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A COMPARISON OF SOCIAL LEARNING IN DOMESTIC CANINES

by
Beatrice Chenkin

A Thesis
Submitted to the Graduate School, the College of Education and Human Sciences and the School of Psychology at The University of Southern Mississippi in Partial Fulfillment of the Requirements for the Degree of Master of Science

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ABSTRACT

Domestic canines (Canis familiaris) provide a unique insight into the processes by which species can grow to cooperate efficiently with humans. Few studies have compared whether their behavior is more affected by humans or other canines. This study uses a two-action feeder (an apparatus that can be opened in one of two ways) to look into the methods of social learning they use and compares how they learn from humans vs. other canines. Sixty-four dogs from the Humane Society of varying backgrounds, ages, sexes, and reproductive statuses were tested on their ability to open the two-action feeder and the amount of time they spent interacting with the apparatus. Between-subject comparisons were drawn between three different conditions: no demonstration, and two conditions in which the methods used to open the apparatus were demonstrated, first by a human, and then a canine. Only two dogs accomplished the task, and it could be argued that they opened it accidently; however, social learnings defined as any alteration of behavior as a result of the observation of another individual. There was a significant difference in the length of time they spent interacting with the feeder ([F (2,61) = 3.169, p<.05]), specifically, they spent significantly more time interacting with the apparatus without a demonstration than with a human demonstration, and more with dog demonstration than a human. These results indicate that dogs as a species may not have evolved to learn from humans.
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DEDICATION

This thesis is dedicated to Dr. Sarah Chenkin and Dr. Carl Chenkin for their support throughout my life, and their ability to encourage and aid in facilitating my academic ventures.
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CHAPTER I - INTRODUCTION

Social learning is one of the most crucial tools for expanding our knowledge of the world, for humans in particular. We learn more from others (both conspecifics and heterospecifics) than any other species. We also use social learning in a unique way, as we are able to build upon knowledge gathered by other humans without direct observation, and therefore can integrate information from a large variety of sources when developing theories, solving problems, and in our overall behavior (Bandura, 1971) Any species that would have to rely fully on trial and error learning is therefore at a distinct disadvantage.

This form of learning is a type of social cognition, which is in turn a component of social psychology, that addresses how people learn from and apply information about others to social situations (Laland, 2004). Social cognition has been a focus of research for decades. Humphrey, one of the first researchers to delve into the analysis of the relationship between social cognition and animal behavior believed that it was the social environment, and not the physical environment that drove humans to develop a heightened level of intelligence (As cited in Cooper, Ashton, Bishop, West, Mills, & Young, 2003). Accordingly, it is possible that the social environment may be the true driving force behind the evolution of mental processes which allow social species such as domestic canines to work more efficiently with other individuals, whether they be conspecifics and heterospecifics (Miklósi, Topál, & Csányi, 2004).

Canines have been shown to be proficient in a variety of forms of social learning (Miller, Rayburn-Reeves, & Zentall, 2009; Udell, Dorey, & Wynne, 2010; Mersmann, Tomasello, Call, Kaminski, and Taborsky (2011)) and have therefore come to be one of the most common subjects in this field of research.
**Costs and benefits of social learning**

Overall, social learning is a faster, more efficient method of transferring information although, as with any mechanism in the natural world, there are costs and benefits that relate both to individual survival and the survival and evolution of the species as a whole (Laland, 2004). All individuals that are capable of social learning still have to weigh the possible costs of social learning against those of asocial learning. This decision, as discussed in Laland’s model includes strategic “when” and “who” strategies including such circumstances as “copy when asocial behavior is costly” and “copy the majority.” There are advantages and disadvantages to nearly every information processing system, and social learning is no exception.

*Advantages.* Typically, in nonhuman animals, social learning is used for foraging, predator avoidance, and reproduction. Finding sustenance is a skill that is often most efficiently developed through observation. Many species of primates give food calls to indicate productive foraging sites to conspecifics (Rapaport & Brown, 2008), and birds are often attracted to sites where they have witnessed others foraging (Avargués-Weber, Dawson, & Chittka, 2013). Learning how to avoid predators through trial and error is often deadly and those who have survived to adulthood have learned methods to avoid being captured or killed. Birds who observe mobbing responses in responses to specific species commonly react fearfully to their presence (Griffen, 2008). Fish exude a chemical when they come into contact with a predator, thereby indicating its presence to others in the area (Griffen, 2004). The act of reproduction can be dangerous (especially due to competition) and time consuming. Through observing the traits of those who have mated with conspecifics, individuals often develop similar preferences in those with whom they choose to reproduce. Female guppies (Dugatkin, 1998) and Japanese quail (Galef &
have both been documented to show a preference towards those conspecifics they have seen mating with other females. In males (e.g. Japanese quails; Galef & White, 1998), the opposite phenomenon has been observed: they have a tendency to avoid females they have witnessed mating with another male in order to maximize the probability of successful reproduction.

Disadvantages. Social learning also requires a specific set of neurobiological structures not present in all species (see section on social learning in nonhuman animals for more detail). Evidence shows that one of the costs of relying on this form of obtaining information is an increase in brain size and complexity (Reader & Laland, 2002). While social learning may be beneficial, this increase can have a debilitating effect on the species overall. The cephalic expansion naturally leads to an increase in the energy required to facilitate and maintain the necessary neurological structures, meaning that a larger amount of energy intake is necessary (Sukhum, Freiler, Wang, & Carlson, 2016).

