

The background of the entire page is a high-angle, top-down photograph of five dogs of various breeds. From top left to bottom right, there is a black French Bulldog with its mouth open, a tan and white dog (possibly a Jack Russell Terrier) with its mouth open, a brown and white dog (possibly a Pit Bull mix) with its tongue out, a white dog with grey markings and its tongue out, and a tan dog (possibly a Weimaraner) with its mouth open. The dogs are all looking towards the camera on a plain white surface.

The Relevance of Breed

IN CHOOSING A PET DOG

Can we rely on a breed label to determine whether a dog is suitable as a companion?

By Janis Bradley

The Relevance of Breed in Selecting a Companion Dog

By: Janis Bradley

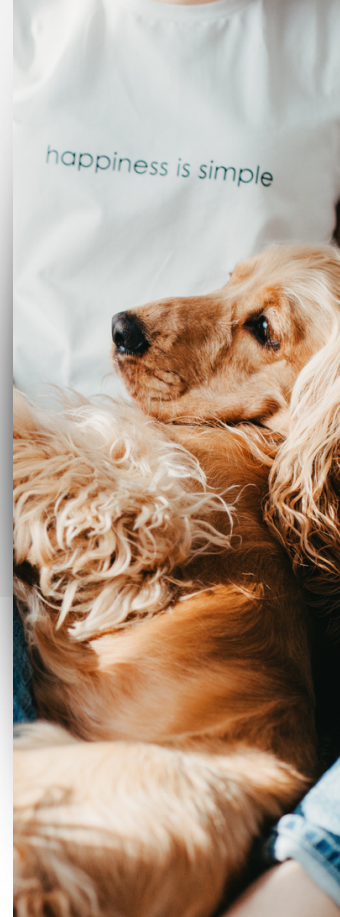
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National Canine Research Council is a non-profit canine behavior science and policy think tank that focuses on the relationship between dogs and people. Our mission is to underwrite, conduct, and disseminate academically rigorous research that studies dogs in the context of human society.

Our goal is to make the best and most current research accessible to everyone who loves, lives with, or just wants to know more about dogs. We put canine behavior science in the context of the world dogs live in – the human one. So you will find discussions on public policy about living with dogs, home insurance, dog training, how we think about dog breeds, what happens when dogs are between homes, and all of the other issues that affect how we live with and think about our best friends.

As more research is produced that focuses on dogs in the context of humans we expect to progress in our understanding of our relationship with dogs. Canine behavior studies may impact public policy and thus the welfare of dogs and their owners. Canine behavior research should therefore be held to a high standard of sound methodology and should always correctly characterize dogs as individuals living in a man-made environment.



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Table of Content

Introduction	0
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Section 1: Appearance and Breed

Introduction	8
Does Appearance Matter to Adopters?	9
What is the Connection Between Appearance and Breed?	8
Morphological Variability in Mixed Breed Dogs	9
Research on Breeds and Appearance - From Scott and Fuller to Present	890
Does Appearance Help People to Identify Breed Ancestry In Mutts in the Real World?	98
Recommendation for Matchmakers	98
Recommendation for Policy Makers	98

Section 2: Personality and breeds

Introduction	0
Does it matter to Adopters?	00
General Background Regarding Genetics and Behavior	00
Does Breed Predict the Likelihood of Personality Traits in An Individual Dog?	00
Current Genetic Research Says No.	00
The Role of Breed-Based Expectations on Behavior	00
Socialization, (i.e. Environment) vs. Breed Stereotypes	
Warning and Biting Behavior -- Is Breed a Factor	00
Recommendations for Matchmakers	00
Recommendations For Policy Makers	00

Section 3: Purpose breeding and action patterns

Introduction	
Do Action Patterns Matter to Adopters	00
Action Patterns, Genetics, and Breed	00
Purpose Breeding for Action Patterns in Practice Greyhounds as a Case Study	00
Recommendations for Matchmakers	00
Recommendations for Policy Makers	00

References	00
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Introduction



Is breed relevant to an adopter's choice of a pet? Does identifying a dog as a member of a specific breed help people make a choice that will satisfy their emotional hopes and practical expectations of living with that animal? If yes, how might breed identification help? If it's not helpful, why not? These questions are divided into several categories: how a breed label may influence adoption decisions, how those decisions may play out in the resulting relationships, and what the implications are for people facilitating adoptions or making public policy regarding how people may live with dogs.

The purpose of this paper is to investigate whether making predictions regarding a dog's behavior based on breed or on assumed breed is likely to yield helpful results. This is an attempt to use the existing scientific literature to address these questions.

The research findings are from:

- **Canine morphological and behavioral genetics**
- **Our human perceptions regarding dogs**
- **The connections between canine behavior and relationship outcomes**

These findings are affected by whether the dogs being studied are pedigreed members of closed gene pools--often referred to as "purebreds"-- or "mutts." One goal of this review is to guide people working in rehoming and puppy selection to better assist potential adopters in their search. The other goal is to inform decision-makers on matters of housing and husbandry practices involving citizens and their pets.

Prospective pet owners and policymakers would like to be able to predict the probable future behavior of dogs so that they can choose appropriate companion dogs. They also want to be able to anticipate actions such as warning and biting behavior toward humans. Such predictions are commonly made based on presumed breed characteristics, both in the case of purebred and non-purebred dogs. The question is whether breed identification is a useful indicator of behavior.

Fortunately, the relevant scientific literature has yielded some answers. One large research project, in particular, has advanced our knowledge substantially. (Morrill et al, 2022). We will rely on it heavily here, although certainly not exclusively, specifics regarding canine behavioral genetics.for

In broad strokes, the collected scientific literature supports the following points:

- **A majority of dogs in the U.S. are “mutts”**
- **Even among purebreds, breed is an unreliable predictor of behavior.**
- **Most of the specific behaviors that can be associated (however weakly) with particular breeds are not particularly related to the qualities people look for in pets**
- **While these behaviors may be modestly associated with a group of related dogs they can never be reliably predicted to be expressed by any individual dog.**

These points lead inevitably to the following practical recommendations:

- **The practice of relying on breed identification as a guide in either choosing a pet or making dangerous dog designations should be abandoned.**
- **As visual attributions of breed ancestry to mixed-breed dogs are inherently misleading, dog professionals should transition to other ways to describe individual dogs.**
- **The focus of predicting behavior should shift to the particular dog's demonstrated personality with the understanding that even the most deterministic interpretation of genetics can show us only “genes determining the tendency to develop X [a particular trait] in certain environments”(Block, p. 105) .**
- **The owner's choices about how to live with a canine companion are part of the environment that shapes the dog's behavior.**
- **Public policy decisions should focus on the actual behavior of both the individual dog and the owner.**

APPEARANCE AND BREEDS

Adopters, according to research, are influenced by a dog's appearance in their initial decisions when looking for a new companion, at least in shelters, and by extrapolation on online rehoming sites, although the latter has not been studied. Presumably, people who acquire dogs through breeders are choosing a breeder based on the appearance of the dogs they offer.



Appearance and breed are highly correlated among pedigreed dogs. This is readily explained by the emphasis on appearance in breeding practices since the late 19th century. Among dogs with multiple breeds in their ancestry, morphology is so varied, that it's completely unpredictable. This was well established more than 60 years ago (Scott and Fuller, 1965) and continues to be validated by current research (Morrill et al, 2022). This variability has led to the widely documented inaccuracy of visual breed identification even among experts (Voith et al, 2009; 2013).

Many adopters have preferences with regard to appearance, of course. These are not necessarily breed preferences. People working in rehoming would be well advised to support potential adopters' appearance preferences. Those preferences should be unpacked, when possible, to reveal the qualities an adopter actually cares about.

Does, “I’m looking for a Beagle,” for example, mean:

- A small, short-coated dog with drop ears?
- A connection with a childhood dog?
- A specific behavior the person associates with Beagles?



Sorting out such questions is the appropriate task of the matchmaker among organizations with the resources to engage in it. Not all rehoming organizations, of course, have the human resources for lengthy conversations with potential adopters. They can take comfort in the fact that the vast majority of dog owners acquire their pets without the benefit of professional advice, and as an extensive review of the adoption return and relinquishment literature shows, their choices are generally successful (Patronek et al, 2022).



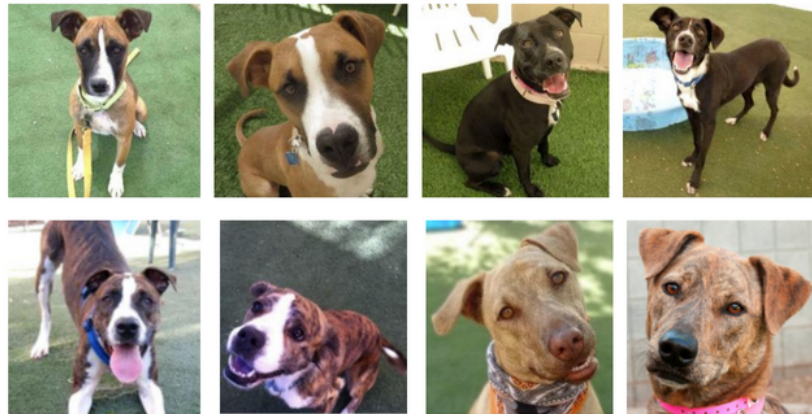
In addition, context has been shown to affect perceptions of photographs of dogs of the same appearance, suggesting that context can be used when posting online descriptions of available dogs to trigger pleasant associations for potential adopters.

For policymakers, whether concerned with pet policies related to housing or to husbandry, any attempt to categorize dogs by breed based on appearance will be error-ridden, even aside from the inevitably erroneous assumptions correlating breed with personality traits discussed in section 2.

Section One

APPEARANCE AND BREEDS

The context surrounding a dog's appearance and label has been shown to impact perceptions, changing responses to dogs who looked much alike and even to the same dog. A study conducted in multiple large shelters (Gunter et al., 2016) revealed that dogs labeled as pit bulls, for instance, stayed in the shelter three times longer compared to visually similar dogs in another shelter where the dogs had no breed labels. To ensure the comparability of the paired dogs' attractiveness, a separate group of individuals assessed them, finding no discernible difference.



(Photo credit: See reference 3. Gunter)

Furthermore, the presence of a person in a photo with a dog constitutes another form of contextual influence, shaping the observer's impressions of the dog's personality. Experiments involving the same dog's picture paired with different people yielded varying perceptions of the dog's personality traits (Gunter). Both studies fundamentally challenge the logic connecting appearance to breed to personality.

Recommendations for Matchmakers

When it comes to rehoming, one of the main objectives for matchmakers is to assist adopters in selecting a dog who is likely to fulfill their expectations for daily life with a four-legged companion. This often involves engaging in conversations with potential adopters to uncover their true hopes, and then suggesting specific dogs who align well with those expectations. This approach is equally helpful for trainers and behavior consultants who provide their expertise to clients seeking guidance in making these decisions.

Does Appearance Matter to Adopters?

