing, emotional reactivity, and stronger reliance on simplified or polarised interpretations of experience. While these phenomena are often discussed independently through concepts such as cognitive bias, emotional dysregulation, attentional fatigue, or threat response, they may reflect interconnected manifestations of a

broader systems-level process.

This paper proposes that two interacting organising dynamics may help integrate these observations within a unified conceptual framework.

First, cognition itself may be fundamentally relational in structure, organising experience through processes of comparison, distinction, contrast, and pattern differentiation. Perception appears dependent upon relational detection rather than absolute interpretation; the brain continuously identifies similarity, difference, deviation, and continuity in order to orient behaviour and generate meaning.

Second, regulatory state may be strongly influenced by perceived resource sufficiency. The nervous system appears highly responsive to conditions associated with safety, energetic availability, predictability, and environmental stability, while perceived diminishment of resources may contribute to physiological contraction, attentional narrowing, and reduced cognitive flexibility.

Within this framework, behavioural rigidity, polarity, and diminished tolerance for complexity may not simply represent failures of reasoning or characterological weakness, but state-dependent adaptations emerging from the interaction between comparative cognition and regulatory constraint.

The purpose of this paper is not to propose a singular or exhaustive theory of mind. Rather, it seeks to introduce an integrative systems framework capable of linking cognition, regulation, and behaviour across multiple domains of inquiry. By examining the interaction between comparison-based cognition and resource-dependent regulation, this paper aims to provide a conceptual model for understanding how cognitive flexibility, polarity, behavioural adaptation and mental performance may emerge from the dynamic relationship between perception and physiological state.

Comparison as a Cognitive Organising Principle

A central proposition of this paper is that cognition may be fundamentally organised through relational comparison. Rather than perceiving the world through isolated or absolute interpretation, the cognitive system appears to orient through distinction, contrast, deviation, and similarity detection. From basic sensory perception to abstract reasoning, comparison may function as one of the primary mechanisms through which meaning, prediction, and behavioural orientation emerge.

This relational structure is observable across multiple levels of cognition. Within sensory systems, perception depends heavily upon contrast detection rather than absolute measurement. Visual processing identifies edges, movement, depth, and form through differences in luminance, colour, and spatial orientation, while auditory processing similarly relies upon comparative distinction across frequency, intensity, rhythm, and temporal change. At the perceptual level, the nervous system appears optimised not merely to register information, but to detect relational variation within changing environments.

Contemporary predictive processing models further support the view that cognition operates through continuous comparison between expected and incoming sensory information [1,2]. Within these frameworks, the brain is understood not as a passive receiver of reality, but as an active prediction-generating system that continuously compares internal models against sensory input. Discrepancies between expectation and perception generate prediction error

signals, which subsequently drive learning, attentional adjustment, behavioural adaptation, and model updating [2].

Under this interpretation, cognition is inherently relational. Meaning does not emerge from isolated stimuli alone, but from the relationship between current input and prior expectation, memory, context, or predicted outcome. The system continuously evaluates similarity and difference, continuity and deviation, familiarity and novelty, congruence and incongruence. These comparative processes appear central to learning, categorisation, behavioural adaptation, and environmental orientation.

Comparison also appears closely linked to salience detection and attentional prioritisation. Organisms must continuously determine which stimuli require immediate behavioural response and which can be ignored. Comparative deviation from expectation often increases salience, drawing attentional resources toward novelty, uncertainty, inconsistency, or potential threat [7,8]. Within this framework, attention is not allocated randomly, but organised around biologically and behaviourally relevant differences that may influence survival, adaptation, or goal-directed behaviour.

At more abstract cognitive levels, comparison contributes substantially to categorisation and conceptual organisation. Categorisation itself depends upon identifying shared and divergent features between objects, experiences, or symbolic representations. Language acquisition, social perception and identity formation similarly rely upon comparative distinction. Concepts such as self and other, success and failure, safety and threat, or inclusion and exclusion may all emerge through relational differentiation processes that allow cognition to simplify and organise complex environmental information.

From an evolutionary perspective, such relational processing likely confers substantial adaptive advantage. Organisms capable of rapidly distinguishing environmental change, identifying anomalies, and detecting deviations from expected patterns would possess improved capacity for survival, learning, and behavioural flexibility. Comparative cognition therefore may not simply represent a higher-order intellectual function, but a foundational adaptive strategy embedded within perception itself.

Importantly, comparison may also contribute to the emergence of polarity and binary simplification. Human cognition frequently organises experience into oppositional categories, including good and bad, safe and dangerous, success and failure, belonging and exclusion, certainty and uncertainty. While reality itself is rarely fully binary, polarity may represent an efficiency-oriented compression strategy that reduces cognitive load and accelerates behavioural decision-making under conditions requiring rapid orientation.

