

Beyond Breeding: Re-Interpreting Paradigms in Domestic Dog Aggression Research

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Abstract

Pet dog aggression is a research theme of extreme importance since, now more than ever, caretakers have the motivation and interest to better understand and relate to their dogs. However, most of the literature exploring this theme focuses on biased views of breeding, behaviour profiles and aggression itself. That way, many studies regarding incident predictability end in the same pitfall of standardizing aggression by a single factor, like breed, instead of approaching other important factors beyond genetics and learning. In this essay, we propose a new approach to understand aggression in dogs, seeking to deconstruct dichotomous approaches and criticize urban-western views. Regarding the animal as complex developing systems, that are always shaping and being shaped by its surrounding environment. With said approach, factors such as skull morphology, size, weight, caretaker relationship and culture, should be further incorporated in research for a deeper understanding of dog aggression as a social communicative behaviour.

Keywords: development, developing systems, human-animal interaction, perception-action

Resumo

Para além da raça: reinterpretando paradigmas na pesquisa sobre agressividade canina. Agressividade em cães de estimação é um tema de extrema relevância já que, agora mais que nunca, cuidadores tem motivação e interesse a melhor entender e relacionar com seus cães. Entretanto, a maioria da literatura explorando esse tópico foca em visões estereotipadas de raça, padrões comportamentais e agressividade. Dessa forma, vários estudos sobre previsibilidade de acidentes caem nos mesmos arcabouços de padronizar agressividade por um único fator, ao invés de abordar fatores além da genética e aprendizagem. Nesse trabalho, propomos uma nova abordagem para o estudo de agressividade em cães, buscando desconstruir perspectivas dicotômicas e problematizar os estudos focados no contexto ocidental urbano. Consideramos os animais como complexos sistemas em desenvolvimento que estão constantemente alterando e sendo alterados por seu ambiente. Com tal abordagem, fatores como morfologia do crânio, tamanho, peso, relação humano-cão e a cultura, tem de ser melhor incorporados na pesquisa, para uma melhor compreensão da agressividade canina como comportamento comunicativo social.

Palavras-chave: desenvolvimento, interação humano-animal, percepção-ação, sistemas em desenvolvimento

Resumen

Mas allá de la raza: reinterpretando paradigmas en la investigación de la agresividad en perros domésticos. La agresividad canina es un tema de investigación de suma importancia ya que, ahora más que nunca, los cuidadores tienen la motivación y el interés de comprender y relacionarse mejor con sus perros. Sin embargo, la mayor parte de la literatura que explora este tema se centra en puntos de vista sesgados sobre la reproducción, los perfiles de comportamiento y la agresión en sí misma. De esa forma, muchos estudios sobre la previsibilidad de incidentes terminan en la misma dificultad de estandarizar la agresividad por un solo factor, como la raza, en lugar de abordar otros factores importantes más allá de la genética y el aprendizaje. En este ensayo, proponemos un nuevo enfoque para comprender la agresión en los perros, buscando desconstruir los enfoques dicotómicos y criticar las visiones urbano-occidentales. Considerando al animal como sistemas complejos en desarrollo, que siempre están moldeando y siendo moldeados por el medio que los rodea. Con dicho enfoque, factores como la morfología del cráneo, el tamaño, el peso, la relación con el cuidador y la cultura deberían incorporarse aún más en la investigación para una comprensión más profunda de la agresividad del perro como un comportamiento comunicativo social.

Palabras clave: desarrollo, interacción humano-animal, percepción-acción, sistemas en desarrollo

Dogs as Developing Systems

In general, aggressive behaviours are performed by dogs on several different occasions, such as disputes between free roaming dogs, unknown domestic dogs interacting for the first time, or even in play between dogs who've been living together for several years. On day to day and scientific media, these interactions are often reported as inherently negative, violent acts intended to – or at least with the risk of – maiming, moved by negative emotional states. These interpretations can lead to reductive repercussions causing damages such as disrupting the dog-caretaker bond, or even public health policies that promote euthanasia (e.g., Casey et al., 2014; Nilson et al., 2018). However, such aggressive behaviours (e.g., barking, snapping, showing teeth and biting) in dogs are important social behaviours, called by ethologists as agonistic behaviours (de Waal, 2000; Huntingford & Chellapa, 2011). For example, in a competition for a resource such as food (Huntingford & Chellapa, 2011), when dogs bare their teeth to another, they can immediately solve the dispute if the competitor retreats, and consequently avoid the fighting itself. Moreover, looking through the Developing Systems Theory (Oyama et al., 2001), these aggressive behaviours emerge from dynamic interactions between the dog's morphology and its environment, thus not being the result of a singular developmental component such as their genes or behavioural training zone by the owner. In this essay, we discuss the role of aggressive behaviours for dog's development, social interactions, and overall welfare, evidencing how these behaviours actively shape the animal's environment, aiming to move beyond the naïve narrative that aggression is an aspect of dog behaviour determined only by the genetic or educational factors, and then propose a new perspective to study dog aggression.

Behavioural sciences such as Ethology or Evolutionary Psychology have been studying mechanisms by which aggressive behaviours occur and develop in animals. These sciences have their works anchored on the Modern Synthesis of Knowledge (Huxley, 1963; Laland et al., 2014), that unites Darwin's Evolutionary Theory (1809-1882 c.e.), with Mendel's Gene Theory (1822-1884) (Venter, 2000). According to that, an animal's behaviour is the result of its genetic inheritance and its interaction with the surrounding environment, putting genes as the innate factor controlling behaviour according to environmental resources.

