

NATURE VS. NURTURE: THE GENETICS OF BEHAVIOR

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Although today there is a wide acceptance that both genetics and environmental experiences define an animal's behavior, at one time it was thought that perhaps environmental experience alone determined an animal's behavior. Some of the first definitive work, published by Tryon in the 1940's, supported the genetic basis of behavior. Tryon studied rats and their ability to complete a maze. He grouped the rats that made the fewest errors and completed the maze the most quickly (maze-bright) and he grouped the rats that made the largest number of errors and took the longest to complete the maze (maze-dull). He bred maze-bright to maze-bright and maze-dull to maze-dull. Within seven generations he obtained a statistically significant difference in completion of the maze between the maze-bright rats and maze-dull rats. These rats were raised in identical environmental conditions. Subsequent to this first work, multiple studies have been published regarding the ability of genetics to influence multiple different behaviors in multiple different species.

It is much more labor and cost intensive to do generational studies on dogs due to their longevity and housing requirements. Despite this, in the 1970's Murphree and colleagues did studies on the fearful behavior of pointer dogs. A group of pointer dogs were obtained and then segregated according to their behavior: nervous or unstable dogs vs. normal or stable dogs. Nervous were bred to nervous and normal were bred to normal. Within a few generations the nervous dogs showed less exploratory behavior in new environment, were more likely to freeze at a loud noise, and less likely to greet people. Physiological differences between the groups of dogs (heart-rate and neurochemistry) were documented. Cross-fostering "nervous" pups onto "normal" bitches had no effect of behavior. All bitches and pups were raised and handled in a similar fashion, minimizing the environmental influences. Attempts to modify the nervous pup behavior with both training and drug therapy met with limited improvement.

Scott and Fuller did studies regarding the breed differences between five breeds of dogs: Basenjis, Beagles, American Cocker Spaniels, Shetland Sheepdogs (Shelties) and Wirehaired Fox Terriers. On 42 behavioral tasks, including emotional reactivity, trainability and problem-solving tasks, 31 of the tasks had breed differences. The Terriers, Beagles and Basenjis showed higher reactivity than did Shelties or Cocker Spaniels. The Cocker Spaniels were the easiest to train of the five breeds tested. Problem solving tasks showed differences between breeds in individual tests but overall, one breed didn't stand out as consistently better on all tests than another breed. Breed differences of twelve behaviors including reactivity, trainability and aggressiveness, are outlined in the book, [The Perfect Puppy](#) by Hart and Hart. The data was compiled via questionnaires to AKC judges and veterinarians. Twenty-seven breeds are included and it provides a valuable guide to help people select the best dog for them based upon behavioral traits of the breed.

How genes exert their influence on behavior is not a simple situation, such as gene X makes a dog fearful. Instead, the genes encode for the production of enzymes and proteins that make anatomic structures and physiological processes that shape behavior. During this process different environmental things may influence their development such as temperature, experience and nutrients. Therefore, genes and experience are inextricably bound together in the development of a behavior. For a specific behavior, i.e. fearfulness, there may be many genes contributing to its expression. As canine genetic mapping projects continue, we will gather more information about the genetics of canine behavior.

Due to the likely complexity of inheritance of behaviors, genetically influenced behavior problems may not show up quickly. Thus it is important for breeders to follow their lines closely for multiple generations to determine if there are either undesirable or desirable traits coming from lineages.

Environmental influences on the behavior of a puppy most likely start in utero with tactile sensations, temperature variations, etc. During the neonatal and transitional period (birth to three weeks) environmental influences are also critical to behavioral development. Gentle handling and enrichment should start shortly after birth. Adequately stimulated puppies have better coordination, higher sociability towards people and are less fearful in new situations than are un-stimulated puppies. The behavior of the bitch also plays a role in the pup's development. A hand reared puppy may suffer from lack of social interactive skills and have a slower maturation process and be more prone to disease than a pup reared by the bitch.

There are stages in development of a dog where experiences can more greatly influence the dog than at other times. These are known as the sensitive periods. The sensitive period for socialization (ability to form social attachments and form attachments to environmental elements) in dogs is thought to be between 3-12 weeks of age. Exposure to situations that the puppy will experience later in life and exposure to people, other animals etc. should be started when the animal is young.

Puppies should be left with their mother and littermates until they are seven weeks of age. This allows for adequate interaction and development of communication and social skills with the littermates. Seven weeks of age is the perfect time to place puppies in new home. Throughout this sensitive period for socialization, but especially between seven-twelve weeks of age, the puppy should be introduced to various situations and types of people that it may need to interact with later in life. New experiences should be made positive by engaging in play, verbal rewards or giving treats. Do not force fearful or shy puppies to experience things in a fearful state of mind. This is a time when the puppy is also susceptible to disease - it is imperative that owners have their puppies adequately vaccinated and that they make conscientious decisions about how and where to expose these puppies to novel environments and objects.

Puppy temperament testing has been widely publicized as a means of selecting the right pet for the right person. These tests include a variety of situational experiences for the puppy and its response to those situations is purported to predict the puppy's future temperament or ability to perform certain tasks as an adult. These tests lack scientific studies supporting their reliability. Not only is there a lack of data supporting a findings that puppy test scores at seven weeks of age correlate with adult behavior, there have been studies that have found that there is no correlation between scores at seven weeks of age and behavior at two-four years of age. Another study by Beaudet et. al found that the same puppy may score a substantially different scores at seven weeks of age vs. sixteen weeks of age. After struggling with low success rates of successful completion of training, the Guide Dogs for the Blind developed a test to predict future performance as a guide dog. Within twenty years they increased their success rate at predicting successful completion of training from 8% to 90%. Retrospective analysis showed that the tests that predicted future success in Guide Dog training weren't always closely correlated with the future task.

In summary, it is critical to remember that both genetics and environmental influences play an important role in the behavioral development of dogs. Through both responsible breeding and raising it will be possible to produce puppies that will successfully integrate into our lives.