As the number of asocial learners decreases, it is possible that asocial learning will mean the use of beneficial behaviors may increase. If, as an environment changes, the social learners continue to copy the same behaviors, they will not evolve to find the most efficient paths to survival. According to some researchers, social learning is actually a form of “information parasitism” (Giraldeau, Valone, & Templeton, 2002). Barnard and Sibly (1981) categorize asocial learners as producers and social learners as scroungers, and state that according to game theory, scrounging will only be an adaptive advantage when rare in the population. In this case, most of the producers will be asocial learners that have established reliable information about the environment. When producers are rare, the information that is passed through social learning may not be accurate or be the most effective behavior in that situation (Boyd & Richerson, 1996; Giraldeau et al.,
2002). For example, guppies were equally likely to follow the shortest or the longest route to a foraging site depending on which route they had observed a conspecific using (Laland & Williams, 1998). In terms of mate selection, if females become more attracted to a specific phenotype due to social learning, it is possible that a less advantageous phenotype will be spread through a population by breeding, which can negatively affect the evolution of traits that increase survival (Verzijden et al., 2012).

**Forms of Social learning.**

Social learning is a form of information transfer that is defined as “an incidence in which individuals acquire new behavior or information about their environment via observation of, or interaction with, other animals or their products” (Brown & Laland, 2003, p. 280-281). It not only includes circumstances where an individual learns a new skill or a solution to a problem, but also instances where they alter their behavior according to what they have observed, such as enhanced attention and interaction with stimuli. Examples of social learning have been found in a variety of species, but the forms vary significantly. There are a variety of mechanisms that fall under the category of social learning (see appendix 1), most of which are not true imitation. The processes used are one of the factors that may separate the transference of knowledge in humans versus nonhumans. These mechanisms include stimulus enhancement, local enhancement, social facilitation, emulation, and imitation.

Stimulus enhancement occurs when the mere presence of an individual will increase the observer’s attention toward a stimulus, thereby enhancing the probability that the observer will learn about the object (Caldwell & Whiten, 2002). For example, when pairs of monkeys were placed in separate cages with the same set of objects, the observer would most commonly attend to the same object as the model (Warden & Jackson, 1935).
Local enhancement on the other hand refers to situations where an observer is more likely to form an association between a stimulus and a location because the model demonstrates a relationship between the two. Bumblebees have been shown to be significantly more likely to choose flower patches where they have seen conspecifics collecting nectar (Leadbeater & Chittka, 2007). Social facilitation involves the phenomenon in which an observer is more likely to attend to an object or location or reproduce a behavior while in the presence of a conspecific while he is performing a behavior. In a study by Hoppitt, Blackburn, and Laland (2006) birds were seven times more likely to preen when other individuals were also preening and were 4 times more likely to sit when their conspecifics were sitting (indicating social facilitation).

Emulation is another form of social learning that can be especially difficult to separate from imitation. When emulation is used, the subject learns the end goal of a behavior but does not copy the behavior used to achieve that goal. Overall, it has been found that while the emulation of a human model is possible in several species such as great apes (Call, Carpenter, & Tomasello, 2004), red squirrels (Weigle & Hanson, 1980), and keas (Huber, Rechberger, & Taborsky, 2001), however imitation is much rarer. When controlling for the variables of social facilitation and stimulus enhancement in a bidirectional procedure (where subjects are presented with a handle that can pushed either to the right or left to produce a reward), it was found that the dogs would more consistently obtain the reward but would not reliably manipulate it in the same way as their human model. This indicates that the results were examples of emulation as opposed to imitation as they would still produce the reward, but not necessarily by using the same method (Miller et al., 2009 Rayburn-Reeves, & Zentall, 2009).
Imitation requires the animal to not only learn that an end goal is possible, but also learn through observation the exact method needed to achieve it. Imitation is the rarest form of social learning in the animal kingdom. While many species have been found to be more likely to understand the end goal of an action, far fewer seem to grasp not only the goal, the intent, and the method, all of which are necessary for a behavior to be classified as imitation (Heyes, 2004). While rare, imitation is not unheard of outside humans. After witnessing a demonstration Pigeons and Japanese quail would, reliably used the same method as a model to open a two-action feeder as the model (Akins & Zentall, 1996), and budgerigars were more likely to remove a cover from a flat dish with either their beak or their feet depending on which method was demonstrated (Galef, Manzig, & Field, 1986).

The issue with studying social learning is that it is often difficult to differentiate between all the mechanisms of learning. The most effective method of separating out forms of learning is through the use of a bidirectional (or two-action) task, originally developed by Meltzoff (1995). In this paradigm, an apparatus (feeder) is that can be opened by the subject using one of two methods in order to retrieve the reward hidden inside. If the subject is shown to attend more to the object but is not more likely to successfully access the reward, the effect is most likely due to stimulus enhancement, local enhancement, or social facilitation. If the animal is more likely to succeed at opening the device but does not use the same method as the model, it indicates emulation. If, however, the subject uses the same behavior to access the reward, it indicates imitation.
Nonhuman animals.

Humans vs. nonhuman animals. Some forms of social learning seem to be a defining difference between nonhuman and human animals. While humans are very capable of, and often utilize, true imitation, nonhuman animals are much more likely to use other forms of social learning such as emulation or simply local and stimulus enhancement.

