# *Canine canaries in the coalmine: welfare warnings, opportunities, and obstacles*

As a prominent example of modern *One Health* research applications, pet dogs have been widely studied and recognized as sentinels for human wellness in the 21st century for a wide range of toxins, diseases, pollutants, chemicals, compounds, and pathogens in the shared human exposome. Potential outcomes for comprehensive welfare improvement beyond the scope of biological health, for both humans and their figurative canine canaries, are however greatly restricted by persistent speciesism and the limited scope of research inquiries reflecting the same. While pet dogs represent a unique and largely untapped opportunity to examine a more complete scope of welfare concerns for modern people, their value will be limited in this capacity until the hierarchical model separating humans from other species of animals is effectively challenged. Unless the many longstanding historical and adopted biases still dominating cultural belief systems about human animals in relation to the natural world are confronted, and the ecological origins of human animals are accepted, validated, and popularly integrated, these anthropocentric constructs and consequences will continue to actively undermine not only the welfare of other species perceived as inferior, but that of people themselves in the Anthropocene.

A true biophilic renewal - the re-integration of and further investment in ecologically and phylogenetically informed concepts in research and subsequent applied cultural resource development - so poignantly indicated and readily potentiated in humans' modern relationships with dogs, is elemental to the ultimate adaptive success of humanity and so reflective of the life-saving promise of these canine canaries in the coalmine. It is proposed that the very phenomenon of pet dog keeping - perhaps the most remarkable symbol of canine sentinel potential in the modern age - may be understood collectively as a ***warning*** and an ***opportunity*** quite literally at the feet of humanity, while simultaneously symbolizing the pervasive cultural and cognitive ***obstacles*** to optimizing future adaptive benefits for both people and animals.

## Biological warnings and current indicator limitations

Dogs have been warning people about potential threats in the environment as an "extra alarm system" (Coppinger and Coppinger, 2002) since the beginning of their evolutionary relationships with humans tens of thousands of years ago. Where their capacity to alert to approaching intruders or predators was so instrumental to human survival for the majority of their shared history, these canine obligate synanthropes (Coppinger and Coppinger, 2016; Lord et al., 2025) have more recently become increasingly valued for their ability to serve as sentinels for a range of environmental threats to human health and wellness (Rabinowitz and Moses, 2022; Schmidt, 2009; Sexton and Ruple, 2024; Sumner et al., 2020; Wise et al., 2020). Dogs are therefore considered to be promising as modern day "canaries in the coalmine" (Rabinowitz, 2022), as they live in and are thus exposed to the many features and effects of modern human conditions. Pet dogs' sentinel capacities have been identified for a range of environmental health factors such as chemical pollutant or contaminant exposures (Avila et al., 2023; Backer et al., 2001; Knapp et al., 2013; Matheson et al., 2024; Nass et al., 2022), infectious disease transmission (Bowser and Anderson, 2018; Cleaveland et al., 2006;), dangers in walking/exercise opportunities (Jaffe, 2024; Collins et al., 2022), and even social welfare risk factors (Sexton and Ruple, 2024).

Dogs commonly suffer many of the same subsequent exposome-related ailments as people do, and are uniquely positioned to offer an early warning system to human health consequences given their similar genomes, certain shared biological/clinical features, and much shorter lifespans (Wise et al., 2020). As a result, an appreciation for the welfare of canines as animals to which people have at least indirect moral duties is representative of the many such substantiating arguments for justifying the *One Health* framework - where human interests are understood to be inextricably linked to those of other species of animals and the environment, and so are better served by a concern for them (One Health High-Level Expert Panel, 2022).

While impressive in scope of application and potential benefits, however, the modern canine sentinel concept and related *One Health* research reveal a number of significant oversights, persistent indicator biases, and pervasive anthropocentric and reductionist worldviews which may compromise extensive additional opportunities for improving both human and animal welfare (Chalmers and Dell, 2015; Johnson et al., 2024; Cox, 2022; Segal, 2019; Verbeek et al, 2024; Volsche and Sobol, 2025).These unintentional prejudices may well be traced back to one singular crossroads in human evolution and history - the departure from the hunter-gatherer's biophilic circle-of-life worldview, in which there was no marked delineation between people and other animals in the natural world. Where these hunter-gatherer human animals had long perceived themselves as having direct duties to other animals as moral agents in an environment to which they were so deeply connected (Serpell, 2005), their divergence from this ecological trajectory would alter the course of planetary history irreparably as humanity moved to dominate animal and natural resources (Diamond, 1987; Gowdy and Krall, 2013; Webb, 2025).

An historical review and evolutionary contextualization of human phylogeny preceding this profound biological and psychological biophilic severance and related false distinctions (Serpell, 2005; Chapman and Huffman, 2018; Leach et al., 2023; Webb, 2025) are paramount to dismantling certain obstacles and potentiating the many further capacities in which modern canines may serve as sentinels - beyond the scope of largely anthropocentric assessments of predominantly biological functioning indicators currently so widely appreciated in the literature (Lindenmayer and Kaufman, 2021).

**Original obstacles - sacrificing biophilia**

As humans attempted to cope with the guilt-inducing effects of their natural anthropomorphism (Urquiza-Haas and Kotrschal, 2015) regarding the consumption of animals (Rasmussen, 1929) in the face of shifting environmental pressures catalyzing the neolithic revolution and animal domestication (Caffrey, 2023), new exonerative belief systems and practices (such as animal and human sacrifice) were psychologically necessitated. In order to relieve their mounting cognitive dissonance, humans managed their guilt by appeasing imagined gods and animal deities with rituals intended to rebalance the scales, as once free-agent animals became readily exploited human dependents in a newly established "ontological supremacy" (Serpell and Paul, 1994). With the ultimate sacrifice of Jesus and the accompanying emergence of Judao-Christian concepts and doctrines of anthropocentric dominion over the rest of nature (Webb, 2025), many humans perceived themselves as permanently off the anthropomorphic hook. This "ultimate exonerative belief system" (Serpell, 2005, 2022) catalyzed a psychological split perceived between humans and other species on earth - the "magic wall" (Brevik and Barbieri, 2019) - that would ripple consequentially, exponentially, and indefinitely in the Anthropocene epoch.

