Spring 2015

Human-animal communication in captive species: Dogs, horses, and whales

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Human-Animal Communication in Captive Species: Dogs, Horses, and Whales

An Honors Program Project Presented to

the Faculty of the Undergraduate

College of Arts and Letters

James Madison University

by Mackenzie K. Kelley

May 2015

Accepted by the faculty of the Department of Writing, Rhetoric, and Technical Communication, James Madison University, in partial fulfillment of the requirements for the Honors Program.

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This work is accepted for presentation, in part or in full, at the JMU Honors Symposium on April 24, 2015 .

I would like to dedicate this honors research thesis to my parents, John and Karen. You are my inspiration and my rocks. I am proud to be your daughter. This project is as much a reflection of your success as parents as it is mine as a student. I love you. And thank you for giving me Callie, and initiating my love for animals.

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Acknowledgements

I would like to thank the team of professors and advisors who have worked with me during the various stages of this project. This research would not have been possible without their advice, support, and wisdom. Huge thanks and acknowledgement are due to Dr. Shelley Aley, who inspired me with her passion of horses. I would also like to thank Dr. Alex Parrish, who first introduced me to the wonders of animal communication, and Dr. Susan Ghiaciuc, who has always supported and encouraged her students' dreams of being published.

In addition, all members and faculty of the WRTC department have my utmost gratitude and respect. They have shaped not only this project, but also my entire knowledge on writing and rhetoric, my process for critically analyzing any work, and my ability to connect meaning and draw implications across disciplines. Truly and sincerely, I thank you.

Thanks are also due to the students and faculty of *Lexia*, who have supported and recognized my research on animal communication. I would also like to acknowledge the JMU Honors Program, without whom this opportunity to realize what my passions are and to develop my understanding of them over months of involvement would never have been possible.

Finally, I would like to thank my parents, who have inspired me in more ways than they will ever know.

Introduction

I began this project with the interest of studying animal communication. However, I quickly realized how broad a topic animal communication is. Did I want to study animal-to-animal communication or human-animal interaction as well? What species did I want to look at? What kinds of communication? What was the purpose of even studying animal communication anyway? Why does it matter to us? Why was I interested in it? After asking myself some of these difficult questions, I realized that I was interested in the animals that I personally interacted with on a regular basis: dogs, cats, other common household pets, etc. I wanted to study exactly what it is about these animals that make them so human-friendly as opposed to other wild animals. Why can we communicate and live side by side with them and not others? The answer is complex. These species have not always been so compatible with humans. Rather, they became domesticated over thousands of years due to purposeful human intervention in the evolution of their species. Humans decided on the genes that these species would pass on to offspring. Of course, humans chose the traits that would make these animals most useful to humans themselves as well. Thus, artificial selection guided the evolution of these formerly wild beasts into household pets.

I now had a bit more focused topic: human-animal communication among domesticated species. More specifically, this research will cover the species of dogs and horses, both of which have been domesticated over hundreds and thousands of years by humans and who still live under human dominance. However, these species also both have wild counterparts, which allows for a comparison of the communication and interaction in their environments between the wild and the domesticated. Thirdly, I will focus on cetaceans (whales and dolphins). I chose to study them in addition to dogs and horses even though they have not been domesticated. Whales, like

the orca whale and certain dolphin species, have only recently been held in captivity by humans, whether for scientific or entertainment purposes. In a way, whales are in the early stages of domestication by humans. I am not saying that in a few hundred years, whales will be typical household pets. But rather, we can see the effects that humans have had on the evolution of dogs and horses as far as training, control, communication, and breeding goes. Humans are now starting to exert this same control over cetacean species. We are training whales to fetch things, obey commands, and do our bidding for rewards. In this way, by looking at the results of human intervention in dog and horse species, we can predict certain implications for whales and dolphins that may result over generations of prolonged captivity.

My hopes for this project are to collect and analyze the current research in the field of animal communication (as it pertains to my specific subject). I will be completing a sort of meta-study on the research already done by experts and professionals in the field and which will be divided into two parts. In the first part, my goal is to define animal communication, specifically within human contexts. I will look at how the history of humans and certain species have intertwined to result in their modern day relationships. I will also explain why we should care about animal communication in the first place. Our history with animals is a long and complex one. We have depended on them for survival and some of them have depended on us and still do. Humans can benefit from understanding animal communication. We can also learn more about ourselves by studying our animal neighbors. I hope to persuade the reader of this importance.

In the second part, I will look at the three specific species I have chosen to study: dogs, horses, and cetaceans. I will provide a brief history of our roles as humans in the evolution of their contemporary domestic counterparts, as well as make a few comparisons to their wild counterparts. Mainly, I want to compare the wild and the domesticated in order to illustrate the

immense effect human communication has had on their development. Finally, I hope to make some of my own conclusions on what the future could hold for whale and dolphin species, as well as any other species held in human captivity.

Part One: Defining Animal Communication within Human Contexts

Defining Communication

The definition of communication varies according to whom you ask or which scholars you read. A very basic definition of communication could be the transfer of meaning from one point to another. This definition encompasses communication among humans, animals, even through technology or the mass media. One bit of information is spread to a second point of reception, where it is then processed and understood. However, it is broad and does not say anything about rhetoric or the reasons behind communication. Perhaps another definition would include the transfer of meaning in order to persuade, inform, entertain, or move another being to action. We could define it according to the psychological comprehension of the receiver, or the intellectual and emotional connections that result from communicating.

An interesting interpretation of communication arises based off the *theory of mind* as explained by Lori Gruen in her textbook, *Ethics and Animals*. In her text, Gruen explains that a theory of mind is necessary (according to some theorists) in order to communicate. To clarify, theory of mind is not a definition of communication itself, but rather a requirement or standard for intelligent beings in order to be considered as a being capable of communication. Gruen's theory of mind reads: "Someone who has a theory of mind…has to understand, at a minimum, that they are individuals who are distinct from the other; that the other has experiences, perceptions, and thoughts; and that those thoughts may be different from one's own" (Gruen 13). In other words, a creature has to have not only an understanding that it has thoughts and emotions, but also an understanding that other creatures have different thoughts and emotions from its own. It was this theory that tended to support the idea that only humans could truly

communicate, as no animals were known to have the cognitive resources to perceive that other minds exist different from one's own. Gruen describes several animal experiments done to disprove that only humans have theory of mind, including tests done with chimpanzees to illustrate that chimps could, indeed, perceive that human's had distinct thoughts and motivations different from their own. Yet the results were not as definitive as hoped. As a result, many researchers point to the theory of mind as proof that human communication is superior to animal communication.

In my own research, I would argue that theory of mind is *not* an adequate argument for suggesting that human communication is superior to animal communication, nor would I argue that it is a *requisite* for communication. The philosophy behind the theory of mind stems from the belief that human intellect is superior to animal intellect. During the second half of the 1900s, breakthroughs in animal communication research and evidence of evolution brought the question of animal vs. human intellect to a forefront. There was a need to establish a separation between humans and animals that had for so long made humans comfortable with using animals for their own purposes. Thus, theory of mind was given credit as a way of establishing this separation. However, theory of mind should be left out of defining animal communication. Today, most animal communication experts tend to stay away from it anyway, because the goal of modern research is not so much to prove human superiority as to simply learn from animals. Theory of mind uses the wrong premises to define communication. It may or may not argue whether one species intellect is greater than that of another species, but regardless of intellectual prowess, those two species can still communicate. This is where theory of mind fails. Simply because two differing levels of intellect are communicating does not mean they cannot succeed based off their differing levels. For example, a five year old may not be as intellectually developed as a forty

year old, yet the two can successfully communicate. Theory of mind also fails in insisting that communication can only occur among beings who can recognize the emotions and thoughts of others and can recognize them as different from their own. For example, the simplest minded dog may not be self-aware or aware of the thoughts and motives of a human's actions, but it is generally agreed that the two are still communicating when a human gives the dog a command, or when the dog brings the human its leash as if wanting a walk.

So now we have ruled out theory of mind from the definition of communication. A creature need not be aware of its neighbor's different experiences to communicate. Different species of different intelligences can interact and succeed in communicating. Note that I am separating communication from intelligence, which theory of mind does not. After all, technology can communicate, but it lacks a self-aware intelligence.