Using a two-action feeder humans and chimpanzees were compared in a task that was designed to differentiate between emulation and imitation. A tube presented to the subjects contained a reward and could be opened either by breaking it in the middle or pulling the caps off the ends. In the action-only trials the methods necessary to open the tube were shown but the tube was never opened. In the end state only condition the tube was open but the method used was not shown. In another set of trials both the action and the end result were shown, and in another neither was presented. Unlike human children, chimpanzees showed no preference for a specific action across conditions, although they were more successful at opening the tube with a model (using any possible method). Children not only were more successful, they were more likely to copy the specific method shown by the model in both the action-only and full demonstration trials. These results indicate that chimpanzees were learning only that the tube could be opened as opposed to how it could be opened (emulation), and children were learning the specifics of how to open it (imitation) (Call et al., 2004).

In many animals, the skills required for survival can be learned by any one individual through trial and error, whereas many of the skills necessary in human society require an understanding of techniques previously developed by others (Tennie, Call, & Tomasello, 2009). For example, the ability to write a haiku requires knowing what a
haiku is and understanding language, neither of which could be fully developed by itself. The ‘ratchet effect’ describes how while some animals do show evidence of culture (Tomasello & Rakoczy, 2003), only humans show cumulative culture. The vast amount of previously accumulated culture has significantly decreased the costs of social learning. Furthermore, once animals have established a method that is sufficient to perform a task they will rarely look to others to find a process that may be more efficient, whereas humans will often continue to observe others and adapt processes to increase efficiency (Laland, 2004). The most beneficial circumstances under which to use cultural learning is to only use it when the costs are minimal, and the information is most likely to be accurate. (Boyd, Richerson, & Henrich, 2011).

Humans’ ability to occupy most of the world provides a valuable example of how social learning may have affected their evolutionary path. The availability of cultural information may have led to the evolution of bigger brains to allow for the processing of a vast amount of information. Due to the techniques for such actions as cooking, creating weapons, and using tools, there were new pressures affecting the formation of our bodies (Boyd et al., 2011). Humans, more than any other species, are confronted with ever-changing social relationships and environmental changes. This is believed to be one of the bases for the expansion of the neocortex. The abilities of this enhanced neocortex allow humans to be able to adjust to the ever-changing culture surrounding us. (Flinn, 1996).

*Dogs vs. wolves.* Dogs have been chosen as a particularly useful model for a few reasons. Dogs come in a multitude of breeds from a myriad of backgrounds. Training, rearing environment (e.g. as a stray or in a home for example), the possibility of abuse, and differences between breeds charactistics are just a few examples of the variables
that can affect a dog’s ability to learn socially. For example, dogs who have very little exposure to humans have a much lower probability of being able to pick up on communicative cues such as pointing, body posture, etc. Dogs who are trained for specific tasks, such as herding dogs and service dogs, need to be trained to have a higher level of attentiveness towards the humans they are working with.

Also, the fact that domesticated canines have a closely related yet undomesticated species (wolves), allows for a unique insight into what may have caused their changes in behavior and possibly in their ability to learn from humans or conspecifics (Miklósi et al., 2004). Many hypotheses regarding the possible origins of domestic canines’ sociocognitive abilities have been posited.

Comparing dogs to wolves (the most direct evolutionary ancestor of domestic canines) could potentially provide insight into whether their social learning strategies have changed within these species and if so, why. The subject of the origin of a domestic canine’s affinity for communicating with humans is a topic of much debate. Humans integrated wolves into their lives, causing a change in their characteristics as they became domesticated, but the question is how (and what led to) changes in social learning capabilities (if any such changes exist). Generally, research has shown that dogs outperform wolves frequently in a variety of different tasks, which has led to the development of different theories meant to explain these variations; however, each theory has contradicting evidence (Topál et al., 2005; Miklósi, Topál, & Csányi, 2007; Hare, 2002). It is important to understand that while there are a variety of hypotheses, none of these are mutually exclusive. It could be that certain factors from each hypothesis are true, or it could be that their developments were at first due to one of these explanations,
and throughout their evolution a different hypothesis could explain other steps of their evolution.

**Emotional reactivity hypothesis**

The emotional reactivity hypothesis posits that dogs are less aggressive with conspecifics and therefore outperform wolves when intraspecies communication is advantageous (Hare & Tomasello, 2005). Some believe that the development of traits that allow for cooperation and communication with humans led to genetic predispositions that caused the development of certain human skills. The two main traits that have been associated with this evolution are social tolerance and social attentiveness. Social tolerance is related to the emotional reactivity hypothesis, which posits that a temperament with reduced fear and aggression is what allows dogs to cooperate and communicate with humans as well as conspecifics. According to this theory, dogs have also developed a predisposition for social attentiveness where they are able to adjust their behavior based on both conspecifics and humans (Hare & Tomasello, 2005).

The evolution of these kinds of “prosocial” behaviors through the domestication process is illustrated in the studies of domestication in the silver fox (Belyaev, Plyusnina, & Trut, 1985). The researchers separated the foxes into two groups; one was selected for friendliness, the other for aggressiveness. Domestication led to many changes in their characteristics, and not all were behavior related. Those in the domesticated group would open their eyes earlier in their development and react to sound more quickly. Once these changes occurred, they were more inclined to explore and form social relationships. The study showed that the shorter the sensitive period of socialization, the more likely the pups were to show more aggressive behavior towards humans (Belyaev et al., 1985). However, a secondary experiment using the same population of foxes also showed that
those in the domesticated group not only differed in friendliness, but in many other social behaviors – for example, this group would vocalize frequently towards unfamiliar humans for a significantly longer time than those in the aggressive fox group (Gogoleva, Volodin, Volodina, Kharl'moya, & Trut., 2010). These results show that the domestication process does lead to changes in nonhuman animals’ behavior towards humans, but additionally indicates that it can have biological effects that may be the basis for these changes in behavior.

