

Fall 2019

Animal Conciousness

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Consciousness of Animals

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Acknowledgements

To Dr. Bracha for his expertise and support and to my dogs, Wrigley and Bella, who are, without a doubt in my mind, conscious.

Abstract

The consciousness of animals is a topic that has captivated the interest of philosophers, neuroscientists, and psychologists since the days of Aristotle. More evidence that the once impermeable separation between animal and human is not as strong of a barrier as once believed. The study of consciousness, however, is difficult because it is impossible to study the subjective experience of another man, let alone another species. Some scholars believe that consciousness is uniquely human. However, studies that demonstrate cognitive capabilities of animals have researchers demonstrating different aspects of behavior that could be indicative of a conscious experience. Some attribute consciousness to brain size, or the ability for language. Others support a hybrid of these ideas, among many others. However, no evidence currently exists to support any hypotheses of animal consciousness. This paper provides a brief history of the study of consciousness and the changing perspectives of where animals stand in the conversation. Different studies and beliefs that exist are addressed as well as the relevance of animal consciousness.

Introduction

Consciousness is a difficult, often controversial, topic of study. For one, there is no widely accepted definition of consciousness. There is also no way to measure consciousness, let alone directly observe it in another organism. It is not possible to measure the subjective experience of another being. The goal of science is to observe objective facts that explain phenomenon. In general, both neuroscientists and philosophers agree that to understand the consciousness of another being, you must know “what it is like to be” that being, which is not possible (Nagle, 1974). However, as technology becomes more advanced and more is learned through psychology, neuroscience, and ethology, scientists are gaining a better idea of the behavior and experience of other species and drawing more similarities to the human conscious experience. Addressed in this paper is a brief history of the growing curiosity in the subject of consciousness. Also, the controversy and difficulty of the definition of consciousness, and some of the criteria that were once associated with what make exclusively humans conscious are considered. Finally, recent studies of animal consciousness are discussed, as scientists attempt to measure and define it (Allen, Trestman, 2017).

The History of Studying Consciousness

The subject of consciousness has been explored since the beginning of philosophy. Records show the idea of consciousness puzzled philosophical thinkers as early as in the 6th century BC. The first real systematic approach to studying consciousness began with French philosopher René Descartes (Blackmore, 2016). Descartes established Cartesian dualism, which classifies things in the world as either physical (the body, matter) or mental (the mind, soul, and consciousness). The soul (mind, consciousness) could exist without the body and the body alone could not think. However, normally the soul inhabited the body (in epiphysis) and interacted with the world through the body. The problem with dualism is that there is no solution to how the mind interacts with the body. For the mind and body to be connected, there must be a way that physical experiences are converted into thoughts, and decisions.

Descartes even proposed a location for where in the brain this happens, however, even with a defined location, a defined mechanism, be it cellular impulses or energy transfers, become physical, instead of the mental. Blackmore noted that when one attempts to breakdown dualism into its most basic components, there comes a point where one reaches an element of “magic” or something that science cannot approach methodically (Blackmore, 2016).

Later in the eighteenth century began the early studies of psychology, defined during this time as studies of the philosophy of mental life. With this began an objective approach to a study of the mind based on the monistic perspective. William James defined psychology as the study of the mental life, its phenomena, and its conditions. This included the components of consciousness: feelings, impulses, and perceptions. James understood that all these components of consciousness were affected by physiological effects, and was included at the center of studies pertaining to memory, sensation, and the nervous system. James’s psychology centered on consciousness. James began what is now termed psychophysics, or the study of physical stimuli and internal, reportable sensation (Blackmore, 2016). Psychophysics was a key turning point in the study of consciousness because it was the beginning of a scientific approach to looking at consciousness. It was the beginning of finding a way to quantify or measure consciousness, even if indirectly (Blackmore, 2016).

