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Speaking in Code, Mental Time Travel and Mind Reading: an exploration of the study of animal intelligence

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Abstract

Many humans believe they are separate from nature based on "unique" characteristics. For many centuries, our advanced tool use was believed to separate us from other animals. However, discoveries made by Jane Goodall in the 1960's demonstrated that humans are not unique for this capacity.[1] In light of these discoveries, the definition of human was altered to suggest that our intelligence sets us apart from other animals. This definition has been used in order to justify our exploitation of other animals by suggesting that we are unique, and therefore, superior due to this "unique" intelligence. However, humans are not alone in our capacity for complex thought. Other animals exhibit three major features of intelligence: language, episodic memory, and theory of mind. However, homocentric methodology has denied these animals the opportunity to demonstrate their intelligence by confining them to human-specific standards. Only through species-specific testing can we reveal the true intellectual capacities of other animals. Through the recognition of these commonalities, the distinction between "human" and "other animals" can be blurred, thus aiding in conservation efforts as humans recognize that we are not superior to animals and therefore are not more deserving of our Earth's resources.

[1] Goodall, Jane. *The Chimpanzees of Gombe: Patterns of Behavior*. 1986.

Portfolio Introduction

Throughout the writing of this thesis I have become more confident in the writing process and my literary voice. My background in Ecology has meant that the majority of my academic career has been spent writing academic scientific papers. These types of papers are immensely structured in both the research and the writing. Scholarly scientific papers require data collection in orderly, pre-determined ways that have little room for flexibility. Similarly, during the writing process itself, I was trained to write in a passive, impersonal, and jargon-laden voice. As a result of this background, I had to learn the new language of public scientific writing. To break free from this pattern of passivity felt immensely liberating and allowed me to explore my voice in new ways.

However as is the nature of freedom, I become overwhelmed by the vast amount of voices I could adopt. The main model for my writing was Frans De Waal, the author of my favorite book *Are We Smart Enough to Know How Smart Animals Are?* DeWaal discussed academic scientific research in a way that was simultaneously nuanced and accessible. Throughout my piece I hoped to imitate this public writing style as I found it incredibly effective and engaging. However following DeWaal too closely as a model had its challenges. Since I knew I wanted to collect data that mirrored DeWaal's, I fell into the trap of starting my narrative with an answer rather than a question.

Animal equality has long been a passion of mine. This passion, coupled with my specific vision for my piece led me to only seek out data that supports my argument. This was dangerous as it caused my initial writing to be biased. This bias is apparent throughout my shorter experimental pieces as I continually used small amounts of

evidence to make big claims about animal equality. An important shift in my research process occurred after I changed my research question. Initially, I was exploring how other animals' perceived intellectual dissimilarity to humans perpetuated their exploitation. However, after discussion with my professor Misty Beck, I shifted the focus of my question. Instead of assuming that animals were similar to us, I shifted the assumption to humans' exploitation of other animals. My new question became "given humans' exploitation of animals, how do our perceptions of their intelligence affect their exploitation?" Here, I am not assuming that intelligence has a particular positive or negative affect on their exploitation as I was in my first question but instead am exploring the relationship between these two topics.

The second pivotal moment for me was when Professor Beck taught me the power and authority of personal narrative. Once I began exploring my personal relationship to this new question, I began to see new opportunities for my personal learning and growth. In my experience with academic scientific writing, I was able to hide my insecurities behind the research of professional scientists and scholars and impressive jargon; however, in writing a scientific piece for a public audience, these crutches are stripped away. Instead of assuming my audience's knowledge, I now had to explain these specialized topics to a non-expert audience. But through this explanation, I learned a valuable lesson. Through the detailed explanation of these concepts I was teaching *myself* as well! This revelation provided me the opportunity to become more confident in my authority as an author.

One of the pieces in which I first found a new voice was through our study of new types of rhetoric. Through this piece, I wanted to engage my reader with the scientific

study while trying to keep the tone humorous and light in order to make the piece more relatable. I truly enjoyed writing the set-up to the study as it allowed me to be more playful with my words than I had ever been before. However, the progress I made towards relatability nearly fully disappeared by the time I began describing the study. The study here almost reads like a methods section of a paper, a passive tone I sought to eliminate entirely from my final piece. Additionally, the dramatic claim for conservation at the end of this piece demonstrates my narrow-minded focus for this study. I chose to include this rhetoric piece in my final portfolio as it most clearly highlights my initial challenges with translating academic scientific writing as well as my struggle with beginning my thesis with an answer rather than a question. Through helpful feedback from my peers, I learned that I needed to make an effort to convey only the essential information for my reader as well to make an effort to build my conclusion logically upon this research.

For this reason, my podcast script was a welcome challenge in brevity. Through this piece I strove to give each word a purpose. This was a challenge as at this point in the writing process, I was still feeling insecure about using my own voice; therefore, in being concise, I no longer could hide behind wishy-washy words. The podcast exercise coupled with David Hall's discussion of "Conciseness" in *Writing Well*, were immensely valuable to me during my editing process. However, the podcast demonstrates a second important aspect of my writing journey: the exclusion of myself. If I were to rewrite this piece now, I feel that I would be able to provide my audience more context for my motivation for and authority over the topic.

Finally, my three-page paper provided me the opportunity to take advantage of the skills I learned through the other pieces. While I believe that this piece is the most effective out of the three, I still struggled with my overall question. The conclusion of this piece is incredibly dramatic, especially based on the evidence provided. Here, I was working through the major ideas of my bigger paper and allowed myself to get carried away by my enthusiasm. Learning how to keep focus and not allowing my passion for this topic to get the better of me, was a challenge until the end. I feel that through this practice pieces I was able to work through, and engage with these mistakes, allowing me to create a more effective final piece.

It is through these my questions, and failures, and determination to push on that I found the heart of my topic. Intelligence is malleable. It does not take one form. My history with structured academic scholarly pieces does not dictate my fate as a writer. Just as scientists should be open to accepting new forms of intelligence across species, so too have I discovered that I must be more open to new avenues for my creativity and inquisitiveness. Writing this this thesis has given me the privilege to explore my literary voice as well as improve my question-asking abilities. I am grateful for all this thesis has taught me and I look forward to seeing where these new skills will take me in the future.

Introduction

The relationships between humans and animals in *The Jungle* by Upton Sinclair disturbed me so profoundly that I immediately became a vegetarian. The book follows the lives of recent immigrants to America during the early 20th century and their traumatic introduction to the American meat industry. Sinclair does not spare any details. Throughout the novel are vivid descriptions of masses of animals trapped nauseatingly into overcrowded and noxious corrals while waiting for their slaughter, of their screams of pain and fear as they were almost absent-mindedly killed, and of the animals' carcasses being thrown around like sacks of flour by apathetic workers to begin the meat processing. Despite these gruesome images, the nonchalance of the workers was perhaps the most disturbing. The vast majority of these immigrants had been forced to become desensitized from the atrocities they were committing in order to survive. But this detached attitude towards other animals is not a relic of the 20th century. Desensitization to the exploitation of animals remains a pillar of our society today. I felt disgusted that I had been compliant in this system of violence. So, I quickly adopted vegetarianism in order to attempt to amend my wrongs.

My shift to this lifestyle was met with minimal resistance from either my family or friends, who expressed little curiosity in my moral reasoning. Whenever I alluded to why I had become disgusted with our mal-treatment of animals, people would quickly shut it down. It seemed that in my experience, people wanted to remain naive to their role within this flawed system. This disturbed me. Just like the immigrants in Chicago, those around me were choosing to remain blind to their impact on animals' lives. I began to wonder how this had happened and humans decided we were separate from other

animals? I will not attempt to speak for all of the human species. My observations and conclusions within this paper are based solely on my experiences, academic or otherwise, in which I have observed that humans' well-being is consistently prioritized over that of other animals. However, the consistency with which I have experienced this unconcern for other animals has shocked me enough to feel that it must be addressed.

The exploitation of other animals arose from humans' perception of their separation from, and superiority over nature. The term "nature" was created during the Industrial Revolution, when the creation of technology was rapidly increasing in order to refer to all that was not human, and therefore all that could be exploited. This attitude was the result of hundreds of thousands, if not millions of years of the evolution of tool use which began to act as a buffer between people and their world. The increasing physical separation between humans and their environment through man-made tools contributed to the mental separation between humans, our environment, and other animals that later became pervasive in culture.

This repeated exploitation led to the fabrication of the hierarchy of humans over other animals in order to justify our exploitation of our environment. Human tool use was the initial justification for this domination as some believed that we were uniquely human abilities. However, Jane Goodall, the renowned primatologist shattered this illusion in the 1960's through her discovery of chimpanzees' use of long stems of grass to facilitate termite collection.[2] Louis Leakey, the famed paleoanthropologist who contributed greatly to our knowledge of human evolution, responded to this discovery: "now we must

[2] Goodall, Jane. *The Chimpanzees of Gombe: Patterns of Behavior*. 1986.

redefine tool, redefine man, or accept chimpanzees as humans."[3] This highlights the dangers of making exclusive definitions - one can frequently find exceptions. Since the 1960's we have found that not only chimpanzees have been admitted into the exclusive "tool user" club but so have monkeys, crows, and dolphins.[4] [5] [6] But this was not enough proof of humans' connection to animals. Instead of recognizing parallels, we chose to redefine what traits make us unique and therefore, superior.

Instead of being identified by our tool use, humans are now defined by our intelligence. But to define intelligence itself is another matter. At a psychology conference in 1921, fourteen experts came together attempt to collectively agree on a single definition of intelligence. They failed.[7] Over the course of the 20th century, definitions of intelligence were relatively constant due to the work of two great thinkers of the 20th century. William Wundt and William James believed that humans' cognitive processes are entirely different from those of other animals.[8] Wundt believed that apperception, the ability to use knowledge to comprehend the unknown, is a uniquely human skill while animals can only utilize "simple laws of association." [9] However, due to the lack of data on animal cognition at the time, these conclusions were not supported by sufficient data. For example, one of the leading papers at the time concluded that: "[Our study] has denied the existence in animal consciousness of any important stock of

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[3] Peterson, Dale. *Jane Goodall: The Woman Who Redefined Man*. Houghton Mifflin Harcourt, 2014. P. 212

[4] Ottoni, Eduardo B., and Patrícia Izar. "Capuchin Monkey Tool Use: Overview and Implications." *Evolutionary Anthropology: Issues, News, and Reviews* 17, no. 4 (2008): 171-78.

