

Systems Linguistics: Representation, Compression, and Productive Coordination

John A Challoner, June, 2026.

Abstract

Language is fundamental to human understanding, communication, and coordination, yet its relationship to cognition and reality is often taken for granted. This paper explores the proposition that language evolved as a representational system built upon earlier cognitive capabilities developed for recognising and responding to recurring patterns within the environment. Drawing upon insights from systems theory, cognitive psychology, and the philosophy of science, it is argued that human cognition employs two complementary modes of understanding: configurational cognition, which specialises in the recognition of recurring patterns and states, and causal cognition, which specialises in the recognition of interactions, transfers, constraints, and processes.

Both forms of cognition rely upon compression to manage the complexity of reality. Configurational compression supports efficient pattern recognition, while causal compression supports explanation, prediction, and intervention. Concepts, theories, and disciplines may therefore be understood as compressions of reality that preserve useful information while reducing complexity to cognitively manageable forms.

The paper argues that linguistic divergence emerges naturally as cultures, disciplines, and individuals develop specialised compressions of reality and represent those compressions through different symbolic systems adapted to different purposes and contexts. At the same time, hidden convergence persists beneath this diversity because recurring structures within reality and cognition continue to generate similar representational patterns. This observation suggests the possibility of a systems linguistics focused not upon replacing existing languages or terminologies, but upon identifying and translating the common structures that underlie them.

The paper concludes that productive coordination depends increasingly upon the ability to compare, translate, and integrate diverse forms of knowledge. A systems linguistics may therefore provide a foundation for improved interdisciplinary communication, knowledge integration, and AI-assisted productive coordination. More broadly, the paper proposes that beneath the apparent fragmentation of modern knowledge there may exist deeper forms of unity arising from the shared realities, cognitive processes, and representational structures through which human understanding is constructed.

1. Introduction

Language is one of humanity's most remarkable achievements. It enables individuals to communicate experiences, share knowledge, coordinate activities, and transmit culture across generations. Despite its central role in human affairs, language is often taken for granted. We routinely use words, concepts, and theories without reflecting upon how they relate to reality or how they influence our understanding of it.

The importance of language extends far beyond everyday communication. All forms of knowledge are represented through symbolic systems. Scientific theories, legal frameworks, economic models, religious traditions, and philosophical arguments all depend upon language for their expression and transmission. Even mathematics, often regarded as distinct from ordinary language, can be understood as a specialised symbolic language developed for the representation of quantitative and logical relationships.

For systems theorists, language presents a particularly interesting challenge. The field encompasses a wide range of disciplines, including physics, biology, engineering, psychology, sociology, economics, and management. Each of these domains has developed its own specialised terminology and conceptual frameworks. As a result, similar phenomena are often described using different vocabularies, while identical terms may carry different meanings in different contexts. Communication across disciplinary boundaries therefore becomes increasingly difficult as knowledge expands and specialisation increases.

Several systems theorists have attempted to address this challenge by identifying common patterns that recur across diverse domains. Notably, Len Troncale's work on Universal Systems Properties and Linkage Propositions sought to identify structures and relationships that appear repeatedly in physical, biological, social, and technological systems. Such work suggests that apparently diverse systems may share important underlying characteristics.

The present paper addresses a related but distinct question. Rather than focusing primarily upon recurring properties within systems themselves, it explores how those properties are represented through cognition and language. In particular, it examines the role of compression in human understanding, the emergence of linguistic divergence through cultural and disciplinary specialisation, and the possibility that recurring structures may persist beneath apparently different terminologies. The paper argues that these common structures may provide the basis for a systems linguistics capable of supporting translation, knowledge integration, and productive coordination across disciplinary and cultural boundaries.

The argument proceeds in several stages. First, the evolution of representation is examined, from iconic perception to symbolic language. The paper then explores the

relationship between configurational and causal cognition and their role in the compression of complexity. This provides a foundation for understanding how linguistic divergence emerges and why communication difficulties arise. Finally, the paper considers how hidden convergence beneath divergent vocabularies may support translation, systems linguistics, and productive coordination.

2. The Evolution of Representation

Living systems must continually navigate their environments. To survive and reproduce, they must avoid threats, exploit opportunities, acquire resources, and interact effectively with other organisms. These tasks require some form of representation. Without the ability to distinguish beneficial from harmful conditions, even the simplest organisms would be unable to respond appropriately to their surroundings.

The earliest forms of representation were almost certainly iconic rather than symbolic (Bruner, 1966). Organisms evolved sensory systems capable of detecting recurring features of their environments and associating them with particular outcomes. A shadow overhead might indicate a predator. A particular scent might indicate food. A specific sound might signal danger. Such representations need not involve conscious thought. They merely need to provide a sufficiently reliable correspondence between aspects of the environment and adaptive responses.

As evolution progressed, increasingly sophisticated forms of representation emerged. Organisms became capable of recognising more complex patterns and states within their environments. These patterns often reflected recurring threats and opportunities that had significance for survival and reproduction. The resulting ability to identify meaningful configurations provided substantial evolutionary advantages and remains a central feature of human cognition to this day.

Communication appears to have evolved as an extension of this representational capability. Many species communicate information concerning predators, food sources, territorial boundaries, mating opportunities, and social relationships. Alarm calls, territorial displays, chemical signalling, and social behaviours all enable information acquired by one organism to influence the behaviour of others. Communication therefore allows knowledge to be distributed beyond the direct experience of a single individual.

Human language represents a particularly powerful development of this process. Unlike simpler signalling systems, language allows individuals to communicate not only immediate observations but also abstractions, hypothetical situations, plans, explanations, and accumulated knowledge. Language extends representation beyond the here and now, enabling information to be preserved, transmitted, refined, and combined across generations.

The relationship between cognition and language has long been debated. Some theorists have argued that language shapes thought, while others have argued that thought precedes language. The present paper adopts a position that recognises the importance of both while proposing that cognitive development is the more fundamental driver. Organisms must first perceive and recognise aspects of reality before they can develop symbols to represent them. Language therefore appears to build upon pre-existing cognitive capabilities rather than creating them from nothing.

This does not imply that language is a passive reflection of cognition. Once established, symbolic systems influence perception, memory, reasoning, and social organisation. Language and cognition therefore co-evolve, each influencing the development of the other (Vygotsky, 1934/1986). Nevertheless, the ability of language to communicate information ultimately depends upon its capacity to represent distinctions and relationships that have significance within the world.

This perspective suggests that language is neither arbitrary nor detached from reality. Although different cultures and disciplines employ different symbols and terminologies, these symbolic systems have evolved because they assist individuals and groups in understanding, predicting, and responding to aspects of their environments. Consequently, language may be expected to retain traces of the cognitive processes from which it emerged and, indirectly, of the realities those processes evolved to represent.

The next section explores this possibility by examining two complementary forms of cognition: configurational cognition, which specialises in the recognition of recurring patterns and states, and causal cognition, which specialises in the recognition of interactions, transfers, and processes. Together these provide a foundation for understanding how complexity is compressed into concepts and communicated through language.