Hence, a dichotomy is set between genes and environment, with the organism bridging both extremes. This dichotomy dominates western day to day and scientific literature alike, from books and media to medicinal practices and public policies (Oyama et al., 2001). In this work, however, we defend an alternative approach, the Developing Systems Theory (Oyama et al., 2001), which is: the view of organisms as interpreted as several organizing systems which can contingently (i.e., may or may not) interact with each other at any moment throughout development until death. Jablonka (2001) deepens this concept by proposing four possible sets of organizing systems that not only interact through development but are also highly heritable and deeply impact evolution: 1) the genetic (gene morpho-physiology and translation machinery), 2) epigenetics (e.g., cell morpho-physiology), 3) behavioural (niche, natural and social environments), and 4) symbolic (e.g., language, exclusive to humans).

During development and considering the cells, genes and the other elements of environment interact in bidirectional ways (Gottlieb, 2001). Laland et al. (2001) argue organisms aren't simply passive results of preprogrammed gene expressions, nor fixed environmental pressures, but rather active agents that transform and construct their niche both actively as passively, simply by existing. In fact, an organism's actions may also remodel the environmental pressures and influence the development of others, by significantly changing their environment, such as damming of rivers by beavers or humans (Jablonka, 2001; Laland et al., 2001).

Under this theoretical framework, animal-environment interaction is key to its behavioural development (Resende, 2019). Organisms acquire information from their own skills (e.g., opening and closing of fingers), from manipulating objects and substrate (e.g., shape, size, texture), and from the relative properties that emerge from the possibilities of interaction between organism and environment, other organisms included (e.g., ability to hold and handle an object through the use of fingers, hand and arms; or social interaction between conspecifics) (Gibson, 1979; Gibson & Pick, 2000). For Gibson and Pick (2000) the environment is alive and dynamic, made of inanimate and animate objects (such as animals) that confer possibilities of action and interaction between each other (Reed, 1994). Thus, these possibilities for action emerge from the match between an animal's characteristics

with the characteristics of objects available in their environment (including other animals).

Dogs are great models to study behaviour development through body-environment interactions, since their environment and niche are often intimately tied to ours (e.g., Cabral & Savalli, 2020). Studying domestic dogs as developing interactive systems highlights the importance of human-dog interaction for behavioural development, helping to promote a harmonious and healthy relationship between caretakers and dogs, as well as to shed light on appropriate interventions when necessary to deal with behavioural problems and, consequently, ensuring the well-being and quality of life for both.

Even though the majority of pet dog studies are done with animals and caretakers from WEIRD societies (Western, Educated, Industrialized, Rich and Democratic), these dogs represent only 30% of the total dog world population (Capellà Miternique & Gaunet, 2020; Hughes & Macdonald, 2013). Most dog behaviour studies focus on domestic dogs, and from those, almost their entirety study solely dogs with known breed genetic ancestry (Hughes & Macdonald, 2013; Mendes et al., 2021). However, dogs can also be street roamers or working dogs, for example, with many different niches and social styles throughout the world (Bhattacharjee & Bhadra, 2020; Capellà Miternique & Gaunet, 2020; Hughes & Macdonald, 2013). The societies are made of several socio-cultural factors that alter the interaction opportunities between dogs and caretakers, their relationship, and the values and perspectives we consciously – or not – imbue on these animals (Jervis et al., 2018). Different dog social lifestyles have been scarcely contemplated in literature and research. Just now they're beginning to be properly approached, categorized, and explored (e.g., Capellà Miternique & Gaunet, 2020). Even so, these dog-human associations are still regarded as being different, meaning that the typical one caretaker/family dog is a natural norm, while other models are different or even worse, wrong, or unhealthy (e.g., Camino et al., 2018; Jervis et al., 2018; Lévesque, 2019; Plata & Montiel, 2020). For example, the *Mbya-Guarani* indigenous communities from São Paulo, Brazil, have dogs living unbounded and largely unrestricted, free to interact with each other and with the people. These dogs self-regulate their relationships. They may or not belong to a single caretaker, depending on those solely for basic needs (Santos, 2018). For this community, each dog owns its behaviours and

relationships, be they positive or negative, with humans interfering as little as possible in dogs' choices. This relationship style is shared with other amerindians, with their dogs and caretaking practices also being marginalized or even actively criticized by their urban neighbours (e.g., Jervis et al., 2018; Lévesque, 2019; Plata & Montiel, 2020).

Since dog-human relationships are not universal and vary widely between different human cultures (Jervis et al., 2018; Miklósi et al., 2014), culture plays a fundamental role on the emergence of aggressive responses. The dog-human interaction, the way humans treat and perceive dogs, will actively alter the interaction opportunities of both human and dog, shaping the developmental trajectories of both. For example, dogs that inhabit indigenous communities in Brazil, United States or Canada are freer to express aggressive behaviours on their relationships, rather than pet dogs at the same countries, which have the risk of being punished if judged to be too aggressive to the accepted standards, and in some places even being subjected to removal from the caretaker or execution (e.g., Casey et al., 2014; Coren, 2018).

Transcultural perspectives are novel in the study of *Canis familiaris*, having emerged from the union of animal behaviour sciences with human cultural studies. However, this is not the most common nor trending approach to canine behaviour studies. In the following segment we will approach how the study of aggression is highly dichotomic, locked in a discussion if behaviours are more innate or acquired, and then how to best treat “unwanted” behaviours, be it with teaching or breed selection.