[5] Mann, Janet, Brooke L Sargeant, Jana J Watson-Capps, Quincy A Gibson, Michael R Heithaus, Richard C Connor, and Eric Patterson. "Why Do Dolphins Carry Sponges?". *PloS one* 3, no. 12 (2008): e3868.

[6] Hunt, Gavin R. "Manufacture and Use of Hook-Tools by New Caledonian Crows." *Nature* 379 (01/18/online 1996): 249.

[7] Thorndike, Edward L., V. A. C. Henmon, and B. R. Buckingham. *Intelligence and Its Measurement: A Symposium* [in English]. [Baltimore]1921.

[8] Greenwood, John D. "Intelligence Defined: Wundt, James, Cattell, Thorndike, Goddard, and Yerkes." In *Handbook of Intelligence*, 123-35: Springer, 2015.

[9] Wundt, Wilhelm. "" Lectures on Human and Animal Psychology". Translated by Je Creighton and Eb Titchener." (1894). P. 350

free ideas or impulses, and so has denied that animal association is homologous with the association of human psychology."[10] Animals were denied these abilities long into the twentieth century.

While animal cognition has now become a field of study in its own right, humans' desire to justify their superiority still lingers. A challenge for many scientists is their confirmation bias. By approaching an experiment expecting to find that animals exhibit lesser intelligence, they will unconsciously seek out evidence that supports this hypothesis:

> Our ability to think of alternative explanations for behaviors is limited to a greater extent by our own lack of imagination than by physical or psychological constraints on the subjects. Belief is easy to think of, but the human interest in others' beliefs may act as blinders that hide the true cognitive mechanisms behind the actions, and the actions of other animals."[11]

Consequently, by viewing the world only through a human-specific lens, our "objective" studies of animal cognition are suddenly not so objective. The persistent bias in these studies has provided ample evidence to reinforce humans' perceived superiority.

Homocentrism, or humans' self-interest, limits our perspective. Homocentrism can be thought of through the lens of the geocentric universe, which placed Earth at the center of the solar system rather than the sun. By placing Earth at the center of the universe, scientists indicated that Earth was the most valuable body in the known solar system. This limited perspective existed for almost two millennia, despite available evidence to the contrary. Similarly, placing humans at the top of the animal hierarchy, we

[10] Thorndike, Edward L. "Animal Intelligence: An Experimental Study of the Associative Processes in Animals." *The Psychological Review: Monograph Supplements* 2, no. 4 (1898): i. p. 108
[11] Andrews. *The Animal Mind: An Introduction to the Philosophy of Animal Cognition*. 2014. p. 116

are indicating that we are the most important organism and thus deserve to treat ourselves as such. However, this is an outdated model. New research has discovered species who are truly essential to their environment. These are called keystone species. Humans are not one of them.

Recognizing equality between ourselves and other animals can only be accomplished by recognizing the parallels between humans and animals. Humans share three major aspects of intelligence with other animals: language, episodic memory, and theory of mind. Through the exploration of these capacities I hope to draw your attention to two key points. First, humans are not unique. Specifically, we are not unique in such a way that justifies our exploitation of other animals. The belief that humans' unique characteristics are validation for our superiority is an outdated way of thinking. Second, acknowledging other animals' intelligence could be an effective way for humans to begin recognizing the inherent value of other organisms. Through the appreciation of other organisms, we will soon find that we share more in common with other animals than we initially believed. If we are as smart as we say we are, then changing our mindset to accept these new perspectives shouldn't be so challenging, should it?

Chapter 1: Language

I was once lucky enough to go to Paris. I had long dreamed of this trip. Of warm pastries, twinkling lights, and long evening walks down cobblestone streets with accordion music softly playing in the background. However, through all my romantic dreaming, I never had the practical concern about how I would communicate. My realization hit me while standing in the middle of a busy thoroughfare, French words swirled around me in beautiful, but unintelligible whips. At first, this was a welcome change and it allowed me to get lost in my reverie. But as time wore on, I became frustrated that I could not communicate easily with anybody and began to feel isolated. One day, after hours of aimless wandering, I become lost. After frantically searching my map, I built up the nerve to ask a passerby for directions to the metro. He earnestly tried to gesture which turns to take but the specifics got lost in translation. While I eventually found my way home, those moments of navigating unfamiliar streets in a exotic city where I could not speak to anyone I felt helpless.

Language is powerful. It defines our world. But it is an exclusive club, only those who can participate are welcome. Even simple word choice can have immense impacts on those around us. To call a wolf a “beast,” “pest,” or “critter” will paint vastly different images of violence greed, or gentleness. A critter would never eat your sheep but a beastly pest? Now that’s a different story. The stories we tell matter. But sometimes these stories are just that: fiction.

Language has effects both on our world but also on our personal lives. The ability to communicate is an evolved behavior and has played a significant role in our survival

as a species. Due to the perspective that humans as separate from nature, connecting language with survival may seem like a stretch. But think of an interview. During the course of the conversation with your potential future employer, you are attempting to convey how qualified you are for this new job. If you got the job, you would ideally improve your quality of life as you earned more money and built more connections which could further your success while a failure to do so would bring less success. This could all happen because of a single conversation which was driven by the power of language. Through communication you can either make or break alliances (friendships, professional relationships, romantic relationships, etc.) which may affect your prosperity in life and more indirectly, your survival. But this is on an individual scale. The ability to communicate also has clear impacts on the success of group living. Successful communication can warn about predators, aid in finding a mate, or inform others about the location and quality of food sources.[12] Learning when and how to communicate effectively is intrinsically linked with our upbringing. Because young mammals and birds are entirely dependent on their parents in order to survive, they are in more extended contact with their parents More time together means more time to learn. And what is learning without some form of communication?

So, we and our fellow animals evolved language. While this much is widely accepted by scientists, some believe that not all language was created equal. Two revolutionary philosophers, Descarte and Noam Chomsky declared that our language abilities are what separate us from other animals.[13] Marc Hauser, a former professor at Harvard, summarizes this perspective: "Most current commentators agree that, although

[12] Hillix, William Allen, and Duane Rumbaugh. *Animal Bodies, Human Minds: Ape, Dolphin, and Parrot Language Skills*. Springer Science & Business Media, 2013.
[13] Hillex, Allen, and Rumbaugh. *Animal Bodies, Human Minds: Ape, Dolphin, And Parrot Language Skils. 2013*

bees dance, birds sing, and chimpanzees grunt, these systems of communication differ qualitatively from human language. In particular, animal communication systems lack the rich expressive and open-ended power of human language."[14] Most notable here is the use of the word "qualitative." This is troubling. Does human language truly represent a unique form of communication?

For a trait to be definitively unique, there must be substantial evidence that demonstrates conclusively that this trait does not exist elsewhere in the animal kingdom. This is a deceptively challenging task. Recall, for example, of the Spot-the Difference game you may have played as a child. You are provided with two similar-looking pictures and are asked to find differences between them. Perhaps a window disappears from one to the other or a car may change color. Finding differences is simple enough as you can clearly identify the specific differences between pictures. Yet now imagine that you are provided with two pictures and are asked to prove the pictures are the same. How can you say for certain that they are exactly the same picture? How would you support your argument? Due to the relative ease of highlighting differences and the challenge of illuminating similarities especially with animals with whom we cannot communicate, our data may appear skewed.[15]

Data is skewed not only as a result of experimental difficulties but also inherent bias. Some argue that due to chimpanzees lacking "essential" structures in their brain, they could not possibly have the same language capacities as us.[16] The evidence against

[14] Hauser, Marc D, Noam Chomsky, and W Tecumseh Fitch. "The Faculty of Language: What Is It, Who Has It, and How Did It Evolve?". *science* 298, no. 5598 (2002): 1569-79. p. 2
[15] Hauser, Chomsky, and Fitch. "The Faculty of Language: What Is It, Who Has It, and How Did It Evolve?". 2002
[16] Candland, Douglas K. *Feral Children and Clever Animals: Reflections on Human Nature*. Oxford University Press, 1995.

this argument can be found within our own species. A person who becomes visually impaired over the course of their life will frequently acquire new sensory sensitivities they did not have before the loss of their vision. They may become more sensitive to touch or sound, allowing them to continue to navigate the world despite this potential handicap.[17] The brain is a flexible organ. If the brain can adapt to new sensory conditions in one lifetime, it is incredibly likely that over the course of generations through the millennia that other animals' brains could evolve different pathways to accomplish similar tasks. This sentiment is supported by American psychologist Duane M. Rumbaugh who states: "It is also possible that the fact on which the negative argument is based is *not* a fact, and that chimpanzees have areas homologous to all of the speech areas of the human brain, some of which are reduced in size or found in different locations."[18] By only exploring areas of the brain which are homologous to humans, we are limited ourselves to: the human perspective.

This homocentrism can be seen throughout animal linguistic studies.[19] Studies supposedly concerned with exploring animals' capacity for language frequently involve teaching an animal a form of human language which is then used as a marker for their natural abilities. For example, when studying dolphin's capacity for language, Dr. Herman chose to avoid the use of any whistles, a natural communication tool for dolphins in the wild, so as to "avoid confusion."[20] This is essentially the equivalent of someone

[17] Hugdahl, Kenneth, Maria Ek, Fiia Takio, Taija Rintee, Jyrki Tuomainen, Christian Haarala, and Heikki Hämäläinen. "Blind Individuals Show Enhanced Perceptual and Attentional Sensitivity for Identification of Speech Sounds." *Cognitive brain research* 19, no. 1 (2004): 28-32.

[18] Candland. *Feral Children and Clever Animals: Reflections on Human Nature*. 1995. p. 247

[19] Hillix, Allen, and Rumbaugh. *Animal Bodies, Human Minds: Ape, Dolphin, and Parrot Language Skills*. 2013 p. 221

[20] Herman, LM, RJ Schusterman, JA Thomas, and FG Wood. "Dolphin Cognition and Behavior: A Comparative Approach." (1986).

coming saying, “I want to see how well you speak English, so I will test you in Chinese.” How would an animal’s ability to learn human language shed light on their natural abilities? It can’t. If one actually wanted to learn about an animal’s capacity for language then they should study their *species- specific language*. If resources are lacking for this study, it then becomes important to take note of specific preferences or learning patterns that study species exhibit. But even this is not done consistently. Take, for example, David Premack, the creator of the Theory of Mind (a revolutionary topic we will explore in the next chapter). During his studies of chimpanzee cognition, he discovered that chimpanzees preferred to write in a top-to-bottom style rather than the traditional English left-to-right. [21] Had he further explored the chimpanzees’ preference for vertical words, he could have potentially provided deeper insight into their natural linguistic tendencies.

