8TH CANINE SCIENCE FORUM
BUDAPEST, HUNGARY, 11-14 JULY 2023

ABSTRACT BOOK

Canine Science Forum 2023 Budapest

Abstract book

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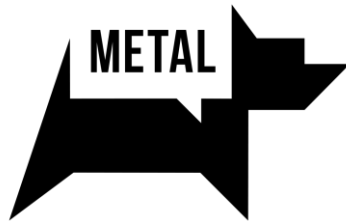   – Prof. Daniel Mills
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Welcome to the 8th Canine Science Forum!

Welcome back to Budapest 🙂

When on the 6th of July, 2018 we said farewell to each other at the closing ceremony of the 6th CSF, it was a different world then. We had our plans to meet again in 2020, we did not know the word COVID, we could not imagine that for years travelling will not be really an option, and we also did not expect that in our neighbor there will be a war. And on a smaller scale, at our Department of Ethology we definitely did not hope to become the hosts again of the next 'real, in-person' Canine Science Forum after 2018!

Nevertheless, we are more than happy to welcome back everyone to Budapest, our regular participants and the first timers alike. For us, 'old timers', who followed, nurtured and guided the constantly developing CSF along the years and venues, this is a heartwarming feeling to see each other again, and perhaps already planning the next event for 2025. But for those, who attend now the first time, it can be an even more exciting event, because the CSF is the oldest and most prestigious recurrent conference dedicated solely to the complex research of Canids. To be a presenter on this conference truly means a lot, and we are happy to see the young participants among us. It is our greatest pleasure to greet our plenary speakers at the conference. Although the invitation may came late, less than half year before the event, they all said "Yes" without hesitation. We could not be happier, preparing to hear their intriguing thoughts about such topics that surely will influence our scientific thinking and plans for future projects.

Again, among them we can recognize returning friends as well as new participants of the world of CSF. Either way, we expect to learn a lot from you!We have to admit, the role of being conference organizers and hosts of this CSF befell on us suddenly and unexpectedly back in December 2022. It was a close call and against all the odds, we are happy to announce that the 8th Canine Science Forum managed to enlist 100 presentations and near 200 participants from all around the world. For this to happen, our efforts would not be enough. It is you, who made it really possible to fledge, everyone, who heard the invitation and readily changed your plans for the sake of coming to Budapest, and to share your newest results and thoughts about the science of Canids. Thank you, and enjoy!

In the name of the Organizers:

Péter Pongrácz and Ádám Miklósi

PLENARY TALKS

Dr Attila Andics

Neuroethology Lab, Department of Ethology, ELTE, Budapest

Are dog brains tuned to humans?

Dogs navigate efficiently in the human social niche. Whether their human communicative cue reading performance is supported by neural processing preferences is largely unknown. Are dog brains, as a consequence of domestication and/or living with humans, specialized in human faces and voices, similarly to our brains? And do dogs exhibit brain sensitivities to some stimulus parameters that are specific and central to speech? Despite evidence for certain neural preferences for processing information about others and also for a human-analogue speech processing hierarchy, until recently no results have convincingly demonstrated that dog brains would be tuned to humans. In this talk I overview our latest awake dog EEG and fMRI findings on the topic.

Dr Anindita Bhadra

Indian Institute of Science Education and Research Kolkata

A dog's life - learning from free-ranging dogs in India

My talk will cover stories about the eco-ethology of free-ranging dogs in India. I will share our experience of working with this fascinating model system for the last 14 years, learning about their strategies for survival in the human jungle.

Dr Erin Hecht

Harvard University, Dept. of Human Evolutionary Biology

Brain-behavior evolution in dogs and foxes

What can neuroscience tell us about canine behavior? In humans and our primate relatives, decades of research have examined how variation in brain structure and function is linked to variation in cognition, perception, and emotion. Surprisingly, these approaches are only just beginning to be applied to canines. This talk will describe three canine behavioral neuroscience studies. The first study compared brains of tame, aggressive, and conventional farm foxes from the experimental domestication project at the Institute of Cytology and Genetics at Novosibirsk in the Russian Academy of Sciences. In this program, animals are bred solely based on their social approach/avoidance behavior toward humans. Analyses revealed changes to prefrontal-limbic networks – surprisingly, sometimes in the same direction for tame and aggressive foxes. A second study analyzed MRI scans in domestic dogs. We identified significant differences in brain networks across breed groups. These networks appear to map onto breed-specialized skills such as hunting, herding, and guarding, suggesting that selective breeding by humans has had a significant effect on dog brain anatomy. In the third study, we examined the same dataset in relation to breed-average temperament measurements as indexed by C-BARQ. This revealed that brain organization can also be linked to traits like fear, aggression, and trainability. Together, these results are relevant for understanding general mechanisms of brain-behavior evolution and the specific mechanisms underlying variation in behavior in domesticated canids.

Prof. Ludwig Huber

Comparative Cognition, Messerli Institute, VetMed, Vienna

How dogs understand us

In recent years, researchers from both applied and basic cynology have become increasingly interested in how dogs understand us humans, given that they show impressive abilities for interacting and communicating with us. Such level of heterospecific understanding is especially interesting because decoding social signals across species boundaries is extremely challenging. In dogs, researchers assume both phylogenetic and ontogenetic sources for this ability. That is, a combination of both domestication and latent learning during a pet dog's life in the human environment. And the function of this skill seems obvious when we consider how well dogs work for and alongside us. But what are the underlying cognitive mechanisms? My lab's ongoing research has been seeking answers to this fundamental question of canine cognition by using state-of-the-art technology, such as touchscreen-based learning environments, eye-tracking, 3D tracking and fMRI. In my talk, I would like to present recent findings that show precisely how well dogs discriminate our facial expressions, copy us, follow us, and even take on our perspective. By being sensitive to what we see, know, intend, and believe, dogs manage to infer and anticipate what we do next, which, until very recently, was only conceded to humans and great apes. The cumulative knowledge of how dogs perceive and understand us is important for our appraisal and appreciation of the very nature of Canis familiaris.

Dr Jennifer Meadows

Dept. of Medical Biochemistry and Microbiology, Uppsala University, Sweden

Placing dog genetics in the wider world of mammalian evolution

In the last five years, the field of dog genetics has exploded. We now have multiple reference genomes, every expanding catalogues of single nucleotide and structural variation, as well as information on gene content and the timing and location of gene expression. But how can we use this information to understand canine biology and dissect disease genetics? In this talk, I will first discuss Phase I of the Dog10K project and the release of >30M single nucleotide- and structural variants from 1929 individuals; 1591 mixed and breed dogs, 281 village dogs and 57 wolves. The variant set spans the autosomes, X chromosome and mitochondria. This diverse dataset allows us to see where variation naturally occurs in the genome, and to begin the search for sites with a breed, or species restricted allele frequency. I will follow this with a discussion of the tools available to dissect the function of variants in the coding and non-coding regions of the dog genome. This includes the recently released Zoonomia constraint scores derived from 240 mammals. Zoonomia constraint scores allow us to identify likely functional regions of the genome, gene bodies and non-coding regulatory elements, even if the key tissue or time-point is yet to be experimentally assayed. This is possible as genomic positions with high constraint, highlight those positions that are likely key to function, and that are under high pressure not to change. In the case of Zoonomia, this is pressure was over ~100 million years of mammalian evolution. In closing, I will bring the dog genome, variant catalogues and constraint together, with case examples of breed restricted variants and their potential impact on gene function, as well as discussing how constraint can allow us to examine those regions of the genome that allow a population to adapt to its environment. Both the Dog10K data and Zoonomia scores are freely available for community use.

Prof. Peter Sandøe

Univ. of Copenhagen, Dept. of Food and Resource Economics

Will dog breeds as we know them today soon be a thing of the past?

Purebred pedigree dogs emerged in England in the middle of the nineteenth century and have had a major effect on the dog population, notably in Europe and North America. Only dogs with a pedigree documenting that they are descendants of a finite group of founders qualify as genuine members of the breed, and until recently organized dog breeding was controlled by breeding organizations. Around the turn of the 21st century, it was estimated that in Northern Europe over 75% of dogs were purebred, even though not all of them had a pedigree, and most of the rest were mixes of recognisable breeds. However, several recent trends suggest that this dominance of purebred dogs is fading: 1) Diminishing influence of the traditional kennel clubs, particularly for some of the fashion breeds. 2) The emergence of 'designer breeds', such as Labradoodles and Cockapoos, where existing purebreeds are purposely mixed. 3) A growing interest in a new kind of dog called the 'rescue dog' based on its source rather than its traits or body shape. 4) A growing focus on the negative health and welfare of purebred dogs due to breeding in small populations and due to a preference for extreme phenotypes. 5) Some of the extreme breeds, notably the brachycephalic ones, are being outlawed in parts of Europe. In light of these trends we will discuss whether dog breeds as we know them today will soon cease to exist and if so whether this would be a positive development.

Dr Kristyn Vitale

Unity College, Dept. of Animal Health and Behavior

Similar or different: Comparisons between cat-human and dog-human interactions

Cats and dogs are the most popular companion animals in the world and given their popularity it is inevitable that they are commonly compared to one another. Although the public may perceive considerable differences in the sociability and social abilities of dogs and cats, are these differences supported by science? This talk will explore the similarities and differences between dogs and cats, namely in their social behavior, socio-cognitive abilities, and interactions with humans. Although species-specific differences exist, many similarities also exist which have contributed to the popularity of these animals in the lives of humans.

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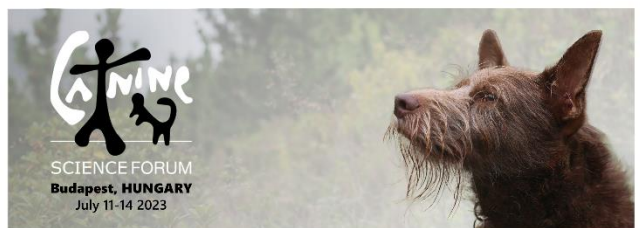
Dr Annika Bremhorst

University of Lincoln, UK

The face of canine emotions - Novel approaches to exploring facial behaviour of emotions in dogs

In recent years, emotions have become a popular topic in canine science. However, accurately identifying emotions in dogs remains a challenge, requiring the establishment of emotion indicators. Facial expressions have been extensively studied as a source to infer emotions in human research. Dogs' complex range of facial behaviours may offer a similar avenue. This project explored facial expressions of positive anticipation and frustration in dogs to identify potential emotion indicators. It was the first of its kind to compare these two emotions in carefully controlled experimental settings with dogs, systematically varying emotion-triggering stimuli and controlling for breed. Positive anticipation and frustration are particularly interesting emotions because they have opposing valences but are related – both can arise when expecting a reward. Emotion indicators should consistently correspond with the specific emotion across various contexts. In this project, dogs were tested over a series of studies in different contexts linked to positive anticipation and frustration, varying the expected reward type and social context. Dogs' facial expressions were measured with the uniquely systematic and objective Dog Facial Action Coding System (DogFACS); it was its first application to compare dogs' facial behaviour of positive and negative emotions in experimental settings. Although some facial expressions only accompanied positive anticipation or frustration in a specific context, Ears adductor was consistently produced during positive anticipation across all contexts. Frustration was associated with Ears downward, Ears flattener, and Nose lick in all contexts. To evaluate the accuracy of the identified facial expressions as potential emotion indicators, we used diagnostic accuracy assessments, a method traditional to medical research. Introducing this novel approach to animal emotion research provided a valuable method to evaluate the validity of putative emotion indicators. Our results showed that relying on a single facial movement as an individual emotion indicator may not be sufficient, emphasising the need to examine the complexity of canine emotional behaviour, including the interaction between various facial and body expressions. Therefore, our findings provide a foundation for future research to develop more comprehensive indicators of dog emotions. Beyond its implications for canine science, this project has broader applications in veterinary medicine, animal welfare, and human-animal interaction. Its unique dataset produced, depicting facial emotional behaviour of dogs, has also attracted significant attention from computer science. One additional important contribution of this project was that its dataset enabled the development of the first of their kind AI models for automating detection of DogFACS units and emotions in dogs. This was made possible only due to the controlled and systematic way in which the experimental data was collected and analysed, as well as to the close collaboration with AI experts on how to make the model explainable. This project highlights the importance of systematically exploring facial behaviour in dogs to better understand their emotions. It also calls for multidisciplinary approaches in animal emotion research, drawing on methods and tools from other fields to advance our understanding of animal behaviour and welfare. The findings have the potential to pave the way for future studies on dog emotions.

Dr Anna Gergely

Inst. of Cognitive Neuroscience and Psychology, Research Center for Natural Sciences, Budapest

The role of our voice and face in dog-directed communication

People tend to use a specific communication style when addressing dogs (dog-directed speech, DDS), which resembles the well-known infant-directed speech (IDS) and differs significantly from the communication style that we use with other adult partners (adult-directed speech, ADS). Such exaggerated prosody possesses several affective (e.g. attention getting, expressing emotions) and cognitive functions (e.g. language tutoring, conveying intentions). By comparing prosody towards dogs (non-speaking heterospecific partners), infants (future-speaking homospecific partners) and adults (speaking homospecific partners) we can study these functions systematically. In a series of comparative experiments with speakers who had family dogs and infants, we found evidence that not only the well-studied acoustic prosody of IDS with heightened and more variable pitch can be found in DDS, but also the less-studied visual prosodic aspects of dog-directed communication resemble that of IDS. Both acoustic- and visual prosody had similar context-dependent features in IDS and DDS during attention getting situations, but differ in language tutoring context which suggests that speakers adjust their prosody to similar affective needs and different cognitive capacities of infants and dogs. Moreover, we found evidence that the acoustic and visual modalities of prosody followed a different pattern through the interactions and probably served different functions toward dogs, infants and adults. While speakers used similarly exaggerated or even more intense acoustic prosody towards dogs than toward infants, they used less frequent and intense facial prosody during DDS compared to IDS and ADS. One hypothesis would be that different facial communicative signals of humans and canids caused this difference, namely that showing teeth and white sclera connected to agonistic interactions in wolves but they are involved in positive emotional expression in humans (i.e. happy and/or surprise). On the other hand, it is also possible that dogs pay more attention to the acoustic prosodic features and less to the visual prosodic features of human communicative signals. In order to investigate the recipient's point of view, we studied dogs' behaviour (i.e. attention and preference) toward addressee-specific prosody. In a comparative eye-tracking experiment we found that both family dogs and 14-16 months-old infants were able to match congruent visual and acoustic information about humans and dogs and suggest equal importance of the acoustic and visual modules during dog/infant-caregiver interactions. In our playback study, we found evidence that not only mean pitch, but pitch variability also had a major role in dogs' preference toward DDS. In a non-invasive fMRI experiment, we identified two non-primary auditory regions responding more to DDS and/or IDS than to ADS, especially when spoken by female speakers. This activity increase was driven by sensitivity to mean fundamental frequency (perceived as pitch, F0) and variance of human prosody. These findings showed that the dog auditory cortex, similarly to that of human infants, is tuned to the acoustic properties of speech directed to non-speaking partners and further highlights the importance of pitch variability in dogs' prosody perception and preference.

REGULAR TALKS

Acoustic analysis of dog-directed human vocalizations produced in positive and negative contexts

Flavie Bensaali-Nemes 1*, Fanni Lehoczki 1, Tamás Faragó 1, Kinga Surányi 1,3, Attila Andics 1,2

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2 ELTE NAP Canine Brain Research Group

3 Doctoral School of Biology, Institute of Biology, ELTE Eötvös Loránd University, Budapest, Hungary;

Companion dog, Behavior, Interaction with humans

Comparative studies on emotional vocalisations suggest that mammalian species follow the same acoustic rules to convey different inner states to their conspecifics: positive sounds are shorter, higher pitched and more tonal, negative sounds are longer, lower pitched and noisier.

It is unclear, however, how humans modulate these acoustic parameters in vocalizations to manipulate the behaviour of heterospecific individuals. Here we test the hypothesis that the acoustic regularities described in the literature can also be detected in the vocalizations produced by humans in the direction of dogs.

In this study we instructed humans to vocally communicate different, simple meanings to their dogs, using the syllable "bü" only, while being visually isolated behind a screen. We tested 52 individuals (27 female, 25 male) in four conditions: recalling, chasing away, encouraging and inhibiting. We investigated how the acoustic parameters call length, fundamental frequency and noisiness are affected by the interaction of sex and conditions.

We found a condition effect on each investigated acoustic parameter: call length (LRT $\chi2$ 4=69.685, p<.0001), fundamental frequency (LRT χ 2 4=349.61, p<.0001) and noisiness (F=17.544, df=4, p<.0001). All effects were in the expected direction, that is positive intended meanings (recall and encourage) were shorter, higher pitched and more tonal than those corresponding to negative meanings (chase and inhibit) in both sexes.

This suggests that humans follow the general acoustic rules of within-species vocal communication when intending to convey simple meanings to heterospecific partners.

Association between medical detection dogs' cognitive bias and their task performance

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2 Medical Detection Dogs, Great Horwood, Milton Keynes, UK

Assitance/therapy/working dogs

Medical detection dogs are used in the diagnosis of diseases from remote samples (bio-detection) and for assisting patients with chronic conditions (medical alert assistance). There is scarce information on how dogs' decision-making tendencies relate to task performance.

This study used an established cognitive bias task to investigate whether medical detection dogs' 'optimism' or 'pessimism' when making decisions in an ambiguous context was associated with their success as a medical detection dogs and their tendency to be impulsive, since more impulsive individuals may make faster and potentially less accurate decisions.

We assessed 58 trainee and trained medical detection dogs using a cognitive bias test based on Mendl et al. (2010). Dogs were trained to discriminate between a positively associated (bowl baited with food) and a negatively associated (empty bowl) location. During testing, we measured the dogs' latency to approach ambiguous locations intermediate to the trained ones.

For trainee dogs (n=39), we used trainers' ratings of a range of important traits to derive a composite total score of their ability as a medical detection dog. We also used dogs' training outcome (pass/fail). For trained bio-detection dogs (n=27), we used scent sensitivity and specificity scores derived during their clinical trials. Dog trainers also completed the Dog Impulsivity Assessment Scale (DIAS) (Wright et al., 2011) to calculate each dog's impulsivity score.

Dogs took an average of 18.42 trials to reach training criterion. Dogs with a higher overall ability (n=56, p=0.039) and those with higher impulsivity scores (n=56, p=0.04) approached the ambiguous locations significantly faster. For trained dogs, latency to approach ambiguous stimuli was positively correlated to their scent specificity levels (n=27, p=0.021) suggesting more 'pessimistic' dogs tended to be more specific. No significant relationships existed between cognitive bias outcomes and training outcome or scent sensitivity levels.

Our study is the first to investigate the association between cognitive bias and medical detection dogs' performance. Detection dogs with higher overall ability were more 'optimistic' when making decisions. More impulsive dogs were also quicker to approach an ambiguous location, perhaps reflecting a hastier decision-making process. However, bio-detection dogs with higher scent specificity were more 'pessimistic' and may be more cautious in decision-making. Personality traits that determine styles of response in a cognitive bias test may also influence dog's style of searching and responding as a detection dog. Future research is needed to explore these associations further and investigate the value of cognitive bias tasks in predicting later search performance.

Action observation in the dog and human brain and the role of the social temporal lobe

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Comparative research, Cognition

Observing the actions of other individuals provides a wealth of social information and can be the source of social learning. Research in humans and non-human primates has revealed a distributed brain network involved in action observation and species differences regarding temporal lobe involvement. These differences have been linked to the occurrence of tool-use behaviour and the ability to imitate the actions of others. Although domestic dogs are not known as tool users, they have advanced imitation skills and a temporal lobe that evolved in carnivorans independently of primates.

The neural bases of action perception in dogs have yet to be studied. We investigated whether dogs possess an action observation network functionally analogous to humans and how this network is engaged in the two species when they perceive each other's actions. We expected engagement of the occipito-temporal lobe beyond agent-sensitive regions and activation in both species' somatosensory and motor cortices.

While undergoing functional MRI, N = 28 dogs (12 females, mean age: 5.64 years) and N = 40 humans (22 females, mean age: 23 years) saw videos of transitive (i.e., picking up a ball) and intransitive (ball edited out) actions performed by dogs or humans and of two control conditions (object motion, phase-scrambled video).

Compared to the control conditions, action observation resulted in greater activation in the temporal lobe beyond both species' agent-sensitive regions and the somatosensory cortex. We further observed parietal lobe and premotor activation in humans. In dogs, we found no difference in activation during the observation of transitive and intransitive actions. In humans, transitive actions lead to greater activation in the inferior temporal cortex. Observing conspecific compared to heterospecific actions resulted in increased activation in an agent-sensitive region in the dog temporal lobe and the human primary visual cortex. The human action observation network responded stronger to heterospecific than conspecific actions. All results are p < .05 FWE-corrected at the cluster level (threshold: p < .001/.005 humans/dogs).

Our study revealed a partly functionally analogous action observation network in both species. The differences in frontoparietal lobe involvement during action observation likely reflect the species' divergent object-manipulation skills. Analogous to humans, observing transitive and intransitive actions elicited activation in the dog's temporal lobe, representing first evidence of the link between temporal lobe engagement and the ability to imitate in a non-primate species. Overall, our study provides novel insights into the neural bases of social behaviour and learning.

Development of an ethogram of dogs' predatory behaviour

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Companion dog, Assitance/therapy/working dogs, Behavior

Hunting behavior is an important part of dog's behavioral repertoire, being a trait of selection and a target of training. It can also be a threat to wildlife, livestock, pets, and humans.

Developing a detailed descriptive characterization of dogs' predatory behavior.

We selected 60 videos showing unambiguously predatory acts by dogs belonging to the Pointing Dogs, Scent Hounds, and Sight Hounds breed groups, hunting birds, hares. Two observers described every video, split into each of the 4 presumptive phases (search, approach, chase, bite). Systematic comparisons of descriptions resulted in the definition of an ethogram for each phase and dog type, which was organized in different levels.

An excerpt of the ethogram of Pointing dogs' search phase. Function: Identify the presumed location of the prey. General description: exploratory and dynamic phase, the dog moves quickly with changing/unprecise direction. When the dog apparently detects a sensory cue of the prey, the next phase starts. This transition can happen suddenly, or gradually, with a clearer directionality of the movements and a gradual decrease in pace until a complete halt. Body postures and movements: Initially, the dog moves with running gaits, displaying zigzag patterns of direction. The head initiates direction changes, followed by the rest of the body. The dog presents a centered barycenter and extended limbs. The trunk is straight and parallel to the ground. The position of the head in relation to the trunk line varies according to where the olfactory cue is located, i.e., the dog's sniffing area ranges from the ground to up in air. The tail is held along, under or above the trunk line, generally with very rapid and shallow wag; rarely not wagging. Perceptual features: clear visual and olfactory exploration of the environment, with lateral, upward and downward head movements accompanied by sniffing activity, sometimes visible by nostril movements. Ears are still neutral, while towards the end of the phase, they can begin to be held forward.

Phase-function consistencies between groups of dogs were found, as well as behavioral within-phase consistencies between subjects of the same group. However, differences were found between group of dogs in relation to behaviors within phase, as well as to the structure of the sequence. This ethogram represents the first systematic description of predatory behavior and sequence in dogs, and could serve as a model for further investigation on other groups of dogs, as well as on factors possibly affecting its expression.