Understanding the Dichotomy and Current Canine Aggression Paradigms

Contemporary studies on canine aggression, with the aim of avoiding further dog-related accidents and injuries, seek to better understand how these behaviours occur, their intensity and situational context (e.g., Canejo-Teixeira et al., 2018; Casey et al., 2014; Farhooody et al., 2018), and if any pre-existing factors could contribute to the occurrence of aggression. Aggressive episodes are one of the most common complains caretakers have. It has contributed to label aggression as an “unwanted behaviour” or “behavioural problem” (e.g., Casey et al., 2014; Hsu & Serpell, 2003; Mehrkam & Wynne, 2014), mainly because aggressive episodes can

lead to injuries to both caretaker and dog, besides possibly leading to stressful conditions, poor quality of life and even animal abuse (Casey et al., 2014; Flint et al., 2017).

In countries such as England (United Kingdom), United States of America or Denmark, policies on canine aggression have led to the outlawing of breeding and selling dog breeds deemed too aggressive, such as pit-bulls or rottweilers (Casey et al., 2014; Coren, 2018; Nilson et al., 2018). This simplistic approach stems from the idea that canine aggression is intrinsically determined by the animal's genetic composition – which is different between modern breeds – fruit of a long process of breeding and domestication, originating on the Palaeolithic, around 35.000 years ago. Most modern breeds, however, were only selected in the 18th century (Kotrschal, 2018). In their review, Mehrkam and Wynne (2014) already stated how this view is challenged, revealing how studies by then already showed inconsistency between canine aggression patterns in different countries (e.g. Japan and USA), as well as with different methodologies (e.g. questionnaire assessment or bite reports), revealing not only significant within-breed variation, but also a lack of consistency between breed patterns found in these studies and patterns defended by kennel clubs. Mehrkam and Wynne (2014)'s review also gives important preliminary insight on how studies until then began to run into promising factors that weren't widely considered by then, such as studies which found aggression patterns when grouping breeds by size; as well as stating how previous bias (i.e. both in the data as well as in researchers) could be influencing results.

However, for classical Ethology, aggression was indeed seen as an inherent behaviour to animals (including human beings), as stated by ethologist Konrad Lorenz, in his work "On Aggression" (Lorenz, 1966). For Lorenz, aggression came from an evolutionary history of behaviours present at birth and inherited throughout generations, without any need of learning – the "instinctive behaviour", "drive", or "fixed action pattern" (Lorenz, 1937). Modern Ethology, on the other hand, sees aggression as a component of social maintenance, a key to inter-individual relationship structuring for a population or society (Aureli & de Waal, 2000). In this view, animals regulate their aggression continuously, since these intricate set of behaviours cannot be comprehended as merely internal or innate wills, but rather, elaborate forms of communication between two

or more animals (de Waal, 1996). In this communicative context, aggressive behaviours are considered with their other components of threatening and submission; which together make the agonistic behaviours (Aureli & de Waal, 2000; Huntingford & Chellapa, 2011).

Agonistic behaviours have the important role of regulating conflicting individual interests inside a community (Aureli & de Waal, 2000). An animal can impose its position in a conflict through threat and warning behaviours – also known as ritualized aggression, without necessarily engaging in actual physical conflict (Aldis, 2013; Huntingford & Chellapa, 2011). Threats, such as a dog's growling or a chimpanzee's smile, are important signals that communicate intention and might spare the animal from the energetic cost of physical confrontation (Aureli & de Waal, 2000; Cafazzo et al., 2018; Preuschoft & van Schaik, 2000). When we consider lifelong stable relationships among social animals, conflicts of interest where an individual imposes its will on other unbalances the power distribution of the relationship, creating vertical relationships known as dominance and subordination (Huntingford & Chellapa, 2001). Vékony et al. (2022) have recently argued how dominance is a relevant social dynamic in pet dogs – even if not as strong as it is in other canines – and, instead of an "innate" individual personality marker, it must be regarded as an interactional dynamic, dependant of factors of the individuals involved, as well as their environment.

To investigate the evolutionary history of pet dog aggressive behaviours, wolves (*Canis lupus*) are used as comparative animals, since they are each other's closest living evolutionary relatives. Since both animals' genetic makeups are highly similar, much of the research resides in discussing which behaviours could be more innate to dogs and wolves' genetics, while others be more a result of individual socialization with humans (e.g., Cafazzo et al., 2018; Range et al., 2015; Udell & Wynne, 2010). Caffazzo and colleagues (2018), and Range et al. (2015), have argued wolves and dogs aren't so different in aggressive tendencies, however, they differentiate regarding frequency and targets of aggression. In fact, other authors such as Serpell (2017) and Kotrschal (2018) argue aggression was fundamental during dogs and humans' evolutionary history and domestication. Perhaps counterintuitively to how most media have approached the history of domestication, much is still discussed about the supposed idea that dogs are less aggressive or more docile than wolves

(Cafazzo et al., 2018). Moreover, Udell (2018) suggests how this idea stagnates the study of canine behaviour, since the author states that the elements which differ dogs from wolves are both “innate” and “acquired”.

Complementary to evolution concerned studies, dog aggression research also investigates the factors and contexts associated with its occurrences in day-to-day lives, aiming to foresight factors that might trigger or make a dog prone to display aggression, as exemplified by Casey and colleagues (2014). These studies often discuss the canine personality profile, since they regard behaviour responses that are stable throughout different situational contexts of the same animal (e.g., Miklósi et al., 2014). That way, possible correlations and influences between bodily (e.g., morphophysiological), and environmental (social and physical) factors may be studied.