Multiple studies show that people who adopt a dog from a shelter are influenced by the dog's appearance. (Protopopova et al, 2016; Weiss et al 2012). One study compared the attractiveness ratings of photos of dogs who had been adopted with ones of dogs who had been euthanized. The adopted dogs' photos were perceived as more attractive. Protopopova and Wynne also inferred that people's preferences might have been based on assumptions about the breed ancestry of the dogs in the photographs. But they could not confirm this.

However, in a later study, they found that while appearance had a kind of initial influence, it did not carry enough weight when it came to a final decision.

Those decisions were very heavily influenced by how the dog interacted with the potential adopter during a first meeting once outside the kennel (see section 2 for more details).

This lends credence to Protopopova's hypothetical chain of adopter reasoning. The chain goes from:

Preconceptions about breed-based behavioral tendencies

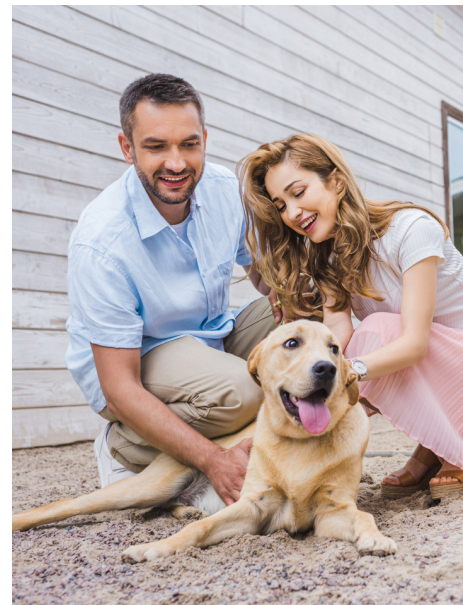


Preconceptions about appearance as indicative of breed ancestry



Inferring the likelihood of the dog having the behaviors the adopter hopes for

It is important to uncouple this chain of misconceptions when it comes to adoption matches.



APPEARANCE AND BREEDS

Does Appearance
Matter to
Adopters?

EMOTION AND DOG SELECTION - CONDITIONED EMOTIONAL RESPONSE IN HUMANS

Humans, like many other species, form emotional associations with many, perhaps most things we encounter in our experience. These associations are called **conditioned emotional responses (CER)**.



Researchers have studied CERs in many species for more than a century. The formation of CERs is fundamental to learning and difficult to disregard. So a person may have happy memories of life with a dog in the past. These memories are evoked by other dogs of similar appearance. Such a visual CER can then become associated with the breed or supposed breed of the first dog.

As long as the adopter can be guided to see a similar-looking dog as an individual with their own unique personality, attraction elicited by appearance can enhance a bonding process.

CONTEXT AS AN ASPECT OF APPEARANCE



(Photo credit: See reference 3, Gunter)

A CER based on appearance, however, is often not a standalone phenomenon. These associations, whether pleasant or unpleasant can be influenced by context. The context may contain stimuli that carry their own associations.

We have been aware for many years that context can affect how a person perceives a dog, even when that dog's appearance is the only information available.

One study showed that assumptions about an unknown dog's personality (based only on a photograph), could be strongly influenced by the demographic of the person appearing in the photo with the dog (Gunter, 2013). Placing the same dog with an elderly woman or a child resulted in viewers considering the dog more adoptable, more friendly, and less aggressive than placing that same dog in a picture with a man the authors described as "rough looking."

This clearly suggests that adoption marketing images should take into consideration the context, particularly the human context, in which they present dogs.

This can both defuse potentially negative biases and simply help adopters create positive images of their own future with a new companion.

What Is the Connection Between Appearance and Breed?

DOES APPEARANCE HELP IN IDENTIFYING BREED IN PEDIGREED DOGS?

The current gold standard for research on canine behavioral genetics (Morrill et al., 2022) reported on correlations between breed and appearance, particularly among mixed-breed dogs. This large study was conducted by Darwin's Ark, part of the Broad Institute, a collaboration of MIT and Harvard, among other institutions (Morrill et al., 2022).

The researchers collected extensive behavioral information, images, and genetic samples on more than 20,000 dogs for their analysis. They also conducted 2 additional research projects on visual breed identification and behavioral breed bias. To no one's surprise, in pedigreed dogs they found appearance and breed to be highly correlated.



In fact, morphological traits among these closed gene pools were so strongly genetically correlated that they used one (size) as a baseline from which to describe the genetic connections with other kinds of traits--primarily behaviors.

The authors found that the genetic data showed that:



Associations to physical traits, but not behaviors [see section 2 for details], tend to overlap signals of genetic differentiation in modern breeds, suggesting that aesthetics, and not behavior, has been the focus of selection.



Thus they concluded that since the advent of modern breeding 150 years ago, the selection criteria for breeding choices regarding pedigreed dogs have been concentrated primarily on influencing aesthetic traits. This finding is not new, as other researchers over the past several decades have come to the same conclusion.

APPEARANCE AND BREEDS

What is the
connection
between
appearance and
breed?

MORPHOLOGY AND OTHER PHYSICAL TRAITS

Morphological traits can come along for the ride, so to speak, in some cases where the selection criteria in closed gene pools are aimed at traits other than appearance. This typically falls under the category of physical abilities that breeders are attempting to enhance. Racing Greyhounds are a good example.

These dogs represent the rare, perhaps the only remaining, large closed gene pool rigorously selected for success in a single, clearly defined activity—reaching the finish line on a racetrack in pursuit of a rapidly retreating object ahead of other dogs on the track. This reproduction criterion has two aspects. One is behavioral. The dogs must be keenly motivated to chase (more on this in section 3). Second, they must be physically able to run faster than other dogs. The physical criterion has multiple aspects and affects everything from the cardiovascular to the endocrine system in Greyhounds.



The result is a dog with extremely elongated long bones, which facilitate an extraordinarily long stride, minimal body fat to minimize weight, and extremely exaggerated musculature on the hind legs, generating the impulsion for those long strides.

These dogs are the unusual case of a breed whose members look very similar, but whose appearance is in no way deliberately selected for. In the simplest terms, racing Greyhound breeders have no interest in what the dogs look like.

The characteristic appearance is just what you get when you allow only the fastest runners to reproduce.

One could hypothesize that you might select only the fastest-running Pugs for reproduction. After enough generations, you might have dogs that look much like Greyhounds. There are various genetic caveats, but we cannot say with certainty at this point that this would not occur.



APPEARANCE AND BREEDS

What is the
connection
between
appearance and
breed?

MORPHOLOGY AND OTHER PHYSICAL TRAITS

We should also acknowledge that there are various cohorts within modern-day breeds, where enthusiasts have selected, more or less rigorously, for the performance of particular tasks (more on this in section 3). These are often called "working lines."



Working line of Siberian Huskies

The groups of dogs within such cohorts often deviate significantly in appearance from the main breed population. A main population of a dog breed is usually referred to as a "show line." These differences are typically inconsistent, demonstrating more the effect of randomizing toward a species variability norm than consistent appearance helpful in the performance of particular tasks.



Show line of Siberian Huskies

APPEARANCE AND BREEDS

What is the
connection
between
appearance and
breed?

CAN APPEARANCE EVER FOLLOW BEHAVIOR? THE SILVER FOX EXPERIMENT

People sometimes point to the famous silver fox experiments in Siberia in response to this question. Beginning in 1959, Dimitri Belyaev and his colleagues began selectively breeding captive foxes for what they labeled “tameness.” Their goal was to define the genetic changes involved in domestication, which the researchers hypothesized might be the same across species.



Researcher Lydmila Trut with
one of the domesticated foxes

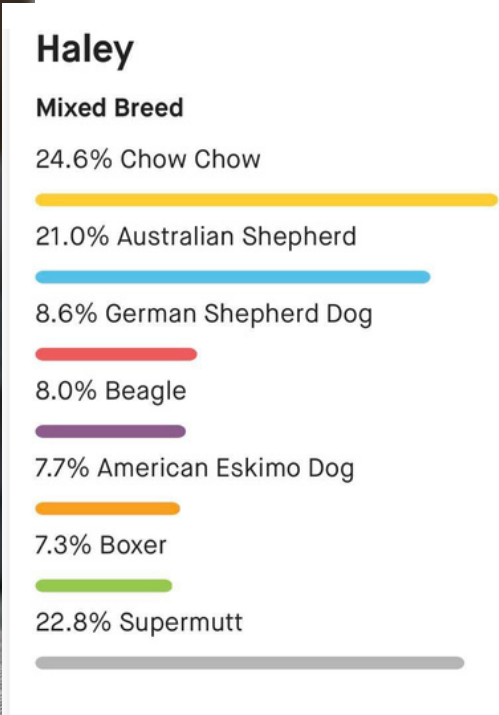
The results were surprisingly rapid, resulting in a study sample of foxes who behaved much like very friendly dog puppies in just six generations. The genetic changes have been identified as involving genes of wide-ranging effect, ones that influence the expression of other genes rather than being specific to particular traits. Over the decades, changes have been found in the neurobiological, endocrine, and reproductive systems of the tame foxes. Appearance has also been affected, with changes in coat color and pattern, tail shape, skull shape, and ears, to name only some.

Domesticated animals are clearly different from wild ones. So if we want nicer dogs, shouldn't we just breed the ones with white patches in their coats? Or drop ears, perhaps? Or perky short noses?

**Not so fast. We are not trying to domesticate dogs.
They crossed that Rubicon many millennia ago.**

Dogs are already overwhelmingly affiliative with human beings, which is why the tame foxes are often described as “dog-like.” We all know what is meant by this expression. Domestication is almost certainly binary. Fine gradations of appearance can tell us no more about the personality of a domestic dog than they can tell us about how tame an already tame fox is.

Morphological Variability in Mixed Breed Dogs



In the Broad Institute research, morphology varied dramatically in the mutts, who made up half the dogs in the survey, Overall, Morrill’s findings are consistent with 60 years of research about the disconnect between the appearance of a dog with individual dogs of varied breeds in their ancestry and the appearance of any or all of those pedigreed ancestors.

But, Morrill’s data brought some interesting new insights to the table.



