Object Neophilia in Domestic Purebred Dogs

Lydia B. Kniowski

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Gene Sattler, Ph.D.
Thesis Chair

_____

Norman Reichenbach, Ph.D.
Committee Member

_____

Harvey Hartman, Th.D.
Committee Member

_____

Marilyn Gadomski, Ph.D.
Assistant Honors Director

_____

Date

Abstract

Neophilia is defined as a preference for novelty. This characteristic has been described in a variety of animal species, and may have been a contributing factor in the domestication of dogs. This study tested three purebred dog breeds for neophilia with inanimate objects. Observations of dogs' selections when presented with two familiar toys and a novel toy were analyzed. Novel toys were preferred in 60% of selections presenting a significant neophilic trend (P=0.002). Of the breeds analyzed, Labradors selected novel toys 53% of the time, while Brittanys preferred them in 67% of selections. Although both breeds showed a neophilic trend, only in one was it significant (Brittanys, P=0.009). Differing degrees of neophilic tendency may exist among breeds. These tendencies may have played a role in the domestication of dogs, and may lend insight into breed characteristics.

Object Neophilia in Purebred Domestic Dogs

Description of Neophilia

Neophilia has been defined as a positive response or "spontaneous attraction" to a new item or location (Greenberg, 2003, p. 179), while neophobia is defined as a negative response to the same categories. The neophilic response shows much variation, whether among similar species or across the animal kingdom. Cognitive processes, physiological variables, and social factors are cited as aspects that contribute to the expression of this trait. Impacted through differences in development and the environment, these factors influence the behavioral flexibility of an organism, affecting the way it adapts to new conditions and environments (Sabbatini, Stammati, Tavares & Visalberghi, 2007).

Conventionally, neophilia is divided into several classes although the divisions are broad and somewhat arbitrary. The four overarching categories of neophilia are recognized in response to animate objects, inanimate objects, foods, and spatial areas, corresponding to the animal's reaction to novelty of different types. Examples of animate objects include conspecifics or predators. Inanimate objects encompass any novel object within the environment of the creature, while novel foods and areas correspond with those foods or spaces that are new to the animal. The response an animal gives in one category may or may not correlate with its responses in another. Defined in this way, a creature could be both neophobic and neophilic at the same time. For example, an animal may have a positive attraction to novel food and a neophobic reaction to novel objects (Reader, 2003).

Although it has been somewhat customary to view neophilic and neophobic traits in contrast, these behaviors are not completely understood. Some researchers feel that

these traits are independent of one another with regard to the novel stimulus. Thus, an animal may respond simultaneously with both neophilic and neophobic behavior to a single stimulus. This creates a complex reaction from which the animal may benefit. This response has been noted particularly among birds, such as the corvids and psittacines. For example, although the exploration of new locations within the environment is necessary and beneficial, these birds must, none-the-less, execute investigation with utmost caution (Greenberg, 2003). These tendencies combine in many different forms within a variety of species.

The complexity of neophilic reactions can be elucidated by the ecology of the creature, as ecology is thought to play a significant role in a species' neophilic tendencies. For example, those species that occupy a more ecologically complex habitat are thought to express more interest in novelty than those occupying a narrower habitat. This idea was supported in a comparison between geladas (*Theropithecus gelada*), a type of monkey, and chacma baboons (*Papio ursinus*). Although these species may live sympatrically, baboons have a broader diet than the geladas, which maintain a more specialized niche. Geladas were found to be less attracted to novel objects than the baboons. It is thought that baboons interacted with the objects in order to determine their edibility, as objects that were shown the most interest had a shape similar to a known foodstuff (Bergman & Kitchen, 2009).

The examination of a variety of parrot species likewise favored an ecological connection to neophobia, with neophobic response again being related to diet. Those parrot species that consumed leaves were found to be the least neophobic. Conversely, the insect eaters showed a positive correlation with neophobia. It is thought that species

that eat leaves have a lower chance of encountering unsafe foods, while those that consume insects have a greater chance of encountering a potentially toxic meal, thus favoring neophobia (Mettke-Hofmann, Winkler, & Leisler, 2002).

Food neophilia has also been explored as it relates to social aspects of species. Infant marmosets show a combination of neophilic and neophobic tendencies related to novel food. This mixture of traits serves the young well as they learn to distinguish foodstuffs. When separated from adult conspecifics, the young marmosets were hesitant to investigate novel food and consumed little, if any, of the material. However, when adults were present, the infants became more neophilic. They explored the foods more readily and were more likely to eat them. Novel foodstuffs were also more readily consumed when obtained from a more experienced adult (Voelkl, Schrauf, & Huber, 2006). It has been suggested that an animal's responses (neophilic or neophobic) toward new environments and objects will also correspond with their responses to individuals outside their troop. However, the contrary was observed in the comparison of geladas and baboons. Although the baboons showed greater neophilia toward objects, interactions with unfamiliar baboons were far more limited than the geladas (Bergman & Kitchen, 2009).