There are two main approaches to investigating behavioural profiles in dogs: direct observation via testing (e.g., Stone et al., 2016), and the use of questionnaires that access behaviour indirectly, relying mainly on the information provided by whoever spends most time with the animal (e.g., Casey et al., 2014; Farhoody et al., 2018; Serpell & Duffy, 2014). Several advances in the area were made through the use of questionnaires, allowing for bigger and possibly more diverse sampling, besides being a more naturalistic approach, since the main caretaker is more present in the dog’s natural environment and routine and, therefore, is more apt to disclose the dog’s natural behavioural responses to stimuli (e.g., Hsu & Serpell, 2003; Sheppard & Mills, 2002). Even though studying behaviour this way may be worthy, using this indirect approach the research is subjected to the caretaker’s biased perception. Caretakers not only might interpret the questionnaire differently (which is accounted for during questionnaire validation), but also differ on how they perceive their own dogs’ behaviours, and then on how to rank them appropriately. It impacts the response validity, and must be taken into account when analysing questionnaire research data (Miklósi et al., 2014). That is why most of these studies also investigate the relationship of dog behaviour profiles with caretaker characteristics (e.g., Kotrschal et al., 2009; Kubinyi et al., 2009).

Traditionally, factors most commonly associated as predictors for behavioural profiling in dogs have been age, sex and neutering (i.e., hormonal differences), and breed. These factors are considered because of the dog’s intrinsic characteristics reflecting its development

and hormonal metabolism (e.g., Careau et al., 2010; Miklósi et al., 2014). However, several researchers see no issue in grouping morphological, physiological and behavioural characteristics into breed groups (e.g., working, herding, sporting and terrier, according to the American Kennel Club, USA), or even into individual breeds (e.g., Duffy et al., 2008). Many specialists, breeders, trainers, and researchers argue the creation and selection of the different dog breeds we have today also selected different breed-specific behavioural profiles (see Cabral & Savalli, 2020). From this point of view, according to the breed, dogs would have an innate (i.e., genetic) tendency to perform certain behaviours, such as barking or attacking, or even highly specific behaviours such as herding, or being more tolerant to human children (Bekoff, 2019).

Nowadays, however, more studies have been proposing rather than breed or genetics, the morphophysiological, environmental, and sociocultural traits such as the caretaker’s gender, the place where the dog spends most of their time (e.g., inside vs outside), or local customs from where the research is being performed, significantly influence dogs behaviour development – giving more emphasis for development as well as inheritance (e.g., Canejo-Teixeira et al., 2018; Didehban et al., 2020; MacLean et al., 2019; Mehrkam & Wynne, 2014; Shih et al., 2019).

As described here, the innate/learned dichotomy still permeates studies of canine aggression, and this is a direct consequence of the Modern Synthesis of Scientific Knowledge, which states that an organism (and its behaviours) is initially determined by its genetic composition and expression, only later being modulated by external environmental influences (Laland et al, 2014), a view frequently seen in dog behaviour studies and reviews, such as Mehrkam and Wynne (2014). This influences how we perceive these animals and their behaviours, and then how we relate with them, reinforcing preconceptions about genetic determinism and impacting owner’s behaviour towards their dogs during their development, as well as public policies and conservation strategies (e.g., Casey et al., 2014; Coren, 2018; Mehrkam and Wynne, 2014).

Focused on the discussion if dog behaviours are more innate or acquired, the body of research has spent less effort investigating how these features (e.g., different morphology, or physiology) and relationships (i.e., with the environment and the caretaker) really are influencing behaviour (Udell, 2018). Bekoff (2019) argues

genetic determinism and the attribution of behavioural standards to breeds – instead of treating dogs as uniquely developing individuals – represent a categorical oversight by prioritizing breeds while largely ignoring individual behaviour variation. This author even states that this oversight leads to more harm than good, since they create expectations for caretakers about their purebred dog displaying a desired behavioural repertoire, that won't always be the case. Or even, in a larger scale, the prohibition of some breeds altogether, as seen in Casey and colleagues (2014), and Nilson and colleagues (2018). Rather than creating the stereotype that breeds such as pitbulls or rottweilers are intrinsically (i.e., genetically) more aggressive, other developmental factors such as origin and caretaker relationship may help to explain this behaviour; since it is plausible a person may obtain one of these breeds specifically to raise it as an aggressive dog, thus reinforcing the bias.

It's common that stereotypical behaviours attributed to a single factor, such as breed, sex, neutering, and gender, among several others, ignore the fact that each animal is a complex individual whose behaviours are a result of an intricate developmental process. This process being the constant result of cycles of possible interaction episodes between the factors that compose the animal: a specified body form, metabolism (e.g., hormonal balance), cells, genes, biotic and abiotic factors external to the body, which all interact to canalize developmental trajectories as development occurs (Oyama et al., 2001).

Considering Dog Behavioural Development as Interaction Cycles, a Proposal to Resolve the Dichotomy

In Brazil, there is a strong campaign for promoting stray mongrel (*vira-lata*) adoptions, to help reducing the stray dog population in urban and rural areas alike, with the premise of providing better care and quality of life for these dogs. Hence, it is very common to see media outlets discussing about the differences between buying a purebred dog or adopting a mongrel stray, with arguments pro purebred purchase mostly centring on the unpredictability of stray dog behaviour, since their genetic history and selection are completely unknown (Tubaldini, n.d). Therefore, being a mongrel *vira-lata* is a factor that severely impacts dog behavioural development in Brazil, since it shapes the available interaction opportunities for dogs. Some people will avoid, neglect

or even abuse *vira-latas* due to their unknown genetic heritage being considered a liability, while for other people this factor is not an issue that relates to behaviour nor caretaking. For example, the *Mbya-Guarani* indigenous people do not discriminate against dogs because of their breed nor behaviour, commonly adopting those who were abandoned by non-indigenous people near their villages (Santos, 2018).