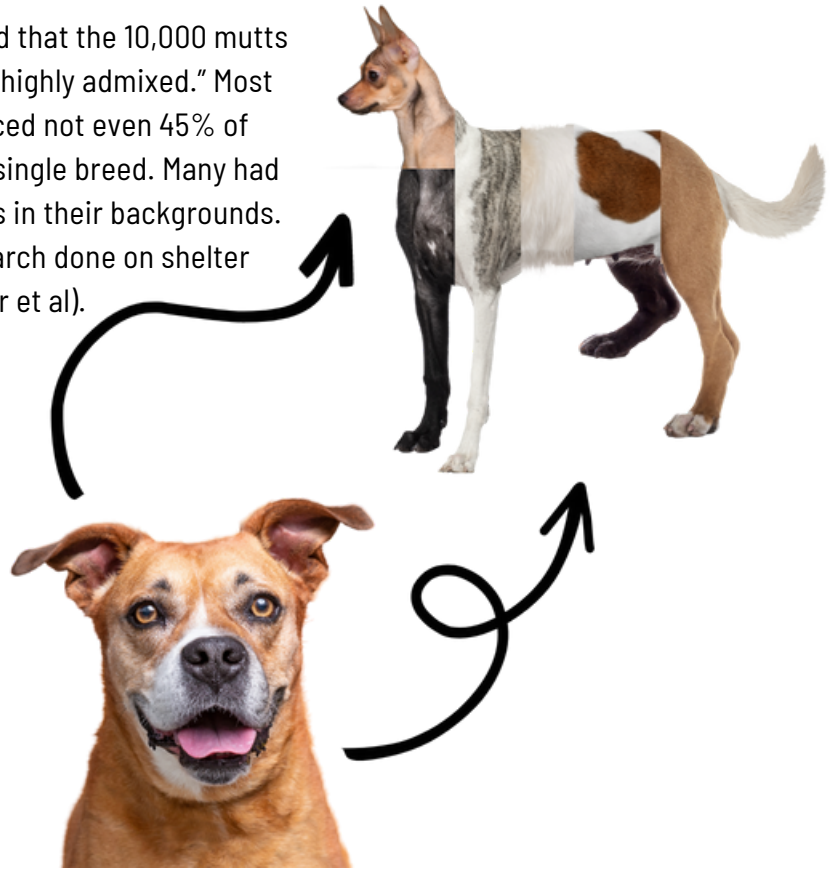
One insight is that the average person tends to only think of the limited number of breeds they know when making a breed guess. In other words, short legs translate as “Dachshund,” blue eyes equal a Husky, and so on.

Section One

APPEARANCE AND BREEDS

Morphological Variability in Mixed Breed Dogs

They also confirmed that the 10,000 mutts in the survey were “highly admixed.” Most of them (~70%) traced not even 45% of their ancestry to a single breed. Many had four or more breeds in their backgrounds. This confirms research done on shelter dogs in 2018 (Gunter et al).



The study showed that the American Pit Bull Terrier is the most common breed found in mutts.

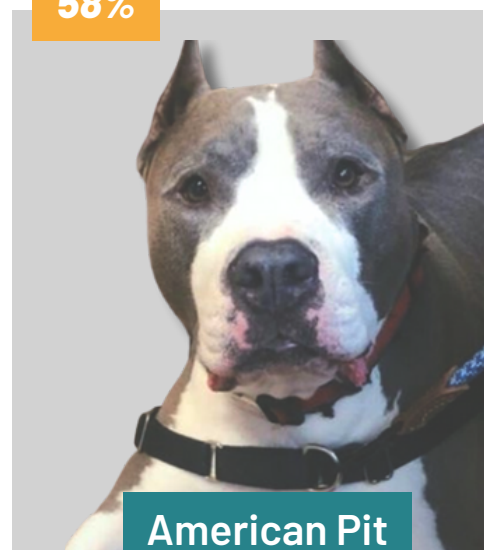
It showed up in ~10% of dogs. Often, these dogs did not show any discernible physical resemblance to an APBT.

59.9%



American Pit
Bull Terrier

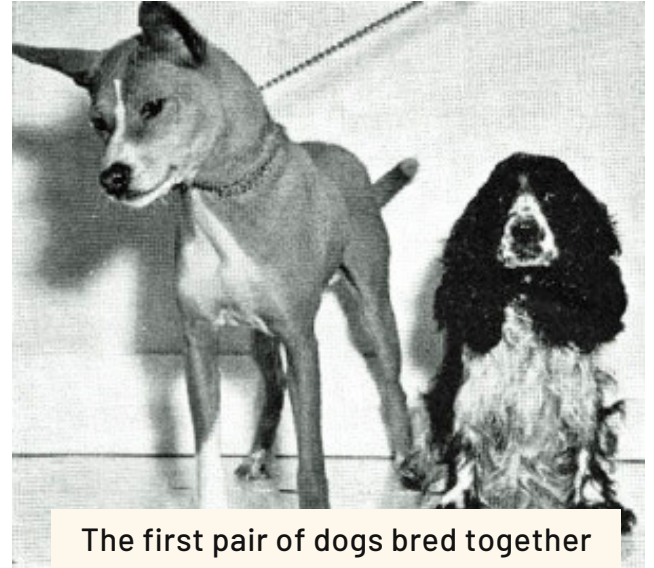
58%



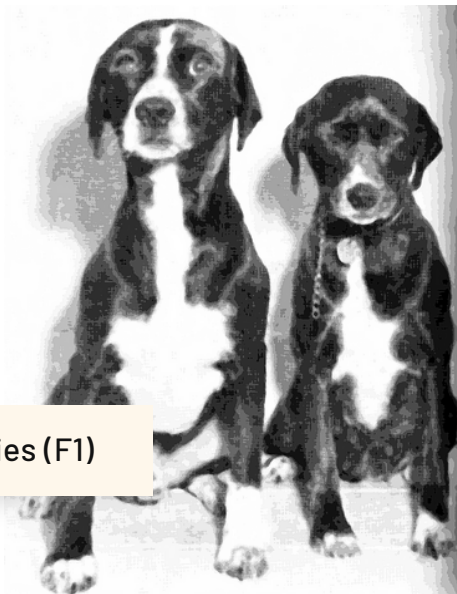
American Pit
Bull Terrier

Research on Breeds and Appearance
From Scott and Fuller to the Present

People have been researching the connection between appearance and behavior long before modern genetics was developed. Previously, a book published by Scott and Fuller in 1965 described the most famous study of genetics and dog behavior. They found that even if there are only two breeds in a dog's lineage, the first-generation (F1) crosses often do not resemble either of their parents' breeds.

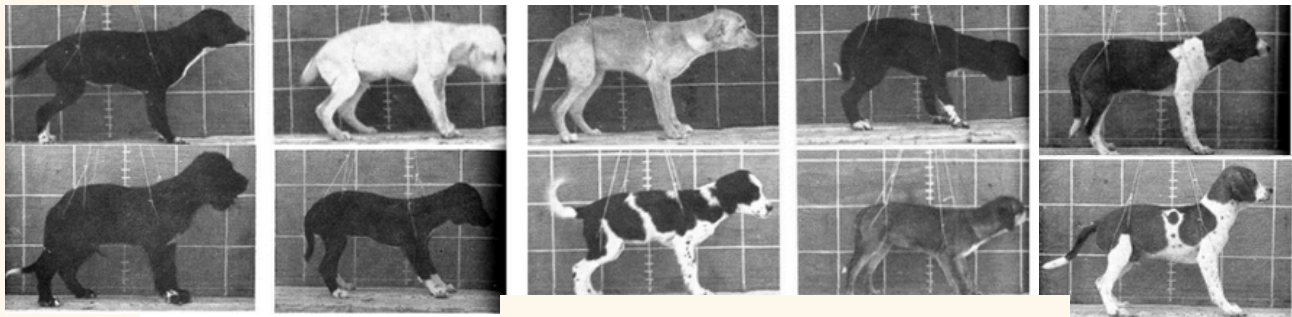


The first pair of dogs bred together
for the Scott and Fuller study



First generation of puppies (F1)

The photographs accompanying the text showing the F2 generation of Basenji/Cocker crosses (see below) reveal startling physical diversity. Some of the puppies would likely be readily visually identified by professionals as "predominantly" of breeds such as Labrador, Beagle, or perhaps Springer Spaniel when their actual grandparents were two Cocker Spaniels and two Basenjis



Second generation of puppies (F2)

Section One

APPEARANCE AND BREEDS

Research on Breeds and Appearance

A modern genetic study comparing dogs from eighty breeds, feral dogs, and wolves showed that a large number of morphological traits in dogs, from length of limbs to skull shape to weight to ear set and coat type, are determined by a very small number of "large effect" genes. This means that even a small proportion of a particular breed in a dog's ancestry may result in a strong resemblance to that breed.

Remember the "Short Legs Equals Dachshund" mistake that Morrill found.

It would actually be surprising if we could accurately attribute "predominant breed" identification to any mixed breed dog based on appearance, no matter how striking the resemblance.



Laika

Mixed Breed

46.6% American Pit Bull Terrier

13.9% Basset Hound

9.5% Labrador Retriever

9.5% Miniature Pinscher

6.3% German Shepherd Dog

14.2% Supermutt

Appearance, like other traits, can only be used to reliably infer membership in a particular group if that group becomes

so inbred that the natural diversity of the species has gradually disappeared. This is a phenomenon called genetic drift. But even the results of inbreeding readily disappear with very slight outcrossing (the introduction of new individuals from outside a closed gene pool).

For example, in a wild wolf population in Sweden so extremely inbred that the population was dying out because of fertility problems, the introduction of a single outside individual brought so much diversity that the problem allele (the code written on a gene) was re-randomized into the mix and no longer presents a threat.

Any given trait, such as a morphological characteristic, is simply a very poor indicator of the breeds in the background of any mixed-breed dog, i.e., any dog either of whose parents was not a purebred of the same breed.



A specific trait illustrates this point. There has been some study of the genetics of skull shape in domestic dogs.

Dog skulls vary in several dimensions, and while not on a perfect continuum, some dimensions become larger or longer or wider or narrower in concert with others. One need only think of a Pekingese's head and compare it with that of a Greyhound to form a mental image of the range of diversity.



Individuals of any skull shape can be bred gradually in lines that will bring them closer and closer to the other types. No one expects, however, that this change would carry with it any other traits found in different breeds that also have the same skull shape.

A similar skull shape is not indicative of the relatedness of two individuals.

Skull shape carries no implications of common breed ancestry.

To make such an inference would be tantamount to ascribing a specific ethnicity to a human based solely on hair color, e.g., assuming a person with blond hair must be Swedish. There are almost certainly as many genetic pathways to blocky or pointy skulls in dogs as there are to blond hair in humans.

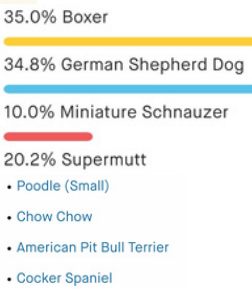
Does Appearance Help People to Identify Breed Ancestry In Mutts In the Real World?

People in animal welfare often assume that their experience makes them experts at visual breed identification. But this is not so. In one study, shelter workers only correctly guessed a mutt’s predominant breed in 1 out of 4 dogs (Voith et al, 2009). What’s more, they often did not agree with each other’s identifications (Voith et al, 2013).

The figure below shows some examples not only of how far a dog’s appearance can diverge from that of the standard appearance of their varied ancestry, but how widely even professionals’ guesses can diverge.