Since this original biophilic severance, at what some believe to be the dawn of the Anthropocene (Ruddiman, 2010), human beings have increasingly rejected their hunter-gatherer origins as a species in preference for the anthropocentric origin story and hierarchical model of humanity's position over other animals and the natural world (Webb, 2025). Despite the enormity of the evidence to the contrary (National Academy of Sciences, 1999), people have continued to reject evolutionary and biological models as applying to humans, and rather distinguish themselves as superior non-animal beings (Chapman and Huffman, 2018) - the lasting effects of such speciesism observable throughout language (Leach et al., 2023), culture and science (Swartz and Mishler, 2022; Webb, 2025), and indeed human and non-human animal welfare today (Herzog, 2010; Bekoff, 2010).

People came to easily dismiss, or at least minimize, the consciousness of other species of animals (Serpell and Paul, 1994; Bekoff, 2010) as a means of effectively shielding or reducing the effects of their cognitive dissonance (Powell, 2025), as they garnered increasing exploitative powers of control over them. Such social distancing - "in-group" and "out-group" distinctions degrading the moral status of "other" beings (Brewer, 2007) - separated people from their biophilic connections as a consequence of psychologically enabling the maltreatment of creatures perceived as inferior to humans. This stratification of animal sentience and related debates continue even today (Paul et al., 2020), as the consciousness of various species of animals are commonly compared to the human standard and arranged accordingly, hierarchically, rather than understood as variations for uniquely adapted organisms with respectively differing operating mechanisms and hardware (Baars, 1988; Zych and Gogolla, 2021; Webb, 2025). The welfare consequences of this original discrimination between the God-like status of human beings and the subordinate value of all other creatures as non-sentient resources have been severe, for humanity as well as the natural world (Webb, 2025).

E.O. Wilson, in his hallmark book, *Biophilia* (1984), described the inertia and profound human welfare consequences of the departure from the rest of nature:
*"The world began to yield, first to the agriculturalists and then to technicians, merchants, and circumnavigators. Humanity accelerated towards the machine antipode, heedless of the natural desire of the mind to keep the opposite. Now we are near the end. The inner voice murmurs You went too far, and disturbed the world, and gave away too much for your control of Nature."*
The gap between human beings and their ecologically connected niche on earth has continued to widen to an extreme of *evolutionary mismatch* (Li et al., 2018; Volsche and Sobol, 2025), as the almost universal homo-sapien predicament in the modern age. Characterized by profound experiential and emotional welfare deficits and dysfunction in the Anthropocene (Montgomery, 2018; Chagi, 2025), this unnatural existence is one people would come to unwittingly extend to their canine companions as pets (Grandin, 2010; Coppinger and Coppinger, 2002; Meyer et al., 2022; Pierce, 2016, 2023; Volsche and Sobol, 2025), as they brought them along into their figurative mines.

**Further warnings**
The rapidly declining comprehensive welfare of these captive sentinels in the 21st century, so indicative of the habitual narrow prioritizing of physical health and safety over behavioral and emotional welfare (Brophey, 2011; Volsche and Sobol, 2025) and alarmingly reflected in canine behavioral and emotional health disorders (Pierce, 2023) recently reported to be experienced by over 99% of pet dogs in the United States (Beaver, 2024), may well be forecasting the same for humanity. In the same manner that any captive species of animal may struggle to cope in habitats

which fail to afford the expression of natural behaviors and struggle in present conditions for which they are not biologically prepared (Arndt, 2022), both dogs and humans may be experiencing similarly compromised welfare (Volsche and Sobol, 2025).

A human mental crisis lags only slightly behind such daunting statistics for dogs in this regard (McGrath et al, 2023; Surkalim, 2022; World Health Organization, 2025), and may very well be due to a loss of biophilic experiences and opportunities in the environment for which humans are designed (Chawla, 2020; Haidt, 2024; Hidaka, 2012; Lee, 2025; Louv, 2005; Mate and Mate, 2022; Montgomery, 2018; Nesse, 2019; Volsche and Sobol, 2025). As University of Lincoln's animal behaviorist and researcher states, "Dogs in our home share not only our physical environment, but may also share some of the psychological challenges associated with modern living. Our pets may be excellent models of some human psychiatric conditions associated with emotional disturbance." (Paul, 2025). The "intensely homed" (Pierce, 2023) environmental conditions of modern captive pet dogs are, after all, the same habitats shared with people.

**Opportunities in other lenses - resurrecting biophilia**

As a direct consequence of the false distinction between human beings and other animal species, more comprehensive modern animal welfare models, such as the "three concerns" (Fraser et al., 1997) often cited as the *three circles* or *realms*, are not generally considered applicable to people. Therefore, there may be undue emphasis unconsciously placed on the realm of "biological functioning", while the "natural living" realm and its affective consequences are largely neglected in the human population (Lindenmayer and Kaufman, 2021). Beyond the currently recognized scope of "biological functioning"- related welfare indication value of these canine canaries in the coalmine in a *One Health* framework (Sexton and Ruple, 2024), there lie tremendous opportunities to research, understand, and endeavor to reconcile the other two principal realms of animal welfare - for both species (Lindenmayer and Kaufman, 2021). The "natural living" and "affective state" realms (Fraser et al., 1997) are also applicable to cognitively and culturally captive human beings (Lee, 2025; Thompson, 1967), as fellow animals themselves, despite their apparent agency and control in the modern world. Humans may therefore benefit tremendously through biophilic experiences and nature therapy (Roszak, 2001; Robbins, 2020; White et al, 2019), as well as a framing of their own pathologies as adaptive natural responses rather than stigmatized deficiencies (Schroder et al., 2023; Montgomery, 2018).