Research exploring stress physiology, scarcity, and executive functioning suggests that increased physiological or psychological load is associated with reduced cognitive flexibility, attentional narrowing, diminished tolerance for ambiguity, and greater reliance on simplified heuristics or rigid interpretations [3,4]. Under conditions of perceived constraint, binary categorisation may therefore become increasingly adaptive from a metabolic and regulatory perspective, even when it reduces nuance or complexity.

Importantly, this paper does not propose that comparison functions as the sole mechanism of cognition. Cognitive processing clearly involves multiple interacting operations, including prediction, memory consolidation, attentional regulation, simulation, emotional

processing, and associative learning. However, comparison may function as one of the primary organising dynamics through which these processes become integrated into coherent behavioural orientation.

Within this framework, cognition can be understood as fundamentally relational rather than purely representational. The brain may not simply store objective representations of reality, but continuously organise perception through dynamic comparative interactions between expectation, context, memory, physiology, and incoming sensory information.

This perspective provides a foundation for the second core proposition of this paper: that the flexibility, rigidity, and complexity of cognition may be significantly shaped by the organism's regulatory state and perceived resource sufficiency.

Resource Perception and Regulatory State

While comparison may function as a central organising mechanism of cognition, cognition itself does not appear to operate independently of physiological state. A growing body of evidence across neuroscience, behavioural economics, stress physiology, affective science and interoceptive research suggests that perception, decision-making, attentional flexibility and behavioural complexity are profoundly shaped by the organism's regulatory condition.

This raises an important distinction. If comparison helps organise how cognition interprets reality, regulatory state may strongly influence the conditions within which cognition operates.

Within this framework, the nervous system can be understood not simply as a reactive threat-detection system, but as a dynamic regulator of energetic and environmental sufficiency. Organisms continuously assess conditions related to safety, predictability, energetic availability, relational stability, metabolic demand, and environmental uncertainty. These assessments influence physiological arousal, attentional allocation, emotional regulation, behavioural flexibility, and cognitive complexity.

Importantly, many of these evaluative processes occur prior to conscious reasoning. Stephen Porges proposed that the nervous system continuously engages in processes of "neuroception", automatically detecting cues of safety, danger, or life threat independent of deliberate cognition [6]. Similarly, predictive processing frameworks suggest that the brain continuously updates internal models in relation to anticipated environmental demands, uncertainty, and energetic efficiency [1,2].

Research within interoceptive neuroscience further supports the view that cognition is deeply influenced by the body's internal physiological condition. Interoception refers to the brain's ongoing monitoring and interpretation of internal bodily signals, including heart rate, respiration, autonomic arousal, hunger, fatigue, pain, and visceral sensation. Rather than functioning as a secondary influence upon cognition, interoceptive signalling appears central to emotional experience, self-representation, behavioural regulation, and decision-making processes [9,10].

Antonio Damasio argued through the Somatic Marker Hypothesis that bodily states significantly shape cognition and decision-making, particularly under conditions involving uncertainty, complexity, or risk [11]. More recently, Lisa Feldman Barrett proposed that the brain continuously regulates the body through predictive allostasis, constructing emotional and cognitive experience in relation to

anticipated energetic needs and bodily resource management [12]. Within this interpretation, cognition is not detached from physiology, but emerges through continuous interaction between predictive modelling and bodily regulation.

Under conditions perceived as stable and sufficiently resourced, organisms generally demonstrate increased exploratory behaviour, social engagement, cognitive flexibility, and tolerance for ambiguity. In contrast, perceived diminishment of resources or increased uncertainty often produces physiological contraction, attentional narrowing, heightened threat sensitivity, and reduced behavioural flexibility. Research exploring scarcity has demonstrated that diminished perceived resources can significantly reduce cognitive bandwidth and impair executive functioning, often biasing individuals toward short-term prioritisation and simplified decision-making strategies [3].

From a neurophysiological perspective, chronic stress and elevated allostatic load further impair prefrontal cortical regulation, reducing working memory capacity, attentional control, emotional regulation, and adaptive decision-making [4,5]. Under sustained stress conditions, cognition increasingly shifts toward survival-oriented processing characterised by rapid threat assessment, heuristic simplification, and defensive behavioural organisation.

Within this context, rigidity and polarity may emerge not solely as ideological or psychological phenomena, but as adaptive responses to perceived constraint. When energetic, emotional, or environmental resources appear diminished, the nervous system may prioritise certainty, efficiency, and rapid orientation over complexity, openness, or nuance. Binary categorisation reduces computational demand and accelerates behavioural decision-making under pressure, even when doing so narrows perception or reduces cognitive flexibility.