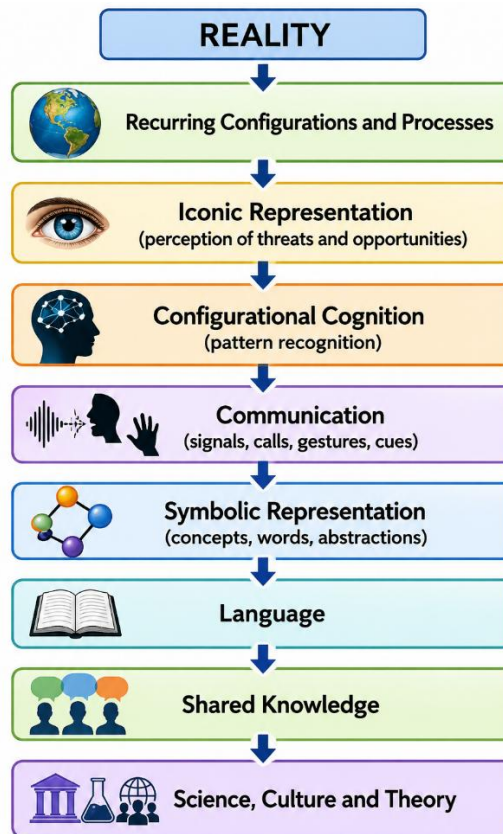


Figure 1: Evolution of Representation

A simplified model of the evolutionary development of representation. Organisms first evolved iconic forms of representation enabling recognition of recurring threats and opportunities. Communication extended this capability by allowing information to be shared between individuals. Symbolic representation and language subsequently emerged, enabling increasingly complex forms of knowledge, abstraction, and cultural transmission.

The model is intended to illustrate a dominant evolutionary trend. Communication, cognition, and language almost certainly co-evolved through reciprocal feedback rather than as a strictly linear sequence.

3. Configurational and Causal Cognition

The previous section suggested that language evolved upon foundations established by earlier representational and cognitive capabilities. If this is correct, then understanding language requires an understanding of the forms of cognition that preceded and shaped it. The present paper proposes that two complementary forms of cognition are particularly important: configurational cognition and causal cognition.

Configurational cognition is concerned primarily with the recognition of recurring patterns, states, and arrangements. It enables organisms to identify meaningful configurations within their environments and associate them with threats, opportunities, resources, or other significant outcomes. A predator's shape, a familiar

face, a food source, a shelter, or a dangerous location may all be recognised as recurring configurations. Importantly, such recognition does not necessarily require an understanding of the causal mechanisms involved. The pattern itself may be sufficient to guide behaviour.

This form of cognition appears to be evolutionarily ancient. Long before the emergence of human language or abstract reasoning, organisms needed to recognise recurring features of their environments in order to survive and reproduce. The ability to identify beneficial and harmful configurations therefore likely evolved early and remains a fundamental feature of cognition today. Much of what is commonly described as intuition, expertise, or instinctive judgement appears to rely upon the rapid recognition of familiar patterns. An experienced physician may recognise a disease before consciously analysing symptoms. A skilled engineer may identify an abnormal condition before understanding its cause. A chess master may recognise a strategic position before calculating detailed variations. In each case, recognition precedes explanation.

Configurational cognition is often highly efficient. It enables rapid responses under conditions of uncertainty and allows large amounts of information to be compressed into manageable forms. Contemporary psychology frequently associates such processes with intuitive or Type 1 thinking, characterised by speed, automaticity, and low cognitive effort. The persistence of configurational cognition throughout human evolution suggests that it continues to provide substantial adaptive advantages.

While configurational cognition enables recognition, it does not necessarily explain. A second form of cognition appears to be concerned with the identification of causal relationships, interactions, and processes. This paper refers to this as causal cognition. Causal cognition extends beyond the recognition of recurring patterns to infer the mechanisms that generate them. It is therefore associated with explanation, prediction, and intervention. In this respect, causal cognition bears similarities to Kahneman's Type 2 thinking (Kahneman, 2011), which is characterised by conscious deliberation, analytical reasoning, and greater cognitive effort. The correspondence is not exact, but both frameworks emphasise the role of reflective reasoning in moving beyond immediate perception towards deeper understanding.

The earliest forms of causal cognition were likely associated with events and actions rather than with abstract concepts such as energy, information, or system flows. Human language reflects this orientation. A simple sentence typically describes one entity acting upon another, following the familiar subject–verb–object structure. Such expressions may be represented as Process–Transfer–Process (PTP) relationships in which a transfer connects two processes. PTP reasoning therefore corresponds closely to everyday descriptions of events and actions and has a long history within human thought and communication.

Within the framework developed elsewhere in this series of papers, causality is understood more generally as involving the transfer of matter, energy, or information between processes. Complex causal networks may therefore be represented as chains of interconnected processes and transfers (...PTPTPT...). A transfer links one process to another, allowing influence to propagate through a system. This is referred to as PTP causality where each cause and effect has the structure PTP. This perspective also permits an alternative representation of causes and effects in which processes transform inputs into outputs. Such relationships may be represented as Transfer–Process–Transfer or TPT. The concepts are introduced here only briefly and will be developed in greater detail in a future paper.

A further distinction arises from the way causes and effects connect to form chains and networks. In PTP representations, causes and effects share a process. In TPT representations, causes and effects share a transfer. It is this sharing of a common component that allows causes and effects to connect into larger causal structures. However, transfers are often more difficult to perceive than processes because they are frequently distributed, transient, or hidden from direct observation.

In the case of TPT, when transfers cannot be directly identified, cognition is often left with the observable spatio-temporal configurations that causal relationships create. This may help explain why configurational reasoning appears to be both cognitively natural and historically prominent. For example, Hume's analysis of causation emphasised temporal precedence, spatial contiguity, and constant conjunction (Hume, 1748/2007). These are fundamentally configurational observations concerning the arrangement of events in space-time. Similarly, Rothman's sufficient-component-cause model identifies causal structures through recurring configurations of contributing factors. In both cases, causal understanding is inferred primarily from recurring patterns of co-occurrence rather than from direct observation of the transfers that connect causes and effects (Rothman, 1976).

From this perspective, configurational cognition may be understood as an early cognitive strategy that evolved before the explicit recognition of transfers. Rather than representing causality directly, it represents the recurring configurations produced by causal processes. Causal cognition extends this capability by progressively identifying the interactions, relationships, and transfers responsible for those configurations. Scientific and systems theory may therefore be understood as successive extensions of an ancient pattern-recognition capability towards increasingly explicit representations of causality.

Configurational cognition therefore focuses primarily upon recurring entities, patterns, and states. Causal cognition focuses upon the interactions, transfers, and processes that generate them. Both forms of cognition remain essential. Configurational cognition provides speed, efficiency, and rapid recognition, while causal cognition provides

explanation, prediction, and the ability to intervene. Together they provide the cognitive foundations upon which language, science, and systems theory have been constructed.