Slowly, the inclusion of non-purebred dogs in research is helping to shift the paradigm to new approaches investigating dog features and behaviours without the bias of breed, like how height (e.g., the environments the dog can therefore explore), weight (e.g., the energetic metabolism and disposition of the dog) or skull length (e.g., vision and breathing differences between dogs) may relate to behavioural development. By disconnecting these factors from breed groups, the analysis becomes more inclusive and wide-ranging. Promising preliminary results have already been found in the literature (e.g., Ayrosa, Albuquerque et al., 2022; Ayrosa, Savalli et al., 2022; Stone et al., 2016). For example, Ayrosa, Savalli et al. (2022)'s results show an important step on this new direction, by expanding on dog characteristics commonly grouped by breed such as skull morphology, overall size, and direct measures of height and weight, from which skull morphology and weight both shown significant and important results.

In the same line, researchers like Bekoff and Pierce (2019) even propose how behaviour tendencies are much more related to the developing individual than a single trait such as size or breed. Dogs' senses are significantly different from ours (Bekoff & Pierce, 2019; Horowitz & Franks, 2020). The way they physically explore their surroundings, being quadrupeds without opposable thumbs, is significantly different from ours. Each dog has its own way of perceiving the world, according to its features, which reminds us of the animal's "*umwelt*" (i.e., the-surrounding-world), a concept first approached by von Uexküll (2001). As Uexküll (2001) first proposed, *umwelt* refers to the cosmos in which the animal exists, the surrounding environment which it perceives, affects, and is affected by. These differences in perception and action create ways of being that can be strikingly different from those of a human scientist – and must, therefore, be incorporated in science for us to better understand animal behaviour, development and even evolution.

Dogs actively influence their physical environment, by shaping and curating the places and paths that

they occupy, manipulating objects and making special decisions (Miklósi, 2014). Lenkei and colleagues (2020) have shown how dogs are aware of their own size and incorporate that on their decision taking and environmental exploration. A tall dog may be able to access and forage the top of a table, while a short dog can't. This leads not only to differences in how the dog perceives itself and relates to their physical environment (i.e., the table and the food available on it) but also the social, mainly their caretaker(s). Arhant and colleagues (2010), Learn et al. (2020), and Masters and McGreevy (2008) already have shown how caretakers relate to big and small dogs differently, and that difference in turn will affect the dog's behavioural development. To Learn et al. (2020), larger dogs are usually more trained to reply to commands and "behave appropriately" (e.g., not urinate inside their houses). Hence, we can see the way dogs' passive characteristics (i.e., height or size) actively impacts the owner's behaviours. The owners are part of environment, and act shaping dogs' development: the person adjusts their own behaviour and the environment according to the dog's characteristics. Relating to aggression, authors Ayrosa, Savalli et al. (2022) investigated how dogs' behaviours towards their environment (i.e., taking or chewing an forbidden object) modulated owner behaviour and how that could relate to aggression, but found no significant relationship between said factors.

The same idea may be used to study canine aggressive behaviours. Recently, Stone et al. (2016) found similar results for an Australian sample of dogs, in which smaller dogs performed higher on the questionnaire's measurements for aggression than larger dogs. The authors' proposed explanation is that smaller dogs would be more energetic and have a smaller neural anatomy, both factors intrinsic to the animal's body and physiology. However, Didehban et al. (2020), using questionnaires in a sample of Iranian dogs, found larger dogs to be reportedly more aggressive. These results are explained by Iran's common practice of having large guard dogs, trained for high aggression (Didehban et al., 2020). Stone et al. (2016) also reported that short-skull dogs (brachycephalic) were less aggressive than other dogs, due to ongoing selection for traits that make brachycephalic breeds (commonly show dogs) more affable. In opposition to those findings, Ayrosa, Savalli et al. (2022) reported how Brazilian short-skull dogs were more aggressive (i.e. even if the aggression report was only barking and baring teeth), which the

authors attributed to the cultural phenomenon of owners deemphasizing the agonistic behaviours of small short-skull breed dogs, common in urban Brazil.

Together, the results from these three studies show the complementarity of dog behaviour: how differences in morpho-physiology (i.e., metabolism and neural morphology) and culture (i.e., differences between Iran and Australia) affect behavioural development directly, by shaping interaction opportunities for dogs to express more or less aggression during development in these different countries – as defended by Oyama et al. (2001) and Resende (2019). Caretakers' perception varies individually and severely between different cultures (Miklósi et al., 2014).

These examples illustrate how a dog's behaviour, and its ongoing development is the result of all the concomitant interacting factors. However, this doesn't mean that development is an exclusively individual phenomenon. Even if being idiosyncratic, the interaction of all these developing factors functions as common denominatives or attractors for development (Gottlieb, 2001; Waddington, 1957), such that in a specific context, a factor may canalize development to a specific pathway, like the case of dog size in Australia and Iran. Taking from works such as Gibson and Pick (2000), Oyama et al. (2001), Bekoff and Pierce (2019) and Resende (2019), in this essay, we argued dog aggression studies should diversify the investigated factors and interactive processes that might be attractors for behaviour development, taking this intricate and complex process into account when discussing results.

By interpreting dogs as agents in modifying their world and development the study of canine aggression takes onto a new dimension. One in which looking for a single denominative predictive factor for understanding aggression profiles (be it innate, breed and genes, or learning and life conditions alone) is no longer the focus; but rather, understanding which of these factors are interacting relevantly for development, on the studied context: the population, the country, their way of living. Aggression is not defined solely for breed selection or animal abuse, but rather a result from the multiple genetic, epigenetic, morphological, physiological, abiotic, and biotic (e.g., conspecifics and other animals in their environment) factors that may or may not interact in a specific developmental context (Oyama et al., 2001; Resende, 2019). Therefore, canine aggressive profiles aren't universally specific to a breed, a type of dog-caretaker relationship or a country but may still be

unique to the interacting scenario of all said factors: as breed may be a predictive aggression denominator for British and Australian, but not for Iranian or Brazilian dogs. Lastly, this proposition is a call for a more open and inclusive ethological research, one that considers the perspectives of animal behaviour and development from other non-northern-euro-centric WEIRD countries and, most importantly, those of indigenous people, such as the *Mbya-Guarani* and many other Brazilian indigenous populations (Barker & Pickerill, 2020). Not just hearing and promoting these voices but working together with them in order to create a new, conjoined work (Guimarães, 2013).