Admittedly, if scientists were to take an animal’s apparent preference into account, it could be immensely challenging to determine the authentic meaning of these animals’ vocalizations. Willard Quine, an American philosopher, demonstrates the potential dangers that may arise by making assumptions of meaning. Pretend you are in a foreign country where you have no knowledge of the language.[22] You are walking with a local when suddenly, a white rabbit runs across the path. The local next to you shouts “gavagai!” while pointing at the rabbit. What does she mean? You may assume that “gavagai” means rabbit. This is reasonable, but is it correct? She also could have meant “white” or “watch out!” or “it is moving quickly!” or “shoot it!” or any number of other potentially relevant meanings. Making an assumption of a word’s meaning can be dangerous. In studies of animal cognition, “gavagai” has come to represent “glossing” or

[21] Premack, David, and Ann James Premack. "The Mind of an Ape." (1983).
[22] Quine, Willard V. "On the Reasons for Indeterminacy of Translation." *The Journal of Philosophy* 67, no. 6 (1970): p. 178-83.

the assumption of the potential connection or meaning of a symbol, if there is one at all.[23] It is impossible to know the true meaning of the word until it is experienced in a variety of novel, unique situations.[24] Even after which point we can still never be entirely certain of their true meaning.

Yet despite these challenges, scientists have ventured to make several conclusions regarding other animals' linguistic abilities. I have selected four aspects of language which I have designated as essential for the purpose of our study: intentional and referential communication, vocal imitation and invention, theory of mind, and grammar. Arguments could certainly be made for why others should be included in this list or why some should be excluded but for now, let us proceed with these concepts in mind. These demonstrate an animal's ability to create, adapt, and use language in a meaningful way that has the potential to address both their own feelings as well as the feelings and beliefs of others. Evidence of animals' capacity for these aspects of language would demonstrate that humans are not in fact unique in our abilities.

First, let us explore intentional communication, which refers to an animal's ability to communicate information regarding a specific purpose, object, or organism. Perhaps the most well-known example of evidence of intentional communication in animals was Alex the African grey parrot. Alex was part of a thirty-three-year long study that explored the capacity of non-primate animals' had the capacity for language. Alex far surpassed any expectation, making him the mascot of animal intelligence. Over the course of his life, Alex learned over 80 words (this is a wider vocabulary than most 24 to 30-month

[23] Quine, "On the Reasons for Indeterminacy of Translation." 1970.
[24] Quine, "On the Reasons for Indeterminacy of Translation." 1970.

year old human children).[25] This incredible vocabulary included many words for identification. Throughout the study, Alex would frequently be presented with a tray of objects varying in size, shape, color, material etc. After exploring the objects with his tongue and beak, Irene Pepperberg, his trainer, would ask him questions about the objects he found. He could correctly answer specific questions regarding the material a particular object was made out of or the number of objects of a specific color. This incredible ability to accurately describe these objects suggests that he had flexible vocabulary on which he apply to changing experimental conditions.[26] Critics suggested that Alex obtained these skills simply through rote memorization; however, the objects he was presented with and tested on changed so periodically that it seems unrealistic that he would be able to recall the details of each one. Despite studies with Alex occurring in a human language, he demonstrated that an animal does not need to look like us to communicate effectively.

Non-verbal forms of language have been explored in studies of chimpanzees. Chimpanzees and other primates have a different vocal cord structure from humans, making them unable to mimic human speech.[27] In order to circumnavigate these differences, researchers have found great success with symbolic language as a satisfying alternative to standard speech patterns. In the 1980's Premack, Theory of Mind creator and chimpanzee specialist, studied whether chimpanzees could be trained to communicate using symbols to represent words.[28] Each symbol's shape and color were

[25] Farkas, George, and Kurt Beron. "The Detailed Age Trajectory of Oral Vocabulary Knowledge: Differences by Class and Race." *Social Science Research* 33, no. 3 (2004): 464-97.
[26] De Waal, Frans. *Are We Smart Enough to Know How Smart Animals Are?* : WW Norton & Company, 2016.
[27] Cheney, Dorothy L, and Robert M Seyfarth. "Constraints and Preadaptations in the Earliest Stages of Language Evolution." *The Linguistic Review* 22,
[28] Premack, David, and Guy Woodruff. "Does the Chimpanzee Have a Theory of Mind?". *Behavioral and brain sciences* 1, no. 4 (1978): 515-26.

arbitrary and therefore did not provide any clue to the meaning behind the symbol. Learning the words was a multi-step process that mimicked the verbal coaching between a parent and their child. Sarah, one of the stars of this study, would be provided with the symbol for "apple." After she successfully placed it on the magnetic board, she would be given a piece of apple as a reinforcement. Eventually, her vocabulary grew enough to allow her to create more complex sentences. For example, Sarah learned how to request multiple types of fruit by using multiple nouns within a sentence. "Mary give Sarah apple orange."[29] This particular test is fascinating as it demonstrated Sarah's flexible understanding of these symbols.[30]

Now we have seen that non-human primates and other animals alike have demonstrated their abilities to intentionally and flexibly reference objects, but what of imitation and theory of mind? The answer to our question comes in the form of a gorilla named Koko. Over the course of her study, Koko learned how to make 154 signs, some of which she made up herself.[31] While watching Koko play, Penny Patterson, an American psychologist, found ample evidence for Koko's self-awareness. Koko was fond of a small gorilla doll which she would carry around with her throughout the enclosure. One day, she took the doll to a corner of her enclosure and began to treat the doll as if it were a real baby: she named the doll, "breastfed" it, and ended her games by identifying three similar parts between the doll to herself (foot, belly button, and stomach).[32] This short interaction is loaded with important implications. First, Koko demonstrated that

[29] Premack, David. "A Functional Analysis of Language." *Journal of the experimental analysis of behavior* 14, no. 1 (1970): 112 - 113

[30] Premack. "Functional Analysis of Language." 112 - 113

[31] Patterson, Francine GP, and Ronald H Cohn. "Language Acquisition by a Lowland Gorilla: Koko's First Ten Years of Vocabulary Development." *Word* 41, no. 2 (1990): 97-143.

[32] Patterson and Cohn. "Language Acquisition by a Lowland Gorilla: Koko's First Ten Years of Vocabulary Development." 1990

sign language had been so well-integrated into her life that she chose this (unnatural) language for her play. Next, she was able to recognize herself in the gorilla doll and could easily find parallels between their bodies, demonstrating her sense of self and her ability to recognize another's individuality.[33] Koko's sense of self extended into the development of individuality. I will use "individuality" instead of "personality" in order to avoid the perpetuating the standard that for an animal to be recognized as an individual it must be human-like. Koko had a sense of humor! In an interaction with her trainer Barbara Hiller she demonstrated her playful nature:

> **Barbara Hiller**: Would you like to be able to fly like a bird?
> **Koko**: Down.
> **Barbara**: You'd rather stay on the ground?
> **Koko**: Down floor.
> **Barbara**: I think you're smart.
> (Koko laughed). [34]

Finally, her creativity extended to allow her to create her own terms: "fruit lollipop" (frozen banana), "eye hat" (mask) and many others.[35] Koko's recognition of individuality and ability to create new words demonstrates that we are not alone in these lingual abilities.

We have thus far found striking similarities between humans' and other animals' capacities for intentional communication, invention, and theory of mind; however, I would be leading you astray if I made it appear that other animals' language mirrored to humans in all ways. Scientists have yet to observe animals' use of complex grammar

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[33] Patterson and Cohn. "Language Acquisition by a Lowland Gorilla: Koko's First Ten Years of Vocabulary Development." 1990
[34] Patterson and Cohn. "Language Acquisition by a Lowland Gorilla: Koko's First Ten Years of Vocabulary Development." 1990 p. 116 - 117
[35] Patterson and Cohn. "Language Acquisition by a Lowland Gorilla: Koko's First Ten Years of Vocabulary Development." 1990 p. 143

structures.[36] So as far as we know, birds or apes cannot discuss something that happened to them in the past. Before proceeding, I present two notes of caution on this statement. First, through my educational experience, I found that I frequently perceived "complexity" to be synonymous with "superior." In both scholarly work and art, to be "complex" seems to suggest a deeper level of thought and intelligence. But this is not the case. Here, I am merely stating that our human grammar rules vary from the known grammar rules of other organisms. Next, because scientists have yet to observe it does not mean that these abilities do not exist. As we have seen, many studies of other animals' language have been specifically regarding whether other animals can adopt human language; therefore, animal's may naturally have the capacity for complex grammar structures but these abilities may not be apparent through the acquisition of human languages.

A recent study of the Japanese great Tit (*Parus minor*) demonstrates the importance of studying an animal's natural language. Toshitaka Suzuki, a Japanese animal behaviorist, discovered that these birds have a grammar and syntax structure similar to humans.[37] He found that these bird calls used "discrete infinity." This is an essential feature of language which allows an individual to construct an infinite array of expressions from finite sources.[38] Suzuki and his team found that birds would answer to the call ABC (a call for danger) and D (an instruction to approach the caller) but would never answer to D-ABC, suggesting phrase order plays an essential role in

[36] Hillix, Allen, and Rumbaugh. *Animal Bodies, Human Minds: Ape, Dolphin, and Parrot Language Skills*. 2013
[37] Suzuki, Toshitaka N, David Wheatcroft, and Michael Griesser. "Experimental Evidence for Compositional Syntax in Bird Calls." *Nature communications* 7 (2016): 10986.
[38] Hauser, Chomsky, and Fitch."The Faculty of Language: What Is It, Who Has It, and How Did It Evolve?". 2002

comprehension.[39] If these birds have this complex ability then what other animals have we been underestimating? Perhaps other animals' language systems are too complex for *us* to understand.

Scientific studies have provided promising evidence that we are not unique in our capacity for language. In light of these discoveries, our obligations are simple: to continue pursuing *objective* observation of other animals' in order to gain insight into the minds of other animals. Understanding how animals communicate can reveal an incredible amount about their worldview. These perspectives may align with ours in unexpected ways, and can facilitate the creation of connections between ourselves and other animals. This respect which will arise from the recognition of these similarities should in turn allow us to recognize the harm we have put other animals through. Other animals use communication to facilitate their survival, yet many are struggling due to the new challenges we have exposed them to as humans. For example, birds who live in proximity to airports have been forced to change their calling patterns in order to compensate for the noise of the roaring engines overhead.[40] [41] This is unacceptable. We have the ability, and consequently the obligation, to communicate with each other to create a world in which all species are valued, regardless of their abilities in arbitrary traits such as language. Talk is cheap. Equality is better.