Given the resistance to a direct extension of traditional animal welfare models for the human population in light of their perceived exclusivity (Chapman and Huffman, 2018; Leach et al., 2013), other human-based research disciplines and frameworks may present greater potential for effectively integrating welfare insights beyond the scope of physical health. The *biopsychosocial model* (Engel, 1977) provides a largely analogous and overlapping framework to the three circles model (Fraser et al., 1997), although again there appears to be little attention given to the "natural living" (Fraser et al., 1997) needs of humans in their "social/environment" domain (Engel, 1977). In order to fully appreciate the persistent deficits in human and animal welfare in the 21st century, additionally valuable concepts, models, and disciplines - such as *evolutionary mismatch* theory (Li et al. 2018; Longman and Shaw, 2025; O et al., 2024) and *mismatch resistance* (Egeland, 2024), *cultural runaway evolution* (Kubinyi and Turcsan, 2025), the growing field of *ecopsychology* (Roszak, 2001; Robbins, 2020), and *One Welfare* (Cox, 2022) - may be further effectively applied in

the interest of optimizing comprehensive welfare across the three realms of animal welfare for both humans and other species.

Dogs may not only reflect certain natural welfare consequences of unnatural contemporary conditions shared with people for which neither species is in fact biologically prepared or adapted (Arndt et al, 2022; Coppinger and Coppinger, 2002, 2016; Haidt, 2024; Hidaka, 2012; Li et al, 2018; Lea et al., 2023; Longman and Shaw, 2025; Mate, 2022; Nesse, 2019; Volsche and Sobol, 2025; Todd, 2024), but further represent a valuable bridge by which humans may more readily understand their own animal needs and natures, overcome their biophilic severance, and improve their welfare (Beetz et al., 2012; Serpell and Paul, 1994; Wood et al, 2017; Zijlema et al, 2019). Pet dogs are not merely positioned to improve human welfare as sentinels across a range of welfare considerations; their very keeping in people's modern lives in many ways exemplifies both the greatest persisting barriers against, as well as the clearest windows of opportunity for, the possibility that people may appreciate and attend to their shared animal welfare needs and present deficits.

**Pet dog keeping and evolutionary mismatch - a warning to heed**

In light of the rapid rise in pet dog keeping in modern Western households in recent years (Megna, 2025; Pierce, 2023; Powell, 2025), a great deal of debate around the question of whether pet keeping is evolutionary adaptive to survival and reproduction, maladaptive, or even neutral has arisen in tandem to account for this escalation in human cross-species adoption (Lea et al., 2024; Serpell, 2002; Herzog, 2011, 2014; Serpell and Paul, 2012; Volsche and Sobol, 2025). However, there are other potential explanations for the surge in modern pet dog keeping practices that may account for its prevalence (Herzog, 2014), such as the aforementioned *evolutionary mismatch* theory (Li et al. 2018; Longman and Shaw, 2025; O et al., 2024) and the associated *cultural runaway theory* that describe an "amplification of certain traits or behaviours beyond their original utility" in new ecological or social conditions (Kubinyi and Turcsan, 2025).

In this way, the growing prevalence of modern pet dog keeping may invite attention to human conditions of *evolutionary mismatch* (Li et al. 2018; Longman and Shaw, 2025; O et al., 2024). Though the practice of pet dog keeping may significantly improve health and welfare to some degree for individuals (Beetz et al., 2012), this does not necessarily translate into evolutionary fitness or adaptive fitness; rather it may be somewhat compulsory to human biology (Longman and Shaw, 2025; Serpell and Paul, 2012) and an indication of people's own mounting unmet social needs as certain preserved behavioral traits once necessary for survival catalyze significant motivations for the behaviors to be expressed in mismatched conditions (Arndt, 2022; Longman and Shaw, 2025). Indeed, this theory could alternatively be extended to explain the various ways in which captive animals elect to engage in enrichment affordances in captive environments as biologically adaptive behavioral interaction substitutes (Morris et al., 2011).

**Human enrichment - opportunities to engage**

It may subsequently be important to consider the question of whether pet dog keeping is somewhat indicative of and even conceivably imperative to human welfare for much of the modern population, particularly women, as a sort of substitute coping mechanism provision in the "natural living" realm of mismatched environmental conditions (Longman and Shaw, 2025) - both a red flag warning of declining welfare as well as an enrichment opportunity for humans, who are social obligates (Grinde, 2024; Walton, 2019) historically exhibiting alloparenting behavior (Serpell, 2022). Pet

keeping, particularly the keeping of pet dogs, may provide valuable affordances (Gibson, 1979) for the expression of certain social suites of behaviors that the human species is highly motivated to perform, such as those larger family and community child rearing traits specific to human evolutionary history (Bradshaw and Paul, 2010). People may then be effectively "transferring our genetic tendency to seek relationships to another target, being our pets" (Powell, 2025) as the "baby schema" response (Lorenz, 1943), our relationships with our pet dogs therefore argued to "have obvious biological fitness implications" (Serpell, 2002).