Representation of rewards differing in their hedonic valence in the caudate nucleus correlates with the performance in a problem-solving task in dogs (Canis familiaris)

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Companion dog, Cognition, Neuroscience

Dogs (Canis familiaris) are capable of distinguish qualitatively different rewards, exhibiting greater motivation to obtain a specific reward over another, and learning associations between sounds and different rewards.

In Experiment 1, we used a problem-solving paradigm to assess the associations between two sounds and two distinct appetitive stimuli in family dogs (n = 20). In Experiment 2, a separate cohort of family dogs (n = 20) participated in the same problem-solving paradigm and underwent functional magnetic resonance imaging (fMRI) to test the neural representation of both sounds. We hypothesized that in both experiments, dogs would display a shorter latency to solve the problem when hearing the sound associated with a higher reward value (HRV) compared to the sound associated with a lower reward value (LRV). Moreover, in Experiment 2, we hypothesized that the response of the caudate nucleus would be related to the reward value associated with each sound.

In both, Experiment 1 and 2, dogs learned two associations: a sound was related to HRV, and another sound was related to LRV. In the problem-solving paradigm, dogs were presented with a parcel wrapped in paper while hearing one of the sounds in two separate trials. Additionally, in Experiment 2, we used fMRI to assess the brain response to both sounds before and after associative training.

We found that dogs were faster (p = 0.01) to solve the problem upon hearing the sound associated with HRV than with LRV in Experiment 1. However, in Experiment 2, we did not find any differences (p > 0.05) in the latency to open the parcels associated with HRV and LRV. In the fMRI study, we found that after the associative training, the response in the caudate nucleus was higher for the sound related to HRV than to the sound related to LRV (t (19) = -1.96, p = 0.032). In a whole-brain representational similarity analysis, we found that the cerebral patterns in the caudate nucleus to the two sounds were distinct only after training (p < 0.001 pcluster < 0.05). Furthermore, we observed a positive correlation (rs = 0.85, p < 0.001) between the dissimilarity index in the caudate nucleus for activation responses to the two sounds and the difference in latencies to solve the behavioural task: the larger the difference between the conditions in latency to solve the task, the greater the difference in the neural representation of the two sounds.

Our study introduces a problem-solving paradigm to measure motivation related to associative learning and reveals a correlation between neural representation of two sounds associated with qualitatively different rewards in the caudate nucleus and the performance in a problem-solving task.

Can I help you? Factors influencing spontaneous dog-human cooperation

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Companion dog, Assitance/therapy/working dogs, Interaction with humans

Dogs' ability to effectively cooperate with humans in a variety of situations is widely acknowledged, whether their task is hunting, herding, or assisting disabled people. The factors that influence family dogs' spontaneous cooperative tendencies, on the other hand, remain largely unknown.

Our aim was to investigate which of the following factors may play a role in the success of spontaneous dog-owner cooperation: 1) training background, 2) social motivation, and 3) breed function.

Family dogs (N=100) of various training backgrounds and breed groups (Cooperative working breeds, Independent working breeds, Non-working breeds and mongrels) were compared in a cooperative "out-of-reach" task with their owner as their partner. Since our goal was to investigate dogs' spontaneous behaviour, owners did not directly ask for help during the problem situation. We measured dogs' behaviour along the lines of the three main components of successful cooperation: 1) paying attention to the owner, 2) understanding the problem, and 3) willingness to cooperate with the owner to help them achieve a common goal.

More attention related behaviours were shown by dogs with high training levels (Orienting at owner: p=0.025, Closeness to owner: p=0.030, Gaze alternation: p<0.001) and high social motivation (Orienting: p=0.028, Closeness: p=0.014, Gaze alternation: p=0.013). Dogs with high social motivation and more extensive experience in fetching tasks were more likely to cooperate with the owner (p=0.019; p<0.001). The breed function was significantly associated with only one of the attention-related variables: Independent working breeds were more likely to stand by the door leading to the goal than any other breed group (p=0.040).

Our results highlight the significance of training experience and social motivation in dogs' spontaneous cooperativity and attention towards the owner. To ensure the validity of future studies on this topic, it may be necessary to either carefully balance the sample or exclude subjects with specific training experiences. This study also underscores the need for developing experimental procedures that do not rely on specific skills (such as fetching), which could influence dogs' cooperative success.

Investigating stress and welfare in dogs transitioning from commercial breeding kennels to homes: a longitudinal pilot study

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Behavior, Canine welfare

Rehoming of dogs is a potentially distressful experience, which may present particular challenges for retired breeding dogs transitioning from a kennel to a home environment. To date, no direct observational studies have explored the short and long-term effects of rehoming on the welfare of dogs from commercial breeding kennels (CBK).

This study aimed to investigate the effects of rehoming on physical, physiological, and behavioral indicators of welfare of dogs retiring from CBKs during their first 12 months after adoption.

Twenty adult dogs (17 females, 3 males) from 8 CBKs were assessed. Indicators of physical health [body condition score (BCS)], physiological stress response [hair cortisol concentration (HCC)], and levels of social fear during a brief stranger approach test (FIDO+) were collected immediately prior to each dog leaving the kennel (M0), and at 2 (M2), 6 (M6) and 12 months (M12) afterwards. Analysis consisted of descriptive and Friedman statistics. Dogs' behavioral responses to an unfamiliar person were recorded as fearful, non-fearful, or ambivalent.

Individual variability in response to rehoming was seen. Some dogs consistently scored as fearful/ambivalent (n=7) or non-fearful (n=4) while others improved from fearful/ambivalent to non-fearful (n=7) or exhibited more fear (n=2) toward an unfamiliar person. Friedman's statistics found BCS to be significant (Fr=9.217, p=0.027) but not HCC (Fr=0.789, p=0.852) or FIDO+ (Fr=0.489, p=0.921). While not significant, mean (±SE) HCC increased from M0 (22.08±2.38) at M2 (36.29±10.75) and M6 (40.01±19.12) and decreased at M12 (22.11±4.39) as predicted. Similarly, mean (±SE) BCS decreased from M0 (3.50±0.14) at M2 (3.15±0.11) and M6 (3.40±0.13) and increased at M12 (3.50±0.14).

These results suggest that while some changes observed may reflect coping with underlying stressors, the dogs did not appear to experience major distress due to rehoming. The first six months appear to present the greatest challenges for adaptation. Furthermore, there appears to be high individual variability in behavioral responses to social stressors that warrants further investigation. The small sample size makes it difficult to generalize these findings to a larger population or to determine the extent to which risk assessment predicts rehoming outcomes. Additional analysis may provide further insight to identify factors associated with successful rehoming candidates and inform recommendations for practices tailored to individuals to promote the successful transition of retired breeding dogs to family homes.

Dog breeds and detours – cooperative working dogs perform better than independent breeds in a social learning task

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Companion dog, Cognition, Interaction with humans

Interspecific social learning is a main synchronizing mechanism, enabling dogs (Canis familiaris) to coexist and cooperate with humans. So far, no fundamental differences were found among the various dog breeds in their social learning performance.

We hypothesized that visually cooperative and visually independent working dog breeds may behave differently in a problem-solving task that is based on social learning from a human demonstrator.

We used the well-known detour paradigm with and without human demonstration. The experimental device was a transparent, V-shaped wire mesh fence, 1m high, and the two wings were equally 3m long, forming an 80 degree angle. Subjects (N=63) were at least 1 year old family dogs who were unambiguously sorted into one of the two breed groups, regardless of their size and sex. We included the widest possible range of breeds, thus avoiding over-representation of any breed in either of the groups. We tested 17 cooperative breeds and 18 independent breeds. The experiment consisted of three, one-minute long trials. In the control condition the dogs had to obtain the reward without demonstration. In the demonstration condition, before trials 2 and 3 the experimenter placed the reward to the inner corner by walking around the fence. We formed the following groups: cooperative/control (N=22); cooperative/demo (N=13); independent/control (N=14); and independent/demo (N=14).

Latency of reaching the target in the first trial wasn't associated with keeping conditions (P=0.830); training level (P=0.354) and group-assignment of the subjects (P=0.208). The dogs' task-orientedness was the same in each group and across the trials: durations of leaving the vicinity of the fence wasn't associated with demonstration (P=0.440); breed group (P=0.437) and repeated trials (P=0.088). Independently of the demonstration and breed group, dogs looked at the humans less frequently (P=0.052) and performed successful detours more often (P=0.003) in trial 3 than in the previous trials. Most importantly, cooperative dogs reached the target significantly faster (P<0.001), while independent dogs did not detour faster in trials 2 and 3 after the human demonstration (P=0.123). No improvement of detour latency was found in the control groups (cooperative: P=0.079; independent: P=0.132).

We showed that cooperative dogs were more capable to use information from human demonstration. This is the first empirical evidence, demonstrating that functional breed selection could affect the traits of dogs that are important for social learning. The selection for cooperativeness could cause higher attention towards human communication and behaviour, thus elevating dogs' ability to learn from humans easier.

Turning anecdotes into evidence with the power of citizen science: Gifted Word Learner dogs reveal characteristics of a distinct dog population

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Companion dog, Cognition, Behavior

Dogs with a vocabulary of object labels (Gifted Word Learner Dogs - GWLDs) have great potential as a model for studying comparative cognition. However, studies on GWLDs have been limited by a small sample size (i.e., N= 1 or 2) preventing the generalization of the findings to other GWLDs. And yet, GWLDs appear to share many of the same characteristics, such as the ability to learn a large vocabulary.

Here we asked whether these reports are merely coincidental anecdotes. We suggest that if GWLDs share the same characteristics, they can be considered as a unique dog population, presenting previous findings as more valid and generalizable to other GWLDs.

We located GWLDs through an international social media campaign. Owners that believed their dogs knew the names of toys were invited to participate in a vocabulary assessment test. We used binomial tests to calculate the dogs' performance. Owners of dogs that performed above chance in the test, were asked to complete a questionnaire about their dog's life experience, their own experience with dogs, and the process through which the dogs learned the names of the toys.

Forty-one dogs performed above chance in the test (all p<0.001). The questionnaire replies highlighted several characteristics that are shared among most GWLDs, such as the informal play process through which they learned the names of the toys, their learning speed, and their ability to reach a large vocabulary. Eighty-five percent of the dog owners were not professional trainers and 74% said that they did not intentionally train their dogs to learn the names of the toys. All multi-dog households (n=8) included only one GWLD and only 3 owners, out of 26 that raised dogs in the past, reported that one of the previous dogs knew the names of toys.

In this study, we harnessed the power of citizen science to examine an unprecedentedly large sample of rare individuals. Our findings suggest that owners' skills are not the main factor contributing to the dogs' vocabulary acquisition, as most dogs acquired the toy names spontaneously during play sessions with owners that were not professional trainers and did not previously own a GWLD. Our findings also validate previous anecdotal evidence on the size of the vocabulary GWLDs can possess and the speed at which they learned new toy names, presenting GWLDs as a distinct population with unique characteristics.

Species-specific and acoustic effects on dogs' perception of social messages in vocalisations

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Companion dog, Comparative research, Behavior

Predicting the partner's behaviour and appropriately reacting with approach or withdrawal during social interactions might benefit both interaction partners. Vocalisations play a key role in such communicative interactions by providing information about the valence of the callers' emotional state (positive or negative) and conveying a social message. Reacting to calls indicating a positive state with approach and a negative state with withdrawal is often adaptive. Signal evolution thus favoured calls with acoustic structure distinctively encoding these messages, leading to species-independent coding rules. However, in group-living social species, distress calls like separation cries, although reflecting a negative emotional state, are expected to evoke an approach reaction. This dissociation suggests that the acoustic encoding of emotional valence and social message in vocalisations may be separable.

Thus, we aimed to test in a group-living social species, the dog, whether the emotional valence or the social message of the vocalisation determines listener reactions within and across species.

We played back dog, chimpanzee and human agonistic (expectedly negative, withdrawal eliciting), distress (expectedly negative, approach eliciting) and playful/comfort (expectedly positive, approach eliciting) calls and speech from a hidden speaker to 240 dogs in 4*3 groups, respectively. We coded and compared their initial approach/withdrawal reaction to the sounds between species and call emotion groups. Additionally, we tested which acoustic parameters affect the dogs' reactions.

Dogs hearing conspecific distress (p=0.025) or playful/comfort calls (p=0.079) were more likely to approach the speaker than those hearing agonistic growls. In contrast, we found an opposite response to chimpanzee calls, where positive calls more likely evoked withdrawal than agonistic calls (p=0.048). In response to human calls, we saw a general approach, independently from the call type or context. Interestingly, regardless of both species and context, more noisy vocalisations evoked withdrawal (p<0.001), while higher-pitched calls tended to elicit an approach (p=0.09).

This response pattern suggests that for dogs, the social message in conspecific calls had a stronger effect than the emotional valence of the caller in deciding how to behave. The general approach reactions might be due to the strong general preference towards humans, and the opposite than expected response to chimp agonistic and play vocalisations might be explained by the effect of tonality. Together, these findings suggest that species-specific acoustic differences and social preference due to domestication might affect how dogs perceive social messages in vocalisations.

Puppies - but not kittens and wolf pups - tend to spontaneously imitate human actions

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Comparative research, Cognition, Interaction with humans

Doing what others do is a convenient way for young individuals to learn new skills and it also promotes belonging to a social group. Dogs', cats' and wolves' different innate sociality and domestication histories may influence their tendency to learn socially from humans. Dogs' and wolves' ancestors lived in social groups with within-group cooperation; cats' ancestors were solitary hunters. Dogs and cats are domesticated species, but dogs were domesticated earlier and were selected for several forms of cooperation with humans.

We investigated whether dog puppies, kittens and wolf pups show a different tendency to match human actions, without food reward and training. Based on their inherent cooperative nature, we hypothesized that dog puppies and wolf pups would be more influenced by demonstrations than kittens. Based on dogs' and cats' different domestication histories, we predicted that dog puppies would show a greater tendency to spontaneously match human actions.

We first observed whether N=42 puppies, N=39 kittens and N=8 wolf pups, socialised and living with humans, touched a novel object with nose or paw. Next, the experimenter demonstrated an action on the object different from the one eventually performed by the subject. We measured latency to attend and assessed whether subjects performed the demonstrated action.

Puppies attended to the demonstration sooner than wolf pups and kittens (P<0.001). Puppies and wolf pups replicated the demonstration twice as often as kittens (P=0.007). Only dog puppies imitated the action with a homologous body part to that of the human demonstrator (P=0.017), even when this differed from the one they used in the absence of demonstration (P=0.039).

Dog puppies showed the greatest tendency to attend to the experimenter and were more likely to match an action that differed from their own preferred one, revealing their tendency to conform their behaviour to that of humans, even in the absence of food reward. Kittens were least affected by the demonstrations. The results support the effects of inherent sociality and domestication history, and also provide the basis for developing training methods that rely less on food rewards and, instead, exploit puppies' predisposition for social learning.

Do they differ in testability or in reliance on human gestures? Comparing dogs and cats

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Comparative research

Although the dog is considered a unique model species for investigating the evolution of human communication, a similar role has recently been proposed to the cat. We compared both the testability and the performance of companion dogs and cats for their reliance on human pointing gestures in a two-way choice task.

We expected dogs to be more testable and perform better than cats, and cats to perform better at home.

As a first step, family cats were habituated to the laboratory environment; only 60% of the cats could be successfully habituated. We started the test sessions with 21 dogs and 43 cats (9 had to be excluded). After a familiarization phase and a motivation test, subjects participated in 14 dynamic-sustained and 14 momentary distal (>80cm) pointing trials presented in random order within one session. A subsample of cats was also tested at home.

In the laboratory, dogs proved to be more testable; all dogs but less than 50% of cats had >14 choices. Dogs made more choices than cats (p<0.001), and cats' tendency to make a choice declined during the trials (p<0.001). Cats were more likely to make a choice at home (p=0.031), where their willingness to choose did not decrease over time. At the group level, both species relied on both pointing gestures above chance level (all p<0.001). However, dogs were more successful than testable cats (p=0.002), irrespective of the gesture type. At the individual level, 50% of the dogs and none of the cats performed better than chance.

Our findings draw attention to the fact that in most experiments cats are either tested at home or are preselected, what raises doubts about the generalizability of the results. Of note, including not testable cats into the analysis would further increase the differences in the success of dogs and cats. Identifying the reason(s) why it is more difficult to involve cats in standard laboratory tests (e.g., different socialisation, less motivation, stress in an unfamiliar environment, attention deficit, frustrating human handling, etc.) requires further investigation. Although the two most popular domesticated species today have fairly similar roles as human companions, cats seem less suitable for standard comparative studies of communicative abilities than dogs.

Using mobile eye tracking to study dogs' understanding of human referential communication

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Companion dog, Cognition, Interaction with humans

A large body of research in canine cognition has been devoted to the question to what extent dogs understand and follow human referential communication. While it is widely accepted that dogs follow (some) human referential signals, the way they understand them remains controversial. In this study, we recorded dogs' (N = 20) gaze behaviour using mobile eye tracking to investigate how ostensive pointing and gaze cues affect the dogs' visual attention.

We addressed the question whether dogs would follow referential communication more than other directional actions with their gaze to the indicated referent. We predicted that especially the combination of gaze and pointing signals would elicit a shift of the dogs' gaze to the signaled referent.

After the habituation to the mobile eye tracker, dogs were tested at the Clever Dog Lab Vienna. In an object-choice task, we presented them with cues that indicated where a food reward was hidden, while they wore the mobile eye tracker. We presented the dogs with five conditions (pointing, pointing + gazing, gazing, fake throwing and no-cue control), four of which provided the dogs with a directional cue indicating the baited bowl. The dogs could choose one of two bowls (only one was baited) after receiving the cue. We analyzed their choice performance and looking times to the signaled referent by fitting generalized linear mixed models.

The dogs' choice performance ($\chi2(4)=21.48$, $p<0.001$) and looking times ($\chi2(4)=20.06$, $p<0.001$) to the referent varied significantly between conditions. The eye tracking data revealed that the dogs followed the cues to their referent (the bowl) especially in the pointing + gazing condition. In the pointing + gazing condition, they chose the correct bowl significantly above chance levels and looked at the correct bowl the longest as compared to the other conditions. Other hand movements such as fake throwing also directed the dogs gaze away from the experimenter in the indicated direction, but not specifically to the target object and they did not significantly influence the dogs' subsequent choice performance.

We conclude that the combination of pointing and gazing seems to be an especially effective way to direct the dogs' attention to the signaled referent. Mobile eye tracking provided an objective and precise way to quantify the dogs gaze behavior in response to human referential communication.

Unravelling brain representations of emotional human faces in dogs

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Companion dog, Cognition, Interaction with humans

Dogs possess a remarkable ability to distinguish between human facial emotions and respond to them selectively, particularly to those that express happiness. However, the brain processes underlying this ability remain unclear.

To shed light on the neural representation of emotional human faces in dogs, we conducted two experiments using functional magnetic resonance imaging (fMRI). We hypothesize that (i) processing of happy human faces involves the temporal cortex in dogs, (ii) there exist specific neural signatures related to processing happy faces that make their discrimination from other emotions possible, and (iii) the dog brain can distinguish between human faces expressing negative emotions as well.

In Experiment 1, eight dogs were presented with happy and neutral human faces, and they exhibited increased brain activity in the right rostral Sylvian gyrus, prorean gyrus, piriform cortex, and right caudate nucleus when viewing happy faces ($z > 2.3$, cluster corrected at $p < 0.05$). In Experiment 2, 12 dogs were presented with human faces expressing happiness, anger, fear, or sadness.

Using the cluster identified in Experiment 1, a machine-learning classifier was trained to discriminate between neural response patterns to different pairs of emotions. The classifier successfully discriminated only between happiness and negative emotions (permutation test, $p < 0.05$), revealing that the brain regions identified in Experiment 1 were specifically involved in processing happy faces rather than emotions in general. Additionally, to investigate how dog brains differentiate between negative emotions, we used whole-brain representational similarity analyses ($z > 3.1$ cluster corrected at $p < 0.05$). We expected that activity patterns in brain regions involved in the discrimination between facial emotions would exhibit low dissimilarity for same-emotion stimulus pairs but high dissimilarity for different-emotion stimulus pairs. Our analysis revealed such distinctions between same- and different-emotion pairs in the right mid ectosylvian gyrus and the left splenial gyrus for angry vs. fearful faces, and in the right rostral suprasylvian gyrus for sad vs. fearful faces. We did not observe this pattern in any region for angry vs. sad faces.

To our knowledge, this study provides the first evidence that dog brains can not only categorize human facial expressions based on valence but also distinguish between two negative facial expressions.

Human-directed behaviour during the unsolvable task associated with higher trainability and lower impulsivity

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Companion dog, Cognition, Interaction with humans

The unsolvable task has been used extensively in canine research to assess human-directed social behaviour. When dogs are faced with a task which is impossible to solve, they may use one of three strategies: a) attempting to solve the task independently, b) gazing at the human or engaging in other human-directed behaviours, or c) abandoning the task. The human-directed strategy has been interpreted as attraction to the human face, lack of persistence, or communicative, help-seeking behaviour. However, we still know almost nothing about the behavioural or personality traits that might be associated with this behaviour.

Our aim was to investigate whether dogs' behaviour in the unsolvable task could tell us something about their behavioural traits outside of the test situation.

We collected questionnaire answers from dog owners who had participated in the unsolvable task with their dogs (N = 1,058). We included two validated questionnaires: the Canine Behavior Assessment and Research Questionnaire (C-BARQ), and the Dog Impulsivity Assessment Scale (DIAS). Associations between questionnaire factors and human-directed behaviour in the unsolvable task were analyzed using linear mixed models and generalized linear mixed models. We controlled for variables such as breed, age, sex, training history, and food motivation.

Human-directed behaviour in the unsolvable task correlated negatively with impulsivity (DIAS behavioural regulation, p = 0.005), management problems (p < 0.001), and stereotypies (p = 0.01), and positively with fear of humans (p = 0.007) and obedience/trainability (p < 0.03). In contrast, human-directed behaviour did not correlate with excitability, energy level, impulsive aggression (DIAS), or slowness to learn new tasks.

Our preliminary results show that the performance of dogs during the unsolvable task may be indicative of their behaviour in their daily lives with their owners. Dogs which utilized a more human-directed strategy during the unsolvable task were more likely to obey commands, less impulsive, and they displayed less stereotypic behaviours and management problems, but were more fearful of humans. These results further our understanding of dog behaviour and the possible reasons behind human-directed behaviour during the unsolvable task.

Puppy socialisation: The effect of age and the UK/ROI COVID-19 lockdown.

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Companion dog, Interaction with humans

Lack of socialisation during puppyhood has been associated with social and non-social fear in adult dogs. The timing of socialisation experiences (in relation to critical socialisation periods) and effect of COVID-19 lockdowns of puppies warrants investigation due to potential consequences on later behaviour.

Did the proportion of total socialisation experiences reported for puppies aged 56-133 days (inclusive) change with age and in relation to the first COVID-19 lockdown period in the UK/ROI? It was hypothesised that during lockdown, puppies would have fewer experiences compared to pre- and post-lockdown periods.