Thus, communication can be tricky to define. For this paper's purposes, I will use my earlier definition of communication as the transfer of some meaning from one point to another. However, I will expand it further by requiring some result to happen from the transfer of meaning, whether it is to inform or persuade, to entertain or even just to make another acknowledge a feeling or action. In other words, communication is the transfer of meaning with a purpose. That purpose can be intentional or unintentional, conscious or subconscious, but it still occurs. Intelligence, however that is defined, is not necessarily required, as in the case of technology or mass media. However, as we will see in the case of animals and humans, a form of intelligence is usually there anyways.

A History of Animals and People

Species of animals have inhabited the earth before humans, or even mammals, evolved. However, humans have lived side by side with animals since their beginnings. Though we do not know exactly the scope of human intelligence or communication at the beginning of their evolutionary history, we can safely project that it was probably not as complex as modern day human intelligence. Thus, homo sapiens probably stuck with their own species like most other animals. They of course used other animals and came into contact with them. Humans hunted them for sustenance and used the remains for tools and clothing. But at some point, this pattern changed, and humans stopped merely using animals, but began socializing with them.

An article featured on the blog LiveScience, describes the long history of humans and animals that has instilled a deep, evolutionary human connection to animals. According to the article, "humans may have begun honing the animal connection after they made the leap from prey…to competitive hunter" (Hsu). Once humans made this change, they learned and adopted methods for hunting, which needed to be passed on to subsequent generations: "The need to communicate that knowledge about the behavior of prey animals and other predators drove the development of symbols and language around 200,000 years ago" (Hsu). Thus, one theory of the origin of human language stems from the need to preserve hunting tactics, as well as safety measures from human predators. This knowledge was preserved in ancient cave paintings, the oldest of which often feature many animals and humans together.

However, the article also points out the lack of some crucial survival knowledge in cave drawings. For example, Penn State University paleoanthropologist Pat Shipman tells LiveScience that all the "survival" information is of humans and animals together, but not of

resources without animals: "…crucial survival information about making fires and shelters or finding edible plants and water sources was lacking" (Hsu). Perhaps the conclusion from this observation is that the paintings are not really preserving survival methods after all, but are communicating something else about animals. Perhaps at this point, animals and humans had already made a spiritual connection, which would mean that their social interaction would have started earlier than the known cave paintings.

So which happened first? Did humans start using animals and then develop social connections? Or did humans have social and emotional ties to animals before they started being domesticated and made into human tools? Shipman believes that animals were not domesticated as food sources or means of labor: "It takes a very long time to domesticate animals…to actually do it for the motivation of getting food, you'd have to be planning at a ridiculous time depth. Besides, killing a deer in the woods gets the same amount of meat as killing a deer in a fenced area…something else must have driven humans to corral or keep animals in the first place" (Hsu). That 'something else' is not easy to define, since domesticated animals have been a part of human history for thousands of years. It is almost impossible to pinpoint the moment in evolutionary history when homo sapiens realized that socializing with animals would be beneficial for them. All we know for sure is the date 40,000 years ago, roughly when humans transformed nature by domesticating animals.

The process of domesticating a specie of animal involves selective breeding. Humans must have noticed certain animals of a specie had better or more beneficial behaviors or traits than others. Then, humans isolated those animals with the "good" traits so that they could only breed with one another. The offspring was then almost guaranteed to have that trait. Then the next generation would be isolated for certain traits again, and so on, for many generations.

Eventually, a new specie can evolve out of the original, such as dogs evolving from wolves. Thus, domesticating animals requires human intervention in the evolution of a species through selective breeding, otherwise known as artificial selection.

The benefits of domesticating animals are myriad. One of the oldest domesticated species, dogs, served as both a hunting aid and protective guard. Today, they are service animals; they can search and rescue, drug sniff, detect arson, shepherd, provide entertainment, or provide physical or psychological care. Cats, too, were fierce hunters of rodents, protecting stored food as humans grew into agricultural societies. Cows, goats, sheep, and camels eventually became regular livestock to provide renewable resources like milk, wool, and meat. Species of camels, donkeys, and horses could travel long distances with heavy loads, making useful transportation for humans. Animals have also debuted on war fronts. Horses were not only transportation tools, but battle weapons. The use of calvary became a winning battle strategy. In addition, battles could be fought over longer distances with horses. With animal travel came ancient "mail" methods of sending messages and news long distances, furthering the spread of information and culture. Clearly, animals played a major role in shaping human history and revolutionizing human ways of life. They are ubiquitous in every human society.

Their history as human resources, nevertheless, still does not elaborate on the social connection humans formed with animals. What made humans reach out to animal species and intentionally care and nurture them in the first place has yet to be answered. Regardless, animals have made their way into human life, and it is only natural to study them to understand our relationships with them and why they are so important to us.

The Significance of Animal Communication

The importance of animals in human culture has been established. We can understand and appreciate their roles in human societies. But why should we care about animal communication? Why does understanding animal communication styles matter to us? After all, humans have clearly already dominated many animal species. It appears that we know how to communicate with them enough to do our bidding. Knowing enough to make an animal obedient may be enough for certain functions, but delving deeper into how some animals communicate has led to major scientific breakthroughs, better quality of living, and healthier emotional lives.

For example, it is well known that dogs use their noses to communicate (often through the social etiquette of butt sniffing). However, only once humans took the time to research the significance of smell in a dogs life did they realize the opportunities for communicating through it. Dogs now communicate to humans in numerous ways by using their sense of smell, after humans learned to harness the power of a dog's nose. One dog, named (look up the name), is the only arson dog in (look up country). The dog is specially trained to sniff out accelerants to detect if a fire was caused by arson. In the medical community, the power of a dog's nose is being realized through cancer detection. In one case, a woman's dog became emotionally depressed, aloof, and exhibited uncharacteristic sadness. It would also repeatedly press its nose to the woman's breast. The woman eventually connected the dog's behavior to the chance of breast cancer and went to get checked. Once she was cancer free, she reported her dog's behavior as normal again. Other research is specifically training dogs to detect certain cancers by smelling urine samples.

Dogs are not the only animals paving the way for scientific advances through their communication styles. Cetaceans, specifically humpback whales, take advantage of a "sound channel" in the ocean, in which sound originating there can travel for miles uninterrupted. Scientists discovered cetacean's use of the sound channel and began exploring how it worked. The same scientific principles used in the sound channel by whales have been applied to tiny glass fibers, in which light can be sent miles without interruption. Thus, fiber optics technology was born. With fiber optics, the internet and communication systems can travel at the speed of light, all from realizing how whales sent messages across long distances in the ocean's sound channel.

Studying animal communication has been monumental to scientific and medical progress. However, it can also tell us more about ourselves as human beings. As discussed earlier, some scientists theorize that our interaction with animals initiated early forms of language. Animals are present in early art and writing, suggesting that they might have even been the stimulus for making prehistoric art or physical records. Perhaps humans took cues from animals as the development of language progressed. We use very human ways of communicating with our pets, and they understand. Maybe our communication styles have deep-rooted similarities or interlocking histories.

The idea that animal communication can tell us about human behavior is nothing new to the field of psychology, which has used animals as the focus of many a study that ended up telling us about human nature too. Pavlov's dogs are probably one of the most widely known examples in which communication among dogs revealed learning methods for humans as well, in addition to how and why humans react to stimuli.

Of course, there is the more recent research with animals regarding their affects on the mental and emotional health of humans. Service dogs are no longer just for physical disabilities, but also for psychological care. People with depression, anxiety, and autism, just to name a few, can all benefit from animal interaction. In one study conducted by (look up name), she analyzed blood samples taken from people who had not pet any dog, who had pet a dog for a minute, and who had pet a dog for five or more minutes. The study found that those who had pet the dog had higher amounts of ___ in their blood, signaling the occurrence of an emotional bond. Similar blood levels are found among women after giving birth and holding or breastfeeding their babies. Moreover, the levels did not just increase in the humans, but also in the dogs, suggesting that the emotional benefits are mutual. The benefits do not just come from interaction with dogs either. Cats, horses, and similar pets have also been found to improve emotional health through simple communication techniques like petting or playing.

In short, humans should care about animal communication for a variety of reasons. The understanding of animal communication can have effects ranging from individual happiness to global technological breakthroughs. Homo sapiens have already made great evolutionary strides through the incorporation of animals into their culture. It is only logical to continue the cycle of learning from animals.

Part Two: Dogs, Horses, and Whales

Evolution of Dogs

There is not a single moment in the history of dogs' existence on earth that they have not lived side by side with humans. Humans had been living on the planet long before dogs evolved from their still living ancestor, the grey wolf. In fact, the evolution of the dog is a result—over thousands of years—of wolves' close proximity to humans.