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[39] Suzuki, Wheatcroft, and Griesser. "Experimental Evidence for Compositional Syntax in Bird Calls." 2016.

[40] Patricelli, Gail L, and Jessica L Blickley. "Avian Communication in Urban Noise: Causes and Consequences of Vocal Adjustment." *The Auk* 123, no. 3 (2006): 639-49.

[41] Damsky, Jacob, and Megan D Gall. "Anthropogenic Noise Reduces Approach of Black-Capped Chickadee (Poecile Atricapillus) and Tufted Titmouse (Baeolophus Bicolor) to Tufted Titmouse Mobbing Calls." *The Condor* 119, no. 1 (2016): 26-33.

Chapter 2: Episodic Memory

When I hear the song "Hungry Like the Wolf" by Duran Duran I am immediately transported to summers of my childhood. I remember my parents playing this song during warm evening car rides through the back roads of rural Western Massachusetts. I can see the lush trees whirling past my window as the stars glow above me. My mind is filled with the anticipation of the next day's adventures playing in the lake, catching frogs, and exploring new corners of the forest. These memories are so intrinsically linked with this song that I cannot help but be vividly transported back these summer nights every time I hear it. This incredible ability is called episodic memory. It's also known as mental time travel.[42]

Episodic memory enables us to remember these frivolous moments as well as important learning moments, which could have a greater impact on our lives. For example, when I remember how awfully sick my brother got after eating spoiled yogurt, I am likely to be more proactive when checking the expiration dates on my food. This has clear implications for my health. Because of episodic memory allows me to extract important information from my memories including practical questions such as who I was with, what I was doing, when it occurred, where I was, etc.). It's important here to acknowledge that self-awareness is essential for episodic memory.[43] We will explore the ability of theory of mind in a later chapter, but for now let me say that it is not an ability that is considered to be shared by all other animals. Due to this intrinsic link, episodic

[42] Clayton, Nicola S, Timothy J Bussey, and Anthony Dickinson. "Can Animals Recall the Past and Plan for the Future?". *Nature Reviews Neuroscience* 4, no. 8 (2003): 685.

[43] Kabadayi, Can, and Mathias Osvath. "Ravens Parallel Great Apes in Flexible Planning for Tool-Use and Bartering." *Science* 357, no. 6347 (2017): 202-04.

memory is believed to be uniquely human.[44] But as we have seen though our exploration of animal language, this is a dangerous assertion. This is especially dangerous as most studies of animals' episodic memory abilities have only arisen within the last several decades, meaning there is not enough comprehensive data to support this claim.

Three criteria have been developed for exploring "episodic memory" in other animals. First, they need to be able to remember the content of *what* happened, *where* or *when*. Next, the individual must be able to *structure* the event in the correct way by placing it within the context of how it occurred. Finally, they must have flexibility with this memory and be able to recall information from this memort and apply it to new situations.[45] Although the criteria may sound logical they have never been scientifically proven to necessarily occur all at once for each instance of episodic memory.[46] There is evidence that birds, rodents and non-human primates meet the first criteria of *where, what, when*.[47] [48] [49]While only birds and rodents have the flexibility to place their memories into context.[50] [51] Scrub jays are the only organism that has been found to meet all three specific criteria in an experimental setting.[52]

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[44] Clayton, Bussey, and Dickinson. "Can Animals Recall the Past and Plan for the Future?". 2003.
[45] Allen, Timothy A, and Norbert J Fortin. "The Evolution of Episodic Memory." *Proceedings of the National Academy of Sciences* 110, no. Supplement 2 (2013): 10379-86.
[46] Allen and Fortin. "The Evolution of Episodic Memory." 2013
[47] Clayton, Nicola S, DP Griffiths, NJ Emery, and Anthony Dickinson. "Elements of Episodic–Like Memory in Animals." *Philosophical Transactions of the Royal Society B: Biological Sciences* 356, no. 1413 (2001): 1483-91.
[48] Ergorul, Ceren, and Howard Eichenbaum. "The Hippocampus and Memory for "What,""Where," and "When"." *Learning & Memory* 11, no. 4 (2004): 397-405.
[49] Hoffman, Megan L, Michael J Beran, and David A Washburn. "Memory for "What","Where", and "When" Information in Rhesus Monkeys (Macaca Mulatta)." *Journal of Experimental Psychology: Animal Behavior Processes* 35, no. 2 (2009): 143.
[50] Clayton, Nicola S, and Anthony Dickinson. "Memory for the Content of Caches by Scrub Jays (Aphelocoma Coerulescens)." *Journal of Experimental Psychology: Animal Behavior Processes* 25, no. 1 (1999): 82.
[51] Babb, Stephanie J, and Jonathon D Crystal. "Episodic-Like Memory in the Rat." *Current biology* 16, no. 13 (2006): 1317-21.
[52] Allen and Fortin. "The Evolution of Episodic Memory." 2013

Despite the lack of experimental scientific evidence, the structure in our brain responsible for episodic memory, the hippocampus, is present across much of the animal kingdom.[53] Timothy Allen and Norbert Fortin, neurologists from California, recognized that the hippocampus evolved in the common ancestor between us, non-human primates, rodents, and birds.[54] Allen and Fortin go on to describe this ancestral relative as potentially having proto-episodic memory. I would like to pause here. As you will soon see throughout this chapter, modern scientists have found it challenging to determine definitively whether other organisms' have episodic memory. For these authors to presume to know the mental capacities of our *extinct ancestor* seems quite preposterous to me. Perhaps the trait evolved slowly, or perhaps it evolved all at once. But until we can understand this trait fully in the present day, I feel it is far too soon to make any claims.

So why do so many organisms share this structure and ability? Episodic memory indirectly aids in our survival by making us more efficient. For example, if you and your family found a rich berry patch, it would certainly be useful if you could recall information about this event. Where was this patch? Did your family steal berries from you? Using your episodic memory, you could remember that the patch was down the river a short way and that your brother ate twice as many berries as you did, so you may decide to go alone the next time. This increases your survival as you now have to spend less energy searching for food as well as less energy competing for this resource. Episodic memory also allows you to place these memories within a wider context. For example, let's say that it is late fall. Winter is coming and you remember how cold and hungry you were last year. These memories may inspire you to seek out this berry patch

[53] Kabadadayi and Osvath. "Ravens Parallel Great Apes in Flexible Planning for Tool-Use and Bartering." 2017.
[54] Kabadadayi and Osvath. "Ravens Parallel Great Apes in Flexible Planning for Tool-Use and Bartering." 2017.

on your own, but also to make sure to collect extra berries you can save for the colder months ahead. Your episodic memory allowed you to escape the present moment and anticipate your future needs despite your current feelings of satiation.

The role of episodic memory in managing food resources is so essential that it formed the basis of a groundbreaking study on episodic memory in scrub jays (*Aphelocoma californica*). Behaviorist C.R. Raby and his team studied western scrub jays' ability to plan for food scarcity.[55] A jay was contained within a small compartment with three chambers, each closed off from each other. In chamber A, the birds were denied a meal in the evening and for the first several hours of the next day. During the late morning and afternoon, the dividers between the chambers were removed to reveal to the hungry jays a pile of powdered pine nuts in compartment B, which the they would eagerly eat. That evening, they were stored in a different compartment (C) and were denied dinner again as they had been in chamber A; however, in chamber C, they were promptly provided with powdered pine nuts in the morning, reducing their hunger as compared to their experience in chamber A. Once again, in the afternoon the dividers were removed to reveal powdered pine nuts for them to consume in the afternoon. This pattern repeated for several days until the researchers determined that the birds were accustomed to the feeding schedule for each compartment. At this point, they began providing the birds with whole pine nuts in the afternoon.[56] The birds' response to this subtle change was immensely revealing about the intellectual capabilities of this species.

[55] Raby, Alexis, Dickinson, and Clayton. "Planning for the Future by Western Scrub-Jays." 2007.
[56] Raby, Alexis, Dickinson, and Clayton. "Planning for the Future by Western Scrub-Jays." 2007.

Despite their bird brains, the jays understood the significance of the whole pine nuts. They could be picked up! The birds began storing the nuts in the cage they associated with more sustained hunger (cage A).[57] They could remember the prolonged discomfort they felt and they planned ahead to mitigate the effect of their hunger. What was most remarkable about this study was that the birds were three times *less* likely to store food in the cage they associated with less hunger (cage C).[58] This demonstrates that storing nuts was not the norm but rather was a direct response to their previous experiences. This study was groundbreaking in its field as it demonstrated that these birds were entirely capable of episodic memory. An ability, I remind you, that was believed to be unique to humans.

A later study of scrub jays' episodic memory revealed they were capable of another key feature of episodic memory: flexibility. Having a flexible memory allows animals to apply information they learned from previous experiences onto new, potentially unique scenarios. This study had three characters: a jay who was caching food who had previously had their food stolen by another jay (let's call them the "wary hider"), a jay who was caching food who had never had their food stolen by another jay (let's call them the "naive hider"), and a competitor who would watch the caching. If a wary hider would re-cache their food if they were watched during the initial caching process. By contrast, a naive hider would not re-cache its food.[59] The differences between these behaviors demonstrate that wary hiders were able to use their previous experiences of having their food stolen in order to determine whether or not they would need to be

[57] Raby, Alexis, Dickinson, and Clayton. "Planning for the Future by Western Scrub-Jays." 2007.
[58] Raby, Alexis, Dickinson, and Clayton. "Planning for the Future by Western Scrub-Jays." 2007.
[59] Emery and Clayton. "Effects of Experience and Social Context on Prospective Caching Strategies by Scrub Jays." *2001.*

suspicious of the motive of their competitor.[60] The ability to apply experiences with other competitors to unfamiliar birds, highlights the jays' flexibility.

So now we have seen that other animals are able to recall details of previous events and use this information flexibly. But can other animals place these events in the context of time? This is easy for us. I can tell you something occurred on hour ago, or thirteen years ago, and you would understand me. But can other animals understand the concept of time even if they don't use a clock? Yes, they can! Pigeons can tell time. Yes pigeons, those grimy omni-present dirty birds were found to accurately understand the time of day. Canadian neuroscientists Lisa Saksida and Donald Wilke exposed their test pigeons to three levels of experimentation for their time-telling abilities and the pigeons succeeded in all.[61] They trained their birds to peck at different keys on the wall at specific times. If they pecked key 1 at 9:30 am they would receive a reward, but not if they pecked at any other key. If they pecked at only key 3 at 4:00 pm they would also receive a reward. They found that the pigeons would consistently peck the appropriate key at the appropriate time.[62] But Saksida and Wilke remained skeptical. Was the pigeons' consistency a result of learning that Keys 1 and 3 would alternate, so that if they last received food from 1 they must then seek it out at 3? In order to test this hypothesis, the researchers would occasionally fail to provide the food reward for a single time slot. Despite this pattern shift, the pigeons would continue to peck the appropriate key in order to receive the reward.[63] Satisfied, Saksida and Wilke moved onto the final stage of their

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[60] Emery and Clayton. "Effects of Experience and Social Context on Prospective Caching Strategies by Scrub Jays." 2001

[61] Saksida, Lisa M, and Donald M Wilkie. "Time-of-Day Discrimination by Pigeons, *Columba Livia*." *Animal Learning & Behavior* 22, no. 2 (1994): 143-54.