Another aspect in which ecology has also been shown to impact neophilia relates to spatial neophilia and exploration among warbler species. The potential differences in spatial exploration were observed by comparing a migratory and a residential warbler species. It was found that the migratory species was more neophilic than the resident species, showing shorter latencies in entering new spaces. However, the neophilic response was not tied to exploration of the environment, as the resident birds showed

higher explorative tendencies. These observations were consistent with the migrant-neophobia hypothesis. This hypothesis proposes that migrant species differ in this area due to life-style adaption. Reduced neophobia during migration periods may increase the bird's ability to handle the rigors of migration (Mettke-Hofmann, Lorentzen, Schicht, Schneider, & Werner, 2009).

Another aspect in which neophilic or neophobic tendencies can be observed is in relation to objects. In a study of tufted capuchin monkeys (*Cebus libidinosus*), it was found that when a food item (novel or familiar) was placed in the presence of a novel inanimate object there was no significant difference in the time that it took the monkey to approach and interact with the food. In this group of animals, responsiveness to the food item was not hindered by the novel object. However, in most cases, the tufted capuchins showed greater neophobia in approaching novel object itself (Sabbatini et al., 2007).

Innovative behavior (of which neophilia is a part) is thought to have played a role in macroevolutionary change. Although this idea is not new, it has resurfaced in recent years and garnered much attention from researchers. It has been proposed that physical and morphological adaptations develop as new behaviors change the way that animals interact with their surroundings (Greenberg, 2003). Species that make use of tools and problem-solving abilities to find their prey often evidence particularly high neophilic tendencies. The need to seek out hidden prey in novel ways is thought to reduce the neophobic response of these species, allowing them to adapt to this type of exploration (Stringer, 2004). This has been especially seen in a number of avian species, where the most neophilic individuals showed the greatest propensity for solving novel tasks (Reader, 2003). Conversely, a study observing neophilia and innovation in callitrichid

monkeys found that these two traits did not positively correlate with one another (Kendal, Coe & Laland, 2005). Innovation was found to be a factor of the age and experience of the individual, while neophilic tendencies were spread more equally amongst the age groups. However, Kendal, Coe and Laland (2005) also concluded that in certain individuals of these callitrichid monkeys neophilia could be a component of innovative behavior.

Significance of Neophilia with Respect to Domestic Dogs

The domestic dog is a prominent part of today's culture. More than 70 million dogs find their home with American families (Udell, Dorey, & Wynne, 2010). The dog is a workmate, a helper, a friend and companion. Their capacity to be trained and their wide-ranging abilities enable them to perform services that both enhance and ease human living. This species has had a long history with the human race.

The domestic dog (*Canis familiaris*) is thought to be the oldest domesticated animal (Sutter & Ostrander, 2004). It was originally thought that the dog may have been domesticated in separate events in the New and Old Worlds. However, this hypothesis has been brought into question by the sequencing of their mitochondrial DNA. Dogs are now considered to have been domesticated in East Asia and their populations to have spread from there. The sequencing of mitochondrial DNA also indicates that the wolf is likely the dogs' sole ancestor (Savolainen, 2007).

Although the process by which dog domestication took place remains a mystery, one hypothesis is that humans brought wolf pups into civilization. Once tamed and trained, the animals were helpful members of society. Through many generations of taming and training, the domestic dog was formed (Coppinger & Coppinger, 2001).

Another view is that the wolf responded to selective pressures placed on it though a new ecological niche. These conditions are likely to have corresponded with wolves' proximity to human populations (Clutton-Brock, 1995, Coppinger & Coppinger, 2001, Morey, 1994). It has been suggested that a neophilic tendency was adaptive in dogs and played a key role in this theory of domestication. This hypothesis proposes that those ancestral animals that were less neophobic (and thus more neophilic), moved closer to human settlements, finding them beneficial, and then gradually found a place in human society (Driscoll, Macdonald & O'Brien, 2009; Kaulfuβ & Mills, 2008).