Domestication hypothesis

The domestication hypothesis is possibly the most commonly used explanation for a dog’s understanding of human communication and behavior. It posits that dogs’ social skills formed as an adaptation to life with humans, who bred them for specific skills allowing them to be more efficient in their communication with humans (Kaminski & Piotti, 2016). These theorists believe that humans specifically selected dogs and bred them to be more cooperative and better able to learn specific social skills. This ultimately meant that humans “designed” dogs to more effectively communicate with humans.

Comparative experiments have been used to examine the domestication hypothesis by examining difference between breeds that have been designed for specific occupations as well as those that are genetically closer or further away from wolves. Both working dogs (German shepherds and Siberian huskies) and non-working dogs (Basenjis and toy poodles) were able to follow human communicative signals regardless of their level of contact with humans, although working dogs showed a higher level of responsiveness. Genetic testing of German shepherds indicates that they are less wolf-like than Siberian huskies and toy poodles are less wolf-like than Basenjis. No significant difference was found between the wolf-like and non-wolf like breeds in terms of their
ability to follow human communicative skills. In addition, the jobs assigned to specific breeds barely affected the communication abilities (Wobber, Hare, Koler-Matznick, Wrangham, & Tomasello, 2009).

A similar experiment using ten of the most common domesticated breeds, separated into “utility,” shepherd,” and “hunting breeds,” used a detour task which showed that although those in the shepherd group looked back more frequently to their owners, no significant differences were found in their ability to follow human communicative signals. This was independent of age. The lack of differences between species indicates that domestication is most likely not the sole mechanism responsible for the development of the domestic dog.

Evolutionary hypothesis

A third commonly accepted hypothesis regarding the development of domestic dogs’ communication with humans is the idea that through contact over a long span of their interactions with humans over time, dogs that communicated more effectively with humans had a better survival rate, and therefore, they have developed traits that facilitate this communication. The difference between the domestication and evolutionary hypotheses is that the evolutionary hypothesis suggests that as humans integrated dogs into their everyday lives the dogs evolved certain characteristics to facilitate their new role in life. The domestication hypothesis, on the other hand, refers to the idea that humans have intentionally bred dogs so that they acquired specific traits. The evolutionary perspective posits that the evolution of processes affecting sociality changes the reaction norms of social behavior which, in turn, changes the potential capacity for a variety of social phenotypes such as attentiveness toward human gestures and an understanding of their communicative intent (Kaminski, Schulz, & Tomasello., 2011).
If the evolutionary hypothesis is true, dogs would be significantly more likely to follow human communicative gestures than wolves, but in studies that include a direct comparison between the two, results have been contradictory (Udell et al., 2008). In the object choice task, animals are presented with two possible locations where a reward could be hidden, and an individual (either conspecific or heterospecific) indicates with one of a few possible communicative gestures (e.g. pointing, gazing, local enhancement) where the reward is located. This paradigm is the basis for many comparisons between wolves and dogs in terms of their receptiveness to communication from humans. Using variations on this paradigm, dogs have been found to follow points, gazes, nods, head-turns, and glances from humans (Miklósi, Polgárdi, Topál, & Csányi, 1998; Bräuer, Kaminski, Riedel, Call, & Tomasello, 2006; Reid, 2009; Hare & Tomasello, 2005).

One such experiment comparing seven wolves and seven dogs (all human-reared) showed that in all conditions other than the control (gazing, pointing, and tapping a baited container, gazing and pointing at the container, pointing at the container, and a control with no communicative gesture), dogs found more food than the wolves (Hare, 2002). However, in another experiment where both dogs and wolves were tested in the same environment (whereas in previous tasks the dogs were tested indoors and wolves were tested outdoors), and both species had similar levels of human socialization, they performed equally well at the object-choice task, and in some cases wolves even outperformed dogs (Udell et al., 2008).

The dogs and wolves used in comparative studies vary significantly in relation to the individual subjects. They can be a variety of breeds with different rearing patterns and environments. Due to the lack of analyses of the subjects’ genetic and phenotypic influences, evidence of the evolutionary background has not been sufficient. The tests
used in all of these studies neglected to take into account these variables and can therefore, overall, not be accepted as true tests of evolutionary effects.

