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Anthropomorphization as a method of working with indirect data

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Abstrakt

Antropomorfizacja jako metoda pracy wobec pośrednich danych

W etologii antropomorfizacja, rozumiana jako przypisywanie zwierzętom cech uważanych za specyficznie ludzkie, jest często krytykowana jako niezgodna z naukowymi standardami. Jednak przyjmując inną perspektywę, podejście to polega na poszukiwaniu analogii między gatunkami, co znajduje swoje odpowiedniki w paleobiologii, w metodach nawiasu filogenetycznego oraz poszukiwaniu analogii wśród współczesnych gatunków. Obie dyscypliny opierają się na danych pośrednich, choć przyczyny tego ograniczenia są różne. Niniejszy artykuł porównuje wybrane metody paleobiologiczne z antropomorfizacją, argumentując, że ta ostatnia powinna być zaakceptowana i używana jako jedna z metod w badaniach nad zwierzęcym zachowaniem i umysłem.

Słowa kluczowe: antropomorfizm, zachowanie, analogia, zwierzę, paleobiologia

Abstract

Anthropomorphization as a method of working with indirect data

In ethology, anthropomorphization – the attribution of uniquely human characteristics to animals – is often criticized as unscientific. However, this approach seeks to reveal analogies between different species, a practice that finds parallels in paleobiology through the use of phylogenetic bracketing and the search for analogies among extant species. Both disciplines share a reliance on indirect data, though the reasons for this limitation differ. This article compares selected paleobiological methods to anthropomorphization, arguing that the latter should be recognized and validated as a legitimate scientific method.

Keywords: anthropomorphism, behavior, analogy, animal, paleobiology

Discussing animal emotions, consciousness, or intelligence often involves using terms traditionally associated with uniquely human traits, which many researchers consider unscientific. Philosopher Joseph Agassi vehemently opposes anthropomorphism, citing examples from the history of science to show how disciplines like physics and chemistry abandoned hypotheses reliant on anthropomorphic explanations as they advanced[1]. The main arguments center on mentalism in scientific attitudes and epistemic difficulties in observing animal's inner subjective states. Mentalism does not qualify as a scientific explanation for at least two main reasons. First, it relies on non-material causes to explain behavior, and second, mentalistic concepts are inherently private and thus subjective, making them incompatible with objective scientific inquiry[2].

This paper does not address the first concern, which also applies to disciplines such as sociology, economics, and psychology, as they too involve an unclear causal relationship between the immaterial and the material. The second issue, however, pertains to the inherent challenge of studying areas not directly accessible to the senses. For instance, when human behavior is observed, investigators can verify their interpretations through direct communication with the human subject. This approach is unavailable in the study of animals. Although certain mental processes can be inferred through neuroimaging, obtaining confirmation from animals remains impossible, further complicating the matter.

Critics of anthropomorphism, including Agassi, argue that it constitutes a scientific error which is absent in modern, advanced sciences. However, this article seeks to challenge that perspective by comparing anthropomorphism with selected methods used in paleobiology, such as the phylogenetic bracket. The aim is to demonstrate that anthropomorphizing can serve as a valuable tool for the sciences investigating animal behavior and cognition and should not be dismissed as unscientific.

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1 J. Agassi, *Anthropomorphism in science*, in: *Dictionary of the history of ideas: studies of selected pivotal ideas*, ed. P. P. Wiener, New York 1973, p. 87–91.

2 C. D. Wynne, *What are animals? Why anthropomorphism is still not a scientific approach to behavior*, "Comparative Cognition & Behavior Reviews" 2 (2007), p. 132, https://doi.org/10.3819/ccbr.2008.20008.

In virtually every modern scientific field, direct observation is often challenging, whether in studying the cosmos, quantum phenomena, or ancient life forms. Paleontology, for example, relies heavily on indirect data. By drawing parallels between research on animal behavior and paleobiology, this article argues that anthropomorphism, when understood as a tool for addressing the absence of direct data, aligns closely with the scientific methods of phylogenetic bracketing or reasoning by analogy. It can be considered a legitimate scientific method, particularly in formulating hypotheses.

A brief introduction to two methods used in paleobiology

Paleontology, particularly its branches of paleobiology, paleozoology, and paleoethology, investigates phenomena that cannot be directly observed. These disciplines, positioned at the intersection of geology and biology, aim to uncover the habitats, physical characteristics, and behaviors of extinct species. Researchers in these fields often work with limited evidence, as fossils — the primary source of information about long-extinct species — are both rare and serendipitously preserved.