The earliest related archaeological discovery of dogs was a dog-like jawbone which was found in Northern Europe. Dating slightly later, the skeleton of a puppy was found buried with a human in northern Israel. Other ancient specimens have been found in Germany, Central and Western Europe, Asia Minor and the Americas. Interestingly, many of these artifacts were found buried in human grave sites. Despite this fact, there are also indications that the dog was a vital food source in some communities. This suggests a complex relationship between humans and dogs (Miklósi, 2007).

As time progressed, signs of domestic canines became more pronounced in art work and handicraft. Sighthound type dogs, as well as a type with shorter legs, were depicted frequently in Egyptian pottery and rock art. Evidence for several unusual (domestic) body characteristics (such as lop ears and curled tails) have been seen through these representations. There is also indication of the function of these dogs within the community. They have been illustrated assisting in hunting game and lying beneath their masters' chairs. The newly domesticated dog had acquired significant variation in size by 1000 BC. However, this size difference only became greater during the Roman

period, as lapdogs made their appearance. Throughout the middle ages, selective breeding increased, and dogs began to be bred for specific tasks. Selective breeding quickly produced new dog types until modern times when artificial boundaries were set between breed types and hybridization was discouraged (Miklósi, 2007).

Humans are still intrigued by dogs and how they have become such an integral part of life and culture. Research has shown that these close companions of man are proficient at responding to human cues. Dogs have been shown to outperform primates, such as chimpanzees, in the use of social cues. Although dogs do not outperform chimpanzees on all social cognition tasks, they are notably better at reading human gestures or other similar measures of communication (Lambach, Herrmann, Call, & Tomasello, 2009). The way that dogs use these communication techniques has been likened to the communication of a human child (Udell et al., 2010). Humans are interested in the reasons behind dogs' notable expertise in this area. Some believe that it could have formed in the domestication process. Others believe that dogs' ability to communicate is a result of coevolution with humans and an understanding of the human mental processes through basic conditioning. Still others feel that dogs are, perhaps, just born with an inclination to learn human gestures (Reid, 2009).

Another aspect of dog cognition that has attracted the attention of research in the recent years is that of breed differences, specifically as they relate to behaviors. Although, few studies have examined behavioral differences between dog breeds, there is some evidence that comparable differences exist. One aspect that has been suggested is that of neophilic tendency (Svartberg, 2006). The study of neophilia is deeply intertwined with the cognitive study of dogs and is a complex subject with many facets

(Reader, 2003). It may have had a large role in shaping the dog that is known today and potentially continues to impact the behavior of this popular animal. Despite the potential importance of this trait, however, there has been little research in the area of dog neophilia.

A study by Kaulfuβ and Mills (2008) found that dogs showed significant neophilic tendencies when presented with a novel inanimate object in a choice test. The domestic cat has likewise been found to select novel objects over familiar ones (Reina, 2010). The present study seeks to replicate and expand on the work of Kaulfuβ and Mills (2008). It attempts to confirm the existence of neophilia in dogs, as well as test for potential differences in the neophilic tendency associated with different breeds. To accomplish this, only purebred dogs were used in this study. It is hypothesized that the overall tendency for neophilia in domestic dogs found by Kaulfuβ and Mills (2008) will be confirmed. If this is so, the dogs will show a neophilic trend in their choices, supporting the previous results. Variation in breed specific neophilic tendencies may also be found. Such a finding may be a function of the task for which the breed was formed.

Method

Participants

The data collection of this study mirrored the study done by Kaulfuβ and Mills (2008), with a small number of changes made relating to the breed of the animals and toy types. Eighteen animals participated in the study, six individuals of three breeds: the Jack Russell Terrier, English Labrador Retriever and Brittany. The dogs were owned by breeders who allowed their participation in the study. Each dog was evaluated individually, and those data compared within each breed, as well as across the entire test

group. The choice to use purebred dogs of specific breeding diverged from the subjects of Kaulfuβ and Mills (2008), who had no requirements for the breed of the dogs.

Materials

Five toys were used, each differing in style and material. They included a tennis ball, a nylon bone, a rope toy, a toy sheep and a rubber toy with a shape which resembled DNA or a coiled spring. To accommodate the size difference between the breeds tested, a smaller, but otherwise identical toy was used for the nylon bone, the DNA and the sheep. The rope toy and tennis ball were the same size for each breed (Figure 1). The tennis ball and rope were randomly assigned to be the toys with which the dogs were allowed to become familiar. No contact, visual or physical, was permitted with the other three toys until they were used during the trials. The toys differed from those used by Kaulfuβ and Mills (2008), but were similar in that they each varied in form, size and color.

