Aggressive dog breeds: Document nr. 1

Heritability of behavior in the abnormally aggressive dog

Probably everyone understands that all of the dog breeds we have created are a result of our own manipulation of inherited physical traits. Until recently, most of us recognized that much of the behavior of pure bred dogs is also a result of manipulating inheritance: if you want to do sheep trials, you get a border collie; if you get a beagle, he will likely become instantly deaf to your calls if he picks up a scent to track. Once the discussion started about perhaps banning breeds that, as a breed, have a high tendency to attack and kill, everything got confused. People started to dispute the heritability of any kind of behavior in dogs, let alone killing behavior. To clear up the confusion, and to bring us back to the realities, we need to understand *how* it is, in fact, possible for behavior to be inherited. Only then can we have a clear and honest discussion about the problem of killing aggression in domestic dogs. First we have to understand a couple of biological concepts. Then we will look at recent research on the physical (thus heritable) mechanism behind abnormal aggression in dogs. In the end, the heritability of certain behaviors in certain domestic dogs is the result of a combination of what biologists call "physical conformation" and "behavioral conformation", often combined with – sometimes on purpose, sometimes inadvertently – selecting for real and/or pathological abnormalities in a breed. In this document, I will give a short summary of how this works. Bear with me, it all comes together in the end with reference to aggressive dog breeds.

Physical conformation

Physical conformation means that the dog has been bred until he is physically shaped specifically for the task we want him to perform. His body – brain, skeleton, muscles, metabolism, heat economy – will be different from other dogs, better adapted to the task we have invented for him. Basically, this just means the physical positions the dog has to assume to do his job will feel good and comfortable to him. The border collie is physically designed for the stalking stance and for switching easily from standing to lying down to standing again (with a frequency that would cause acute arthritis in any other breed), because his skeleton and muscles have been adapted to do these things easily and without damage. The greyhound feels comfortable when he sprints, his deep chest designed to easily provide enough oxygen to his muscles for a burst of high speed; the same deep chest means the greyhound can't run marathons because the deep chest prevents him from losing heat efficiently. The greyhound's brain has been shaped by selective breeding, so that the brain steers the legs in a gait that provides maximum speed in a sprint. The particular composition of the husky's skeleton, muscles and brain enables him to pull a sled with a different gait, one that does not cause him to constantly kick the dog beside him or the harness. His heat economy enables him to do this for long distances. The role the brain plays may not have been pinpointed in all cases (below more on this), but it remains a fact that it does. The border collie "giving eye" (a.k.a. "clap") is hard-wired differently from dogs who don't (probably in the visual cortex and the way that's connected to other parts of the brain); his brain is constantly putting the border collie's special body into the stalk stance. The greyhound runs by leaping, the husky by pushing with always one foot on the ground. The brain is driving the body differently in one breed or the other, having been genetically wired to use the specific body the dog has.

Dog breeders are not geneticists. Though they know they can manipulate the genes to get the traits they are looking for, they do this indirectly. Breeders select for particular traits by simply watching how a dog performs. When they are breeding a dog for a specific task, they

achieve this by removing the dogs who perform less well from the breeding stock. Sometimes they will cross in a dog breed they think will add traits to perform the task better (hybridization), in the hope of speeding up the process of getting better performance to select from. Breeders select for performance without always knowing exactly which traits they are breeding for – for example, until recently no one realized the husky was being bred for a particular heat economy; they just chose dogs who kept on running the longest. In the end, breeders get a dog that is physically shaped to perform its task better than any other dog will ever be able to.