Fossils, which are mineralized remains of plants or animals, are typically classified into two categories: true fossils and trace fossils. Evidence of prehistoric life includes physical remains such as shells, imprints, and bones, as well as traces like burrows, coprolites, and organically-produced chemicals. The preservation of these remnants often relies on rare circumstances, such as rapid burial by mud or sediment, which protects the evidence from decay.

Despite these challenges, our understanding of ancient life has steadily grown. Paleontologists develop hypotheses and theories to address gaps in the evidence, drawing upon principles of biological evolution. When a specific anatomical feature or behavioral detail remains unknown, researchers can employ methods to infer missing information. One such method is referencing the phylogenetic tree, particularly through the application of the phylogenetic clamp[3]. This method involves identifying the evolutionary branch of a species and comparing it with closely related genera or species. If contemporary relatives exhibit a specific behavior or possess an organ with a known function, it is likely that the extinct species in question shared similar traits. This approach is especially promising for reconstructing anatomical features and behaviors, bridging gaps in the fossil record.

Paul Barrett and Emily Rayfield have explored these methodologies in their studies on extinct behaviors. In their work, they distinguish between two categories of methods: ahistorical and historical. The former focus solely on the anatomy of extinct organisms, particularly the mechanics of movement. These hypotheses are supported by drawing analogies with structurally similar organisms or through biomechanical modeling. The historical methods, on the other hand, incorporate the evolutionary history of the organism and rely on the application of the phylogenetic bracket to infer behaviors and traits within an evolutionary context[4].

Identifying appropriate analogies for extinct species is not always straightforward. Closely related animals can differ significantly in anatomy, behavior, and ecological niches. A notable example is the evolutionary relationship between giraffes, hippos, and whales. Despite their shared ancestry, these species differ drastically in structure and habitat. In such cases, researchers often turn to analogies with extant animals that share similar ecological roles or body structures, rather than relying solely on phylogenetic closeness.

A compelling example of this approach is the discovery of *Citipatiosmolskae* in 1993 in the Gobi Desert. This large oviraptorid was found in a posture resembling a modern bird incubating a nest: hind limbs bent, lower legs parallel, and feathered wings covering the nest[5]. The pose, analogous to that of large birds today, allowed paleontologists to hypothesize about the behavior

3 L.M. Witmer, *The Extant Phylogenetic Bracket and the importance of reconstructing soft tissues in fossils*, in: *Functional morphology in vertebrate paleontology*, ed. J. Thomason, Cambridge 1995, pp. 19–33.

4 P.M. Barrett, E.J. Rayfield, *Ecological and evolutionary implications of dinosaur feeding behaviour*, “Trends in Ecology & Evolution” 21 (2006) no. 4, p. 217, https://doi.org/10.1016/j.tree.2006.01.002.

5 M.A. Norell, J.M. Clark, L.M. Chiappe, D. Dashzeveg, *A nesting dinosaur*, “Nature” 378 (1995) no. 6559, pp. 774–776, https://doi.org/10.1038/378774a0.

of *Citipati*, including its nesting habits, parental care, and social relationships. Previous findings, such as *Oviraptorphiloceratops*, further supported these behavioral analogies.

Stephen Brusatte highlights the importance of comparing extinct species with extant vertebrates as one method for reconstructing behaviors, including locomotion. While modern birds and mammals provide useful insights, significant differences in size and other factors can limit the applicability of these comparisons. However, they often yield critical information that fossils alone cannot provide[6].

Evolutionary thinking plays a crucial role in these reconstructions. Researchers must balance two key factors: phylogenetic closeness and convergent evolution (adaptations driven by similar environmental pressures or functions). This dual approach helps bridge gaps in understanding species that are difficult to study directly. In paleontology, data used to construct hypotheses often fall into two categories: hard but indirect evidence, such as fossil remains, and non-hard but direct evidence, derived from evolutionary and behavioral analogies.

For a hypothesis to be scientifically valid, it must be coherent and falsifiable. For example, if a species is hypothesized to be a solitary hunter, the discovery of multiple individuals from that species in proximity to prey could challenge that assumption. Such discoveries demonstrate the interplay of evidence, interpretation, and intuition, which together drive progress in paleontological reasoning.