Figure 1. Toy Sets. The toy sets were composed of a soft, stuffed sheep, a colorful, rubber DNA toy, a nylon bone, a rope and a tennis ball. The large and small toy sizes are illustrated.

The testing took place at the locations of the breeders, with one location for each breed. Although these sites were not identical in features, an effort was made to make them as similar as possible. At each location, a testing site was set up in a fenced, grassy area. A thinly folded tarp was used to delineate the test toys from the environment. To ensure that the dogs were able to approach the tarp comfortably, it remained in the area

throughout the familiarization and play periods as well as when used during the trials. Other dogs were visible at times during these periods, and on occasion the dogs had slight interaction. However, this did not take place during any of the trials. These parameters differed from those of Kaulfuβ and Mills (2008) in that their trials were conducted in the same indoor test area for each of their trials, and no tarp was used.

Procedure

Prior to testing, each animal was given time off the leash in the experimental area. This permitted the animal to become familiar with the tarp and experimenter. The acclimation period was five minutes in length. Each dog was then introduced to the two familiar toys (ball and rope). A play session was instigated by the experimenter with the familiar toys. This allowed for increased contact between the dog and the toys. All interactions with toys were praised. The word, *fetch*, was used several times in connection with the toys. However, the experimenter avoided using labels that the dog might have begun to associate with them. When the play session was over, the dog was placed in its kennel for one hour, and both toys were placed in the kennel with the dog (no kennel information was provided by Kaulfuβ and Mills [2008]). This procedure was used to create familiar toys.

At the conclusion of an hour the animal was brought back to the experimental area and allowed five more minutes to reacclimate to its surroundings. Another ten minute play session, as previously described, then ensued. When this time was completed the dog was removed from the area and the first trial was set up. The familiar toys and a randomly selected novel toy were placed in a row at one meter intervals on the tarp (Figure 2). The arrangement of the toys on the tarp was randomly established

through the use of a random number table. This was done for each of three trials that each individual was subject to, as well as for each member of the breed (See Table 1 and Appendix A).

Table 1. Breed One Toy Assignments.

Trial	Toy in Position 1	Toy in Position 2	Toy in Position 3
A	Ball	Sheep	Rope
B	Rope	Ball	Bone
C	DNA	Rope	Ball

Note: The toys were randomly assigned positions for each of the three trials. All tests were set up with the left position as toy position one.

The tarp remained in its original location at one end of the experimental area. Once the test was in place, the dog was brought back into the area and placed in a position two meters from the line of toys. While staying behind the dog, the experimenter released the dog and said *fetch* (Figure 2). The dog was then given 30 seconds to select a toy by sniffing or picking it up. During this time the experimenter did not speak or make any motions, preventing unintended directional cues to the subject. The one exception to this was if the dog remained at the experimenter's feet with no movement after released. In this case the word *fetch* was said one more time (the word *fetch* was only used once by Kaufulβ and Mills [2008]). Once a selection was made or the time completed, the dog received a treat and praise regardless of choice. This procedure was repeated three consecutive times, each with a different unfamiliar toy. At the conclusion of the three trials for each individual the novel toys were cleaned with a pet-safe enzymatic cleaner to

remove any residual odors. The tarp and the familiar toys were also cleaned at the conclusion of the trials for each animal.

Although the general procedure gave a time limit of 30 seconds for selections to take place, occasionally a toy was selected after this time period. When selection was made within an additional 30 seconds these data were permitted to enter the data set. When it was noted that the dog maintained interest in the toys but had not yet made a selection at the end of the allotted time, additional time was allowed for the dog to complete the selection. If a dog was disinterested or distracted, no extra time was allotted. Additional time was allowed on a total of two occasions during data collection.

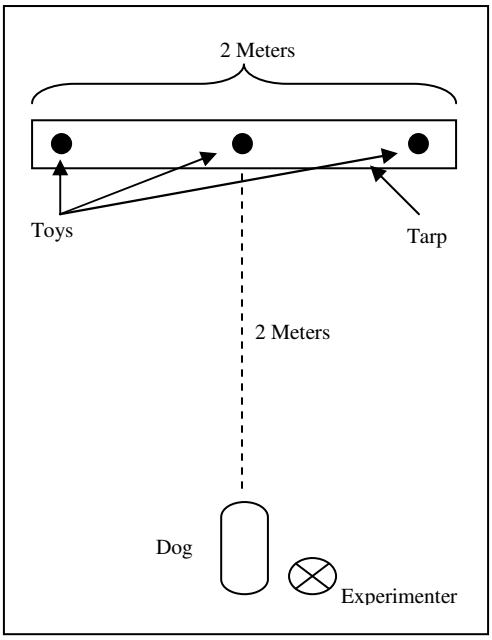

Figure 2. Schematic of Trial Setup
The three test toys were placed on the tarp. The dog was then brought into the area and released from a distance of two meters.