Behavioral conformation

Physical conformation leads to behavioral conformation in a breed. First of all, the brain will be genetically predisposed to grow so it fits and efficiently steers the body it is born in. Secondly, the brain will adapt itself further to its environment – the body it is in – as it grows in the developing puppy. For example the cerebellum will adapt itself early on to drive and coordinate this particular body, with its shorter or longer legs, its particular shape of head and neck, its greater or lesser body mass and agility, and so on. In the end, the adult dog feels good assuming postures or executing behaviors his body and brain are particularly fit for (i.e., the task we have been breeding him for). There is no gene for running or stalking, only genes that give a dog four legs and make those legs longer, shorter, more or less flexible, etc. It is because of the action of genes – which determine differently shaped bodies and brains – that the pointer will feel good pointing, the border collie stalking and staring, the Newfie (with his heavy body and his tendency to store heat) floating in cold water, and so on. The environment will have no influence on the physical shape the dog takes, nor on which postures feel good to the dog. You just will not make a dog into something he has no genetic capacity to be. You may teach a poodle (or Newfie, or greyhound) to herd sheep, but he will never win a competition with a border collie. We have bred certain things into various breeds genetically and thus irrevocably.

You will also not prevent the dog from being what he is genetically predisposed to be. Because the inbred postures and behaviors feel good, fitting the body and brain the dog has been bred with, they are internally motivated and internally rewarded. This means that the behavior is practically impossible to extinguish by manipulating external environmental stimuli. The reward is not in the environment, but in the dog itself! As Coppinger and Coppinger (2001, p. 202) put it, "The dog gets such pleasure out of performing its motor pattern that it keeps looking for places to display it." Some dogs get stuck in their particular inbred motor pattern. We are all familiar with the golden retriever who just will not come out of the water, the border collie who escapes every afternoon to herd the children at the school playground, and the pointer who gets stuck in his point (sometimes for hours, until the owner finally finds him standing there frozen in the woods – a not uncommon problem during training and competitions).

These special behaviors in our dog breeds are not functionally motivated. The natural domestic dog is a scavenger, who has lost the hunting sequence as an inherited behavioral chain. These behaviors in our own highly-bred dog breeds are all the result of our selective breeding practices, which have led to physical and behavioral conformation – selectively reviving and strengthening parts of the lost hunting sequence so the breed could perform some specific task for us. We do this by indirectly manipulating the genetic composition of each breed. In the end, we get a breed that will reliably execute the behavior we have in mind due

to the genes it carries. The behaviors and *the dogs themselves* are, therefore, inarguably genetically predetermined, breed-specific human artefacts.

Selecting for abnormalities and/or pathologies

As dogs are bred by us to perform a certain task or have a certain look, we often select (sometimes inadvertently) for true abnormalities in body and behavior. We do this by looking for mutations and then breeding for them, or by hybridization to speed the process up. A clear case of this is the old English bull dog, who can hardly walk, hardly breathe, and cannot be born but by Caesarean section. The bull dog also provides us with an example of hybridization, as it has been crossed into other breeds by people who wanted to increase aggression in a breed without waiting for mutations to appear (e.g., the mastiff vs. the bull mastiff). Whether we will call such an abnormality pathological depends on how dysfunctional we find the abnormality to be. The Anatolian shepherd is abnormally large. This is functional in the environment he is bred in and works in, but his size would be a pathological trait if you moved this large, heat-keeping dog into a desert environment. The blue heeler is behaving pathologically when he nips a jogger's heels, but not when he does the same to cattle in his working environment.

Selecting for abnormal aggression

Another inbred, genetically determined abnormality that has recently been found is that of "impulsive aggression" in dogs (Peremans 2002; Van Den Berg 2006). This is defined as "aggressive assaults without warning and, therefore, unpredictable in nature" (Peremans, p. 178).

There is such a thing as normal aggression in animals (and dogs). Maternal aggression, territorial aggression, predatory behavior, for example, all depend on different neuronal and hormonal mechanisms, and they are all normal coping responses in a particular environment. These behaviors in the dog have been accepted by humans in the process of domestication, as long as the behaviors can be foreseen. Abnormal disinhibited behavior is not functional, and it is unpredictable. Although high arousal and sudden attack can be functional in certain environments, this behavior is pathological in a safer environment, where a high level of arousal and aggressivity aren't necessary and only lead to unnecessary attacks and injuries. Previous research implicates the frontal cortex, subcortical structures and lowered activity of the serotonergic system in impulsive aggressivity in both animals and man. (Peremans 2002, p. 14, *passim*). In dogs, impulsive aggressive behavior seems to have a different biological basis than appropriate aggressive behavior (*ibid*, p. 158).