In summary, three forms of reasoning may represent successive stages in the evolutionary and cognitive development of representation:

P Reasoning – Recognition of recurring entities, states, and spatio-temporal configurations associated with threats, opportunities, and other significant outcomes.

PTP Reasoning – Recognition of events, actions, and causal interactions between entities, reflected in the subject–verb–object structure of much human language.

TPT Reasoning – Recognition of transfers, flows, and transformations involving matter, energy, and information, reflected in systems concepts such as input–process–output and the explicit analysis of causal networks.

This sequence should be regarded as a hypothesis rather than a definitive account of cognitive evolution. Nevertheless, it provides a plausible explanation for the persistence of configurational reasoning, the close relationship between language and event-based causality, and the relatively recent emergence of systems-based approaches that make transfers and flows explicit.

4. Compression and the Representation of Reality

Reality is extraordinarily complex. Even the simplest objects and events involve vast numbers of interacting components and processes. A tree consists of billions of cells engaged in countless biochemical interactions. A society comprises millions of individuals participating in intricate networks of communication, cooperation, competition, and exchange. The complexity of the world far exceeds the capacity of any individual mind to represent it in full detail.

The ability to navigate such complexity therefore depends upon compression (Shannon, 1948). Compression enables large amounts of information to be represented in simplified forms that remain useful for recognition, communication, reasoning, and action. Without compression, cognition would be overwhelmed by detail and unable to respond effectively to the environment.

Compression can be understood as the process by which recurring patterns are represented using concepts, symbols, or models that preserve important features while discarding much of the underlying complexity. Every concept may therefore be viewed as a form of compression. Rather than representing reality in all its detail, concepts provide simplified summaries that enable efficient thought and communication (Simon, 1962).

The distinction between configurational and causal cognition suggests a corresponding distinction between configurational and causal compression.

At its most general, compression represents recurring organisation in simplified conceptual form. Since reality consists fundamentally of interacting processes connected through transfers of matter, energy, and information, recurring patterns ultimately reflect recurring causal organisation. Useful compression therefore involves the simplification of causal relationships. This more general form of simplification may be termed causal compression.

Causal compression represents common patterns of interaction, transfer, constraint, and transformation. Concepts such as evolution, competition, trust, learning, regulation, democracy, and markets do not merely describe collections of entities. They describe recurring causal organisations that generate characteristic behaviours and outcomes. Such concepts enable individuals to understand not only what is occurring but also why it occurs and how it may change.

Many of the concepts employed within science and systems theory are best understood as causal compressions. For example, the concept of feedback compresses a recurring causal organisation in which information about the state of a system influences future behaviour. Likewise, the concept of a constraint compresses a recurring pattern in which certain possibilities are enabled while others are inhibited. Such concepts capture relationships that recur across many different domains despite being expressed through different disciplinary terminologies.

Configurational compression may be understood as a specialised form of causal compression in which recurring causal organisations are represented through simplified entities, states, or configurations. A predator, a food source, a shelter, or a familiar face may all be understood as configurational compressions. The concept captures a recurring pattern without explicitly representing the causal mechanisms that produce it. Configurational compression therefore supports rapid recognition and efficient response.

Although it may have emerged early in evolutionary history, configurational compression remains a highly sophisticated cognitive capability. Human expertise often depends upon the ability to recognise meaningful configurations within large amounts of information. Physicians recognise disease patterns, engineers recognise failure signatures, and experienced managers recognise organisational dynamics. In many cases, the ability to recognise a pattern develops before the ability to explain it.

The distinction between configurational and causal compression should not be interpreted as a strict separation. Recognition of recurring configurations frequently provides the basis for later causal understanding. Conversely, causal understanding enriches future pattern recognition by enabling observers to identify deeper regularities within apparently diverse situations. Scientific progress commonly involves movement

between the two forms of compression as observations give rise to explanations and explanations inform further observation.

Compression also helps explain the emergence of perspectives. No observer can represent the entirety of reality. Individuals therefore focus upon particular aspects, scales, relationships, and purposes. Different perspectives may be understood as different compressions of overlapping regions of reality. A biologist, economist, psychologist, and sociologist may all examine the same broad phenomenon while employing different concepts, levels of granularity, and explanatory frameworks. Their perspectives differ not necessarily because they inhabit different realities, but because they employ different compressions of the same reality.

As systems become more complex, additional layers of compression become necessary. New levels of organisation emerge, exhibiting properties that are not readily apparent from consideration of their components alone. Concepts such as organism, ecosystem, institution, market, and society enable observers to reason about these higher levels without tracking every underlying interaction.

This observation suggests a close relationship between emergence and configurational compression. Emergence occurs when interacting components give rise to higher-level properties, behaviours, or organisations. Configurational compression occurs when observers represent those higher-level organisations as identifiable entities or concepts. The two processes are therefore complementary. Emergence organises reality into higher-level forms, while configurational compression enables observers to recognise and reason about those forms. The effectiveness of configurational compression may partly reflect the fact that reality itself is structured through stable emergent organisations. Compression therefore provides a bridge between complexity and comprehension.

In summary, causal and configurational compression appear to perform complementary cognitive functions. Causal compression enables observers to simplify recurring patterns of interaction, transfer, constraint, and transformation, thereby supporting explanation, prediction, and intervention. Configurational compression enables observers to simplify recurring entities, states, and emergent organisations, thereby supporting rapid recognition, communication, and action. Together, these forms of compression allow finite cognitive systems to navigate levels of complexity that would otherwise exceed their capacity for direct comprehension.

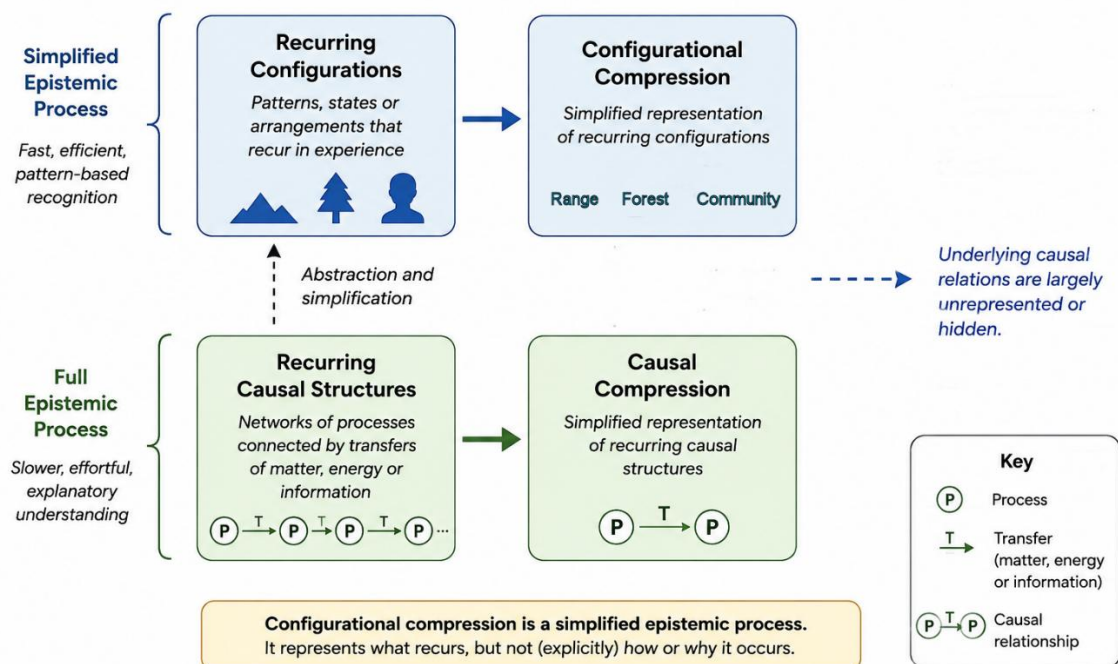
The relationship between the two is asymmetrical. Causal compression may be regarded as the more general process because recurring entities, states, and emergent organisations ultimately depend upon underlying causal relationships. Configurational compression may be understood as a specialised form of causal compression associated with the recognition of relatively stable emergent organisations. Concepts