**Social interaction hypothesis**

Finally, the social interaction hypothesis refers to the idea that the most important variable affecting dogs’ (and other animals’) communicative abilities is the amount of direct contact with humans. In other words, to understand human communications, animals must have extensive contact with humans who are continuously interacting with them socially. Supporting this hypothesis, Udell et al. (2010) showed that when stray dogs residing in shelters were tested with the object choice task, researchers found that none of them were able to follow a momentary distal point (where the human points to an object placed farther away and only for a moment as opposed to an extended). This is in direct contrast to pet dogs who were capable of following this form of gesture (Miklósi et al., 1998). After a few training sessions, however, 86% of the shelter dogs performed above chance in understanding the momentary point, and more than half of these obtained that ability in 15 or few trials (Udell et al., 2010). Lazarowski and Dorman (2015) also found that kennel-reared animals were significantly less capable of following momentary distal points. Hare et al. (2010) on the other hand, found that regardless of the dog’s previous exposure to humans, shelter dogs were equally capable of following a variety of distal points. They propose that the negative results found in other experiments were a result of a very small sample size. Also, similar effects of social interaction were found with apes, particularly when tested on non-distal points (Lyn, 2010), suggesting that direct exposure to humans is a prime variable in successfully learning human communicative signals.
The level of human interaction required in the everyday lives of those dogs trained for specific tasks has been shown to be a variable in their capacity to understand human communication. In the ‘unsolvable task paradigm’ a reward is placed underneath an overturned Tupperware container. In the ‘solvable’ trials the Tupperware can either be slid off a platform or turned over, whereas in the ‘unsolvable’ trials the Tupperware is affixed to the platform. In a comparison between search and rescue and agility dogs using the ‘unsolvable task’ paradigm, agility dogs, who are much more dependent than on human communication than search and rescue dogs, were found to look at their owners significantly more frequently. Search and rescue dogs, whose job is much more independent than agility dogs, only looked towards their owners when the task was unsolvable. (Marshall-Pescini, Passalacqua, Barnard, Valsecchi, & Prato-Previde, 2009). Even when animals have been trained for the same task, but their level of social interaction varies, those with an increased level of human contact are more likely to gaze at their owners. When comparing guide dogs that had just finished their training to those who had been living with a family for at least one year, those who were living with the family gazed at their owner more frequently and for a longer duration than those who had not during the ‘unsolvable’ task implementation (Scandurra, Prato-Previde, Valsecchi, Aria, & D'Aniello, 2015).

Overall, two possible explanations for why, in some of these experiments, wolves and dogs differed in their ability to follow human communicative gestures is 1) the period of peak socialization and/or 2) extreme methodological differences. For socialization with humans to be effective, research has shown that the wolves have to be removed from their mother between ten and 14 days after birth, which is not the case in many of the experiments discussed below. This critical socialization period lasts significantly longer
in domesticated dogs, and therefore many of these comparisons may not be valid. Furthermore, even such small variables as the location where the animals were tested (Udell et al., 2008) the type of harness or leash used, and the form of reinforcement and punishment (Frank, 2011) were found to affect the results.

_Social learning in dogs._ Surprisingly, research on purely conspecific social learning in dogs is much sparser than analyses of human-dog connections. Only a few tasks designed solely for the understanding of their conspecific social learning have been developed. Using a form of a detour task where dogs had to maneuver themselves around a barrier to access a reward, Mersmann et al. (2011) found that the dogs did benefit from a conspecific model in terms of acquiring a reward, but they often did not move in the same direction as was demonstrated. These results indicate emulation because if imitation was used, they would have directly followed the behavior of the model. The subjects did not need to witness a full demonstration of the behavior to solve the task.

When using a two-action feeder and controlling for olfactory stimuli, dogs were significantly more likely to imitate the method of access used by a conspecific. This effect was not seen when another dog was merely in the same room as the subject and the apparatus opened independently (Miller et al., 2009). A variant of the two-action test where subjects were rewarded for either performing the same behavior as the model or the opposite method showed that those asked to counter-imitate were significantly slower to learn the behavior. Similarly, using a horizontal tube that would release a ball by either pulling one of two ropes or pushing down any end of the tube, naïve dogs were significantly more likely to push the tube, while observers used the demonstrated action more frequently (Kubinyi, Pongráz, & Miklósi, 2009). The fact that the detour task and the two-action feeder task produced conflicting results indicates a necessity for further
analyses of a dog’s ability to learn from conspecifics, as well as the mechanisms behind their responses.

Few studies have been conducted comparing conspecifics to heterospecifics in terms of their efficacy for advancing social learning in dogs. In only one study by Hare & Tomasello (1999) using the object choice task were dogs given cues from both a human and a conspecific. The paradigm included two barriers, one of which had a reward hidden behind it. In the human gaze-point trials the humans would merely point at the correct barrier. In the dog gaze-point task, prior to the subject dog entering the room, an experimenter would attract the model dog’s attention towards the correct barrier using a food reward to ensure that the dog was looking at the correct barrier when the observing dog entered. Human models proved more effective at communicating with the dogs. This study, however, cannot be considered conclusive due to the fact that the dog models were only presenting a gaze and the human models were using a purposeful point.

Range and Virányi (2013) compared wolves and dogs in their ability to learn from conspecifics versus human models. Treats were placed in one of three locations in a meadow, equidistant from the starting point. The model dog would be given a food reward and directed to bring it to the chosen location, drop it, and return to the starting location. The human model would use the same procedure. This study showed wolves and dogs were able to learn from the demonstrations of both conspecifics and heterospecifics, despite the generally accepted theory that wolves have not formed as close a bond with humans as dogs have. It is important to note that because the dogs did not need to use a specific method to access the reward, these data only indicate the effectiveness of social facilitation.
CHAPTER II – CURRENT STUDY

The purpose of this study was to contrast and analyze the forms of social learning used by dogs (local enhancement, stimulus enhancement, social facilitation, emulation, or imitation) as well as evaluate whether there was difference in success level or learning methods used when provided with a human versus a conspecific demonstrator.

Domestic canines were assessed in their ability to open the two-action feeder, including a comparison between heterospecific and conspecific models. Condition one served as a baseline to assess dogs’ ability to open the device and the extent of their interaction with the apparatus without demonstration, and conditions two and three analyzed the difference the same variables when comparing human models to canine models. The two-action feeder enabled us to analyze the type of social learning that was being implemented. If a dog was more likely to interact with the device after seeing a human or conspecific manipulating it but was not more capable of determining the method needed to open it, it indicated local enhancement, stimulus enhancement, or social facilitation. If the subject was more likely to be successfully open the feeder and/or required less time when provided with a model but did not use the same method it indicated emulation. If they routinely used the same method as shown by the model, it indicated imitation.

