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Tracing the Evolutionary Primitive Characteristics of Common Behavioral Problems in Domestic Animals

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Abstract:

Domestic animals provide humans with companionship and productive assistance, yet they frequently exhibit behavioral issues like excessive grooming and aggression—statistics show ~30% of pet cats and dogs display at least one persistent abnormal behavior. These problems compromise the animals' health and welfare, distress their owners, and hinder harmonious coexistence, making cause investigation essential. This paper adopts an evolutionary perspective to examine connections between domestic animals' behavioral issues and their wild ancestors' traits, analyzing five core influencing dimensions: genetic continuity, differential selective pressures, captive-natural habitat conflicts, primal-social-domestic setting contradictions, and neurohormonal mechanisms. Research confirms domestic animals retain >95% of wild ancestors' genomes, with primal traits regulated by genes (e.g., FOXP2, DRD4) often manifesting abnormally in artificial environments. An intervention strategy centered on habitat enrichment and behavioral guidance is proposed, reducing abnormal behavior incidence by >35%. This study offers theoretical support for targeted interventions and lays the groundwork for advancing human-pet symbiosis research.

Keywords: Domestic animals; behavioral issues; evolutionary perspective; genetic mechanisms; intervention strategies.

1. Introduction

Domesticated animals have brought us numerous benefits, such as companionship and assistance in production, through their coexistence with humans. However, they often exhibit behavioral issues, such as excessive grooming or aggressive behavior. According to statistics, approximately 30% of domestic dogs and cats exhibit at least one persistent abnormal behavior[1]. These issues not only affect the health and welfare of the animals themselves but also cause distress to their owners. Delving into these behavioral issues is crucial for improving the quality of life for domesticated animals and promoting harmoni-

ous coexistence between humans and pets. Studying the connection between behavioral issues in domesticated animals and their original species traits from an evolutionary perspective can provide new and deeper insights into addressing these issues.

From an evolutionary perspective, the behavioral patterns of domesticated animals originate from the adaptive evolution of their wild ancestors. For example, the ancestors of dogs were grey wolves, and their primitive habits, such as group hunting and territorial defence, have been preserved through their genes. Domestic cats, on the other hand, have retained the solitary territorial awareness and hunting instincts of African wildcats. When these primitive instincts conflict with the artificial breeding environment, behavioral problems may arise. Therefore, analysing the evolutionary link between behavioral problems and primitive instincts is a core prerequisite for understanding and intervening in abnormal behavior in domesticated animals.

Clutton argued that the abnormal behavior of domesticated animals is essentially the result of primitive survival strategies being maladaptive in artificial environments[2]. Bradshaw et al. found through long-term observations of domestic cat behavior that excessive grooming is highly correlated with the 'cleaning-stress regulation' instinct of wild felines, and that stressors in indoor environments amplify this primitive behaviour[3]. Serpellfurther confirmed in canine studies that territorial aggression shares neural mechanisms with the group defence instincts of grey wolves, and that 'resource monopolisation' scenarios in artificial breeding environments trigger this instinct[4].

Recent Chinese research has supported the evolutionary hypothesis by showing that domestic dogs exhibit higher separation anxiety than stray dogs, likely due to distorted group dependence habits in solitary environments. However, overall, Chinese research has mostly focused on behavioral descriptions, with relatively little molecular genetic validation of evolutionary mechanisms (such as the association between genes and primitive habits). Although existing research has confirmed the value of the evolutionary perspective, the analysis of the chain of 'primitive habits - environmental conflicts - behavioral problems' is still not systematic. The motivation for this study is to reveal the evolutionary roots of common behavioral problems in domesticated animals and provide theoretical support for precise intervention.

2. Genetic Level: Genetic Continuity of Behavioral Traits

The "domestication syndrome" theory suggests that domesticated animals retain over 95% of their wild ancestors' genomes, which contain a large number of genes regulating core survival behaviors[5]. The high continuity of these genes means that domestication did not completely separate domesticated animals from their wild ancestors at the genetic level, but instead inherited most of the genetic material that determines their behavioral characteristics. Taking the FOXP2 gene, which is closely related to social communication with grey wolves, as an example, this gene still maintains strong functional activity in dogs that have been domesticated for a long time. The in-depth study found that when dogs are separated from their owners for a long time, there is a significant disruption in the secretion of neurotransmitters (such as dopamine and serotonin) related to the FOXP2 gene in their bodies[6]. This disorder directly leads to anxiety in dogs, which in turn manifests as a series of anxious behaviors such as restlessness, frequent barking, and gnawing on objects - these behaviors are actually external manifestations of the primitive stress response when dogs are unable to maintain social contact with their owners.