Participants in a longitudinal study of canine health and behaviour (living in the United Kingdom/Republic of Ireland) selected socialisation experiences their puppy had had in the last seven days from a list of 16 experiences (including: being out in public on the ground, being in a moving vehicle, and visiting another household). Analysed data were collected (05/2016-11/2022) from puppies aged 56-77, 84-105 and 112-133 days.

To investigate the impact of COVID-19 lockdown, data were split into three categories; surveys completed pre- (before 23/03/2020), during (30/03/2020-18/07/2021), and post-lockdown (26/07/2021 onwards). Data collected 23rd-29th/03/2020 and 19th-25th/07/2021 were excluded to prevent recall of experiences spanning two categories. A Generalised Linear Mixed-Effects Model with a beta distribution was used to assess if age category and COVID-19 lockdown period affected the proportion of socialisation experiences had by puppies.

Data were available for 1,565, 3,456 and 3,921 puppies aged 56-77, 84-105 and 112-133 days, respectively. A significant difference in the proportion of total experiences existed for puppies according to age category (full–null model comparison likelihood ratio test: $\chi2=2058.365$, df=2, p<0.001) and lockdown period ($\chi2=8.935$, df=2, p=0.011). Pairwise comparisons revealed a significantly higher proportion of experiences as age increased, and in pre-lockdown compared to post-lockdown. No significant difference was evident in proportion of socialisation experiences reported between pre-lockdown and lockdown or lockdown and post-lockdown.

Puppies were reported to have had more experiences during the previous seven days as they aged. There was a slight, but significant, higher proportion of experiences pre-lockdown compared to post-lockdown. However, whilst this effect was significant, the effect size was small, indicating that the relationship is subtle. Some of the experiences listed may not have been impacted by lockdown, e.g., hearing loud noises or going in the garden. Future work within this longitudinal study will examine relationships between timing and type of early-life experiences of puppies and subsequent behaviour as adults.

Development and validation of a sleep questionnaire, SNoRE 3.0, to evaluate sleep in companion dogs

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Companion dog, Cognition, Physiology, Behavior, Canine welfare

Disturbances in the sleep-wake cycle are a debilitating, yet rather common condition that accompany ageing not only in humans, but also in pet animals such as family dogs. While there is an emerging need for easy to use tools to detect sleep alterations (in order to ultimately treat and / or prevent them), the currently available veterinary methods which yield valid data (e.g. polysomnography, actigraphy) are both labor intensive and rather expensive.

The current study aimed to develop a modified version of a previously used sleep questionnaire (SNoRE), which is here validated against objective data.

The final SNoRE questionnaire structure was validated by a confirmatory factor analysis (N=194 dog owners), and test-retest reliability was also evaluated (N=97 dog owners). N=68 dogs and owners participated in the further validation of the questionnaire which included construct validity and criterion validity using a further questionnaire as well as polysomnography and actigraphy methods.

Test-retest reliability of the modified SNoRE questionnaire was adequate (ICC=0.817). The questionnaire showed significant associations (r=0.692, p<0.001) with the CAnine DEnemntia Score (which includes a factor concerning sleep). Furthermore there was a significant relationship between mSNORE questionnaire scores and polysomnography data (latency to NREM sleep; r=0.507, p=0.003) as well as Physical Activity Monitors' data (activity between 1:00 and 3:00 AM).

In conclusion the modified SNoRE questionnaire is a valid and reliable tool, that can be used as a cost effective way to monitor dog sleep e.g. in clinical settings.

Permissive training style elicits weaker memory consolidation in more inattentive dogs

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Companion dog, Cognition, Interaction with humans

Learning, stress, and sleep are interconnected both in humans and dogs. Learning is most efficient under moderate stress, and sleep-dependent memory consolidation is described in both species. In humans, academic impairment is primarily related to inattention, however, less is known about the associations between dogs' inattention and learning performance.

Our aim was to investigate the relationship between dogs' behaviour, owner-reported inattention, and learning performance under two Conditions, using permissive vs controlling training styles. We expected more inattentive dogs to show stronger stress-response (i.e. time spent near the owner), perform worse, and have poorer sleep-dependent memory consolidation (less improvement for post-sleep retest).

We measured the behaviour of N=24 companion dogs in a within-subject design, in a command-learning task. Dogs were trained by dog trainers to perform already known actions to newly learned commands on two Occasions, in permissive and controlling training styles. The order of Conditions was balanced between subjects. After both training sessions, an experimenter tested the dogs' learning performance in a neutral style. The test was followed by a 2-hour-long sleep and a post-sleep retest. Dogs' general Inattention was assessed using an ADHD-questionnaire adapted for dogs.

The time spent near the owner was affected by a three-way interaction of Condition × Occasion × Inattention, that is, during controlling training on the second occasion, more inattentive dogs spent less time near their owner (p=0.033). Condition had no effect on pre-sleep test performance, but we found an Occasion × Inattention interaction; on the second occasion, more inattentive dogs performed better (p=0.012). Performance improvement (from test to retest) was affected by Condition × Inattention; more inattentive dogs showed poorer improvement in the permissive condition (p=0.04). Further analysis revealed that on the second occasion, surprisingly, more inattentive dogs needed shorter training sessions (p=0.025).

The behavioural results indicate that more inattentive dogs are probably less stressed by the controlling training style. Differences in the training duration could be caused by the repetitive nature of the trainings - in line with the human literature, repetition improved learning efficiency more in dogs with higher Inattention scores. Accordingly, more inattentive dogs were less exhausted by the shorter training, resulting in better performance in the pre-sleep test. The performance improvement results suggest that more inattentive dogs might not benefit from a permissive training style. Our findings provide insights towards finding the "golden" training approach for inattentive dogs.

Reflective belief revision in pet dogs, Kune Kune pigs and human infants?

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Companion dog, Comparative research, Cognition

Philosophers often hesitate to attribute epistemic and rational agency to infants and non-human animals because they appear to lack the ability to reflect on and re-evaluate their beliefs and their reasons for those beliefs. However, even if they cannot express their reasons verbally, empirical research shows that both infants and dogs, after initially following of an informant's signals, start to hesitate to accept this information if this person proves unreliable or inaccurate.

Going beyond this observation, in this study we set out to investigate whether dogs, pigs and human infants are capable of processing a demanding type of counterevidence (so-called undermining defeaters), and to use this information to revise their beliefs and modify their behaviour accordingly.

For this aim, using identical methods across species, we assessed the capacity of 54 pet dogs, 35 Kune Kune pigs raised and kept at the Clever Pig Lab and 2-year-old infants to make inferences about the reliability of 2 informants. The subjects could search for a reward behind one of 2 screens after having watched one of the informants act on one of them. The actions of the reliable informant indicated the location of the reward in all of her trials whereas finding the reward in the unreliable trials was more difficult, as the unreliable informant acted on a screen independent of the presence of the reward. As in progressing trials the informants used novel actions that in no way resembled their preceeding actions, the subjects needed to make an inference about the reliabilities of the persons in order to make a decision whose actions to follow. We expected that they would follow the reliable informant more and would hesitate more in trials of the unreliable informant. Furthermore, we expected that they would show a preference for the reliable informant over the unreliable one once allowed to interact with both simultaneously, which we tested in subsequent transfer tasks.

When looking at the animal data separately, we found no evidence that the dogs and pigs would have differentiated between the reliable and unreliable informants. Data collection in human infants is ongoing, but preliminary results suggest that 2-year-olds are less likely to follow the unreliable than the reliable informant.

Whether our results indicate that these animals are incapable of this basic form of reflective thinking or are rather due to their high propensity to follow human cues warrants further investigation and methods ouside the social domain.

Comparing overimitation in dogs and 5-year-old children

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Companion dog, Comparative research, Behavior

In a phenomenon called overimitation, people copy actions that are causally irrelevant to a desired goal. For example, before loosening a bolt you may slap a wrench in your hand because this is what your teacher did. Social factors like model identity seem to influence human children's choices to overimitate, particularly when they are shown that irrelevant actions are not needed to succeed in a task. But children aren't the only ones overimitating – recently, dogs have been shown to also copy irrelevant actions, and even more so from their caregivers than a stranger (Huber, et al. 2018; 2020). However, we do not know if this preference persists when action-irrelevance is obvious, when an efficient strategy is revealed.

For the first time in a directly comparable manner, this project aimed to investigate whether dogs and children overimitate their caregivers differently when a task's actions are shown to be clearly causally irrelevant. We also aimed to investigate what irrelevant actions they may prefer to copy.

The first part of our investigation (now complete) tested the influence of familiarity on overimitation with 52 children. We used a two-phase task containing four irrelevant actions, two of which were in physical contact with the puzzle box. In phase one, either the children's parents or a stranger demonstrated all of the actions in pursuit of a goal, and in phase two, the alternative model demonstrated only the goal. The second part of our investigation tested dogs using the same method. We created a new task with four irrelevant actions, which are spatially distanced around a room and can be performed without tools or dexterous hands.

So far, we found that five-year-old children (N=52) significantly dropped their parent's irrelevant actions but kept using the stranger's during the task's second phase ($x2 = 3.8938$, $df = 1$, $p < .05$). Additionally, the type of actions that the children preferred to copy were those in physical contact with the puzzle box ($x2 = 41.4027$, $df = 1$, $p < .001$). Testing dogs is ongoing but first data will be presented.

The new two-phase overimitation task allows us to test dog overimitation in the same manner as the developmental literature, which can make results directly comparable with those of children. By including efficient demonstrations, researchers can test a more deliberate kind of overimitation where individuals may consider social factors in their copying decisions.

"Watch me!": The impact of training experience on social referencing in domestic dogs

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Companion dog, Behavior, Interaction with humans

Dogs use human emotional cues to gain information in novel situations through the process of social referencing. Human emotional cues can range from visual cues such as facial expression and body language to auditory cues such as vocal tone. Dog training reinforces dogs for paying attention to human given cues and could strengthen a dog's likelihood to use social referencing when presented with a novel stimuli.

It was hypothesized that dogs with increased training experience are more likely to use social referencing during a novel object choice task. Additionally, it was predicted that dogs would be more likely to use social referencing to approach stimuli humans reacted to either positively or neutrally than stimuli humans reacted negatively to.

A novel object choice task was used to evaluate dog susceptibility to social referencing of human emotional cues. An experimenter displayed positive, negative, and neutral reactions to five identical pairs of novel objects. Dogs were given the choice to approach either object for 25 second trials. To evaluate training experience, dog owners were given the C-BARQ to obtain a trainability score.

According to a Wilcoxon Signed Rank test dogs (N=32) were more likely to choose negatively valenced object than positively valenced objects (z= -2.0322, p<.04236), did not discriminate between positively and neutrally valenced objects (z= -2.0322, p<.04236), and chose neutrally valenced objects more than negatively valenced objects (z=-0.501, p .0226). According to a Spearman's Rho test there was no significant relationship between C-BARQ Trainability and object choice in any condition. In Positive-Negative conditions r(30)=-.086, p=.641, for Positive-Neutral conditions r(30)=-1.09, p=.552, and for Positive-Negative conditions r(30)=-.083, p=.651.

Dogs do use human emotional cues to social reference during a novel object choice task and were more likely to approach objects with a negative valence when presented with positive and negative objects, but were more likely to approach neutral objects when presented with negative and neutrally valenced objects. This is potentially because a disgust reaction was used during the negative condition, and it is possible that dogs have been habituated to associate human disgust with interesting stimuli. Object choice was not correlated to dog trainability, which may suggest that social referencing is not impacted by dog training. This indicates that dogs may utilize social referencing to gain information on novel situations regardless of their training experience.

Do dogs differ in their response to a judgment bias test when exposed to the odour of human stress or relaxation?

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Companion dog, Cognition, Behavior

How we smell when stressed subconsciously affects the behaviour, emotions and affective state of other people. Dogs have been shown to discriminate between stressed and non-stressed odour samples from humans, however the effect on their cognition, emotion or affective state has yet to be studied.

Does the odour of human stress or relaxation influence the affective state of dogs?

We hypothesise that when exposed to human stress odour during a judgement bias test, dogs experience a negative affective state and take longer to approach food bowls at ambiguous locations than when exposed to the odour of relaxation or no odour.

We collected sweat and breath samples from 11 human volunteers during a stress test (public speaking and mental arithmetic task) and a relaxing experience (watching nature videos). We assessed their stress response using cardiac measurements, anxiety questionnaires and saliva cortisol. All participants had significantly higher cardiac measures and anxiety scores during the stress test versus relaxation. Cortisol concentration was not significantly different between conditions, however there were three outliers with markedly increased cortisol during the stress test versus relaxation. Samples from these three donors were selected for judgment bias testing of dogs, with each dog presented with samples from the same person.

A total of 18 dogs participated in three judgement bias sessions: baseline (no odour), stress odour and relaxation odour, with the order of the two test odours counterbalanced between dogs. Dogs were first trained to associate one bowl position with a food reward (positive) and a distinct bowl position with no reward (negative). Dogs were then presented with a bowl at three ambiguous positions: near-positive, middle, and near-negative, which were used to test their judgement of ambiguity. We used a Generalised Linear Mixed Model to assess the effect of odour on the time to approach each bowl position and included subject as a random variable to account for differences in running speed between dogs.

Preliminary analysis of a subset of data (6 dogs) suggests an effect of odour on time to approach negative, positive, and near-negative positions, but not middle or near-positive positions. Analysis of all dogs will be completed in June once data collection ends.

This is the first study to test how human olfactory cues of stress affect the emotions and judgment bias of dogs. Understanding the role of odour in stress-signalling between humans and dogs is important when considering dog welfare and working performance.

Intense exposure to human social stimuli during domestication and development is not sufficient to trigger attachment towards humans: A pig-dog comparative study

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Companion dog, Comparative research, Interaction with humans

Domestic dogs (Canis familiaris) show human-analogue attachment to their owners with similar function and mechanisms to that of infant-mother bonds, but the origins of this particular interspecific relationship are unclear. Comparative studies on similarly kept highly socialized wolves and dogs support the role of genetic changes in adult dogs' preparedness to form attachment with humans. To find out whether this genetic effect is caused by domestication in general or more specifically by the artificial selection for dependence on and cooperating with humans, it is important to compare the behaviour of different domestic species living in similar conditions as dogs. The domestic pig (Sus scrofa domesticus) is a suitable candidate for such comparative studies as, similarly to dogs, pigs are social, group-living animals who are highly dependent on humans when kept as companions.

We hypothesized that if domestication in general facilitates the emergence of attachment towards a human, then intensively human-socialized companion miniature pigs and dogs will exhibit similar owner-related behaviours. Conversely, if the specific selection for dependence and cooperating with humans is a main factor for interspecific attachment to arise, only dogs will show the specific patterns of attachment behaviour.

Using a Strange Situation Test (SST) we compared the behavioural patterns of highly socialized companion pigs (N=11) and dogs (N=15) towards their owners. Based on the observed behaviour patterns, three major factors were formed and analysed; Attachment to the owner, Anxiety in the strange situation, and Acceptance of the stranger.

According to the preliminary results (1) dogs but not pigs showed significantly different behaviours towards the owner and stranger (P<0.05), (2) dogs' Attachment score was higher than that of pigs (P<0.05) and (3) pigs' owner- and stranger-related behaviours tended to be consistent in time (P=0.05).

Our results suggest that in young companion pigs, the intense exposure to human social stimuli during domestication and development has not triggered the emergence of human-analogue attachment towards the owner. The emergence of dog-owner attachment may thus be facilitated by dogs' unique artificial selection for dependence on and cooperating with humans.

Ability of dog owners to identify their dogs by smell

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Companion dog, Physiology, Interaction with humans

Several studies report that olfactory cues play an important role in human life; humans are essentially able to recognize other family members and friends by their odors. Moreover, recent studies report that humans are also able to identify odors of non-conspecifics.

The aim of this study was to determine whether dog owners are able to identify their dogs by smell and distinguish the odor of their own dogs from those of other dogs. Moreover, wherther selected factors may influence the performance of the owners.

A total of 53 dog owners (40 females and 13 males of different ages) volunteered to take part in this study. A number of the participants (17) owned 2 dogs; these owners took part in the study twice. Sterile gauze pads were used to collect odor samples from the dogs. Each pad was placed in its own sterile glass jar (750 ml) with a twist off lid until the experiment commenced. Participants were asked to identify their own dog´s odor from a line-up of 6 glass containers. All containers contented odor of a dog.

This experiment demonstrated that dog owners are capable of identifying their dogs by smell on a significance level of $P < 0.05$. In total, 71.43% of the participants correctly identified their dogs (28.57% did not). Significant differences were found between men and women (P-value = 0.04). Owners who kept their dogs outside correctly identified their odors at a significantly higher rate ($P = 0.0394$) than did owners who housed their dogs indoors. Participants who fed their dog dry dog food also had a significantly higher rate of success ($P = 0.0270$) than did owners who fed their dogs raw meat. Owners who bathed their dogs frequently were less likely to correctly identify their scent compared to those who did so more often ($P = 0.0314$). Finally, the younger the dog owners the higher the success rate (estimation $= -0.0468$), ($P = 0.0477$).

Results of this study actually showed that humans are able to distinguish their own dogs from others by smell and deepen so results of previous done study. Moreover, it was found that several factors seem to play an important role in successful identification. This is a proof that human olfactory sense is not as poor as previously thought. In future studies, it would be very useful to have better control over all variables in order to study their influence in greater depth.

The effect of owner-reported auditory experiences during puppyhood on fear of fireworks in 2.5 year-old dogs in the UK and Republic of Ireland: A causal inference analysis of longitudinal data

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Companion dog, Behavior, Canine welfare

Fear of fireworks is detrimental to dog welfare and is estimated to affect 26-70% of adult companion dogs. Exposure to social and non-social stimuli during the socialisation period has been associated with a decreased risk of dogs being afraid of fireworks. It is important to investigate if this association is causal, which can be useful for promoting evidence-based preventive measures during puppyhood.

What is the causal effect of owner-reported auditory experiences during puppyhood on owner-reported dogs' fearful response to fireworks at 2.5 years of age? We hypothesised that auditory experiences in puppyhood have a preventive effect on dogs' fear of fireworks as adults.

Pre-lockdown (before 23/03/2020) socialisation data from the longitudinal Generation Pup study were used to create a directed acyclic graph (DAG) depicting the a priori causal assumptions. The minimally sufficient adjustment set of confounders informed by the DAG consisted of puppy, household, and owner characteristics. Logistic regression models informed by the DAG explored the effect of puppies' reported exposure at different age ranges to a pre-defined list of socialisation experiences. The outcome variable was 'fear of fireworks at 2.5 years', based on owner-reported behaviours selected from a list of 26 possible responses to fireworks. The exposure variable was a composite of seven 'auditory' experiences (e.g., attending puppy classes, hearing loud noises, and encountering livestock), reported by owners at 12-15 weeks (n=434), and 16-19 weeks (n=616). We further analysed a subset of puppies between 12-13 weeks (n=393).

The occurrence of fear of fireworks in dogs at age 2.5 years decreased as the proportion of auditory experiences a dog had at 12-13 weeks of age increased (odds ratio [OR] 0.12, 95% confidence interval [CI] 0.02 - 0.85, p=0.034). A smaller effect of the exposure was observed at 12-15 weeks of age (OR 0.17, 95% CI 0.03 - 1.02, p=0.056), and no apparent effect at 16-19 weeks of age (OR 1.06 , 95% CI 0.13 - 8.96, p > 0.9).

The proportion of auditory experiences a dog had between 12-13 weeks of age was found to have a preventive effect on dogs' fear of fireworks at 2.5 years. This highlights the benefit of providing puppies with a variety of auditory experiences up to and around 13 weeks of age. Future work will look into the effect of owner-management strategies on fear of fireworks in adult dogs.

Object peference and social interaction in Gifted Word Learner and typical dogs

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Companion dog, Cognition, Behavior, Interaction with humans

Labeling elicits infants' attention towards objects, that is, infants look longer at labelled images compared to unlabeled ones. Gifted Word Learner dogs (GWLDs) possess the capacity to acquire an extensive vocabulary of object labels through social interactions with their caretaker. Typical (T) dogs do not show this capacity. Dogs are typically neophilic, but it is unknown whether T and GWLDs differ in their preference for novel, labelled, and familiar but unlabelled objects.

Do T and GWLDs differ in their preference for labelled, unlabelled, and novel objects? Based on dogs' neophilia, T and GWLDs would show equal interest in novel objects. Moreover, based on the social context in which GWLDs learn labels, we expected that they would use the novel objects to seek their caretaker's attention. In analogy with labelling in infants, we expected that GWLDs show a higher interest in the familiar labelled objects compared to T dogs.

We recruited 21 T and 10 GWLDs. Before testing, a familiarization phase was conducted, during which the caretaker and the dog played with four objects– labelling only two of them and without giving names to the remaining two. For the test, these 4 and 2 novel objects were placed on the floor. The dog was allowed to interact with the objects freely for 90", while the caretaker remained passive. This procedure was executed twice, with two different sets of novel objects. We measured the duration and frequency of interacting with each type of objects and the caretaker.

T and GWLDs spent the same time with the novel objects ($p = 0.301$; $p = 0.731$). GWLDs spent more time attempting to interact with their caretakers while holding an object in their mouth in both trials ($p = 0.008$; $p = 0.012$). GWLDs also preferred to offer the novel object to their caretakers in both trials ($p = 0.007$; $p = 0.003$). In the first trial, GWLDs interacted less frequently ($p = 0.075$) and spent less time ($p = 0.034$) with the unlabeled objects than T dogs.

Despite the passive caretakers, GWLDs exhibited a greater interest in the social aspect of the experiment and even presented a novel object to them. Like infants, they show less interest in unlabeled objects compared to T dogs but only during the first exposure. As in a previous study, we corroborate that GWLDs exhibit higher levels of playfulness, which may contribute to their ability to learn labels.

Mechanisms of boldness and related traits in subspecies of Gray Wolves (Canis lupus)

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Wild canids, Ecology, Behavior

Boldness is an intensively studied phenomenon across animal taxa. Variation in boldness can lead to different adaptive strategies that intercorrelate with diverse behaviours. Personality traits such as extraversion and curiosity are correlated with bold behaviour. Although personality traits are well studied in many species, there is little data in wolves.

Is there more group-specific than subspecies-specific variation in boldness and personality between Eurasian wolves (Canis lupus lupus) and American wolf subspecies (Canis lupus arctos, Canis lupus lyacon)? Does bold behaviour lead to more social feedback mechanisms compared to other behaviours?

We used an apparatus to test for differences in and consequences of novel object interactions in seven different groups of wolves of different subspecies (SSP). (n=23) as well as five groups of wolf-hybrids (WH) (n=10) of the respective SSP. We accessed personality using questionnaires which have already been tested in wild canids (DOGS, MCPQ-R). We used LME, correlation matrices and non-parametric ANOVAs to test for intra- and interspecific differences. To examine the consequences of bold behaviour in Eurasian wolf (EUW) groups, we used Markov chain models for probability analyses as well as Kruskal-Wallis-test with post-hoc comparisons to test for differences on the probability of a prosocial behaviour chain regarding bold and individual behaviour in Eurasian Wolves.