The social interaction hypothesis seems to provide the most convincing explanation of canine behavior. While it is true that certain breeds, such as sheep dogs, are born with innate drives and biological traits that make them more equipped to conduct certain tasks, studies have shown that this does not actually have as much of an effect on their overall abilities. Dogs used as guides for the blind often come from the same genetic line. Scott and Biefelt, 1976) found that while traits helpful to the training of
seeing eye dogs did become more frequent over successive generations, that factor did not have a significant effect on whether they would become successful service dogs. Comparisons between wolves and dogs have shown fewer differences in their affinity for learning from, and attending to, humans than has previously been assumed (Range and Virányi, 2013; Udell et al., 2008). Keeping that in mind, we hypothesized that having a demonstrator would significantly increase the length of time the dogs spent interacting with the apparatus, but we predicted there would be no difference between the dog and human demonstrator conditions, nor did we believe that dogs will be more capable of opening the device with either model.

In this experiment, we were unable to test the social interaction hypothesis directly due to a lack of background information on the dogs; however, if the results coincided with our hypotheses, it would indicate a lack of evidence of the alternatives (emotional reactivity, domestication, evolutionary hypotheses)

Methods.

Participants. Ex Domestic canines (Canis familiaris) from the Humane Society of South Mississippi were the subjects of this study. All dogs were over one year of age. A pseudorandom array of mixed breeds, sexes, and ages were included. The dogs we used had to be over 1 year old, interested in treats, and not too timid, therefore the selection could not be truly random. We did, however, select dogs of a variety of breeds, sizes, and background. The total set included 64 dogs: 22 in the no demonstration condition, 11 were shown the lever by a human and 11 by a dog, 10 were shown the button by a human and 10 by a dog. The dogs ranged from 1 year old to 9 years seven months. Thirty-two were female and thirty-two were male, thirty-two were fixed, and thirty-two were not. They ranged from 15 to 68 pounds in weight. Five were returned by
their owners within 30 days of being adopted, six were owner surrenders, two were transferred in from other shelters, and 51 were strays; however, we have no way of knowing whether those strays had previously lived in a home.

Materials. A two-action feeder box (2’ x 2’ x 2’) was used in this study (see figure 1, 2). The top of the two-action feeder could be opened to allow the experiment to place a reward inside. On one side of the apparatus was a double door that, when the dog stepped on a lever, swung inwards. On the other side was a door that dropped down when the dog pushed a button either with their paw or their nose. All four sides had a mesh covering so the dog could see that there is a reward inside from all directions.

Figure 1. Two-action feeder button mechanism

Figure 2. Two-action feeder lever mechanism
Procedures.

General procedure for all conditions

Dogs were removed from their enclosures and taken outside for a short walk. They were then brought into the experiment room which was approximately 6’ x 4’. The testing apparatus was placed inside the room prior to the dog’s entry and covered with a tarp. The dog was allowed three minutes to explore the room prior to the start of the experiment. Experimenters sat on either side of the room and, using a stopwatch, kept track of the total length of time the dog spent directly interacting with the device. Each phase was video-recorded by two cameras, one on either side of the apparatus. In all phases the number of dogs who successfully opened the feeder, the length of time the subject interacted with the feeder, the method used to open, and the length of time necessary for the animal to access the reward was recorded. All trials lasted ten minutes. Interactions were defined as any direct contact the dog made with the device.

Baseline procedure

This condition served as a baseline for the canine’s ability to learn how to access the reward on its own. Twenty-two dogs were presented with the feeder individually and after the three-minute acclimation period, were allowed access to the feeder.

Conspecific (canine) demonstration condition

The Conspecific demonstration condition included two groups of twenty-one dogs, each with a canine model. The canine model was trained to open the feeder in one of the two possible ways and was instructed to model the behavior three times in the presence of the observing dog, then was removed from the room.

Group 1 (10 dogs): The dog demonstrated the opening of the apparatus by stepping on the lever
Group 2- (11 dogs): The dog demonstrated the opening of the apparatus by pressing the button.

*Human model condition*

The Human model condition used the same procedure as those in the Conspecific demonstration condition, except instead of a canine model, they were provided with a human model.

*Reliability.* Using the videos from 18 trials, the author and a trained second coder video coded the length of time that each dog spent interacting with the device in order to ensure reliability. We recorded the length of time that the dog spent touching the apparatus in each trial. Timing would begin when the dog touched the apparatus and would end as soon as they broke contact and would then continue when they began the interaction again. We then added those times up to find the total interaction time. Coders’ agreement on total time spent interacting was 98%.

*Statistical analyses and questions.*

1. Is there a difference in the length of time spent interacting with the two-action feeder between the three conditions?

Analysis: A 1 (length of time) x 3 (conditions) ANOVA with post hoc Tukey’s HSD tests will be used to test whether there was a significant difference in the length of time spent interacting with the feeder.

We had hoped to also analyze differences between the animals that had successfully opened the feeder depending on condition, but our results rendered those analyses impossible.
Results.

During all three conditions the dogs interacted with the box, but only two managed to open it: one during the baseline condition and one during the human demonstration condition. It also could be argued that both of dogs succeeded by accident as neither was actually facing the apparatus at the time. Due to this outcome, we were only able to statistically analyze the length of time the dogs spent interacting with the apparatus, comparing the totals across the three conditions.