This perspective may help explain why stress, overload, financial insecurity, chronic uncertainty, social instability, sleep deprivation, and emotional dysregulation are frequently associated with increased reactivity, reduced tolerance for ambiguity, and stronger reliance on polarised interpretations of experience. Under constrained conditions, the cognitive system appears increasingly biased toward compression strategies that simplify environmental complexity into more immediately actionable distinctions.

Importantly, this framework does not suggest that human behaviour is determined exclusively by physiology or resource perception. Rather, it proposes that regulatory state significantly influences the range of cognitive and behavioural possibilities available to the organism at any given moment. Thought, reasoning, emotional regulation and behavioural flexibility may therefore be partially state-dependent capacities rather than entirely stable traits.

This distinction carries important implications for psychology, mental health, education, leadership, and social behaviour. Many behaviours traditionally interpreted as failures of reasoning, motivation, discipline, or emotional maturity may be more accurately understood as emerging from dysregulated or resource-constrained systems operating under reduced adaptive capacity.

Within this proposed model, mental flexibility, openness, emotional regulation, and complexity tolerance may not simply represent cognitive achievements, but emergent properties of sufficiently regulated systems capable of maintaining integration under load.

Accordingly, cognition and regulation may be better understood not

as separate domains, but as dynamically interdependent processes continuously shaping perception, interpretation, behaviour, and adaptation. The interaction between comparative cognition and regulatory state may therefore represent a foundational systems dynamic underlying both human performance and psychological vulnerability.

Cognitive Compression, Polarity, and Complexity Tolerance

If cognition is fundamentally organised through relational comparison, and regulatory state influences the range of adaptive capacities available to the organism, then an important implication emerges: the flexibility and complexity of cognition may vary significantly according to perceived resource sufficiency and physiological constraint.

This paper proposes that polarity and cognitive rigidity can be understood not simply as ideological, emotional, or intellectual phenomena, but as adaptive compression strategies emerging under conditions of heightened load, uncertainty, or diminished regulatory capacity. Within this context, *cognitive compression* refers to the reduction of interpretive complexity into simplified categorical distinctions under conditions of increased cognitive, emotional, or physiological demand.

Human cognition continuously confronts an immense volume of sensory, emotional, social, and informational complexity. Under stable and sufficiently regulated conditions, individuals are generally more capable of tolerating ambiguity, integrating competing perspectives, delaying reactive judgment, and maintaining behavioural flexibility. Such conditions allow for greater nuance, contextual reasoning, and complexity integration.

As physiological or psychological load increases, however, cognition appears increasingly biased toward efficiency-oriented simplification. Under stress, attentional resources narrow, threat salience increases, uncertainty becomes less tolerable, and the nervous system prioritises rapid orientation over exploratory processing [4,5]. Simplified categorisation and binary distinction may become metabolically advantageous because they reduce cognitive demand and accelerate behavioural decision-making [13,14].

From this perspective, polarity may represent a form of adaptive cognitive compression. Complex environmental information becomes condensed into more immediately actionable distinctions:

- safe or dangerous,
- ally or threat,
- right or wrong,
- success or failure,
- belonging or exclusion.

Such compression is not necessarily irrational. Under conditions requiring rapid response, simplified categorisation may increase survival efficiency by reducing computational load and minimising decisional ambiguity. Evolutionarily, organisms capable of rapidly orienting under threat would likely possess adaptive advantages over organisms requiring prolonged deliberation before action.

This interpretation aligns with findings from stress physiology, behavioural economics, and cognitive neuroscience demonstrating that resource scarcity, uncertainty, and elevated stress impair executive functioning and reduce cognitive flexibility [3,4]. Under constrained conditions, attentional bandwidth narrows and individuals increasingly rely upon heuristics, habitual responses, and simplified interpretive frameworks [13].

Rigidity and polarisation may therefore emerge not solely from informational deficits or ideological commitment, but from interactions between comparative cognition and regulatory constraint. Under diminished perceived capacity, the nervous system appears increasingly biased toward certainty, predictability, and rapid orientation. Nuance, ambiguity tolerance, and perspective integration require greater cognitive and physiological surplus than binary simplification [15].

This distinction may hold significant implications for understanding contemporary social and psychological phenomena. Modern environments increasingly expose individuals to chronic informational overload, economic uncertainty, attentional fragmentation, sleep disruption, social instability, and sustained physiological stress. Simultaneously, digital systems and algorithmic media environments frequently amplify emotionally salient contrasts, conflict-based framing, and rapid comparative evaluation.

