1. Introduction

The relationship between observation and reality is still a contested topic. At one extreme, naive realism suggests that human observations can directly access mind-independent environmental structures. At the other, radical constructivism argues that all perceptions are subjective constructions with no objective grounding. This paper argues for a middle position: while observations are necessarily subjective and incomplete, they can still model genuine universal structures through cognitive processes that require interpretation and transformation.

This theory assumes the existence of an objective physical universe, rather than attempting to prove it. Since the primary evidence comes from observers within this hypothesized universe, the theory's depends on this assumption being valid. Therefore, this paper does not argue for the existence of an objective physical reality, instead, it explores the implications that would follow if such a reality exists, demonstrating how the theory's predictions would, if confirmed, provide indirect support for that initial assumption.

The central premise is that each observer possesses some capacity for modelling this universe, but these models vary significantly in both precision and scope. Consider an organism with rudimentary vision but an exceptional sense of smell: while it cannot model advanced visual phenomena like colour, it excels at detecting and categorizing airborne chemical signatures. Neither capacity provides direct access to "truth", our current understanding that colour results from light wavelengths reflecting off molecular surfaces, or that smell derives from airborne molecular interactions, represents our best working theory rather than absolute knowledge. Yet these partial, transformed models appear to track genuine environmental regularities rather than being purely arbitrary constructions.

This framework suggests that cognitive complexity, encompassing both perceptual access and processing capability, may expand the range of environmental structures that can be modelled, while acknowledging that all such models remain necessarily perspectival and incomplete.

Theoretical Foundations

This analysis adopts a critical realist position that distinguishes between environmental structures that exist independently and our necessarily limited access to them through cognitive systems. Unlike naive realism, this framework recognizes that cognitive architecture actively shapes environmental models. Unlike radical constructivism, it maintains that environmental structures constrain possible representations.

It is important to note that our evaluation of environmental models is bound by human cognitive limitations. Any model more complex than human cognition can grasp would be, by definition, incomprehensible to us. While there might be models that are better in representing reality, our current models are at the limit of current cognitive capabilities.

Cognitive Complexity

Central to the theory is the concept we introduced as cognitive complexity, this refers refers to the ability of an observer to perceive and model reality. We divide it in two major dimensions:

Observational Capability: This is the range and precision of environmental information that can be perceived by an observer in all sensory modalities. This not only depends on inherent sensory capabilities but also the physical access to this information (e.g. an organism capable of perceiving colour would likely not be able to model this if it would exist in a space without light).

Processing Capability: The capacity to integrate, analyse, and represent perceptual information in its environmental model. This includes cognitive abilities like pattern recognition, cross-modal integration, temporal modelling, causal reasoning, and abstract representation.

The capacity for a more accurate model originates from the interaction between these the dimensions. An observer would not be able to accurately model parts it cannot perceive (although indirect perception could in many cases be enough), regardless of processing capability. A large observational capability, provides limited modelling advantage without sufficient processing capability to help integrate this information.

It is also important to consider that cognitive complexity is not equivalent to adaptive success. Highly complex systems may be poorly adapted to specific environments, while specialized systems may excel in particular domains despite lower overall model complexity.

3. Evidence for Cognitive Complexity and Environmental Modelling Convergence

This section consists of two parts: The first discusses differences in cognitive complexity, and how these affect environmental modelling capabilities. The second discusses convergence of models (especially in mathematics), which offers support for the theory that these are all modes that describe the same environmental regularities,

In many organisms, an increase in cognitive complexity is consistent with an increase in the comprehensiveness of their environmental models. Less complex organisms like jellyfish and worms (possessing both limited sensory information and processing capability) are limited to direct, local environmental cues and simple reflexes.

More complex organisms like birds, or mammals have more capable perceptual systems and their cognitive system allows for the integration of information across time and modalities. This allows them for flexible behaviours such as tool use, problem-solving, and social interaction (Clayton & Emery, 2015; Hanlon & Messenger, 2018).
High complexity systems (e.g., humans, dolphins, corvids) have the ability to model abstract relationships, multistep causal chains, and even construct explicit models of their own perceptual limitations (Dehaene, 2011; Connor, 2007).

These differences are seen both in the range of features)and level of abstraction or causal modelling of environmental representation.

Convergence
An important concept of the theory is convergence. In the context of this paper, this refers to models starting to overlap when increasing in complexity. Since all observers are attempting to model the same physical reality and our access to information front his environment is similar, one would expect that the models created by these observers must share some fundamental similarities. An especially interesting modality is the field of mathematics. Interesting because a number (if not all) of different sensory modalities are influenced or constrained by it: I can see the difference between one, or two trees, feel the difference of one or two marbles in my hands or hear the difference between one or two notifications on my phone.