Despite the utility of these methods, they are not without challenges. Factors like the unknown amount of dispose tissue can distort reconstructions of extinct species' appearances. However, every new fossil discovery and improved analogy with better-understood animals brings researchers closer to the truth.

In other scientific disciplines that explore phenomena beyond human sensory experience — such as cosmology or quantum physics — sophisticated mathematical models often compensate for the lack of direct observation.

6 S. Brusatte, *Dinosaur paleobiology*, Chichester–Hoboken, NJ 2012, pp. 137–139, https://doi.org/10.1002/9781118274071.

In paleontology, such tools are less applicable, placing a greater reliance on comparative methods and speculation. As science advances and technologies like genetics and engineering become more integral, the role of speculation in paleontology has diminished. However, the higher risk of error inherent in these methods should not discredit their use, especially when there are no alternatives. What matters is that hypotheses are testable and contribute meaningfully to our understanding of ancient life.

Anthropomorphism in animal behavior and cognition research

The attribution of emotions, intentions, planning, and creative thinking to animals is a topic of significant interest and controversy among researchers across multiple disciplines. This debate has far-reaching implications for ethics, morality, and the redefinition of humanity's place in the natural world. Such attributions are often described as anthropomorphism: "In the context of animal cognitive research, 'anthropomorphism' is defined as the attribution of uniquely human mental characteristics to non-human animals"[7]. Is it appropriate, for example, to describe a chimpanzee mother as experiencing sadness or mourning when she exhibits dejection or loss of appetite after losing her offspring? Similarly, can we speak of creativity and problem-solving when an octopus opens a jar to retrieve a snack?

Some researchers are more receptive to using human-centric terms to describe animal mental states. Renowned primatologists Jane Goodall and Frans de Waal argue that applying such terms to animal behavior is no more risky or incorrect than denying animals these characteristics entirely — a stance De Waal refers to as anthropodenial[8]. The two approaches diverge sharply in their

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7 K. Andrews, *Beyond anthropomorphism: attributing psychological properties to animals*, in: *Oxford handbook of animal ethics*, eds. T.L. Beauchamp, G. Frey, Oxford 2011, p. 469, https://doi.org/10.1093/oxfordhb/9780195371963.013.0017.

8 F.B. de Waal, *Are we in anthropodenial*, "Discover" 18 (1997) no. 7, pp. 50–53; F.B. de Waal, *Anthropomorphism and anthropodenial: consistency in our thinking about humans and other animals*, "Philosophical Topics" 27 (1999) no. 1, pp. 255–280, https://doi.org/10.5840/philtopics199927122.

attitudes toward parsimony. Anthropodenial emphasizes cognitive parsimony by refusing to attribute mental states to animals, while anthropomorphism leans on evolutionary parsimony, using evolutionary proximity as a justification for such attributions.

A nuanced approach, critical anthropomorphism, contrasts with naïve anthropomorphism. Originated by researchers like Gordon Burghardt[9], critical anthropomorphism involves creating testable hypotheses that align with current scientific knowledge and incorporate the evolutionary history, ecology, and sensory capabilities of the species being studied. This approach aims to counter anthropocentrism and encourages scientists to adopt the perspective of the species under observation, as closely as possible.

Marc Bekoff offers yet another perspective on anthropomorphism, viewing it as a natural and evolutionary product that enhances human interactions with other species. He argues that anthropomorphism should not be criticized and considers aversion to it a philosophical, rather than scientific, issue. Bekoff posits that resistance to anthropomorphism often stems from a reluctance to acknowledge the fundamental similarities between humans and other animals. Furthermore, he highlights the inherent limitation of language: as humans, we describe behaviors using terms familiar to us, inevitably drawing on human concepts. According to Bekoff, "if we don't anthropomorphize, we lose essential information". He views opposition to anthropomorphism as a dead-end, selectively and inconsistently applied, often representing scientific negligence or a lack of respect for animal cognition[10].

Beyond animal behavior studies, anthropomorphism can also be seen as a hallmark of early scientific reasoning across disciplines. The gradual elimination of anthropomorphic language has been a key aspect of scientific progress in fields such as physics and chemistry. However, what has been fruitful for understanding inanimate nature may not be as beneficial for biology, particularly in ethology and the study of animal behavior.

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9 G. Burghardt, *Cognitive ethology and critical anthropomorphism: a snake with two heads and hognose snakes that play dead*, in: *Cognitive ethology: the minds of other animals. Essays in honor of Donald R. Griffin*, ed. by C.A. Ristau, New York–London 1991, pp. 73–75.