In EUW, bold interactions were more often responded to with prosocial behaviour than other behaviours ($X^2 (2)=6.42, p=0.04; v= 0.63$). The subspecies comparisons showed significant differences in boldness ($R^2= 0.44, p=0.002$; $X^2 (6)=90.72, p=<0.00001$) as well as in related personality traits between subspecies, both between pure wolves and wolf hybrids. The interspecific differences were more significant than the differences between groups or at the individual level, suggesting that subspecies ecology and selection pressure in SSP history might have caused long-lasting adaptations in Canis lupus.

We suggest that differences in boldness and related traits in different wolf subspecies might be due to variation in risk-avoiding traits over a long period of time of the respective SSP and could be linked to the conditions and challenges of their habitat as well as associated survival and dispersal decisions. However, according to our results, boldness is still promoted in shyer subspecies, potentially because of the benefits that individual bold actions can implicate for the group.

Can we predict adult personality from 4-7 month-old puppies?

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Cognition, Behavior

The accurate assessment of puppy personality and cognition as early as possible would give important tools for the owners to guide their training, as well as recognition of potential problem behaviours (e.g. fearfulness) as early as possible.

Our aim was to investigate whether the behavior of 3-7 month-old puppies in test battery correlates with adult behavior, both at test situation, and at home.

We tested puppies (3-7 months, mean 5 months) using the smartDOG™ PUPPY test battery, and later sent questionnaires (CBARQ, DIAS, N=235) to owners to investigate the everyday behaviour of the same dogs as adults (median age 26 months). In addition, 84 dogs took part in the smartDOG™ COGNITION test both as a puppy and as an adult (mean age 24 months), and therefore we were able to investigate the correlation between the PUPPY and COGNITION test results. Both test batteries include shyness-boldness variables (reaction to unknown person and exploration in a novel space), activity (Fitbark measurement during test), as well as cognitive tests: cylinder test (inhibitory control), human gesture test, problem solving (V-detour), social learning and unsolvable task.

Shyness-boldness variables correlated strongly between the two time points (PUPPY and COGNITION test; Sociability $P<0.001$, N=83; exploration $P<0.001$), and also between sociability in the PUPPY test and human-directed fear as adults ($P<0.001$). Cylinder test results correlated between the PUPPY and ADULT test ($p=0.025$), and puppies that showed impulsiveness in the PUPPY cylinder test were also more impulsive at home as adults (higher DIAS, $P=0.04$). Similarly, more impulsive in the PUPPY cylinder test (more impulsive) were more energetic as adults (CBARQ, $P=0.04$). Dogs which were good at understanding human gestures in the PUPPY test did so also in the adult COGNITION test ($P=0.002$) and were also evaluated as having better trainability as adults (CBARQ, $P<0.001$,) by their owners. The more independently dogs behaved (unsolvable task) in the PUPPY test, the more independent they were also as adults ($P=0.019$). Finally, time to solve the V-detour ($P=0.001$,) and general FitBark activity ($P=0.015$) were also correlated between PUPPY and COGNITION test batteries.

At the age of 3-7 months, we can already predict adult personality features, such as shyness-boldness, impulsiveness, activity, independence in problem solving, and even trainability using a simple and dog-friendly test battery. Knowledge of puppy personality features can guide training towards the correct direction. This may also give early selection tools for working dog training.

The hierarchical structure of canine cognition: two domains and a general cognitive factor

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Companion dog, Cognition

Research on general intelligence or g in animals is mostly limited to laboratory settings. Dogs are adapted to the human environment and could become a new model species for studying the evolution and environmental correlates of human g. However, a convincing demonstration of the canine g is still missing.

The main goal of this study was to analyze the correlational structure underlying individual differences in dog cognition and validate the emerging factors with internal and external measurements.

We tested 129 pet dogs of various breeds (age: 3-15 years) in a test battery that included seven tasks measuring various cognitive abilities: 1) following human pointing gesture, 2) persistency in object manipulation, 3) one-trial learning in clicker game, 4) success in problem-solving, 5) sustained attention toward moving object/human, 6) associative learning when training for eye contact with a human and 7) short-term spatial memory. The dogs also participated in tests assessing their exploratory behaviour and neophilia, and a subset of dogs (N=60) in an independent assessment of their discrimination and reversal learning skills.

The performance in five cognitive tasks correlated positively with each other, forming a positive manifold. Exploratory and confirmatory factor analyses revealed a hierarchical structure of dogs' cognitive skills, with two domain-specific factors related to associative learning and individual problem solving, and a higher-order factor (g) at the apex, which explained 42.8% of the total test variance. The cognitive structure was not affected by the age of the dogs. The g score was positively related both to the exploratory behaviour and neophilia of the individuals, and to their discrimination and reversal learning skills.

Our results provide conclusive evidence that the individual differences in cognitive skills in dogs can be characterized by a domain-general cognitive factor which is similar in content and structure to the human g. These findings open the door for using dogs in comparative research that models intelligence in its full complexity.

The Dog Aging Project Brain Health Study – A nationwide effort to study companion dogs with cognitive dysfunction as a model of Alzheimer's disease

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Companion dog, Comparative research, Cognition

Companion dogs mirror several key aspects of human aging and age-related disease that cannot be easily replicated in a laboratory setting. Notably, they are genetically heterogeneous, share the human environment and its various risk factors, receive comparable medical care, and have extensive clinical data available. Like humans, companion dogs also spontaneously develop many age-related diseases. One such disease is Canine Cognitive Dysfunction (CCD), a progressive neurodegenerative disease that mirrors several key aspects of human Alzheimer's Disease (AD): Dogs with CCD show progressive loss of cognitive function, loss of normal sleep patterns, failure to recognize familiar persons, and increased anxiety, and similar to human AD patients, they develop Amyloid-beta 42 ($A\beta42$) and at least some degree of hyperphosphorylated Tau (pTau) pathology in their brains.

$A\beta42$ and pTau can be measured in canine brains through quantitative Luminex assays, can be characterized neuropathologically through IHC, and correlate with the clinical cognitive phenotype of dogs as measured by standardized questionnaires.

As part of the larger Dog Aging Project (DAP; dogagingproject.org), the DAP Brain Health Study is collecting post mortem brains from dogs with known cognitive status that are euthanized for medical reasons, as well as blood and cerebrospinal fluid from live dogs with known cognitive statuses. These samples are being analyzed using both neuropathology and molecular assays in order to elucidate the biomedical processes that are present in dogs with CCD. Brain and CSF samples are also being biobanked and will be made available to other researchers.

Preliminary data shows that $A\beta42$ and cognitive phenotypes are significantly correlated. A rapid post mortem infrastructure has been implemented, focusing on a maximum post mortem interval of 12 hours. A professional communications team is working to manage owner communication and engagement. This talk will focus on the background and logistics of setting up and running a large-scale study on privately owned companion dogs.

Post mortem dog brain samples in combination with the rich environmental and clinical data generated by the Dog Aging Project will enable us to further characterize the parallels to AD in humans, to establish biomarkers, and to potentially test the effect of proposed interventions such as rapamycin on cognitive aging.

Unwilling or Unable? Using 3D tracking to evaluate dogs' reactions to differing human intentions.

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Comparative research, Cognition, Behavior

Whether dogs understand the intentions underlying human actions is still a topic of debate. The unwilling-unable paradigm has been developed to examine whether nonhuman animals are sensitive to intentions underlying human actions. In this paradigm, subjects tended to show more patience toward a human that appears willing but unable to transfer food to them compared to an unwilling (teasing) human.

In the current study, we addressed the question whether dogs differentiate between actions signalling unwillingness vs. inability. Additionally, we investigated whether this distinction could also be identified using machine-learning driven 3D tracking. In a follow-up experiment, we explored whether the dogs' differing reaction would transfer to subsequent preference and point-following tasks.

In the first experiment, pet dogs (N=48) encountered a human who gave them treats. Sometimes the food transfer failed, however, either because the human acted as if she was unwilling (by pulling back the treat in a teasing manner) or because she was unable to do so (by clumsily dropping the treat). We used traditional video scoring as well as machine-learning-driven 3D tracking to record dogs' reactions to the failed food transfer. In a second, we presented dogs (N=48) again with the unwilling-unable paradigm but this time two different experimenters performed the unwilling-teasing and unable-clumsy conditions. In subsequent preference and point-following transfer tasks, we examined whether the dogs had acquired a preference for the willing but unable experimenter over the unwilling experimenter.

Throughout the two preregistered experiments, we found evidence, in line with our prediction, that dogs reacted more impatiently to actions signalling unwillingness to transfer food rather than inability. We found a number of behavioural markers that evidenced this distinction (e.g., they spend significantly more time away from the experimenter in the unwilling than unable condition, $p < 0.001$). These behavioural differences were evident also in the machine-learning generated 3D tracking data ($p < 0.001$). However, in the transfer tests, we found no evidence that the dogs acquired a significant preference for one of the experimenters over the course of the experiment.

Our study highlights the sensitivity of pet dogs to subtle differences in human actions consistent with intention-reading abilities. We discuss different cognitive mechanisms that might underlie dogs' performance in this paradigm.

Human-dog play behaviour: how body language and nonverbal cues are key to clarity in human-canine communication

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Companion dog, Behavior, Canine welfare, Interaction with humans

Play behaviour observed in both puppy and adult domestic dogs (Canis familiaris), occurs socially with conspecifics and humans and asocially with objects. It is enigmatic, and its function is debated. Play behaviour is linked to a range of goals, such as; developing motor skills, enhancing problem-solving skills, and building social cohesion. However, it is also associated with practicing/learning skills required for predatory encounters, agonistic interactions, and courtship. Studies suggest that intraspecific social play might be structurally different from interspecific play. Dogs' playfulness, in social contexts, might be selected during domestication as an adaptive trait to facilitate the formation of emotionally-based bonds between dog and owner. Play frequency and form may therefore indicate the quality of dog-owner relationships.

This study aims to study humans' "play behaviour" as seen in social media and dogs' responses to it.

Two authors searched (04/23) video-sharing platforms/google using three strings "man/woman/child play dog video". The cut-off was set on the 10 most popular videos for each of the search string (2/YouTube,11/IStockphoto,1/Vecteezy,2/Shutterstock,7/Pexels,7blogs); range 5-59/sec./video, showing "playing" between humans (20/adults,8/children,2/infants;16/male,14/female) and dogs (11/dogs<30cm,4/dogs30-45cm,15/dogs>45cm).

Continuous observation showed that the most frequently shown human play behaviours targeting dogs, included: leaning-into/standing-over the dog (53.33%), smile/showing teeth (50%), placing face against the dogs' face (33.33%), touching/stroking the dogs' back/body with hand (60%), directing head gestures at the dog (26.67%), luring the dog with a toy/treat (33.33%), and grabbing and squeezing the dog's throat with hand (43.33%). Most frequently shown dog behaviours during play were; turning head/looking away (50%), panting (60%), licking their nose/lip (13.33%), licking/human (10%), ears back (53.33%), and biting (13.33%). In 46.67% of the video's the dogs tail was not filmed and in 20% the tail was immobile during the video fragment, in 20% we saw a wide high tail movement. Only one dog showed a play bow.

This study revealed significant causes for welfare concerns. One of the main functions of human-dog play is creating and strengthening the bond between species, however our results revealed a high number of stress behaviours which may occur due to miscommunication/misunderstandings during human/canine play directed behaviour. People may not understand/comprehend the information their dog is giving to them, which may result in (repeated) situations which cause their dog discomfort/anxiety/fear/distress, and may result in a fractured human/canine bond, welfare issues for the dog, and the possibility of a dog reacting defensively when communication fails. This warrants further investigation.

Automated video-based monitoring of sheltered dogs welfare

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Stray/shelter dog, Canine welfare

Even for the most well-adjusted dogs shelters can be an uncomfortable, stress-inducing environment, restricting contact and interaction with the outside world. Various protocols to evaluate shelter dog welfare have been proposed. However, the immense variability and difficulty of properly assessing the impact of potential individual stressors, as well as limited shelter resources make it difficult to implement these protocols in practice. Automated video-based monitoring of shelter dogs' behavior present an attractive alternative due to its non-invasiveness, cheap resources and the ability to process large volumes of data with precision and consistency. However, the crucial questions then become how and what to measure in order to produce useful, actionable insights which can support decision making by shelter staff.

Automated video-based analysis is a feasible and useful tool in the context of animal shelters for monitoring dog welfare.

We describe and reflect on: (1) A completed study focusing on changes in dog activity levels before COVID-19 and during COVID-19 using an automated video analysis within a large, open-admission animal shelter in New York City, USA. Activity was analyzed during two two-week long time periods: before and during COVID in a sample of 34 dogs. (2) Another ongoing study focusing on behavioral profiles of a sample of 20 dogs within a small animal shelter in Lod, Israel. Activity and behavior is analyzed during two-week long period: with and without Kong toy in the cell.

In the first study, significant differences in the patterns of shelter dog activity were observed: less activity was observed in the afternoons before COVID-19 restrictions, while during COVID-19, activity remained at a constant average. In the second study, the concept of `behavioral profile' of shelter dogs is developed, which remains consistent across days, but may change with introduction of new stimuli such as enrichment.

Solutions to monitor behavior and evaluate the welfare of shelter dogs need to be practical, cost-effective, and easy to implement by busy shelter management teams. We hope to start a fruitful on the challenging issue of automating shelter dog behavior assessment and monitoring, and how to turn raw data into actionable insights that will promote shelter dog welfare.

PECHA KUCHA
TALKS

Do dogs attribute goal-directedness to robots?

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Cognition, Behavior

Studies show that three-month-old human infants attribute goal-directedness not only to humans but also to animate objects. Adult dogs also expect human actions to be goal-directed, but it is unclear whether animate motion alone can lead to such attribution in dogs as well. Using artificial agent as actors allows investigating the effect of specific motion cues, without the potential influence of embodiment.

Here we tested whether dogs attribute goal-directedness to a robot showing interactive behaviour, animate or inanimate motion, and we included a human actor as control. We expected that animate motion alone leads to goal-attribution, but not inanimate motion.

First, dogs observed the behaviour of the specific actor (between-subject design; N=20/group): (1) the inanimate robot moved with constant speed, without visible starts, turns and stops; (2) the animate robot displayed self-propelled motion, it visibly started and stopped, accelerated and decelerated, and changed its motion direction aligning its heading; (3) the interactive robot followed the commands of a human (stay, come here), who petted and praised the robot when it obeyed; and (4) the human actor had the same motion as the animate robot. Following this, we placed two objects in the room, and the actor approached one of them repeatedly (10 times; Demonstration phase). Then, we changed the location of the two objects, and three times the actor approached the previous object (same object) and three times the other object (same route) (counterbalanced order; Test phase).

Preliminary results (N=53) show that irrespectively of the group (p=0.857), dogs looked at the event in the first three trials of the Demonstration phase longer than in the last three trials (p<0.001) or during the test (same route: p<0.001; same goal: p=0.004); no other differences were found (ps>0.9). However, in the Test phase, dogs looked longer at the goal object when the actor approached the non-goal object (p=0.01), again irrespectively of the specific actor (p=0.218).

Although dogs did not regained their visual interest either when the actor changed its goal or the route, the human/robot moving to a novel object seemed to violate dogs' expectation. Thus, we found indication of the attribution of goal-directedness to robots, even following a short (ca. 90 s), indirect experience with a novel partner. Considering that dogs behaved similarly in case of the inanimate robot as in the other groups, motion alone may be sufficient to elicit such attribution, even without animacy cues, but further studies are needed.

Breed and individual differences in learning in purebred pet dogs

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Companion dog, Cognition, Behavior

Breed-differences in learning processes have not yet been fully explored.

The current study's objective was to identify fundamental learning differences across and within breed clades. We hypothesized that 1) breed clades will differ in basic learning tasks, 2) within-breed differences will be predicted by dog demographics and owner-reported measures, and 3) learning task performances will correlate with owner-reported measures.

Pet dogs (n=93) from five breed clades participated in a virtual learning test. Owners completed the Dog Impulsivity Assessment Scale (DIAS) and the Canine Reward Responsiveness Scale (CRRS) prior to the test. The learning task consisted of sessions of acquisition (nose touch to hand), discrimination (nose touch to one of two hands), reversal learning (nose touch to opposite hand), and extinction (nose touches not rewarded). An exploratory factor analysis of outcome measures revealed a three-factor solution explaining 76.96% of the variance: 'difficulty in discrimination', 'difficulty in reversal learning', and 'resistance to extinction'. Generalized linear models (GLM) were used to determine whether factor scores are predicted by breed clade, sexual status, age, CRRS, and DIAS. To determine within-breed differences, separate GLMs were conducted.

Breed group ($\chi^2(4)$=11.479, p=0.022), sexual status ($\chi^2(3)$=9.240, p=0.026), and age ($\chi^2(1)$=5.547, p=0.019), had significant impacts on difficulty in reversal learning but in no other outcomes. Herding and Retriever dogs experienced more difficulty in reversal learning compared to Mastiffs ($\chi^2(1)$= 5.003, p=0.025; $\chi^2(1)$= 7.112, p=0.008, respectively). Neutered males and spayed females had better reversal learning compared to intact females ($\chi^2(1)$= 8.904, p=0.003; $\chi^2(1)$= 8.253, p=0.004, respectively). Within-breed GLMs revealed that breed clades had varying factors influencing their learning outcomes. Older Mastiff and Herding dogs had higher resistance to extinction ($\chi^2(1)$= 5.410, p=0.020; $\chi^2(1)$= 6.642, p=0.010, respectively), while older Retrievers showed less resistance to extinction ($\chi^2(1)$= 4.501, p=0.034). Ancient and Mastiff dogs with higher DIAS had more difficulty with discrimination ($\chi^2(1)$= 6.101, p=0.014; $\chi^2(1)$= 5.524, p=0.019, respectively), while GSDs with higher DIAS had better discrimination ($\chi^2(1)$= 7.430, p=0.006). Ancient and Herding dogs with higher food responsiveness showed higher resistance to extinction ($\chi2(1)$=4.532, p=0.033; $\chi^2(1)$=4.086, p=0.043, respectively), while GSDs showed less resistance to extinction ($\chi2(1)$=4.727, p=0.030).

Results revealed both between and within-breed differences, depending on the type of learning ability being evaluated. Owner-reported measures predicted more within-breed rather than between-breed measures. Different breeds may have different learning profiles, which may be further influenced by factors such as age, food responsiveness, or impulsivity but not always in the same direction.

Using mobile eye tracking to study spatial navigation in guide and pet dogs

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Companion dog, Assitance/therapy/working dogs, Cognition

Guide dogs for the blind help visually impaired people navigate safely through complex environments during their everyday activities. During their training they learn to assess different situations and indicate or avoid ground, side and height obstacles. For the handler to better perceive the dogs' signals, guide dogs wear specially designed guide harnesses.

In this study, we administer mobile eye tracking to address the question how guide and pet dogs perceive potential obstacles in their surroundings. We predict that guide dogs will gaze longer at the obstacles than pet dogs and do so even when the objects only obstruct the path of the human handler which might indicate that their visual attention is attuned to such obstacles. We predict that they will look longer and more frequently at the obstacles when they are wearing the guide harness compared to when they walk on a leash. We also predict that guide dogs recognize relevant obstacles and will look at them longer than at irrelevant distractors.

We aim at testing 20 guide and 20 pet dogs, which are habituated to wearing a mobile eye tracker. The experiment will take place at the Clever Dog Lab Vienna where the dogs will go through an indoor obstacle course while wearing the mobile eye tracker. We will administer two sessions of 8 trials each for the guide dogs and one session for the pet dogs. In addition to the leash condition, the guide dogs will be wearing their guide harness in a second condition. Each trial will involve three obstacles, which will either be ground, side or height obstacles and will be either on the side of the human or the side of the dog. Additionally, there will also be distractors which will not obstruct the path. During the trials, the dogs wear a mobile eye tracker, which allows us to record when the dogs gaze at the obstacles and distractors while navigating through the obstacle course.

The data collection is currently ongoing, first data will be available at the conference. The looking time to the obstacles will be analysed as well as the dogs' behavioural reactions (e.g, avoidance of the obstacles or stopping).

The findings can inform guide dog training and handling, by providing insight into how specialized training and "off-duty" signals affect guide dogs' processing of environmental information and behaviour compared to pet dogs.

A neural marker of object label understanding in family dogs

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Companion dog, Cognition, Interaction with humans

Dogs' ability to understand referential communication has been widely studied using pointing and gazing, however, whether this understanding extends from human nonverbal to verbal communication is controversial. fMRI studies provide emerging evidence for lexical processing in dogs, at least for praise words. However, recent behavioural studies indicate that only a handful of dogs are capable of acquiring a large vocabulary of object labels, while typical family dogs perform at chance level when tested on their ability to match object labels to their referents, even after extensive training. Indeed, human and animal studies indicate that using only performance measures may be insensitive to capture implicit knowledge effects, thus neuroscientific measures could be more adequate to demonstrate dogs' passive understanding of spoken words.

We hypothesized that even though most dogs do not perform above chance in object-to-name matching behavioural tests, a passive understanding of object names may be a more general capacity among dogs and thus may be measurable using more sensitive neural methods. Therefore, the aim of our experiment was to search for neural evidence of dogs' ability to associate verbal object labels to their referents. We predicted that if present, this ability would be reflected in different brain responses measured by electroencephalography (EEG) in a match-mismatch paradigm.

Event-related potentials (ERPs) from 19 dogs were analysed. Stimuli were personalized for each dog. We asked owners to select five objects, from which at least three labels are known by their dog. During the testing sessions, we first presented to the dogs the object labels embedded in sentences recorded in full by their owners (e.g. "Rohan, look, the ball"). Then we visually presented either an object matching to the label mentioned in the sentence or a mismatching object, and measured dogs' brain responses from the onset of object presentation.

We found a significant difference in dogs' brain responses between the match and the mismatch condition on the frontal electrode (bootstrap median p < 0.001). The window of our effect is comparable to the human semantic N400 effect, which is widely regarded to be an index of semantic processing. Interestingly, however, the polarity of this effect in dogs was the reverse of what is typically seen in human semantic N400 studies.

Our results provide the first neural evidence that even dogs whose name-to-object matching behaviour remains at chance may understand that words can refer to specific objects.

Effect of positive mood on learning and stress resilience in dogs

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Behavior

Learning capability and stress resilience can be influenced by several factors in dogs. However, prior research has found mixed results regarding the effects of positive short-term experiences, or induction of a positive mood state, on subsequent behaviour.

Our goal was to assess the impact of a positive mood state on learning and stress resilience in dogs. We hypothesized that a pre-session positive experience would result in dogs learning faster and having a shorter latency to return to the task in the presence of a disruptor.

Pet dogs were randomly assigned to the experimental (n=20) or control (n=20) group, counterbalanced for age, sex and breed group. Experimental dogs received a structured 15 min walk on a 4.5m leash where they could explore, forage for treats, play with toys, and interact with their owner or two experimenters. Control dogs were kept on leash in an office next to the testing room, without being allowed to explore or interact with their owner or two experimenters for 15 min. After 60 s of habituation to the testing room, dogs were taught to nose-touch the experimenter's hand. After the Acquisition phase, there was a 2 min Disruption phase, in which a remote-controlled car moved inside of a tub at a distance. Measures included the number of hand touches in each phase, the latency to return to the task, and general stress and affiliative behaviour.