Under such conditions, cognitive compression may become increasingly reinforced. Heightened physiological load combined with persistent comparative stimulation may contribute to emotional reactivity, ideological rigidity, tribal identification, and diminished tolerance for complexity or ambiguity. Polarity, in this sense, may function less as a purely intellectual phenomenon and more as an emergent property of chronically constrained regulatory systems attempting to maintain orientation under excessive load.

This perspective does not deny the influence of culture, education, ideology, or personal responsibility upon human behaviour. Rather, it suggests that these factors operate within broader physiological and cognitive conditions that shape the degree of flexibility available to the organism at any given moment.

Complexity tolerance itself may represent a form of adaptive capacity. The ability to hold competing perspectives, tolerate uncertainty, integrate ambiguity, regulate emotional reactivity, and maintain cognitive openness under pressure may depend partially upon the organism's capacity to sustain regulatory stability while processing environmental demand.

Mental flexibility, therefore, may be understood not merely as an intellectual skill, but as a systems-level achievement emerging from the interaction between cognition, physiology, attention, and environmental conditions.

This interpretation carries important implications for mental health, leadership, education, performance science, and social cohesion. Interventions aimed solely at changing thought content may prove limited if the organism remains chronically dysregulated or physiologically constrained. Likewise, efforts to improve reasoning, emotional regulation, or behavioural adaptability may benefit from approaches that simultaneously address regulatory capacity, recovery, interoceptive awareness, and environmental load.

Accordingly, cognitive complexity and behavioural flexibility may be understood not as fixed personal traits, but as dynamic capacities emerging from the relationship between comparative cognition and regulatory sufficiency. Under this interpretation, the preservation of nuance, openness, and adaptive reasoning may depend less upon abstract intelligence alone and more upon the organism's capacity to maintain integration under conditions of stress, uncertainty, and demand.

Adaptive Capacity and the Preservation of Cognitive Complexity

If cognitive compression represents an adaptive response to heightened constraint, uncertainty, or diminished regulatory capacity, then an equally important question emerges: what allows cognition to preserve flexibility, nuance, and complexity under conditions of pressure?

The preceding sections have proposed that cognition organises relationally through comparison, while regulatory state influences the degree of adaptive flexibility available to the organism. Together, these processes suggest that mental flexibility may not simply reflect intelligence, knowledge, or personality, but the capacity to sustain integrated cognitive functioning while navigating stress, ambiguity, uncertainty, and environmental demand.

Under this interpretation, cognitive complexity can be understood as a metabolically and physiologically demanding achievement rather than a default state. The ability to maintain ambiguity tolerance, perspective integration, emotional regulation, contextual reasoning, and behavioural flexibility under pressure likely requires substantially greater regulatory stability than simplified or compressed forms of cognition [15].

This distinction may help explain why individuals often demonstrate dramatically different cognitive and behavioural capacities across changing physiological or environmental conditions. A person capable of openness, nuance, creativity, and reflective reasoning under stable conditions may shift toward rigidity, impulsivity, or defensive simplification under sustained stress, overload, emotional activation, or perceived threat. Such shifts may not necessarily represent changes in intelligence or moral character, but alterations in the organism's available adaptive capacity.

From this perspective, adaptive cognition is not defined solely by analytical ability or informational accuracy. Rather, it may involve the preservation of flexibility under load. The capacity to tolerate uncertainty without premature closure, maintain emotional regulation during conflict, integrate competing perspectives, delay reactive judgment, and sustain behavioural openness despite stress may represent higher-order expressions of regulatory integration.

This interpretation aligns with emerging research suggesting that executive functioning, attentional regulation, emotional flexibility, and social cognition are highly state-dependent processes influenced by physiological regulation, allostatic load, and interoceptive stability [4,5,12]. Under sufficiently regulated conditions, cognition appears more capable of maintaining exploratory processing, contextual integration, long-range planning, and adaptive behavioural flexibility. Under constrained conditions, cognition increasingly shifts toward efficiency-oriented compression strategies prioritising certainty, rapid orientation, and reduced ambiguity.

Openness itself may also carry physiological and cognitive cost. Complexity requires the simultaneous processing of multiple possibilities, competing interpretations, unresolved uncertainty, and dynamically changing information. Such processing likely demands greater energetic availability, attentional stability, and regulatory coordination than simplified categorical distinction [13].

In this sense, cognitive flexibility may function less as a static trait and more as an emergent systems capacity dependent upon the organism's ability to maintain integration while under demand. Psychological resilience, therefore, may not simply reflect toughness,

emotional suppression, or persistence, but the capacity to preserve adaptive complexity without collapsing into rigid compression or behavioural disorganisation [16].