10 M. Bekoff, *The emotional lives of animals: a leading scientist explores animal joy, sorrow, and empathy — and why they matter*, New World Library, 2010, p. 226.

As a staunch opponent of anthropomorphism in any form, American psychologist Clive D. L. Wynne strongly argues against its use in scientific research. Wynne asserts that even the most refined forms of anthropomorphism are unscientific, categorizing them as a form of mentalization. According to him, mentalization involves attributing immaterial causes to observed behaviors, which directly conflicts with the principles of methodological naturalism — a cornerstone of mature and rapidly evolving natural sciences.

Wynne's critique also touches on a fundamental issue discussed earlier: the mental realm is inherently private and subjective, making it inaccessible to direct observation. This limitation, he contends, underscores the epistemic challenges of attributing mental states to animals, further disqualifying anthropomorphism from rigorous scientific inquiry based on methodological naturalism[11].

In any discussion of this topic, it is essential to acknowledge Lloyd Morgan, not only because of the relevance to this article but also due to his profound influence on ethology and comparative psychology. Morgan's most notable contribution to these fields is the formulation of Morgan's Canon, a principle stating that an action should not be interpreted as the result of higher mental faculties if it can be adequately explained by lower ones[12].

Morgan's Canon occupies a place in ethology and comparative psychology comparable to that of Occam's Razor in scientific methodology and ontology. It serves as a critical safeguard against overinterpretation, ensuring that researchers do not mistakenly attribute complex mental properties to animals without sufficient evidence. A well-known example illustrating the importance of this principle is the case of "Clever Hans", a horse believed to possess counting abilities.

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11 C. D. Wynne, *What are animals?*, pp. 132–134.

12 C. L. Morgan, *An introduction to comparative psychology*, London 1903, p. 59, https://doi.org/10.1037/13701-000.

Comparison of methodologies

There are notable similarities between anthropomorphization in studying animal behavior and certain methods used in paleontology. Both fields rely on indirect data to explore phenomena that are inherently challenging to access. In paleontology, the challenge lies in the temporal distance, often spanning millions of years, while in animal behavior research, the difficulty is in interpreting mental states in creatures where direct communication is highly limited or entirely impossible.

The development of fields like paleoethology and paleobiology demonstrates that forming bold hypotheses is both possible and necessary, even when clear data access is lacking. While examining fossils and observable behaviors provides foundational insights, these observations often lead to new questions that require researchers to push the boundaries of their understanding. However, this increased flexibility in hypothesis formulation does not imply a lack of rigor. Scientific hypotheses, even in these challenging domains, must adhere to fundamental criteria, including the possibility of falsification.

The concept of falsifiability, introduced by Karl Popper, requires that a theory or hypothesis be logically capable of being contradicted by empirical testing. This principle is a key criterion for distinguishing scientific claims from non-scientific ones. Anthropomorphic hypotheses, despite their inherent challenges, can often meet this criterion. For example, one could propose a testable hypothesis based on observed behaviors, design related experiments, and establish specific conditions under which the hypothesis could be falsified.

An additional issue is the difficulty of adapting experiments to the unique characteristics of the subjects (e.g., species) under study. Let us consider the example of testing intelligence in dogs using obstacle courses. Without accounting for the physical differences among dog breeds, such experiments risk being less accurate or meaningful[13]. Similarly, in studying an elephant that spends days near the corpse of a deceased companion, we cannot interpret

13 W. S. Helton, *Cephalic index and perceived dog trainability*, "Behavioural Processes" 82 (2009) no. 3, pp. 355–358, https://doi.org/10.1016/j.beproc.2009.08.004.

the behavior in isolation. Instead, we must incorporate existing research on the species' behavior, ecological relationships, and evolutionary history. The animal's non-verbal cues, including unconscious bodily signals, become crucial to interpreting its actions.

Comparable challenges arise in psychology and developmental neuroscience, where researchers study the mental processes of children. Human cognitive abilities do not emerge suddenly but develop gradually, often requiring indirect methods of observation. These include tracking brain activity, monitoring eye movements, or measuring changes in pupil dilation[14]. Similarly, the study of animal behavior requires careful interpretation of non-verbal signals, often informed by prior research and cross-species comparisons.