[62] Saksida and Wilkie. "Time-of-Day Discrimination by Pigeons, *Columba Livia*." 1994,

[63] Saksida and Wilkie. "Time-of-Day Discrimination by Pigeons, *Columba Livia*." 1994,

more rigorous testing. These experiments explored whether the pigeons were using light cues in order to determine when to peck each key. The researchers swapped the light patterns within the lab between 9:30 am and 4:00 pm so that before the morning feeding it would be light and before the afternoon feeding it would be dark. Despite the time change, pigeons would still peck Key 1 at 9:30 am and Key 3 at 4:00 pm, suggesting they had some means of determining the correct time of day.[64]

Critics of this experiment argue that the scientists did not provide enough time for the pigeons' circadian rhythms to adapt to this change.[65] Essentially, they believe the pigeons had jet lag and were continuing to operate on their old reward schedule. This would falsify the claim that the birds were able to place their memories within an episodic context. I have to concede to this argument, as the birds could have continued to operate on their old schedule. However, I believe that even taking these considerations into account, the birds demonstrated through the other two experiments their ability to recall the precise time of the feeding events, even when there was a disruption to the pattern. This is sufficient evidence that the birds had some concept of time and could consequently cater their actions accordingly for the future.

Thus far, we have only concerned ourselves with the ability to recall the past. But the future plays a large role in episodic memory. In 2010, a Swedish cognitive zoologist Can Kabadayi and Mathias Osvath discovered that ravens could successfully plan up to fifteen minutes in the future 78% of the time.[66] This level of future planning matches the

[64] Saksida and Wilkie. "Time-of-Day Discrimination by Pigeons, *Columba Livia*." 1994,
[65] Roberts, William A. "Are Animals Stuck in Time?". *Psychological bulletin* 128, no. 3 (2002): 473.
[66] Kabadayi and Osvath. "Ravens Parallel Great Apes in Flexible Planning for Tool-Use and Bartering." 2017.

abilities of a 4 or 5-year-old human child.[67] These comparisons raise an interesting question regarding cross-species standards. Some scientists, such as the Canadian psychologist William A. Roberts believes that due to the specialized training that these animals require in these experiments, their accomplishments are invalid.[68] Test animals are run through tens if not hundreds of trials of the experiment before they are able to move on to the next stage or before the experiment concludes. However, many of these studies occur in unnatural, human environments to which the test subjects are not adapted. Just as they are learning to navigate this novel environment, so too do young human children learn to navigate our society. Our first four or five years of life could even be considered *our* training period for our life. Therefore, I do not believe that specialized testing should be used to discount the accomplishments of these animals.

Growing up, culture helps us adapt to mature in specialized ways, many of which allow us to develop our intelligence. One of these tools is time, which is entirely culturally created and learned. It's strange to think of time as a tool, but it plays such an essential role in recalling our memories. When you fall into a pattern at work, every day can seem to blend together when nothing particularly of note happens. But having the context of whether an event occurred last week or this Tuesday is immensely helpful when trying to reconstruct a memory. However, memory is not always associated with exact time tags.[69] Instead, people will use significant events in their life as major markers from which they can approximate the occurrence of an event.[70] [71] Roberts, a Canadian

[67] Kabadayi and Osvath. "Ravens Parallel Great Apes in Flexible Planning for Tool-Use and Bartering." 2017
[68] Kabadayi and Osvath. "Ravens Parallel Great Apes in Flexible Planning for Tool-Use and Bartering." 2017
[69] Friedman, William J. "Memory for the Time of Past Events." *Psychological bulletin* 113, no. 1 (1993): 44.
[70] Suddendorf, Thomas, and Michael C Corballis. "The Evolution of Foresight: What Is Mental Time Travel, and Is It Unique to Humans?". *Behavioral and brain sciences* 30, no. 3 (2007): 299-313.
[71] Friedman, William J. "Memory for the Time of Past Events." *Psychological bulletin* 113, no. 1 (1993): 44.

psychologist, argues that because animals do not have clocks or calendars to act as the foundational major memory marker, their ability to reconstruct memory is less effective.[72] "If animals do not have the benefit of this acquired temporal framework, they may be 'stuck in time' and thus unable to experience episodic memories from memories for the succession of events and plan future activities." [73] This mindset highlights the ridiculous and unnecessarily rigorous standard scientists set for test animals. As our pigeons showed us, having a human perception of time is unessential for the success of episodic memory.

The intellectual power of other organisms has been underestimated for decades yet studies like these are shifting our perspective. We are not alone in our ability for episodic memory. However, too many studies of animal intelligence rely on arbitrary human standards. If animals needed specific time, they would have it. Animals only have the abilities they need to survive.

Episodic memory has clear implications on our survival and his made great contributions to humans' colonization of the planet. One could argue that it is this capacity which has led to the development and modification of certain tools and behaviors. It's the mindset of "this wasn't efficient, how could I improve next time?" But we are not alone in this ability. If animals have the capacity to remember past events and anticipate the future, then they have the ability to suffer. By setting unnecessary standards for episodic memory, we are invalidating this capacity for suffering, thus facilitating the

[72] Suddendorf and Corballis. "The Evolution of Foresight: What Is Mental Time Travel, and Is It Unique to Humans?". 2007.
[73] Roberts, William A. "Are Animals Stuck in Time?". *Psychological bulletin* 128, no. 3 (2002): p. 475.

continued exploitation of other animals. More studies must be done to promote studies, which demonstrate that other animals have the capacity for episodic memory. For it is only through the recognition of these abilities that people will feel motivated to reduce other animals' suffering. That's a goal worth planning for.

Chapter 3: Theory of Mind

In middle school, I tried to be everybody. I didn't know who I was or what I liked, but I knew who I wanted my friends to be. I, like many other middle schoolers before me, wanted to be in with the popular crowd. They ran our school, not in the dominating and cruel way that seemed common in other schools. Instead they were sly, smart, and suave. I desperately wanted to be a part of it. I tried changing my clothes, thinking that if I dressed like them, I would start to be like them. It didn't work. I tried copying their mannerisms, their phrases, anything that I thought would be the ticket to success. But nothing worked. Why? Because it wasn't *me*. No matter how hard I tried, I couldn't change who I was. I say, "who I was" because I have changed. From middle school to high school to college, from year to year, to sometimes month by month. I am constantly discovering parts of myself I didn't know existed and strengthening other parts that I value. This growth is an essential part of what it means to be human.

This detailed knowledge of oneself is called theory of mind. This concept was created by David Premack, who trained Sarah the chimpanzee to understand symbolic language.[74] Theory of mind refers to an individual's ability to recognize themselves in both mind and body.[75] It also speaks to an individual's ability to recognize others and their beliefs. It makes evolutionary sense to be aware of one's own thoughts and desires as allows you to move through our environment in a more intentional way. As a result of these benefits, it would seem logical that this self-awareness would be found elsewhere in the animal kingdom. Yet scientists have been slow to collect supporting data. As a result,

[74] Premack. "Does the Chimpanzee Have a Theory of Mind?" 1978.
[75] Vauclair, Jacques. *Animal Cognition: An Introduction to Modern Comparative Psychology*. Harvard University Press Cambridge, MA, 1996.

the myth that humans' individuality is unique throughout the animal kingdom has been allowed to persist.

It was not until only fifty years ago that a study was developed to explore animals' ability to recognize themselves. In 1970, Gordon Gallup Jr. developed the famous "mirror test" which has been replicated around the world and across species numerous times since its origin.[76] During the first iteration of this study, chimpanzees were given a full-length mirror in their enclosure and were allowed to become accustomed to it, and their reflection in it, for ten days. On the eleventh day, they were anesthetized and were given a small, odorless, non-irritating, red mark on their face. After they had awoken, Gallup put the mirror back in the cage and waited. He hoped that the chimpanzees would touch their face more after noticing the mark, which would indicate that they could identify themselves and recognize the change in their appearance. And that's just what happened. The chimpanzees touched their face *four times* more after they had been marked as compared to before.[77] This self-awareness was a groundbreaking discovery and paved the way for the identification of other self-aware animals including capuchins and Asian elephants.[78] [79]

While these results are immensely encouraging, some scientists have found some major critiques with the methodology. Some believe that the animals' ability to recognize themselves only demonstrates a "concept of their own body" rather than a "person

[76] Gallup and Capper. "Preference for Mirror-Image Stimulation in Finches (Passer Domesticus Domesticus) and Parakeets (Melopsittacus Undulatus)." 1970.
[77] Gallup and Capper. "Preference for Mirror-Image Stimulation in Finches (Passer Domesticus Domesticus) and Parakeets (Melopsittacus Undulatus)." 1970.
[78] Plotnik, De Waal, and Reiss. "Self-Recognition in an Asian Elephant." 2006.
[79] Riviello, Visalberghi, and Blasetti. "Individual Differences in Responses toward a Mirror by Captivea Tufted Capuchin Monkeys (Cebus Apella)." 1993.

concept." [80] Essentially this means that the animals have only made the connection that their motions and actions correspond with what they see in the mirror but they have not connected this body to their unique mind. To specifically set the standard as a "person concept" highlights our homocentrism by setting humans as the standard of self-recognition. Does self-recognition look the same across all species?

Species will respond differently to the mirror test due to species-specific behaviors or priorities. For example, monkeys such as macaques have consistently failed the mirror test. Monkeys perceive eye contact as a threat; therefore, they will actively choose to avoid looking into the mirror. Because they do not allow themselves the prolonged experimentation and interaction with the mirror that other animals do, they are unable to recognize themselves.[81] However, without this species-specific knowledge, one would assume that this failure was a result of a lack of intelligence rather than an unrelated behavioral pattern.

