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The role of consciousness in adaptive behaviour: A philosophy for the science of animal consciousness

Walter Veit[1,2]

Abstract

What is the role of consciousness in nature? The science of consciousness has largely neglected the question through its emphasis on human experience. In this précis of *A Philosophy for the Science of Animal Consciousness*, I outline how we can move from a top-down approach that begins with investigations in humans to an evolutionary bottom-up approach that targets the adaptive origins of even the most minimal forms of subjective experience. I will also offer an introduction to the central thesis of the book, that is, the pathological complexity thesis, according to which consciousness evolved in order to enable animals to adaptively respond to their life history challenges.

Keywords

Consciousness, adaptive behaviour, evolution, subjective experience, animal consciousness

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1. Introduction

Consciousness is a real natural phenomenon. Yet, the science of consciousness has for a long time studied consciousness as if it was confined to humans, with only rudimentary versions of it to be found in other animals if at all (see also Ginsburg & Jablonka, 2019). This top-down approach is methodologically limited and motivated me to write *A Philosophy for the Science of Animal Consciousness* (Veit, 2023a) where I outlined how we can move away from such an approach and towards an evolutionary bottom-up approach to consciousness. To many it seemed that this approach is impossible because of the alleged inability to ever know what goes on in the minds of other animals. But the difficulty of this task should not stop us from trying our hardest to uncover the adaptive roles of consciousness as a natural phenomenon in nature, rather than a mere human feature.

The central idea of the book is the following thesis:

1.1. Pathological complexity thesis

The function of consciousness is to enable the agent to respond to pathological complexity.

By 'function of' I mean the teleonomic reason for why conscious creatures had higher fitness than their competitors that led to the evolution of complex forms of conscious experience (Veit, 2022a; 2023b). Ironically, perhaps, I reject the idea that there is a specific function to consciousness. Consciousness, as I argue at length in my book, is a complex multi-dimensional phenomenon with a lot of variations across the animal kingdom. We can ask the question of what evolutionary role does subjective experience in its many variations and gradations, what I call 'phenomenological complexity' (Veit, 2022d), play in the lives of healthy animals in their normal ecological environments that have evolved in order to maximize their fitness? It would be naive to think that a single function could summarize all these benefits consciousness confers on conscious creatures. This is why the pathological complexity thesis offers a more general answer in terms of how consciousness helps animals to deal with their unique life history challenges as well as the common life history problem that led to the evolution of the first sentient creatures. My goal is not to reduce

[1]Department of Philosophy, University of Reading, UK
[2]Munich Center for Mathematical Philosophy, Ludwig-Maximilians-Universität München, Germany

Corresponding author:
Walter Veit, Department of Philosophy, University of Reading, UK.
Email: wrwveit@gmail.com

consciousness to a single feature, but to offer a general ecological and evolutionary framework that can help us to understand the varieties of experience as well as their adaptive benefits for species as different as electrosensing snakes, echolocating bats or magnetoreception in species such as foxes. Pathological complexity just like phenomenological complexity comes in a lot of variations. But before I discuss the pathological complexity thesis in more detail with a focus on the role of consciousness in adaptive behaviour, let me first offer a brief overview of the structure of my book.

2. Brief overview

A Philosophy for the Science of Animal Consciousness is divided into six chapters that each successively build on each other. The first chapter, titled 'A Darwinian Philosophy for the Science of Consciousness', introduces the central themes and motivations of the book, providing an outline for my attempt to incorporate animal consciousness into the Darwinian revolution throughout the rest of the text.

The second chapter, titled 'The Explanandum: Animal Consciousness and Phenomenological Complexity', constitutes the most substantive review in the book. My aim in this chapter is to shift away from the notion of consciousness as an all-or-nothing trait unique to humans, and instead present it as a multi-dimensional phenomenon that varies in degrees across the animal kingdom. I introduce the concept of 'phenomenological complexity' to encapsulate this idea and draw on the proposal by Birch et al. (2020), distinguishing five dimensions of conscious experience that I adopt with slight modifications: sensory experience, evaluative experience, the experience of a self, the experience of time and the experience of a unified conscious field (the latter two abbreviated as diachronic and synchronic experience). I discuss the experimental paradigms they proposed for studying these dimensions, adding several more to demonstrate that we can go beyond merely asking whether species are conscious and instead investigate the actual content of their experiences.