such as feedback, competition, regulation, and constraint compress recurring causal organisations, whereas concepts such as organism, ecosystem, institution, market, and society compress relatively stable emergent forms. Human understanding therefore depends upon both the recognition of emergent entities and the compression of the causal organisations from which they arise.

Knowledge itself may be viewed as a vast network of interconnected compressions. Scientific theories compress observations into explanatory frameworks. Disciplines compress large bodies of knowledge into specialised concepts and terminologies. Languages compress experiences into symbols that can be shared with others. Human understanding therefore depends not upon the elimination of complexity, but upon the construction of useful compressions that make complexity manageable.

This observation has an important consequence. If different individuals, disciplines, and cultures develop different compressions of reality, then divergence in language and understanding becomes almost inevitable. The next section explores how such divergence emerges and examines the forces that simultaneously promote convergence and communication.

Figure 2: Configurational and Causal Compression



Note: Configurational compression is a specialised form of causal compression in which underlying causal relationships are represented through recurring entities, states, or configurations. This simplification supports rapid pattern recognition while leaving many causal relationships implicit.

5. Linguistic Divergence and Convergence

If language and knowledge are constructed through compression, then linguistic divergence becomes almost inevitable. Different individuals, groups, and disciplines encounter different problems, pursue different objectives, and focus upon different aspects of reality. Over time, these differences give rise to specialised concepts, terminologies, and symbolic systems. Linguistic divergence can therefore be understood as a natural consequence of adaptation and specialisation rather than as a failure of communication.

The most obvious form of divergence occurs between cultures. Different societies have developed distinct languages, symbolic traditions, metaphors, and conceptual frameworks (Lakoff & Johnson, 1980). Although many of the realities being described are similar, the symbols used to represent them often differ substantially. Translation between languages therefore involves more than replacing one word with another. It frequently requires the interpretation of concepts embedded within different historical, social, and cultural contexts.

A second form of divergence occurs through functional differentiation. As societies become more complex, specialised activities emerge, each developing its own vocabulary and conceptual structures. Physicists, biologists, economists, psychologists, engineers, and sociologists often study overlapping aspects of reality while employing very different terminologies. These specialised languages improve communication within disciplines but may simultaneously make communication across disciplinary boundaries more difficult.

Disciplines may also be understood as perspective stabilisations. As knowledge grows, different communities of inquiry tend to focus upon particular scales, relationships, variables, and recurring forms of organisation. Over time, these stabilised perspectives give rise to specialised concepts, methods, and terminologies adapted to the problems they most frequently encounter. Divergence therefore arises not only because disciplines study different phenomena, but also because they compress and represent overlapping aspects of reality from different observational perspectives.

A third form of divergence occurs at the level of the individual. Every person possesses unique experiences, interests, goals, and patterns of learning. Consequently, individuals often attach different meanings and associations to the same terms. Even within a single discipline, apparently simple concepts may be interpreted in subtly different ways. Communication therefore requires continual negotiation of meaning, clarification of assumptions, and adjustment of language to context.

Importantly, divergence is not the whole story. Powerful forces also promote convergence. Shared education, dictionaries, scientific nomenclature, professional standards, textbooks, journals, translation systems, and public communication all

contribute towards the development of common understandings. These mechanisms enable cooperation and knowledge sharing on scales that would otherwise be impossible.

Nevertheless, divergence and convergence do not appear to operate at the same rate. Convergence tends to be deliberate, negotiated, institutional, and relatively slow. Divergence, by contrast, is continually generated by innovation, specialisation, new experiences, technological change, and adaptation to local conditions. As a result, linguistic diversity is constantly renewed even as efforts are made to maintain shared understanding.

This relationship may be viewed as a recurring cycle. A common language or conceptual framework develops and enables communication within a community. As knowledge expands and activities become more specialised, new concepts and terminologies emerge. Divergence increases and communication difficulties begin to appear. In response, efforts are made to standardise terminology, develop translation mechanisms, and establish common frameworks. These efforts restore a degree of convergence, but further specialisation eventually generates new divergence. The cycle then repeats.

The consequences of persistent divergence can be observed at several levels. At the individual level, people may believe they agree when they do not, or believe they disagree when they are describing similar phenomena using different terminology. Many interpersonal and organisational misunderstandings arise not from fundamentally incompatible views of reality but from differences in language, assumptions, and interpretation.

At the disciplinary level, divergence can contribute to fragmentation of knowledge. Similar concepts may be rediscovered, renamed, or debated repeatedly within different fields without recognition of their similarities. Potential opportunities for integration may therefore remain hidden. This problem is particularly relevant to systems theory, which seeks to identify common structures and relationships across traditionally separate domains of inquiry.

At the cultural level, divergence may inhibit the transfer of knowledge and understanding between societies. Valuable insights can remain isolated within particular linguistic or cultural traditions. Translation becomes increasingly important but also increasingly challenging because concepts often carry assumptions and associations that do not transfer directly from one context to another.