Much like deviant sexual behavior in modern humans, pet keeping may simultaneously warn of certain maladaptive or dysfunctional *evolutionary mismatch* problems while filling a need to express behaviors humans are highly motivated to perform as *mismatch resistant* or *cultural runaway* traits - without any required ongoing evolutionary adaptive contribution to survival or reproduction (Goetz et al., 2019; Kubinyi and Turcsan, 2025). Certainly, other modern human behavioral phenomena - excessive food consumption or shopping addictions, the popularity of sports, compulsive social media engagement - could readily be described as functionally enriching (if ultimately problematic) opportunities for natural foraging, hazard avoidance, and reproductive/social behaviors respectively in the "natural living" realm of welfare for culturally captive human animals, or explained as additional *mismatch resistant* or *cultural runaway* phenomenon (Kubinyi and Turcsan, 2025). In the same way that naturally and artificially selected canine behaviors specific to respective phenotypic diversity (Dutrow et al., 2022) may be expressed in response to "accidental releasers" (Brophey, 2021) in the environment - such as herding dogs chasing fast moving children, joggers, bikes, or cars in the absence of stock - these kinds of *mismatch resistant* traits require some type of environmental signal in order to provide a transferred adaptive benefit of expression (Egeland, 2024). Pet dogs may clearly represent such an "accidental releaser" for certain human social caretaking behaviors, and so be experienced as enjoyable, reinforcing, or even adaptive for modern people (Serpell, 2002).

But these kinds of behavioral interactions in captivity or mismatch conditions certainly exist at a precarious constant tipping point for both species in their potential to be either conducive or deleterious to welfare. Should their engagement become exaggerated or excessive, it is possible that the natural behavioral diversity thought to be so critical to animal welfare (Miller et al., 2020) may become diminished, stereotypically directed, or resulting in emotional addiction due to homeostatic imbalance (Miller et al., 2020; Montgomery, 2018). This may in part account for the inconsistent findings regarding the adaptive benefits or costs of pet keeping behavior in humans. Importantly, then, while pet keeping may be understood to paradoxically represent both a red flag as well as enriching affordance for human welfare, any such currently identified *mismatch resistance* representative in modern pet keeping should not be inferred as to be mutually exclusive with the possibility for these same behavioral traits to become maladaptive in the future (Egeland, 2024). The greatest opportunity for human enrichment and better welfare, then, may not lie in what dogs are able to provide to people in their own mismatched conditions, but in the ever-present urgent invitation to get out of them.

**The dog door - an obstacle, unless opened**

Instead, modern humans mostly fail to recognize their own predicaments, and so are prone to refuse their escape. People demand that their pet dogs instead fit into their strange conditions, as a matter of cultural normalization (Pierce, 2016, 2023; Brophey, 2018), reinforcing their own perceived

right of dominion as they quite literally practice their control over them. In this way, pet dog keeping sadly epitomizes the original obstacle to modern human welfare improvement - perpetuating, endorsing, and marketing antiquated anthropocentric models of human exceptionalism above and apart from other animals - in common language, perceptions, and practices (Pierce, 2016, 2023) regarding canine “obedience” to the “commands” of their human “masters” (Brophey, 2021).

The modern pet dog industry and culture additionally validates the many highly unnatural conditions of modern pet life that have become standard in recent decades, as well as the expectation that pet dogs adhere to them without protest or problem (Grandin, 2010; Pierce, 2016, 2023). Questions of welfare regarding the training of pet dogs then symbolically revolve around how best to modify natural pet dog behaviors effectively and ethically, rather than how to provide for their healthy expression as a matter of obligation in captivity (Brophey, 2018, 2021, 2025). The welfare cost of such lost agency and full expression of these natural behaviors (Littlewood et al., 2023; Miller et al., 2020) is that of the *good life* (Green and Mellor, 2011) in exchange for the “easy life” of kept, passive, restrained receipt of luxurious conditions in sterile human environments (Brophey, 2025). The modern “petification” of dogs - in which dogs have been so greatly stripped of their autonomy (Brophey, 2018; Meyer et al., 2022; Pierce, 2016, 2023) - may serve to further diminish the biological integrity of humans’ closest animal companions, and so sustain humanity’s perceived “magic wall” of human exceptionalism.

In this way, pet dog keeping represents the original biophilic severance and exonerative beliefs regarding not only people’s responsibility to other animals, but in fact their very place in the world - a denial of their animal selves and associated welfare needs, still culturally and psychologically persistent. However, within this same conflict lies yet another opportunity for humans to better understand themselves and improve their own welfare in a variety of ways, should they choose to open the awaiting door between themselves and the rest of nature that pet dogs provide, and embrace a *One Health/Welfare* ethos acknowledging their inseparability (Lindenmayer and Kaufman, 2021) in theory as well as practice.

**Conclusion**

Pet dogs represent an unparalleled opportunity to provide valuable ***warnings*** for, and related ***opportunities*** to mediate, a variety of welfare concerns for humanity in the Anthropocene. These potential contributions, however, are greatly limited by persisting anthropocentrism in modern popular culture and pet keeping practices themselves. The original biophilic severance between humanity and the natural world presents pervasive ***obstacles*** to progress in improving both human-animal and non-human animal welfare, as well as the natural environment. Pet dogs signal and invite their people through a door back to that world, while personifying human suffering and arrogance in their keeping. Like the canaries, the very presence of dogs indicates certain dangers in human-crafted, unnatural environments. In fact, the increase in pet keeping practices may exemplify those welfare risks to which humans are unconsciously, and yet opportunistically, buffering against via their canine surrogate companions. Should people remember that their dogs are animals, however, and that they are as well, they may realize how suffocating the mines they have built have become and attend to the warnings of their canine canaries. Some deeply biological, subliminal invitation - harkening those biophilic connections sacrificed so long ago and quickening the hearts of humanity - may be felt for the modern human miners who have forgotten that there’s a light at the end of the tunnel at all, where the natural world awaits its reconciliation.

## References:


Arndt, S.S., Goerlich, V.C. and van der Staay FJ (2022). A dynamic concept of animal welfare: The role of appetitive and adverse internal and external factors and the animal's ability to adapt to them. Front. Anim. Sci. 3:908513. doi: 10.3389/fanim.2022.908513

Avila, A., Prieto, L. & Luna-Acosta, A. (2023). Nine decades of data on environmental chemical pollutant exposure in dogs: a bibliometric analysis. Environ Sci Pollut Res 30, 45515–45527 . https://doi.org/10.1007/s11356-022-24791-y

Baars, B. J. (1988). A Cognitive Theory of Consciousness. Cambridge: Cambridge University Press.