The familiarization and testing procedure described above was the same as that carried out by Kaulfuβ and Mills (2008) with three exceptions. First, the Terriers in the trials were not brought to the test site on a leash, but instead were carried there, because all were more familiar with being carried than with being led on a leash. Second, the toys were not cleaned after each trial, as in Kaulfuβ and Mills (2008), but only after the final trial for each animal. This allowed the familiar toys to retain a familiar odor and not be freshly cleaned, because these toys had a porous texture and did not dry as quickly as the unfamiliar toys. Third, Kaulfuβ and Mills (2008) randomly assigned familiar and unfamiliar toys from their toy set to each trial for an individual animal. These toys were

then randomly assigned trial positions. The present study randomly assigned familiar or unfamiliar designations to each toy, and then randomly assigned an unfamiliar toy, and the positions of toys for each trial. The unfamiliar toy and the toy positions were reassigned between breeds; however, the same two familiar toys were used in every trial. Within each breed, the trials were identical, allowing the dogs to be judged against the same standard. The rearrangement of the novel toys between breeds allowed for possible identification of a novel toy preference.

The data were quantitatively analyzed by binomial probability distribution tests. A probability of 0.333 was used in each of the test analyses; given that each trial presented one novel toy and two familiar toys, this would be the expected probability of a dog choosing the novel toy if the dogs were making selections randomly. Each of the three trials was analyzed separately as well as pooled. Likewise, each breed was analyzed both separately and pooled.

Site Comparison

Experimental area. Sites one (Terriers) and three (Brittanys) were more rural in overall environment, while Site two (Labradors) was urban. The grassy yards used as experimental areas were significantly larger for Sites one and two than at Site three. However, the approximate area used during the play periods and trials was similar at all sites. During the acclimation and play periods, the dog being worked with had visual contact with other animals at each site. Limited physical contact (e.g. sniffing noses) with other dogs was possible during acclimation, play periods and testing at Sites one and two. In each case, the trials were conducted away from this area of visibility and contact. During the trial set up, the test animal was briefly taken indoors to prevent visual contact

with the test at Sites one and two. At Site three, the experimenter took the test animal around a corner during test set up, but the animal remained outdoors. Horses were visible to the dogs at times during acclimation, play periods and trials at Sites one and three. At Site one the horses were significantly closer than those at Site three.

Kennels. At Site one, the kennels used during the familiarization period were in a designated room. These kennels were built into the wall several feet off the floor, with others above and below them. Other dogs were in adjacent kennels and on the other side of the room. The test dogs did not have any physical contact with the other animals once in their kennel. At Site two, the kennels were large crates located in an outbuilding on the breeder's property. Only dogs that were involved in the testing were in the kennels during this time. At this site, the dogs had no physical contact and limited visual contact while in the familiarization period. The kennels at Site three were traditional boarding kennel type runs located in a separate building. They were chain-link in construction with a smaller indoor portion and a larger, covered, outdoor portion. The dogs were able to move freely between the portions and had visual and some physical contact with each other. In each location, extraneous background noise was playing in the kennel during the kennel period. At Site one this was a wall-mounted television. Sites two and three had a radio playing. However, no site was loud or distracting.

Experimental time frame. At each location the data were collected at a similar time of day. Collection began mid-morning to early afternoon and was concluded by late afternoon to early evening. At one location (Labradors) the data were collected in one day, while the other two periods (Terriers and Brittanys) were split between two

consecutive days. There were no appreciable differences in weather during the time that trials were conducted.

Results

Out of a total of 54 toy selection trials there were 21 occasions where no toy was selected. Over half (71%) of the non-selections occurred by the Terriers. The remaining 29% was distributed equally between the other two breeds. During the play period, the Terriers' interactions with the toys were markedly lower than that of the other two breeds. It is likely that the reduced interest in the play items affected the success of these trials. In the opinion of the breeder, her dogs are bred for a calm demeanor and require a play environment to shape this characteristic in them. She views play as a learned activity. Because she does not play with the dogs on a regular basis, her animals have little understanding of the behavior. Due to their low responses, the Terrier data were excluded from the analysis.

Considering only the data collected at Sites two (Labradors) and three (Brittanys), six non-selections (17%) occurred out of a total of 36 trials. Twelve selections (33%) were made for the familiar toys and 18 (50%) for novel toys. When calculated without these six trials, novel toys were chosen 60% of the time. The non-selections that occurred with regard to these breeds are likely due to loss of interest in play (one Labrador and Brittany) and interest lost possibly by the length of the procedure (Brittanys on some trials).