These observations suggest that a significant challenge facing contemporary societies is not merely the generation of knowledge but its integration. Historically, communication problems were often framed in terms of access to information. Today, information is more abundant than at any point in human history. The challenge

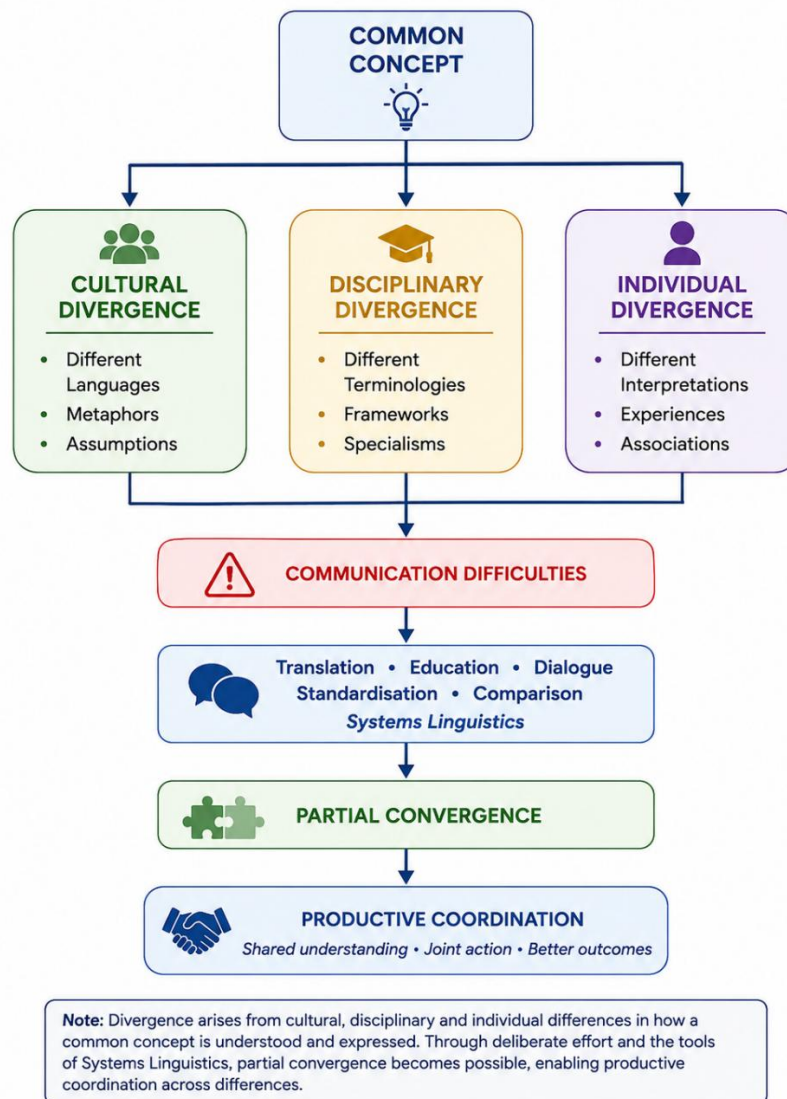
increasingly lies in understanding how knowledge expressed in different forms can be related, compared, translated, and combined.

This issue becomes even more significant when considered alongside the limitations of individual cognition. No individual can comprehend the full complexity of reality. Knowledge is therefore distributed across individuals, disciplines, institutions, and cultures, each contributing different compressions of overlapping aspects of the world (Hutchins, 1995). Productive coordination depends not upon the elimination of these differences but upon the ability to translate and integrate them appropriately.

Evidence for hidden convergence can often be found within the terminology itself. Many concepts that appear different may in fact describe the same underlying phenomena viewed from different perspectives. In systems theory, for example, terms such as system, subsystem, component, environment, process, and holon frequently describe the same organised entities viewed relative to different systems of interest. Apparent conceptual diversity therefore sometimes reflects differences in perspective rather than differences in ontology.

The existence of persistent communication despite widespread divergence suggests that some form of underlying convergence must also exist. Beneath the diversity of languages, terminologies, and perspectives, certain recurring structures appear to persist. The next section explores these deeper regularities and examines whether they may provide a foundation for translation across otherwise divergent forms of representation.

Figure 3: Divergence and Convergence



6. Linguistic Compression

Compression does not occur only within cognition. It is also a fundamental feature of language itself. Human communication routinely relies upon the omission of information that speakers assume listeners will infer from context. Rather than describing reality in complete detail, language communicates compressed representations that can be expanded by those who share sufficient background knowledge.

Many common linguistic devices may be understood as forms of compression. Pronouns replace detailed descriptions, metaphors compress complex relationships into familiar imagery, specialist terminology encapsulates large bodies of knowledge, and ellipsis allows information to be omitted when it is assumed to be understood.

Such mechanisms greatly increase the efficiency of communication by reducing the amount of information that must be explicitly expressed.

This efficiency comes at a cost. Successful communication depends upon the listener reconstructing information that has not been stated directly. Where assumptions, experiences, or conceptual frameworks differ, the same statement may be interpreted in different ways. Communication difficulties therefore arise not only because different groups use different terminology, but also because they decompress linguistic expressions differently.

Linguistic compression may be particularly significant within specialised disciplines. Concepts that are familiar within one field often encapsulate extensive networks of assumptions, definitions, and theoretical relationships. To outsiders, these compressed meanings may be partially or wholly invisible. As a result, specialists frequently underestimate the amount of background knowledge required to understand their terminology.

The existence of linguistic compression helps explain why communication difficulties can persist even when individuals appear to be using the same language. Words and concepts often function as highly compressed representations of broader bodies of knowledge. Effective communication therefore depends not only upon the transmission of symbols but also upon the successful reconstruction of the meanings and assumptions that those symbols represent.

7. Hidden Convergence and Persistent Deep Structures

The existence of widespread linguistic divergence raises an important question. If different cultures, disciplines, and individuals continually develop specialised terminologies and conceptual frameworks, how is communication possible at all? Despite the diversity of human languages and systems of knowledge, people are nevertheless able to exchange ideas, cooperate, and progressively expand collective understanding. This suggests that beneath the surface diversity of symbols and terminologies there may exist deeper forms of convergence.

The distinction between hidden convergence and linguistic divergence bears some resemblance to Chomsky's distinction between deep structure and surface structure (Chomsky, 1965). While the concepts differ in important respects, both suggest that considerable variation may exist at the surface level of language while deeper organisational regularities persist beneath it.

One source of convergence arises from the fact that all human beings inhabit the same underlying reality. Although individuals and groups may focus upon different aspects of that reality, the world itself imposes constraints upon what can be observed, experienced, and communicated. If recurring structures exist within reality, it is

reasonable to expect that they will leave traces within the cognitive and linguistic systems that evolved to represent them.

A second source of convergence arises from the shared architecture of human cognition. The cognitive processes that support perception, pattern recognition, causal reasoning, and communication appear to be broadly similar across cultures and historical periods. While symbolic systems may vary considerably, the underlying cognitive mechanisms responsible for generating and interpreting those symbols remain sufficiently alike to permit communication and translation.

These observations suggest that linguistic divergence may occur primarily at the level of symbols and terminologies, while deeper regularities persist at the level of cognition and representation. The resulting distinction between surface divergence and deep convergence provides a useful framework for understanding communication across disciplinary and cultural boundaries.

One example of such convergence can be found in the widespread tendency to represent events in terms of entities and interactions. Many human languages organise descriptions around structures resembling subject–verb–object relationships. Although grammatical forms vary considerably, recurring patterns involving actors, actions, and recipients appear remarkably common. This observation is consistent with the earlier suggestion that cognition evolved to recognise both configurations and causal relationships within the environment.

From a systems perspective, similar structures may be expressed as process–transfer–process relationships. A transfer connects one process to another, enabling influence to propagate through a network of interactions. While languages and disciplines may employ different vocabularies, many descriptions ultimately refer to entities, processes, relationships, and transfers of one form or another. Such recurring representational structures may reflect both the organisation of reality and the cognitive mechanisms through which reality is understood.