When making comparisons, the focus should not solely be on humans but should also extend to other species, particularly those that are closely related. Comparing the behavior of a dog to that of a human can be challenging, partly due to an inherent human tendency toward self-importance. However, by analyzing a broader network of species and identifying patterns across them, it becomes easier to discern basic mental states, emotions, and experiences that may be shared across species.

In paleobiology, researchers draw analogies between extinct species and their modern counterparts. Similarly, in the study of animal behavior, comparisons are often made between closely related species, such as chimpanzees and bonobos or dogs and wolves. Including humans in this web of comparisons, without assigning them a privileged status, would be a natural extension of existing practices rather than a radical departure from them.

It is also essential to clearly define the focus of the investigation. Given the inherent challenges of studying mental states in animals, it is prudent to avoid overly complex aspects of mental life and instead concentrate on fundamental elements. These include consciousness, basic emotions such as joy, anger, and sadness, creative thinking, and, in some cases, the foundational

14 M. K. Eckstein, B. Guerra-Carrillo, A. T. Miller Singley, S. A. Bunge, *Beyond eye gaze: What else can eyetracking reveal about cognition and cognitive development?*, "Developmental Cognitive Neuroscience" 25 (2017), pp. 69–91, https://doi.org/10.1016/j.dcn.2016.11.001.

manifestations of culture, though this depends on the definition of culture being applied.

Other similarities between the two disciplines

The parallels between paleobiology and animal study, which are two distinct disciplines, can help justify the use of similar methodologies. Both are deeply intertwined with biology, yet neither can be fully reduced to the study of life alone. Fossils, the primary focus of paleobiological research, are geological artifacts extracted from the earth — essentially minerals that must be meticulously prepared and analyzed. Whether fossils are approached from a geological or biological perspective often depends on the interpretive lens applied by researchers. Miquel De Renzi even notes that such interpretative challenges are an intrinsic part of paleontology, grounded in common sense[15].

Initially, a fossil appears as a mineral object that can be studied for its composition, origins, and age. Only through identification and contextualization within evolutionary frameworks does it become a source of meaningful biological insight for paleobiologists. Similarly, animal behavior can also be analyzed in two ways: through a strictly descriptive lens devoid of mentalistic terms, as seen in behaviorist approaches, or through an anthropomorphic perspective that incorporates higher mental states into the interpretation. Both fields face significant interpretative challenges due to the ambiguous nature of their subjects — be it fossilized remnants of living organisms or behaviors attributed to complex mental states. In both cases, raw data gains scientific value only after interpretive processing guided by researchers' expertise and intuitions.

Ethology can learn valuable lessons from paleontology's history of engaging with controversial ideas, particularly the debate between actualism and catastrophism in geology (and thus paleontology). Actualism, also known as uniformitarianism, posits that the Earth's past is shaped by the same physical

15 M. De Renzi, *Some philosophical questions about paleontology and their practical consequences*, "Acta Geológica Hispánica" 16 (1981) Núm. 1–2, pp. 7–8.

and chemical processes observed today, operating at consistent rates. This principle, formulated by James Hutton and refined by Charles Lyell, is often summarized as “the present is the key to the past”. It has provided a basis for reconstructing Earth’s distant history by extrapolating from current processes. Actualism has also influenced explanations for mass extinctions, such as the demise of the dinosaurs, initially steering scientists toward gradual environmental changes or biological factors and away from catastrophic events, on the grounds that “catastrophes do not happen”.

This historical tension offers an analogy to the role of anthropomorphism in ethology. Both actualism and antianthropomorphism represent dominant paradigms within their respective fields, and while they serve valid purposes, they can also stifle alternative hypotheses that challenge prevailing views. In geology, it is hard to dispute that many physical and chemical processes in the past resembled those of today. Similarly, in ethology, invoking higher mental states in animals must be approached with caution, especially when simpler explanations suffice.

At the same time, both paradigms — actualism and antianthropomorphism — have occasionally acted as barriers to innovative and controversial hypotheses that question specific elements of the dominant framework without overthrowing it entirely. Recognizing these parallels highlights the importance of balancing established methodologies with openness to bold, paradigm-expanding ideas in both disciplines.

The landscape of paleontology shifted dramatically with the work of Luis Alvarez, Nobel laureate in physics, and his team. In 1980, Alvarez proposed a groundbreaking hypothesis in his article *Extraterrestrial cause for the Cretaceous-Tertiary extinction*[16]. Based on elevated iridium levels in geological layers, he suggested that the mass extinction of dinosaurs was caused by an asteroid impact. This catastrophic event would have ejected massive amounts of pulverized rock into the atmosphere, spreading globally and lingering for years. The resulting prolonged darkness severely inhibited photosynthesis, disrupting ecosystems.