The problem with psychophysics is that although it began applying scientific standard and quantification to the subject of consciousness, it completely ignored how consciousness is a subjective experience. This wasn’t addressed until the late 1800s with the emergency of phenomenology, the philosophy and psychology based on the subjective experience and introspection. Wilhelm Wundt was trained in physiology, creating experiments that studied a living system from the outside and drew conclusions based on what was happening inside. He wanted, however, to create a psychology and related experiments based on introspection and inner experiences. He believed there were two types of elements. The first were physical, objective experiences such as sounds and light, and the second were more subjective experiences such as feelings. Each conscious experience depended on a combination of the two elements. He created systematic, detailed studies and trained fellow researchers how to reliably observe their own inner experience. Wundt’s goal was to determine the units or atoms that made up the conscious experience, but when people are reporting their own experiences, and there existed so many differences between individuals, it is hard to find uniformity or definition in consciousness, and it was not possible to decide who is “right” when there was so much variation (Blackmore, 2016).

Meanwhile, in 1858, Charles Darwin published *The Origin of Species*. This brought new perspective to biology, and increased the curiosity of scientists in the world of animals. Darwin’s work was significant; it showed that the more research



Figure 1 Darwin’s first phylogenetic tree. Courtesy of The Darwin Project.

done on animals, the more that could be known about humans, rather than just humans. In 1872, Darwin published *The Expression of the Emotions in Man and Animals*. This book considered the origins of human characteristics such as blushing or lifting the eyebrows in confusion. It explored the biological aspects of emotion. For the first time, the idea of subjective experiences was inferred in animals when in the book Darwin suggested human emotion is derived from our animal precursors (Lambert).

In the 1900's came behaviorism and the studies of scientists John B. Watson, B. F. Skinner, and Ivan Pavlov. Behaviorism essentially took the study of consciousness out of psychology. Watson believed that psychology was completely objective, and stated that psychology needed introspection "...as little as do the sciences of chemistry and physics.". Pavlov and Skinner studied classical conditioning and reflexes, and believed that everything, including language, was learned this way and that all of human behavior was shaped off of reinforcements with rewards and punishment. Behaviorism brought a standstill to the conversation and study of consciousness (Blackmore, 2016).

The Hard Problem of Consciousness

The hard problem of consciousness refers to the difficulty in explaining why and how sentient beings have qualia (Harnard, 2000). Qualia are the subjective component of the study of consciousness. Qualia are the personal experience and interpretation of smells, and sight, the details of conscious experience which cannot be scientifically measured (Tye, 2018). The goal of science is to provide an explanation for natural phenomena through objective studies. How can consciousness be quantified if there is no way for one to observe and measure the qualia of another individual, let alone another species? This question was first posed in 1974 by philosopher Thomas Nagel when addressing the disconnect between subjectivity and objectivity in studying consciousness. He used it to illustrate the "hard problem" by saying through science, just about everything is known about the bat: its unique physiology of how the bat hears and sense prey through echolocation, the physics behind how it flies, how and where it lives, its evolutionary history (Dennett, 2018). All of this is known to the scientific community through objective studies. Nagel says that the *consciousness* of the bat, defined as, what it feels like to *be* the bat, to experience objects based on reflected sound rather than on photons, to hang upside down and hunt for prey, cannot be in principle known (Blackmore, 2016). Nagel concluded that even if there were some magical way to be transformed into a bat, you would still not have the true subjectivity of a bat as you would carry your human memories, experiences and interests, just in the form of a bat. In other words, there is no way for a human to experience or measure? the qualia of another human or animal (Nagel, 1974).

Today there is still no generally accepted definition of consciousness (Blackmore, 2016; Vitti, 2010). Most scientists accept that it exists in humans, and like Wundt seek to understand it objectively in terms of science. But without defining the subject of study and devising methods for its detection, determining consciousness to different species is solely based off intuition and subjectivity. Humans show strong bonds with domestic animals such as cats and dogs. These animals exhibit intelligence by solving difficult puzzles in research experiments.

They react to pain and exhibit behavior suggestive of a feeling of melancholy. Most people would say that these animals are in fact, conscious. This assumption, however, is based on human qualia that have been projected onto animals.

With no definition of *human* consciousness and without objective methods for its detection, its hard to study consciousness in animals. In humans, individuals assume that other humans experience consciousness in the same way that they ae experiencing it, and because other humans say they are conscious. So, in spite of not knowing what exactly we are talking about, we believe that all humans possess consciousness. But what about animals who seem to be different and who can't communicate to us to what they are feeling? An attempt to resolve this difficult question was made in 2012 when a group of scientists simply declared that many animals are conscious (declaration reference).