Reddit: u/R-Valaz



- BREED GUESSES**
- Jack Russell Terrier X Rat Terrier
 - Foxhound X Jack Russell Terrier
 - Jack Russel X Shar Pei
 - Beagle X German Shepherd
 - Basenji X Terrier
 - Beagle X Hound
 - Jack Russell X Pit Bull Terrier



Reddit: u/cactuslove



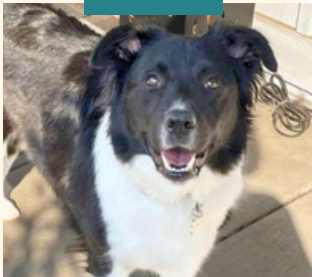
- BREED GUESSES**
- English Shepherd X Cattle Dog
 - Great Pyrenees X Border Collie
 - Heeler X Border Collie
 - Border Collie X Bernese Mountain Dog
 - Springer Spaniel X Great Pyrenees

Additionally, DNA testing repeatedly shows that it is unreliable to use a mutt’s appearance to determine their heritage.

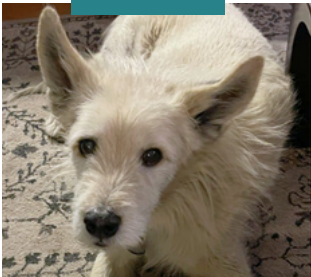
Owners of mixed-breed dogs are often astonished when commercial DNA test results come back very different from what they had expected. As we discussed earlier, their surprise is likely because they are relying on a few physical traits as “earmarks” of specific breeds.

The illustration below shows the range of differences in appearance of dogs, all of whom have at least 35% American Pit Bull Terrier ancestry. Twenty-five percent is often used as a benchmark to designate a “predominant” breed in a mutt’s ancestry., so we’ve used an even higher percentage here.

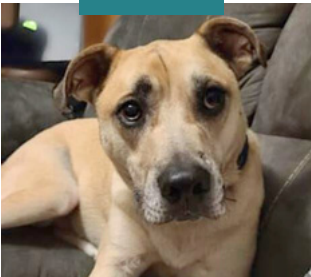
52.5%



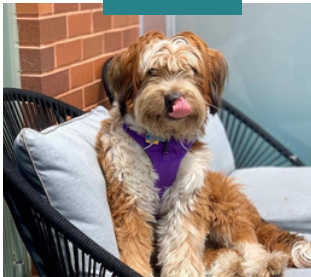
45.4%



40.6%



39.7%



36.5%



Section One

APPEARANCE AND BREEDS

Does Appearance
Help People to
Identify Breed
Ancestry In Mutts
In the Real
World?

This extreme unreliability of visual breed identification of non-purebred dogs if mutts were the exception in the pet dog population. They are not. According to our best estimates, there are approximately 83.7 million domestic dogs in the U.S. as of June 2023. This includes those awaiting rehoming in shelters or with rescue organizations.

More than half of them are mutts (AVMA 2022).

This means that one cannot identify the breed ancestry of more than 43 million dogs in the U.S. by looking at their physical features.

Recommendations for Matchmakers

For people working in rehoming, one of the goals is to help an adopter choose a dog who is likely to match the hopes they have for living with a pet.

In organizations with the human resources to do it, this often means talking with that potential adopter to unpack what those hopes really are, then, suggesting individual dogs who may fit into that picture. Appearance can be helpful in such conversations, but again, do not use it as a proxy for breed identification.

AVOID RELAYING BREED ANCESTRY GUESSES TO POTENTIAL ADOPTERS.

This includes in conversations, on kennel labels, online listings, or other materials.

In addition, these guesses undermine the individual dog's chances of adoption, particularly when the breed label is one that may carry negative bias. In a study of several large shelters, As mentioned above, Gunter (2016) found that dogs who were labeled for adopters as pit bulls, for example, remained in the shelter 3 times longer than lookalike dogs in another shelter who were not breed labeled. To make sure the paired dogs were actually sufficiently morphologically similar, their attractiveness was compared by a separate group of people and no difference was found.

FOCUS ON APPEARANCE AS A PRACTICAL PREFERENCE

It's important to honor a person's practical reasons for wanting a specific physical appearance.

An older person who has lived with large dogs all their life may decide that a small dog is now a better choice. A person may have limited time or resources to devote to grooming, so they want a dog with a minimal coat.

Ignoring these needs or even neglecting to ask about them is a disservice to both the person and the dog.

Assuming that we know these preferences without asking the person is even worse.

It cannot be overemphasized that adopters are as individual as the dogs they seek.

SUPPORT ADOPTERS' APPEARANCE PREFERENCES

If an adopter has a strong preference for dogs with a certain appearance that is not based on stereotypes about behavior, you should support those preferences.

The adopter who frames this as a breed preference is actually helping shelter staff by using breed as a kind of shorthand for basic appearance preferences. It is up to shelter personnel to connect the dots on this.

IT'S EASY TO DETERMINE IF BREED PREFERENCE IS A STAND IN FOR A GENERAL PREFERRED APPEARANCE

"I'm looking for a Beagle," can be easily unpacked with responses like:

"So you're looking for a smallish dog with a short coat and you like multi-colors and droopy ears?"

The person will either agree, and then you can steer them to dogs who match this general description, or they will disagree and say something like:

"No, we had a Beagle when I was a kid and he was happy-go-lucky and loved to play and run around and was friendly with everybody and I want another dog just like that."

In that case, you know that personality is what the person is really looking for.

From there, you can establish whether or not they have any other physical requirements in a dog.

Recommendations for Policymakers Regarding Breed and Appearance

Recommendations here must be simple.

As demonstrated in this section, when looked at from any scientific perspective, from pure genetics to practical applications of attempts at breed identification, there can be no expectation of accuracy in determining breed ancestry through morphology. It's not possible without documentation through pedigree or DNA.

Such documentation, obviously, renders any visual identification unnecessary. Therefore, no public policy regarding the keeping of dogs in a community can ever justify employing such labels.

This should include everything from local dog registration information to regulations about keeping dogs, to housing insurance conditions.

There is simply no place for guesswork in public policy of any kind.



Section Two

Personality and Breeds

There is little question whether people's choice of a pet is influenced by their expectations of or at least hopes of that dog's behavior once they share a home. The extent to which behavioral incompatibilities actually create a risk to the relationship once they've bonded is a more complicated question. We will address that briefly in this section.

The research discussed in Section 1 demonstrates that adopters do make choices based on a dog's initial social responses to that person. This occurs after any initial sorting choices have been made based on appearance, which presumably includes any appearance-based breed identifications.

But what if direct interaction with a dog is not available? What is the likelihood that breed can provide adopters information about an individual dog's personality traits?

KEEP IN MIND

Direct social interaction with an individual dog always provides far superior insight into that dog's personality and social skills than any demographic information could.

Recently, geneticists have provided more credible answers on the correlations between breeds and various behaviors. The all-star team of geneticists and behaviorists at the Darwin's ark project looked at the behavior and ancestry of more than 28,000 pet dogs. The result is the strongest evidence yet that the link with behavioral traits by breed is weak at best.

This is particularly true among personality traits that are often most important to families, such as sociability. The strongest correlation found was with what the researchers called "biddability," which translates roughly to ease of training, and even it was less than impressive.

They found no genetic trail at all with regard to warning and biting behaviors. These are usually categorized as "aggression" in both scientific and popular literature. The study uses the term "agonistic threshold."

They came up with a very clever and elegant way to address the question of how breed-based expectations might color the behavior observations of purebred dog owners. Their evidence is compelling, with larger and more credible samples than ever attempted before and the most convincing phenotyping (concrete descriptions of behaviors) yet completed in owner survey style behavior data collection.

Does It Matter to Adopters?

There are various reasons why people would like to predict a dog's behavior. One of the most common reasons is to choose a dog who will be a good match for the person in terms of social skills and energy level.

For example, someone wants a puppy who will grow into a calm and friendly dog because they want to participate in animal-assisted therapy at local nursing homes. Or it could be someone who is looking for a dog who is likely to be successful in some desired service or competitive role. The person who wants to train a search-and-rescue dog is looking for particular behaviors, primarily a keen, indefatigable retrieving impulse.

In addition, people often would like to predict the behavior of unfamiliar dogs they encounter, especially the likelihood of warning or biting behavior toward themselves or people in general.

In all these cases, assessments are often made based on the breed of the dog or an inferred breed identification based on the appearance of a dog.

Aside from such very specific hopes and expectations when a potential adopter meets a candidate for a new best friend, we need to ask whether there are general benchmarks for behaviors that many find attractive.

Sasha Protopopova and her colleagues in Arizona found potential adopters were indeed swayed by the behavior of dogs they met (2016). A suite of behaviors generally gathered under the category of social competence was influential.



Social competence is a term borrowed from human child psychology. It means, roughly, learned behaviors that allow an individual to behave appropriately and get along with others.

Section Two

PERSONALITY AND BREEDS

Does it matter to
adopters?



In this case, social competency translated to a dog who sought out proximity to the potential adopter and responded to a person's invitations to play.

This was very encouraging to the researchers. It is quite easy in most cases to encourage these responses in most dogs, making them more attractive to adopters.

Earlier attempts had been made at behavior modification to enhance adoptability. This included training the dogs to respond to simple cues (sit, down, etc.), but the attempts were unsuccessful. The issue was not that it was difficult to train the dogs. It was that their "obedient" behavior did nothing to increase their adoption chances.

General Background Regarding Genetics and Behavior

Everyone acknowledges that genetic selection can influence the likelihood that a group of animals will express specific behaviors. People have been selectively breeding domestic animals for millennia. And the literature of modern biology is replete with examples of geneticists taking a single closed population of animals (sometimes a single breeding pair) and dividing the offspring into more and more divergent lines in terms of a single characteristic. It often takes only a few generations to alter the selected characteristic.

Lines of Stickleback fish have been selected to be extremely combative, for example (Bakker, 1986). When biologists breed for behaviors they classify as aggression, what they are usually targeting is more easily and intensely triggered agonistic behaviors toward the animal's own species. They might count how often, in what proximity, and for what duration the males attack one another in the tank. It is unlikely that there is a generalized trait for heightened hostility across species. Rather, there is an intensification of competitively motivated responses to particular stimuli, e.g., conspecific contenders for access to females.

Rats have been successfully separated into lines that fear and bite approaching humans and ones that seek out human contact (Singh 2017), as have, most famously, Siberian Silver Foxes (Trut, 2017)

Experimenters have separated Pointers into generally fearful, nervous lines and much calmer ones (Murphree 1969). In each case, the goal of selective breeding is to isolate some morphological or behavioral characteristic or combination of characteristics that already exist in the population and either increase or decrease its frequency or intensity in subsequent generations.

But this kind of ruthless selection for very specific traits simply does not represent the genetic ancestry of the typical pet dog.

The process of selecting mating pairs for pets is generally much much less systematic, even random, at least within the particular population, such as a group of pedigreed dogs.

So can we expect that dogs of a particular breed will behave in certain ways because they were once (or some lines within them are still) bred to do specific kinds of work? Probably not. Moreover, with the advent of modern genotyping (the concrete mapping an individual animal's DNA), much confusion has arisen.