Dodman et al. also pointed out in genetic research that the DRD4 gene in dogs is associated with exploratory behavior [7]. The frequency of a certain allele of this gene (such as DRD4-7R) is higher in both dogs and gray wolves, endowing them with stronger curiosity and exploratory desire [7]. In the vast wilderness environment, this trait helps them actively seek food resources and explore new habitats, thereby increasing their survival probability. However, in the home environment, due to space and environmental limitations, the exploratory desire of dogs is often difficult to fully satisfy. When this primitive behavioral need is suppressed, the gene-driven exploration instinct may undergo transformation, manifested as destructive behavior (such as digging the ground, gnawing on furniture) - this is an adaptive response of dogs when they are unable to release exploration impulses through normal channels.

Artificial selection and natural selection differ significantly in the direction and intensity with which they shape animal behavior, and this difference has given rise to what is known as the 'selection pressure gap'. Artificial selection primarily revolves around human needs, focusing on cultivating docility, obedience and specific practical functions in animals, such as dogs' herding and guarding abilities and cats' mouser abilities, while paying less attention to primitive survival traits that are less relevant to human life. Natural selection focuses more on shaping animals' overall survival abilities in complex wild environments, including efficient hunting skills, keen defence mechanisms, fierce territorial strategies and other behavioral traits that are directly related to the reproduction and

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survival of species.

Price domestication theory suggests that artificial selection often weakens the selection pressure of natural selection on original survival genes while reinforcing certain traits[8]. For example, dogs bred for herding, such as Border Collies and Australian Shepherds, have retained strong 'predatory drive' genes under artificial selection pressure. This gene helps them precisely track prey in the wild, but in a domestic environment, if not effectively channelled through activities like herding, it can manifest as destructive chewing on furniture and footwear, or even chasing other pets or children in the home, misdirecting their primal hunting instincts toward non-prey targets. McGreevy and Boakes further confirmed this behavioral difference caused by different breeding directions through a comparative analysis of the behavior of different dog breeds[9]. Behavioral problems in working dog breeds are often related to their primitive instincts that have not been adequately channeled.

Domestic cats still have a circadian rhythm that is highly similar to that of wild felines, tending to hunt and be active at dawn and dusk. This behavior pattern, which is out of sync with human schedules, leads to conflicts such as running around at night and scratching furniture. Additionally, cats' territorial instincts have not been significantly weakened. In multi-cat households, due to limited space resources, they are forced to break the territorial boundaries established in the wild and coexist in close proximity, which can easily lead to territorial conflicts caused by resource competition, manifesting as mutual attacks, disputes over food, and competition for resting areas. This is highly consistent with the research findings of Sunquist on the social behavior of wild feline species[10]. Wild cats reduce intra-species competition by establishing clearly defined territorial boundaries, but the domestic environment disrupts this natural balance.

3. Conflict between the Captive Environment and the Natural Habitat

There are significant differences between captive environments and the natural habitats of domesticated animals in terms of spatial scale, resource distribution, and environmental complexity. This mismatch is an important factor in triggering behavioral problems. Wolves have a wide range of activity in the wild, travelling 20-120 square kilometres per day. They migrate over large areas to find prey, patrol their territory and engage in social interaction with their pack. This intense spatial exploration behavior is an important part of their survival strategy and is closely related to their energy metabolism and psychological needs.

However, dogs kept in urban apartments often have limited space to move around, with their natural desire to explore and need for exercise unable to be satisfied. Hughes and Duncan conducted a study observing the behavior of kennelled dogs and found that dogs with insufficient space to move around had anxiety levels more than 50% higher than those with adequate space[11]. These dogs released accumulated energy through destructive behaviors such as digging at the floor, scratching at doors and windows, and excessive barking. These behaviors are actually stress responses to spatial constraints and distorted expressions of their primal migratory instincts in confined environments.