The Cambridge Declaration

The Cambridge Declaration on Consciousness came about at the Francis Crick Memorial Conference in Cambridge, UK on July 7, 2012. It was composed by Philip Low, David Edelman and Christof Koch, while edited and reviewed by eleven scientists at the conference. According to the Conference's website, the Declaration "...aims to provide a purely data-driven perspective on the neural correlates of consciousness. The most advanced quantitative techniques for measuring and monitoring consciousness will be presented, with the topics of focus ranging from exploring the properties of neurons deep in the brainstem, to assessing global cerebral function in comatose patients..." The document itself is two pages, listing four bullet points and a conclusion. The authors declared: "Convergent evidence indicates that non-human animals have the neuroanatomical, neurochemical, and neurophysiological substrates of conscious states along with the capacity to exhibit intentional behaviors. Consequently, the weight of evidence indicates that humans are not unique in possessing the neurological substrates that generate consciousness. Non-human animals, including all mammals and birds, and many other creatures, including octopuses, also possess these neurological substrates." In general, authors asserted, based on similarity of involved brain substrates, that all mammals, birds and other animals possess substrates for generation of consciousness. This implies that all of these animals possess the consciousness.

The Cambridge Declaration on Consciousness is rather unconventional. For one, although alluding to many studies, the Cambridge Declaration only recognizes that studies are being done and the information is becoming more available, with nothing specifically cited, "Consequently, more data is becoming readily available, and this calls for a periodic reevaluation of previously held preconceptions in this field. Studies of non-human animals have shown that homologous brain circuits correlated with conscious experience and perception can be selectively facilitated and disrupted to assess whether they are in fact necessary for those experiences." This is an extremely broad statement, especially so for the world of scientific writing, with no citation to support it. "Previous preconceptions" in the field are noted, suggesting there were clear cut notions regarding the consciousness of animals before this declaration. The document is vague and could be stronger with specific citations, although it is

understandable how additional details could make for an even more controversial or ambiguous statement.

Another detail of the Cambridge Declaration somewhat unsettling is the authors, although notable in their own right, did not include scientists from a number of fields. In his critique of the declaration, Bekoff (2018) noted that of the fifteen people present, only one had done research on animals in the wild. Perspective from scientists who work with wild animals- from marine life to insects- would have provided a more holistic viewpoint to the declaration. However, the impact this would have affected the declaration itself wouldn't be substantial. In saying that, the declaration was not clear regarding which animal groups exactly are endowed with consciousness. In the second bullet point, the declaration states, "sleep and decision making appear to have arisen in evolution as early as the invertebrate radiation, being evident in insects and cephalopod mollusks (e.g., octopus)" which would have a reader assuming insects are included in the consciousness discussion. However, in the summarizing declaration, it is stated: "...the weight of evidence indicates that humans are not unique in possessing the neurological substrates that generate consciousness. Non- human animals, including all mammals and birds, and many other creatures, including octopuses, also possess these neurological substrates.", which could indicate that insects are not included, and if mollusks such as the octopus are included, why not fish (Lowe et al, 2012)? This lack of specificity seems to stem from the lack of specific criteria for a minimum sets of substrates that authors thought could generate the consciousness.

Another area of ambiguity in this document is the reference to different traits that conscious animals share with no clear definition. A good example of this is in the final bullet of the document which states, "...Convergent evidence indicates that non-human animals have the neuroanatomical, neurochemical, and neurophysiological substrates of conscious states along with the capacity to exhibit intentional behaviors." Nowhere in the document are definitions or criteria for neuroanatomical, neurochemical, and neurophysiological substrates of consciousness, and in my opinion this statement is wildly open to interpretation. Although each loosely alluded to, as in the refutation of conscious being requiring a mammalian neocortex or in the final bullet point when pharmacological comparisons between humans and animals (although unclear which species are being referred to) are made, no definitions or criteria are given.