Does Breed Predict the Likelihood of Personality Traits in An Individual Dog? Current Genetic Research Says No.

One might imagine, based on the general genetics and behavior section above, that the answer to this question might be yes. The most current and credible research, however, finds that in the world of pet dogs and their owners it turns out to be quite the opposite.

The authors of the Broad Institute study described in section 1 found that with regard to behavior that is commonly described as “aggressive,” (meaning readiness to engage in warning and biting behaviors directed toward people, which the researchers labeled “agonistic”) breed and even genetics in general, had virtually no influence.

Breed is simply not particularly predictive of the behavior of any individual dog.

This is the first research that compares genetic analysis with behavioral data collected on the same sample of dogs.

Morrill et al 2022

All earlier work on canine genetics and behavior has used separate data sets, meaning different dogs, for the genetic and behavioral information collected (MacLean et al 2019). Some have even tried to correlate DNA data with the behavioral breed descriptions taken from kennel club breeders (Shan, et al, 2021). Such compilations are more properly thought of as enthusiasts’ folklore, having no scientific basis.

Both techniques beg the question they address since their underlying assumption that behavioral traits were largely consistent among members of particular breeds was also part of their findings. The results of such studies could only yield findings that were at best speculative, which is why we do not discuss them at length here.

Morrill and her colleagues for the first time also collected behavioral and genetic information on a sample that was composed of both pedigreed and mixed breed individuals. Because of these major methodological and sample quality improvements over earlier studies, most of the discussion here of correlations between breeds and personality is devoted to the Broad Institute research.

Section Two

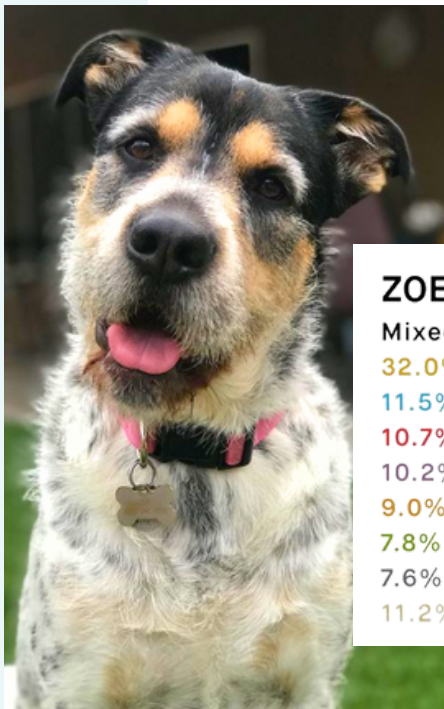
PERSONALITY
AND BREEDS

Does Breed
Predict the
Likelihood of
Personality Traits
in An Individual
Dog?

Moreover, the sample size for the behavior data and genetic sequencing data in Morrill et al is much larger (18,385 and 2,155 respectively) than anything attempted before.

The results also suggest a high level of accuracy in the breed identification of the dogs in the sample. The risk of owner breed bias affecting their reports of their dogs' behavior as a possible confound still exists and was in fact demonstrated in a small study here. However, it is somewhat mitigated through the sample size, the inclusion of breed or other bias neutral questions, and the analysis of the behavior of a large cohort of mixed breed dogs.

All of this further establishes this study as the current gold standard in canine behavioral genetics.



Survey questions (117 in all) for the open-sourced owner survey sample were primarily drawn from the Dog Personality Questionnaire, an instrument for which both reliability and predictive validity have been assessed (Jones, 2008), making it the exception among such survey instruments.

ZOE SCHEMERS

Mixed Breed

32.0% German Shepherd Dog

11.5% Chow Chow

10.7% Boxer

10.2% English Springer Spaniel

9.0% Australian Cattle Dog

7.8% Perro de Presa Canario

7.6% American Staffordshire Terrier

11.2% Supermutt

Factor analysis was then applied to the responses which clustered around eight personality trait continua:

- Human sociability

Arousal level

Toy-directed motor patterns

Biddability
- Agonistic threshold

Dog sociability

Environmental engagement

Proximity seeking

Section Two

**PERSONALITY
AND BREEDS**

Does Breed
Predict the
Likelihood of
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in An Individual
Dog?

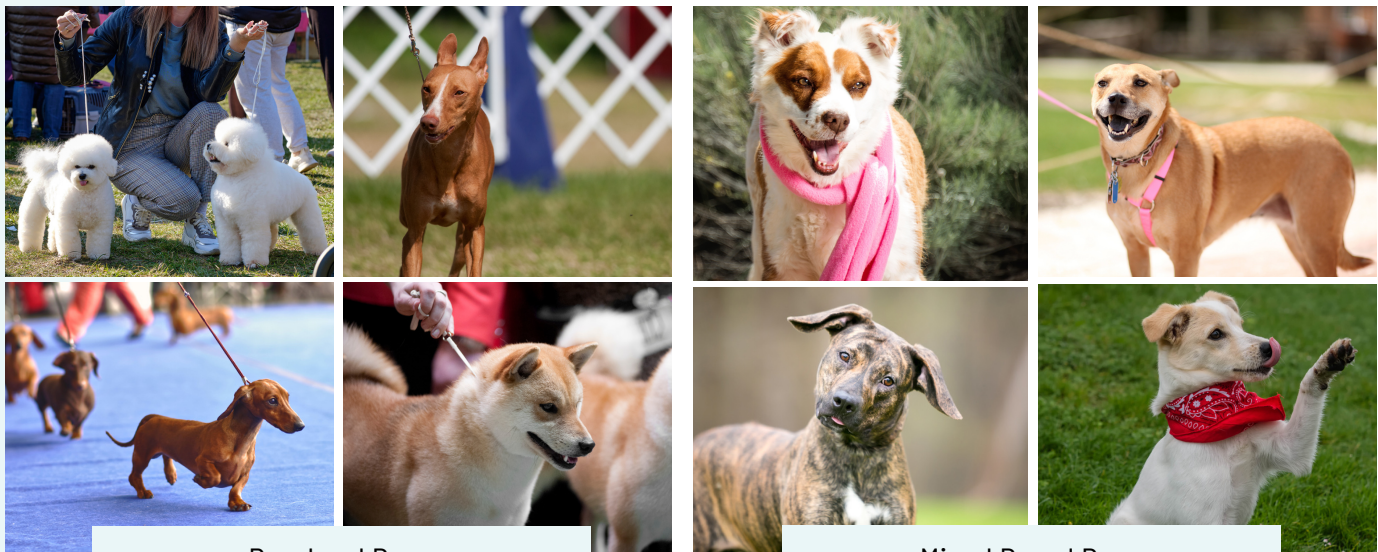
The breed identification algorithm used more markers than the commercially used canine DNA testing kits. It had a high level of agreement with owner reports that their dogs were purebreds, either by pedigree (98.7% agreement) or by reporting only one breed on the survey (85.8% agreement). This suggests a high level of accuracy on Darwin's Ark's breed identification.

The strong correlation between dogs thus “confirmed” as purebreds in the sample and the AKC registration percentages by breed suggest a sample likely to be reasonably representative of the general canine population with the same three breeds making the top five on both lists.



The Labrador Retriever, Golden Retriever, and German Shepherd Dog were among the top 5 most common breeds in AKC registrations and the Morill survey respondents

The proportion of purebred (49%) to mixed breed (51%) dogs also suggests that the Darwin's Ark sample is representative of the pet dog population in the U.S., as mentioned in Section 1.



Purebred Dogs

Mixed Breed Dogs

Section Two

PERSONALITY AND BREEDS

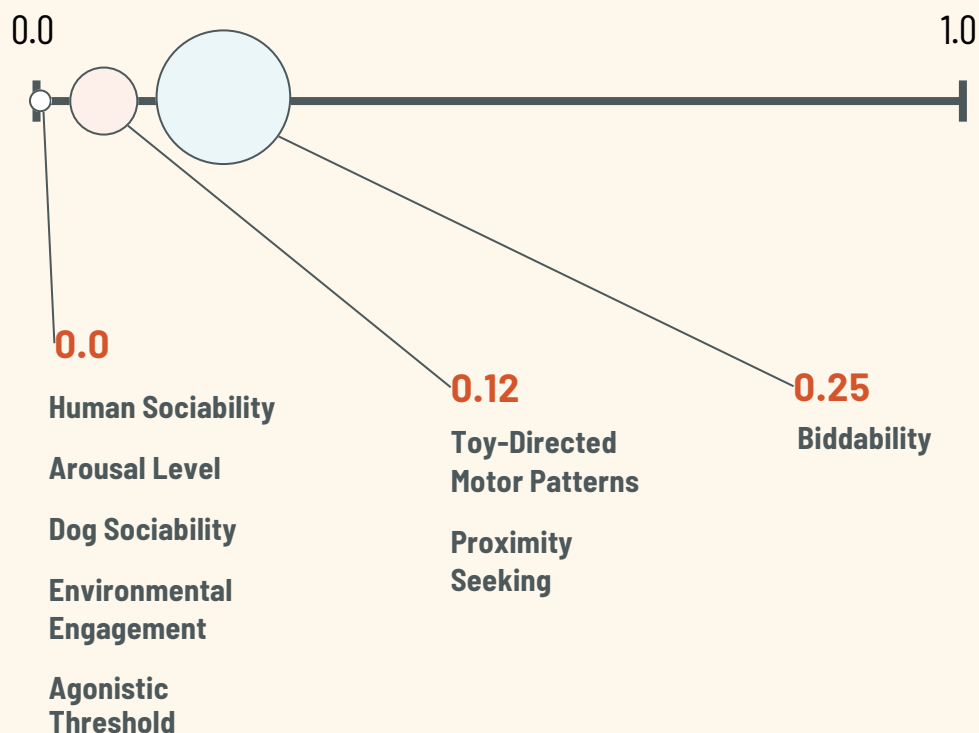
Does Breed Predict the Likelihood of Personality Traits in An Individual Dog?

The effect of breed on an individual dog's score on these 8 factors overall was found to be very low at 9%. The effect of genetics as a whole (unrelated to breed) was 25%.

The effect of genetics in general and breed in particular varied from factor to factor. The effect was so low for agonistic threshold, "how easily dog is provoked by frightening, uncomfortable, or annoying stimulus" (what is often labeled "aggression") that, for practical purposes, it can be said to have no effect at all.

The effect of breed on behavior was highest for biddability, "how readily dog responds to human direction, especially in the context of training," but can still only be described as modest. The Darwin's Ark researchers looked at this from various perspectives. Probably the most relevant to our topic of breeds and pet dog selection is what they found (adapted from Figure 2 in Morrill below) regarding the very limited extent that purebred dogs differed from dogs in general.