Beginning tens of thousands of years ago, the grey wolf first began the domestication process. How do we know that the modern dog is a direct descendent of the grey wolf, and not any other specie of wolf or coyote? Testing of modern dogs' mitochondrial DNA links them to the grey wolf. Different aspects of genetics will change dramatically over the course of a species' evolution. However, the sequences of *mitochondrial* DNA have been found to change very little in a given species' evolutionary history. The patterns of mitochondrial DNA in all domestic dogs look almost exactly like the mitochondrial DNA of the grey wolf (NOVA). Thus, dogs are the verified descendants of the grey wolf.

Before this advancement of genetic testing, only bone remains could be used to compare the structures of grey wolves and dogs. Archeologists discerned that dogs evolved from the grey wolf by examining their similar skull and other bone structures, and they dated the morphing process from wolf into dog at about 12,000 years ago, when the skull shapes started to show visible change in size and form. However, the recent findings with genetic testing refutes that date. Now, geneticists claim that dog evolution began much earlier, up to 100,000 years ago (NOVA).

One thing, however, is agreed upon by both archeologists and geneticists: dogs are the first specie to be domesticated by humans. They are also one of the most diversely altered species, with hundreds of various recognized breeds descending from their wolf ancestors. These numerous breeds all originated from one animal, the grey wolf, thousands of years ago.

Wolves were aggressive pack animals then as they still are now. They saw humans as a danger, as humans likewise saw them. Wolves have stress hormones in their blood that trigger aggression, fear, possessiveness, and territoriality, especially when approached by perceived threats such as a human (Sagan). Because of these natural stress hormones in the blood, wolves never ventured too close to humans. Fear instincts and aggression would naturally arise in wolves as a result of closeness to humans. However, the theory of dog evolution proposes that either a biological mutation or adaptation in some wolves caused naturally lower stress hormone levels in the blood (Sagan). These tamer wolves were the ones who ventured—and remained—close to humans.

A modern study has supported this theory of wolf-dog domestication. Scientists in Russia have been trying to mimic the domestication of the wolf into the dog through an accelerated model using silver foxes, which are closely related to wolves. The study has analyzed the role of both genetics and environmental factors in the 'domestication' of these wild foxes over fifty years.

Beginning in 1959, individual silver foxes were put into cages and then approached by humans. The majority of the foxes exhibited fear and aggression at the approach of the human via growling, baring their teeth, or backing away from the human to the far end of the cage.

However, in less than 1% of these caged silver foxes, the reactions were different (NOVA). Those foxes showed neither fear nor aggression when approached by a human.

These "tame" foxes, who exhibited the least fear and aggression, were chosen to breed with one another. With that new generation of foxes, the process was repeated. They were again approached by a human and selected for by their lack of aggressive behavior to breed with one another. For many generations, only the tamest foxes were bred with one another. One of the lead researchers of the silver fox study, Dr. Lyudmila Trut from the Institute of Cytology and Genetics in Russia, noted dramatic behavioral changes around the eighth generation of tame foxes (NOVA). These eighth generation foxes began actively seeking out human contact and even began showing affection toward humans, through tail wagging, heavy and excited breathing, and howling (NOVA). The study continues today with the offspring of fifty generations of foxes, who are remarkably tame and "dog-like" according to the researchers.

The researchers of this study also bred aggressive generations of foxes as a control group. The most aggressive of the foxes were chosen to breed only with each other, in the same manner as the tame fox breeding process. After multiple generations produced very aggressive foxes, the researchers decided to cross-foster an aggressive cub with a tame mother fox. In a classic analysis of nature versus nurture, the researchers wanted to analyze the role of genetics on aggressive behavior as opposed to the foxes' environmental upbringing. Raising an aggressive cub through a tame mother did nothing to curb the aggression in the fox cub. The results pointed to aggression being an almost entirely genetic trait (NOVA). The researchers then transplanted embryos of aggressive cubs into tame mothers. The results were much the same; the cubs still exhibited extremely aggressive behavior. According to Dr. Trut, these findings prove that the

gene for aggression cannot be altered through a change of environment. It will be preserved and passed down to the next generation of offspring, unless bred otherwise (NOVA).

The silver fox study is a model of wolf evolution into modern day dogs. The study supports the theory that a small percentage of wolves may have had no or little naturally aggressive reactions toward humans, mirroring the similarly small and natural percentage of foxes who did not react aggressively to humans. If these tamer wolves tended to mate with one another, then, theoretically, similar results that appeared in the fox generations would have appeared among the wolf generations. The wolves would have gradually become tamer and tamer, and, eventually, even seek out human contact.

However, the tame foxes in the study were made to mate with one another through human intervention. How did this change in behavior first start in wolves? Humans were not intervening in wolf mate selection at that early a stage tens of thousands of years ago. However, it is likely that only the tamer wolves would mate with each other, or at least mate with each other more often, because they were all in close proximity to humans—and therefore each other (Sagan). If wolves carrying more aggressive genes stayed away from humans, then they would naturally not be available for mate selection among the wolves who stayed closer to humans. Not only were these tamer wolves breeding offspring with lower stress hormone levels and aggressive behavior towards humans, but each generation of new offspring was also learning the same scavenging behavior from their parents, to feed off human leftovers and fear them less (Sagan). The next generations would most likely have an even higher inclination to stay nearer to humans, and thus the pattern would continue. This explanation is likely how the natural selection of “tame” wolves began, long before human artificial selection started. It was both an evolution in biology and learning behavior over generations of wolves that led us to the modern dog today.

The study on the silver foxes clearly demonstrates the likelihood of dogs' descent from the wolf, as well as illustrates the process. But what exactly was the genetic difference between the tame foxes and the more aggressive ones? Dr. Anna Kukekova, a researcher from Cornell University, traveled to the site of the fox study in Russia in order to take blood samples of both the tame and aggressive foxes. She determined that the tamer foxes had lower levels of the hormone adrenaline in their blood, meaning that they experienced less fear, and thus aggressive behavior (NOVA). This finding again supports the theory that a natural adaptation, tens of thousands of years ago, may have left some wolves with naturally lower adrenaline levels in their blood, which was passed down as a genetic trait.

Yet, the genes of the grey wolf and the modern dog are still surprisingly similar. In fact, they are 99.8% identical (NOVA). Could such an overall small genetic variant, like a hormone level, really cause such massive changes in behavior and appearance? Another study led by researchers at Eotvos Lorand University in Hungary decided to test the aggressive genes of wolf cubs by bringing them up in the environment in which most household dogs are raised. The purpose of the study was to see if wolf cubs could be tamed as household pets, and therefore suppress the natural urges of their aggressive genes through constant human companionship from their infancy. Then the researchers could determine if the small .2% variance in their genes really differentiated dog behavior from their wild wolf counterparts, or if the environment played a role as well.

The researchers took a litter of five-day-old wolf cubs into their homes. They cared for them 24 hours a day, carrying them and sleeping with them. To prepare for raising the wolves, each researcher had previously raised a puppy in the same manner (NOVA). Their goal was to create a human-cub relationship with the wolves, similar to most household dogs' relationship

with their owners. The wolf cubs behaved similarly to puppies, until about the age of 8 weeks. Around this age, the researchers noted stark behavioral contrasts compared to that of the puppies. The puppies always maintained an interest in what the humans were doing. When put near a lifelike, robotic, barking dog toy, the puppies engaged with it, approaching it curiously and sniffing it (NOVA). In contrast, the wolf pups lost interest in what their human companions were doing at around 8 weeks old, and were more concerned with their own tasks. When placed near the robotic toy, the wolf pups backed away and acted fearful or anxious (NOVA). In addition, the puppies often responded to human gestures like pointing, which the wolf pups did not. The wolf pups barely made eye contact with the researchers, and became more possessive with their toys and aggressive during playtime (NOVA).

At around two months old, the wolves were much larger and hard to control. They did not respond to human commands. One researcher, Dr. Kubinyi Eniko, noted that her wolf cub would charge into the refrigerator despite aggressive attempts at stopping the wolf on her part. According to Dr. Eniko, “The dog is not a socialized wolf at all. These differences we experienced in the communicative ability and in the social behavior of dogs, this is the effect of domestication” (NOVA). According to this study, the small genetic variance between wolves and dogs really does differentiate their behavior. But what about their significantly different appearances?