Between the 1930's and 1960's, scientists developed a working model of how the aggressive drive operates in the brain. The primitive impulse itself is driven by the subcortical limbic system, with supervisory inhibition located in and directed by the (pre)frontal cortex (Peremans 2002, p. 158). The hypothalamus gives primitive emotions their motive force, in an undirected (reflexive), unrefined (on/off) form. There is immediate discharge of tension in the hypothalamus, without concern or understanding of the consequences. Stimulation of the hypothalamus produces rage, attack and hyperaggression; destruction of the hypothalamus results in the absence of all forms of aggression. The amygdala (a more recent structure) controls and mediates higher order emotions, and is even able to control the rudimentary emotions generated by the hypothalamus. Lesions in the amygdala disturb the animal's ability to conform behavior to social norms. The (pre)frontal cortex is involved in the

behavioral inhibition of drives. Lesions in certain areas are associated with an increase in aggressive conflicts. The influence of neurotransmitters has also been widely demonstrated (serotonine, norepinephrine, dopamine and hormones) (*ibid,* p. 159, *passim*).

Peremans studied two different populations of impulsive aggressive dogs. All of these dogs had executed one or more attacks without the classical preceding warnings, and the severity of the attacks was out of all proportion with environmental stimuli. Peremans found a significant difference in the frontal and temporal cortices of these dogs (but not in the subcortical areas) compared to normal dogs. This suggests that in dogs, as in other animals and man, there is a reduction of the "executive function" – "the capacity to organize cognitive specific resources to allow development of contextually sensitive plans and flexible responses" (Peremans 2002, p. 164). Peremans also found significant dysfunctions of the serotonergic systems in these dogs. Serotonergic dysfunction has been widely shown in many different species to be connected to abnormal, impulsive aggression (*ibid*, p. 163).

The dogs she studied were of various breeds, selected purely on the basis of their behavior. I.e., Peremans was not interested in implicating any particular breed, but in finding the mechanism behind the behavior in *any* dog it occurred in. Indeed, she finds that ALL the dogs with a history of abnormal, impulsive aggression shared the same physical abnormalities in the brain. The gender of the dog made no difference, as did not whether the dog was castrated or sterilized. This study shows that there is a physical and physiological basis for the behavior, which we can now pinpoint. The brains of these dogs are physically different from the brains of other dogs. Peremans leaves the possibility open that we will later find other physical factors "downstream" in the process, e.g., that the adrenergic system may also play an important role.

A second study (Van Den Berg 2006) investigated specifically the heritability of this impulsive aggression in the golden retriever. The goal was find out whether the behavior was hereditary, and if so to isolate the gene responsible for the behavior. This study found, indeed, a high heritability of impulsive aggression, although it did not succeed in isolating the responsible gene(s).

<u>Conclusion: heritability of abnormal aggressive behavior in the certain breeds of dog</u>

The heritability of abnormal aggression in certain breeds of dogs can no longer be denied. We have, first of all, to do with physical conformation. The bodies of these dogs have been selected to be able to execute the killing bite better and more efficiently than other breeds of dogs. These dogs all share a certain physical conformation to the task of killing: the exaggerated jaw muscles, heavy necks and shoulder areas, and body mass that makes defence against an attack much more difficult, often impossible. It remains a fact that if you want a dog who can kill, these are the breeds of choice because they are physically better fit for it than other breeds – no less than the border collie is best fit for herding sheep because of the particular way his body has been shaped by hundreds of years of selective breeding.