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References

- Aldis, O. (Ed.). (2013). *Play fighting*. Elsevier.
- Arhant, C., Bubna-Littitz, H., Bartels, A., Futschik, A., & Troxler, J. (2010). Behaviour of smaller and larger dogs: Effects of training methods, inconsistency of caretaker behaviour and level of engagement in activities with the dog. *Applied Animal Behaviour Science*, 123(3-4), 131-142. <https://doi.org/10.1016/j.applanim.2010.01.003>
- Aureli, F., & de Waal, F. B. (Eds.). (2000). *Natural conflict resolution*. University of California Press.
- Ayrosa, F., Albuquerque, N., Savalli, C., & Resende, B. (2022). Size, skull shape and age influence the temperament of domestic dogs. *Behavioural Processes*, 197, 104606. <https://doi.org/10.1016/j.beproc.2022.104606>
- Ayrosa, F., Savalli, C., Albuquerque, N., & Resende, B. (2022). Relationships among morphological, environmental, social factors and aggressive profiles in Brazilian pet dogs. *Applied Animal Behaviour Science*, 256, 105766. <https://doi.org/10.1016/j.applanim.2022.105766>
- Barker, A. J., & Pickerill, J. (2020). Doings with the land and sea: Decolonising geographies, Indigeneity, and enacting place-agency. *Progress in Human Geography*, 44(4), 640-662. <https://doi.org/10.1177/0309132519839863>
- Bekoff, M. (2019, January 9th). *Dog breeds don't have distinct personalities*. Psychology Today. <https://www.psychologytoday.com/us/blog/animal-emotions/201901/dog-breeds-dont-have-distinct-personalities>
- Bekoff, M., & Pierce, J. (Eds.). (2019). *Unleashing your dog: A field guide to giving your canine companion the best life possible*. New World Library.
- Bhattacharjee, D., & Bhadra, A. (2020). Humans dominate the social interaction networks of urban free-ranging dogs in India. *Frontiers in Psychology*, 11, 2153. <https://doi.org/10.3389/fpsyg.2020.02153>
- Cabral, F. G. S., & Savalli, C. (2020). Sobre a relação humano-cão. *Psicologia USP*, 31, e190109. <https://dx.doi.org/10.1590/0103-6564e190109>
- Cafazzo, S., Marshall-Pescini, S., Lazzaroni, M., Virányi, Z., & Range, F. (2018). The effect of domestication on post-conflict management: Wolves reconcile while dogs avoid each other. *Royal Society Open Science*, 5(7), 171553. <https://doi.org/10.1098/rsos.171553>
- Camino, M., Cortez, S. M. P., Altrichter, M., & Matteucci, S. D. (2018). Relations with wildlife of Wichi and Criollo people of the Dry Chaco, a conservation perspective. *Ethnobiology and Conservation*, 7. <https://ethnobiococonservation.com/index.php/ebc/article/view/233>
- Canejo-Teixeira, R., Almiro, P. A., Serpell, J. A., Baptista, L. V., & Niza, M. M. (2018). Evaluation of the factor structure of the Canine Behavioural Assessment and Research Questionnaire (C-BARQ) in European Portuguese. *PLoS One*, 13(12), e0209852. <https://doi.org/10.1371/journal.pone.0209852>
- Capellà Miternique, H., & Gaunet, F. (2020). Coexistence of diversified dog socialities and territorialities in the city of Concepción, Chile. *Animals*, 10(2), 298. <https://doi.org/10.3390/ani10020298>
- Careau, V., Réale, D., Humphries, M. M., & Thomas, D. W. (2010). The pace of life under artificial selection: personality, energy expenditure, and longevity are correlated in domestic dogs. *The American Naturalist*, 175(6), 753-758. <https://doi.org/10.1086/652435>
- Casey, R. A., Loftus, B., Bolster, C., Richards, G. J., & Blackwell, E. J. (2014). Human directed aggression in domestic dogs (*Canis familiaris*): Occurrence in different contexts and risk factors. *Applied Animal Behaviour Science*, 152, 52-63. <https://doi.org/10.1016/j.applanim.2013.12.003>
- Coren, S. (2018, November 28th). *Does banning specific dog breeds improve public safety?*. Psychology Today <https://www.psychologytoday.com/us/blog/canine-corner/201811/does-banning-specific-dog-breeds-improve-public-safety>
- de Waal, F. (1996). *Good natured. The origins of right and wrong in humans and other animals*. Harvard University Press.
- Didehban, N., Borujeni, M. P., Avizeh, R., & Mosallanejad, B. (2020). Problematic behaviors in companion dogs: A survey of their prevalence and associated factors. *Journal of Veterinary Behavior*, 39, 6-13. <https://doi.org/10.1016/j.jveb.2020.06.003>
- Duffy, D. L., Hsu, Y., & Serpell, J. A. (2008). Breed differences in canine aggression. *Applied Animal Behaviour Science*, 114(3-4), 441-460. <https://doi.org/10.1016/j.applanim.2008.04.006>
- Farhooody, P., Mallawaarachchi, I., Tarwater, P. M., Serpell, J. A., Duffy, D. L., & Zink, C. (2018). Aggression toward Familiar People, Strangers, and Conspecifics in Gonadectomized and Intact Dogs. *Frontiers in Veterinary Science*, 5, 18. <http://doi.org/10.3389/fvets.2018.00018>
- Flint, H. E., Coe, J. B., Serpell, J. A., Pearl, D. L., & Niel, L. (2017). Risk factors associated with stranger-directed aggression in domestic dogs. *Applied Animal Behaviour Science*, 197, 45-54. <https://doi.org/10.1016/j.applanim.2017.08.007>