Another curious result of the silver fox study was the sudden change in physical appearance of the foxes after just a few generations. Dr. Trut noticed an alteration in the normal silver pattern of the foxes’ coats (NOVA). In addition, some fox cubs were keeping their floppy ears for much longer than usual before standing upright, as is natural in adult foxes (NOVA). Moreover, the length of the foxes’ limbs and tails began to shorten in comparison to the more

aggressive foxes (NOVA). In essence, the foxes were starting to show some of the "cute and dog-like" physical traits that are in domesticated household dogs.

According to Duke University Professor Brian Hare, selecting against aggression goes hand in hand with altering the physical appearance of a species:

> If you just select for behavior, a lot of the morphological and physiological changes that we see between wolves and dogs, they just get dragged along…When you're selecting against aggression, what you're doing is you're favoring juvenile traits. Juveniles and infants show much less aggression than adults, and so basically you've frozen development at a much earlier stage. So you have an animal as an adult that looks and behaves much more like a juvenile. (NOVA).

The assumption, then, is that this unintended consequence of selecting against aggression in wild wolves resulted in the hundreds over dog breeds all over the world. The physical changes in wolves started small, with slightly curlier tails or different colored coats. As wolves became tamed and domesticated into dogs, humans did not need to select for aggression anymore, and took more leeway in selecting for physical traits. If a human liked the shape of a dog's tail or snout, he took two dogs with those desired traits and made them mate with each other to produce offspring with those physical traits. Thus, dog breeds evolved.

Physical traits were not the only new selective feature in dog evolution. Humans controlled for other factors like sense of smell, pointing, retrieving, swimming, and guarding.

Breeds evolved and became known for their special abilities like hunting or herding. Their special partnerships with humans eventually changed the way that humans lived too. During the early stages of wolf domestication, humans lived in hunter-gatherer societies. With the advent of the guard dog and herding dogs, humans could settle in one place and raise livestock (NOVA). Agriculture was in essence aided by the skills of dogs in some areas of the world (NOVA). Likewise, humans could more successfully hunt with dog packs. More food meant more offspring. Thus, small nomadic human troops settled in one geographic location and produced more offspring (NOVA). Populations and civilizations grew.

The evolution of the dog is inextricably connected with human activity. From tame wolves following on the outskirts of nomadic groups to current dog companionship in homes, the evolution of the dog has been shaped by human influence. It is no wonder, then, that dog communication styles have evolved in confluence with human communication styles.

Dog Communication

The evolution of dogs meant changing their status as an aggressive, territorial wolf to a docile and obedient human tool. The most effective means of achieving this transformation was selectively breeding against aggression in wild wolves. As previously discussed, this selection occurred naturally in some wolves at first. Yet, as humans became more comfortable around these wild carnivores, they began to control breeding themselves. Only the wolves and early dog ancestors with the least aggressive behavior were allowed to breed.

Breeding against aggression led to a host of other desirable qualities, such as obedience, less possessive or territorial natures, and friendliness. All of these qualities were necessary in

transforming wolves into human instruments for hunting and protection. The more of these traits that showed up in the offspring, the easier the dogs were to "train." The symbiotic relationship between humans and dogs developed.

Before natural or artificial selection interfered with wolf behavior, however, wolves possessed an innately similar trait to humans, perhaps one of the catalysts that led to their extremely successful inter-species partnership. Both wolves and humans are *social*. Both wolves and humans were social creatures before their intimacy developed. They are both social pack animals, and carnivores that hunt by daylight (NOVA). They live, hunt, raise children, and travel in groups.

Humans during this hunter-gatherer period depended on safety in numbers, as well as relied on the specialized skills of group members to provide for the whole community. For example, males were relied upon for foraging for food, while females were relied upon for the upbringing of offspring. Likewise, wolves depended on group efforts. They, like humans, were more successful at hunting because they hunted in packs. Humans, despite also hunting in packs, were not endowed with the speed, four legs, fangs, and claws that other predators like the wolf have. Wolves became both a useful addition to hunting parties as well as a protective barrier from other predators. Wolves and humans may have continued to be useful for each other without their social qualities. But their unique and intertwined relationship may never have formed without their similar need to socialize and belong to part of a group. Survival in the wild brought the two species together, but their social instincts kept them together for thousands of years after.

Neil Degrasse Tyson provides an interesting graphic rendition of wolf evolution into dogs in his television series *The Cosmos*. In one episode, he describes how this partnership evolved and became a "survival of the friendliest" (Sagan). Indeed, the trait of "friendliness" was and still is one of the most desirable breeding requirements for dogs. Selecting for "friendliness" inevitably changed the landscape of human-dog communication. Wolves and early dogs became more outwardly social and less inhibited in approaching humans. Less dominant communication styles appeared, as are seen in today's docile wolf counterparts.

One of the rather notable effects of human intervention on dog evolution is the addition of human communication styles into the repertoire of dog communication styles. Dogs have adapted to communicate with humans via humans' own methods of communication. For example, dogs bark to communicate. This fact in itself is not significant. However, what is significant is that dogs have learned to bark in order to communicate *emotions* to humans, in much the same way that humans talk, and contrary to how their wild wolf counterparts use barking in the wild.

Wolves in the wild only bark as a warning signal. However, dogs bark to communicate excitement, loneliness, and fear, among other emotions. In fact, a study conducted by a research laboratory in Budapest, Hungary, found that humans can generally recognize six universal dog barks, according to their tonality, frequency, and the interval in between actual barks (*Secret Life*). It appears that dogs have added different styles of barking to their repertoire in order to communicate with humans, on whom they depend to meet these emotional needs. In contrast, wolves have never needed to communicate these emotions among their wild companions, and therefore have not evolved those communicative abilities, at least not through barking. Making vocalizations in order to communicate is a very human quality, and perhaps dogs have traded

vocalizations with the other natural methods that wolves use in communicating these emotions in the wild. If this suggestion is accurate, then the barking repertoire of modern day dogs is a direct result of evolving alongside humans.

Perhaps another result of human influence over the evolution of the dog is the dog's extraordinary attention to human gestures and body language. As discussed earlier on the study of wolf cubs raised in human households, wolf cubs would not make eye contact with humans after a few weeks of age. In contrast, dogs are naturally attuned to the human gaze, so much so that they can even receive direction by human eye pointing (NOVA). Cognitive Psychologist Dr. Juliane Kaminski analyzed the differences in dog and chimpanzee intelligence. She found that dogs were far more likely than chimpanzees to make decisions based off both human finger pointing and eye pointing (NOVA). Chimps have been regarded as homo sapiens' closest relative. However, they repeatedly failed in Dr. Kaminski's tests of chimp-human communication. In contrast, the dogs were overwhelmingly receptive to human gesturing. Dogs are far from humans on the specie family tree. However, this study suggests that thousands of years of human influence over dog species' evolution has made them more successful at interpreting human communication than merely having similar genetics has made chimps. Notably, dogs do not use this ability with other dogs, only humans. Dr. Kaminski describes dogs as having a "second language" for humans, one in which they communicate differently than with other dogs (NOVA). She calls dogs "bilingual." This finding again supports the notion that human-dog partnerships have absolutely changed dog species' communication styles.

Besides purposeful gestures, extremely subtle and unconscious human body language is detectable and interpretable by dogs. They can often tell when their owners are going to do something before that human gives any conscious clue that they are about to do it. Certain breeds

are especially adept at anticipating human actions and needs, including Labrador retrievers, who are often trained as guide dogs for just this reason (*Secret Life*). Guide dogs are required to anticipate the movements and needs of their owners, a quality that has developed in Labradors and other dog breeds from evolving alongside humans.

The social and communicative nature of dogs has developed in accordance with human emotions. Dogs, as well as humans, instinctively look to the right side of a person's face first (*Secret Life*). The right side is where humans tend to display their emotions more vividly. Using eye sight recognition software, researchers have been able to trace the eye movements of both dogs and humans, both of whom naturally look to the right side of a human's face first, the side that cues into human emotion (*Secret Life*).

This emotional awareness among dogs and humans is not merely based on perception either. Scientists have empirically measured the emotional connection between humans and dogs in comparison to a mother's emotional connection with her newborn baby. In the study, blood samples were taken from both mothers who were breast feeding newborns and persons petting a dog (NOVA). The samples were taken after one minute and three minutes in order to measure the amount of oxytocin in the blood (NOVA). Oxytocin is a hormone associated with emotions like love and trust, and with physical symptoms like lower blood pressures, lower stress levels, and slower heart rates. After the amounts of oxytocin were recorded and graphed, the charts illustrated very similar peaks of oxytocin in both the breast feeding mothers and the persons petting the dog after the minute and three minute intervals (NOVA). In other words, petting a dog sparks an emotional reaction in the brain similar to that of a mother's reaction to her newborn. Moreover, blood samples were also taken from the dogs being pet. The dogs likewise

had identical peaks of oxytocin, matching the charts of the humans (NOVA). Thus, the emotional reaction is reciprocated in dogs.