Further evidence of hidden convergence can be found within specialised disciplines. Different fields frequently develop distinct terminologies for phenomena that exhibit similar underlying causal organisations. For example, engineers may speak of feedback control, biologists of homeostasis, psychologists of reinforcement, sociologists of social adaptation, and economists of market adjustment. Although the terminology differs, each concept refers to a process in which information concerning the state of a system influences subsequent behaviour. The language diverges while the underlying causal structure remains recognisably similar.

A similar pattern can be observed in relation to constraints. Evolutionary biologists refer to selection pressures, economists to incentives, sociologists to institutions, psychologists to reinforcement contingencies, and engineers to design constraints.

Each discipline employs terminology appropriate to its own domain. Yet in each case the concept refers to influences that enable certain behaviours while discouraging or preventing others. The surface vocabulary differs, but important commonalities remain.

Examples of hidden convergence are not limited to feedback and constraints. Comparable patterns can be observed in discussions of emergence, information transfer, adaptation, regulation, and many other systems concepts. The recurrence of such structures across disciplines was one of the motivations behind Len Troncale's search for Universal Systems Properties and Linkage Propositions (Troncale, 1985). If recurring organisational patterns exist within reality, then it is unsurprising that different fields repeatedly encounter and attempt to describe them.

The present paper differs from Troncale's work in an important respect. Whereas Universal Systems Properties focus primarily upon recurring structures within systems themselves, the focus here is upon recurring structures within the representations used to describe those systems. The concern is not only whether similar patterns exist in reality, but also how different communities compress, interpret, and communicate those patterns through language.

The Jainist parable of the blind men and the elephant provides a useful illustration. Each observer encounters a different aspect of the elephant and develops a description based upon that limited experience. One describes a rope, another a wall, another a pillar, and another a snake. Each description captures something real, yet none captures the whole. The problem lies not in the observations themselves but in the assumption that a partial compression is equivalent to the complete reality. The same challenge frequently arises within disciplines, cultures, and theoretical traditions.

This observation has important implications for knowledge integration. Differences between disciplines do not necessarily imply that one description is correct and another incorrect. Often they reflect alternative compressions of overlapping aspects of the same reality. Some differences represent genuine disagreements, but others arise because observers focus upon different levels, relationships, purposes, or scales of analysis. Translation therefore requires more than matching terminology. It requires understanding the underlying structures and compressions to which terms refer.

A further source of divergence may arise from what might be termed cultural lag. Human language evolved primarily within environments where immediate objects, actions, and events were of primary concern. Modern science, by contrast, increasingly studies abstract processes, constraints, feedback loops, emergence, and complex systems. A partial mismatch may therefore exist between linguistic habits shaped by evolutionary history and the conceptual demands of contemporary scientific understanding. This may help explain why systems concepts often appear counterintuitive despite their explanatory power.

Taken together, these observations suggest that hidden convergence exists beneath much of the apparent diversity of human language and knowledge. While cultures, disciplines, and individuals develop different symbolic systems, recurring structures continue to appear within the realities they describe, the cognitive processes they employ, and the representations they construct. Recognition of these deeper regularities provides a possible foundation for translation, integration, and productive coordination.

The next section explores how these recurring structures might be organised into a systems linguistics capable of supporting communication across disciplinary, cultural, and theoretical boundaries.

8. Towards a Systems Linguistics

The preceding discussion suggests that linguistic divergence and hidden convergence are not contradictory phenomena. Human knowledge continually diversifies as cultures evolve, disciplines specialise, and individuals develop unique experiences. Yet beneath this diversity, recurring patterns and structures continue to appear. Similar causal organisations are often described using different terminologies, while different perspectives frequently represent overlapping aspects of the same reality. These observations raise an important question: can these recurring structures be used to support translation between otherwise divergent forms of knowledge?

One possible response is the development of a systems linguistics. The term is not used here in the conventional linguistic sense of analysing grammar, syntax, or language structure for their own sake. Instead, it refers to the study of how language represents recurring configurations, causal organisations, and systems relationships. Its purpose is not to replace existing languages or disciplinary terminologies, but to identify common structures that persist beneath them.

From this perspective, words and concepts may be viewed as compressions of reality. Different disciplines often compress similar phenomena in different ways because they focus upon different purposes, scales, and relationships. An economist, sociologist, psychologist, and systems theorist may therefore employ different concepts while referring to overlapping causal structures. A systems linguistics seeks to identify these overlaps and make them explicit.

The purpose of such a framework is translation rather than replacement. Scientific and professional disciplines have developed specialised vocabularies because they solve real problems and capture important distinctions. These languages should not be discarded. Rather, they should be viewed as valuable perspectives that contribute to collective understanding. A systems linguistics would provide a complementary layer capable of relating these perspectives to one another without removing their unique strengths.

From this perspective, systems linguistics may be understood as a translational framework whose purpose is not to replace existing disciplinary languages but to identify, compare, and translate the recurring structures that underlie them.

This distinction is important. Attempts to establish common languages often encounter resistance because they are perceived as efforts to impose a particular framework or vocabulary upon others. The approach proposed here is fundamentally different. Its objective is not uniformity of thought but improved communication. The goal is to understand how different terminologies relate to one another and where common structures may already exist.

Several systems concepts appear particularly promising as candidates for such a translational framework. Concepts such as entity, process, transfer, constraint, boundary, feedback, emergence, adaptation, and information transfer recur across many disciplines despite being expressed in different ways. These concepts do not eliminate disciplinary differences, but they may provide reference points through which different perspectives can be compared and related.

Consider, for example, the concept of a constraint. A biologist may refer to selection pressures, an economist to incentives, a sociologist to institutions, and an engineer to design limitations. Although these terms are not identical, each describes influences that shape the range of possible behaviours available to a system. Recognition of this common function creates opportunities for translation and comparison without requiring the concepts to be treated as equivalent.

A systems linguistics would therefore focus not only upon terminology but also upon the underlying compressions represented by terminology. Two concepts may use different words while referring to similar causal organisations. Equally, two concepts may use similar words while referring to very different phenomena. Effective translation requires understanding the relationship between symbols and the realities they seek to represent.

This approach also helps explain why communication difficulties frequently arise between disciplines. Specialists often become highly proficient within their own conceptual frameworks, yet may find it difficult to recognise equivalent or related ideas expressed in unfamiliar language. The problem is not necessarily disagreement concerning reality but difficulty in identifying the relationships between different compressions of reality. Systems linguistics would seek to address this problem by making such relationships more visible.