Dogs in the experimental condition did not show improved learning nor resilience ($ps > 0.10$). Surprisingly, after the disruption started, experimental dogs exhibited a higher proportion of stress signs ($U = 112.5$, $p = 0.018$), spent a higher proportion of time in proximity to the owner ($U = 120$, $p = 0.015$) and showed a tendency to be slower returning to the task ($U = 130.0$, $p = 0.060$). Moreover, control dogs ($M = 12.10$, $SD = 5.44$) exhibited a higher frequency of hand touches during this phase ($t[38] = -2.06$, $p = 0.046$) compared to experimental dogs ($M = 8.40$, $SD = 5.88$).

A short positive experience may be insufficient to improve learning and resilience. The positive experience may have created a contrast effect leading dogs to show higher stress. Alternatively, the control procedure may have resulted in a more thorough habituation to an indoor environment. More research is needed to further explore the effects of mood on dog behaviour.

No bones about it: The effect of chewing on cognition in dogs

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Cognition, Canine welfare

Chewing is naturally rewarding to dogs and is used as a coping mechanism for stress. However, no work to date has examined the possible enriching effect of chewing on cognition in dogs despite strong relationships shown in other species.

The aim of the current study was to determine the effect of chewing on cognition in dogs. We expected that higher levels of chewing would positively predict memory performance on two memory tests but that this relationship would be more pronounced in dogs with high trait anxiety.

Dogs (n=32; F=12) were assessed on two memory tests on separate days. For the working memory test, dogs were first required to correctly locate a treat hidden in one of three buckets with a 1 second delay on 4/5 trials. Immediately after, dogs were given chew toy access for five-minutes. Then delay testing started with three trials at steps of 15, 30, 60, 90, 120, and 150 seconds in which dogs had to get at least 2/3 trials correct to advance to the next delay. The dependent measure was maximum delay reached (MDR). For the maze test, dogs were first required to correctly navigate a maze with three "error areas" by reaching the finish line without committing any errors, before beginning the chew period. Then the maze test started in which dogs had to demonstrate relearning of the maze by meeting the same criteria. The dependent measure was trials to relearn the maze. Chewing audio, extracted from video footage and quantified using a convolutional neural network (CNN), and trait anxiety, assessed using a validated survey, were compared to memory test performance.

For the working memory test, we found an interaction between trait anxiety and frequency of bites (p = .028) such that in dogs with high levels of trait anxiety, a higher frequency of chewing showed a higher MDR while in dogs with low levels of trait anxiety, a higher frequency of chewing showed a lower MDR. For the maze test, we found that maximum bite intensity negatively predicted the number of trials to relearn the maze (p = .009).

These results suggest that chew toy access has positive benefits on cognition, especially in dogs with high trait anxiety. These findings should be considered when determining enrichment strategies for dogs whose behavioral issues may have a cognitive basis (e.g., poor memory for commands or impulsively chewing household items).

A human-analogue approach towards diagnose canine ADHD: a novel questionnaire and a behavioural test battery

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Companion dog, Comparative research, Behavior

Dogs can exhibit neuropsychological deficits similar to Attention-Deficit/Hyperactivity Disorder (ADHD) symptoms in humans. To date, questionnaire methods have mostly been used to assess ADHD-like behaviours and its correlates in dogs, mainly on typical dog populations. While impaired functioning is a diagnostic criterion for human ADHD, its measurement has been neglected in canine ADHD assessments, for which there is currently no validated diagnostic method for dogs.

We aimed to develop and validate a detailed, psychometrically improved questionnaire to assess owner and trainer views on ADHD-relevant dog behaviours. As in modern human assessments, we expected that hyperactivity and impulsivity can be separately measured in dogs. We also aimed to develop a simple behavioural test battery, covering the ADHD symptom domains (inattention, hyperactivity, impulsivity). We expected that the subtests assessing the specific ADHD domain will correlate with the relevant questionnaire scores (e.g., activity test with hyperactivity).

We modified available questionnaires by adding items that allow for separate analysis of impulsivity, and items on functional impairment. We collected data from N=1168 owners for different validation steps of the new questionnaire and, similarly to assessment of humans where teachers also evaluate as an expert control, we collected data from dog trainers (N=70). The behavioural test battery (N=67) consisted of four subtests covering the ADHD symptom domains: activity test (hyperactivity), impulsivity test (impulsivity), sit task (hyperactivity and impulsivity), attention test (inattention).

Exploratory and confirmatory factor analysis revealed 3 factors: inattention (IA), hyperactivity (H) and impulsivity (I), covering all the three human symptom dimensions in dogs. Similarly to human findings, trainer-owner rating comparisons showed fair (IA) to moderate (H, I) agreement. As in humans, greater ADHD scores were associated with greater functional impairment scores (r=0.634, p<0.001). Behavioural tests correlated with the ADHD factor scores: activity test-H (r=0.545, p<0.001), impulsivity test-I (r=0.483, p<0.001), sit task-H (r=0.512, p < 0.001), attention test-IA (r=-0.470, p=0.005).

Our findings support the validity of our novel human-analogue questionnaire for dogs, and that functional deficits are positively connected to ADHD traits reported by the owner, suggesting that dogs with extreme phenotypes of ADHD traits indeed present functional impairments. Behavioural tests have also validated the questionnaire and are able to assess ADHD symptoms. The combined use of the questionnaire and behavioural tests provides an opportunity to diagnose dogs with ADHD. Future studies will focus on defining diagnostic criteria.

Deciphering dogs' facial and postural mimics according to emotional contexts

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Companion dog, Behavior, Interaction with humans

While dogs share our lives for thousands of years, there is still a need for us to better understand them, in order to improve their welfare. Indeed, some studies showed that persons confuse sadness with disgust or surprise with fear, meaning that dogs' facial and postural expressions are still poorly identified by owners. However, being able to recognize the emotions expressed by our companions is crucial to facilitate our interactions with them, promote positive states and reduce negative emotions.

In this context, our study aimed at deciphering and validating the facial and postural mimics expressed by dogs according to a provoked emotional specific context.

55 dogs (14 unneutered females, 11 neuter females, 14 unneutered males and 16 neuter males) from seven months to 10 years old of various breeds such as Labrador, Australian Shepherd, White Shepherd, Dachshund were recruited at the National Veterinary School of Alfort (France) and tested in six situations of daily life: departure of the owner, interaction with a stranger in the absence of the owner, reunion with the owner, games with the owner, positive anticipation by waiting 15 seconds before giving access to a treat and lastly frustration by locking a treat in a box for 1 minutes. The test lasted about fifteen minutes and all the situations were filmed and behaviours quantified using the BORIS software. Statistical analyses were carried out with R software, with Anovas comparing situations and post-hoc tests

First results were analysed from 30 dogs. The behaviors scratch, yawn, blow and sniff appeared significantly more in the frustration situation than in all other situations ($p \leq 0.0495$). Similarly, the behaviors white eyes, gaze and whimper appeared significantly more in the "stress" situation (i.e. absence of owner; $p \leq 0.0001$). The behavior of flattened ears appeared significantly more in the situation of reunion with the owner ($p \leq 0.002$). In this reunion situation, the nose licking behavior appeared significantly more than in the situations of "stress", frustration or interaction with a stranger ($p \leq 0.0278$) and the "ears forward" behavior appeared significantly more than in the situation of play or in that of "stress" ($p \leq 0.0331$).

We find similarities with existing literature such as white eyes and vocalization in stressful situations, but also new information such as blowing behavior in a frustration context or nose licking in reunion with the owner. Further investigations need to be undergone to determine whether factors could influence these results, such as the size or breed of the dog, or its personality.

Preliminary evidence of retention of object labels for 2 years by Gifted Word Learner dogs

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Cognition

Dogs with an extensive vocabulary of object names (Gifted Word Learner –GWL– dogs) are a model for studying language-related cognitive skills, but little is known about the process by which such exceptionally large vocabulary is formed. Successful vocabulary formation requires pairing a word to its referent and then consolidating this pairing to form a stable memory trace, that can be retained over long periods. Previous studies found that GWL dogs can rapidly learn and remember object labels for up to two months, which raises the question whether they could remember for longer periods of time.

We investigated GWL dogs memory of object-labels learned in 2 weeks, for up to 2 years. Based on their rapid learning speed and on the extensive vocabulary that GWL dogs acquire in relatively short time-frames, we hypothesise that they consolidate object verbal labels and retain those for considerably long periods of time.

We present preliminary data on N=3 GWL dogs tested on their memory of verbal labels of 12 toys learned in one week, two years prior this experiment. Successful acquisition of these verbal labels and two-months-long memory of these were tested in 2021 (Dror et al. 2021). For 2 years after this test, the dogs no longer had access to those toys. In 2023, we tested the dogs memory of the verbal labels of the toys that were still available (5-12 toys for different dogs). The tests were conducted remotely, with an online software. The owner asked the dog to fetch the toys ("Go find !") in a randomised order. Each toy was requested twice. The number of toys available for the dogs to choose from varied between 6-4.

Two dogs, Gaia and Rico, performed above chance, successfully retrieving 9 out of 12, and 3 out of 5 toys respectively (Binomial probability P=0.014 and P=0.001). Squall, the third dog, retrieved 4 out of 11 toys (Binomial probability P=0.5). Rico retrieved the requested toys in 6 out of 10 trials, Gaia in 13 out of 24 trials and Squall in 5 out of 22 trials.

This study provides preliminary evidence that GWL dogs remember object verbal labels, learned in a relatively short time and with limited rehearsal, for up to two years. The results shed light on the process by which these dogs acquire an exceptionally large vocabulary of object names and corroborate their validity as a comparative model for studying language-related cognitive skills.

Hearing abilities in dogs: detection and localization of sounds using a staircase method

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Companion dog, Behavior

Dogs' auditory abilities have mainly been studied using electrophysiological methods. However, in both dogs and humans, thresholds found using different methods are different, as well as their inter/intra-individual variability and biological significance. Indeed, only psychoacoustics methods may assess the entire process of sound perception and, to date, only two studies were applying these methodologies to dogs.

The aim of this study was to develop a behavioral methodology to expand our knowledge regarding dog's auditory abilities, allowing also assessment of possible improvement of thresholds' estimation across exposures.

Two procedures were developed in order to determine hearing threshold at three specific frequencies (0.5, 4.0 and 20.0 kHz), and dogs' sound localization capability in the azimuthal plane. Dogs were initially trained to discriminate a pure tone or a white noise, respectively for hearing threshold and sound localization procedure in a two-alternative forced-choice paradigm. Then, for the assessment of hearing threshold, the intensity level of the pure tone was systematically manipulated from 70 to -3 dB SPL. For the assessment of sound localization, two identical speakers were progressively displaced from 120 to 1° of separation. For both procedures, dogs performed descending and ascending assessment using the staircase method, where the intensity level or angle of separation of a set of trials is determined according to the previous performance of the dog.

Hearing thresholds were assessed in 5 dogs per each frequency. The hearing thresholds found were 19.5 ± 2.8 dB SPL at 0.5 kHz, 14.0 ± 4.5 dB SPL at 4kHz, 3.5 ± 12.8 dB SPL at 20 kHz, and were similar to the ones found in the behavioral and electrophysiological studies. However, the electrophysiological methods may often not perform frequency lower than 1 kHz due to technical issues, and have bigger inter-individual variability. The Minimum Detectable Angle (MDA) of sound localization was estimated in 10 dogs, and was found at 7.6 ± 3.4° with an improvement linked to exposure.

Taken together, results indicate that a staircase method is a feasible approach for assessing hearing abilities in dogs, with low inter/intra-individual variability and with a sensitivity of 3 dB SPL for hearing threshold and 1° for MDA. Our results also highlight an improvement across time, underlining the necessity to give enough repetitions to allow a stable estimation of thresholds in a sensory discrimination task.

Providing a Choice: Individual Dogs' Preferences for Activity-based Environmental Enrichment in an Animal Shelter

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Environmental enrichment (EE) has been shown to improve the welfare of dogs in animal shelters. However, little is known about individual preferences. Preference assessments, which have been used to assess object-based EE, may also be valuable for directly measuring the preferences of dogs for activity-based EE.

In this study, we aimed to investigate whether 1) we can identify individual preferences for activity-based EE in dogs housed at an animal shelter, and 2) how much training is required to identify a preference.

Six dogs, housed in an animal shelter, participated in two experimental phases: a choice phase and a control phase. In the choice phase, dogs were asked to repeatedly (3-4 trials/ day) enter a T-maze with two exit options (counterbalanced by entrance to avoid a side bias), one leading to an outdoor play yard for off-leash playtime and the other leading to an outdoor trail for on-leash walking (10 min/ activity). Preference was determined using a binomial distribution test to compare observed proportion of the more selected choice compared to 50%, at $\alpha = .05$. Subsequently, a control phase was conducted, in which the previously preferred exit now led back to the kennel and the opposite exit led to their preferred EE to ensure that dogs were able to track contingencies. Two independent observers reviewed videos of the dogs' choices and latency to exit the maze.

Preference could be determined for four dogs (n = 21 trials): Aerial ($P(X \geq 17) = .0036$), Sky ($P(X \geq 16) = .013$), and Timber ($P(X \geq 14) = .015$) preferred the yard, Beau ($P(X \geq 16) = .013$) preferred the trail. These dogs demonstrated a preference with an average of 9 trials (range: 7 – 12 trials). Allara ($P(X \geq 13) = .19$) and Gina ($P(X \geq 13) = .19$) showed equal preference in the choice phase, with Allara preferring to go back to the kennel in the control phase (n = 16; $P(X \geq 16) < .001$) – suggesting either fatigue or a lack of discrimination of choice options. Gina preferred the EE (trail; n = 22; $P(X \geq 16) = .026$) compared to going back to the kennel, suggesting that she could track contingencies.

Our data showed that dogs have individual preferences for activity-based EE and can demonstrate their preferences within a few days of exposure to a T-maze leading to different activity-based EE options. Future research could investigate whether providing a choice of activity-based EE options results in improved welfare for dogs housed in animal shelters.

Spaces versus objects in canine thought

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Companion dog, Cognition

Dogs consistently treat information as relating to location, which human (infants) link to objects.

This spatial bias could shed light on the evolution of object-centered cognition, yet research needs to rule out that this is not a byproduct of dogs' weaker (compared to humans) vision.

In this study, we used a data set in which dogs were trained on two learning tasks (discrimination and reversal learning) with two rewarded cue types (location and object feature). We further tested how sensory and cognitive capacity each contribute to this spatial bias. To this end, an estimate for general cognitive ability (g) was obtained from a battery of tests, while the cephalic index (CI), a feature shaped by breeding and linked to differences in visual capacity was also measured.

In both tasks, dogs displayed a spatial bias: faster learning when the rewarded cue is a location. CI correlated with the expression of spatial bias (N = 41, P = 0.001) only in the easier discrimination learning task, while a negative correlation between g and spatial bias scores emerged in the more difficult reversal learning task (N = 23, P < 0.001).

We conclude that dogs' spatial bias cannot be reduced to a sensory limitation and is easier to overcome with greater intelligence.

Post-adoption support: Reported behaviours in dogs over the first four months of adoption

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Companion dog, Stray/shelter dog, Behavior

Behaviour problems in dogs are a significant reason for relinquishment to rehoming charities. In part this is due to the breakdown of the bond between the owner and their dog. Recently adopted dogs are at a higher risk of relinquishment for problem behaviours as the dog-owner bond may not yet be fully established. Therefore, recognising and addressing problem behaviours in recently adopted dogs is critical for successful adoption.

What behaviour problems are reported in newly adopted dogs and how do these change over time?

Analysis used data from post adoption support calls for 5522 adoptions from 20 UK Dogs Trust rehoming centres between June – December 2019. Calls took place at 2-5-days, 2-weeks and 4-months post-adoption, and adopters were asked if they had seen any contact behaviour towards people or animals (biting, nipping, grabbing or mouthing), separation-related behaviours, and other problem behaviours in their dog.

Over time an increased number of adopters left their dog alone, with vocalisations the most common separation-related behaviour at all timepoints (2-days: 19.4%; 2-weeks: 7.1%; 4-months: 5.4%). The proportion of adopters reporting contact behaviour towards people or animals increased from 15.9% at 2 days to 20.5% at 2 weeks but fell to 17.3% at 4 months. Other problem behaviours were much rarer. Toileting issues and attention-seeking were some of the most common problems at 2-days but decreased over time (toileting: 2-days: 3.3%, 2-weeks: 3.0%, 4-months: 2.3%; attention-seeking: 2-days: 2.3%, 2-weeks: 1.5%, 4-months: 1.4%). Conversely, on-lead issues and vocalisations were common at 2-days and increased over time (on-lead: 2-days: 2.9%, 2-weeks: 3.1%, 4-months: 3.6%; vocalisations: 2-days: 2.3%, 2-weeks: 2.6%, 4-months: 2.9%), whilst off-lead issues were rare at 2-days but one of the most common problems at 4-months (2-days: 0.5%, 2-weeks: 1.1%, 4-months: 1.9%).

The behaviours problems reported in adopted dogs changed between 2-days to 4-months after adoption. Although separation-related vocalisations decreased, instances of off-lead and on-lead issues increased over time as did problem vocalisations. These findings suggest that the initial few months after adoption are a crucial period for adopted dogs as they settle into their new homes and indicates intervention/ support for some behavioural signs is required later in the adoption journey. Generalised linear mixed models, will be used to identify the risk factors for reporting behaviour problems, which will help to inform strategies for supporting owners with the behaviour of their newly adopted dogs.

How dog-size and owner-robot interaction affect the result of dogs' pointing test

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Companion dog, Cognition, Behavior, Canine welfare, Interaction with humans

Many people have companion animals to ease their loneliness, resulting in more pet dogs than ever before. However, dog owners cannot always bring their dogs wherever they go. Humanoid robots may ease separation anxiety in dogs as social agents at home. To investigate how these robots will be accepted by dogs as social agents, we let dogs observe friendly chatting between their owner a humanoid robot, and assessed if this observation let dogs recognize the robot as a friendly entity.

Does having a dog observe friendly chatting between its owner and a communicative humanoid robot lead to the dog recognizing the robot as a social agent?

In total, 58 dogs (38 small-sized and 20 medium- or large-sized dogs) participated in the study. Firstly, E1 set 6 video cameras to record the dog's behavior. Secondly, the owner and their dog without a leash explored the experimental room. Thirdly, E1 set the robot in front of the owner's chair and the owner interacted with the robot while the dog explored freely. Fourthly, E1 let the dog bite each of two food-bowls and then practiced single choice two times with the dog to let them understand that only one of the two bowls contained food and that they could choose only one of the two bowls at a time. Finally, E1 controlled the robot's movement remotely from outside the room, and conducted a pointing test 10 times with the robot. The robot always pointed to the correct bowl and dogs were expected to choose one bowl within 1 min.

The average number of times that small-sized dogs chose a bowl according to the robot's pointing was higher in the no-interaction condition (6.47) than in the interaction condition (5.94). On the other hand, that of medium/large-sized dogs was higher in the interaction condition (5.92) than in the no-interaction condition (5.33). There was no significant difference in the number of times dogs chose a bowl based on the robot's pointing in terms of dog size or the owner-robot interaction.

While there were no significant differences in the pointing test in terms of dog size or owner-robot interaction, it is noteworthy that the pointing test (as a playful game) eased some dogs' anxiety toward the robot, which resulted in better scores on the pointing test and taking photographs of the dogs and the robot close together as qualitative results.

Friendly dogs are more successful in training for sniffing dogs

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Assitance/therapy/working dogs

Sniffing or detecter dogs can be trained to search various target objects with odors. Previous studies of working dogs suggest that differences in dog's performance are mainly due to their behavioral or personality differences rather than sensory or physical differences. To assess the suitability for working dogs more objectively, simple and feasible tests focusing on dog behavior itself are needed.

The aim of this study is to explore a possible association between a dog's behavior and successful training in sniffing dogs in Japan. Recent studies suggest that the selection for 'tameness' or 'friendliness' towards humans has played a major role in the early stage of domestication in modern dogs, which is called the emotional reactivity hypothesis. Based on this, we hypothesized that the friendliness of dogs is associated with a proper dog-human relationship that can lead to successful training for sniffing dogs.

We obtained behavioral data of a total of 159 Labrador Retriever dogs and 37 German Shepherd dogs that were trained to be drug detection dogs in Japan. We conducted a simple behavioral test that a human experimenter (i.e., stranger for the dog) approached the kennel where a dog is living and stayed with a direct gaze to the dog for 60 seconds. Based on the subsequent video analysis, we analyzed (1) the dog's approach/avoidance behavior towards a stranger based on the time spent on the side near or far to human experimenter, and (2) the dog's reactivity scores using the number of stress responses (e.g., barking, licking, self-scraching, yawning) during the test.

We found that the dog's approach/avoidance behavior was significantly associated with a dog's successful training in Labradors; the dogs that qualified as detection dogs had significantly longer time spent near to human ($P < 0.01$) and shorter time spent far side ($P < 0.01$) than the unqualified dogs. This result was not replicated in Shepherds. We found no significant associations between the dog's reactivity scores and the training success for sniffing work in both Labradors and Shepherds. Our findings suggest that that the dogs' friendliness may regulate individual differences between dogs in their responsiveness to training for odor detection. Although it is necessary to accumulate data on a larger number of dogs to improve the validity and reliability of the test, the simple and low-cost test used in this study may be promising method as a new behavior evaluation tool for working dogs.

Our findings suggest that that the dogs' friendliness may regulate individual differences between dogs in their responsiveness to training for odor detection. Although it is necessary to accumulate data on a larger number of dogs to improve the validity and reliability of the test, the simple and low-cost test used in this study may be promising method as a new behavior evaluation tool for working dogs.

Facial prosodic features of infant and dog-directed communication

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Comparative research, Interaction with humans

Although motherese is a well-studied topic, recent findings have broadened our understanding of infant-directed (ID) speech, shedding light on its use by both males and females and in dog-directed (DD) communication. However, the visual component of ID speech has fallen out of the scope for the first 3-4 decades, leaving room for in-depth investigations.

This comparative study aimed to examine differences in visual prosodic features regarding the addressee and intended goal of communication, and to what extent they exist.

Parents who were also dog owners were asked to participate and interact with their infant (6-18 m.o.; ID condition), their family dog (DD condition) and their spouses (AD condition) in three different, 1-2-minute-long scenarios: language tutoring (LG), attention-getting (AT), fix sentences (FIX). Since dogs and infants attend to human facial expressions similarly, we expect similar visual prosody in the AT and FIX situations. At the same time, dogs and infants differ in their linguistic competence, hence, we expect a greater difference in the LG situation. As ID speech is reported to be distinguishable from adult-adult communication, where the interlocutors share resembling levels of affective and cognitive assets, we included AD as a control.

Speakers' (N=46; 23 female, M age= 34.41 years, SD=4.41) facial expressions (i.e. happy, valance) were recorded and compared between the scenarios and conditions by using Noldus FaceReader software. Results revealed a significant interaction effect of Situation and Condition, (GLMM, all $F(4,135399) \geq 153.03$, all $p < .001$), which took shape in intriguing tendencies.