This study emphasizes that the emotional connection of humans and dogs is mutual. Both dogs and humans, then, have emotional interests in one another, and therefore both have stakes in communicating effectively with one another. The methods of communicating effectively with one another have evolved over the thousands of years of human influence over dog domestication. Humans have undoubtedly affected the communication styles of their dog companions.

Evolution of Horses

Unlike dogs, horses evolved for most of their history without the influence of humans. Their ancestors have been around for millions of years longer than dogs. The earliest known species of horses are recorded around 55 million years ago (AMNH). Originating in North America, horses traveled to other continents where they diversified into different species, adapting to the different climates and resources. Eventually, wild horses in North and South America became extinct around 10,000 years ago, but they were reintroduced thousands of years later by human immigrants (AMNH).

The domesticated breeds that are called horses today all fall under one species, Equus Caballus (AMNH). This species is one of seven total species belonging to the genus Equus. The other species include zebras and donkeys (AMNH). Today, few wild horses remain. They have almost entirely been domesticated. The only still fully wild breed is the Przewalski (Hirst).

For the majority of their evolutionary history, horses were considered prey by humans. Their original predator-prey relationship started around 40,000 years ago, when both horses and humans settled in Europe during its Ice Age (AMNH). Ancient cave paintings and relics of hunting weapons have given insight into the role of horses around this time, as food to be hunted. It would not be until thousands of years later that this relationship changed.

Their domestication history is even shorter than that of the dog, beginning around 5,000 to 6,000 years ago. The first captively held horses are believed to have been kept by the Botai people at a location called Krasnyi Yar in modern day Kazakhstan (Hirst). However, according to archeology expert Kris Hirst, the timing of horse domestication has been hard to trace: "Unlike other animals, criteria such as changes in body morphology (horses are extremely diverse) or the location of a particular horse outside of its 'normal range' (horses are very widespread) are not useful in helping resolve the question" (Hirst). Instead, researchers have turned to other clues to suggest the timing of horse domestication.

One such clue is the skeletons of horses. The ancient horse bones found at the Krasnyi Yar archeological site are marred with cut marks that denote the horses' butchering for meat (AMNH). The ancient peoples who lived there clearly ate horsemeat. Yet how do archeologists know if the horses were wild or domesticated? Hirst describes remnants of the village that suggest that the horses were kept in captivity: "Krasnyi Yar includes over 50 residential pithouses, adjacent to which have been found dozens of postmolds. The postmolds—archeological remnants of where posts have been set in the past—are arranged in circles, and these are interpreted as evidence of horse corrals" (Hirst). In addition, the soil tested around the area of the postmolds were found to contain high levels of phosphates and nitrogen, the effects of manure (AMNH). Those are not the only evidence found at the site. Tools made from horse

bones and skin, leather horse gear, manure found on the village houses likely used for insulation, and the knowledge that no crops were grown in the area all hint that the Botai people of Krasnyi Yar kept horses in captivity for food (AMNH). This archeological site is the probably the first instance of horse captivity, roughly under 6,000 years ago.

Some of the next evidence of horse domestication as tools—to draw chariots—is formed in drawings from about 4,000 years ago in Mesopotamia (Hirst). For over 3,000 years, records show the use of horses as a weapon in war. Japanese samurai began using horses in warfare in the 800s (AMNH). The use of horses in war probably spread west from these Asian riders to the Mediterranean and then to Europe. Eventually, Europeans sailed across the Atlantic to reintroduce the horse to North and South America. Specifically, in the 1500s, the Spanish brought the horse to South America, which ultimately aided the Spanish warriors in their defeat of the Incan Empire.

Over these last 5,000 years when the horse became a prop in human civilization, some major evolutionary changes occurred. Horses particularly started to be bred for strength and size by Europeans (AMNH). The British made fervent attempts to breed the largest horses:

> Knights in shining armor were too heavy for most British horses, so large horses had to be imported from other European countries until at least the 1500s. Determined to increase the size of British horses, King Henry VIII decreed in 1535 that major landowners must keep at least two large mares, and in 1541 he banned stallions from grazing on public lands unless they met certain height requirements. (AMNH).

Thus, the Europeans began altering the physiology of the horse, creating some of the largest breeds. Horse breeding developed not only for size and strength, but also for speed, agility, and even beauty. Like the dog, horse domestication and breeding has been influenced for the benefit of human production. Horses have been bred and used for travel, for warfare, to pull heavy loads, to plow fields, and to herd livestock. However, unlike the dog, horse domestication has not necessarily led to a complete change in horse communication styles. In fact, humans have best worked with horses by understanding their natural instincts, and then training horses based off their natural communication manners.

Horse Communication

Like humans and dogs, horses are social animals. They have a strong herd mentality that affects most aspects of their communication, both with other horses and humans. Horses maintain strict group hierarchies in these herds, which are led by a female horse, or mare. New horses joining a herd often remain on the outskirts until they learn the group's hierarchies, as well as their own position in the group. Within the herd, social behaviors like stroking another group member's mane or swatting away flies from one another are common and establish bonds.

Horses were also once prey to many predators in the wild, which has resulted in a naturally acute perception of their surroundings. They listen with highly flexible ears and watch with eyes that can see two scenes at once from each side of their head. Horses are extremely sensitive to movement because of this evolutionary need to monitor their surroundings for predators. In fact, the keen ability of horses to detect movement is "why a horse is much flightier on windy days; things that are normally stationary are now moving and perceived as a potential

threat" (Rutgers). The biological adaptations of horses are just as important to their communication styles as their social herd instincts.

Communicating with horses requires knowledge of these natural instincts, and often overrides humans' own natural communication instincts. For example, verbalizing commands is a common human instinct when communicating desired actions. This reaction will work with dogs once they learn the vocal commands. However, humans cannot rely on vocalizations with horses. Body language altogether is perceived by the horse, and so communication must be considered more holistically. Experienced horse trainer and English teacher, Erica Tom, has analyzed the importance of human body language from both her experiences with horses and in the classroom: "In horsemanship, the basic assumptions of human communication go by the wayside…humans must work beyond what is said in words, re-evalutating and exploring other communicative pathways" (Tom 110). Unlike the domestication of the dog, where dogs have largely adapted to pick up and interpret human communication cues, horse domestication has not erased their long-standing natural communication habits from the wild.

Instead, humans must be the rhetorical adjusters, adapting to the horse's communicative approaches. Tom reiterates this point in her essay "Pasture Pedagogy" by stating, "When humans attempt to communicate with horses they must, out of necessity, relinquish their dependence on spoken language" (Tom 111). So what do humans instead turn to if not the spoken word? Body position and movement in relation to the horse is one answer. Using spatial relationships communicates hierarchies and dominance: "Horses exert dominance by controlling the movement of their peers. Horses accept dominance when: a) we or another animal cause them to move when they prefer not to, and b) we or another animal inhibit movement when they want to flee" (Rutgers). Trainers use this knowledge when asserting their authority over a horse. They

use ropes, lines, pens, and body positioning to encourage certain movements from the horse. By making the horse understand that they decide the movement, they assert their leadership.

Because horses are so involved in the sociality of the herd, they do not like being separated from it. Chasing a horse away from the herd is one method of punishment for undesirable or disruptive behavior in the group. Trainers likewise can use this technique to chase horses either away from other herd members or even from the human trainers. In addition, the natural instinct to follow a leader can be used to make horses go against some of their other natural instincts, like jumping hurdles. An inexperienced horse will follow an older, more dominant horse over a fence or hurdle despite their first natural reaction not to jump it (AMNH).

When trainer Erica Tom was working with feral horses, she used natural horse behavior to introduce herself to the group: "I focused simply on being there…Just as new horses are kept on the perimeter of a herd before being accepted, I wanted to offer my presence rather than exert authority; thus, I kept to the edge of the pasture until my coming and going became familiar" (Tom 113). She used other tactics, too, such as letting the horses come to her, keeping her body angled open rather than directly facing the horses, and mimicking horse grooming within the herd by stroking the mane where horses often groom each other with their teeth (Tom). She adopted the body language of the horses in order to enter their rhetorical arena, and eventually asserted her own dominance once the horses accepted her presence and movement.