Similarly, even if an animal does successfully pass the mirror test, it does not definitively indicate that they are self-aware. The logic of the mirror test has been described as follows: "If you can recognize yourself in a mirror, then you can identify the object reflected in the mirror as yourself. If you can understand the object in the mirror as yourself, then you know who you are. If you know who you are, you are self-conscious. Therefore, if you can recognize yourself in a mirror, then you are self-conscious." [82] Essentially this suggests, that the act of recognizing one's own body does not have a

[80] Kummer, Hans as cited in Vauclair. *Animal Cognition: An Introduction to Modern Comparative Psychology*. 1996. p. 143
[81] Vauclair. *Animal Cognition: An Introduction to Modern Comparative Psychology*. 1996.
[82] Andrews and Huss. "Anthropomorphism, Anthropectomy, and the Null Hypothesis." 2014.

direct correlation with recognizing one's own mind. This is a valid concern that can become significantly more important if the experiment is not catered to the specific test animal. Perhaps the macaque could watch its body as it played in front of the mirror and could notice that its actions paralleled that of the reflection in the mirror. But without being able to look into its own face, it could not associate its identity with this reflection, thus demonstrating how an individual could recognize their mind but not their body. Despite these obstacles, mirror tests have provided valuable insight into the minds of other animals and have given us a strong foundation on which to build future studies of self-awareness.

But self-awareness isn't only concerned with identifying the connection between one's body and mind but also monitoring one's consciousness. Humans have the powerful ability to recognize the limitations on our knowledge: we know what we do not know. This plays itself out countless times throughout the day. Whether you pick up an article on a topic you are curious about, ask a question for clarification, choose what jobs to apply to, or choose not to eat something you cannot identify, you are constantly making decisions in your life based on the known scope of your knowledge. But can other animals do the same?

In order to explore whether macaques were also able to acknowledge the extent of their knowledge they were given a delayed matching test. After being presented with a symbol the monkeys were forced to wait varying amounts of time before being given the opportunity to identify the symbol they were initially presented. They were given three options: pressing the same symbol (after which they would be given a high-value reward), the incorrect symbol (for which they would be given no reward), and finally an

option which allowed the monkey to decide whether or not to take the test, (which would give them a less valuable reward). As the gap between the presentation of the initial image and the selection option widened, the monkeys would more consistently select the option to opt out. By selecting this option, the macaques demonstrated that they knew what they didn't know.[83] Some may argue that rather than demonstrating that the monkeys could analyze their knowledge, the monkeys had merely been trained to seek out the food rewards. However, as the correct key would produce a more favorable reward, it was in the monkeys' best interest to be correct rather than opt out.[84] But it is not only monkeys who share this capacity with us: both dolphins and rats were also found to share these abilities. These results demonstrate that humans are not the only creatures that can observe and analyze their own minds.

But how do animals *feel* about these thoughts? This concept refers to an animal's consciousness, which is the subjective interpretation of one's experiences.[85] Scientists have studied many aspects of other animals' brains without ever answering the question of what it feels like to be an animal with these thoughts and abilities. Our consciousness ties emotion to our actions and defines how we live our lives. This who we are on an individual level, leading some to argue that it defines us as humans. Some scientists have agreed to resist this dominant belief and have created The Cambridge Declaration of Consciousness in Non-Human Animals 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. Consequently, the weight of

[83] Hampton. "Rhesus Monkeys Know When They Remember." 2001.
[84] Hampton. "Rhesus Monkeys Know When They Remember." 2001.
[85] Andrews, Kristin. *The Animal Mind: An Introduction to the Philosophy of Animal Cognition*. Routledge, 2014.

> 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.[86]

Adopting this mindset has important implications on research. Scientists no longer have to prove the existence of animal consciousness - a task that could be endless and constantly be critiqued. Instead, they are now leaving themselves open to the idea that animal consciousness exists but may adopt different forms than those seen in humans. The challenges avoided with this mindset can be summarized as follows:

> When an animal isn't part of our social circle, we're not in a position to see that individual as conscious the way we are with other humans. And since for various reasons we may be unable to take some species into our social circle, on the non-inferential approach we would remain without a means for deciding whether or not such individuals are conscious." [87]

It is immensely challenging to free ourselves from these biases but it is essential if we are to learn more objectively about our fellow animals.

So how can we, with our human biases, ever presume to know what is occurring in the mind of another animal? The act of mindreading is known as theory of mind. This is the capacity which provides us with the ability to predict or manipulate others' behavior, help others, or satisfy our curiosity.[88] [89] In order to fully embody the concept of theory of mind, an individual must be able to read another's mind effectively in order to infer another's beliefs and how they perceive the world around them.[90] The uncertainty in this topic lies in the differences between seeing and believing. For example, someone can

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[86] Low, Philip. "The Cambridge Declaration of Consciousness in Non-Human Animals " Paper presented at the Francis Crick Memorial Conference on Consciousness in Human and non-Human Animals, Churchill College, University of Cambridge, July 7, 2012 2012. p. 2

[87] Andrews. *The Animal Mind: An Introduction to the Philosophy of Animal Cognition*. 2014. p. 51

[88] Lurz, Robert W. *Mindreading Animals: The Debate over What Animals Know About Other Minds*. MIT press, 2011.

[89] Andrews. *The Animal Mind: An Introduction to the Philosophy of Animal Cognition*. 2014.

[90] Andrews. *The Animal Mind: An Introduction to the Philosophy of Animal Cognition*. 2014.

see a tree when they through perception, but they can only *believe they see a tree* through belief. While perception holds more certainty than belief, it still does not take correctness into account. So, you can say you *see* a tree, but perhaps it is a mere mirage. These actions allow someone to recognize others as independent agents who make their own decisions, a belief that many humans do not attribute to animals. Due to our limited perspective, many of the tests for theory of mind have involved an animal, usually a chimpanzee, predicting a *human's* mind. If we as humans are struggling to analyze what is occurring in the minds of these test species, then how are we to presume they can understand what we are thinking as humans?

Despite this homocentric perspective, studies regarding other animals' theory of mind have challenged our claims of human uniqueness. Many of these studies followed a similar pattern of a test subject having to indicate the "knower" as opposed to the "guessers." In one highly repeated model, a chimpanzee was allowed to watch a trainer (the "knower") hide food in a container. After the food was out of sight, the three "guessers" would enter the enclosure and proceed to point to different containers they believed would hold the food. Only the "knower" would point to the container with food.[91] By the end of the experiment, all four chimpanzees could consistently indicate which trainer was the "knower."[92] This is significant as the chimpanzees were able to understand that the "knower" was the only trainer in the room during the time of the food hiding and consequently, they were the only one who could possibly know where the food was hidden.

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[91] Povinelli, Daniel J, Kurt E Nelson, and Sarah T Boysen. "Inferences About Guessing and Knowing by Chimpanzees (Pan Troglodytes)." *Journal of Comparative Psychology* 104, no. 3 (1990): 203.

[92] Povinelli *et al.* "Inferences About Guessing and Knowing by Chimpanzees (*Pan Troglodytes*)." 1990.

But maybe the chimpanzee was just pointing at the trainer they saw holding the food rather than the trainer they believed to have seen the food. Not necessarily. In order to address this concern, the experimenters ran another round of experiments in which all trainers were in the room during the baiting. The catch? The three "guessers" had to keep bags over their head as the food was being hidden.[93] Had the monkeys only been pointing at the trainer they associated with food, this would have been an immensely challenging shift. However, the chimpanzees continued to point correctly at the "knower."[94] This demonstrated with more certainty that chimpanzees were able to predict the perceptions and beliefs of other individuals.

This experiment relied heavily on a manufactured experience between the chimpanzees and their caretakers. How well would chimpanzees be able to recreate these prediction abilities with an individual of the same species? One model explored whether a submissive chimpanzee could anticipate the thoughts of a dominant chimpanzee with regards to food.[95] There were two experiments made using this model. In the first experiment, a dominant chimpanzee was allowed to hide food while being secretly watched by a subordinate chimpanzee. In this scenario, the subordinate chimpanzee was seen rushing for the hidden food. The subordinate chimpanzee predicted that the dominant chimpanzee would suspect no reason to hurry to their food as they believed it was hidden secretly, therefore providing an opportunity for the subordinate chimpanzee to rush in and claim it.[96] Here, it is important to note that in chimpanzee society, whoever

[93] Povinelli *et al.* "Inferences About Guessing and Knowing by Chimpanzees (*Pan Troglodytes*)." 1990.
[94] Povinelli *et al.* "Inferences About Guessing and Knowing by Chimpanzees (*Pan Troglodytes*)." 1990.
[95] Hare, Brian, Josep Call, Bryan Agnetta, and Michael Tomasello. "Chimpanzees Know What Conspecifics Do and Do Not See." *Animal Behaviour* 59, no. 4 (2000): 771-85.
[96] Hare *et al.* "Chimpanzees Know What Conspecifics Do and Do Not See." 2000.

touches food first has claim over it.[97] Similarly promising evidence was gathered from the second scenario. Here, a dominant chimpanzee was allowed to store food but was now fully aware that they were being observed. In this scenario, the chimpanzee who hid the food was observed to pretend to dig up their food elsewhere, as if to distract and confuse the watching chimpanzee who they understood were aware of the food's location.[98] Through both of these experiments, we are able to see exciting evidence of theory of mind carried out between individuals of the same species within a lab.

But what of wild animals? This artificial environment has the potential danger of altering behaviors in a way that could potentially dramatically affect results. For example, in 1990, Dorothy Cheney and Robert Seyfarth, two American psychologists, concluded from lab tests that macaques could not predict the knowledge of other members of their species.[99] However, research conducted with a population of wild macaques found that these monkeys could in fact understand what others saw, heard and knew.[100] Unfortunately, they could not find evidence that the monkeys could predict what others believed.[101] Here, the irony is that humans were struggling to understand the beliefs systems of other organisms. Instead of leaving the point open for further discussion, Lindsay Drayton and Laurie Santos said rather conclusively that due to the macaques' inability to predict beliefs, some aspects of theory of mind must be uniquely human.[102] This is a rather dramatic position to take on the basis of one study of a single species.

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[97] Hare *et al.* "Chimpanzees Know What Conspecifics Do and Do Not See." 2000.
[98] Hare *et al.* "Chimpanzees Know What Conspecifics Do and Do Not See." 2000.
[99] Cheney, Dorothy, and Robert Seyfarth. "Attending to Behaviour Versus Attending to Knowledge: Examining Monkeys' Attribution of Mental States." *Animal Behaviour* 40, no. 4 (1990): 742-53.
[100] Drayton, Lindsey A, and Laurie R Santos. "A Decade of Theory of Mind Research on Cayo Santiago: Insights into Rhesus Macaque Social Cognition." *American journal of primatology* 78, no. 1 (2016): 106-16.
[101] Drayton and Santos. "A Decade of Theory of Mind Research on Cayo Santiago: Insights into Rhesus Macaque Social Cognition." 2016.
[102] Drayton and Santos. "A Decade of Theory of Mind Research on Cayo Santiago: Insights into Rhesus Macaque Social Cognition." 2016.