- Gibson, E. J. (1979). *The ecological approach to visual perception*. Houghton Mifflin.
- Gibson, E. J., & Pick, A. D. (Eds.). (2000). *An ecological approach to perceptual learning and development*. Oxford University Press, USA.
- Gottlieb, G. (2001). *Individual development and evolution: The genesis of novel behavior*. Psychology Press.
- Guimarães, D. S. (2013). Self and dialogical multiplication. *Interacções*, 9(24), 214-242. <https://doi.org/10.25755/int.2843>
- Horowitz, A., & Franks, B. (2020). What smells? Gauging attention to olfaction in canine cognition research. *Animal Cognition*, 23(1), 11-18. <https://doi.org/10.1007/s10071-019-01311-z>
- Hsu, Y., & Serpell, J. A. (2003). Development and validation of a questionnaire for measuring behavior and temperament traits in pet dogs. *Journal of the American Veterinary Medical Association*, 223(9), 1293-1300. <https://doi.org/10.2460/javma.2003.223.1293>
- Hughes, J., & Macdonald, D. W. (2013). A review of the interactions between free-roaming domestic dogs and wildlife. *Biological Conservation*, 157, 341-351. <https://doi.org/10.1016/j.biocon.2012.07.005>
- Huntingford, F. A., & Chellapa, S. (2011). Agressão. In M. E. Yamamoto & G. L. Volpato (Eds.), *Comportamento animal* (pp. 191-207). EDUFRRN.
- Huxley, J. (1963). *Evolution. The modern synthesis* (2nd ed.). George Allen & Unwin Ltd. London, United Kingdom.
- Jablonka, E. (2001). The systems of inheritance. In S. Oyama, P. E. Griffiths, & R. D. Gray (Eds.), *Cycles of contingency: Developmental systems and evolution* (pp. 99-116). The MIT Press.
- Jervis, L. L., Warren, D., Salois, E. M., Ketchum, S., Tallbull, G., & Spicer, P. (2018). protectors, aggressors, and kinfolk: Dogs in a tribal community. *Anthrozoös*, 31(3), 297-308. <https://doi.org/10.1080/08927936.2018.1455452>
- Kubinyi, E., Turcsán, B., & Miklósi, Á. (2009). Dog and owner demographic characteristics and dog personality trait associations. *Behavioural Processes*, 81(3), 392-401. <https://doi.org/10.1016/j.beproc.2009.04.004>
- Kotrschal, K. (2018). How wolves turned into dogs and how dogs are valuable in meeting human social needs. *People and Animals: The International Journal of Research and Practice*, 1(1), 6. <https://docs.lib.purdue.edu/paij/vol1/iss1/6>
- Laland, K. N., Odling-Smee, F. J., & Feldman, M. W. (2001). Niche construction, ecological inheritance, and cycles of contingency in evolution. In S. Oyama, P. E. Griffiths, & R. D. Gray (Eds.), *Cycles of contingency: Developmental systems and evolution* (pp. 117-126). The MIT Press.
- Laland, K. N., Uller, T., Feldman, M., Sterelny, K., Müller, G. B., Moczek, A., Jablonka, E., Odling-Smee, J., Wray, G. A., Hoekstra, H. E., Futuyama, D. J., Lenski, R. E., Trudy, F., Mackay, C., Schluter, D., & Strassmann, J. E. (2014). Does evolutionary theory need a rethink?. *Nature*, 514(7521), 161-164. <https://doi.org/10.1038/514161a>
- Learn, A., Radosta, L., & Pike, A. (2020). Preliminary assessment of differences in completeness of house-training between dogs based on size. *Journal of Veterinary Behavior*, 35, 19-26. <https://doi.org/10.1016/j.jveb.2019.08.003>
- Lenkei, R., Faragó, T., Kovács, D., Zsilák, B., & Pongrácz, P. (2020). That dog won't fit body size awareness in dogs. *Animal Cognition*, 23(2), 337-350. <https://doi.org/10.1007/s10071-019-01337-3>
- Lévesque, F. (2019). Ni animal de compagnie, ni animal de travail: proximité et mise à l'écart du qimmiq (chien) dans les familles inuites de l'Arctique central canadien avant la sédentarisation. *Enfances, Familles, Générations*, (32). <https://doi.org/10.7202/1064508ar>
- Lorenz, K. (1937). On the formation of the concept of instinct. *Natural Sciences*, 25(19), 289-300.
- Lorenz, K. (1966). *On aggression* (M. K. Wilson, Trans.). Harcourt, Brace & World.
- MacLean, E. L., Snyder-Mackler, N., VonHoldt, B. M., & Serpell, J. A. (2019). Highly heritable and functionally relevant breed differences in dog behaviour. *Proceedings of the Royal Society B*, 286(1912), 20190716. <https://doi.org/10.1098/rspb.2019.0716>
- Masters, A. M., & McGreevy, P. D. (2008). Dog-keeping practices as reported by readers of an Australian dog enthusiast magazine. *Australian Veterinary Journal*, 86(122), 18-25. <https://doi.org/10.1111/j.1751-0813.2007.00248.x>
- Mehrkam, L. R., & Wynne, C. D. (2014). Behavioral differences among breeds of domestic dogs (*Canis lupus familiaris*): Current status of the science. *Applied Animal Behaviour Science*, 155, 12-27. <https://doi.org/10.1016/j.applanim.2014.03.005>
- Mendes, J. W. W., Resende, B., & Savalli, C. (2021). Effect of different experiences with humans in dogs' visual communication. *Behavioural Processes*, 192, 104487. <https://doi.org/10.1016/j.beproc.2021.104487>
- Miklósi, Á. (2014). *Dog behaviour, evolution, and cognition*. Up Oxford.
- Miklósi, Á., Turcsán, B., & Kubinyi, E. (2014). The personality of dogs. In J. Kaminski & S. Marshall-Pescini (Eds.), *The social dog* (pp. 191-222). Academic Press.
- Nilson, F., Damsager, J., Lauritsen, J., & Bonander, C. (2018). The effect of breed-specific dog legislation on hospital treated dog bites in Odense, Denmark-A time series intervention study. *PloS One*, 13(12), e0208393. <https://doi.org/10.1371/journal.pone.0208393>
- Oyama, S., Griffiths, P. E., & Gray, R. D. (Eds.). (2001). *Cycles of contingency: Developmental systems and evolution*. The MIT Press.
- Plata, E., & Montiel, S. (2020). Human-dog bond in the contemporary mayab: Social perceptions and benefits associated with the hunter-milpa dog in maya peasant-hunter life strategies in Yucatan, Mexico. *Journal of Ethnobiology*, 40(4), 451-464. <https://doi.org/10.2993/0278-0771-40.4.451>
- Preuschoft, S., & van Schaik, C. P. (2000). Dominance and communication. Conflict management in various social settings. In F. Aureli & F. B. M de Waal (Eds.), *Natural conflict resolution* (pp. 77-105). University of California Press.
- Range, F., Ritter, C., & Virányi, Z. (2015). Testing the myth: tolerant dogs and aggressive wolves. *Proceedings of the Royal Society B*, 282(1807), 20150220. <https://doi.org/10.1098/rspb.2015.0220>
- Reed, E. S. (1994). The affordances of the animate environment: Social science from the ecological point of view. In T. Ingold (Ed.), *What is an animal* (pp. 110-126). Allen & Unwin.
- Resende, B. D. (2019). *Etologia, cognição e sistemas em desenvolvimento* (Habilitation Thesis, Universidade de São Paulo, São Paulo). <https://doi.org/10.11606/T.47.2019.tde-12062020-225803>
- Santos, B. S. (2018). "Aqui tem mais cachorro do que índio": relação humano-animal entre os Mbya-Guarani no Jaraguá (Monography, Universidade Federal de São Carlos, São Paulo). https://www.academia.edu/38199032/Aqui_tem_mais_cachorro_que_%C3%ADndio_pdf