Proactively adopting horse body language is important in approaching a horse, but so is reacting to that horse's responses. Humans must comprehend what the horse is trying to tell them through their own body language too. The height of the head and stance or movement of the legs reveal a great deal about a horse's emotions, as do the movement of its ears. The tilt of a horse's

ears can suggest whether or not they are listening to a human's voice or body rhythms: "a horse's ears are their antennae, and you can tell where a horse's attention is by observing the direction of their ears. Although a horse will move to face the direction of a threat or engage with a person or another horse, their ears are the more subtle signals of their constant awareness. This is helpful in anticipating their movements and in evaluating their mood" (Tom 121). The bent of a horse's ear can suggest the focal point of its concentration, yet as humans we do not emphasize the importance of ear movement in communication. Subtle yet crucial signals like these can go unnoticed by humans without the understanding of a horse's communication channels. In that case, effective communication wanes.

Despite thousands of years of domesticating the horse, humans have actually imposed on their communicative repertoire very little. In contrast, a significant effect of human domestication of the wolf was the infliction of human communication styles onto its modern descendent, the dog. While still maintaining many of its wild natural instincts, the dog has still clearly adapted some very human rhetorical devices. However, the evolution of the horse under human captivity appears to have had less of an effect. Instead, humans are just recently in past decades delving into horse communication styles in order to effectively connect with the species. Humans will more successfully converse with horses by taking on their communication styles rather than attempting to enforce dominance through human-to-human methods.

The Evolution of Cetaceans

The evolution of modern whales is an intriguing—and almost backwards—one. Most anyone who has studied evolutionary theory understands that modern life forms on earth

originated out of the oceans, beginning with prehistoric fish. From these ancient ancestors we received our many species of fish still inhabiting the oceans today, among other creatures. One might guess that whales are direct descendants from these fish as well. However, their origins actually stem from a group of land animals—the mammals.

The first creatures to leave the water did so around 400 million years ago, but still maintained a dependence on water for certain life functions such as laying eggs (Rendell 50). This group of organisms still exists today, known as amphibians. From the amphibians, other major evolutionary splits occurred, including those of reptiles, which led to today's reptiles and birds, and mammals, which resulted in humans. Mammals evolved on land around 200 million years ago. They became warm-blooded and able to give birth to and nurse live offspring. A significant factor in the survival and incredibly diverse evolutionary history of mammals is attributed to mammals' great adaptability, according to Rendell and Whitehead in their chapter "Mammals of the Ocean." Mammals have been able to take over countless environments on earth, from the coldest to the hottest, from the highest altitudes to the lowest, and of course, from the driest to the wettest.

Whales and dolphins are prime examples of the incredible adaptability of mammals. This group of mammals started as land animals with four limbs. At some point in their evolutionary history, they started spending their time around the water for some reason, possibly plentiful food options or fewer threats from predators. As time went on, they developed features to suit life in the water: slick, hairless bodies for maneuvering quickly through water and preventing build up of barnacles; nostrils on the top of their heads for easy surface access for breathing; limbs that evolved into fins for swimming. These creatures, known collectively as the cetaceans, also lost a good portion of their sense of smell. According to Whitehead and Rendell, smell is not

a significant sense in the ocean: "Moving from air to water changes the relative benefit of each of the senses. Chemical signals are not dispersed as widely or predictably under water as in air, so taste and smell have less value for marine animals…Sight is also degraded in the ocean because light is absorbed by water. At depths of a few hundred meters there is virtually no light…" (54). Instead, the cetaceans (whales and dolphins) attuned another sense more practical to ocean dwelling: hearing.

First, it is important to grasp just how different our environment is from that of the cetaceans. Only then can we understand how crucial this highly attuned sense of hearing is to whales and dolphins, and just why our methods of communicating are so different, yet equally important to our survival, and equally deserving of the title of "communication." As humans, our hearing adapted to sound traveling through airwaves, generally within close proximities of each other. Cetaceans faced a greater challenge in moving to the oceans. Sound now had to travel through dense, viscous water, and often at great distances up to tens of kilometers. The typical vocal projections of land mammals were not suitable to communicating in the ocean. Thus, the physiological structures of cetaceans evolved to be able to project both short and long range vocals in dense water, as well as hear fellow cetaceans' projections.

Different cetacean species adapted their airways in diverse ways, all very successfully for their unique purposes. For example, some dolphins have more than one airway to produce multiple sounds at once (Rendell 60). The sperm whale evolved one of the most impressive sound systems in the ocean with very specific adaptations described by Rendell and Whitehead: "The nose, formally called the spermaceti organ, takes up a quarter to a third of the animal's body. It contains fine grade oil, is surrounded by a huge muscle, and is bookmarked by air sacs, connected by looping nasal passages…The immediate result is the natural world's most powerful

sonar system, a system that makes the sperm whale a supremely adept predator" (60-61). It takes a considerable amount of energy to support the huge bodies of most whales. Bodily resources must be expended wisely. The fact that the sperm whale's nose consists of a third of its body speaks to the importance of this natural sonar device to the survival of the species. Humpback whales, too, have a unique communication adaptation. They use a "sound channel" in the ocean (about 1km deep), in which sound travels particularly well. They adapted to dive at this depth for extended periods of time to "sing" to other humpback whales, the only known whale to produce "songs" with seemingly no practical purpose that research has yet confirmed. These great sound tools are far from impractical, however. Cetaceans use sound and echolocation for everything from hunting and mapping their surroundings to communicating and socializing.

Communication in Whales and Dolphins: Creatures of Sound and Sociality

The importance of sound mechanics in the ocean cannot be emphasized enough for the cetaceans, who have mastered deep-water communication. Sound is the basis for their everyday life activities, including feeding, mating, defense from predators, and social living, each of which will be covered in this next section.

Hunting for food is, of course, a high priority for any animal in the wild. Cetaceans take advantage of their acute sonar senses to make this task a little easier. A prime example is the sperm whale. With its enormous nose and vocal system, the sperm whale makes clicking noises in the deep ocean to search for some of its favorite prey, the squid. Because the sperm whale spends so much time in deep water, it has been hard for researchers to follow their activity.

However, Rendell and Whitehead note that some methods have been successful in tracking the whales' hunting patterns, particularly its use of sound in hunting squid:

> The regular series [of clicks] is interspersed with "creaks" in which the clicks are much more closely spaced still, sounding rather like a creaking door. We assume that this is when the whale has something, often a squid, in its acoustic sights. Clever tags placed on diving sperm whales that record sounds and movements show creaking whales accelerating, twisting, and maneuvering underwater. Often the creaks are followed by pauses; presumably the sperm whale is eating. (147).

While the sperm whales are solitary hunters, dolphins, in contrast, use their highly social nature in hunting for food, often relying on teamwork and synchronized movements to round up prey. In fact, observations of dolphins show that individual dolphins are relied upon by the group for specific hunting techniques. For example, in a effort called "mud-ring feeding," one dolphin will drag its tail along the sea bottom in a circle, kicking up mud and trapping fish in its cloud, while the rest of the group waits hidden outside the mud cloud to leap after the confused catch (Rendell 106). In yet another example of individual dolphin specialization, one dolphin will drive a school of unsuspecting fish against a wall of other dolphins waiting for the food (106). Rendell and Whitehead remark, "It seems that individual dolphins become specialized into specific roles within this cooperative framework…145 separate bouts of this [driving] behavior and in all of them just a single individual from each group did the driving" (106).

Dolphins are not the only ones who realized that success comes in numbers. Perhaps the most famous cetacean predator, the killer whale, owes its hunting success to playing well with others as well. Rendell and Whitehead praise this incredibly intelligent species for its predatory success, "They are such devastating predators because they are social, clever, and cultural. And the evolution of their societies and intelligences has undoubtedly been driven, at least partially, by their predatory nature" (128). One well-known example of orca co-hunting is the synchronized swimming and tail pumping in order to create a wave that washes over a floating ice chunk inhabiting a seal. Two or more orcas will simultaneously create a wave to break over the ice, knocking the seal into the water, where the killer whales wait to ambush it.

Orcas will also work together to hunt herring. Groups of orcas will swim quickly in a circle around a group of herring forming a "ball." Then the whales will "slow down for the feeding phase but continue to swim tightly around the herring ball, making sounds and blowing bubble clouds. Individuals will slap the herring ball with their flukes, stunning the herring, which they then eat" (Rendell 139-140). Thus, orcas depend on inter-group communication and teamwork for hunting prey just like their dolphin counterparts.