Of the six Labs that were tested for object neophilia, five dogs made selections in each trial, resulting in a total of 15 selections. One dog made no selections in any trial. The Labradors showed nearly equal selections of familiar and unfamiliar toys with novel

selections made 53% of the time. Of the six Brittanys that were tested, each made at least one selection during the trials. However, one dog made no selection for the second trial and two made no selection for the third trial. A total of 15 selections were made in this breed as with the Labs. The Brittanys preferred the novel object in 67% of selections.

The responses for the Labrador trials showed a significant neophilic trend in the second trial (P=0.045). While the first and third trials were not significant (P=0.21, P=0.87), the first trial showed a trend in the direction of neophilia (Table 2). Combining the data for the three Labrador trials, there was likewise a neophilic trend, though not quite significant (P=0.088). The responses for the Brittany trials showed a significant neophilic trend for both the first and the second trials (P=0.017, P=0.045). As with the Labradors, the third trial was non-significant (P=0.80) (Table 3).Combining the data for the three Brittany trials, the data exhibited a significant neophilic tendency (P=0.009).

Combining data from the Labrador and Brittany trials, there was a significant neophilic trend for both the first and second trials (P=0.009, P=0.003), but not for the third trial (P=0.0856) (Table 4). Combining the data for the three trials, there was overall a significant neophilic trend (P=0.002)

Discussion

Evaluation of Neophilic Tendency in Dogs

The same basic trend in neophilia was observed in both breeds tested here, and when the data from each were pooled (Table 4), significance levels for the first two trials were of the same order of magnitude as found by Kaulfuβ and Mills (2008). Pooling data across all three trials and for both breeds, the level of significance for neophilia found

Table 2. Result of toy choice trials for the Labrador Dogs

	Item chosen	No. of Dogs	Observed Proportion	*P**
First trial	Unfamiliar	3	0.60	0.209
	Familiar	2	0.40	
Second Trial	Unfamiliar	4	0.80	0.045
	Familiar	1	0.20	
Third Trial	Unfamiliar	1	0.20	0.868
	Familiar	4	0.80	

*Binomial probability distribution test

Table 3. Result of toy choice trials for the Brittany Dogs

	Item chosen	No. of Dogs	Observed Proportion	*P**
First Trial	Unfamiliar	5	0.83	0.018
	Familiar	1	0.17	
Second Trial	Unfamiliar	4	0.80	0.045
	Familiar	1	0.20	
Third Trial	Unfamiliar	1	0.25	0.802
	Familiar	3	0.75	

*Binomial probability distribution test

Table 4. Result of toy choice trials for the combined breeds

	Item chosen	No. of Dogs	Observed Proportion	*P**
First Trial	Unfamiliar	8	0.67	0.009
	Familiar	3	0.33	
Second Trial	Unfamiliar	8	0.80	0.003
	Familiar	2	0.20	
Third Trial	Unfamiliar	2	0.22	0.856
	Familiar	7	0.78	

*Binomial probability distribution test

here (P=0.002) was an order of magnitude higher that found by Kaulfuβ and Mills (P<0.0001). However, the overall significance level for neophilia found here was lowered because both Labradors and Brittanys showed no preference for the unfamiliar toy in trial three only (P=0.868 and P=0.802 respectively). This shift in degree of preference for the unfamiliar toy by both breeds in trials one and two (chosen from 60-83% of the time) compared with choice in trial three (chosen 20% and 25% of the time by Labradors and Brittanys respectively) may have been an artifact of the material the unfamiliar toy was composed of in trial three. Although toy assignments were made randomly, the nylon bone was assigned to be the unfamiliar toy in the third trial for both breed groups (Appendix A). This nylon bone was the only toy of the five used in this study that was made of a hard unmalleable material (Figure 1). In a study of preference of toy types in a kennel setting by Pullen, Merrill, and Bradshaw (2010) it was found that dogs had a greater interest in and played with soft toys more compared with hard toys. Thus, it seems plausible that the dramatic shift in choice of toys by both breeds between trials one and two and trial three was an artifact of the toy's different composition in trial three. If trial three is excluded from these results, and data are pooled for trials one and two and for both breeds, the overall level of significance for neophilia found here (P<0.0001) is the same as the overall level of significance found by Kaulfuβ and Mills (2008).