But breeders also selected for behavioral conformation. For hundreds of years, they have selected these dogs on the basis of performance for their specific task. To perform well, the pit-fighters had to attack without provocation or warning in a sudden outburst of unbridled aggression and to continue attacking regardless of the responses of the other. The bull- and bear-baiters had to be willing to attack in the absence of species-specific signs that normally provoke aggression, responding to the mere presence of another species, again not stopping in

the response to any external stimuli. The dogs used to guard extended farmlands in such countries as France (the Bordeaux) or South Africa (the Boerbull), the slave-chasers (Dogo Argentino, Fila Brasiliero), they were all selected for killing performance at the sight of strangers of another species – thus again a willingness to attack in the absence of the normal signals that provoke aggression in a dog and the unwillingness to stop (sometimes even after the other is long dead).

As they selected for performance, breeders could not know exactly which physical changes they were selecting for. That has changed now. Research now shows that, through selection for aggressive performance, we have in fact been consistently selecting for very specific abnormalities in the brain. These abnormalities appear in many breeds of dog as an accident or anomaly, which breeders then attempt to breed out of the dogs. In the case of the aggressive breeds, the opposite was true. Rather than excluding abnormally aggressive dogs from their breeding stock, breeders focused on creating lineages in which all the dogs would carry these genes (i.e., dogs which would reliably exhibit the desired impulsive aggressive behavior). They succeeded. Now that we know exactly which brain abnormalities breeders have been selecting, the assertion that this aggression is not heritable is no longer tenable. It is also not tenable to assert that not all the dogs of these breeds will carry these genes. The lack may occur as an accident where selection has failed, just as the golden retriever may *have* the genes due to failing selection against the genes. But the failure to have the gene is, in the aggressive breeds, just that – a failure. It is therefore misleading to assert that the aggressive breeds will only have the selected genes as a matter of accident, or that most of them will be fit to interact safely with other animals and humans. We have selected intensively for these genes in these breeds, for hundreds of years, and the accident that may incidentally occur is *lack* of the selected genes.

The bodies and brains of all these breeds have, just like the pointer, the husky, the greyhound and the border collie, been selected so that certain postures and behaviors just simply feel good. These dogs will seek opportunities to execute the behaviors they've been bred for, just simply because the behavior feels good. The behaviors are internally motivated and rewarded, thus the behaviors are not subject to extinction. Learning and socialization do not play a role and will not prevent the behaviors from appearing. The owner of such a dog might hope that learning and socialization could help the behavior to appear only at appropriate moments, however this is unrealistic. It's also not realistic to pretend that implusive aggression is not pathological. The environments (the fighting pit, the baited bull, the escaping slave) for which these behaviors were selected as an adaptive response are so extreme that in fact there is no appropriate context for these behaviors in normal life. Functional in the pit or facing the bear, these behaviors must, in all other contexts, be called pathological. In addition, the fact we now know that selection took place for *impulsive* aggressivity (Peremans 2002) means, by definition, that the behavior will always emerge suddenly and unpredictably, thus always escaping secure control by the owner of such a dog.

Speculating in favor of the aggressive breeds, let's suppose that human artificial selection will fail as infrequently in the aggressive breeds as it does in the golden retriever (according to Van Den Berg 2006, in approximately one out of a hundred dogs). Such a similarity is unlikely in reality, since aggression in the GR is probably due to an inadvertent founder effect, whereas the aggressive breeds have been carefully selected for these genes for hundreds of years. But all the same, let's suppose this favorable scenario for the sake of argument, that selection will fail in one out of a hundred dogs of the aggressive breeds. The figures that emerge remain appalling. They translate into owner of a golden retreiver taking a

1% chance of endangering others by choosing this dog, while owners of the aggressive bred dogs are taking (in this favorable scenario) a 1% chance of *not* endangering others in their surroundings by choosing such a dog.

Given the scientific proof that is now emerging about the source of the behavior in these dogs, it is time to stop letting the owners of these dogs deny that they could have known the dog would execute a serious to deadly attack. It is time to hold them – and the breeders of such dogs – fully responsible and liable for the risk they choose to take with others' lives.

Can you breed it out of them?