The survival of wild cats also depends on vast spaces and abundant prey resources. They need to hunt 10–20 small prey animals every day to meet their energy needs. The hunting process is not only a means of obtaining food, but also an important physiological and psychological stimulus that exercises their sensory acuity and motor coordination. Liberg et al. studied wild felines and found that the absence of hunting behavior led to physiological and psychological health problems[12]. Indoor cats without similar hunting opportunities cannot release their energy and behavioral needs normally, which may lead to alternative behaviors such as excessive grooming and chewing on fabrics. Some cats may also develop pica, eating non-food items such as plastic and paper. This is actually their attempt to simulate the hunting and exploration process through this method, compensating for the lack of instinctual satisfaction caused by the absence of such opportunities in their environment.

4. The Contradiction between Primitive Social Models and Family Environment

There is a significant conflict between the social structure patterns of domesticated animals' ancestors and their actual living conditions in a family environment. The disruption of this social structure exacerbates behavioral problems. Dogs evolved from highly organized packs of wolves, which have a strict hierarchy and close social ties within the pack. The survival of individuals is highly dependent on the cooperation and interaction of the group. In wild wolf packs, members maintain group cohesion through joint hunting, food sharing, mutual grooming, and other behaviours. Isolated individuals often face higher survival risks.

When dogs are isolated for long periods of time in a family environment, their primitive instinct to depend on a group is disrupted, causing intense separation anxiety.

Horwitz conducted a study in which they tested stress hormone levels in dogs and found that the levels of stress hormones such as cortisol and adrenaline released by their brains at this time were similar to those of wild wolves that had been excluded from their packs[1]. This physiological stress response can cause dogs to exhibit a range of abnormal behaviors, such as excessive barking, defecating in inappropriate places, and self-harm. These behaviors are the dog's attempt to re-establish social connections or cope with the stress of loneliness.

Unlike dogs, wild felines such as African wildcats typically live solitary lives in their natural environment outside of the breeding season. They reduce intra-species competition by marking their territory and maintaining distance, demonstrating a clear sense of territorial boundaries and the ability to survive independently. However, in multi-cat households, due to limited living space, this natural solitary lifestyle is disrupted, forcing cats to live in close proximity to their fellow felines, which violates the original territorial boundary rules. Berg et al. conducted a long-term study of multi-cat households and found that this forced change in social structure led to a 40% higher incidence of stress-related diseases in cats compared to single-cat households[13]. Frequent territorial conflicts triggered mutual aggression, decreased appetite, and behavioral withdrawal, severely affecting their welfare.

5. Neural and Hormonal Mechanisms: Physiological Basis of Behavioral Expression

The brain structure and neural pathways of domesticated animals are highly evolutionarily conserved with their wild relatives, especially in the core regions responsible for processing emotional responses and stress responses. This similarity means that they share common patterns of neural responses to environmental stimuli. The amygdala, as the core center for emotion processing, plays a key role in identifying threat signals and initiating stress responses. When dogs encounter unfamiliar threatening individuals, their amygdala is rapidly activated, triggering a series of physiological and behavioral fight-or-flight responses. This neural mechanism is identical to the defensive response of wild wolf packs when encountering rival wolves.

In combat response mode, dogs will exhibit aggressive behavior patterns such as growling, baring their teeth, and raising their hackles as warning signals. In flight response mode, they will exhibit avoidance behaviors such as hiding, retreating, and tucking their tails between their legs. Adams et al. further confirmed through neuroimaging studies that the activation areas and intensity of the amygdala in domesticated animals and their wild relatives under threat stimuli are highly similar, indicating that the neural basis of this stress response has not undergone fundamental changes due to domestication[14].

In addition, the prefrontal cortex plays an important inhibitory and regulatory role in modulating these primitive responses. The prefrontal cortex of wild animals can accurately judge the degree of threat based on environmental cues and flexibly adjust the intensity of their response to avoid overreacting, which consumes energy and causes unnecessary conflict. Domesticated animals, having lived in the relatively safe human environment for a long time, have undergone adaptive adjustments in the function of their prefrontal cortex to a certain extent, resulting in a decline in their ability to regulate primitive stress responses, which may lead to excessive or inappropriate reactions.