As expected, the DD condition showed the least intense visual prosody, possibly due to the role of acoustic prosody as the main attention grabber or the varying importance of human facial expressions in canine communication. Furthermore, while LG had the lowest intensity, FIX, with lexical content intended for infants was consistently the most intense across all conditions. Interestingly, AD appeared to be much more like ID, contrary to previous literature. This study is the first to compare ID to AD, where speakers engaged with their partners, and we suspect that the results reflect the influence of this attachment. Despite the limitations, this study confirms the relevance of continued characterization of visual prosody. These findings serve as an open invitation for further clarification and reconsideration of the dynamic between the motherese's visual and acoustic aspects.

Attitudes toward dogs and cats in a representative sample: One in ten pet owners considers their pet more important than anyone else

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Companion dog, Interaction with humans

Pet keeping is deeply rooted in human cultures, and treating pets as "family members" has probably become more common in the past decades. Our previous study on a Hungarian convenience sample found that more than 60% of dog owners either somewhat or completely agreed with the statement that their dog means more to them than any human (Szánthó et al., 2017, PLoS One, 12:e0170397). However, representative data on attitudes towards pet ownership are generally lacking.

The aim of this research is to obtain representative data on attitudes towards pet ownership, particularly whether the sentiment that pets are valued more than humans is prevalent among a representative sample of pet owners.

The TÁRKI Ltd. conducted a questionnaire-based survey on pet ownership in Hungary on our behalf in April and May 2022 (N=1023). The sample biases were corrected by weighting the sample to adjust for deviations from the composition of the adult population in Hungary based on the 2011 census.

We found that 38.5% of the adult population in Hungary lives in households where animals are primarily kept for companionship. 30% live in households where a dog (or dogs), and 19% where a cat (or cats) are kept. Only 1% of respondents keep a pet other than a dog or a cat exclusively. Pets are more common in households with three members (48%) or at least four members (52%) compared to single-person households (29%; p<0.001). Households with children under the age of 18 are more likely to have pets (48% vs 36%; p=0.002) regardless of the household size. 66% of dog owners and 73% of cat owners completely or mostly agree that their pet is a family member, and 12-12% consider their pet more important than any human. However, there is no difference in the health status, well-being, or medication use of pet owners compared to non-pet owners. The frequency of dog walking is positively correlated with self-reported health status.

Dogs and cats are equally regarded by pet owners as family members, and more important than any human. Although the proportion of those who consider their pets more important than anyone else is significantly lower in the representative sample, it cannot be neglected, as approximately every tenth Hungarian pet owner completely or somewhat agrees with the statement that their pet is more important to them than anyone else, which highlights the immense emotional significance of pets.

Canine obesity: Owner management effort and outcome differ according to dog's food motivation

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Companion dog, Behavior, Interaction with humans

A canine obesity epidemic mirrors that observed in the human population and is affected by many of the same risk factors – modern pet dogs have increasingly less active lifestyles and ready access to calorie dense food. Canine obesity is commonly dismissed as the consequence of lax owner management of diet and exercise, but we hypothesised inherent differences in dogs food drive are important to determining obesity risk.

We tested how food motivation affects obesity risk and how variance in the environmental exposure to food and activity affected obesity outcome overall and depending on the degree of food motivation.

We studied >19,000 pet dogs whose owners had completed the Dog Obesity Risk Assessment (DORA) Questionnaire. All had Body Condition Score (BCS, 0-9 score) 4 or higher and were 1-19 years old; 7,533 females and 7,426 males of more than 244 breeds were included. BCS was analysed with a multiple linear model that included Food Motivation Score (FMS) tertile, information on management from DORA Questionnaire, age, sex and neutered status with two-way interactions. Minimal modelling was performed using Akaike's Information Criterion (AIC), and relevant risk factors identified for further assessment. The ß-values obtained were used to compare effect size of each variable on BCS.

Food Motivation Score had the greatest significant positive effect on BCS (ß=1.64/9, $p<2\times10^{-16}$). Exercise and Restriction of Human Food both had a significant negative effect on BCS that was greater for highly food motivated dogs (ß=-0.8/9, $p<2\times10^{-16}$; ß=-0.47/9, $p<2\times10^{-16}$) compared to low food motivated (ß=-0.6/9, $p<2\times10^{-16}$; ß=-0.33/9, $p=3.50\times10^{-10}$) dogs. Owner Intervention Score had a significant negative effect in highly food motivated dogs (ß=-0.48/9, $p<2\times10^{-16}$) but a positive effect in dogs with a low food drive (ß=0.11/9, $p=0.016$). Age had a significant positive effect (ß=0.028/9, $p<2\times10^{-16}$). Being female and being neutered were risk factors with greater effect for the most food motivated animals (ß=0.23/9, $p=3.42\times10^{-12}$; ß=0.15/9, $p=4.86\times10^{-6}$) but not those in the lowest FMS tertile (ß=0.15/9, $p=4.66\times10^{-7}$; ß=-0.039, $p=0.26$).

These data shed light on how biologically determined food drive is a powerful driver of weight gain in pet dogs. Owners' interventions on dogs weight provides evidence that control of environmental access to food and activity is of particular importance in highly food driven individuals and a 'one size fits all' approach to weight management advice is unlikely to be successful unless the challenges of effective intervention are appreciated and supported by those giving animal care advice.

Neural processing of con- and heterospecific voices in two domesticated species

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Companion dog, Comparative research

Intra-species communication relies on the ability of individuals to distinguish the vocalizations produced by members of their own species from environmental noises and vocalizations of other species. In mammals, for instance, there is considerable neural evidence supporting the separate processing of conspecific vocalizations. Dogs (Canis familiaris) are unique in that they maintain a lifelong close relationship with another species, humans.

Here we tested the hypotheses that living with humans, in combination with (1) domestication in general, or with (2) dogs' special selection for cooperation with humans in particular may or (3) may not have led to neural specializations for processing the human voice. We therefore investigated whether dogs' brain process human vocalizations differently from other heterospecific voice stimuli. Furthermore, we compared dogs' voice processing with that of similarly raised individuals of another domestic mammal, the pig (Sus scrofa domesticus), which has not been selected for cooperation with humans.

We used non-invasive, awake electroencephalography (EEG) to identify potential intra- and inter-species differences in voice processing; subjects (N=35 dogs, N=14 pigs) listened to 80-80 human, dog, pig, and environmental sounds while event-related potentials (ERPs) were registered.

We found that both dogs and pigs exhibited distinct ERPs for processing conspecific vocalizations vs. heterospecific (cluster-mass statistics; dogs: 0.330-0.398 ms, $p < 0.001$; pigs: 0.270-0.410 ms, $p < 0.001$) and environmental sounds (cluster-mass statistics; dogs: 0.318-0.434 ms, $p < 0.001$; pigs: 0.078-0.440 ms, $p < 0.001$). But neither species showed ERP difference between processing human vs. other heterospecific vocal stimuli (cluster-mass statistics, no significant cluster).

Our findings corroborate earlier research on mammals, indicating that the neural processing of conspecific sounds is distinct from that of heterospecific and environmental sounds in both dogs and pigs. To our knowledge, this is the first ever non-invasive electrophysiological evidence for conspecific voice sensitivity in non-primate mammals. Finding no evidence for differential processing of human vocalizations in either dog or pig brains supports hypothesis (3) that neural specializations for species-specificity in voice processing may not have been affected by recent evolutionary adaptations to the increased exposure to human vocalizations in domestic mammals.

Dogs' understanding of human knowledge through an unsolvable puzzle task

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Companion dog, Cognition, Interaction with humans

Social cognition enables individuals to understand other's mental states, like their perspectives and knowledge. Whereas understanding perspectives allows individuals to follow another's gaze, understanding knowledge allows individuals to also take into account what that individual is seeing. Dogs understand others' perspective, even that of humans. They can read our facial expressions and body language, and can in turn solicit a person's help in specific situations. However, we do not know if dogs solicit this help based on their understanding of our knowledge of a situation, or rather because of simple associative learning.

In an ongoing study, we tested if dogs can differentiate between a person with relevant knowledge and one without, using the 'unsolvable puzzle' set-up. Dogs (N = 21) learned to solve a puzzle for a food reward and were then presented an unsolvable version in which a mobile part was fixed. A puzzle was visibly prepared by one of two experimenters in front of the dog and dogs were expected to look for help specifically at this 'knower'.

Two one-minute trials were done per dog, each with a different puzzle, but with some missing values, resulting thus far in 37 trials. Each trial, the puzzle was placed on the ground by either the knower or the bystander, which varied to check if dogs simply focussed on the last person touching the puzzle. Roles and positions were varied across trials. We focussed on the first 10 seconds after a dog looked up at either the knower or bystander, which occurred in 32 trials (21 dogs).

In 25 out of 32 trials the dogs looked at the knower first (binomial P=0.001, one-sided), and dogs looked at the knower longer than at the bystander (26 trials out of 31, with 1 tie, Binomial P<0.001). Who placed the puzzle on the ground had no effect in linear mixed model analyses on several behaviours directed at the experimenters.

The findings that dogs facing an unsolvable puzzle first look for help at someone who prepared that puzzle, and do not simply follow who had last touched the puzzle, suggests that they have a basic understanding of knowledge in humans. However, dogs did not have to memorize much about what experimenters experienced and knew accordingly, as events were staged with a short time frame and actors remained in view. Further studies should thus assess how good dogs are in understanding knowledge in others.

The nature and function of domestic dogs' visual signals: Intra and interspecific audience effects on dogs' behavioural patterns and facial expressions

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Companion dog, Physiology, Behavior, Interaction with humans, Animal Communication

Many visual communicative signals consist of behaviours that originally did not have a communicative function but evolved to become efficient signals. To disentangle behavioural patterns caused by generalized excitement from those performed as a means of communication, the presence of a social partner, the so-called "audience effect" has been used in different species.

We investigated the influence of a positive and negative arousal situation and the presence of human or conspecific audience on dogs' behavioural displays and facial expressions. We hypothesized that if behavioural patterns are used as means of communication they would be positively associated with the presence of an audience.

A visible piece of food on a table was either delivered (Postive Anticipation) or moved away and denied (Frustration) after a 5 second interval. Either a human, a conspecific or no audience was present. A total of 95 dogs were tested. We coded facial expressions (with DogFACS) and general behaviours.

Displacement behaviours of "looking away" and "sniffing the environment" occurred more in the frustration-evoking compared to the positive anticipation condition and were correlated with cortisol concentrations. "Ears forward" occurred more in the positive anticipation compared to the frustration-evoking condition ($Z=3.074$, $p=0.002$), was positively influenced by the presence of the human ($Z=2.153$, $p=0.003$), and negatively correlated with pre-test cortisol concentration ($Z=-2.668$, $p=0.008$), suggesting being an indicator of dogs' level of attention. "Ears flattener" ($Z=2.651$, $p=0.008$), "blink" ($Z=2.510$, $p=0.012$), "nose lick" ($Z=2.082$, $p=0.037$), "tail wagging" ($Z=6.134$, $p<0.001$) and "whining" ($Z=2.823$, $p=0.005$) were associated with the presence of an audience but were not correlated with cortisol concentrations, suggesting a communicative component. With a conspecific (compared to a human) audience, dogs assumed a more avoidant attitude, keeping their distance and not looking directly at the audience. Furthermore, dogs exhibited more facial expressions (ears rotator: $Z=-2.671$, $p=0.021$), displacement behaviours (lip wipe: $Z=-2.881$, $p=0.011$), panting ($Z=-3.991$, $p=<0.001$) and whining ($Z=-2.828$, $p=0.013$) when faced with the conspecific compared to the human audience. Cortisol concentration did not increase during tests and no difference emerged between conditions, excluding high arousal as an explanation for the behavioural differences found.

These findings are a first step to systematically test which subtle cues could be communicative signals in domestic dogs and the first evidence that dogs use different behavioural repertoires towards conspecifics and humans in a comparable experimental situation.

Did dog domestication contribute to language evolution?

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Interaction with humans

Recent research underlines what we experience living together with dogs: Dogs developed impressive abilities to communicate and cooperate with humans. The domestication process shaped dogs` behaviour thus they could integrate themselves into human social structures. For communication with their human caregivers dogs improved barking and developed a special eye muscle (LAOM) increasing paedomorphism, thus triggering human nurturing. A recent model of dog domestication is the „Active Social Domestication" hypothesis focusing on the impact of interspecific prosocial contacts reducing environmental stress conditions as a kind of domestic niche constraction not only for dogs but also for their human caregivers.

Although different factors account for the emergence of present-day languages in our human species, from biological changes, to new behaviours, to cultural innovations, I hypothesise about a positive effect of dog-human interactions on aggression management and increased social capabilities and more generally, on our self-domestication, ultimately, contributing to aspects of language evolution.

I review evidence of diverse sort (ethological mostly, but also archaeological, genetic, epigenetic and physiological) supporting a positive feedback loop between dog domestication and human-self domestication that might have favoured the mechanisms promoting structural complexity in human languages.

A recent model of dog domestication is the „Active Social Domestication" hypothesis focusing on the impact of interspecific prosocial contacts reducing environmental stress conditions as a kind of domestic niche constraction not only for dogs but also for their human caregivers. Compared to extinct hominins, we exhibit many of the features found in domesticated mammals, like changes of skull and brain morphology, improved social skills (including reduced aggression, increased prosocialitiy, and enhanced play behavior), neotenic features, and genetics, among others. This human self-domestication phenotype has been hypothesized to result from selection of less reactive aggressive individuals in response to changes in our ecology and environment, and it has been recently invoked as one important force favouring language complexity mostly via a cultural mechanism. As a consequence, evolutionary changes impacting on aggression levels are expected to have fostered this process.

In the time window of dog domestication, starting roughly about 35KaBP, the full globularization of the human brain occurred (this enabling more complex language processing), features of self-domestication reached its peak (this seemingly favouring the complexification of our cultural niche), and important cultural changes occurred as a consequence.

Are results of a Judgement Bias Test affected by pre-session discrimination or generalization training in dogs?

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Companion dog, Cognition, Canine welfare

The spatial Judgement Bias Test (JBT) is a cognitive test that involves teaching dogs that a container in one location will provide a food reward and the same container in another location will not. The dog is then presented with the container in ambiguous locations and the latency to approach those locations is often used to measure expectation of reward, operationally defined as 'optimism'. Some authors suggest that greater 'optimism', as shown in a JBT, indicates higher welfare. However, performance in JBTs may also be indicative of learning history; dogs that have learned to be more discriminative likely show lower 'optimism' independently from their welfare.

Therefore, we hypothesized that a dog's 'optimism' in a JBT may differ following a learning task that promotes discrimination or generalization.

Pet dogs (n=16) each completed a JBT pre-treatment, a learning task (treatment), and a JBT post-treatment. During the JBT, dogs were presented with 5 locations: 1 rewarded, 1 unrewarded, and 3 ambiguous (all unrewarded). Dogs were randomly assigned to a trial-based learning task: Discrimination (n=8) or Generalization (n=8). The task involved teaching the dog an arbitrary behaviour—a nose-touch to the palm of the hand. In Discrimination, an experimenter presented the dog with two hands in each trial, but the dog was only rewarded for touching one specific hand. In Generalization, dogs were presented with one hand per trial in alternating sequence and responses on both hands were rewarded. To control for possible frustration differences due to the presence of non-rewarded trials in Discrimination, dogs in the Generalization were yoked to dogs in the Discrimination to receive the same number of randomly distributed unrewarded trials. As a further control, owners were asked to describe the current emotional state of their dog prior to any sessions. To investigate the latency to approach the ambiguous locations, we used a linear mixed model that included dog ID as a random effect and location*JBT session as a repeated measure with compound-symmetry variance structure.

We found that dogs did not differ in their latency to approach the ambiguous locations between pre and post JBT sessions ($F_{1,13}=0.25$, $p=0.63$) and that the treatment did not influence latency ($F_{2,13}=0.08$, $p=0.92$).

This suggests that 'optimism' as measured in this JBT procedure may not be sensitive to the type of short pre-session discrimination and generalization training used in our study. Future research can investigate other pre-session experiences that may alter interpretations of cognitive tasks.

ManyDogs 1: A multi-lab replication study of dogs' pointing comprehension

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The ManyDogs Project is an international consortium of research teams working on reproducible research in the field of canine science. Contact the ManyDogs Project at manydogsproject@gmail.com. More information about the consortium is available at www.manydogs.org

Companion dog, Cognition, Behavior, Interaction with humans

The ManyDogs consortium aims to promote collaboration, replicability, and open science practices within canine science. Using substantial, diverse samples, we hope to look at how various testing environments and research methods affect the robustness of findings, explore the impact of variations between populations and breeds, and encourage open science practices by registering hypotheses, methods, and analysis plans in advance. Our first study focused on dogs' ability to follow human pointing, a phenomenon that appears highly reliable. We enlisted global participants to help address the question of whether dogs interpret pointing as a social communicative gesture or as a simple associative cue.

Our main hypothesis was that ostensive cues preceding a human pointing gesture will have a facilitating effect on dogs' following of human pointing gestures. Hence, we predicted that if dogs perceive pointing gestures as socially informative cues, they will follow points significantly above chance levels in an ostensive condition, but not in a non-ostensive condition.

We tested 455 dogs across 20 research locations. Owners first provided information on their dog's background, such as breed, training history, and trainability. Dogs then took part in two different conditions of an object-choice task: Ostensive, where the experimenter deployed a contralateral, momentary point to a baited cup after making eye contact and saying the dog's name, and Non-ostensive, where the experimenter pointed without eye contact after a throat-clearing auditory control cue.

Across all research sites, we found that dogs' responses were significantly above chance in both conditions (ostensive: Mean = 0.53, 95% CI [0.51, 0.54], $t(454) = 3.47$, $p < .001$, $BF10 = 19.4$; non-ostensive: Mean = 0.52, 95% CI [0.51, 0.54], $t(454) = 2.95$, $p = .003$, $BF10 = 3.8$), and there was no significant difference between their responses in the two conditions ($X2(1) = 0.15$, $p = 0.70$).

The study's empirical results indicate that using ostensive cues (subject-focused gaze and dog-directed speech) did not increase rates of point-following in dogs relative to using non-ostensive cues. Across both conditions, point-following was found to be quite low, albeit above chance levels. Our results suggest that there may be inherent limitations to point-following behaviour in dogs and not all styles of pointing are equally effective in eliciting a response from dogs. Furthermore, our study emphasizes the importance of careful procedural design in research and the need for replication studies in the field of canine science.

Investigating the associations of breed selection and morphology with the separation behaviour of dogs

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Companion dog, Behavior, Canine welfare

During dog domestication and breed selection, selection for certain morphological traits may have affected the behaviour and the relationship with the owner. For example, small size and a flat face are baby-schema characteristics that evoke increased care in humans, which can trigger a stronger dependence in dogs. In addition, selection for the companion function in lap dogs can also result in more separation-related behaviour problems.

We aim to investigate the relationship between body size, head shape, and separation behaviours. We assume that individuals with smaller sizes or shorter heads/snouts show more intense separation behaviour. Furthermore, by comparing bull and allometric types of snout shortening, we expect that allometric types show more intense separation behaviour, as these breeds were originally selected for small size as lap dogs in contrast to bull types, where snout shortening resulted from selection for bite force.

We studied the behaviour of 181 purebred and 74 mix-breed dogs, divided into short- (61), medium- (56), and long-headed (59) groups based on head shape. The sample included 43 allometric and 25 bull shortening types. We examined the behaviour of the dogs during a 3-minute separation from the owner and used PCA to create five behavioural components based on the duration of their behaviours. We tested the interaction effects of head shape and wither height on the components with linear models.

Compared to longer-headed dogs, shorter-headed individuals tried to get out of the situation (jumping up and scratching the door) for a longer time and used more barking and yelping, indicating an aroused, frustrated inner state (short > medium, p= 0.001; short > long, p= 0.016). Longer-headed (long > medium, p= 0.0039) and smaller-sized (p= 0.008) individuals spent more time near the exit and whined more, indicating passive stress. We also suspect that the shortened heads/snout could influence the production of whines. Shorter-headed (short > long, p= 0.0115) and smaller-sized (p= 0.0144) dogs sat more during the test. Dogs with shorter heads were less active and explored less (p=0.032). As an explanation for these latter results, we think that the individuals were less active due to the physical strain caused by the frustrated behaviour, which may be due to breed-related health problems, such as Brachycephalic Obstructive Airway Syndrome (BOAS).

Our results support that, as predicted, the selection for morphological traits in dogs influenced the separation behaviour.

Of fish and dogs – What undomesticated working fish can teach us about the importance of play in training and working with service dogs

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Assitance/therapy/working dogs, Comparative research, Cognition, Behavior, Interaction with humans

When we think of working animals, we usually refer to specific domesticated species, that have evolved with human direction into fulfilling a specific role. The dog is an ultra-domesticated being has evolved to not only work beside us, but also to form deep social bods, read our expressions and body language, and soothe us physically and emotionally. On the other, unexpected side of the working animals spectrum, we have lower-order, undomesticated species that serve humans in various ways. These animals are not usually thought of as working animals, but in the realm of neuro-cognitive behavioral research, these animals are trained to perform experiments that would allow us a glimpse to the root of complex cognitive processes. Archerfish are a monotypic family of fish species which prey on insects. In the lab, this remarkable ability can be captured and trained on cue, which allows researchers to train the fish to shoot at various objects on-screen. The fish, much like service dogs, have a well-crafted schedule that includes resting, eating, social interaction with handlers, and framed working periods.

Using the knowledge we gain from engaging and caring for non-domesticated, lower-order working animals can teach us a lot about training and engagement with working dogs, and especially with service dogs.

Unlike dogs, archerfish aren't domesticated. Since they don't reproduce in captivity, they are also not undergoing any artificial selection process. Most importantly, unlike all other working animals, fish lack a neocortex, and we can only assume the ways in which they process and learn information. These challenges force us to be creative in the ways in which we train the fish. Since coercion and positive punishment aren't appropriate options, training is done by making it into a playful interaction between handler and fish. Adjusting play-related methods used in training of lower-order, undomesticated animals could be extremely useful in working dog training.

It is likely that play-based training methods used with lower-order species such as the archerfish, that require lower cognitive capacities and no affinity to human-animal communication, would come more intuitively to a dog and hence ease the cognitive workload.

Knowledge by interacting with working fish, allows to explore how teaching, training, and bond facilitating techniques used with low-order animals might contribute to the success of service dog training process and to the dog's subjective workload and welfare.

The use of positive vs. aversive dog training methods is correlated with animal ethics orientation - a US study

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Companion dog, Interaction with humans, Ethics

The relationship between ethical orientations and owners' choice of dog training methods is not well understood. This study explored whether the propensity to hold four animal ethics orientations, Animal Rights, Anthropocentrism, Animal Protection, and Lay Utilitarianism, among dog owners was associated with an almost exclusive use of positive reinforcement (R+) or the use of physical punishment (PP).