Adopting this limited mindset affects our capacity to learn of the intelligence of other organisms as the lens through which we view evidence will be inherently skewed.

The ability to recognize another individual's knowledge is an essential first step in the learning process. "To teach one must recognize a difference between one's own knowledge and someone else's knowledge and then take explicit steps to redress this imbalance."[103] If we as humans do not believe that other animals offer any unique or valuable new intellect, then we will either not seek it out or will ignore evidence that states the contrary. A key ability of learning is understanding how to apply newly acquired information to a flexible range of situations.

Despite the odds, evidence has been found of social learning in animals. Social learning in particular provides an individual with context for their information. It is defined as "learning about stimuli, objects, or events…. [and] whether to attach a positive or negative value to them by virtue of their relationships with other objects and events."[104] Social learning demonstrates an individual's ability to think independently and flexibly even in the absence of their teacher. The vast majority of learning you have done in your life is social learning. As a child, you are impressionable in order to absorb information that will shape your world. As an adult, you make your judgements about the world more independently, but the powerful influence of your peers and community continues to linger throughout your life. In fact, you can teach an old dog new tricks. Such was the case for a community of Japanese macaques who was wholly affected by the actions of one young individual. An 18-month-old female began washing the sand off

[103] Cheney and Seyfarth. "Attending to Behaviour Versus Attending to Knowledge: Examining Monkeys' Attribution of Mental States." 1990. p. 306
[104] Vauclair. *Animal Cognition: An Introduction to Modern Comparative Psychology*. 1996. p. 127

of the potatoes prior to eating them.[105] This action, while simple, was revolutionary as it made this delicious food even more palatable. As others learned the benefits of washing sweet potatoes prior to their consumption, the habit spread throughout the population by both young and old.[106] This process relied on observing and mimicking knowledgeable individuals in order make their actions more effective, even in the absence of their teacher.

The manner in which chimpanzees teach their young to crack nuts also speaks to their capacity for social learning. Knowledgeable adults have been seen leaving ideal nut-cracking rocks near a pile of nuts in order to encourage their young to practice this important skill. Once the young begin to practice, adults will correct their motions if they are being inefficient or ineffective.[107] [108] These intentional actions demonstrate the adults' understanding of the adolescents' naivety, thus demonstrating their ability to read others' minds.

These complex perceptions of self and others have important implications on conservation. Recognizing the individuality of other animals could have the power to, dare I say it, humanize them. These organisms have emotions, relationships, and individual identities that mirror those seen in humans. These discoveries make it unconscionable to continue the exploitation of other animals and their habitat as we are directly impacting conscious, thoughtful individuals. In fact, these actions should weigh on *our* conscious. We are individuals capable of theory of mind. We cannot selectively

[105] Kawai, Masao. "On the Newly-Acquired Behaviors of the Natural Troop of Japanese Monkeys on Koshima Island." *Primates* 4, no. 1 (1963): 113-15.
[106] Kawai. "On the Newly-Acquired Behaviors of the Natural Troop of Japanese Monkeys on Koshima Island." 1963.
[107] Boesch, Christophe. "Teaching among Wild Chimpanzees." *Animal Behaviour* (1991).
[108] Boesch, Christophe. "Aspects of Transmission of Tool-Use in Wild Chimpanzees." (1993).

pick which individuals we can recognize and feel empathy for; therefore, if we are to make this a standard for "intelligence" then we must use this ability to its full extent. We must recognize other animals as the valuable individuals that they are.

Conclusion

As a child, I considered the Natural History Museum my second home. I would spend hours upon hours, wandering the halls and peering deep into each diorama, wondering what it would be like to *be* that animal. I would latch onto the tiny details as if they were clues that would reveal this hidden world. Standing in front of the dimly lit Arctic Wolf diorama, the northern lights glowing above, I could almost feel the chill of the December air, almost hear the ragged breathing of my pack as we glided silently over the snow, almost feel the wild, unrestrained freedom of the hunt. And when I tired of this adventure, I would move to the next. What would it be like to be a leopard, curled invisibly into a tree? A bear fishing for salmon in a pristine river? A loon calling mournfully at sunset? A seal swirling gracefully in the surf? These were dreams I explored endlessly, always hoping to one day know the secrets of these animals. But it was not meant to be.

Despite the incredible breadth of our knowledge, the human perspective is limited. Acclaimed British-Austrian philosopher Ludwig Wittgenstein famously stated: "If a lion could talk, we could not understand him."[109] Lions have a unique worldview that reflects their own species-specific priorities. Although we may try to hypothesize what these may be, we can only ever be a human pretending to be a lion. By fitting this information into our human perspective, we lose its essential meaning. While we can never conclude with certainty what is occurring in the minds of other animals, it is important to recognize our commonalities.

[109] Ludwig Wittgenstein as cited in John Churchill. "If a Lion Could Talk…." *Philosophical Investigations* 12, no. 4 (1989): 308-24. p. 308

However, the culture that we have created does not leave room for the recognition of other animals' prowess. Through the repeated telling of the narrative of humans versus nature, a dualism is created. This dualism separates us from our environment in such a way that we become comfortable attempting to analyze and dominate it, as if we will not be impacted by our own actions. This brazen attitude has led to the destruction of our environment and the extinction of countless species. Allowing the dualism to persist between humans and other animals is to consent to the continued abuse of other animals.

In order to end this pattern of violence, humans must recognize that we are not superior in our abilities. Humans share numerous intellectual capacities with other animals, including our capacities for language, episodic memory, and theory of mind. These abilities have provided humans with the capacity to dominate the planet with unprecedented speed. Ironically, the intellectual capacities with which we have justified our actions are the same abilities we share with other animals. Our species' intelligence does not make us superior, but rather demonstrates our interconnectedness with animals around us.

David Premack, the primatologist, questioned whether animal and human intelligence are concentric or overlapping circles.[110] If our intelligence is concentric, it is assumed that human intelligence would encompass that of animals, suggesting that all animal intellectual capacities are accessible to, and demonstrated by, humans. By contrast, the overlapping circle metaphor suggests that humans and animals may share certain abilities with each featuring their own traits. This question can quite simply answered through color. Other animals are able to see portions of the color spectrum that

[110] Hillix, Allen, and Rumbaugh. *Animal Bodies, Human Minds: Ape, Dolphin, and Parrot Language Skills*. 2013

humans cannot, including infrared and ultraviolet.[111] While the photoreceptors in the animals' eyes are responsible for detecting the color, their brains also must be capable of interpreting these signals. These animals consequently have a different worldview than us and therefore have different types of knowledge, demonstrating that the intelligence of humans and other animals could be modeled by overlapping circles rather than concentric circles.

Recognizing that other animals are capable of human-like intellect as well as unique forms of knowledge could be an effective tool for their conservation. One challenge of the conservation movement is encouraging people to feel responsibility for topics which may not immediately pertain to them or their wellbeing. People like causes that feel relatable. This trend can be seen quite clearly through the IUCN Red List. The Red List uses scholarly research to determine the threat level of tens of thousands plants and animals. Unfortunately, of the more than 91,523 species currently on the Red List 50% are vertebrates (with the other half representing the three categories of invertebrates, plants, and fungi).[112] Mammals represent 12% of recorded vertebrates. Humans have an affinity for animals that remind us of ourselves; however, this preference alone is not enough to effectively conserve all threatened species.[113] Using intelligence in order to demonstrate our similarities to other animals could be an effective tool in animal conservation by fostering a common connection between these two entities, human and other animals, which have long seemed at odds with each other. Creating an inclusive

[111] Hill, Geoffrey Edward, and Kevin J McGraw. *Bird Coloration: Mechanisms and Measurements*. Vol. 1: Harvard University Press, 2006.
[112] "IUCN Red List Summary Statistics." International Union for Conservation of Nature and Natural Resources,
[113] "IUCN Red List Summary Statistics." International Union for Conservation of Nature and Natural Resources,

community with other animals by means of our similar characteristics could allow others to see that our future and the future of other animals is intrinsically linked.

In order to level the playing field for other animals, we must first *objectively* observe their intelligence. As we have seen throughout our look into animal cognition, many tests of animal intelligence have depended heavily on human standards or a human worldview. No longer should we test animals' capacity for language by teaching them our language. Instead, we must go to them. A larger proportion of studies of animal linguistics should occur within the animal's natural environment and within their own language. How are we ever to learn of their true abilities if we are constantly tainting data with our own expectations? These are expectations that concern with how we think the study species *should* act. These are dangerous assumptions to make as we are dooming many species to failure. By not taking into account animals' species-specific behaviors, may be forcing them to play a losing game. Future studies of animal intelligence should take greater care to specifically catered to the idiosyncrasies and preferences of each study species. Additionally, scientists must go into these studies with an open mind, for animal intelligence is not a one-size-fits-all. Being flexible could open up whole new worlds of knowledge which we had never previously considered.

Eliminating bias terminology, such as "instinct" from studies of animal cognition can further increase objectivity. "Instinct" has long been used to discount animal intelligence. For example, some scientists argue that certain tool-use behaviors are Not representations of intelligence as they are merely the result of simple biological

impulses.[114] All of our actions are merely impulses from the brain; therefore, all actions of humans or animals could be described as "biological programming." However, a human would never describe their own actions in this way due to the perceived separation between humans and nature. Those who believe themselves to be superior to nature may assume they can overcome their "instincts." In fact, in one instance where my friend jumped at a loud noise, she laughed it off by saying "that's my monkey brain in action!" To submit to one's instincts is to become animal-like, which in turn is seen a degradation of oneself. Rather than believing animals to be less valuable than ourselves, we should appreciate the diversity of forms of intelligence they represent and the unique perspectives which arise from these ways of thinking.