Backer, L. C., Grindem, C. B., Corbett, W. T., Cullins, L., & Hunter, J. L. (2001). Pet dogs as sentinels for environmental contamination. The Science of the total environment, 27*4*(1-3), 161–169. https://doi.org/10.1016/s0048-9697(01)00740-9

Beaver, B.V., (2024). The prevalence of behavior problems in dogs in the United States, Journal of Veterinary Behavior, Volume 76, Pages 34-39, ISSN 1558-7878

Beetz, A., Uvnäs-Moberg, K., Julius, H., & Kotrschal, K. (2012). Psychosocial and psychophysiological effects of human-animal interactions: The possible role of oxytocin. *Frontiers in Psychology*, *3*, 234. https://doi.org/10.3389/fpsyg.2012.00234

Bekoff, M. (2010). *The animal manifesto: Six reasons for expanding our compassion footprint*. New World Library.

Bowser, N. H., Anderson, N. E. (2018). Dogs (Canis familiaris) as Sentinels for Human Infectious Disease and Application to Canadian Populations: A Systematic Review. Veterinary sciences, 5(4), 83. https://doi.org/10.3390/vetsci5040083

Bradshaw, J. W. S., & Paul, E. S. (2010). Could empathy for animals have been an adaptation in the evolution of *Homo sapiens*? *Animal Welfare*, *19*(Suppl), 107–112.

Brevik, K, Barbieri, L. (2019). There is no magic wall. Minding Nature. 12. https://www.humansandnature.org/there-is-no-magic-wall.

Brewer, M. B. (2007). The social psychology of intergroup relations: Social categorization, ingroup bias, and outgroup prejudice. In A. W. Kruglanski & E. T. Higgins (Eds.), Social psychology: Handbook of basic principles (Vol. 2, pp. 695–713). [New York, NY: Guilford Press].

Brophey, K. (2011). Dog in the Coalmine - The Dog as a Reflection of Human Wellness in the Modern World, AB Tech Continuing Education Department

Brophey, K. (2018). Meet your dog: The game-changing guide to understanding your dog's behavior. Chronicle Books.

Brophey, K. (2018, April 4). The problem with treating a dog like a pet [Video]. TED Conferences. https://www.ted.com/talks/kim_brophey_the_problem_with_treating_a_dog_like_a_pet.

Brophey, K. (2021). L.E.G.S. Applied Ethology Family Dog Mediation Professional Course, Family Dog Mediation Education Center, https://kimbropheylegscourses.thinkific.com/courses/legs2-0

Brophey, K. (2025). The Good Life of a Good Dog - A Total Welfare Model for the Future of the Pet Dog Industry, https://kimbropheylegscourses.thinkific.com/courses/The%20Good%20Life%20of%20a%20%22Good%20Dog%22%20-%20A%20Total%20Welfare%20Model%20for%20the%20Future%20of%20the%20Pet%20Dog%20Industry?ref=a0daf4

Caffrey, C., (2023). EBSCO, Neolithic Revolution, https://www.ebsco.com/research-starters/agriculture-and-agribusiness/neolithic-revolution

Chagi, S. (2025). Human evolutionary mismatch: Navigating modern life with ancestral minds World of Paleoanthropology. [World of Paleoanthropology].

Chalmers, D., & Dell, C. A. (2015). Applying One Health to the Study of Animal-Assisted Interventions. *EcoHealth*, *12*(4), 560–562. https://doi.org/10.1007/s10393-015-1042-3

Chapman, Colin A. and Huffman, Michael A. (2018). Why do we want to think humans are different?. Animal Sentience 23(1) DOI: 10.51291/2377-7478.1358

Chawla, L. (2020). Childhood nature connection and constructive hope: A review of research on connecting with nature and coping with environmental loss. People and Nature, 2(3), 619–642. https://doi.org/10.1002/pan3.10128.

Cleaveland, S., Meslin, F. & Breiman, R. (2006). Dogs can play useful role as sentinel hosts for disease. *Nature* 440, 605 . https://doi.org/10.1038/440605b

Collins, D., Lee, H., Dunbar, M. D., Crowder, K., & Dog Aging Project Consortium. (2022). Associations between Neighborhood Disadvantage and Dog Walking among Participants in the Dog Aging Project. International Journal of Environmental Research and Public Health, 19(18), 11179. https://doi.org/10.3390/ijerph191811179

Coppinger, R. and Coppinger, L. (2002). Dogs (2nd ed.). University of Chicago Press, Chicago, IL.

Coppinger, R. and Coppinger, L. (2016). What is a Dog? University of Chicago Press, Chicago, IL.

Cox, J. (2022). Operationalising One Health-One Welfare. https://www.wellbeingintlstudiesrepository.org/ hw_onehealth/5/

Diamond, J. (1987). The worst mistake in the history of the human race. Discover Magazine, 8(5), 64–66.

Dutrow, E. V., Serpell, J. A., & Ostrander, E. A. (2022). Domestic dog lineages reveal genetic drivers of behavioral diversification. Cell, 185(25), 4737–4755.e18.

Egeland, J. (2024). Mismatch Resistance and the Problem of Evolutionary Novelty. Biol Theory 19, 279–291, https://doi.org/10.1007/s13752-024-00468-2

Engel G. L. (1977). The need for a new medical model: a challenge for biomedicine. Science (New York, N.Y.), 196(4286), 129–136. https://doi.org/10.1126/science.847460

Fraser, D., Weary, D. M., Pajor, E. A., & Milligan, B. N. (1997). A scientific conception of animal welfare that reflects ethical concerns. Animal Welfare, 6(3), 187–205.

Gibson, J. J. (1979). *The ecological approach to visual perception*. Houghton Mifflin.