It was hypothesized that higher Animal Rights and Animal Protection scores would be associated with higher use of R+ and lower use of PP. In contrast, higher Anthropocentric and Lay Utilitarian scores would be associated with lower use of R+ and higher use of PP.

Data was collected via a cross-sectional, online survey containing questions about demographics, dog training methods, and ethical orientation toward animals. The survey was completed by 964 US residents, 513 of whom met the study's inclusion criteria. Participants were recruited from dog-oriented groups on Facebook. The Multidimensional Measure of Animal Ethics Orientation was used to assess animal ethics orientations.

The two outcome variables of interest were constructed based on responses to multiple questions about training practices. The use of R+ was a dichotomous variable, whereas the use of PP was an ordered variable with four categories. Multivariable logistic regression was employed to identify which orientations predicted R+. All four orientations and a number of control variables were included conjointly as explanatory variables. For PP, multivariable ordered logistic regression was used for the same purpose and with similar explanatory variables included.

Ethics orientations were clearly associated with the use of training methods. Unexpectedly, higher Animal Rights scores were not associated with higher use of R+, and higher Lay Utilitarian scores were not associated with lower use of R+. As expected, higher Anthropocentric scores resulted in a lower propensity to use R+ ($p < 0.001$), and higher Animal Protection scores resulted in a higher propensity to use R+ ($p = 0.02$). Turning to PP, as hypothesized, higher Anthropocentric scores were associated with a higher propensity to use PP ($p < 0.001$), whereas higher Animal Rights ($p < 0.001$) and higher Animal Protection ($p < 0.05$) scores resulted in a lower propensity. Unexpectedly, higher Lay Utilitarian scores were not associated with the use of PP.

This is the first study to demonstrate that an owner's choice of dog training methods is associated with their ethical orientation toward animals. It provides new insight into "ethical" factors that may influence training method choice.

POSTERS

Dog-robot interactions: What does it take to become best friends?

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Cognition, Behavior

Development of social robots is in its rising and although the main focus is on human-robot interactions, more and more developers strive to design robots capable of interacting with pets. However, there are a number of questions in the development of these robots, including the minimal skill set required for artificial agents to be recognized as social partners and whether they can function as appropriate partners in complex social interactions.

Here, we review our main findings about the features facilitating to establish preference toward and interaction with an artificial agent, and introduce interactive situations in which the robot seemed to be an effective partner.

We used self-propelled objects unfamiliar to dogs (Unidentified Moving Object, UMO) as partner, to be able to investigate the effect of specific behaviour cues in themselves, without the potential effect of embodiment based solely on its similarity to dog- or human-like appearance. We tested whether simple animacy cues of the robot are sufficient to elicit interactive behaviour, and investigated dogs' behaviour toward the robot in various contexts (e.g. problem-solving tasks). As controls, we used human partners and inanimate/non-interactive robots.

Our studies show that self-propelledness alone is sufficient to elicit preference toward a UMO, and the UMO using multiple trajectories and reacting to the dog's behaviour contribute to the acceptance of the robot as an interactive partner. When presented with a problem-solving task, dogs exhibited similar behaviour toward the UMO as in social interactions with humans (e.g. gaze alternation), even without the UMO directly providing reward to the dog. Preliminary results also suggest that the occurrence of some elements of dogs' separation-related behaviours (e.g. behaviours related to the door where the owner left and vocalization) decreased when a previously interactive UMO was present during separation.

In sum, our research indicates that simple behaviours displayed by a novel artificial agent can facilitate the establishment of a social(-like) interaction between the robot and a dog, and only a short experience with the robot is sufficient to achieve this. The robot may also provide partnership for dogs in various situations contributing to their well-being in the future, but more research is needed on the topic. These findings provide promising foundation for future behaviour research using UMOs, and can contribute to design the behaviour of social robots capable of engaging in complex interactions with dogs.

Mobile app for enhancing behavioral testing of working dogs

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Assitance/therapy/working dogs, Behavior

One of the main methods for behavioral assessment of working dogs are experimental approaches in which dogs are presented with a set of tasks, situations, and stimuli while their behavior is scored by a trained rater (one example of such approach is the `Stranger Test', where a dog is placed in a room with a stranger). These approaches are quite labor- and time- intensive to administer, and their robustness under scoring methodology and the subjective perception of human evaluators have been criticized in the literature. However, they continue to be one of the commonly used methods in the field. The goal of this research is to explore digital ways to enhance the human evaluators in their scoring of a battery of standardized behavioral testing protocols.

A mobile app supporting behavioral testing of dogs in real time can increase consistency and efficiency of testing, as well as help minimize diversity of interpretation of scoring by different evaluators.

Development of a mobile app with a "bank" of standard dog testing protocols accompanied by matching questionnaires for testers. Two types of evaluation of the app will be performed: consistency (checking agreement of several raters), and accuracy (checking the app scoring with expert scoring).

We have established data collection protocols in two different facilities, handling working/defense dogs and therapy dogs. We have so far collected and analyzed data from two different testing protocols with (n=17) puppies, including such tests as stranger test (reaction to stranger), surface test (placing puppy on elevated surface), etc.

The development of a designated mobile app for behavioral testing of dogs has several contributions: - Standardized descriptions of tests (stranger test, table test, etc.) and instructions for rating them (making them independent from testing environment is a challenge). - An app supporting multiple testers assessing the same dog provides a power instrument for studying agreement of testers on different tests. - Complementing the app with video tracking (and its automated analysis) can provide additional insights into reasons for disagreement between raters. - Moving from `pencil and paper' testing to data-driven approach where each dog has a traceable history of testing which can be revisited creates a valuable database that can be used by the research community.

Associations between the dogs' rank in the hierarchy and their attachment to the owner

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Companion dog, Behavior, Interaction with humans

In case of social animals, within-group hierarchy regulates the access to limited resources with minimal conflict between the group members, thus they can avoid causing serious injuries to each other. Family dogs usually have an abundance of essential resources (food, place to rest, etc.), but still, hierarchy-related behaviors are often observed in multi-dog households.

We assume that this is related to the exceptional role of the owner as the main and at the same time strongly 'limited' resource. Dogs try to monopolize their access to the owner's vicinity, attention and joint activities. Consequently, dogs' ranks should influence their behaviors towards the owner, including their typical behavior that manifest themselves in the framework of the dog-human attachment behavior complex. Dogs' attachment to their owners is considered as one of the fundamental mechanisms that enables dogs to become an integral member of any human family. The aim of this study was to find whether companion dogs from multi-dog households show different attachment behavior towards their owner depending on their position in the hierarchy.

With a validated questionnaire, we assessed the dogs' position in the hierarchy. We calculated a 'Rank score' for each dog, and depending on these scores, it was possible to find out where the particular dogs fell in the hierarchy. We hypothesized that higher and lower ranked dogs, living in the same household would behave differently in an attachment test, because this test is based on the specific interrelationship between the dog and its owner, in a mildly stressful context. We tested 70 dogs in our study. We performed the 'Strange Situation Test' (SST) with these dogs to characterize their behavior. The SST provides a composite score for each dog that consists of three sub-scales: 'Attachment', 'Anxiety' and 'Acceptance (of the stranger)'.

According to our results, although the characteristic attachment to the owner can be observed in all family dogs, dogs with the highest Rank scores showed significantly less signs of anxiety than the ones with lower scores (p= 0.0173). We also found a trend, showing that dog with the lowest Rank scores again, showed somewhat lower anxiety levels than the dog that had intermediate Rank scores.

Our results indicate that dogs with stable high, or stable low Rank scores may react with less anxiety to the mildly stressful departure of their owner at a strange place, than dog with ambiguous rank position.

Human implicit and explicit emotional responses towards wolves and dogs

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Cognition, Behavior

Wolves cause strong adverse emotional reactions in humans, although attacks are rare. Dogs, on the other hand, have a valued position in many human societies providing functional and health benefits to their owners. However, compared to wolves, they pose a significantly higher risk for accidents and diseases. A potential explanation for such discrepancies in the human perception of both species is that our attitudes towards wolves and dogs are not just based on explicit knowledge of the two species but also on implicit processes grounded in our emotional, immediate reaction to them. Thus, implicit and explicit evaluative processes contribute to attitudes towards wolves and dogs, and a complete understanding of these attitudes requires considering both.

We investigated human attitudes towards wolves and dogs using neuroscientific (functional MRI) and psychological (self-report) methods that aim to elucidate both the implicit and explicit reactions to the animals compared with responses to another control species (i.e., snakes). We expected activation in emotion and visual processing areas, such as the amygdala and the inferior temporal cortex. More specifically, we predicted the strongest amygdala activation for snakes regardless of behavioural display, followed by the wolf images. We expected the most pronounced species differences for the non-threatening stimuli with dogs resulting in activation in brain areas associated with reward and affiliation (e.g., caudate) and snakes and wolves eliciting threat responses in the amygdala. Based on earlier reports of discrepancies between explicit vs implicit responses, we predicted that the imaging results will not correlate strongly with explicit (self-report) measures, at least for wolves.

N = 42 human participants (24 females, mean age: 24 years) saw images of wolves, dogs, and snakes displaying threatening or non-threatening behavioural displays (2 x 3 within-subject design) while undergoing functional MRI. After scanning, we assessed participants' explicit attitudes towards the target stimuli using a visual analogue scale ranging from 0 (not at all threatening) to 100 (extremely threatening).

Data analysis is in progress, and results will be reported at the conference.

Human attitudes towards wolves and dogs remain largely unstudied. The present study will elucidate how implicit and explicit processes and their interplay influence human attitudes toward the two species. By understanding these attitudes, we can gain insight into our perceptions of these animals, which may be vital in informing public debates on the reintroduction of wolves.

Brachycephalic dogs' outstanding attention towards humans seems not to contribute to their popularity

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Companion dog, Canine welfare

Brachycephalic (flat-faced) dogs' popularity is rising worldwide despite the numerous health problems they often face. To take meaningful steps in solving the brachycephalic dog welfare crisis, we need to understand what the appealing features of these dogs are, and what the features of brachycephalic dog enthusiasts are. Previous research found that these dogs show outstanding attention toward humans, they look longer at faces, form eye contact faster with a stranger, and follow pointing gestures more readily than their longer-headed counterparts.

However, it is not known whether brachycephalic dog enthusiasts value these dogs' tendency to form eye contact, or this behaviour trait is irrelevant regarding their popularity. We hypothesised that people who love flat-faced dogs are sensitive to dogs' eye contact, and, in addition, they have lower knowledge about the health problems associated to brachycephalism and have a specific personality profile.

In an online survey, we asked respondents (N=1156) about their most liked and disliked dog breeds and appearance. Then we showed them photo pairs of 25 dogs: in one photo, the dog looked into the camera (formed eye contact), and in the other photo, the dog looked away. Participants could choose a photo from the pair that they liked more or indicate that they liked the photos equally. We also collected data about the respondents' knowledge of brachycephalic dogs' health problems, demography and personality.

In contrast to our expectations, people with a positive attitude towards brachycephalic dogs (23.2% of respondents) chose the photos of dogs making eye contact (looking into the camera) less frequently than photos of dogs looking away (p<0.001) compared to respondents with a negative attitude (19.8%) or neutral attitude (57%). In other words, brachycephalic dog enthusiasts seem to be less sensitive to dogs' eye contact. Moreover, they associated more health problems with brachycephalic dogs (p<0.001). They were also found to be younger (p<0.001), more often women (p<0.001), have lower levels of education (p<0.001), and a higher level of agreeableness (p=0.012), conscientiousness (p=0.050), and dog-directed emotional empathy (p=0.004).

Our results suggest that the tendency of brachycephalic dogs to form eye contact does not play a role in their popularity and neither high emotional empathy nor knowledge about health problems deters people from liking these dogs. Our study also showed what demographic features may make humans susceptible for becoming a brachycephalic dog owner, contributing to the welfare crisis.

General preference for shorter-headed dogs in humans - first results of an online survey

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Companion dog, Canine welfare

Brachycephalic (flat-faced) dogs are popular worldwide, despite their numerous health issues. To solve this welfare crisis, we must uncover the factors that drive people to prefer these dogs.

Although it has not been investigated before, head length itself seems to be an important factor, as even among flat-faced breeds, enthusiasts tend to prefer those with even shorter heads.

In an online survey, we aimed to explore the associations between people's attitudes towards their ideal dog's role (such as family member or pet), their expectations of the dog's characteristics, and their preference towards shorter or longer head shapes. We examined whether the head length itself can trigger a preference, therefore we used profile photos only. We surveyed respondents' preferred roles and features in an ideal dog, and assessed their preference for different head lengths using profile photos of 14 mongrels, each depicted with four head lengths [much shorter (-15%), a bit shorter (-5%), a bit longer (+5%), and much longer (+15%) than the original] morphed with WebMorph. We analysed the associations between respondents' preferred roles and important characteristics using Generalized Linear Models. We also used Cumulative Link Mixed Models to examine the relationship between these factors and respondents' head length preferences.

We collected data from 624 respondents by the date of abstract submission. Classifying the ideal dog in a human-like role (family member, child, friend) was positively associated with the appreciation of the dog's appearance ($p<0.001$), the dog's health ($p<0.001$), and control over the dog ($p=0.020$), but negatively with affection towards the dog ($p<0.001$). Classifying an ideal dog in animal-like role (pet, fellow worker) was positively associated with the appreciation of affection ($p<0.001$) and exercise requirements ($p=0.031$). Among the photos, the much shorter head (-15%) was chosen in 33.0% of cases, the bit shorter head (-5%) in 36.7%, the bit longer head (+5%) in 21.7%, and the much longer head (+15%) in only 8.6%. Those who preferred a longer head shape were less likely to prioritize health ($p=0.004$), more likely to value control over the dog ($p=0.017$) and tended to classify the ideal dog in an animal-like role ($p=0.027$).

Preliminary results suggest that respondents' expectations of an ideal dog's role are associated with external features they find appealing. We also observed a general preference for shorter head lengths. In the future, we plan to compare different groups of people based on their preferred breeds. Data collection is ongoing.

The use of video to study dogs' intraspecific visual communication

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Companion dog, Behavior

Dogs' displacement behaviors (e.g., lips licking, yawning, blinking, sniffing) have been suggested to serve as communicative, appeasement, signal during social interactions. We investigated how dogs respond to videos of conspecifics showing threatening and neutral behavioral display.

If displacement behaviors have a communicative function and are showed to reduce conflict in potentially aggressive situations, we expected dogs to show these displays more towards a threatening conspecific than a neutral one.

Videos of 2 conspecifics with threatening (lunging and barking), or neutral (standing and panting) attitude were projected on a wall screen. 56 dogs were exposed to 4 videos (Dog1&Dog2 threatening; Dog1&Dog2 neutral) with natural sounds and the same series with artificial sounds (Session-1). The same procedure was repeated after 5 minutes (Session-2) in a counterbalanced order between subjects. General behaviours and facial expressions (according to DogFACS) were coded using the software BORIS.

Dogs looked more the videos of threatening conspecifics rather than neutral ones ($p < 0.001$) and paid more attention to videos in Session-1 than Session-2 ($p < 0.001$), probably due to habituation. Differences were found for ears movement (EADs): subjects kept their ears forward (EAD101) more when the Threatening-stimuli were shown ($p < 0.001$). Ears were flattener (EAD103) more when videos with the artificial sounds were played ($p = 0.006$), probably a sign of uncertainty towards the unfamiliar noise; while their rotation (EAD104) were exhibited more in the Neutral-stimuli condition ($p = 0.002$). Finally, ears were kept downward (EAD105) more in front of the Neutral-stimuli ($p = 0.05$). Displacement behaviours of "sniffing", "yawning" (AU27), "lip-wiping" (AD37), and "nose-licking" (AD137) were expressed more towards the Neutral-stimuli rather than the Threatening ones; "blinking" (AU145) occurred more when neutral stimuli with normal audio were shown ($p = 0.020$). The "whining" occurred more when Neutral-stimuli ($p = 0.040$) with normal sound ($p = 0.023$) were shown

Dogs were more attentive towards the videos of threatening conspecifics, as highlighted by the time spent looking at them and the ears' positions (EAD101). Whilst in contrast with our hypothesis, displacement behaviors, "ears downward" (EAD105) and "whining", were showed more frequently towards Neutral stimuli. These results suggested that displacement behaviours are not exhibited in a context of open conflict but in more ambiguous situations where avoidance/de-escaltion could be a successful coping strategy. In fact, a conspecific standing frontally and panting could be an ambiguous stimuli eliciting a conflict motivation in dog, while a conspecific barking is a clearer stimulus deserving attention and potential defensive behaviour.

The sound of fun in dogs: Exploring the acoustic and neural differences between play and exercise pantings

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Companion dog, Interaction with humans, Neuroscience

During social play, dogs spontaneously produce a unique type of panting, which has been suggested to be a play signal and functionally distinct from panting associated with physical exercise, which serves to regulate body temperature.

Our aims were to acoustically compare pantings produced during social play and exercise and to describe whether the dog brain shows a differential response to play pantings. We hypothesized that pantings in dogs during play and exercise will exhibit different acoustic properties, and that the dog brain will show differential activation in response to these two types of vocalization.

Eighteen dog-human dyads participated in play and exercise sessions lasting a minimum of three minutes each. The play and exercise sessions were recorded on video, and ten audible pantings from each participant were selected from each session, except for two dogs who did not pant during the exercise session. In addition, we used non-invasive functional near-infrared spectroscopy (fNIRS) to measure the brain response of three family dogs to play pantings, exercise pantings, and scrambled sounds.

We found differences between the play and exercise pantings in five acoustic features: play pantings had a lower spectral spread and a higher peak frequency, spectral slope, spectral centroid, and duration. Furthermore, the average FFT revealed a peak frequency for play pantings at 1500 Hz, while the exercise pantings peaked at 562 Hz. Using the first two components of the PCA, we were able to predict the vocalization type (play or exercise panting) with a significant classification accuracy of 0.89 ($p < 0.01$). Regarding fNIRS results, a repeated measures ANOVA showed significant differences ($p < 0.01$) in activation between play pantings and the other two types of sounds (exercise pantings and scrambled sounds) in ten detectors (three near the right temporal cortex, four near the left temporal cortex, two near the left parietal cortex, and one near the left frontal cortex). All results were corrected for multiple comparisons using false discovery rate).

We conclude that the play pantings of dogs are acoustically different from exercise pantings, and that the dog brain can differentiate between these two vocalizations.

Like caregiver, like dog? Caregiver stress predicts dogs' physical activity – but not dogs' heart rate variability – as captured by a Garmin smartwatch and PetPace smartcollar

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Companion dog, Canine welfare, Interaction with humans

Smart wearables function as non-invasive tools to measure dog and caregiver physiology and activity in naturalistic settings. The current study describes Garmin smartwatch, PetPace smartcollar and caregiver-reported survey data collected in teleworking caregivers and their dogs.

First, associations between dog and caregiver psychological stress and physical activity measured by smart wearables are explored. Second, we assess whether caregivers through self-report can assess dogs' stress and activity measured by a smartcollar.

Continuous 24-h smartcollar and smartwatch data and daily survey data were collected in the Spring of 2021. A sample of 12 teleworking dog caregivers wore a Garmin smartwatch and their dog wore a PetPace smartcollar during 10 to 19 days (Ndatapoints_wearablesonly=166). The smartwatch provided data aggregated on the day-level about physical activity and psychological stress. The smartcollar provided data aggregated on the day-level about physical activity, and continuous (i.e. every 2 to 15 m) data about heart rate variability (HRV), which we aggregated on the day level. Dog activity was measured with a tri-axial accelerometer in the collar and HRV was calculated using vasovagal tonal index. Finally, participants provided daily survey data about their dog's stress and activity during 10 consecutive workdays at the end of each day (Ndatapoints_includingsurvey=110). Smart wearable data were aggregated on the day level and merged with the daily survey data.

Mixed coefficient modeling results showed that daily caregiver stress was negatively associated with daily dog activity (βcaregiverstress_pmc = –0.35, p=.016, N=166), but not with daily dog HRV (βcaregiverstress_pmc = –0.02, p = .360, N=166), when accounted for person-level caregiver stress and daily caregiver activity. In addition, caregivers successfully assessed their dogs' daily activity but not stress, as daily self-reported perceived dog activity (βperceiveddogactivity_pmc = 4.30, p =.027, N=110) but not perceived dog stress (βperceiveddogstress_pmc = –0.03, p=0.861, N=110) predicted daily dog activity and HRV, respectively, measured by a smartcollar. The latter analyses were accounted for daily caregiver activity and self-reported daily dog-caregiver interactions.

While exploratory, our study is the first that examined associations between dog and caregiver 24-h physiological data and daily survey data. Since significant associations were found between caregiver stress and dog activity, this study suggests that methodological approaches to examine mechanisms of dog-caregiver interactions may benefit from incorporating the use of smart wearables. Finally, our findings show that caregivers are capable of identifying their dog's activity level but—confirming previous studies—suggest the lack of such an ability concerning their dog's stress.

Humans can differentiate and recognise dogs by their whines

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Behavior, Interaction with humans, Vocal communication

For a species living in complex groups, identifying individuals can be crucial. Due to anatomical constraints, specific parameters of vocalisations can be individual-specific, promoting individual differentiation or even recognition. Vocal encoding and perception of identity are important primarily within species. However, in the case of domesticated animals, cross-species identity perception might gain significance. As humans can differentiate individuals of even phylogenetically distant species, like birds, their low success in differentiating dogs by their barks is surprising. One reason can be the barks' harsh acoustic structure, but their acoustic and contextual variability can hinder human perception of individual-specific features.

In contrast with the multifunctional barks, contact vocalisations might have evolved to convey individual information for listeners specifically. While barks were extremely diversified through domestication, dogs' separation whines have a more conserved acoustic structure and have a function to maintain contact with the owner. Thus, we hypothesise that they will carry individual-specific features, and humans will be able to discriminate and recognise dogs by their whines.

From a pool of separation whines recorded from 138 dogs, we selected individuals (N=26) that produced at least 30 calls. First, we tested their acoustic individuality using permuted Discriminant Function Analysis (pDFA). Then in an online questionnaire, we 1) tested humans' (N=248) ability to differentiate dogs by their whines in a same-different forced choice test, then 2) we used a one vs four match-to-sample paradigm to test their recognition abilities too. Finally, besides the participants' success, we tested which acoustic parameters affect their differentiation performance.

The pDFA suggested a significant discriminability (p<0.001) with 55% accuracy. Accordingly, both discrimination (p<0.001) and match-to-sample performance (71% vs 25% chance; p<0.001) showed humans' ability to identify dogs by their whines. Acoustic differences between samples affected the performance. Greater call length (p=0.049) and pitch (p<0.001) difference, presence of nonlinear phenomena (p=0.027), including biphonations (p=0.003), promoted correct discrimination of individuals. Similarly, samples from the same dog with more prominent differences in these parameters were more likely misidentified as coming from different individuals.

As call length and pitch are likely proportional to body size, dogs' morphological variability might explain these findings. Also, nonlinear phenomena are related to vocal fold asymmetries, thus their occurrences promote vocal individuality. In conclusion, our results suggest that dog whines carry individual identity-diagnostic cues that humans can perceive, thus these contact vocalisations might play a role in individual recognition in dog-human interactions.