For sperm whales, sound is the ultimate hunting tool. Whereas for dolphin and orca groups, teamwork is the key to survival. Whether using sound or social techniques in foraging for food, one necessity is clear for these cetaceans: communication. Without their styles of communicating, hunting for these cetaceans would prove to be much more difficult in the vast and unforgiving ocean environment.

Communication plays a large role in dolphin societies, not only in foraging for food as we have just seen, but also for mating. Mating among dolphins is a fierce competition, particularly

for the males. In what are called “alliances,” male dolphins communicate with each other to round up a potential mate: “Males use alliances to outcompete other males and to engage in a behavior called herding, where alliance members will aggressively guard a single female in a highly coordinated way” (Rendell 102). The ‘highly coordinated ways’ described by Rendell and Whitehead include precise synchronization with other dolphins’ movements. Male dolphins use their well developed mimicking abilities to match the movements of their alliance members with impeccable timing and symmetry. Working together both wards off other males as well as helps corral a female. There are probably many communicative aspects that help to coordinate such synchronization such as using eyesight, making clicking noises, watching and learning the behavior from older males, and then mimicking it. The male dolphin takes advantage of every communicative tool he has in order to pass on his genes.

In comparison to the chaotic and competitive mating environment of the dolphins, the majority of whales operate solo when trying to find a mate. However, they too use a communication tool, which researchers believe is meant to attract mates: the song. No one has been able to say for sure that whales sing purely to attract mates. Nevertheless, the mass of research on whale songs has indicated that at least one of the functions of singing is for the benefit of attracting female whales. The main indicators that whales sing in order to mate: 1) singing is not typically heard during the summer months when whales are feeding, but rather only during the mating season and migrations, and 2) of all the whales recorded singing, only males were identified singing, leading to the hypothesis that males are using their voices to attract females (Rendell 82). These behavioral patterns for singing among male whales are very similar across species of whales as well. In all species recorded singing, only males have been tagged as the source of the song and typically not during feeding time, including humpbacks,

bowheads, fins, and minkes. It appears that, despite the specie, singing has evolved as an efficient communication tool with the benefit of using few resources.

Despite their massive sizes, cetaceans are vulnerable to predators just like any other animal in the wild. Naturally, they use their best assets to combat predators, including communication techniques and teamwork. Take, for example, the sperm whale. Next to humans, the largest threat to the sperm whale is actually another whale, the orca. In the Pacific, orcas have been known to occasionally attack sperm whales. Rendell and Whitehead describe the reaction of Pacific sperm whales to orcas: "sperm whales usually react quickly to the arrival of killer whales by forming a tight group at the surface, sometimes facing outward at the killers and sometimes putting their heads together, with their tails radiating outward like a wagon wheel" (155). Clearly, survival of sperm whales against orcas includes relying on group members to work together to ward off the predators.

Likewise, dolphins depend on large group sizes to scare away potential threats, especially in the deep, open ocean. Sometimes dolphin groups can accumulate to thousands of individuals in the deep ocean (100). They, too, depend on teamwork and communication to outmaneuver predators, send warning signals to other members, and protect their young.

Animals in the wild depend on using their resources wisely to hunt, defend themselves, and pass along their genes. However, not every specie is also particularly social or has complex group hierarchies. Dolphins do have such complex social systems, and just one way of enforcing their group culture is through sound. Rendell and Whitehead point to a primary use of dolphin sound in maintaining group bonds and associations, the whistle: "Each dolphin has a distinctive 'signature' whistle, which they use rather like we use names. When isolated they make these

whistles, presumably to get in touch, and may use each others' signature whistles to initiate communication" (118). These whistles are attached to a specific individual in each dolphin community. The sound of a particular whistle can generate unique reactions from different dolphins. For example, dolphins in captivity have elicited behavior in response to a whistle from a dolphin they used to live with tens of years ago, which suggests that they remember and still have strong social ties to that dolphin (119).

Dolphin whistles are learned through interaction with group members, and the dolphins accumulate a knowledge set of whistles from the dolphins surrounding them. Rendell and Whitehead suggest that this aggregation of known whistles can constitute a "them vs. us" type of culture among dolphin societies. Dolphins come to know their own by their whistles, and can easily recognize intruders through sound alone:

> It follows from this that each dolphin develops an awareness of the signature whistles of multiple other dolphins in its community, and this knowledge must be similar across many dolphins within a given community. It has to be learned socially—you cannot learn another's whistle without hearing it from them—and to the extent that dolphins in one community carry knowledge of the unique collection of signature whistles belonging to that community and, more important, which individuals the whistles "belong" to, then this is shared information. Perhaps, then, we should describe this aggregated and shared knowledge that dolphins build up about their community as culture. (119).

In essence, the different collections of whistles throughout the ocean, or at least in geographically close regions where they would affect each other, constitute different cultures, in which dolphins create social bonds and self-identify with their own groups or "cultures." The effect is a population of different cultures living among each other, delineated by different "languages" of whistles.

Rather similarly, orcas use sound to form distinct social groups. Like the dolphins, orcas learn their own dialects of clicking within a group. Individuals do not have signature whistles like the dolphins. However, the clicking among specific orca pods is so distinct in its patterns and organizations that some researchers can recognize orca groups just by their sounds. Presumably, the orca groups can tell each other apart by their sounds, too. After all, they spend their whole lives communicating through these clicks and can probably understand certain subtleties of dialect that we are probably not even aware of yet. One graduate student researcher, John Ford, noticed the intricacies of orca dialects back in the 1980s:

> The pulsed calls of the killer whales can be extremely complex—with different pulsed-call elements being made in intricate patterns or even at the same time. Ford found that each pod of residents had its own repertoire of pulsed calls…Dialect mirrors social system at other levels, too. The calls of the matrilineal units within pods are also a little different, while each pod shares some of its repertoire with other pods, part of their clan. But there are other pods that have completely distinct repertoires, members of other clans. So the different levels of social structure…are mapped onto characteristic dialects. (Rendell 135).

Thus, killer whales recognize social units and hierarchies within those units by distinct dialects. These whales not only use these calls to strengthen social ties, but more importantly to create an "us vs. them" marker between different killer whale pods. The dialects among orca pods seem to even more strongly create in-groups and out-groups than those among dolphins. Rendell and Whitehead even go as far as to describe killer whales as xenophobic, describing examples of groups of killer whales that "either studiously ignore or go to some lengths to avoid one another" (130). In one case, one group of whales became aggressive toward another group of whales, chasing them out of the area, for seemingly no reason such as competition for food (131). This example is used to support the idea that killer whales are fiercely isolationist and prefer little interaction with pods with different cultures.

Whether in close proximity or over tens of miles, cetaceans use the principles of sound in almost every aspect of daily life. They hunt, mate, and defend themselves through various communication efforts. In addition, they socialize, play, create group cultures, and establish hierarchies based on types of underwater dialects. Clearly, communication is essential for survival for these creatures in the open ocean.

Cetaceans in Captivity

The first cetaceans believed to be held in captivity were some beluga whales in the early 1860s. One of the famous founders of the Barnum and Bailey Circus, P.T. Barnum, captured several beluga whales for display in the New York Museum (PBS). The longest living of those Belugas in captivity lasted for almost two years. Though some beluga whales and dolphins continued to be held in captivity for the next several decades, it was not until the late 1930s and

early 1940s that organizations started seriously investing in cetacean captivity. In 1938, the first commercial marine park, Marine Studios, opened to the public (PBS). Marine Studios began specializing in cetacean entertainment with regular shows for the public, and in 1947, the first calf (a bottle-nosed dolphin) born in captivity occurred at the park.

The public's fascination with dolphins grew exponentially in the 1960s with the arrival of Flipper. In 1965, the first orca was brought into captivity. Lack of knowledge about cetaceans and their needs for proper welfare, as well as little to no legislation on marine animal care, led to new and prospering marine parks with more and more animals. Not until 1972 did the first act involving the protection of marine animals pass, however, this act merely required that US citizens have a permit to capture and transport animals (PBS).

From the 1970s onward, more research of these marine animals was initiating. As the public became more informed about them, more ethical issues about captivity arrived on the public's radar. Washington State banned all orca hunting in its waters. The International Whaling Commission made efforts to ban whaling altogether in international waters. However, the issue of cetacean captivity never became a high priority for most politicians and citizens. Most recently, the 2013 documentary *Blackfish* reestablished the issue of cetacean captivity in the public's mind. Its main target, SeaWorld, has received enormous backlash and criticism in the media since its release. Other similar documentaries like *The Whale* in 2013 or *The Cove* in 2009 have further pointed to unethical treatment of cetaceans, as well as highlight our still limited understanding of their ways of life and importance to the oceans' ecosystems.