While some believe mathematics to be a purely human invention, a remarkable range of animals posses some rudimentary mathematical capabilities:

“Number sense”: Many animals such as birds, primates, and some fish can discriminate between different numerical quantities and follow basic numerical rules (Nieder, 2016; Dehaene, 2011).

Symbolic and Abstract Reasoning: There is also evidence that some more complex organisms have the ability to handle symbolic representations and abstract mathematical operations. Some great apes, corvids, and especially humans can manipulate symbols and perform arithmetic that goes beyond immediate perception.

While not the central thesis, *convergence* across diverse lineages provides an important corroborating pattern: when different cognitive architectures independently evolve similar strategies (e.g., grid cells for spatial navigation in both mammals and birds, or Weber’s law in numerical cognition across taxa), it suggests that these

Modelling strategies are effective ways to capture recurring environmental regularities (Nieder, 2016; Jacobs, 2014). This does not mean convergence is necessary for all modelling, but where it occurs it strengthens the claim that cognitive complexity enables access to genuine structure.

Limits and Specializations

The evidence also shows that increased complexity does not guarantee universal superiority:
- Some simpler organisms outperform complex ones in specialized domains (e.g., magnetic navigation in sea turtles, olfactory discrimination in dogs).
- Cognitive complexity often trades breadth/depth for metabolic cost and potential bias, so the relationship is not linear or absolute.

Taken together, these lines of evidence support the thesis that **cognitive complexity expands the capacity for environmental modelling—enabling broader, deeper, and more integrated representations—though always within perspectival and biological constraints**. Convergence is one sign that certain solutions are especially effective, but the main support comes from the observed expansion of modelling capacity with increasing complexity.

Limit of Complexity
As supposed by the theory, more cognitive complex observers can create more comprehensive models of reality. However, from this one could assume that a sufficiently complex observer might be able to accurately model reality in its entirety.

First and foremost, this would depend entirely on the finiteness (or infiniteness) of the universe, if the universe possesses an infinite of information to process, it would be impossible for any observer to ever model all reality. In the case of a finite universe, it would theoretically be possible. However, in reality this might not be possible to either evolutionary constraints (It might not be possible for such a complex system to evolve from natural circumstances) or physical (It might be impossible for such a cognitive system to exist in this universe given the universal laws of reality.)

4.2 The Gödel Limitation
However, Gödel's incompleteness theorems pose fundamental constraints. Any cognitive system capable of mathematical representation will encounter true statements about the universe that cannot be proven within its own framework. Since the universe appears to contain mathematical structure, complete universal modelling carries inherent logical limitations—any sufficiently powerful modelling system will find environmental truths that exceed its formal capacity.

Artificial Intelligence and Cognitive Complexity

The rise of artificial intelligence provides a unique opportunity to further explore the relationship between cognitive complexity and environmental modelling. Unlike biological systems, AI systems are not bound by the same evolutionary pressures or sensory limitations. Advances in machine learning, particularly in deep learning and reinforcement learning, have enabled AI systems to process vast and diverse datasets, integrate multimodal information, and perform complex pattern recognition and reasoning tasks.

AI systems already demonstrate the ability to model environmental regularities at scales and speeds unattainable for biological organisms, for example, in climate modelling, protein folding (AlphaFold), or large-scale data analysis. Importantly, as AI systems grow in complexity (through larger architectures, more sophisticated algorithms, and access to greater data), their capacity for environmental modelling also expands, supporting the thesis that modelilng scope and depth are functions of cognitive complexity.

However, AI also highlights the perspectival limitations of modelling: AI models are constrained by their training data, objective functions, and architectural choices. They may surpass human abilities in specific domains, but their models remain incomplete and shaped by their design and input. Furthermore, even the most advanced AI systems encounter fundamental limits analogous to those faced by biological cognition, such as computational constraints, the impossibility of perfect generalization, and the boundaries set by formal logic (e.g., undecidability and incompleteness).

AI thus serves as both a test case and an extension for our theory: it demonstrates how increases in cognitive complexity (whether biological or artificial) can broaden and deepen environmental modeling, but it also confirms that perspectival and structural limitations remain.

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5. Conclusion

This paper has argued for a framework in which cognitive complexity—encompassing both perceptual and processing capacities,expands the scope and depth of environmental modeling, albeit always within perspectival and biological (or physical) constraints. Evidence from comparative cognition, mathematical convergence, and artificial intelligence supports the thesis that more complex observers can access and model a broader range of environmental regularities. However, modeling never achieves direct or complete access; all models are shaped by the observer's architecture and the limits of the universe itself.

Convergence across species and systems, particularly in mathematics and fundamental cognitive structures, provides corroborating evidence that these models are not arbitrary but track genuine features of reality. Yet, the limits posed by physical laws, evolutionary constraints, and formal systems (as exemplified by Gödel's incompleteness theorems) ensure that no observer, biological or artificial, can ever achieve a fully complete or objective model.

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