Goetz, C. D., Pillsworth, E. G., Buss, D. M., & Conroy-Beam, D. (2019). Evolutionary Mismatch in Mating. Frontiers in psychology, 10, 2709. https://doi.org/10.3389/fpsyg.2019.02709

Gowdy, J., Krall, L. ( 2013). "The ultrasocial origin of the Anthropocene," Ecological Economics, Elsevier, vol. 95(C), pages 137-147, https://doi.org/10.1016/j.ecolecon.2013.08.006

Grandin, T. (2010). Animals make us human- Creating the best life for animals. First Mariner Books

Green, T. C., & Mellor, D. J. (2011). Extending ideas about animal welfare assessment to include ‘quality of life’ and related concepts. *New Zealand Veterinary Journal*, *59*(6), 263-271. https://doi.org/10.1080/00480169.2011.610283.

Grinde, B. (2024). The Evolution of Human Social Behavior. Encyclopedia, 4(1), 430-443. https://doi.org/10.3390/encyclopedia4010029

Haidt, J. (2024). The Anxious Generation: How the Great Rewiring of Childhood Is Causing an Epidemic of Mental Illness. Penguin Press.

Herzog, H. (2010). Some we love, some we hate, some we eat: Why it's so hard to think straight about animals, Harper Collins Publishers.

Herzog, H. (2011). The impact of pets on human health and psychological well-being: Fact, fiction, or hypothesis? Current Directions in Psychological Science 20 (4):236–39. doi:10.1177/0963721411415220.

Herzog, H. (2014). Biology, culture, and the origins of pet-keeping. *Animal Behavior and Cognition*, *1*(3), 296–308. doi: 10.12966/abc.08.06.2014

Hidaka B. H. (2012). Depression as a disease of modernity: explanations for increasing prevalence. Journal of affective disorders, 140(3), 205–214. https://doi.org/10.1016/j.jad.2011.12.036

Jaffe, R. (2024). Prosthetic species: Security dogs and the more-than-human sensing of urban danger. City & Society, 36(1), 35-45. https://doi.org/10.1111/ciso.12476

Johnson, L. S. M., Ferdowsian, H., & Pierce, J. (2024). How One Health Instrumentalizes Nonhuman Animals. AMA journal of ethics, *26*(2), E184–E190. https://doi.org/10.1001/amajethics.2024.184

Knapp D.W., Peer W.A., Conteh A., Diggs A.R., Cooper B.R., Glickman N.W., Bonney P.L., Stewart J.C., Glickman L.T., Murphy A.S. (2013). Detection of herbicides in the urine of pet dogs following home lawn chemical application. Sci. Total Environ., 456–457:34–41. doi: 10.1016/j.scitotenv.2013.03.019.

Kubinyi, E., Turcsán, B. (2025). From kin to canines: understanding modern dog keeping from both biological and cultural evolutionary perspectives. BIOLOGIA FUTURA 76, 213–220 . https://doi.org/10.1007/s42977-025-00264-4

Lea, A. J., Clark, A. G., Dahl, A. W., Devinsky, O., Garcia, A. R., Golden, C. D., … Ayroles, J. F. (2023). Evolutionary mismatch and the role of G×E interactions in human disease. Evolutionary Applications, 16(4), 735–749. https://doi.org/10.1111/eva.13400

Leach, S., Kitchin, A. P., Sutton, R. M., & Dhont, K. (2023). Speciesism in everyday language. The British journal of social psychology, 62(1), 486–502. https://doi.org/10.1111/bjso.12561

Lee, J. C. (2025). Built for the wild, born in captivity. Mental Healthiness, June 30. mentalhealthiness.com

Li, N. P., van Vugt, M., & Colarelli, S. M. (2018). The evolutionary mismatch hypothesis: Implications for psychological science. Current Directions in Psychological Science, *27*(1), 1–7. APA PsycNet

Lindenmayer, J. and Kaufman, G. (2021). One Health and One Welfare. In: Stephens, T.(ed) *One Welfare in Practice: The Role of the Veterinarian*. CRC Press

Littlewood, K. E., Heslop, M. V., Cobb, M. L.. (2023). The agency domain and behavioral interactions: assessing positive animal welfare using the Five Domains Model, Frontiers in Veterinary Science, Volume 10,, ISSN 2297-1769

Longman, D. P., & Shaw, C. N. (2025). Homo sapiens, industrialisation and the environmental mismatch hypothesis. Biological Reviews, *101*(4), 1-15. DOI: 10.1111/brv.70094.

Lord, K.A., Larson, G., Allaby, R.G., Karlsson, E.K., (2025). A universally applicable definition for domestication, Proc. Natl. Acad. Sci. U.S.A. 122 (22) e2413207122, https://doi.org/10.1073/pnas.2413207122.

Lorenz K. (1943). Die angeborenen Formen möglicher Erfahrung. *Z. Tierpsychol.* 5 233–519 10.1111/j.1439-0310.1943.tb00655.x

Louv, R. (2005). Last child in the woods: Saving our children from nature-deficit disorder. Algonquin Books of Chapel Hill

Maté, G., & Maté, D. (2022). The myth of normal: Trauma, illness, and healing in a toxic culture. Avery, an imprint of Penguin Random House. For in-text citations, use (Maté & Maté, 2022) and include a page number for direct quotes, as in (Maté & Maté, 2022, p. 15).