This distinction may carry significant implications for mental health, leadership, education, and performance science. Traditional models frequently evaluate individuals primarily through behavioural outcomes while insufficiently accounting for the underlying regulatory conditions shaping cognitive flexibility and adaptive capacity. Behaviours commonly interpreted as motivational failure, emotional immaturity, attentional inconsistency, or poor decision-making may sometimes reflect fluctuations in the organism's available capacity to sustain integrated functioning under load.

The framework proposed here also offers an alternative perspective on mental fitness. Rather than defining mental fitness exclusively through productivity, emotional positivity, or symptom reduction, mental fitness may be understood as the capacity to maintain cognitive flexibility, emotional regulation, perspective integration, and adaptive behavioural responsiveness across changing environmental conditions.

Under this interpretation, mental fitness involves more than the optimisation of thought content. It involves preserving the conditions that allow complex cognition to remain available under pressure. Recovery, physiological regulation, attentional restoration, interoceptive awareness, sleep stability, emotional safety, and environmental predictability may therefore play central roles in sustaining adaptive cognitive functioning.

This perspective further suggests that modern environments may increasingly challenge the preservation of cognitive complexity. Chronic informational overload, fragmented attention, continuous comparative stimulation, economic uncertainty, algorithmic salience amplification, and sustained physiological activation may progressively reduce the organism's available adaptive surplus. Under such conditions, rigidity, emotional reactivity, impulsive interpretation, and polarised cognition may emerge less as isolated psychological failures and more as downstream expressions of chronically constrained adaptive systems.

This framework does not imply that complexity or flexibility are inherently superior in all contexts. Compression itself remains adaptive under conditions requiring rapid orientation, immediate threat response, or decisional efficiency. Human cognition likely depends upon the dynamic capacity to move fluidly between compression and expansion according to environmental demand.

The central distinction proposed here is therefore not between "good" and "bad" cognition, but between differing modes of adaptive organisation shaped by the interaction between comparative processing and regulatory state.

Viewed collectively, these observations suggest that the preservation of nuance, openness, and behavioural flexibility may depend less upon abstract intelligence alone and more upon the organism's capacity to sustain integrated functioning while navigating uncertainty, demand, emotional activation, and environmental complexity. Under this interpretation, adaptive cognition emerges not merely from what the mind knows, but from the conditions the organism is capable of sustaining.

Toward an Integrative Systems Model of Cognition and Regulation

The preceding sections have proposed that cognition and regulation may be more dynamically interconnected than many conventional models assume. Comparative processing appears central to how organisms orient through distinction, prediction, and salience detection [1,2], while regulatory state influences the degree of adaptive flexibility available to the organism under changing environmental conditions.

Taken together, these observations suggest the need for a more integrated systems-level understanding of cognition and behaviour. The framework proposed in this paper conceptualises cognition and regulation as continuously interacting processes that collectively shape perception, interpretation, behavioural flexibility, and adaptive capacity. Cognition organises experience relationally through comparison [1,2], while regulatory systems influence the degree of complexity the organism is capable of sustaining under environmental demand.

Within this model, comparative cognition continuously evaluates similarity and difference, continuity and deviation, familiarity and novelty, expectation and outcome. These processes contribute to prediction, salience allocation, categorisation, and behavioural orientation. Simultaneously, the nervous system continuously regulates physiological and energetic conditions in relation to perceived environmental demands through processes associated with interoception, allostasis, neuroception, attentional regulation, and stress adaptation [6,10,12].

The interaction between these systems may significantly influence the range of cognitive and behavioural responses available at any given moment. As perceived constraint increases, available adaptive capacity may diminish, biasing cognition toward compression-oriented processing characterised by attentional narrowing, heuristic simplification, binary categorisation, heightened threat salience, and reduced ambiguity tolerance. Conversely, under sufficiently regulated conditions, greater adaptive surplus appears to permit expanded cognitive flexibility, contextual reasoning, emotional regulation, exploratory processing, and perspective integration [5,12].

Accordingly, cognition may operate across a dynamic continuum between cognitive compression and adaptive complexity.

At one end of this continuum, sustained physiological or environmental constraint biases cognition toward rapid orientation and simplified behavioural organisation. These compression-oriented states may increase short-term survival efficiency under conditions requiring immediate response by reducing computational demand and accelerating decisional clarity [13,14].

At the opposite end of the continuum, sufficiently regulated conditions appear to support greater complexity tolerance [15]. Under these conditions, individuals may become more capable of sustaining ambiguity, integrating competing perspectives, regulating emotional reactivity, delaying premature closure, and adapting behaviour flexibly across changing contexts.