The fiction that, for example, the American Staffordshire terrier is a different dog from the pitbull, just because the breeding has (also fictionally, by the way) been going on separately for about 30 years is just that: a fiction. Although Beljaev succeeded in breeding fear out of foxes in only eighteen generations (Belyaev 1975, 1984/85), aggression is a more complex response and much more dangerous to live with while you try to breed it out. Furthermore, Belyaev's foxes were bred under laboratory conditions, where there was absolute control over not having the wrong genes creep back in again. The same goes for the fiction that you can keep the appearance of these breeds while making them into safe, peaceful dogs. Physical and behavioral conformation mean that you cannot breed out behavior and keep the dog the same shape. In fact, as Belyaev bred his foxes into the pettable creatures he wanted, they began to have an increasingly floppy-eared mutt exterior. Form follows function – you can't have a dog whose entire body and brain are adapted to executing the killing bite without having, in fact, a dog who will execute the killing bite.

The appearance of this problem in other breeds

As pointed out above, this kind of aggression has appeared in some other breeds as an unexpected and undesired anomaly – the golden retriever, the Berner Senne hund, the cocker spaniel have all had this problem. The lovers of aggressive breeds try to use these breeding accidents to prove that their aggressive breeds are just like any other dog, "see, they're no different from the cuddly breeds." But a cuddly breed sometimes ending up stuck with a genetic disaster does not prove that the behavior is normal canine behavior. All it proves is that the behavior is genetically determined. The occasional appearance of impulsive aggression in cuddly breeds is most likely the result of an inadvertent founder effect, and there has been mixed success in breeding it out of the dogs again.

But what about dogs like huskies and German and Belgian shepherds, which also figure significantly in the statistics on impulsive-aggressive attacks as defined here? These breeds are a separate problem. The problem with the husky may well be due to myths about the husky being a close relative of the wolf, which has resulted in some people breeding huskies to wolves to get "better" huskies. It is possible that people buy a husky that possesses non-domestic genes from some far grandparent the present breeder doesn't even know about, and that this is the cause of the occasional (though still too frequent) maladaptive aggression in a husky. Household breeds (such as the German shepherd and the Belgian shepherd) that are also used for police work suffer a different problem. These dogs are often bred in special guard-dog kennels, where selection unknowingly takes place for the same abnormalities in the brain as in the fighting dogs and other aggressive breeds. This is due to the mistaken idea that a good guard- or police-dog is a dog that will be anxious to bite and will do so savagely. In any case, many of these police dog lines will be kept separate from the general police dog

population, but not all. When a dog fails to successfully complete the guard-dog training, he is often sold to be a household companion. His pedigree goes with him, and he ends up in the general breeding population. As a result, his – apparently –recessive genes for abnormal aggression enter the general breeding population, polluting the gene pool and resulting in increasing abnormal attacks by members of the breed in households. Again, the appearance of this kind of aggression in these breeds is not proof that this is normal canine behavior, but acts rather as all the more proof that the behavior is genetically predetermined.

Finally, a couple of quotes from Coppinger and Coppinger (2001) that illustrate the point:

"If a dog is bred for exaggerated behavioral conformation and is expected to display it in a working environment, it is hard to imagine that the household environment is going to provide the proper stimulation for such displays. … This results in dogs that have motor displays not only inappropriate in the household environment, but that also can turn into compulsive disorders. A highly bred working dog raised in a nonworking household environment will still show the working behaviors it has been selected to display, but it will display them abnormally. Worse, it will display those behaviors in bizarre and obnoxious ways." (p. 242)

"Certain breeds make bad pets no matter what you do. We should recognize this and not try to make pets out of them." (p. 325, citing further the example of a border collie they owned)

These comments by two eminent biologists were intended to show that it is a mistake to hope that a border collie (for example) will make a great lazy living room dog. But they are all the more relevant when we speak of dogs who have been *genetically* selected not for staring and heel-nipping, but for impulsive aggressivity and sudden, all-out, non-stop, deadly attacks.

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