Matheson, R., Sexton, C. L., Wise, C. F., O'Brien, J., Keyser, A. J., Kauffman, M., Dunbar, M. D., DAP Consortium, Stapleton, H. M., & Ruple, A. (2024). Silicone tags as an effective method of monitoring environmental contaminant exposures in a geographically diverse sample of dogs from the Dog Aging Project. *Frontiers in veterinary science*, *11*, 1394061. https://doi.org/10.3389/fvets.2024.1394061

McGrath, J. J., Al-Hamzawi, A., Alonso, J., Altwaijri, Y., Andrade, L. H., Bromet, E. J., Bruffaerts, R., Caldas de Almeida, J. M., Chardoul, S., Chiu, W. T., Degenhardt, L., Demler, O. V., Ferry, F., Gureje, O., Haro, J. M., Karam, E. G., Karam, G., Khaled, S. M., Kovess-Masfety, V., ... Kessler, R. C. (2023). Age of onset and cumulative risk of mental disorders: a cross-national analysis of population surveys from 29 countries. The Lancet Psychiatry, 10(9), 668–681. https://doi.org/10.1016/S2215-0366(23)00193-1.

Megna, M. (2025). Pet Ownership Statistics 2025, Forbes, https://www.forbes.com/advisor/pet-insurance/pet-ownership-statistics/

Meyer, I., Forkman, B., Fredholm, M., Glanville, C., Guldbrandtsen, B., Izaguirre, E.R., Palmer, C., Sandøe, P. (2022), Pampered pets or poor bastards? The welfare of dogs kept as companion animals, Applied Animal Behaviour Science, Volume 251, 105640, ISSN 0168-1591

Miller, L. J., Vicino, G. A., Sheftel, J., & Lauderdale, L. K. (2020). Behavioral Diversity as a Potential Indicator of Positive Animal Welfare. Animals : an open access journal from MDPI, 10(7), 1211.

Montgomery J. (2018). Evolutionary Mismatch, Emotional Homeostasis, and “Emotional Addiction”: A Unifying Model of Psychological Dysfunction. Evol. Psychol. Sci. ;4:428–442. doi: 10.1007/s40806-018-0153-9

Morris, C.L., Grandin, T., Irlbeck, N.A., (2011). COMPANION ANIMALS SYMPOSIUM: Environmental enrichment for companion, exotic, and laboratory animals, *Journal of Animal Science*, Volume 89, Issue 12, Pages 4227–4238

Nass S., Berkower C., Cooper R., editors. (2022). Companion Animals as Sentinels for Predicting Environmental Exposure Effects on Aging and Cancer Susceptibility in Humans: Proceedings of a Workshop. Washington (DC): National Academies Press (US); 2022 Apr 22. Proceedings of a Workshop. https://www.ncbi.nlm.nih.gov/sites/books/NBK584936/

National Academy of Sciences (US). (1999). Science and Creationism: A View from the National Academy of Sciences. National Academies Press (US). https://doi.org/10.17226/6024

Nesse, R. M. (2019). Good Reasons for Bad Feelings: Insights from Evolutionary Psychiatry. Dutton.

One Health High-Level Expert Panel (OHHLEP), Adisasmito, W. B., Almuhairi, S., Behravesh, C. B., Bilivogui, P., Bukachi, S. A., Casas, N., Cediel Becerra, N., Charron, D. F., Chaudhary, A., Ciacci Zanella, J. R., Cunningham, A. A., Dar, O., Debnath, N., Dungu, B., Farag, E., Gao, G. F., Hayman, D. T. S., Khaitsa, M., Koopmans, M. P. G., … Zhou, L. (2022). One Health: A new definition for a sustainable and healthy future. PLoS pathogens, *18*(6), e1010537. https://doi.org/10.1371/journal.ppat.1010537

O, J., Aspden, T., Thomas, A. G., Chang, L., Ho, M.-R., Li, N. P., & van Vugt, M. (2024). Mind the gap: Development and validation of an evolutionary mismatched lifestyle scale and its impact on health and wellbeing. *Heliyon*, *10*(15), e34997. https://doi.org/10.1016/j.heliyon.2024.e34997.

Paul, E. S., Sher, S., Tamietto, M., Winkielman, P., & Mendl, M. T. (2020). Towards a comparative science of emotion: Affect and consciousness in humans and animals. Neuroscience & Biobehavioral Reviews, 108, 749–770. https://doi.org/10.1016/j.neubiorev.2019.11.014.

Paul, A. (2025). Golden retrievers and humans share 'striking' genetic similarities, Popular science, https://www.popsci.com/science/golden-retrievers-humans-share-genes/

Pierce, J. (2016). Run, Spot, Run: The Ethics of Keeping Pets. The University of Chicago Press.

Pierce, J. (2023). Who's a good dog?: And how to be a better human. The University of Chicago Press.

Powell, L. (2025). Companion animals: theories of petkeeping, Animals and Society, Animal Welfare and Behavior Program, University of Pennsylvania.

Rabinowitz, P. and Moses, L. (2022). National Academies of Sciences, Engineering, and Medicine. Companion Animals as Sentinels for Predicting Environmental Exposure Effects on Aging and Cancer Susceptibility in Humans: Proceedings of a Workshop. Washington, DC: The National Academies Press. https://doi.org/10.17226/2789.

Rasmussen, K. (1929). Intellectual culture of the Iglulik Eskimos. (Published in English, 1930 as a volume in the Report of the Fifth Thule Expedition).

Robbins, J. (2020). Ecopsychology: How immersion in nature benefits your health. Yale School of the Environment, January 9, https://e360.yale.edu/features/ecopsychology-how-immersion-in-nature-benefits-your-health

Roszak, T. (2001). The voice of the earth: An exploration of ecopsychology (2nd ed.). Red Wheel/Weiser.

Ruddiman, W. F. (2010). How did humans first start altering global climate? The Anthropocene Review, *1*(1), 47-53.