It should be pointed out that the Declaration is not a scientific document providing either original data or an objective overview of existing literature. Rather, it is a statement of a belief. It does not provide any testable hypothesis. The document, and its purpose, was blown out of proportion and was not meant to be a definition as it has been portrayed to be. The signees of the Declaration recognized a need for the definition of consciousness- scientific conclusions are hard to draw when analyzing the subjectivity of another being. They recognize that similarities exist between humans and animals, and address current research that demonstrate the similarities. In his critique of the Declaration, Torley (2013) stated that even the signees of the document disagreed on their personal views of criteria for consciousness and which animals were conscious. Presumably, some of the signees have even told him that they

have views in opposition to statements made in the Declaration (Torley, 2013). Overall, the Cambridge Declaration on Consciousness did not accomplish much, it was merely blown out of proportion.

So, Are Animals Conscious?

Cambridge Declaration aside, scientists have tried to conduct studies based on scientific method to elucidate the question of animal consciousness. Some of these studies are addressed in this section. Even if no universally accepted definition or criteria exist, criteria for consciousness have been proposed. Certain scholars argue that only “higher organisms” are conscious, referring to humans and those evolutionarily in close relationship to humans. Searle, in his book, *The Mystery of Consciousness* discussed how it is “obvious” that humans and higher animals are conscious (Searle, 1997). An area of gray that arises with this concept is that in terms of evolution, the phylogenetic tree isn’t a straight line or a continuum. It has many branches and sub-branches that would make it difficult to determine a hard “order” of consciousness. Likewise, on what basis do we draw the line between conscious and unconscious animals? In a review of current publications, Griffin and Speck (2004) agreed with Searle that animals are conscious, and that the content of their consciousness most likely varies along a continuum. This continuum ranges from simple feelings to thinking about the challenges they face and alternative actions the animal might choose. Unlike others in the field, they choose to not include metacognition (which is thinking about one’s thoughts or the thoughts of others) in their criteria of consciousness. Animals are often responsive to objects and events, including social relationships, memories, and simple short-term anticipation of events likely to happen in the near future, and they make choices of actions they believe are likely to get what they want or avoid what they dislike or fear. Some scholars refute consciousness of animals saying that these types of reactions—that is getting a positive reinforcement and avoiding a negative one—are purely reflexes and conditioning. However, Griffin and Speck go on to explain that when unexpected challenges arise, considering alternative actions and choosing the one believed to be most helpful in solving the problem at hand is often more effective than reliance on learned responses. That is, consciousness provides animals with an evolutionary advantage (Griffin, Speck, 2004). Below we will discuss studies that not only attempt to evaluate the conscious state of animals, but also distinguish learned behaviors from conscious decisions.

Brain Size

Some scholars proposed that consciousness evolved along a continuum, and that brains larger in size are more conscious as opposed to species with smaller brains. Specifically, both Greenfield (2000) and Roth and Dicke in their book, *The Long Evolution of Brains and Minds* (2005), proposed that the consciousness increases with brain size. Commenting on this

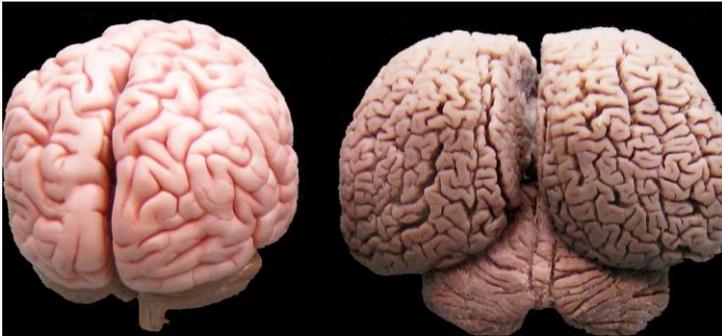


Figure 2 A human brain, left, compared to a dolphin brain, right. According to Roth and Greenfield, the larger dolphin brain would indicate dolphins are more conscious than humans. Photo Courtesy of underwater360.com

hypothesis, Blackmore suggested that if this theory is true, sperm whales, African elephants, and dolphins are all more conscious than humans are. Similarly, a Great Dane and a Labrador are more conscious than a Jack Russel dog breed (Blackmore, 2016). It seems that this theory of consciousness is too narrow and that there is more to consciousness than the size of the brain.