16 L.W. Alvarez, *Extraterrestrial cause for the Cretaceous-Tertiary extinction*, “Science” 208 (1980) Issue 4448, pp. 1095–1108, https://doi.org/10.1126/science.208.4448.1095.

Animals that survived the initial impact and the enormous tsunami on the far side of the globe faced another lethal challenge: a collapsed food chain. The scarcity of nutritious plants decimated herbivore populations, which in turn led to the extinction of predators. Alvarez's hypothesis, rooted in physical evidence like iridium deposits, marked a turning point for paleontology. It demonstrated how the field could adopt more mathematized and empirically driven methods akin to those used in established natural sciences. This approach minimized speculative theories and gained credibility through subsequent fossil discoveries and corroborative evidence.

In comparison, the field of ethology faces unique challenges, particularly when exploring animal mental states and behaviors. Unlike paleontology's focus on tangible data, such as fossilized remnants, ethology often grapples with the study of subjective experiences, which are inherently elusive and difficult to quantify. This creates an area of vulnerability for anthropomorphic hypotheses, as they risk being criticized for attributing human-like mental states to animals without solid empirical backing. Until a comprehensive scientific understanding of consciousness or a resolution to the mind-body problem emerges, efforts to study animal mental states are likely to remain controversial.

Anthropomorphization as a scientific method

Assuming that anthropomorphization serves as a useful analogy to compensate for difficulties in acquiring data, this article aims to demonstrate that similar practices are employed in other scientific disciplines, such as paleontology, without facing similar accusations of lacking scientific rigor.

One key criterion for the scientific validity of hypotheses is falsifiability, which requires hypotheses to be subject to experimental testing. Models that propose the appearance and behavior of extinct species face limited opportunities for direct experimental validation, unless they involve technological constructs or futuristic endeavors, like the resurrection of extinct species portrayed in films like *Jurassic Park*. In the case of anatomical hypotheses, new discoveries, such as finding better-preserved skeletons, may offer additional data.

However, this challenge does not prevent the formulation of hypotheses regarding the appearance and behavior of species that lived millions of years ago. Similarly, paleobiology and paleoethology — despite the challenges in determining the coloration of extinct animals, their body fat composition, or their behavior — are not excluded from scientific inquiry, often relying on analogies with extant species.

Ethology, however, enjoys a more privileged position, as the animals it studies are still part of the planet's living fauna. Their behavior can be observed both in natural settings and in controlled laboratory environments. With this approach, ethologists can map brain activity in relation to behavior, enabling researchers to distinguish between behaviors driven by fear and those motivated by pleasure. While this does not grant us insight into the subjective experience of animals — such as "what it is like to be a bat" — it does provide a framework for understanding certain behavior patterns, even in the absence of direct communication. This issue is not unique to humans; animals, too, demonstrate complex behaviors, though they may lack our sophisticated means of communication.

A key distinction between paleobiology and animal cognition research is that paleobiology deals with the material realm, focusing on physical evidence such as fossils, while animal cognition research delves into mental phenomena like desires, planning, and consciousness. As noted in the introduction, a consistent rejection of mentalistic questions in animal cognition research would effectively exclude fields such as economics, psychology, and sociology, which also study mental states. The challenge stems from the unresolved issue of the mind-body relationship and the absence of a clear definition of consciousness.

The problem of anthropomorphism would be easier to address if science could provide a general answer to how the human brain produces consciousness and higher mental states. Solving this would clarify which animals possess consciousness and to what extent, enabling a more objective approach to the question of anthropomorphism. Until such answers are found, anthropomorphism should not be dismissed as unscientific. Instead, it can serve as a valuable, heuristic tool, used cautiously and with testability in mind, to stimulate progress in the relatively young field of animal cognition research. When applied thoughtfully and in alignment with previous findings on animal behavior, anthropomorphization can enrich our understanding of animal cognition, complementing other methods of study rather than replacing them. It should be viewed as one potential approach to addressing the inherent lack of direct access to animal mental states, not as a panacea for understanding animal behavior. Following Frans de Waal's opinion, the use of anthropomorphization, which broadens the scope for generating hypotheses, does not exempt researchers from maintaining high scientific standards and adopting a critical approach in their enquiries.

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