Schmidt P. L. (2009). Companion animals as sentinels for public health. The Veterinary clinics of North America. Small animal practice, 39(2), 241–250. https://doi.org/10.1016/j.cvsm.2008.10.010

Schroder, H. S., Devendorf, A., & Zikmund-Fisher, B. J. (2023). Framing depression as a functional signal, not a disease: Rationale and initial randomized controlled trial. Social Science & Medicine, *328*, 115995. Research Papers in Economics

Segal, D. (2019). Ecopsychology and the emergence of a life-sustaining civilization, Post Growth Institute, https://medium.com/postgrowth/ecopsychology-and-the-emergence-of-a-life-sustaining-civilization-c1aa899b7f62

Serpell, J. A., & Paul, E. S. (1994). Pets and the development of positive attitudes to animals. In A. Manning & J. A. Serpell (Eds.), Animals and human society: Changing perspectives (pp. 127–144). Routledge.

Serpell, James. (2002). Anthropomorphism and Anthropomorphic Selection—Beyond the "Cute Response". Society and Animals. 10. 437-454. 10.1163/156853002320936926.

Serpell, J. A. (2005). Animals and religion: towards a unifying theory. In F. de Jonge & J. van den Bos (Eds.), The human-animal relationship: Forever and a day. Royal Van Gorcum.

Serpell, J., Paul, E.S. (2012). Pets in the Family: An Evolutionary Perspective. The Oxford Handbook of Evolutionary Family Psychology. 10.1093/oxfordhb/9780195396690.013.0017.

Serpell, J. (2022). The origin of animal ethics, Animals and Society, University of Pennsylvania, Animal Welfare and Behavior Program.

Sexton, C., & Ruple, A. (2024). Canine sentinels and our shared exposome. Science (New York, N.Y.), 384(6701), 1170–1172. https://doi.org/10.1126/science.adl0426

Sumner, R. N., Harris, I. T., Van der Mescht, M., Byers, A., England, G. C. W., & Lea, R. G. (2020). The dog as a sentinel species for environmental effects on human fertility. Reproduction, 159(6), R265-R276. https://doi.org/10.1530/REP-20-0042

Surkalim, D. L., Luo, M., Eres, R., Gebel, K., van Buskirk, J., Bauman, A., & Ding, D. (2022). The prevalence of loneliness across 113 countries: systematic review and meta-analysis. BMJ (Clinical research ed.), *376*, e067068. https://doi.org/10.1136/bmj-2021-067068

Swartz, B., & Mishler, B.D. (2022). Speciesism, Science, and Society. Published by Springer, this book specifically addresses the concept of speciesism within both biological and cultural frameworks.

Thompson, E. P. (1967). Time, work-discipline, and industrial capitalism. Past and Present, *38*(1), 56–97

Todd, Z. (2024) Bark! The Science of Helping Your Anxious, Fearful, or Reactive Dog. Greystone Books, Vancouver, BC, Canada.

Urquiza-Haas, E. G., & Kotrschal, K. (2015). The mind behind anthropomorphic thinking: Attribution of mental states to other species. *Animal Behaviour*, *109*, 167–176. https://doi.org/10.1016/j.anbehav.2015.08.011.

Verbeek, P., Majure, C. A., Quattrochi, L., & Turner, S. J. (2024). The Welfare of Dogs as an Aspect of the Human-Dog Bond: A Scoping Review. Animals : an open access journal from MDPI, 1*4*(13), 1985. https://doi.org/10.3390/ani14131985

Volsche, S., & Sobol, S. (2025). Breaking boundaries: Interdisciplinary perspectives on One Welfare and the human-animal bond. *Human-Animal Interactions*, *13*(1). Human-Animal Interactions - CABI Digital Library.

Walton, Jamie. (2019). The Evolutionary Basis of Belonging: Its Relevance to Denial of Offending and Labeling those who Offend. Journal of Forensic Practice. 10.1108/JFP-04-2019-0014.

Webb, C. (2025). *The arrogant ape: The myth of human exceptionalism and why it matters*. Avery, an imprint of Penguin Publishing Group.

White, M.P., Alcock, I., Grellier, J. et al. (2019). Spending at least 120 minutes a week in nature is associated with good health and wellbeing. *Sci Rep* 9, 7730 . https://doi.org/10.1038/s41598-019-44097-3

Wilson, E. O. (1984). Biophilia. Harvard University Press

Wise, C. F., Hammel, S. C., Herkert, N., Ma, J., Motsinger-Reif, A., Stapleton, H. M., & Breen, M. (2020). Comparative Exposure Assessment Using Silicone Passive Samplers Indicates That Domestic Dogs Are Sentinels To Support Human Health Research. Environmental science & technology, 54(12), 7409–7419. https://doi.org/10.1021/acs.est.9b06605

Wood, L., Martin, K., Christian, H., Houghton, S., Kawachi, I., Vallesi, S., & McCune, S. (2017). Social capital and pet ownership - A tale of four cities. SSM - population health, *3*, 442–447. https://doi.org/10.1016/j.ssmph.2017.05.002

World Health Organization. (2025). Over a billion people living with mental health conditions - services require urgent scale-up, https://www.who.int/news/item/02-09-2025-over-a-billion-people-living-with-mental-health-conditions-services-require-urgent-scale-up

Zijlema, W. L., et al. (2019). Dog ownership, the natural outdoor environment and health: a cross-sectional study, *BMJ Open* 9(5): e023000. National Institutes of Health website.

Zych, A. D., & Gogolla, N. (2021). Expressions of emotions across species. Current opinion in neurobiology, 68, 57–66. https://doi.org/10.1016/j.conb.2021.01.003

**Added after submission - but highly relevant**

*****Sykes, N., Beirne, P., Horowitz, A., Jones, I., Kalof, L., Karlsson, E., King, T., Litwak, H., McDonald, R. A., Murphy, L. J., Pemberton, N., Promislow, D., Rowan, A., Stahl, P. W., Tehrani, J., Tourigny, E., Wynne, C. D. L., Strauss, E., & Larson, G. (2020). Humanity's Best Friend: A Dog-Centric Approach to Addressing Global Challenges. Animals : an open access journal from MDPI, 10(3), 502. https://doi.org/10.3390/ani10030502*****