The preservation of cognitive complexity under conditions of stress may therefore represent one of the defining functions of adaptive regulation.

This distinction may help explain why cognitive flexibility fluctuates substantially across contexts rather than functioning as a fully stable

trait [4,16]. The same individual may demonstrate markedly different capacities for emotional regulation, creativity, executive functioning, ambiguity tolerance, behavioural openness, and reflective reasoning depending upon physiological load, environmental predictability, attentional demand, perceived resource sufficiency, and social context.

From this perspective, many behaviours traditionally interpreted as fixed expressions of personality, intelligence, motivation, or psychopathology may be more dynamically state-dependent than commonly assumed. Cognitive rigidity, emotional reactivity, impulsive interpretation, and behavioural inconsistency may partially reflect alterations in available adaptive capacity rather than exclusively stable deficits in reasoning or character.

The framework also suggests that contemporary environments may increasingly bias cognition toward compression-oriented processing. Chronic informational overload, fragmented attention, continuous comparative stimulation, economic instability, social uncertainty, sleep disruption, and persistent stress activation may progressively reduce available regulatory surplus while simultaneously increasing salience demand. Under such conditions, maintaining cognitive complexity may become increasingly metabolically and psychologically demanding.

This interpretation carries implications across multiple domains, including mental health, education, organisational performance, leadership, trauma research, behavioural science, and neurodevelopmental conditions. Interventions focused exclusively upon changing thought content without addressing regulatory stability, physiological recovery, attentional load, or environmental conditions may prove limited in their ability to preserve adaptive cognitive flexibility under sustained demand [16].

Importantly, the present framework remains theoretical and integrative rather than definitive. The model proposed here is not intended as a singular explanation for all cognition or behaviour, nor does it suggest that comparison or resource perception fully account for the complexity of human psychological functioning. Rather, it is offered as a systems-oriented conceptual framework capable of integrating findings across predictive processing, stress physiology, behavioural economics, interoception, and cognitive regulation research.

Viewed collectively, the model suggests that cognition may be shaped not solely by informational processing, but by the organism's ongoing capacity to regulate complexity under changing environmental and physiological conditions. Under this interpretation, mental flexibility, behavioural adaptability, and psychological resilience emerge not merely from what the mind knows, but from the degree of integrated complexity the organism is capable of sustaining under load.

CORE PROPOSITIONS OF THE FRAMEWORK

Proposition 1

Cognition Organises Relationally Through Comparison

Cognition appears to organise experience through relational processes of distinction, contrast, deviation detection, similarity recognition, and predictive comparison. Perception, interpretation, salience allocation, and behavioural orientation emerge not through isolated processing alone, but through the continuous evaluation of relational differences between expectation, context, memory, and incoming sensory information.

Proposition 2

Regulatory State Influences Available Adaptive Capacity

The organism's regulatory state significantly influences the range of cognitive, emotional, behavioural, and physiological flexibility available under changing environmental conditions. Processes associated with stress regulation, interoception, autonomic activity, energetic demand, and perceived safety or constraint shape the adaptive capacities accessible to the organism at any given moment.

Proposition 3

Increased Constraint Biases Cognition Toward Compression

As perceived environmental, emotional, cognitive, or physiological constraint increases, cognition appears increasingly biased toward compression-oriented processing characterised by attentional narrowing, heuristic simplification, heightened threat salience, binary categorisation, and reduced ambiguity tolerance. These shifts may function as adaptive efficiency strategies under conditions requiring rapid orientation or reduced computational demand.

Proposition 4

Adaptive Complexity Requires Regulatory Stability

The preservation of cognitive flexibility, contextual reasoning, emotional regulation, ambiguity tolerance, and perspective integration appears dependent upon sufficiently regulated physiological and attentional conditions. Adaptive complexity may therefore represent a metabolically and regulatory demanding achievement rather than a default cognitive state.

Proposition 5

Cognitive Flexibility Is State-Dependent Rather Than Entirely Trait-Dependent

Cognitive flexibility, behavioural openness, executive functioning, and emotional regulation may fluctuate substantially according to physiological load, attentional demand, uncertainty, recovery status, and perceived resource sufficiency. Accordingly, many behavioural expressions commonly interpreted as fixed traits may be more dynamically state-dependent than traditionally assumed.

Proposition 6

Compression and Complexity Represent Adaptive Modes Rather Than Moral Categories

Compression-oriented and complexity-oriented cognitive states likely serve differing adaptive functions depending upon environmental demand. Compression may support rapid orientation and survival efficiency under acute stress or uncertainty, while complexity-oriented cognition may support long-range planning, cooperation, exploratory processing, creativity, and contextual integration under sufficiently stable conditions.