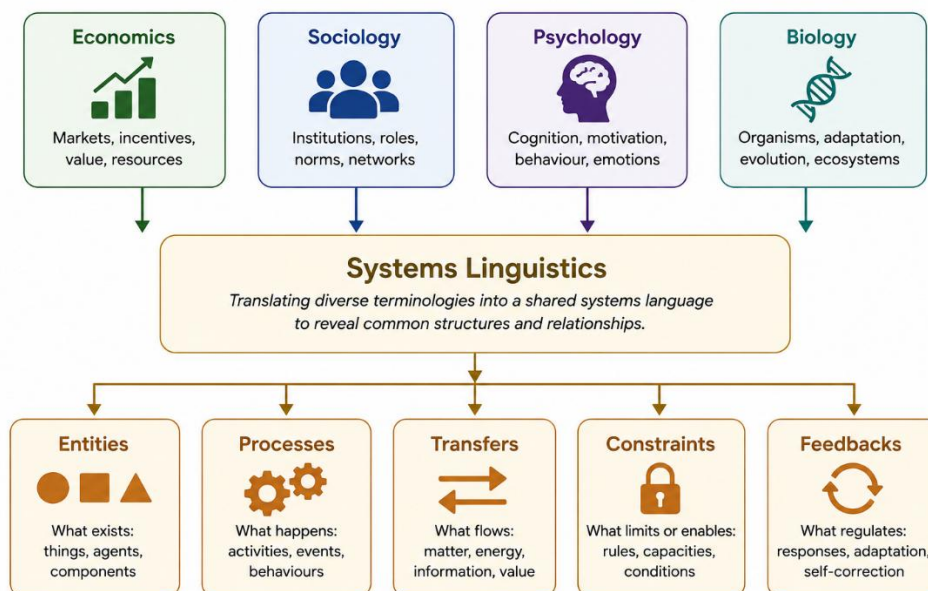
The emergence of artificial intelligence may further increase the practical importance of this approach. Large language models are capable of identifying patterns across vast bodies of text and may therefore assist in the discovery of hidden correspondences between terminologies, concepts, and theories. Such tools do not replace human

understanding, but they may significantly enhance our ability to compare, translate, and integrate knowledge across traditional boundaries.

A systems linguistics should therefore be viewed not as a completed theory but as a research programme. Its central proposition is that recurring structures within reality give rise to recurring cognitive and linguistic compressions, and that these compressions can be studied, compared, and translated. If successful, such an approach may help reduce unnecessary fragmentation of knowledge while preserving the diversity and adaptability that specialisation provides.

The practical significance of this possibility extends beyond communication alone. Translation enables comparison, comparison enables integration, and integration enables more effective coordination. The final section therefore considers how systems linguistics may contribute to productive coordination within increasingly complex and specialised societies.

Figure 4: Systems Linguistics as Translation



9. Productive Coordination

The preceding sections have argued that human cognition relies upon compression to manage complexity, that linguistic divergence emerges naturally through specialisation, and that hidden convergence persists beneath much of this diversity. These observations have important practical implications. If different individuals, disciplines, and cultures develop different compressions of overlapping aspects of reality, then effective cooperation depends upon the ability to compare, translate, and integrate those compressions appropriately.

This challenge becomes increasingly significant as societies become more complex. Modern knowledge is distributed across vast networks of individuals, organisations,

disciplines, and institutions. No individual can possess comprehensive understanding of every relevant domain. Expertise therefore becomes specialised, and the resulting knowledge becomes increasingly fragmented. While specialisation enables deeper understanding within particular areas, it also increases the difficulty of integrating knowledge across boundaries.

The problem is not simply one of communication. Information can often be transmitted successfully while understanding remains incomplete. Individuals may use identical words while attaching different meanings to them, or use different words while referring to similar underlying phenomena. Productive coordination therefore requires more than the exchange of information. It requires sufficient understanding of alternative compressions to determine how they relate to one another and to the realities they describe.

This observation aligns closely with the principles of poly-perspectivism. From that perspective, no single viewpoint can fully capture the complexity of reality. Different individuals, disciplines, and cultures inevitably focus upon different aspects, scales, and relationships. Productive coordination therefore depends not upon the elimination of differences but upon the ability to recognise when alternative perspectives are complementary, when they are genuinely incompatible, and when they address different questions altogether.

In this sense, poly-perspectivism may be understood as a social response to the limitations of individual cognition and compression. Because no observer can represent reality in its entirety, knowledge becomes distributed across communities of inquiry. Different groups develop different conceptual frameworks, each capturing aspects of reality that may be overlooked by others. Productive coordination emerges when these alternative compressions can be compared, translated, and integrated in ways that preserve their strengths while reducing unnecessary misunderstanding.

The practical value of translation becomes particularly evident when addressing complex social, environmental, technological, and organisational challenges. Such problems rarely fall neatly within the boundaries of a single discipline. They involve interacting biological, psychological, social, economic, technological, and ecological processes. Effective responses therefore require the integration of multiple forms of expertise. Without mechanisms for translation, important insights may remain isolated within disciplinary silos, limiting collective understanding and reducing the effectiveness of intervention.

The concept of productive coordination refers to the process through which diverse forms of knowledge are brought into constructive relationship. This does not require complete agreement, nor does it require the adoption of a single universal language. Instead, it involves developing sufficient understanding of alternative perspectives to

enable meaningful comparison, communication, and collaboration. Differences remain, but they become resources for collective learning rather than barriers to cooperation.

From this perspective, systems linguistics may be viewed as a possible mechanism for supporting productive coordination. By identifying recurring structures beneath divergent terminologies, it provides a means of relating specialised forms of knowledge without eliminating their distinctive contributions. Translation becomes possible because hidden convergence exists, while diversity remains valuable because different compressions reveal different aspects of reality.

Recent developments in artificial intelligence may significantly enhance these possibilities. Large language models and related technologies are capable of analysing vast bodies of text and identifying relationships that might otherwise remain hidden. Such tools may assist in the discovery of conceptual overlaps, the translation of terminology, and the comparison of theories across disciplinary boundaries. Artificial intelligence cannot replace human judgement, but it may substantially increase our capacity to navigate linguistic and conceptual complexity.

This possibility forms the basis of the emerging concept of AI-Assisted Productive Coordination (AIAPC). The aim is not to automate understanding but to augment it. By helping individuals identify hidden convergence, compare alternative compressions, and translate between specialised terminologies, AI may support more effective communication and collaboration across increasingly diverse communities of inquiry.

The broader implication is that many conflicts traditionally interpreted as disagreements about reality may instead reflect differences in representation. Individuals and groups often describe overlapping phenomena using different symbolic systems, conceptual frameworks, and terminologies. Some disagreements are undoubtedly substantive. Others, however, arise because participants fail to recognise the relationships between their respective compressions. In such cases, translation may reveal areas of agreement that were previously obscured by linguistic divergence.

The purpose of a common systems idiom should therefore not be to create uniformity of thought. Diversity of perspective remains essential for adaptation, innovation, and learning. Rather, the objective is to facilitate translation between diverse perspectives so that their insights can be compared, integrated, and applied more effectively. Productive coordination is achieved not through the elimination of difference but through the development of shared understanding sufficient to enable collective action.

The final section draws together the main arguments of the paper and considers their implications for systems theory, communication, and the continuing development of knowledge in an increasingly interconnected world.