We ended with 22 dogs in the no demonstration condition and 21 in both the human and dog conditions, however due to pooled variances this would not affect the results. There was a significant effect of the demonstration condition on the length of time the dogs spent interacting with the apparatus [F (2,61) = 3.169, p<.05]. Post hoc tests concluded that the significant difference lay between the no demonstration and dog conditions, as well as between the dog and human conditions, the latter showing the largest disparity (see graph 1). The assumption of homogeneity of variance was met [F (2, 61) = 1.296, p=.296], and the variances were normally distributed in the no demonstrator condition. Post hoc tests concluded that the significant difference lay between the no demonstration and dog conditions, as well as between the dog and human conditions, the latter showing the largest disparity (see graph 1). We also found that dogs who had been neutered were spent significantly more time interacting with the apparatus [F (2, 61) = 6.449, p<.01], but found that age, weight, nor gender did not have a significant effect.
Qualitatively, results also indicate that demonstrators were effective in changing the behavior of the dogs. During the trials, researchers noted the dogs’ behavior toward the apparatus – for instance whether they attended to or interacted with a specific mechanism. Surprisingly, we saw the most correctly directed attention in the human demonstrator trials, with two dogs lifting the lever repeatedly in the human-lever trials, and two consistently sniffing at the button in the human-button trials. This is in direct contrast to the no demonstration trials in which no dogs showed increased attention to either the button or the lever. In the dog demonstrator trials only one dog interacted with the lever in the dog-lever trials, although that dog was persistent. These data are somewhat inconsistent with the time data in that those data had shown that the least length of time they spent interacting with the apparatus was during the human demonstration trials.

Figure 3. Total durations of all dogs’ contact with the puzzle feeder
CHAPTER III – DISCUSSION

Humans have developed a diverse assortment of hypotheses to explain canines’ behavior in terms of their connections with humans and other dogs, as discussed above. The original design of the experiment was intended to focus on the effectiveness of demonstrations from humans and conspecifics on their ability to understand and complete a task; however, since only two of the dogs opened the apparatus, the assessment became more focused on social facilitation.

As mentioned above, both stimulus enhancement and local enhancement are forms of social facilitation and are evidenced by an increase in a behavior and/or attraction towards a stimulus /location following the observation of our model. We can conclude that this does still show an indication of social learning because the dogs’ behavior was altered after witnessing a model interacting with the apparatus. Our study seemed to, as predicted, lack evidence to support the evolutionary, domestication, or emotional reactivity hypotheses. Dogs were not able to learn how to open the device by observing canines nor humans. Therefore, it is more likely that a dog’s ability to communicate either with conspecifics or heterospecifics is actually due to their upbringing and exposure and is further supported by the fact that sexual status (neutered/spayed) had a significant effect on their interaction time while age, weight, and gender did not.

Social facilitation (both through stimulus and local enhancement) has been shown in all social animals and is a mechanism that is less debated than emulation or imitation by scientists. In this case while the animal is more drawn to an object after observing other animals interacting with it, the animal is still required to obtain information about the object separately, All of the experiments mentioned in this paper where a canine was
asked to solve a problem based solely on a demonstration showed evidence of social facilitation, while only a few showed any indication of direct imitation or emulation (Marshall-Pescini, Passalacqua, Barnard, Valsecchi, & Prato-Previde, 2009; Scandurra, Prato-Previde, Valsecchi, Aria, & D’Aniello, 2015; Miklósi, Polgárdi, Topál, & Csányi, 1998; Bräuer, Kaminski, Riedel, Call, & Tomasello, 2006; Reid, 2009; Hare & Tomasello, 2005).

As was also expected, there was a significant difference in the length of time between conditions that the dogs spent interacting with the apparatus. We assumed that due to social facilitation they would be more drawn to the apparatus, but we did not expect there to be a difference in the interaction time between the dog and human demonstration conditions. On the contrary, we did find a significant difference between those conditions. Additionally, while there was a significant difference between the no demonstration and dog model conditions, there was not one between the no demonstration and human model conditions. This seems to indicate that while most hypotheses suggest that dogs have developed more of an affinity for cooperating with humans as opposed to other dogs, that may not be case. However, the fact that the more dogs in the human-model condition seemed to pay additional attention to the mechanism that was demonstrated to them (as opposed to the apparatus in general) does imply some level of social facilitation and even suggests the use of imitation. These results further support the social interaction hypothesis, because, if the emotional reactivity, domestication, or evolutionary hypothesis had been correct, we would have at least seen a significant increase in the length of time they spent interacting in the human model conditions when compared to the no demonstration condition.
These results further negative alternatives to social interaction hypothesis, because, if the emotional reactivity, domestication, or evolutionary hypothesis had been correct, we would have at least seen a significant increase in the length of time they spent interacting in the human model conditions when compared to the no demonstration condition. We also found that the largest difference lay between the human and dog model conditions, but the results actually showed that the dogs spent significantly more time interacting in the dog model condition. If the alternative hypotheses had been correct, we would expect to have found the opposite.