The third chapter, titled 'The Origins of Consciousness or the War of the Five Dimensions', explores which of these five dimensions of consciousness is likely to have emerged first in evolutionary history. I adopt an adaptationist approach, arguing that evaluative experience (involving negative and positive feelings) is the best candidate for the origin of consciousness. While the other dimensions leave open the question of why they couldn't be processed unconsciously, evaluative experience presents fewer challenges to this explanatory gap. Since evaluation is central to agency and action, this dimension offers the most compelling explanation for the origins of consciousness without making its adaptive benefits mysterious.

The fourth chapter, titled 'Pathological Complexity and the Dawn of Subjectivity', proposes a theory for how evaluative experience may have arisen during the Cambrian explosion, around 540 million years ago. I argue that the computational explosion in pathological complexity (life-history complexity; more on that shortly) – resulting from new degrees of freedom in the available actions of animals due to the evolution of new appendages – led to the need for a common currency for decision-making: hedonic evaluation. As this is the central idea of the book, I will discuss it in greater depth following this overview.

The fifth chapter, titled 'Pathological Complexity Meets Phenomenological Complexity', applies my framework to specific animal groups. While the previous chapter focused on how evaluative consciousness may have first emerged, with the other dimensions developing later, this chapter explores how my theory can be used in contemporary research on phenomenological complexity in animals. I focus on several groups. First, I examine whether gastropods (snails and slugs) have sensory experiences and whether insects have evaluative experiences. Next, I consider octopuses as the best model for self-awareness, due to their unique bodies compared to other animals. Fish and reptiles serve as models for studying the unity of experience, particularly because their brains are split and have limited connections between hemispheres. This section explores whether there might be adaptive benefits to having two distinct streams of experience. Finally, I turn to the cover animals of my book: corvids, such as ravens and crows. Thanks to a wealth of studies on avian cognition and their engagement in caching activities (hiding food for later use), corvids provide an ideal model for exploring the experience of time in animals. By examining the unique challenges of pathological complexity they face, my framework allows us to make predictions about what types of subjective experiences would be adaptive for certain species and infer aspects of animals' life histories based on experiments about their subjective experiences. In doing so, consciousness becomes not just a phenomenon in need of explanation, but an explanatory tool within biology.

Ultimately, we reach the final chapter, titled 'The Final, Crowning Chapter of the Darwinian Revolution', named after a quote by Donald Griffin, the founder of cognitive ethology (Griffin, 1998, p. 14). In many ways, this book is dedicated to Griffin for breaking the taboo on the study of animal consciousness. The final chapter reviews how far we have come in fulfilling his vision of including animal minds in the study of biology. With this overview complete, let us now turn to the central idea of the book.

3. Pathological (life-history) complexity and consciousness

The central motivation of this thesis was to establish a tight link between consciousness and health as natural phenomena. While the notions of health and pathology have received a lot of attention by philosophers of medicine as a normative ideal or culturally relative concept (Veit, 2020, 2021, 2022b, 2022c; Matthewson & Griffiths, 2017; Veit & Browning, 2021), I wanted to emphasize and make clear that there is a distinct kind of biological normativity found in the biological world that researchers interested in evolution and adaptation should readily recognize. All organisms designed by natural selection have an optimal life history strategy in the pursuit of reproductive fitness. The species-specific life history challenges they will encounter during their lives is what I refer to as 'pathological complexity'. This should not be confused with complexity related to pathogens, but rather the living complexity of any system in trying to implement their optimal strategy. Any deviation of such an optimum, e.g. the failure of an organ, can be considered pathological. This is an evolutionary view of pathological states that identifies any deviation in terms of fitness from the optimum that isn't due to chance as pathological. Indeed, it is necessary for biology to distinguish between healthy and pathological states such as the absence of a limb. And this can and must be extended to behaviour and cognitive processes that ultimately need to pay off for the organism. This is why the ethologists such as Konrad Lorenz emphasized the importance of distinguishing pathological variations of behaviour in order to extend the Darwinian revolution to include behaviour (Lorenz, 1981), and my goal in this book was to do the same for consciousness: extend the Darwinian revolution once more.