Comparison of Breeds

Little research has been done regarding behavioral traits between breeds. However, traditionally it has been thought that specific traits come from the past history of that breed (Svartberg, 2006). Kaulfuβ and Mills (2008) were not able to evaluate

neophilic trend with respect to dog breed. Eight of their dogs were Labradors, but the sample size of any other breed from the remaining nine dogs of their study was no greater than three. The present study had an effective population size of five dogs for both Labradors and Brittanys in most trials, which allowed these breeds to be compared, although this limited sample size restricts the strength of conclusions that can be drawn from this comparison.

Comparing pooled Labrador trial results with those of Brittanys, the significance level testing for neophilia in Labradors (P=0.088) was an order of magnitude greater than that in the Brittanys (P=0.0085). Thus, evidence for neophilia was stronger in Brittanys than in Labradors. This difference could be linked to their breeding. Over the years, Labradors have primarily been bred for their retrieving abilities, collecting the game once it is down (American Kennel Club). Brittanys, on the other hand, are bred both to find and hold game, as well as for retrieving (The American Brittany Club). This directed breeding during the development of these breeds may have given Brittanys a greater level of neophilia.

On the other hand, research has suggested that it is not selective pressures of past development that has the strongest influence on the behavior of specific dog breeds, but rather its current selection regime. An analysis of a Swedish dog population identified differences in the behavior of breeds. The four characteristic behaviors evaluated were: playfulness, curiosity or fearlessness, sociability and aggressiveness. Contrary to popular thought, however, no correlation was found between the origin of the breed and the current behaviors that it displayed. Instead, these characteristics were found to relate more to the current use of the breed. It is thought that cultural changes have altered the

function of the dog in society from that for which it was originally bred. Thus, the characteristics desired by the population have fluctuated, shifting more in the direction of companionship and physical appearance. Svartberg (2006) hypothesized that although these behavioral traits are understood to be stable in the evolutionary context, they may change rapidly and within few generations. This suggests that domestication is a continuing process, and should be given greater consideration in dog breeding (Svartberg, 2006).

Possible Relationship of Neophilia to Adaption and Domestication

Neophilia plays an adaptive role in many aspects of a species' biology, and related processes have been shown to hold value in a diverse group of animals. For example, juvenile common ravens (*Corvus corax)* have strong neophilic tendencies in the period during which they follow their parents. However, this inclination has been found to decrease as maturation occurs and food sources, hidden or obvious, have been identified (Heinrich, 1995). The field slug (*Deroceras reticulatum*) has also shown an adaptive trait that is related to neophilia. This slug has strong preferences for novel food items unless it is fed an artificially enriched diet. It is believed that the slugs' neophilic tendencies towards food are related to physiological changes associated with deficiencies that can exist in its diet. (Cook, Bailey, McCrohan, Nash & Woodhouse, 2000).

A neophilic trend could have impacted the early domestication and adaption processes in the domestic dog. As mentioned earlier, although there are differing views on the mechanism of dog domestication, it has been proposed by some researchers that neophilia facilitated this progression as wolves showing less fear of humans as a result of neophilia were eventually integrated into human culture through domestication.

Domestication is defined, in part, as the "process of genetic and ontogenetic adaptation of organisms to the conditions of culture" (Kleisner & Stella, 2009, p. 459). Although the dog cannot be redomesticated to observe what behavioral and morphological changes were associated with this process, similar insight into what may have been involved has been provided by captive foxes. When farm raised silver foxes (*Vulpes vulpes)* were selectively bred for friendliness toward humans, in the process of raising them to harvest their pelts, it was noted that they began to show signs that are typically attributed to domestication in dogs. A desire for human contact and dog-like signals, such as tail wagging, were observed. Subsequent generations showed morphological changes associated with the domestication of the dog as well; the foxes developed pied color patterns and floppy ears. Physiological changes likewise took place, leading to earlier reproductive maturity, as characterizes dogs (Trut, Plyusnina, & Oskina, 2004). Within a small number of generations, a pathway, perhaps similar to that hypothesized for dog domestication, was reproduced.

As dog domestication occurred, neophilic tendencies may have led to changes not only behaviorally and anatomically, but physiologically as well. Physical and psychological stress has been shown to reduce the lifespan of pet dogs. In general, dogs that exhibited increased fear of unfamiliar individuals were shown to have shorter life spans. It was also found that dogs fearful to be without their owners have a higher incidence of skin diseases (Dreschel, 2010). Neophilia has likewise been shown to have a positive effect on the health of infant rats (Cavigelli & McClintock, 2003). A preference for what is novel may relieve stress in an animal living in a captive setting;

therefore neophilic tendencies may positively influence the health of dogs and ultimately their longevity.