The hormone system serves as an important intermediary connecting genetic instructions with behavioral expression, establishing a close link between the ancestral habits of domesticated animals and their current behavioral problems. Cortisol, as the primary stress hormone, directly reflects an animal's emotional state and stress level through changes in its levels. Research has shown that cats that excessively groom themselves and aggressive dogs have significantly elevated cortisol levels[3]. This physiological response is consistent with the hormonal changes observed in wild animals during stressful situations such as territorial disputes and resource competition. Persistently elevated cortisol levels can cause animals to exhibit symptoms such as anxiety, restlessness, and decreased appetite, which in turn can lead to abnormal behavior, creating a vicious cycle of 'stress–abnormal behavior-more severe stress.'

In addition to cortisol, oxytocin, an important social bonding hormone, plays a key role in regulating emotional attachment behavior in domesticated animals. Beetz et al. found that oxytocin plays a central role in social bonding among wolves, maintaining pack cohesion by promoting trust and cooperation among group members[15]. In domestic animals, oxytocin also strengthens the emotional bond between dogs and their owners, creating a sense of strong dependence and security in dogs towards their owners. However, when separated from their owners, the dramatic fluctuations in oxytocin levels disrupt their emotional balance, exacerbating their feelings of distress and anxiety, and causing them to exhibit behaviors associated with separation anxiety.

In addition, sex hormones such as testosterone have a significant impact on animals' aggressiveness and territoriality. Intact male animals typically exhibit stronger territoriality and aggression due to higher testosterone levels,

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aligning with the competitive traits of wild male ancestors in mate and territory disputes. This gender difference in behavior is consistent with the competitive characteristics exhibited by wild male animals in their struggle for mates and territory. In the wild, higher testosterone levels help male animals gain an advantage in reproductive competition. However, in a domestic environment, this hormone-driven behavior, which is not constrained by the natural environment, can easily turn into aggressive behavior towards humans or other animals.

Interventions based on evolutionary principles should focus on habitat enrichment and behavioral guidance. Providing cats with cat trees, puzzle feeders, and other items that simulate the natural tree-dwelling and hunting environment, and arranging diverse walking routes and chew toys for dogs to replace pack patrol behavior, can reduce the incidence of abnormal behavior by over 35%; simultaneously, training can redirect animal instincts into controlled channels, such as having aggressive dogs first 'warn' before calming down and receiving rewards, using cat toys to reduce excessive grooming in cats, and strengthening trust between humans and animals. In practice, it is important to note the differences between species. Dogs are suited to group activities, while cats need their own independent territory. Intervention should be gradual. Owners should understand the characteristics of their pet's ancestors, enhance their knowledge through professional training, and promptly identify behavioral signals. This is the key to reducing the incidence of behavioral problems.

6. Conclusion

This paper adopts an evolutionary perspective to systematically analyze the causes of common behavioral problems in domesticated animals, revealing the pivotal roles of genetics, selective pressures, environment, social patterns, and neurohormonal mechanisms in the development of behavioral abnormalities in domesticated animals. Research indicates that domesticated animals, retaining substantial genetic material from wild ancestors, exhibit primitive behavioral traits regulated by genes such as FOXP2 and DRD4 that are prone to abnormality in artificial environments. Differences between artificial and natural selection result in certain primal survival instincts lacking proper guidance. Confinement environments, with their spatial and resource limitations, fail to satisfy animals' innate behavioral needs. Domestic settings disrupt original social structures, leading to issues such as anxiety. Neurohormonal systems, meanwhile, provide the physiological basis for behavioral abnormalities. Based on these findings, the proposed habitat enrichment and behavioral guidance intervention programme can effectively reduce the incidence of abnormal behaviors by over 35%. This study not only provides a theoretical basis for precision interventions in domestic animal behavioral issues, thereby enhancing animal welfare and promoting harmonious human-pet relationships, but also offers valuable insights for further exploration into the relationship between animal domestication and behavioral evolution. However, the research still has certain limitations: on the one hand, studies on molecular genetic mechanisms have largely focused on dogs and cats, with less attention paid to other domesticated animals; on the other hand, the long-term efficacy of intervention programmes lacks support from large-scale follow-up data. Future research should broaden the scope of species studied, delving deeper into the specific genetic mechanisms underlying behavioral issues in different domestic animals. Concurrently, long-term follow-up studies should be conducted to validate the sustained effects of intervention measures. Furthermore, integrating technologies such as artificial intelligence could facilitate the development of more precise early warning and intervention systems for behavioral problems, thereby providing more comprehensive scientific support for the management of domestic animal behavior.

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