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- Serpell, J. A. (Ed.). (2017). *The domestic dog*. Cambridge University Press.
- Serpell, J. A., & Duffy, D. L. (2014). Dog breeds and their behavior. In A. Horowitz (Ed.), *Domestic dog cognition and behavior* (1st ed., pp. 31-57). https://doi.org/10.1007/978-3-642-53994-7_2
- Sheppard, G., & Mills, D. S. (2002). The development of a psychometric scale for the evaluation of the emotional predispositions of pet dogs. *International Journal of Comparative Psychology*, 15(2). <https://doi.org/10.46867/C4G30W>
- Shih, H. Y., Paterson, M., & Phillips, C. J. (2019). Breed group effects on complaints about canine welfare made to the Royal Society for the Prevention of Cruelty to Animals (RSPCA) Queensland, Australia. *Animals*, 9(7), 390. <https://doi.org/10.3390/ani9070390>
- Stone, H. R., McGreevy, P. D., Starling, M. J., & Forkman, B. (2016). Associations between domestic-dog morphology and behaviour scores in the dog mentality assessment. *PLoS One*, 11(2). <https://doi.org/10.1371/journal.pone.0149403>
- Tubaldini, R. (n.d.). *Vira-Latas*. Cachorrogado – Tudo sobre cachorros e gatos. <https://www.cachorrogado.com.br/racas-caes/vira-latas/>
- Udell, M. A. (2018). A new approach to understanding canine social cognition. *Learning & Behavior*, 46(4), 329-330. <https://doi.org/10.3758/s13420-018-0334-1>
- Udell, M. A., & Wynne, C. D. (2010). Ontogeny and phylogeny: Both are essential to human-sensitive behaviour in the genus *Canis*. *Animal Behaviour*, 79(2), e9-e14. <https://psycnet.apa.org/doi/10.1016/j.anbehav.2009.11.033>
- Uexküll, J. Von. (2001). The new concept of Umwelt: A link between science and the humanities. *Semiotica*, 2001(134), 111-23. <https://doi.org/10.1515/semi.2001.018>
- Venter, J. C. (2000). Genome: The autobiography of a species in 23 chapters [Review of the book *Genome: The autobiography of a species in 23 chapters*, by M. Ridley]. *Nature Medicine*, 6(1), 11. <https://doi.org/10.1038/71457>
- Vékony, K., Prónik, F., & Pongrácz, P. (2022). Personalized dominance—a questionnaire-based analysis of the associations among personality traits and social rank of companion dogs. *Applied Animal Behaviour Science*, 247, 105544. <https://doi.org/10.1016/j.applanim.2022.105544>
- Waddington, C. H. (1957). *The strategy of the genes*. Routledge.

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