While capturing health in terms of fitness may not capture how we understand health in human societies, that is not my goal here. The goals of having a concept for societal issues such as deciding who should receive treatment and insurance coverage do only partially overlap with the biological goal to understand health as a natural phenomenon or 'biological normativity' (Griffiths & Matthewson, 2018; Matthewson & Griffiths, 2017; Veit, 2021). Nevertheless, because it is hard for some to separate these distinct senses of health from their tangled folk usage, I also use the term 'life-history complexity' and 'teleonomic complexity' interchangeably with 'pathological complexity'. If we think of the adaptive benefits of consciousness we must answer the question how such a complex trait pays off for itself - why is it that in the evolution of subjective experience 'more conscious' organisms outcompeted those with less subjective experience. Consciousness in humans can appear incredibly complex and detached from fitness benefits. We can have conscious goals that are vastly different from our biological goals as Darwinian creatures. Yet, that doesn't mean that the evolution of subjective experience itself was disconnected to fitness. After all, no plausible account of consciousness should just treat it as an automatic feature of cognitive processes. Consciousness is too complex, too well-fitted to our environments, and too decision-relevant as that epiphenomenalism could be true, that is, the dualist view that consciousness is merely a byproduct of the brain's physical processes and never their cause. The complex neural architecture of consciousness is not cheap and would 'quickly' be down-sized and removed if it wasn't for its benefits that make the biological investments into this architecture worthwhile. If we try to understand biological organisms as teleonomic systems, that is, goal-directed systems, pursuing the 'goal' of fitness-maximization. Here, life-history theory or to be more precise a generalized state-based behavioural and life-history theory offers the best theoretical framework since it is derived from economic models of rational choice for agents and can thus help us to understand how and why agents evolved. As Lewontin once put it in his call to complete the Darwinian revolution, we need to address the 'functional needs' of organisms (Lewontin, 1985, p. 85).

4. Complexity and adaptive behaviour

One of the reasons why I selected this journal for this special issue, was that Peter Godfrey-Smith published a précis to his 1996 book *Complexity and the function of mind in nature* in this journal (Godfrey-Smith, 1996a; 1996b). The core idea of Godfrey-Smith's book was what he called the environmental complexity thesis, which he aimed to summarize a common view among evolutionists (especially Herbert Spencer and John Dewey) that the environmental complexity of organisms leads them to evolve cognitive capacities: 'The function of cognition is to enable the agent to deal with environmental complexity' (Godfrey-Smith, 1996a, p. 3). The pathological complexity thesis differs in both its explanandum and explanans, but it is nevertheless intended as an ancestor to the environmental complexity thesis in both its elegant formulation and its aim to capture the continuity between the mind and life. Furthermore, one of the reasons I see it as an upgrade for Godfrey-Smith's earlier work is that it offers us a framework for naturalizing much of his recent work on the role of agency in the evolution of consciousness (Godfrey-Smith, 2016, 2020). State-based behavioural and life-history theory elegantly naturalizes agency into scientific theorizing and helps us to make sense of the now common idea in animal consciousness research (Feinberg & Mallatt, 2016; Ginsburg & Jablonka, 2019; Godfrey-Smith, 2020; Trestman, 2013) that consciousness probably arose with the origins of multicellular animal actions during the Cambrian explosion.