DIFFERENCE BETWEEN DOGS IN A BREED AND RANDOMLY SAMPLED DOGS (SCALE FROM 0.0 TO 1.0)



This low correlation between breed and behavior was in stark contrast to the very high correlation between breed and appearance, but even the morphological correlation only applied to purebred dogs. Once again, this confirms earlier research regarding the unreliability of identifying mixed-breed dogs by their appearance, which bears mentioning again here.

Section Two

PERSONALITY AND BREEDS

Does Breed Predict the Likelihood of Personality Traits in An Individual Dog?

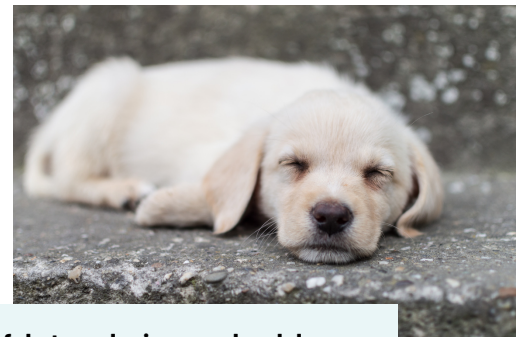
The study also confirms earlier research which used a sample of dogs living in shelters ([Gunter et al, 2018](#)) that most mutts are mixtures of several breeds at least: 66% according to Morrill et. al., Mixes of only 2 breeds are unusual (17%). The most common breed signature among mutts is the American Pit Bull Terrier, appearing in 10% of the mutts' ancestry.

People often expect certain behaviors from purebred dogs, believing that their forebears "have been bred for centuries" to hunt or guard or fight or herd. They also believe that these tasks have implications for more general personality traits, like friendliness or fearfulness for example.

This is simply not the case with modern dogs.

First, the lineages of modern registered breeds are very recent. Most date back only decades. The "bred for centuries" idea does not apply with regard to specific breeds.

Second and more importantly, in the relatively short period since there have been standardized selection criteria for purebred dogs, those criteria have related exclusively to appearance, not to behavior. Breed standards will sometimes give lip service to desired temperament, but these qualities are never defined in a way that can be applied by a judge to the dog in a show ring. Because of that fact, that purebred dogs are judged in the show ring entirely by how they look, morphological qualities are what breeders select for.



Breeders are very successful at producing purebred dogs who look alike, but not at getting them to behave similarly

There are still breeders who specialize in breeding dogs for very specific tasks, such as hunting and herding. Here, the concern is for performance rather than appearance. These are often the source of the "bred for centuries to do X," that one often hears. Usually this means selection for what are called action patterns.

Section Two

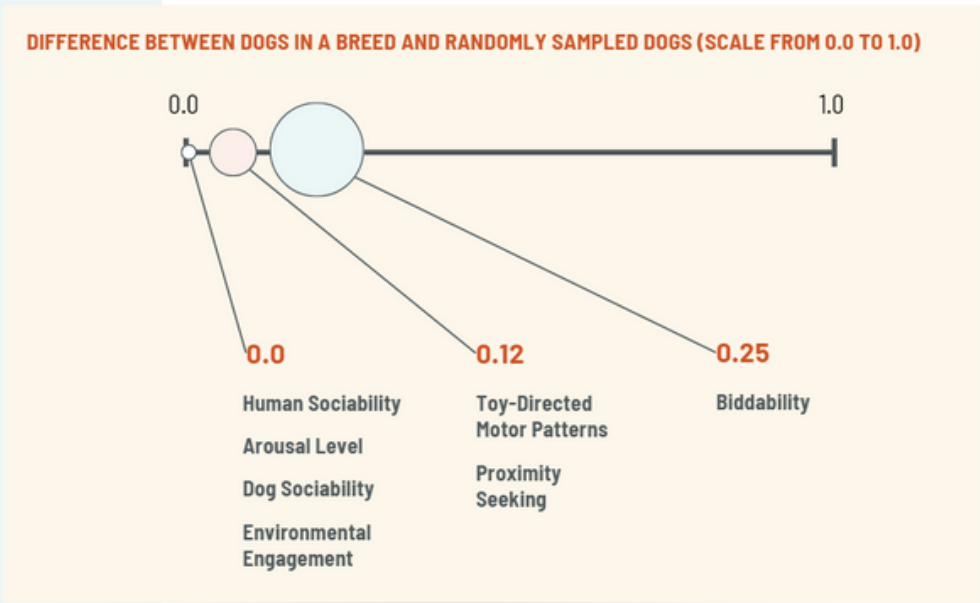
PERSONALITY
AND BREEDS

Does Breed
Predict the
Likelihood of
Personality Traits
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Dog?

Action patterns are very specific behaviors that are triggered by specific stimuli. A more appropriate, albeit certainly imperfect, analogy would be to think of them as reflexes. They are automatic impulses that do not need to be learned and the actions they spark tend to be very simple, with little connection to anything we think of as personality traits.

Increasing or decreasing their prevalence requires rigorous, even ruthless, selection, that is not the norm in modern pedigree breeding. So these dogs almost certainly represent a small subset of the purebred population. There is, however, some evidence that these impulses and the actions they trigger may have been somewhat genetically conserved over the centuries.

We'll discuss these more in section 3, but the important point to understand here is that they are not personality traits of the sort that a pet owner is likely



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Moreover, nearly the full range of behavior across all the breeds studied occurred within every breed. This suggests that work-related behaviors have long since randomized across the species. Again, when the breeds were grouped according to their original functions (terrier, herding and guarding*), the breeds from each group were equally distributed on all the qualities (Svartberg, 2006).

The Role of Breed-Based Expectations on Behavior

In addition to considering owners' actual preferences regarding how they expect their pet to behave, studies of breed differences in behavior would have to find a way around the confounding variable of the owners themselves.

An owner's expectations of a breed are likely to influence their treatment of a dog. And those decisions are likely to influence both how they choose to live with the dog and how they perceive and label that dog's behavior. The person who chooses a dog with the expectation that it will be an enthusiastic watchdog is likely to treat that dog differently than he would treat a dog he had chosen with the expectation that they will be rambunctiously friendly with everyone they meet.

Morrill and her colleagues have begun to take on this question in an ingenious part of their research. They hypothesized that if owner reports of their dog's behavior regarding one personality factor were different from the species average, then they should see a corresponding difference among mutts whose ancestry included a substantial percentage of members of that breed. The mutts' behavior should vary from the norm on that particular behavioral trait in the same direction.

Genotype is inextricable from environmental conditions.

In other words, if Golden Retrievers were more sociable toward people than dogs in general as their owners reported, then mutts with a high percentage of Golden Retrievers in their DNA should fall somewhere between purebred Golden Retrievers and dogs in general. They didn't.

This suggests that the owners of the pedigreed dogs were influenced in how they perceived and labeled their dogs' behavior by the breed. When they couldn't know the breed, because their dog was a mutt, this bias disappeared. Morrill and her colleagues were careful to include only mixes with at least 45% ancestry matching that of the pedigreed dogs they compared them with.

In general terms, as genetic research progresses, geneticists have become more and more certain that a complex personality trait, such as level of "sociability," will be found to involve multiple genetic aspects. It is also clear that the genotype is so inextricable from the environmental conditions—primarily often in the form of social opportunities—that it is simply meaningless to talk about the two aspects separately. For all practical purposes, there is no nature versus nurture debate.

Socialization, (i.e. Environment) vs Breed Stereotypes

Even the most venerable and the only environmentally controlled study, that is most often cited in support of breed-specific differences in behavior, contains support for the primacy of socialization in developing dogs as suitable pets.

This is the major work completed in 1965 by Scott and Fuller. It compares Beagle, Basenji, Shetland Sheepdog, and Fox Terrier puppies raised in a controlled kennel environment on a variety of problem-solving tests and various other assessments. This includes warning and biting behavior toward dogs and humans (Scott and Fuller 1965).

The study found some significant differences among the breeds when the puppies were raised in kennels. But a striking finding is seldom mentioned.

It concerns a few puppies who were raised as family pets, rather than in the relatively socially impoverished kennel setting.

Regardless of breed, the puppies raised in a home environment grew up to be the most confident, social, and affiliative with humans among all breeds.

They differed little amongst each other on those qualities. They did not even differ dramatically from their kennel-raised peers on the problem-solving tests that were central to the project.

PERSONALITY AND BREEDS

Socialization vs Breed Stereotypes

In the 1990s ethologists began to study social competence in dogs. An early small study of twenty-eight dogs of fourteen breeds from sporting, working, and terrier groups offers dramatic evidence of the power of dog/human relationships in influencing a dog's behavior.

Dogs who lived in homes and were considered family members by their owners were compared with dogs who lived outside (in kennels or unconfined) and were considered to be primarily working or guarding animals (Miklosi 1997). Those in the first group, who had an opportunity to form bonds with at least one human, were dramatically more friendly to humans in general. They were more inclined to stay close to people, more playful, and more likely to look to their human companions for help and encouragement when confronted with a problem-solving task than the dogs in the second group.

Breed differences had no significance with regard to this behavioral division between the two groups. This finding lends support to the position that differences in socialization may be most powerful in a dog's development.

The Swedish study mentioned earlier (Svartberg, 2006) found differences among breeds with regard to how boisterously the dogs greeted and played active games like tug of war with a stranger and how upset the dog became when confronted with very loud noises (gunshots and chains beating on metal) or the sudden appearance of scary human-size dummies. This may be a fruitful line of inquiry, although it presumes that boisterous greeting and play are more preferable to pet owners than more moderate behavior when, in fact, this is probably the kind of trait preference that varies widely among dog owners

**One person's irreconcilable differences is
another person's too cute for words**

The active field of behavioral genetics may, of course, uncover genetic markers for relevant behaviors. However, the most fruitful area for research in helping people live more happily with their canine companions would focus on identifying the husbandry techniques that best foster good relationships.

Warning and Biting Behaviors — Is Breed a Factor?

Based on the Darwin's Ark findings, we can say that the answer to this is an emphatic, "no."

Of course, this aspect of canine behavior is important to a person's choice of a pet. In general, people may be wary of adopting a dog who exhibits warning behavior, although there is ample evidence that many continue to live with dogs they have bonded with who are sometimes grouchy. (Guy, 2001)

How people respond to bites varies. For instance, It does bear mentioning that owners respond differently to the same behaviors, even warning behaviors. So, they are not always a deal breaker in a human/canine relationship.

One study found that owners considered bites more serious and more likely to require intervention, for example, if the dog was a large male rather than small or female.(Guy 2001).

Researchers have attempted to find differences among breeds on this aspect of behavior. The Swedish breed comparison study also presented some conclusions regarding breed and warning and biting behaviors. However, the author's own analysis demonstrated that the way the behaviors were measured was invalid. This is another example of why studies need to be both reliable and valid to bear out the expectation that dogs bred for appearance are likely to have behavioral uniformity on any traits. No such validated or reliable tests exist at this point.

Studies have only found very modest differences in warning and biting prevalences between breeds. None can claim the sample quality underlying the null finding in the Broad study.