Cognitive Ethology

Another attempt to provide an explanation of the consciousness of animals is the study of Cognitive Ethology. Cognitive Ethologists would be in agreement with Speck and Griffin that consciousness is an evolved concept, surviving natural selection. Started by Dr. Donald R Griffin, Cognitive Ethology is the study of the mental experiences of animals as they behave in their natural environment in the course of their normal lives. It involves the “hard”, subjective, experiences of animals combined with the neuroscience, which Dr. Carolyn Ristau refers to as the “easy” problems which can (and hopefully someday will) be defined by neuronal mechanisms. Both the Dr. Griffin and Dr. Ristau agree that evidence of consciousness include possible neural correlates of consciousness, versatility in meeting novel challenges, and animal communication which Griffin postulates as a potential ‘window’ into the mental experiences. Studies in this field involve deciphering the capabilities of animals in their environment such as foraging and storage of food and parenting techniques, and seeing the extent that these techniques are learned and how they are taught among a population within a species. Ristau makes a point that this must be heeded with caution, as cognitive ethological studies can be interpreted to fit either story. For example, one could argue that the beaver utilizes higher cognitive skills in repairing broken parts of a dam. Not only does it require skills and use of tools, beavers have the capability to learn technique from one another. Also, an element of preparing for future events was involved as weaker portions of a dam were reported to be repaired in anticipation of their breaking. These are all points supported by studies that a cognitive ethologist might use to support their theory of animal consciousness. However, in a different study, the beavers' cognitive abilities in constructing and repairing their dams have been criticized. In this study, it was found that when presented with a loudspeaker that was playing white noise, a sound similar to water rushing through a hole in a dam, beavers plastered mud over the speaker (Wilson, 1971). An adversary of animals having consciousness

could say that the dam building, including the seemingly predictive nature of maintaining the dam, were merely learned reflexes in response to sound. In general, in Griffin's cognitive ethology, each species is given a probability of 0.5 of being conscious. Based on information gained from studies, the probability changes, but as demonstrated, interpretation of data from cognitive ethology studies can be a difficult task.

Consciousness and Communication

Briefly touched on previously in this section is the concept of animal communication. When assigning characteristics that contribute to why *humans* are conscious, many scholars point to our capability of linguistic communication (Haladjilan, 2016). Unlike other species, humans learn complicated linguistic rules without voluntary effort during the early years of development. As vocabulary expands with age, humans are able to determine sentence structure, word selection, and how sentences and words can be used for social and practical purposes. Psychology defines language as,

“a communication system that involves using words and systematic rules to organize those words to transmit information from one individual to another.” If the key component to this definition lies with the action of “transmitting information”, perhaps broader definitions of language are needed when discussed in terms of assigning consciousness. Many species, perhaps not linguistically in the way humans communicate, have evolved mechanisms for communication that allow transmission of information from one member of the species to another. Some examples include honey bees performing different dances to indicate to another that a water source is near (Barron and Plath, 2016), peacocks displaying their tail feathers as well as emitting sounds to potential mates at a frequency undetected by humans (Freeman and Hare, 2015), and even more impressive, killer whales have demonstrated that when socialized with bottlenose dolphins, the communication between the whales became very similar to the way dolphins communicate with one another (Musser et al, 2014). Some people argue that these mechanisms of communication are instinctive, however, in the case of the dolphin and whale, the whales have demonstrated the ability to learn from the dolphins. Although not vocal communication like humans, if the components of consciousness are going to include language, it must be considered that some forms of non-vocal language is just as effective and indicative of cognition levels similar to humans. Perhaps, in the way humans have not needed to evolve a dance to indicate a food source like the honey bee, no other species have faced a need to evolve vocal language.

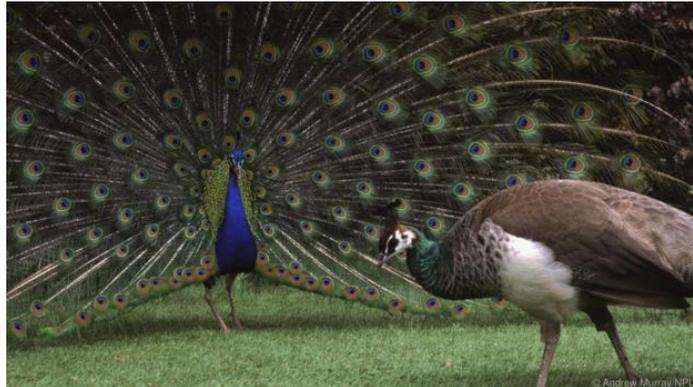


Figure 3 A peacock displays his feathers to a peahen. The feathers vibrate at a frequency undetectable to humans as a form of communication. Courtesy of Andrew Murray and BBC.