10. Conclusion

This paper began with a simple observation: language is so familiar that it is often taken for granted. Yet language lies at the heart of human understanding. Every theory, model, discipline, and culture depends upon symbolic systems through which knowledge is represented, communicated, and transmitted. Understanding language is therefore inseparable from understanding how human beings comprehend and coordinate within an increasingly complex world.

The paper proposed that language can be understood as part of a broader evolutionary process of representation. Organisms first evolved the ability to recognise meaningful patterns within their environments. Communication emerged as a means of sharing information about those patterns. Human language subsequently extended this capability, enabling the communication of abstractions, explanations, plans, and accumulated knowledge. In this sense, language may be viewed not as an isolated phenomenon but as an extension of earlier cognitive processes.

A distinction was drawn between configurational cognition and causal cognition. Configurational cognition enables the recognition of recurring patterns, states, and arrangements, while causal cognition enables the understanding of interactions, transfers, constraints, and processes. These complementary forms of cognition give rise to corresponding forms of compression through which complexity becomes manageable. Configurational compression supports efficient pattern recognition, while causal compression supports explanation, prediction, and intervention.

The concept of compression provides a useful perspective on knowledge itself. Concepts, theories, disciplines, and perspectives may all be understood as compressions of reality. Because no individual can represent reality in its full complexity, different individuals, disciplines, and cultures inevitably develop different compressions of overlapping aspects of the world. Linguistic divergence is therefore a natural consequence of adaptation, specialisation, and the distributed nature of human knowledge.

At the same time, divergence is not the whole story. Beneath the diversity of languages, terminologies, and conceptual frameworks, recurring structures continue to appear. Similar causal organisations are often represented through different vocabularies, while apparently distinct perspectives may describe overlapping aspects of reality. These hidden convergences suggest that translation between perspectives is not only possible but may already occur implicitly whenever communication succeeds across disciplinary, cultural, or theoretical boundaries.

This observation provides a foundation for the idea of a systems linguistics. Such a framework would not seek to replace existing languages or disciplinary traditions. Rather, it would seek to identify common structures, recurring compressions, and

shared patterns beneath divergent vocabularies. Its purpose would be translation rather than standardisation, integration rather than uniformity.

The practical significance of this possibility lies in its implications for productive coordination. Modern societies increasingly depend upon knowledge distributed across many individuals, organisations, disciplines, and cultures. The challenge is no longer merely to generate information but to integrate it effectively. Productive coordination requires the ability to compare, translate, and combine diverse forms of understanding while preserving the benefits of specialisation and diversity.

The central argument of this paper may therefore be summarised as a progression:

- Reality gives rise to recurring structures and processes.
- Cognition evolves to recognise and understand those structures.
- Compression enables complexity to be represented in manageable forms.
- Language communicates those compressions.
- Specialisation generates divergence.
- Hidden convergence makes translation possible.
- Translation supports productive coordination.

Seen in this way, linguistic diversity and productive coordination are not opposing forces. Diversity provides the variety of perspectives necessary for adaptation, creativity, and discovery. Coordination provides the means through which those perspectives can be related, integrated, and applied. The challenge is not to eliminate difference but to understand it.

If recurring structures exist within reality, and if human cognition and language have evolved to represent those structures, then the search for common patterns beneath divergent forms of expression is neither arbitrary nor unrealistic. It is a natural extension of humanity's continuing effort to understand itself and the world it inhabits.

The development of systems linguistics remains at an early stage. The ideas presented here should therefore be regarded as exploratory rather than definitive. Nevertheless, they suggest that beneath the apparent fragmentation of modern knowledge there may exist deeper forms of unity. Identifying and understanding those unities may prove increasingly important as humanity confronts problems whose complexity exceeds the capacity of any individual, discipline, or culture to solve alone.

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Definitions

D4.1 – Representation

A physical or symbolic state that stands for, models, or corresponds to aspects of reality, enabling a system to recognise, communicate, or reason about them.

D4.2 – Configurational Cognition

The recognition and interpretation of recurring patterns, states, or arrangements without necessarily identifying the causal relationships that generate them.

D4.3 – Causal Cognition

The recognition and interpretation of recurring causal relationships, interactions, transfers, constraints, and processes.

D4.4 – Compression

The simplification of information through the representation of recurring structures, patterns, or relationships in cognitively manageable form.

D4.5 – Causal Compression

The representation of recurring causal organisations in simplified conceptual form.

D4.6 – Configurational Compression

A specialised form of causal compression in which recurring causal organisations are represented through recurring entities, states, or configurations.

D4.7 – Linguistic Compression

The omission or implicit representation of information within language, relying upon contextual reconstruction by the listener or reader.

D4.8 – Linguistic Divergence

The tendency for cultures, disciplines, and individuals to develop different symbolic representations for similar or overlapping concepts.

D4.9 – Hidden Convergence

The persistence of common underlying structures, patterns, or causal organisations beneath apparently divergent representations or terminologies.

D4.10 – Systems Linguistics

A systematic approach to identifying, comparing, and translating common structures across diverse symbolic systems, terminologies, or disciplines.

Propositions**P4.1 – Representation Proposition**

Representational systems evolve because they assist organisms in recognising, predicting, and responding to recurring aspects of reality.

P4.2 – Evolutionary Reasoning Proposition

Configurational (P), Process–Transfer–Process (PTP), and Transfer–Process–Transfer (TPT) reasoning may represent successive developments in the evolutionary and cognitive representation of causality. P reasoning emphasises recurring entities, states, and spatio-temporal configurations. PTP reasoning emphasises events and interactions and is reflected in much human language. TPT reasoning makes transfers, flows, and transformations explicit and is reflected in systems-theoretical representations of causality.

P4.3 – Compression Proposition

Human understanding depends upon compression because the complexity of reality exceeds the direct processing capacity of cognitive systems.

P4.4 – Configurational Compression Proposition

Configurational compression is a specialised form of causal compression in which underlying causal relationships are represented through recurring entities, states, or patterns.

P4.5 – Emergence–Compression Proposition

Configurational compression frequently corresponds to recurring emergent organisations within reality. The ability of observers to represent complex systems as identifiable entities reflects the tendency of interacting components to form higher-level emergent structures.

P4.6 – Compression Hierarchy Proposition

Causal compression is the more general form of cognitive compression because it represents recurring patterns of interaction, transfer, constraint, and transformation. Configurational compression is a specialised form of causal compression in which recurring causal organisations are represented through relatively stable entities, states, or emergent organisations.

P4.7 – Linguistic Divergence Proposition

Linguistic divergence arises naturally as cultures, disciplines, and individuals develop specialised compressions adapted to different purposes and contexts.

P4.8 – Hidden Convergence Proposition

Despite linguistic divergence, recurring structures within reality and cognition tend to generate recurring representational patterns, producing hidden convergence beneath surface differences.

P4.9 – Translation Proposition

Translation becomes possible where hidden convergence exists between apparently different symbolic systems.

P4.10 – Productive Coordination Proposition

The capacity for productive coordination increases when participants can identify, compare, translate, and integrate complementary representations of shared realities.