Moreover, the findings with regard to breeds and agonistic behavior have been conflicting, to say the least. In science, when researchers find widely diverging answers to the same question it often means that they're either asking the wrong question or addressing it with the wrong methodology. In the study of prevalence of warning and biting behavior between breeds of dogs, the findings vary wildly between asserting prevalence differences based on breeds, breed groups, even morphology, to ones that show no differences at all.

PERSONALITY AND BREEDS

Warning and Biting Behaviors - Is Breed a Factor

Another null finding came out of a large study in Germany. It found no significant levels of “inappropriate aggression” among eleven breeds that the government of Lower Saxony labeled particularly dangerous (Schalke 2008). A follow-up study then compared members of these breeds with Golden Retrievers and again found no significant differences (Ott 2008). The results of this study actually resulted in the repeal of breed-specific legislation in Lower Saxony.

One large widely cited and publicized owner-reported behavior study did not make the distinction between “appropriate” and “inappropriate” behavior. It did find some differences among breeds in stranger-directed, owner-directed, and dog-directed aggression (Duffy, et al, 2008).

This conflicts with Morrill’s finding of no correlation between size and agonistic threshold. In any case, the striking finding in Duffy is that the rate of threatening behavior toward humans was extremely low across all breeds. The mean on all human-directed warning and biting for every breed included was between “no” and “moderate” levels of the target behaviors. And only very small percentages of any breed were reported as ever showing what the study defined as “serious” behaviors.

The difference between one or five dogs in a hundred is not informative when it comes to an individual person looking for an individual pet.

These differences also appeared between working and conformation lines within breeds. This can be easily attributed to different husbandry decisions between show dogs and field competition dogs.

It is possible that the wide variety of findings on this topic over the years is because of weaknesses in the sample sets, as well as the generally unvalidated status of the surveys and tests themselves (Patronek et al, 2019).

We do know that no previous research matches the thoroughness and size of Darwin's Ark. So, again, we can say that the current scientific findings say that no correlation between breed and agonistic behavior exists.

Recommendations for Matchmakers Regarding Breed and Personality Traits

OBSERVATIONS OF AN INDIVIDUAL DOG'S BEHAVIOR WILL ALWAYS TRUMP ANY GENETIC PREDISPOSITION

CONTINUALLY DIRECT A POTENTIAL ADOPTER'S ATTENTION TO A DOG'S OBSERVABLE BEHAVIOR

REMEMBER THAT AN ARBITRARY OR KNOWN BREED LABEL TELLS YOU NOTHING ABOUT A DOG'S INDIVIDUAL PERSONALITY

WHEN POSSIBLE, GET A BEHAVIORAL HISTORY FROM PREVIOUS OWNERS

REMEMBER THAT PRIOR BEHAVIOR, WITHIN THE SAME CONTEXT, IS THE MOST RELIABLE PREDICTOR OF FUTURE BEHAVIOR

FOSTER HOMES ARE THE IDEAL WAY TO COLLECT INFORMATION ABOUT A DOG

ALWAYS LOOK FOR OPPORTUNITIES TO MIMIC A HOME ENVIRONMENT IN THE SHELTER SETTING

Activities as simple as leash walks and play groups with other dogs, or even time spent simply relaxing in a “homelike” room with staff or a volunteer can yield information helpful to adopters.

Recommendations for Policy Makers Regarding Breed and Personality Traits

**YOU CANNOT MAKE ANY CORRELATION BETWEEN BREED AND BEHAVIORS
COMMONLY CATEGORIZED AS AGGRESSION**

**IT IS SCIENTIFICALLY UNJUSTIFIABLE TO USE BREED IDENTIFICATION IN
ANY PUBLIC OR PRIVATE POLICIES THAT REGULATE DOG OWNERSHIP OR
HUSBANDRY PRACTICES**

**SAFETY MEASURES REGARDING DOGS AND PEOPLE ARE ONLY EFFECTIVE
WHEN THEY ARE BASED ON THE ACTUAL BEHAVIOR OF INDIVIDUAL DOGS
AND THEIR OWNERS.**

“

**“Breed is simply not particularly predictive of
the behavior of any individual dog”**

Morill 2022

”

Section Three

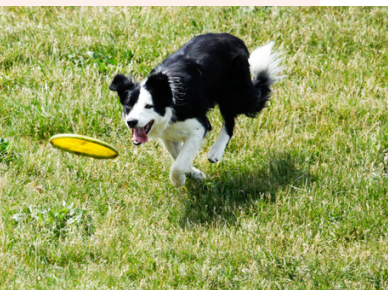
Purpose Breeding and Action Patterns



People often say, “well, pointers point and retrievers retrieve and herders herd.” There is little debate whether very specific behaviors, called action patterns, can be or has already been increased or decreased through selection in closed populations. It is much less clear whether the populations that have been selected for these behaviors are analogous to modern breeds or breed groups.



The extent to which a trait varies among members of a given population, and therefore may, but only may, be subject to future selection is called “heritability”. This term is the subject of much confusion in the general population and is even often misused among researchers. For now, we can just say that it does *not* mean “inheribility. This warrants repetition. “Heritability” does **not** mean the extent to which a trait can be inherited from one’s parents. The word “selectability” might be a more accurate label.



In any case, the behavioral target of this selection among domestic dogs for the centuries long efforts to influence the prevalence of specific traits has been these action patterns. These may be more easily understood as automatic impulses. They don’t have to be learned and are more or less spontaneously expressed when the right trigger stimulus comes into the picture.



In dogs, the simple, spontaneous impulses that humans have been most interested in targeting for increase or decrease in particular dog populations have to do with predation related urges. These impulses have been targeted by breeders toward work that is useful to humans, like tracking, and herding, and pointing, and racing and such. And it’s likely (although not actually scientifically demonstrated yet) that the expression of these impulses has been rendered more likely in some populations of dogs than in others, although probably less at the specific breed level, than at a kind of ancient genetic group level.



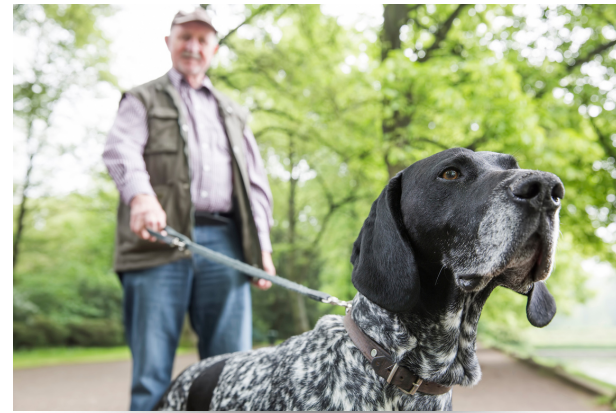
The important thing to remember, though, is that these simple, spontaneous impulses are not personality traits, nor do they have anything to tell us about the prevalence of personality traits, which are things like friendliness and the ability to form attachments and generally get along with others, even across species lines. These are the big traits that fall under the large umbrella of social competencies, require much learning, and have nothing to do with simple almost reflex-like responses.

Do Action Patterns Matter to Adopters?

A dog's personality traits and their social competence certainly matter to pet owners. But as discussed, these cannot be scientifically tied to breed. With action patterns the existence or lack of correlation with breed is more ambiguous.

Action patterns are simple behaviors that are predictably triggered by specific stimuli, almost like reflexes. So if very specific stereotypical behaviors can be shown to be more likely to occur in pedigreed members of a particular breed, would these behaviors be relevant to successful relationships in human households?

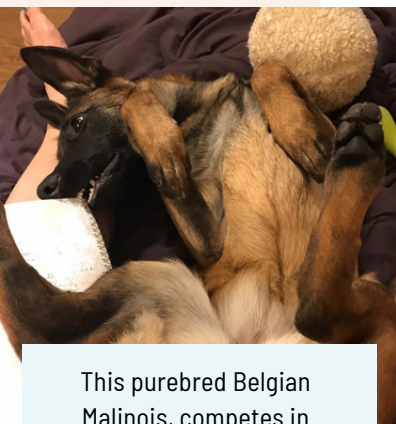
Let's say that some populations of dogs had the ability and the inclination to do work that they were selected for centuries ago. And, let's say that these abilities and inclinations were still more frequently expressed among members of those breeds than in the general canine population. What implications would this have for them as pets?



Most of this canine work is made up of fragmentary expressions of predation (tracking, stalking, chasing, etc.). If a dog is particularly inclined to chase small animals (or tennis balls for that matter), this may influence the kinds of games their owner plays with them.

It is also possible that a dog with an extremely heightened inclination to specific behaviors that may be seen in working lines may have difficulties in a typical pet dog home, e.g., the retriever who seemingly endlessly presents the ball to be thrown, or the cattle dog who nips at the heels of runners, or the pointer who spends hours quartering the local off-leash space looking for birds. All these behaviors originally needed to be expressed for many hours at a time; the work, whether herding sheep or cattle, or searching out and retrieving game, was likely to go on all day.

Unless a person is looking for a long-distance-running companion dog or a competitive Frisbee® dog, the energy level and motivation to sustain such physically strenuous work for a long duration can be a challenge to the pet owner seeking to keep their companion occupied.

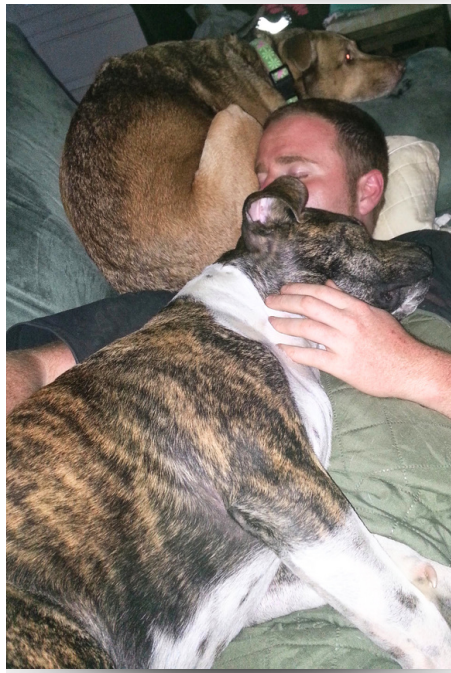


This purebred Belgian Malinois, competes in working dog shows and also lives comfortably as a pet with adequate play, training, and mental stimulation – two things all dogs need.

Section Three

PURPOSE BREEDING AND ACTION PATTERNS

Do Action
Patterns Matter
to Adopters?



There is little evidence that impulse-driven action patterns have any predictive value in the ultimate success of any human/canine relationship. One does not negate the other.

It is important to note at this point, that there is little evidence that any of this has much predictive value in the ultimate success of any human/canine relationships. After decades of research attempting to establish behavioral risk factors for relinquishment of dogs to shelters and on the range of behaviors of dogs in ongoing successful relationships, no substantial links can be made between an individual dog's behavior and the likelihood that they will live compatibly with their human guardians (Patronek, et al 2022).