Proposition 7

Adaptive Regulation Preserves Integrated Complexity Under Load

One of the defining functions of adaptive regulation may be the preservation of integrated cognitive complexity under conditions of stress, uncertainty, and environmental demand. Under this framework, mental flexibility, resilience, and adaptive functioning emerge not solely from informational processing or intellectual ability, but from the organism's capacity to sustain integrated complexity without collapsing into compression under load.

LIMITATIONS AND FUTURE DIRECTIONS

The framework proposed in this paper is intended as an integrative and theoretical model rather than a definitive explanatory account of cognition or behaviour. While the present synthesis draws upon findings from predictive processing, stress physiology, behavioural economics, interoception, affective neuroscience, and cognitive regulation research, the relationships proposed between comparative cognition, regulatory state, adaptive capacity, and cognitive compression remain largely conceptual and require further empirical investigation.

Several limitations should therefore be acknowledged

First, the framework necessarily simplifies highly multidimensional processes. Human cognition emerges through the interaction of biological, psychological, developmental, social, cultural, and environmental influences that cannot be fully reduced to comparison-based processing or resource-dependent regulation alone. The present model should therefore not be interpreted as a comprehensive theory of mind, personality, or psychopathology.

Second, several constructs introduced within this paper remain conceptually rather than operationally defined. Terms such as *cognitive compression*, *adaptive complexity*, *regulatory surplus*, and *complexity tolerance* are proposed as systems-oriented constructs intended to organise observations across multiple domains of inquiry. Further refinement and empirical validation will be necessary before these concepts can be reliably measured or experimentally tested.

Third, while the framework proposes a continuum between compression-oriented and complexity-oriented cognitive states, these modes are unlikely to exist as fixed or discrete categories. Compression itself may remain highly adaptive under conditions involving immediate threat, time pressure, or survival demand, while complexity-oriented cognition may prove advantageous under conditions permitting exploratory processing, social cooperation, and long-range planning.

Despite these limitations, the framework may offer several potentially valuable directions for future research.

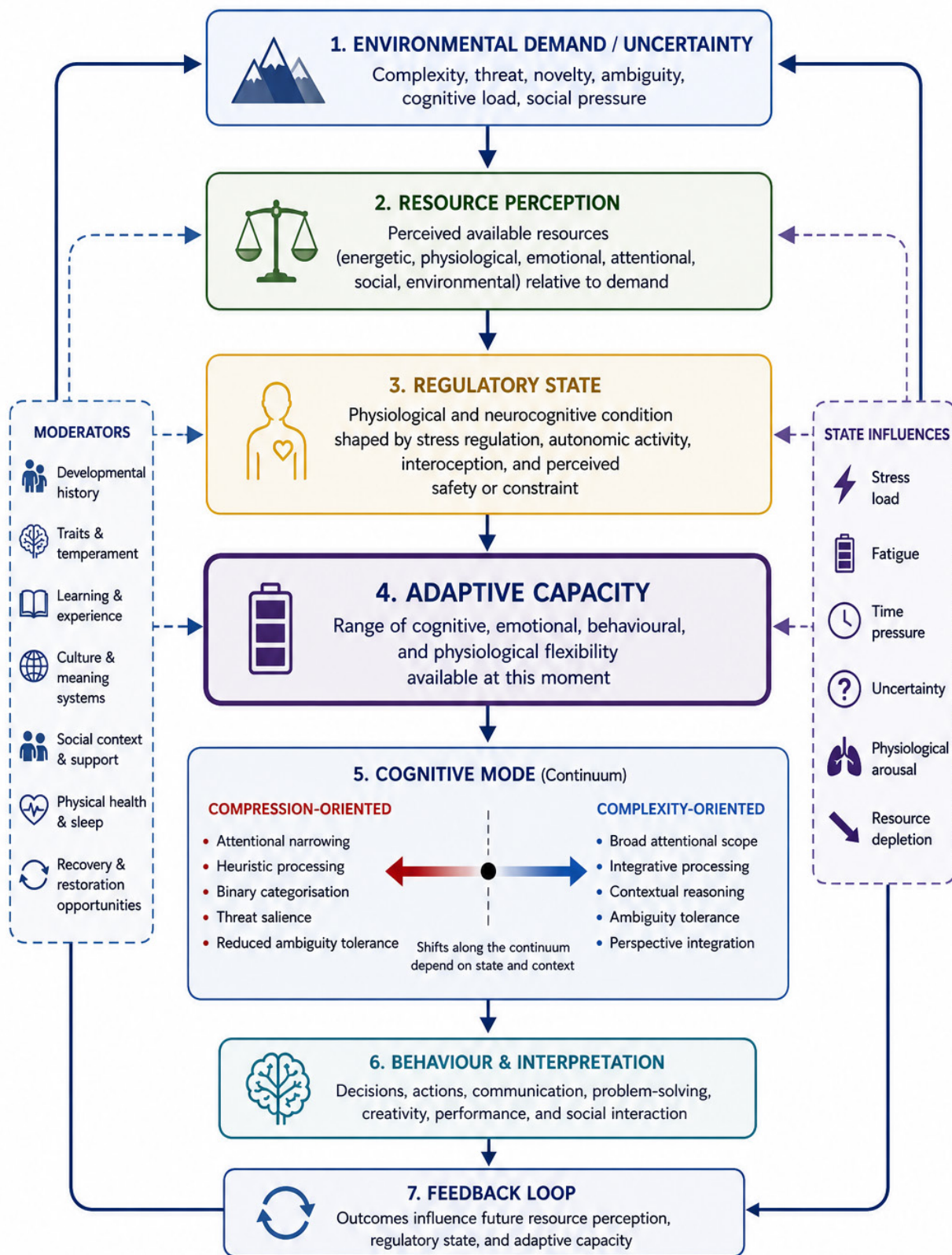
One important area for investigation involves examining the relationship between physiological regulation and cognitive flexibility under varying levels of stress or uncertainty. Future work may examine whether measures associated with autonomic regulation, interoceptive awareness, recovery capacity, or allostatic load correlate with ambiguity tolerance, behavioural flexibility, executive functioning, or susceptibility to polarised cognition [4,5,15].