Theory of The Mind

Another quality associated with human consciousness is the theory of the mind. Theory of the mind refers to an individual's understanding of another individual's knowledge, beliefs, emotions, and intentions and using that understanding to navigate social situations (Thompson, 2017). It is considered a theory because, like many proposed components of consciousness, it has to do with unobservable, subjective experiences of others. In a 1978 study, chimpanzees were confronted with photos and videos of humans facing problems. For example, one showed a video of an actor locked in a cage. The chimpanzees were able to select the correct solution to each of these problems, representing that they understood the actor's problem and purpose (Premack, Woodruff, 1978). These studies illustrated that they were able to consider the perspective of another and anticipate future plans. There are not many other species scientists have been able to study theory of the mind with, due to its extremely subjective nature. One however is the domestic dog. In this experiment, the human in the room (the dogs met shortly before the experiment started) portrayed some sort of body language either encouraging or discouraging the dog from pursuing a food sample in the room. Examples of experimental designs would be the human distracted with a handheld game, or staring at the food source, or with their back completely turned. The experimenter did not react contingently to the dog's behavior either during the trial or after the trial was concluded to avoid dogs learning to take the food regardless of whether this was forbidden. The results of the study indicated that dogs were in fact sensitive to the state of the human in the room in regards to approaching the food source. The dogs were particularly aware of whether the experimenter's eyes were open versus closed, indicating that the dogs perceived the eyes as an important component in determining the attentional states of humans. The authors of the study are keen to comment in the discussion that they realize it could be argued that the dogs could be using other cues besides eye contact from the humans, but this was carefully controlled in the experimental design (Call et al, 2003).



Figure 4 In Call et al's study, The experimenter placed food on the ground and forbade the dog to take it (photo A) and then sat on a chair with their back turned to the dog (B), and the dog took the food (C).

Self Recognition

The final component of consciousness addressed in this paper is self-recognition, or the ability to be the object of your own attention. Until recently, self-recognition was thought to be characteristic to only humans and non-human primates (Gallup, 1977). The great apes, dolphins, elephants and magpies have recently been included as self-recognizing subjects (Morrison, 2018). In this study, used for almost fifty years now, animals are made familiar with mirror for three days. After three days, a sticker or mark is placed somewhere on the animal to where they cannot see it without using the mirror. Humans begin to demonstrate self-recognition at three years of age, chimpanzees at four, and dolphins at an impressive seven months (Preston, 2018; Morrison, 2018). For example, the primates had a sticker placed on their face. The object is to observe if the animal looks in the mirror and notices the abnormality on their self, which is an indication of awareness of self. As with other cognitive ethology studies, it can be difficult to objectively analyze the results. The chimpanzee was fairly easy to draw the self-reflection conclusion, as when looking in the mirror, after some time they stopped making threatening sounds at the mirror, as they would at another animal. They picked food out of their teeth and picked their nose, and immediately investigated red paint on their ear or eyebrow. This isn't as straight forward in other species. For example, aquarium dolphins studied their eyes and mouths, did flips and blew different kinds of bubbles. When marked with black marker, they spent more time looking at the side with the black marker (Reiss, Marino, 2001). While this may very well be conclusive to the dolphin reacting to the knowledge that the mirror is reflecting their self, it arguably could also have similar reactions to seeing another dolphin and curiosity. The creator of the test, Dr. Gallup, has critiqued experiments that conclude more than humans, chimps, and orangutans as being self-aware. He concluded that a lot of the studies granting self awareness to other species didn't produce consistent results (Anderson, Gallup, 2015). It's difficult to interpret animal behavior, and in self recognition studies, as Gallup points out, it can be easy to make the mistake of interpreting *any* behavior as results. To study self recognition in animals that are not considered visually oriented, Horowitz designed a species relevant test that required dogs identify their own scent versus the scent of another canine. Dogs were presented with canisters of their own urine, the urine of another dog, and a mixture of the two. It was concluded that dogs spend less time investigating their own urine, an indication that they are aware it is their own scent (Horowitz, 2017).