It could be that the dogs in the shelter have actually had more exposure to other dogs than they have to humans, although due to our lack of background information, we are unable to be conclusive about that fact. It would be interesting to conduct the same experiment with dogs of an array of breeds and ages when some have been exposed more frequently to humans and some have had a higher level of interaction with dogs. Another possible explanation is that because the dog had already met and greeted the demonstrator, its attention was not as drawn towards the human model as it was by the dog model, who was completely unfamiliar, due to habituation. This could have been part of the reason we did not find a significant difference in the interaction times between the no demonstration and human demonstration trials. Further experiments could prevent any contact with the experiment before the human model condition.

It also would have been beneficial to measure the length of time they spent interacting with either side of the apparatus instead of the total time. If the dogs were more likely to attend to the same side as had been used in the demonstration, that could have been more reliable in indicating whether there was a significant difference in the level of social facilitation when comparing the three conditions.
Task difficulty is a factor in all experiments that use the two-action feeder. Each dog was only exposed to the apparatus once, and in the model conditions, the model only demonstrated how to access the reward three times. It would be interesting if, using further experiments, we could look at how many demonstrations are necessary for the dog to open the apparatus, and if there is a difference in how quickly they learn from humans versus other dogs. We could then further analyze, depending on which method they use to open the apparatus, whether they are more likely to use emulation or imitation, as opposed to merely looking at the effects of social facilitation.

The results of our experiment suggest that communication between dogs and humans and dogs and conspecifics is mostly due to the level of exposure and extent of interactions they have had over the course of their lives. Social facilitation was the only factor that changed across conditions, as none of the dogs were able to learn how to open the apparatus. This study supports the social interaction hypotheses and lays the groundwork for future experiments, in particular those that look into the amount of exposure necessary to allow the dog to learn to operate the apparatus through demonstrations.
APPENDIX A – Methods of Social Learning.

*Table A1. Forms of Social Learning*

<table>
<thead>
<tr>
<th>TYPE OF LEARNING</th>
<th>DEFINITION</th>
<th>EXAMPLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stimulus Enhancement</td>
<td>Presence of an individual increases the observer’s attention towards a stimulus, thereby increasing the probability the observer will interact with and learn about the stimulus.</td>
<td>When monkeys were placed in separate cages with the same set of objects, the observer would more commonly attend to the same object as the model (Warden &amp; Jackson, 1935).</td>
</tr>
<tr>
<td>Local Enhancement</td>
<td>Situations where, because a model has shown a relationship between a stimulus and a location, the observer is more likely to form an association between the two.</td>
<td>Bumblebees have been shown to be significantly more likely to choose flower patches where they have seen conspecifics collecting nectar (Leadbeater &amp; Chittka, 2007).</td>
</tr>
<tr>
<td>Social Facilitation</td>
<td>Includes both stimulus and local enhancement. Being in the presence of a conspecific while he is performing a behavior increases the probability of the observer attending to either the stimulus.</td>
<td>In one study, birds were seven times more likely to preen when other individuals were also preening, and 4 times more likely to sit when their conspecifics were preening.</td>
</tr>
</tbody>
</table>
Table A1 (continued).

<table>
<thead>
<tr>
<th>Emulation</th>
<th>Using the two-action test (where a handle could be pushed either to the left or right to produce a reward), dogs would interact more consistently with a handle when they observed a human manipulating it but would not reliably manipulate it in the same manner as the model (Miller et al., 2009).</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Emulation</strong></td>
<td>Through observation, the subject learns the end result or goal of a behavior but does not copy the method used to achieve that result.</td>
</tr>
<tr>
<td><strong>Imitation</strong></td>
<td>The subject will copy the behavior of a model exactly in order to produce the same reward.</td>
</tr>
<tr>
<td><strong>Imitation</strong></td>
<td>Using the two-action test with pigeons and Japanese quail (Akins &amp; Zentall, 1996), results showed that both species were more likely to use the same method to open the apparatus as was demonstrated by the model.</td>
</tr>
</tbody>
</table>
APPENDIX B – IACUC Approval Letter

NOTICE OF COMMITTEE ACTION

The proposal noted below was reviewed and approved by The University of Southern Mississippi Institutional Animal Care and Use Committee (IACUC) in accordance with regulations by the United States Department of Agriculture and the Public Health Service Office of Laboratory Animal Welfare. The project expiration date is noted below. If for some reason the project is not completed by the end of the approval period, your protocol must be reactivated (a new protocol must be submitted and approved) before further work involving the use of animals can be done.

Any significant changes should be brought to the attention of the committee at the earliest possible time. If you should have any questions, please contact me.

PROTOCOL NUMBER: 18020801
PROJECT TITLE: Social Learning in Canines Heterospecific and Conspecific Models
PROPOSED PROJECT DATES: 02/2018 – 09/2020
PROJECT TYPE: New Protocol
PRINCIPAL INVESTIGATOR(S): Heidi Lyn
DEPARTMENT: Psychology
FUNDING AGENCY/SPONSOR: N/A
IACUC COMMITTEE ACTION: Approved
PROTOCOL EXPIRATION DATE: September 30, 2020

Jake Schaether, PhD
IACUC Chair
February 28, 2018
APPENDIX C – The Process of Domestication in Canines

I'm cold and hungry. I see humans around a bonfire. Maybe I can ask for food. What could possibly go wrong?

30000 YEARS LATER
REFERENCES


doi:10.1111/jzo.12015


doi:10.1016/s0003-3472(81)80117-0


doi:10.1016/j.beproc.2010.12.001


doi:10.1016/j.anbehav.2009.11.033


doi:https://doi.org/10.1016/j.tree.2012.05.007

doi:10.1080/08856559.1935.10533146


doi:10.1075/is.10.2.06wob