My goal was to develop a framework that could transform such claims into more precise and measurable statements. When the teleonomic life-history complexity of organisms strongly correlates with their degree of agency, because further increases in an organism's choice set vastly increase their pathological complexity, we could at least in principle try to assess the life-history complexity of Cambrian animals. Here, I hypothesised that the explosion in pathological complexity of Cambrian animals developing richer body plans with more complex forms of action would lead to the origins of sentience, that is, the first hedonically valended experiences. This is because I argued that hedonic valence could provide animals with a more efficient form of decision-making to deal with this added complexity of having more degrees of freedom available to them. All life, of course, has to deal with trade-offs. There are no Darwinian demons that can live forever and produce infinitely. But as with the design of organisms, trade-offs also exist in the form of choices between alternative actions, and it is these trade-offs that present a much more acute and repeated problem to the organism. In my book, I discuss the centrality of weighing opportunities and problems in the decision problems of animals such as the opportunity of a common brushtail possum (*Trichosurus vulpecula*) to harvest unsupervised fledglings, while the possum presents a danger to them. The environments of animals are filled with opportunities for fitness-enhancing actions, but also fitness-decreasing dangers. Dealing with trade-offs between starvation and foraging under high predator density brings with it complex decision problems animals have to solve. When I speak of 'action' here, I am defining it in a teleonomic sense as any kind of functional activity that biological systems produce at the exclusion of other such activity (see also Millikan, 1995; Spurrett, 2020). This helps us to recognize what is unique to animals as opposed to plants: what plants do is typically happening in parallel, there is nothing even remotely like a 'central decider' that weighs actions against each other. Individual cells have much more autonomy than that. The evolution of the first kind of subjective experiences, that is, hedonic valence, can simply be understood as a mechanism to deal with these decision-problems in producing adaptive behaviour – giving birth to the kind of experienced utility neuro-economists are also interested in (Garcia et al., 2021; Kahneman et al., 1997). Inspired by earlier work by the neuroscientist Michel Cabanac, who also argued that pleasure constitutes both a 'common currency' for decision-making and the origins of consciousness (Cabanac, 1992, 1996; Cabanac et al., 2009), I have tried to bring renewed attention to the idea that consciousness might have evolved to provide us with a common currency akin to fitness for decision-making. In reference to earlier work by Dennett (Dennett, 1995) and the utilitarian Jeremy Bentham, I coined these first conscious animals 'Benthamite creatures'. The provision of this new adaptive form of decision-making not only led animals to make better decisions and learn from them, but also enabled natural selection to explore a much larger range of animal body plans in the organismal design space that were hitherto locked. Investments into more complex bodies do not come cheap since the increases in decision-theoretic complexity lead to an explosion in pathological/life-history complexity that need to be handled in order for organisms to reap the adaptive fitness rewards of such investments. But once organisms had this adaptive hedonic common currency new body plans could be readily put to use, thus explaining the rapid explosion of new body forms during the Cambrian (see Ginsburg and Jablonka (2019) for a detailed competing explanation and a for a response to them, Veit, 2023c). The difficulty of assessing this decision complexity real animals solve in their complex environments is unfortunately underappreciated by animal consciousness researchers who often focus on highly constrained lab experiments. But as behavioural ecologists have long argued, it is almost impossible to have a unified foraging theory addressing all the options available to animals, since 'more complex models can rapidly become computationally unwieldy' (Mangel & Clark, 1986, p. 1135). And this problem not only exists for modelers, but also for the animals themselves. We can think of hedonic evaluations – simple feelings of attraction and dislike – as a simple solution evolution came up with during the Cambrian to enable animals to pursue adaptive behavior. Evaluative consciousness was a simple yet deceptively useful way to manage and control the degrees of freedom of Cambrian animals, enabling natural selection to explore even higher levels of pathological complexity. A beautiful quote that I use in my book illustrates this point nicely:

> "[D]ecisions among different courses of action must be made in terms of a common currency, and weighted among a common set of criteria. The necessity for comparing the merits of different courses of action implies that there must be some "trade-off" mechanism built into the motivational control system. Since the trade-off process must take into account all relevant motivational variables, it is clear that the mechanism responsible must be located at a point of convergence in the motivational organization." (McFarland & Sibly, 1975, p. 290)

Furthermore, once a basic form of evaluative consciousness is present, it becomes less puzzling to understand why other forms of consciousness exist. Accounts of consciousness that are based on models of sensory information processing or self-recognition often encounter the 'hard problem' – failing to explain why these processes could not occur unconsciously. However, the explanatory gap is narrower when it comes to evaluative experience: we can recognize these evaluations as what it means to be an experiencing agent. The felt aspect of these processes constitutes its function, that is, to matter to the organism. Nevertheless, this does not eliminate the explanatory gap entirely. The challenge of disentangling conscious from non-conscious evaluative processes in the nervous system remains a complex task; one that future research will help us make progress on. Yet, one can readily explain the other non-evaluative aspects of consciousness once evaluative experience is in place. Sensory experience is simply the gradual enrichment of this basic capacity in its representational and discriminatory ability to distinguish different kinds of stimuli and summarize them in a useful manner to the organism. Self-awareness can be explained as further gains in the capacity to distinguish those stimuli coming from inside the organism from those outside of it. These aspects of consciousness are likely to have relatively 'quickly' evolved during the Cambrian. The field and flow of consciousness that we associate with human experience, on the other hand, are likely to be later features in the organization of experience itself with plenty of variation between different animals. By studying the life histories of animals, the pathological complexity thesis aims to make predictions regarding these variations of subjective experience across the animal branch of life. It enables us to ask the adaptive question of what benefits there would be for different species to undergo some forms of subjective experiences as well as what the disadvantages of such a capacity would be (not only restricted to its 'hardware' costs). For instance, I have used it elsewhere to explain the evolution of anxiety and the possibility of sex differences in experiences (Veit & Browning, 2022, 2023). More speculatively perhaps, I have also argued that the framework can be used to develop AIs that replicate the useful aspects of consciousness such as introspection (Browning & Veit, 2023).

Naturally, one of the main objections I anticipate for my project is the lack of a mathematical measure of pathological/life-history complexity. This is why I have visited and collaborated with Rob Salguero-Gómez's Life History research team at the University of Oxford. An early programmatic paper for why measuring life history complexity is relevant for biological research even in the absence of its role for consciousness has been uploaded as a preprint and will likely be published soon (Veit et al., 2023). A second paper comparing the life history complexity of dozens of species will come out next out of this collaboration and help us to test the pathological complexity thesis. If the life history complexity of species turns out to run counter to my predictions, for example, animals we consider (following a series of experiments and evolutionary reasoning) to have high degrees of consciousness turn out to have low life history complexity and vice versa for animals we consider to be non-conscious, this would be a significant blow to the thesis. In this, my framework offers both a way of making useful predictions and a way of 'falsifying' the theory.

5. Conclusion

I hope that this succinct summary of some of the core ideas of my book has given a good introduction to my theorizing on the adaptive roles of consciousness. Because of the length of my books I can unfortunately only tease some of the more extensive arguments, but I hope that this précis raised the interest to potential readers to dive into my longer monograph. The pathological complexity thesis is indebted to many scholars – both dead and alive – and I hope that it can bring us closer towards an adaptationist study of consciousness that uncovers the fitness benefits of different forms of subjective experience. I am happy to see that there has been great interest in my monograph and that other scholars that I respect have taken the time to write up their thoughts on my ideas. I look forward to reading their criticisms of *A Philosophy for the Science of Animal Consciousness* and formulating my responses.

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ORCID iD

Walter Veit https://orcid.org/0000-0001-7701-8995

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About the Author

Walter Veit is a Lecturer in Philosophy at the University of Reading. His primary research interests lie in the intersection of the biological, social, and mind sciences and empirically informed philosophy and ethics.