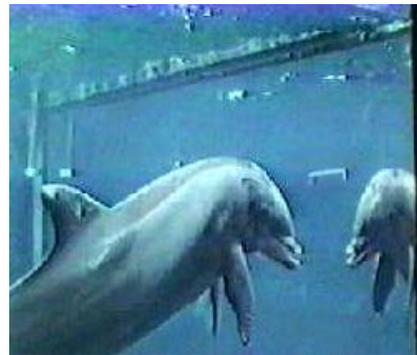


Figure 5 One of Dr. Reiss' dolphins encountering the mirror used in the study (Reiss,

In summary, even with no definition of consciousness, there are certain attributes that are often considered to be an important part of human consciousness. These include, as

aforementioned, short-term anticipation of events likely to happen in the near future, considering alternate actions when unexpected events occur, language, theory of the mind, and the ability to recognize one's self. It is being assumed that if one could show these attributes in animals, then one could deduce that they possess the consciousness. In the case of animals, research has shown that the definitions of criteria for these features are either just recently being explored or the definition is too narrow. As we are just beginning to scratch the surface on the cognitive abilities of animals, much of what makes humans conscious exists in animals, but may manifest differently, like in the case of linguistic ability.

Conclusion

Humans have always been curious in the relationship we share with our animal ancestors. Exploring the reasons animals are conscious could provide important insights into our own consciousness. Likewise, the more information learned about consciousness in animals could provide medical breakthroughs for humans who experience injuries that leave them unconscious (Boly et al, 2013). Adversaries of granting consciousness to animals may hold the opinion that we can't acknowledge animals as conscious, because this question is in principle unknowable. Also, drawing from animal analogies of human cognitive abilities could be deceiving as suggested by recent developments in artificial intelligence. For example, most would agree that self-driving cars are by design not conscious. Yet, a self-driving car is able to react based on traffic. Is this any different than a dog reacting differently based on a human's eye contact? It seems that questions like this will continue to puzzle future generations of neuroscientists.

Human beings have been curious about our own consciousness and the consciousness of our animal counterparts for as long as philosophy has been around. As cognitive psychology and cognitive ethology continue to advance, the gap separating humans and animals, as far as perceived consciousness, will close. Qualities that scholars assumed were required for consciousness, that once seemed exclusive to humans, are being demonstrated by animals. That being said however, it is pertinent to continue to be conservative in the interpretation of results of studies with animals in terms of their subjective experience, as there truly is no way to absolutely know what it is like to be another species. Alluded to in the Cambridge Declaration, some scientists pose that there are neuronal correlates that are associated to being conscious, and that is being researched in humans. If neural correlates are found, perhaps they exist in animals. However, in the absence of an unequivocal evidence, I do believe that consciousness has evolved from our animal ancestors and we can at least *infer* what their subjective experience is.