The early years of captivity for cetaceans often meant small, inadequate housing and harsh training methods like starvation, punishment, and bullying tactics. It also meant a shorter

life span, often significantly shorter than wild counterparts. However, early captivity also paved the way for new research and scientific studies. Limited technology and resources made studying these underwater creatures very difficult. For species of whales that spend a large part of their time in deep water, like the sperm whale, research is still very limited. However, ethical implications aside, keeping these animals in a controlled and viewable environment led to new discoveries about their behavior, much of which contributes to designing more humane captivities today. Researchers, after conducting studies in captivity and in the wild, were also better able to support the need for new legislation and protection around these animals.

Keeping these cetaceans in captivity is not without its issues, though. Captivity has been almost entirely restricted to dolphins and small whales because of size restraints. However, even then there is often not enough room for these smaller species of cetaceans. A large pool cannot compensate for the hundreds of miles of ocean that these whales and dolphins are used to roaming daily. During migrations from feeding grounds to breeding grounds, they are used to swimming even further for thousands of miles. In captivity, their domain is restricted to a few tens of meters. In some instances, even the quality of the pool construction caused health problems for the animals, who might chew and swallow the lining or other industrial objects in the water.

Besides logistical difficulties, marine parks face the challenge of managing the cetaceans' social groups, which are artificially forced upon the animals by placing them in pools with unfamiliar inhabitants. As stated, these animals form intense social bonds in the wild. Their groups develop specific languages and dialects. Dolphins learn unique whistles while orcas maintain strict separation from out-group members. By removing the animals from their wild societies, or even moving captive ones among park locations, humans are disrupting their natural

social order. Captivity throws their developed social bonds into chaos. Dolphins have to learn new whistles. Killer whales have to learn new dialects. Furthermore, when a new whale or dolphin is introduced to a captive group, the cetacean may face aggression from the community because it is seen as an intruder. Instances of violence against a new pool member have been recorded in marine captivity. In the wild, cetaceans have hundreds of miles to distance themselves with from another group. In a pool, such an option is not available. Thus, tensions mount and are quite often released as aggressive behavior. As a result, marine parks sometimes isolate individual cetaceans to prevent physical harm from being inflicted on them. However, the ultimate repercussion from this isolation is to deny the cetacean its instinctual social need, its desire for interaction and emotional connection.

A common practice among marine parks is to breed among already captive animals. Numerous calves have been born to orca mothers in captivity. The mother-calf bond is particularly important in orca social structure. Generations of orca females live together in their groups and will never leave the group throughout their lives. Rendell and Whitehead call orcas "matrilineal," which differs from matriarchal societies like those of elephants and horses: "…daughters stay with their mothers. This is not the same as 'matriarchal,' which means female elders have power or influence…we currently have no evidence that they [orcas] are matriarchal, though we suspect that they are" (126). Thus, orca mothers and calves develop intensely close bonds.

In addition, as more information on the killer whale's brain is surfacing through research, we have learned that their brain is rather developed in a particular region that processes emotions. In fact, it is far more elaborate in comparison to a human brain, leading scientists to theorize that killer whales may be even more highly socialized creatures than humans. They may

be biologically adapted to live an extremely social lifestyle, with complex relationships and powerful group bonds. If this is the case, which most evidence points to, then separating group and family members could be causing traumatic emotional stress on orcas, which in turn affects physical well being. In the 2013 documentary *Blackfish*, two cases of separating mothers and calves are described by former SeaWorld trainers. In the first, a young four year old calf named Kalina is taken from her mother Katina and moved to a different park. Trainers described screeching and moaning sounds coming from the mother for hours afterwards. No other orcas in the pool would approach the mother. One trainer could only describe what she witnessed as "grief," demonstrating a human connection to a whale's emotion. The trainer could personally recognize and empathize with another species based on the orca's behavior and what behaviors we, as humans, attribute to certain emotions like empathy. In yet another case, a calf named Katara was removed from her mother's pen to be moved to another park as well. The mother, Kasaka, was recorded making long-range vocals, searching for her calf.

Clearly, keeping cetaceans in captivity has its challenges for both humans and the marine animals. Maintaining captivity over these animals has its benefits as well. We have learned much about their culture, social lives, languages, brain functions, and relationships that may not have been possible by only observing them in the wild, or at least not as quickly. However, these benefits appear at the most advantage to humans. It is true that cetaceans in captivity have access to veterinary care and abundant food, nevertheless, their life spans still tend to be much shorter in captivity than in the wild, and their social lives are not nearly as disrupted in the wild as in captivity. So is the shorter, less socially meaningful life for the cetaceans really fair for the research and entertainment value pursued by humans? Is it ethical to keep these large, socially complex animals under our supervision when we still do not know the extent of all their needs,

nor are we sure we can even provide them? The next section will explore the ethics of cetacean captivity briefly while touching upon a comparison of their species to the previously domesticated species of horses and dogs.

Ethics on Cetacean Captivity and Human Involvement

We have already seen the long-term effects that human involvement has had on the evolution of horses and dogs. Humans have only just begun in the past century to become seriously involved in the lives of cetaceans. If humans were to have a domesticating force on these smaller of the cetaceans like the orca and dolphin, it would most likely not be any time soon. However, I would argue that humans will probably never permanently hold these animals captive to that point of domestication for several reasons. First, logistical difficulties like the size, medical care, and amount of food needed would be very costly and inconvenient. Though horse care and maintenance is not cheap or easy either, the environmental differences between a horse and a cetacean would be hard to overcome.

Secondly, these environmental contrasts between these domesticated animals and cetaceans is so considerable that the human-animal relationship or bond would not be as forthcoming. Horses and dogs are adaptable to human lifestyles partly because they are also terrestrial animals that we can play with, exercise with, sleep with, and engage with in our everyday habitat. Humans are equal with dogs and horses in that they are all mammals living on solid ground, with four limbs, breathing air, and interacting with similar environmental conditions like the weather and other animals. Connecting with cetaceans requires humans to leave their comfortable habitat and enter the water, where cetaceans have the advantage. Humans

simply cannot physiologically understand what cetaceans hear, feel, or see underwater. We could only connect with them in brief, momentary glimpses. We cannot live side by side with them. Thus, I would maintain that holding these animals in captivity will never lead to that path of normalcy in our everyday lives, just as holding hundreds of other animals in captivity has not yet led to that intimacy either. However, I do not believe that captivity of these animals will end anytime soon either. For many of these same reasons, I would argue against the captivity of cetaceans.

Humans can, of course, form relationships with these animals. After all, they are social creatures just like us with many of the same social needs. However, as argued before, humans cannot fully grasp cetaceans' lifestyles because of our extreme physiological and environmental dissimilarities. Our worlds are so different that we can only understand them at a superficial distance, as a sympathetic outsider looking in, and we can only reach out and try to grasp at the evanescent revelations that they give us of their culture, language, and social lives in order to pretend that we actually know them and what they need.

So is it ethical of humans to assert our lifestyles and wants on whales and dolphins? No, not if we truly have their interests at heart. If humans desire a closer understanding of these mammals, then the most realistic outlook will come from research in the wild. While research on wild animals can have its own dangers and complications, it is not ethical to rob wild animals of a free and quality life because we are not prepared or unwilling to face those challenges. However we also cannot ignore the ethical implications of interfering with the habitats of wild animals. Human interaction with wild animals can be just as harmful. Rendell and Whitehead cite a community of dolphins who became dependent on tourists' feeding them. A study on the dolphin community found that those dolphin mothers who relied on human feeding had a higher

likelihood of their calves dying than those mothers who depended on foraging for themselves (find citation for this). Likewise, numerous accounts of human interaction with whales or dolphins in the wild have led to their injury or death. These concerns then raise the question of whether it is safe or ethical to communicate with them in the wild either? Is captivity, then, more or less ethical than the facing the risks found in the wild? These questions do not have clear answers to them. However, I contend that prolonged harm in captivity is less humane than trying to interact with wild counterparts. While there may not be a "proper" way to interact with cetaceans, humans are more likely to change the behavior of the cetaceans in captivity than in the wild, which is not conducive to accurate research. The majority of captive cetaceans are kept more for commercial and entertainment motives.

Whales have a long and complex evolutionary history. They live socially aware lives with strong emotional connections and intricate communication methods. While we still have much to learn about these amazing creatures, we should not interfere with their natural development in the wild. If humans can learn to respect cetaceans and study them with the dignity they deserve, they can have much to learn from them.

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