Significance of Neophilia to Cognitive Studies of Dogs

Neophilic inclination has been cited as having a possible impact on the results of cognitive studies in canines. The way an animal responds to novelty has been identified as an essential psychological process with regard to innovation, which is one aspect of animal intelligence and its cognitive processes in general. Neophilic tendencies allow for increases in the perception or insights of the individual, and appear to facilitate innovative behavior (Ramsey, Bastian & van Schaik, 2007). This type of behavior however may modify the interpretation of cognitive tests if proper guidelines or parameters are not in place. Kaulfuβ and Mills (2008) believe such a situation may have occurred during testing of an individual dog by Kaminski, Call and Fischer (2004) for the ability to reason by exclusion. A dog was presented with a set of eight items (seven familiar, one novel) and asked to retrieve the novel toy. The dog correctly retrieved the new toy on seven of the ten trials which was interpreted as evidence in this dog of association of an novel object with a new word. Kaulfuβ and Mills (2008), however believe that this success may have been due more to neophilic tendency than to the ability to utilize linguistic reasoning, and that this case illustrates the need to understand neophilic behavior in assessing the cognitive ability of animals when using certain testing regimes.

Understanding such different breed inclinations may thus offer greater insight into the cognition of breeds. It may also offer insight into some of the behavioral responses of dogs. As another example, it has been found that sled dogs and retrievers

have a propensity to maintain a friendly demeanor even when a novel human approaches in a threatening manner. On the other hand, Belgian shepherds, exposed to the same stimulus, often responded with aggression. This is thought to be the result of different breed regimes (Vas, Topál, Gácsi, Miklósi, & Csányi, 2005). Researchers and behaviorists may therefore find interest in, and greater understanding of, breed characteristics through documentation of the neophilic trends expressed by the breeds tested.

Application of Neophilia to Other Canines

Little research has been done on coyote cognition; however, it has been found that coyotes have intriguing neophilic tendencies. These results allow for greater understanding of coyote behavior, and may be helpful when trapping this species. For example, when exposed to novel objects and scent stations in a familiar environment, captive coyotes show higher neophobia than when these same treatments are administered in an unfamiliar location. Wild coyotes show a similar trend when comparing their responses to scent stations placed within their home range and those scent stations on the periphery (Harris & Knowlton, 2001). These findings have obvious practical application to coyote trapping efforts, as coyotes may be more inclined to investigate traps placed on the edge of their home range.

Suggestions for Further Research

While the present study found significant evidence of neophilia in the two breeds of domestic dogs, more research and a larger sample size would be desirable to further confirm this relationship. Further testing is also recommended to confirm and clarify the relationship between breed and neophilia. In addition to increasing sample size, more

robust test results might be obtained by previewing dogs to assess if their interest level in the toys is high enough to be sustained throughout the testing. Another consideration would be the use of an indoor area, preferably an empty room, for the testing procedure. This would have the advantage of channeling the dog's attention away from outdoor scents and other uncontrollable distractions that can interfere with the choice task. Finally, regarding the testing procedure itself, it is suggested that the length of time of the acclimation and play times be reviewed and adjusted, particularly if the tests are taking place in an area with which the animals are familiar. During trials it may also be prudent to allow a time span longer than 30 seconds for a dog to make a toy choice. In addition, it may be helpful to consider a dog to have made a choice of a toy not on the basis of first contact, but rather to be the first toy played with or carried.

Conclusion

These data supported the findings of Kaulfuβ and Mills (2008) in that both Labradors and Brittanys demonstrated some neophilic tendencies in their toy selections. This trend was similar in both breeds, and was more strongly supported when the sample size was increased by pooling the data. The novel toy used in the third trial may have introduced a systematic bias in the results that obscured the occurrence of neophilia in that trial and weakened the overall support for neophilia. It appears that neophilia can be expressed differently across dog breeds, as the Brittanys showed a stronger preference for novel toys than did the Labradors. However, further research is needed to confirm and understand these possibilities regarding breeds.

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Appendix A

Table 1. Breed Two Toy Assignments.

Trial	Toy in Position 1	Toy in Position 2	Toy in Position 3
A	Ball	Sheep	Rope
B	DNA	Rope	Ball
C	Bone	Ball	Rope

Table 2. Breed Three Toy Assignments.

Trial	Toy in Position 1	Toy in Position 2	Toy in Position 3
A	DNA	Rope	Ball
B	Ball	Sheep	Rope
C	Ball	Bone	Rope

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