Bibliography

- Blackmore, Susan J. *Consciousness*. Oxford, 2016.
- Calarco, Matthew. "On the Separation of Human and Animal." *Stanford University Press Blog*, Stanford University, 29 Sept. 2015, stanfordpress.typepad.com/blog/2015/09/on-the-separation-of-human-and-animal.html.
- Lambert, Tim. "Charles Darwin." *A Short Biography of Charles Darwin*, www.localhistories.org/darwin.html.
- Tye, Michael, "Qualia", *The Stanford Encyclopedia of Philosophy* (Summer 2018 Edition), Edward N. Zalta (ed.), URL = [<https://plato.stanford.edu/archives/sum2018/entries/qualia/>](https://plato.stanford.edu/archives/sum2018/entries/qualia/)
- Nagel, Thomas. "What Is It Like to Be a Bat?" *The Philosophical Review*, vol. 83, no. 4, 1974, p. 435., doi:10.2307/2183914.
- Allen, Colin and Trestman, Michael, "Animal Consciousness", *The Stanford Encyclopedia of Philosophy* (Winter 2017 Edition), Edward N. Zalta (ed.), URL = [<https://plato.stanford.edu/archives/win2017/entries/consciousness-animal/>](https://plato.stanford.edu/archives/win2017/entries/consciousness-animal/).
- Dennett, Daniel C. "Facing up to the hard question of consciousness" *Philosophical transactions of the Royal Society of London. Series B, Biological sciences* vol. 373,1755 (2018): 20170342.
- Lowe, et al. "The Cambridge Declaration on Consciousness." *Animal Cognition*, Francis Crick Memorial Conference on Consciousness in Human and Non-Human Animals, 7 July 2012, www.animalcognition.org/2015/03/25/the-declaration-of-nonhuman-animal-consciousness/.
- Bekoff, Marc. "Animal Consciousness: New Report Puts All Doubts to Sleep." *Psychology Today*, Sussex Publishers, 26 Jan. 2018, www.psychologytoday.com/us/blog/animal-emotions/201801/animal-consciousness-new-report-puts-all-doubts-sleep.
- Roth, G, and U Dicke. "Evolution of the Brain and Intelligence." *Trends in Cognitive Sciences*, vol. 9, no. 5, 2005, pp. 250–257., doi:10.1016/j.tics.2005.03.005.
- Griffin, Donald R., and Gayle B. Speck. "New Evidence of Animal Consciousness." *Animal Cognition*, vol. 7, no. 1, 2004, pp. 5–18., doi:10.1007/s10071-003-0203-x.
- Freeman, A. R., & Hare, J. F. (2015). Infrasound in mating displays: A peacocks tale. *Animal Behaviour*, 102, 241-250. doi:10.1016/j.anbehav.2015.01.029

Vitti, Joseph. *The Distribution and Evolution of Animal Consciousness*. Harvard University, 26 Mar. 2010, scholar.harvard.edu/files/jvitti/files/animalconsciousness_cr_0.pdf.

Premack, David, and Guy Woodruff. "Does the Chimpanzee Have a Theory of Mind?" *Behavioral and Brain Sciences*, vol. 1, no. 04, 1978, p. 515., doi:10.1017/s0140525x00076512.

Andrew B. Barron, Jenny Aino Plath. "The evolution of honey bee dance communication: a mechanistic perspective" *Journal of Experimental Biology*, 2017 220: 4339-4346; doi: 10.1242/jeb.142778

Wilsson L. Observations and experiments on the ethology of the European beaver (*Caster fiberL.*): A study in the development of phylogenetically adapted behavior in a highly specialized mammal. *Viltrevy Swed Wildlife* 1971, 8:115–266.

Thompson, Brittany N. "Theory of Mind: Understanding Others in a Social World." *Psychology Today*, Sussex Publishers, 3 July 2017, www.psychologytoday.com/us/blog/socioemotional-success/201707/theory-mind-understanding-others-in-social-world.

Gallup, Gordon G. "Self Recognition in Primates: A Comparative Approach to the Bidirectional Properties of Consciousness." *American Psychologist*, vol. 32, no. 5, 1977, pp. 329–338., doi:10.1037/0003-066x.32.5.329.

Preston, Elizabeth, and Quanta Magazine. "A 'Self-Aware' Fish Raises Doubts About a Cognitive Test." *Quanta Magazine*, Dec. 2018, www.quantamagazine.org/a-self-aware-fish-raises-doubts-about-a-cognitive-test-20181212/.

Morrison R, Reiss D (2018) Precocious development of self-awareness in dolphins. *PLoS ONE* 13(1): e0189813. <https://doi.org/10.1371/journal.pone.0189813>

Horowitz, A. (2017). Smelling themselves: Dogs investigate their own odours longer when modified in an "olfactory mirror" test. *Behavioural Processes*, 143, 17-24. doi:10.1016/j.beproc.2017.08.001

Anderson, J.R. & Gallup, G.G. *Primates* (2015) 56: 317. <https://doi-org.proxy.lib.iastate.edu/10.1007/s10329-015-0488-9>

Call, J., Bräuer, J., Kaminski, J., & Tomasello, M. (2003). Domestic dogs (*Canis familiaris*) are sensitive to the attentional state of humans. *Journal of Comparative Psychology*, 117(3), 257-263.

Boly, Melanie et al. "Consciousness in humans and non-human animals: recent advances and future directions" *Frontiers in psychology* vol. 4 625. 31 Oct. 2013, doi:10.3389/fpsyg.2013.00625