Further research may also investigate whether cognitive compression can be operationalised experimentally through measurable changes in attentional narrowing, binary categorisation, heuristic reliance, salience sensitivity, or reduced complexity tolerance under conditions of increased cognitive or physiological load.

The framework may additionally hold relevance for research involving chronic stress exposure, trauma-related conditions, burnout, anxiety disorders, attentional dysregulation, and neurodevelopmental conditions such as ADHD, where fluctuations in executive functioning, emotional regulation, and behavioural consistency frequently appear highly state-dependent.

Future research may also investigate whether adaptive complexity can be operationalised through measurable relationships between

Figure 1. Integrative Systems Model of Cognition and Regulation



Note. The model depicts dynamic, bidirectional influences between environment, perception, regulation, cognition, and behaviour. Movement along the compression–complexity continuum is state-dependent and context-sensitive.

physiological regulation, ambiguity tolerance, attentional flexibility, and context-sensitive behavioural adaptation under varying levels of environmental demand.

Finally, the present model may offer opportunities for greater interdisciplinary integration across neuroscience, psychology, behavioural economics, education, organisational performance, and systems theory by examining how adaptive capacity emerges through the interaction between comparative processing, regulatory stability, environmental demand, and behavioural context.

The framework proposed here should therefore be understood not as a final explanatory model, but as a conceptual foundation for further interdisciplinary investigation into the relationship between cognition, regulation, complexity, and adaptive human functioning.

CONCLUSION

This paper has proposed an integrative systems framework suggesting that cognition and regulation may be more dynamically interconnected than many traditional models assume. Rather than conceptualising cognition as an isolated informational process, the framework presented here suggests that cognitive flexibility and behavioural adaptability emerge through the ongoing interaction between comparative processing and physiological regulation.

Within this model, cognition appears to organise relationally through processes of distinction, prediction, and salience detection, while regulatory state influences the degree of adaptive complexity the organism is capable of sustaining under environmental demand. Under sufficiently regulated conditions, cognition appears more capable of sustaining ambiguity tolerance, contextual reasoning, perspective integration, exploratory processing, and behavioural openness. Under conditions of heightened constraint, uncertainty, overload, or diminished adaptive capacity, cognition may increasingly shift toward compression-oriented processing characterised by attentional narrowing, heuristic simplification, binary categorisation, and reduced complexity tolerance.

From this perspective, cognitive compression may represent an adaptive response to perceived constraint rather than simply a failure of reasoning or emotional maturity.

Viewed collectively, the framework proposed here suggests that cognition cannot be fully understood independently from the regulatory conditions within which it operates. Comparative processing and physiological regulation appear to interact continuously in shaping the degree of flexibility, openness, and behavioural adaptability available to the organism under changing environmental demands.

Under this interpretation, the preservation of cognitive complexity under conditions of stress may represent one of the defining functions of adaptive regulation. Mental flexibility, resilience, and adaptive functioning therefore emerge not simply from informational processing alone, but from the organism's capacity to sustain integrated complexity without collapsing into compression under load.

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