Action Patterns, Genetics, and Breeds

It is important to remember that selection for any trait can only be accomplished when there is any variability in the expression of that trait to begin with, as was discussed briefly in the explanation of the term “heritability”. In other words, if a trait is truly fixed—if every pointer in fact points, for example—then there is no variability to select from and nothing can change, except through mutation, which is an infrequent source of genetic diversity. So if all pointers do in fact point (by no means an established fact), then the heritability of pointing among pointers is zero, even though the trait itself is probably very much inherited, which is an entirely different concept. While this can sound like a mere semantic distinction, it is an important one, if we are to have even a general concept of what is being said when statistically calculated percentages of “heritability” are claimed in research findings.



This speaks to the power of hybridizing among other things. In the world of domestic dogs, what this means is all non-purebred dogs, what the authors of the Broad Institute study called “mutts” who make up at least half of the US dog population. If 100% of a population of retrievers were documented to retrieve, the heritability calculation would yield zero, but the whole picture could be changed by mating one non-retrieving pointer with one of the retrievers if any of the offspring were non-retrievers. This would increase the group’s heritability number by increasing the variation of the

retrieving trait in the population. So the question that a heritability number actually answers is how possible it is to influence the occurrence of a trait through selection in the future, not how much it has been influenced by selection in the past. Such potential can be dramatically randomized by our mating of one pointer with one retriever. And to be cautious, we should note that there is actually little research on the prevalence of phenotypically defined pointing or retrieving or herding behaviors, so we cannot say for certain that these behaviors are in fact more prevalent among breeds that carry such labels, but the anecdotally based belief is so strong that we will proceed here on the assumption that the notion is correct.

Action patterns are quite different from traits that we typically think of as aspects of personality, things like friendliness, attentiveness, or various other aspects of social competence, that large suite of abilities that allow us to understand and perform actions that help us get along with others

Section Three

PURPOSE BREEDING AND ACTION PATTERNS

Action Patterns, Genetics, and Breeds

A common example of a human spontaneous unlearned impulse (an action pattern) may be helpful here. Let's talk about yawning for a minute. It wouldn't surprise anyone if just reading that sentence gave you an urge to yawn. Or it might take watching or listening to someone yawn to trigger the urge. Lots of dogs do this too—not the reading about it version—seeing another dog or a person yawn and reacting with their own jaw stretching action. This is one of those spontaneous impulses (action patterns), a simple reflexive (to use an admittedly rough analogy) act triggered by a particular stimulus. It doesn't have to be learned, although learning can sometimes modify the expression if not the impulse. Dogs, like many animals, have a pretty extensive repertoire of these action patterns, many originating from how their wolf ancestors' main way of making their living (i.e., by predation).



So you—let's say you're a wolf--string together a series of simple impulse-driven actions, one triggering the next.

They include following scents, stalking, orienting toward the prey and freezing so as not to alert them, chasing, grabbing, and biting, and you wind up with . . . lunch. You don't have to think about when to do what—there's usually not time—but you can get better at them with practice and with some animals, by watching how your successful elders do it.



PURPOSE
BREEDING
AND ACTION
PATTERNS

Action Patterns,
Genetics, and
Breeds

Probably quite early in our cohabitation with our now best friends and while the dogs themselves were actually transitioning to other ways of making a living, people noticed these impulses and began to try to sort them into specialties. So people began to group dogs for breeding or simply preferential treatment that increased the dogs' chances of surviving to reproduce according to which ones seemed keenest on following scents. These dogs became the hunting guides, the stalking and freezing ones became the pointers and setters and herders, and the chasing and stalking, and maybe grabbing ones became the retrievers, and so on.

Now, of course, we've known about this for a long time, but Dutrow and colleagues have backtracked the ancestry history of 4,000 dogs and found that they can sort dogs into general lineages according to the kind of impulse driven action patterns they've specialized in and have identified some genes that may relate to those specific impulses (Dutrow et al, 2023).

Furthermore, they found that most of these genes are what are called "non-coding," meaning that they don't control the production of proteins, and which geneticists once classified as "junk DNA" but which we now know serve a regulatory function. It turns out they have crucial roles in how or even whether genes are actually expressed. Kathleen Morrill, the first author of the recent groundbreaking study of canine behavioral genetics mentioned throughout this book, suggested thinking of them as "fine tuning switches" (Morrill, personal communication). The groupings of dogs by ancestral occupation found by Dutrow turned out to be similar to ones already reported in the last couple of decades of research on the relatedness of various breed groups (Parker et al, 2012). But this new study uses a different methodology and so confirms this ancient selection process, and suggests that at least some of these pre-breed inclinations may still be expressed in modern dogs, even though the intentional selection has been focused on appearance for the brief time since the late 1800's when breeds as we know them now have come into existence.



Ancestral occupation, ancient selection processes, and the persistence of pre-breed inclinations influence impulse-driven action patterns in modern dogs.

Purpose Breeding for Action Patterns in Practice Greyhounds as a Case Study

Racing Greyhounds are an interesting real-world case of rigorous selection for a specific impulse driven action pattern. They are probably the only remaining example in the United States of a large population of dogs selected strictly for behavior and physical ability. The effect on morphology was discussed in Section 1. Until about a decade ago, at least 23,000 racing greyhounds were bred in the United States annually (Greyt2KUS). In racing Greyhounds, as with other purebred dogs, we have a closed gene pool with pedigrees maintained over many generations and no outcrossing permitted.

A Greyhound's ability to run faster than other dogs which drives the breed's morphology among other traits is of no use to the racing industry if the dog is not strongly motivated to chase.

The inclination to chase (or rush the prey) is probably the aspect of the predation sequence that is most commonly exhibited across the entire *canis familiaris* species, and so it ought to be relatively easy to select for. Such action patterns you will recall do not have to be learned, but are immediately fully expressed in the presence of the triggering stimulus, although in some cases the trigger exposure has to occur at a specific developmental stage or the behavior will never manifest.

The six-week-old retriever puppy, for example, who toddles after the first object that rolls across the floor and picks it up is expressing an action pattern. Breeders of hounds select for search behaviors; herding dog breeders want the stalk and rush, but usually not the grab (except in cattle dogs) and certainly not the kill and dissect; retrievers are supposed to rush and grab; pointers and setters primarily stalk, and so on.



Section Three

PURPOSE BREEDING AND ACTION PATTERNS

Purpose
Breeding for
Action Patterns
in Practice
Greyhounds as a
Case Study

Greyhound breeders, on the other hand, don't worry about getting rid of the aspects of the sequence that do not relate to chasing. They don't need to. The kill and dissect behaviors aren't a problem as the racers never have the opportunity to catch the mechanical "prey," and they are unlikely to emit the search or stalk behaviors on the racetrack because the prey appears already in motion, which triggers the chase. The unselected behaviors randomize-some individuals will have them and some won't because nobody cares. But in Greyhounds the rush or chase is ruthlessly selected for. Unsuccessful dogs simply do not reproduce.



Dorotas Wildcat, a racing greyhound, known for winning the 2018 English Greyhound Derby.



Tommy, flunked out of racing school, unamused by squirrels.

Yet even after hundreds of generations of this selection, experts in the field estimate that at least 25% of the pups in racing lines wash out long before they ever get to a race-track where they can be weeded out if they are not fast enough (American Greyhound council). Remember, breeders are selecting for a trait that is already expressed in most dogs across the species. Greyhounds who aren't keen to chase are culled before they can race

PURPOSE
BREEDING
AND ACTION
PATTERNS

Purpose
Breeding for
Action Patterns
in Practice
Greyhounds as a
Case Study

As an aside, it's quite possible that this inability to get Greyhounds to fully "breed true" to the chase behavior is their large gene pool relative to other breeds. Breeding for a specific behavior, even a very common one, is an iffy business, even if it is done with single-minded rigor. Anything less than strict selection is likely to result in behavior re-randomizing across the gene pool.

Since the other parts of the predation sequence aren't selected for or against, some retired racing Greyhounds will, in fact, and this is true across the species, kill a small animal once they catch it; others will not and may even be injured by an indignant but unscathed cat. Some are inclined to follow scents when at liberty in the open. Others are not interested. Some like to tear up their toys (dissect); others have the same toys undamaged for years.

Breeding for specific behaviors is challenging and may result in randomization of other behaviors.

The consequences of the Greyhound's selective breeding are in stark contrast to what happens with wolves, who are ruthlessly selected by their environment to emit the full predation sequence. The alternative is starvation and failure to reproduce. Since domestic dogs seldom rely on complete predation for survival or reproduction opportunities, the behaviors tend to occur across the species, with some individuals expressing the entire sequence, others showing fragments, and some showing no inclination toward predation at all. There is no way to predict even the probability of how much of the predation sequence will turn up in a domestic dog's genetic profile unless rigorous selection for specific impulse-driven action patterns has occurred.



Recommendations for Matchmakers Regarding Action Patterns

OBSERVATIONS OF AN INDIVIDUAL DOG'S BEHAVIOR WILL ALWAYS TRUMP ANY ANCESTRAL PRESUMPTIONS

A PERSON LOOKING FOR A PET IS LOOKING FOR AN INDIVIDUAL, NOT A BREED

BREED-SPECIFIC EXPECTATIONS ARE IRRELEVANT IN MATCHMAKING AND SORTING AT SHELTERS

ATTRIBUTING BEHAVIOR TO IMAGINED BREED ANCESTRY DOES NOT ENHANCE A DOG'S ATTRACTIVENESS

MAKING UNJUSTIFIED CONNECTIONS BETWEEN BREEDS AND BEHAVIOR CAN TRIGGER OTHER BREED BIASES

DEPICTING WHAT THE DOG LOVES TO DO IS MORE INDIVIDUALLY DESCRIPTIVE AND BOND-ENHANCING

OBSERVING INDIVIDUAL PREFERENCES HELPS MAXIMIZE EFFICIENCY IN ENRICHMENT ACTIVITIES

PRESUMPTIONS BASED ON BREED LABELS HINDER THE ABILITY TO IDENTIFY THE BEST ENRICHMENT ACTIVITIES FOR EACH DOG.

Recommendations for Policy Makers Regarding Action
Patterns

RESEARCHING GENETICS AND IMPULSE-DRIVEN ACTION PATTERNS MAY
LEAD TO UNJUSTIFIED CONCLUSIONS ABOUT CORRELATIONS BETWEEN
DOG BREEDS AND BEHAVIOR

THESE CONCLUSIONS HAVE NO RELEVANCE TO DISCUSSIONS ABOUT
PUBLIC SAFETY REGARDING HUMAN-DOG INTERACTIONS

POLICY MAKERS SHOULD PRIORITIZE COMPETENT SCIENTIFIC
CONSULTATION IN DECISION-MAKING PROCESSES TO AVOID CONFUSION
CAUSED BY EVERYDAY LANGUAGE OR MEDIA DISTORTIONS OF SCIENTIFIC
FINDINGS.

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“Canine behavioral diversification predates
modern breed formation”

Dutrow 2022

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