However, relying on intelligence to create these connections is only crutch. Intelligence represents a single evolutionary strategy and therefore cannot be held as the standard for all animals. Therefore, we cannot rely on intelligence as the *only* indicator of an animal's worthiness. Instead, humans should learn to acknowledge animals' inherent worth. This is a significantly more challenging request as it requires humans to become humbler. We do not live in the homocentric world which we have aspired to create. Instead, we are members of a complex and fragile web of ecosystems. Just as every species fills a role within an ecosystem, so too must humans find a niche. Fortunately, we have the power to choose which role we want to play in the environment: pest or umbrella species. We have heard of a keystone species, but what is an umbrella species? These are charismatic organisms which, when conserved, can in turn save numerous other species. Here, we are allowed to indulge ourselves. Through our intellectual

[114] Jacobs, Ivo, and Megan Lambert. "What Makes an Animal Clever? Research Shows Intelligence Is Not Just About Using Tools." *The Conversation* (2017).

knowledge of the complexity of ecosystems and specific species, we can chose to become an umbrella species by protecting other animals from the harm of our pest-like past. While important work in conservation is being done, much of our society is continuing on the path of humans as a parasitic pest. While humans certainly have had a disproportionate effect on our planet, if humans were to disappear, the ecosystems we inhabit would not just continue, they would thrive.[115] We are nonessential and therefore should not continue to prioritize ourselves over animals. The planet cannot afford to support our homocentrism anymore.

But we have a long way to go before we can acknowledge animals' inherent worth. For now, I will continue to dream myself into the minds of other animals in order to see the world through their perspective. Opening ourselves up to these perspectives will open up entirely new worlds our human minds could never dream of, for we should never stop learning. It's the smart thing to do.

[115] O'neill, Robert V, and James R Kahn. "Homo Economus as a Keystone Species." *BioScience* 50, no. 4 (2000): 333-37.

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Appendix A: Exploring Humorous Rhetoric

Growing up in New York City, one acquires a particular distaste for pigeons due to their unique ability to constantly be in the wrong place at the wrong time. If you are running late for an appointment and already must dodge tourists, taxis, and strollers, the pigeons will always be the last straw. They will meander slowly in front of you, pecking at the cement and fixing one beady eye on you challengingly, as if to say "this is my ground, lady, and I am not budging." No matter which way you swerve, there a pigeon will be. If you have the misfortune of encountering a flock on a narrow sidewalk, do not slow or show fear. They can smell it. Keeping a confident pace and a slightly ducked head will make the flock part like the Red Sea and keep your head mostly free from pigeon fallout.

I cannot help but admire the pigeon's audacity in traffic. In true New York fashion, they will J-walk, weaving between cars until they settle in the *perfect* location right in the middle of the road. The ideal time for this activity always seems to be during a green light, when there's a moving vehicle, an angry taxi driver, and a SUV all gunning for the first position at the next red light. They eagerly take the front-row seat in the action and wait. And wait. And wait. Until both the driver and any onlookers have already deemed the pigeon dead, when suddenly it will lazily fly out of danger and flutter softly to a new spot only two feet away.

During moments like these, it seems unfathomable that such a clueless creature could have figured out how to distribute its species so thoroughly around the planet. Pigeons' survival instincts are perhaps more complex than they appear on the surface. During a 2017 study, Sasaki and Brio discovered that pigeons are capable of Cumulative Cultural Evolution (or CCE). CCE is a pattern that has previously only been attributed to humans due to the complex problem-solving skills required to learn and acquire new efficient behaviors over time. During this study, homing pigeons (*Columbia livia*) were allowed to fly individually, in flocks, or were strategically paired

with an older more experienced pigeon during their flights. Each pigeon has their own idiosyncratic way of flying from point the study location to their home. When flying in a flock, the average of these routes is used. However, when an older pigeon is paired with a younger one, the younger pigeon begins to adopt the route of the older one. Over the course of several generations, the paired pigeons learned and passed on the fastest routes home from the study location. This study had three major findings. First, Pigeons are able to contribute information to their overall flock's knowledge. Next, pigeons can create solutions to problems through their collective intelligence. FInally, homing pigeons are able to weigh the pros and cons of different approaches to a problem in order to determine the most efficient solution. The presence of CCE in pigeons suggests that these animals' may have the capacity for more complex intelligence than were previously believed.

Animal intelligence can take on different forms than humans but that does not reduce its value. While pigeons may have the ability to improve their collective intelligence over the course of generations, they still stand in front of oncoming traffic and get hit. Does the frequency of the latter outweigh the significance of the former? Intelligence is frequently used to determine worth; however, as can be seen in homing pigeons, a species may exhibit several types of "complex" intelligence while still retaining more "basic" patterns of thinking. Therefore, intelligence should not be used to determine a species' worth due to the diversity of forms it may take.

Of course, pigeons are not in need of any conservation, but if this animal, which is commonly considered a pest, is capable of complex social structures then who knows what else lies below the surface. Humans are not the most worthy or complex species on this planet and therefore we do not have a right to degrade our environment. Perhaps we can take a lesson from pigeons and realize we can learn from the mistakes of our ancestors. We must conserve our environment and all the species within it while we still can.

Appendix B: Podcast

Labelling someone as a bird brain suggests that they are dim-witted, incompetent, and absent-minded… all things a PROPER human should NOT be. The idea that a human would have anything in common with such a puny creature is almost unfathomable…. Or is it?

Humans always like to tell the myth that our intelligence is unprecedented and there has never been any other animal to have a brain like ours. It certainly cannot be denied that humans' minds are exceptionally powerful, but we may not be quite as unique as we like to believe.

Take for example, a raven. In a 2010 study, Swedish cognitive zoologist Mathias Osvath tested ravens for their ability to plan for the future by examining whether they could learn how to use a tool to acquire a reward even after a delay. He provided the test birds with a small stone which could be used to extract some dog food from a box. He allowed them to repeat this trial several times until he felt they were comfortable with how it worked. Then would provide the raven with a selection of objects, including the same stone tool, without the box. 15 minutes after the raven had selected their tool, they would be presented with the box of food where they could attempt to dislodge the food reward… 78% of the time the raven would select the correct tool because of their previous experience with the food box, even with a delay.

This behavior is called episodic memory, meaning these animals have the ability to learn from past experiences in order to prepare for future ones… an ability previously

believed to only be had by humans…. Maybe being called a bird brain isn't so bad after all.

Appendix C: Three-page draft

A bird's brain is notoriously underappreciated. There is a common misconception that its size is determinant of its abilities; however, this is not the case. However, recent studies have revealed that many bird species have similar capacities for future planning as humans.

In order to test the theory that ape-like creatures are not the only ones capable of thinking outside the present moment, an American neurologist Cristina Atance and Canadian psychologist Daniela O'Niell studied western scrub jays ability to plan for food scarcity. A Western scrub jay (*Aphelocoma californica*) was contained within a small compartment (A) with three chambers, each closed off from each other and was denied a meal in the evening and for the first several hours of the new day. During the late morning and afternoon, the dividers between the chambers were removed to reveal powdered pine nuts in the middle compartment, which the jays eagerly ate. That evening, they were stored in a different compartment (C) and were denied dinner once again but were promptly provided with powdered pine nuts in the morning. Once again, the dividers revealed powdered pine nuts for them to consume in the afternoon. This pattern repeated for several days until the researchers determined that the birds had been accustomed to the feeding schedule for each compartment. At this point they began providing the birds with whole pine nuts in the afternoon. This change may seem subtle, but it is immensely revealing about the intellectual capabilities of this species.

This study was based on a type of intellect called "episodic memory." Episodic memory refers to an organism's ability to recall memories and potentially use this

information to proceed in the future. For example, you may have an episodic memory of an exam you were underprepared for. Remembering this time may leave you feeling nervous and upset, despite the amount of time that separates you from this event. You may recall these feelings when you are gearing up for another test or other project and feel motivated to avoid this experience by being better prepared. This is a capacity we as humans may take for granted as it is so essential to the day-to-day function of our lives it can seem impossible to even imagine how one could function without it. Raby and his team wanted to explore whether this capacity could be seen in scrub jays, which must recall information such as their food storage locations.

The jays, equipped with their bird brains understood the significance of the whole pine nuts and began storing them in the cage they associated with hunger (A). They were able to recall their experience of discomfort each morning in cage A and realize they could cache the pine nuts from cage B in cage A so they could be prepared for the morning. What was perhaps most remarkable about this study was that birds who knew they would spend the night in compartment C (where they were provided breakfast in the morning) were less likely to store the pine nuts because they did not associate that location with hunger in the same way as they did with cage A. This reveals that the caching of the pine nuts was not the norm but instead was a direct adaptation to the study conditions in cage A. Raby's research team concluded that scrub jays are capable of episodic memory… an intellectual ability which has previously only been attributed to humans.

Ravens, too, are forcing us to rethink what intellectual abilities are "unique" to humans. In 2010, a Swedish cognitive zoologist Mathias Osvath tested ravens for their

own episodic thinking capabilities. He provided each bird with a small stone and a box. When the stone was inserted into the box, it would reward the bird with dog kibble. Once familiarized with this process after several trials, Osvath would introduce them to a new challenge. Instead of giving the ravens the correct tool upfront, he provided them with an array of tools, only one of which would be successful in dislodging the food. After the ravens selection of the tool, Osvath would wait 15 minutes before presenting the box containing their (potential) food reward. A remarkable 78% of the time, the ravens would select the correct tool.

This study has two significant implications. First, these birds have the capacity to recall on their previous experiences with the food box and were able to successfully determine which tool they would need for their future task. The act of dislodging food from a box with a stone is, unsurprisingly, not a challenge they encounter in the wild. So how were ravens able to know what to do with the objects provided for them? These birds have mental flexibility which allow them to project their knowledge from one situation (tool use in the wild to acquire food), onto this unique situation in an effective way. Osvath's study also demonstrates that ravens are capable of planning for the future. Corvids are the only known non-human family of organisms that is capable of future planning. When provided with selection of tools, the ravens had to recall past trials with the pebble and box, select the correct pebble from the tools in front of them, and hold onto the tool for 15 minutes, before finally having the opportunity to use the tool and collect the reward. This behavior demonstrates a remarkable capacity in thought and planning.

Future planning has clear contributions to humans' ability to colonize the planet. By having the power to learn from previous experiences and alter behavior for the future, changes can be made rapidly in a person's lifetime. One could argue that it is this capacity which has lead to the development and modification of certain tools. It's the mindset of "this wasn't efficient, how could I change it to be more effective next time?" But now we have learned we are not alone. The power of a bird's brain has been underestimated for decades yet studies like these are shifting our perspective. One could question that if humans have used this capacity to develop complex technology, then why haven't birds? The sarcastic answer would be that a bird has no use for an iPhone. Of course this is wildly extreme but it conveys an important message, which is that birds have not developed human technology because they have no need to. They have, and are, evolving the technology which are most useful for them based on their own individual and communal needs and experiences. They are able to learn how to use stones to receive a reward or how to store food to prevent hunger because these are experiences which they encounter in their lives. Their bird brains are functioning just as they should and perhaps even more similarly to ours than we currently know.