Factors affecting time to adoption of dogs presented in a virtual shelter in Spain

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Companion dog, Stray/shelter dog, Canine welfare

Over the last few years several online platforms have being created to connect potential adopters with shelters and people who need to rehome their pets. Previous studies conducted in animal shelters suggest that physical and behavioural characteristics of dogs would influence their chances of being adopted. A study was designed to identify factors related to the probability of adoption in a virtual shelter.

The probability of adoption could be influenced by the characteristics of the dog but also by the way the information is made available and presented to potential adopters.

The records of 61,624 dogs included in the database of a virtual shelter platform were analyzed. The information included physical characteristics, behaviour, temperament, general health and source of the animal (i.e., uploaded by an animal shelter or by a family who wanted to rehome the dog). We calculated the median length of stay in the virtual shelter, which has been proposed in the literature as a cutting point to classify shelter dogs as short-term or long-term dogs. The 9912 dogs that stayed in the system 213.7 days or less were selected for further analysis. Binary logistic regression (BLR) was used to compare the characteristics of adopted versus non-adopted dogs.

The BLR model was good and strong (Omnibus Tests of Model Coefficient, $p<0.0001$; Nagelkerke $R2=0.51$; percentage of correct classification = 88.3%). Individual factors associated with an increased probability of being adopted included being younger, microchipped and not belonging to the list of breeds included in the Dangerous Dogs legislation. Dogs were 31.6 times more likely to be adopted if presented by an animal shelter than directly by a family. Records with missing information about age, health status or behaviour were linked to decreased chances of adoption.

Animal characteristics but also the way information is made available to the public seems to influence the probability of adoption in virtual shelters. According to our results, special efforts should be made to promote the adoption of dogs coming directly from private owners, as well as to encourage shelters and families giving their dogs on adoption to include the maximum amount of information about dogs waiting for adoption.

Cut into life – Behavioural correlation between breed and neutering in male dogs?

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Companion dog, Behavior

Dogs are often neutered as a preventative measure against disease and to eliminate undesirable behaviour. The reasons vary according to the sex of the dog, with female dogs more often neutered for medical reasons. In contrast, holders of male dogs are more likely to mention behavioural reasons.

The aim of the study is to examine neutering from a behavioural perspective and to identify possible breed-related behavioural changes after neutering.

The study was conducted using an online study with two questionnaires related to the dog's personality. One questionnaire focuses on specific behavioural problems. The other provides information on four personality traits (extraversion, trainability, calmness, dog sociability) according to Turcsán et al. (2011). A total of 242 holders of male dogs (n= 130 intact and n= 112 neutered) participated in the questionnaire on specific behavioural problems. The questionnaire regarding personality traits was completed by 211 dog holders (n= 115 intact and n= 96 neutered males). Participating breeds were categorized into four breed clades according to Parker et al. (2017): and renamed as "shepherds","retrievers","terriers" and "hunting dogs".

Our study revealed significant differences in terms of extraversion between intact and neutered males. Both within the clade of shepherds (Mann-Whitney-U-test: $p = 0.03$) and within the terriers (Mann-Whitney-U-test: $p = 0.04$) the intact males showed bolder behaviour than the neutered males. Aggressive behaviour occurred more frequently in neutered males than in intact males in all breed clades except hunting dogs. There was also a significant difference in castration status regarding panicking behaviour. Neutered males were significantly more often exhibiting problem behaviour in the form of panic (multinomial logistic regression: $p = 0.04$). As a result, the increased incidence of panic behaviour in neutered males independently of breed suggests a correlation with neutering status.

The results of this and previous studies call into question the use of castration as a method of behaviour modification, as a measure of reproductive control in an integrated environment and disease prevention.

The effect of familiarity on dog-directed communication

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Companion dog, Interaction with humans

Studies have found that dog owners tend to use higher-pitched, more exaggerated tones of voice and specific facial expressions when speaking to their dogs compared to when they are speaking with other adult humans. It has been shown that dog-directed speech (DDS) resembles infant-directed speech (IDS) both acoustically and visually, however only IDS has been studied in relation to familiarity (i.e. the absence or presence of attachment with the caregiver).

In the current study we aimed to examine the effect of familiarity on the acoustic and visual prosodic features of DDS. Therefore, we recorded and analyzed the acoustic and facial prosodic aspects of DDS during human-own dog and human-unfamiliar dog dyads. In line with previous studies on IDS, we expected more exaggerated (higher and more variable pitched voice and more intense facial expressions) toward unfamiliar dogs compared to own dogs.

We collected video recordings from 42 female dog owners on a voluntary basis, who had been coupled with each other based on their own dog's breed (i.e. in each group there were 2 participants with 2 dogs from the same breed or breed group). Participants were instructed to interact with their own dog and the unfamiliar dog for 1.5 minutes during which they asked to (1) play a hide-and-seek game with a ball (30 sec.), (2) attract and maintain the attention of the dog while presenting a treat (30 sec.), (3) tell a nursery rhyme to the dog (30 sec). Order of condition (own dog, unfamiliar dog) and situation (hide-and-seek, attention getting, nursery rhyme) were counterbalanced between participants.

In line with our hypothesis we found that speakers used a higher pitched voice when interacting with an unfamiliar but same breed dog compared to their own dog (GLMM, $F_{1,257}=10.96$, $p=0.001$). Interestingly, the pitch range of the voice, happy and surprised facial expressions were not affected by familiarity, but the size of the dog (GLMM, $F_{1,257}=6.94$, $p=0.009$; $F_{1,257}=7.29$, $p=0.007$). With smaller dogs, speakers used wider pitch range and more intense happy facial expression irrespective of familiarity (both $p<0.01$).

We provided evidence that dog-directed prosody is affected by familiarity, as female speakers tended to heighten their pitch when interacting with an unfamiliar dog in comparison to their own dogs. Interestingly, we also found out that the size of the dogs had a significant effect on both the acoustic and visual aspects of dog-directed prosody. Smaller dogs, therefore, can evoke more exaggerated dog-directed prosody from female speakers, which is similar to the more intense infant-directed prosody of mothers toward younger than toward older infants.

Does ambient temperature influence the reproductive behavior of wild canids?

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Wild canids, Ecology, Behavior

Climate change, as part of a global process is a widely accepted phenomenon influencing animals and their surrounding environment. A variety of studies show that, especially invertebrates, amphibians, birds and plants are influenced by rapid ambient temperature increase (Root et al., 2003). Temperature-related traits of animals that could change are timing of events (phenology), morphology, behavior or genetic frequencies (Root et al., 2003). Less is known about the impact of the climate change on mammals, but some studies of living canid species indicate that ambient temperature and precipitation could have an influence on canid reproductive behavior (Chatdarong et al., 2007; McNutt et al., 2019; Sen Majumder & Bhadra, 2015).

Reproduction of captive canid species is one tool of species conservation. Thus, we are studying reproduction of captive canids to increase the reproductive success and contributes to the canid conservation. One part of the project investigates correlations of ambient temperature, as a climate factor, with the reproductive biology of captive canids. We assume that wild canids react to rapid climate changes during the reproductive season and that mating time occurs earlier or later in year according to the average year temperature.

We observed pair-bonding behavior, took data from zoo and studbook records and calculated correlations between pair-bonding behavior and the female estrus phases in reproductive season of captive canids (grey wolves, maned wolves, corsac foxes, dholes etc.) in different German zoos in addition to records of EEP (European Endangered Species) studbooks. Pair-bonding behavior is recorded via seasonal observation (50h per month) of captive canid pairs (or groups) in different German zoos (e.g., Waldzoo Gera, Zoo Osnabrück or Tierpark Berlin). A similar observation protocol is used for all observations including focal observation and scan sampling.

Obervations and data from canids in differently located European zoos suggest some impact of the ambient temperature on the reproductive behavior of canid species. Earlier mating in the year is found in several species (corsac fox, maned wolf, dhole) but could not been correlated to annual mean temperature for every species (Heinze, 2021; Kotte, 2021; Levy, 2023). Correlations between low daily ambient temperature and increased pair-bonding behavior could be observed in some species, e.g. corsac fox and Hudson Bay wolves (Heinze, 2021; Meyer, 2021).

These previous findings lead us to investigate more species and group canids in European zoos, ultimately data from free-ranging populations should also be included.

Cylinder test performance associated with impulsivity, trainability, and problem behaviour

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Companion dog, Cognition, Behavior

The cylinder test has been used to measure motor inhibitory control in a wide range of species, and it has recently been found to correlate with impulsivity in dogs. During the task, the animal is required to detour around a transparent barrier and inhibit its prepotent response to reach directly for the reward. However, there is ongoing debate about the suitability of the cylinder test as a measure of inhibitory control / impulsivity. Surprisingly there is almost no previous research on possible correlations between cylinder test performance and personality or behavioural traits.

Our aim was to find out whether dogs' performance in the cylinder test could tell us something about their behavioural traits outside of the test situation.

We collected questionnaire answers from dog owners who had participated in the cylinder test with their adult dogs (N = 984). We included two validated questionnaires: the Canine Behavior Assessment and Research Questionnaire (C-BARQ), and the Dog Impulsivity Assessment Scale (DIAS). Associations between questionnaire factors and human-directed behaviour in the unsolvable task were analyzed using linear mixed models and generalized linear mixed models. We controlled for variables such as breed, age, sex, training history, and food motivation.

We found that higher inhibitory control in the cylinder test correlated positively with obedience/trainability ($p = 0.04$), and negatively with with impulsivity (behavioural regulation, DIAS, $p < 0.001$), slowness to learn new tasks ($p = 0.02$), excitedness ($p = 0.01$), and energy level ($p = 0.03$). No associations were found between cylinder test performance and management problems, stereotypies, impulsive aggression (DIAS), or fear of humans.

Our preliminary results show that the performance of dogs during the cylinder test may be indicative of their behaviour in their daily lives with their owners. Dogs which had higher inhibitory control in the cylinder test were more obedient, faster at learning new tasks, and less impulsive, excitable and energetic. These results further our understanding of dog behaviour and the possible reasons behind dogs' performance in the cylinder task.

The development of a dog quality of life assessment tool based on a hierarchy of dogs' needs

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Companion dog, Stray/shelter dog, Canine welfare

Undoubtedly the vast majority of dog owners want their dogs to have a high quality of life (QoL), if not the best quality of life possible. Similarly, animal shelters and rehoming organisations intend for the dogs in their care and once they are adopted to have a high quality of life. However, it is imperative to investigate whether the intentions of both translate into reality.

The tendency of people to anthropomorphize dogs can impact these good intentions, resulting in an even poorer ability to understand dogs' needs. Although, if dogs' needs are accurately recognized, then it is likely that people will be more able to meet them, thereby improving dogs' QoL and decreasing the likelihood of relinquishment. Even though the volume of dogs being admitted to shelters worldwide is staggering, there has been very limited research into QoL throughout the rehoming process. Moreover, an assessment throughout the entire process will help shelters to allocate their very limited resources more efficiently and ensure suitable adopters re not being unjustifiably turned away. This study is part of a larger project . In the initial theoretical portion of the project a hierarchy of dogs' needs was developed, which included 42 individual and species level needs (e.g. access to daylight and fresh air on a daily basis) organized into 16 need groups (e.g. provision of preventative veterinary care), based on Maslow's Hierarchy of Needs. The aim of this study was to develop a practical tool to assess dogs' QoL based on the theoretical model.

A dog's QoL was qualified as a function of how well their needs are met. In order to create a reliable assessment tool, it was necessary to ensure that it was as objective as possible by omitting subjective assessor interpretations. To achieve this, a forced-choice style questionnaire was developed, including both binary (yes/no) and multiple-choice questions. Items on the questionnaire addressed each individual need within each need group, beginning with the bottom level (most basic needs) and progressing up the hierarchy (more specific needs). The same hierarchical need level necessity categories were used in the questionnaire (i.e. mandatory and preferred).

The assessment tool is now ready to be used to investigate the QoL of dogs pre- and post-adoption.

Although this assessment tool was developed to be used in a shelter/rehoming context, the tool was designed for usage in any setting with any population of dogs (e.g. community owned dogs).

Humans' mask wearing has limited effect on family dogs' behaviour in standard test situations

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Companion dog, Cognition, Behavior

COVID-19 has changed our lives in many aspects. Among the most spectacular changes is probably the mandatory wearing of masks, which was proven to negatively influence human social interactions as well as communication. The different COVID protocols, however, not only affected humans but also had a huge impact on companion animals, such as dogs, living in human society. For example, it is particularly alarming, that throughout the lockdowns the number of registered dog bites increased significantly. The phenomenon has been explained with the generally elevated stress level as well as family members and dogs spending more time together in restricted closed space. On the other hand, the communication deficit caused by the constant usage of masks cannot be ruled out as a further contributing factor.

In the current study we used previously validated, standard test situations (responsiveness to human pointing, basic obedience, spontaneous play, emotion recognition, threatening approach) where the human experimenter was with, or without wearing a mask.

N=20 family dogs were tested in a within subject design, with a minimum of 3-day difference between the two occasions. Tests were carried out in different sequences for each subject to eliminate the order effect. The order of the masked and maskless occasions was randomized as well.

We found that the mask-wearing of the experimenter did not influence dogs' performance in cognitive tests (all p>0.05). The only difference found was between dogs' reaction to the masked versus non-masked experimenter in the threatening approach situation. Reaction score was coded as an ordinary measure from friendly to aggressive on a 1-5 scale. The number of more aggressive responses was significantly higher for the masked as compared to the non-masked experimenter (Mann-Whitney test: U=21, p=0.016).

These results have two important implications. First, it seems that (at least in the situations investigated) dogs' cognitive performance is not affected by the experimenters mask wearing, thus suggesting that research carried out while COVID protocols enforced mask-wearing are valid. Second, and perhaps more importantly, dogs seem to react with more aggression to unfamiliar people wearing masks in ambivalent situations, thus special attention needs to be devoted to dog attacks when these regulations are in place. Further research needs to address aditional factors, e.g. the familiarity of the interacting (masked) human.

Exploring the demographic, evolutionary, and cultural drivers of dog keeping

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Companion dog, Interaction with humans

The number of dogs in the USA and in Europe has increased in the last two decades, while the number of children has remained stable or decreased. However, whether and how pets make people happier and healthier, in terms of the strength of social networks, level of entertainment, and contribution to physical and mental health, is contradictory and unclear.

The aim of this study is to investigate the hypothesis that people are turning to dogs for "unconditional love" as human fertility rates decline and the availability of kin decreases.

This literature review presents a critical and systematic analysis of existing research and literature on trends in attitude changes toward dogs, evolutionary theories on dog keeping, as well as the costs and benefits of dog ownership.

In human evolution, people lived in family groups and depended on their kind for their survival. The novel "dog keeping runaway theory" suggests that due to the demographic transition, people's strong innate preference for social proximity and nurturing group members has shifted to pets in the scarcity of available human kin. The cultural reinforcement of pet dog ownership and the lack of economic constraints have accelerated this trend. However, caring for pets may reduce opportunities and the desire for caring for children, while in post-industrialized societies, parents are often left alone with childcare and would require social support. On the other hand, the artificial selection for infant-like traits in dogs, such as brachycephalism, and treating them as surrogate children can lead to health and behavioral problems in dogs.

The dog keeping runaway theory offers a cultural evolutionary framework for understanding the role of dogs in modern societies and how this role might impact both the human and pet populations. Several avenues are proposed for future research. Considering that the complex relationships between dogs and owners can simultaneously have positive, negative, or neutral effects for both parties, the contradictory results about the benefits of dog keeping are understandable. Research needs to provide predictions on which type of dogs might be beneficial for certain groups of owners. Other currently largely unexplored questions are whether dogs regarded as family members decrease, increase or do not affect the biological fitness of humans; whether dogs facilitate or worsen humans' network complexity; how cultures differ in pet keeping practices; and why women are more closely associated with dogs than men.

Associations between dog owner temperament, dog-owner relationship and dog behavior

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Companion dog, Cognition, Interaction with humans

Owner characteristics influence the dog behavior and dog-owner interaction. However, previous studies are rather diverse, thus we aimed to clarify the interconnections of dog owner temperament, dog-owner relationship, and dog behavior.

We examined whether dog owner temperament is associated with the quality of dog-owner relationship or dog's behavior; and whether the dog breed group (FCI1 vs. FCI5) modulate the associations between the owner temperament and dog behavior.

Dogs (n = 440) underwent object choice, unsolvable task and cylinder tests, and their owners answered questionnaires of the owner temperament (revised adult temperament questionnaire, ATQ-R factors negative affectivity, extraversion, effortful control, orienting sensitivity) and dog-human relationship (Monash dog-owner relationship scale, MDORS). The correlations between ATQ-R, MDORS and dog behavioral tests, and linear models to predict the dog-owner emotional closeness (MDORS-EC) and perceived costs (MDORS-PC) were constructed in the SPSS software.

ATQ-R correlated with dog-owner relationship (Spearman's Rho; MDORS-EC: negative affectivity $p = 0.233$, $p < 0.001$; orienting sensitivity $p = 0.199$, $p < 0.001$; effortful control $p = -0.118$, $p < 0.05$; MDORS-PC: negative affectivity $p = 0.174$, $p < 0.001$; effortful control $p = -0.281$, $p < 0.001$; extroversion $p = -0.130$, $p < 0.01$). Extroversion also correlated with dog cylinder test results ($p = 0.106$, $p < 0.05$), and orienting sensitivity correlated with dog time in other than problem-solving in the unsolvable task ($p = 0.134$, $p < 0.01$). Furthermore, the connection of dog owner temperament and dog behavior differed according to the dog breed group: owner temperament correlated with the behavioral test results of FCI1 group dogs (orienting sensitivity—cylinder test $p = -0,177$; $p < 0.05$; negative affectivity—object choice $p = -0,216$; $p < 0.05$; effortful control—object choice $p = 0,216$; $p < 0.05$), but not FCI5 dogs. Owner negative affectivity and orienting sensitivity increased (linear regression; $T = 4.5$, $p < 0.001$; $T = 3.0$, $p < 0.01$, respectively) and higher number of children decreased MDORS-EC ($T = -2.3$, $p < 0.05$), whereas owner effortful control, extraversion, higher number of dogs and dog male gender decreased MDORS-PC ($T = -6.1$, $p < 0.001$; $T = -2.2$, $p < 0.05$; $T = -2.8$, $p < 0.01$; $T = -3.2$, $p < 0.001$).

Our results confirm that dog owner temperament affects the dog-owner relationship, and in FCI1 dogs, also the dog behavior, highlighting the human contribution for the dog-owner interaction.

A systematic review of non-invasive canine electroencephalography (EEG)

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Companion dog, Cognition

Within the past decade, the non-invasive use of EEG with canines has provided accessible, portable, and high temporal resolution neuroimaging insight, creating opportunities to investigate the neural underpinnings of canine cognition, and leading to the emergence of the field of canine cognitive neuroscience.

The aim of this paper is to systematically review non-invasive canine EEG studies, map their conceptual and methodological approaches, assess and frame their findings, and propose potential avenues for future research.

We conducted a systematic review of non-invasive canine EEG studies, utilizing a search query optimized for the SCOPUS database: (TITLE ((canine* OR dog*)) AND TITLE-ABS-KEY ((eeg OR erp OR electroencephalography))) AND PUBYEAR > 2010 AND PUBYEAR < 2024). We used a liberal inclusion criteria to select all studies using EEG with the canidae family (n=89) and a strict exclusion criteria to filter studies looking at domestic and non-sedated dogs (n=45) using non-invasive methods, i.e. no piercing of the epidermis (n=22). Studies were then dissected based on research questions and participants, technical setups, data-set makeup, and analysis frameworks and results.

The majority of the 22 identified studies focused on sleeping dogs (n=14) and investigated general questions of sleep macrostructure and patterns as well as specific variation across conditions. Studies in awake dogs explored questions in visual (n=3), auditory (n=1) and language processing (n=2), methodology (n=1), and individual variation (n=1). Most studies (n=18) worked with companion dogs of various ages and breeds and a handful used purpose-bred Beagles. The number of participant dogs varied between 2 - 155, with a median of 16 canine participants. A total of six different EEG setups at four different centers were used to collect eighteen unique EEG datasets. Setups varied in the number, type, and position of electrodes, with active channels ranging from 1 to 7. Most datasets consisted of continuous recordings (n=12), with the remaining (n=6) consisting of segmented events. Awake dog studies used event-related potentials (ERP) to interpret data, although nascent adoption of machine learning techniques were seen for artifact detection and category prediction.

We outline potential avenues for furthering EEG canine cognitive neuroscience, including the use of standard data structures such as EEG-BIDS and a shift towards predictive modeling. We end by highlighting the significant advances and affordances enabled by non-invasive and portable canine neuroimaging, especially with regards to comparative neuroscience and medicine, working dogs and human-canine interactions.

Associations between attitudes towards animal assisted therapy (AAT) and personality traits

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Companion dog, Assitance/therapy/working dogs

Despite the benefits and increasing popularity of animal assisted therapy (AAT), perceptions considerably differ regarding both sectoral and target group aspects. Research investigating attitudes towards AAT suggests that the possible reason for the diverse perceptions of AAT stems from the lack of clear methodology or principles, imprecise or incomplete knowledge on AAT, or aversion to possible barriers to methods.

Our study aimed to assess attitudes towards the most commonly used form of AAT, namely canine assisted therapy (CAT), in the light of different personality traits.

Questionnaires were applied to assess attitudes towards AAT (Attitude Towards AAT Test), attitudes on dogs (Coleman Dog Attitude Scale, CDAS) and knowledge on AAT (AAT Knowledge Test). Personality traits were assessed by the Big Five Inventory-2 (BFI).

Results identified associations between different personality traits, knowledge on AAT and attitudes towards AAT and dogs. Higher knowledge on AAT, as well as positive attitudes towards dogs correlated with positive attitudes towards AAT. Higher results on the Extroversion (E) and Agreeableness (A) trait dimensions of the Big Five scales correlated with positive attitudes towards dogs (ϱ = ,195, p (two-tailed) < ,0) and AAT (ϱ = ,252, p (two-tailed) < ,01), while Agreeableness (A) also correlated with positive attitudes towards dogs (ϱ = ,194, p (two-tailed) < ,01) and AAT (ϱ = ,186, p (two-tailed) < ,01). Positive attitudes towards AAT were associated with higher Conscientiousness (C) (ϱ = ,184, p (two-tailed) < ,01) and Openness to experience (O) (ϱ = ,152, p (two-tailed) < ,05). Meanwhile, higher Neuroticism (N) correlated with rather negative attitudes on AAT (ϱ = –,174, p (two-tailed) < ,05).

Findings identified associations between attitudes towards dogs and AAT, and different personality factors. Assessing individual perceptions of AAT in relation to personality traits might be considered crucial regarding the applicability of AAT.

Does owner-reported problem behaviour in dogs aged 6 months lead to an increased likelihood of relinquishment?

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Companion dog, Comparative research, Behavior

The relinquishment of companion dogs represents a major welfare concern. Owners report a variety of reasons for relinquishing their dog. However, the most frequent reason provided by owners for relinquishing their dogs is problem behaviour, although other human- and dog-related factors also play a role.

Are owners who report problem behaviour in their 6-month-old puppies (with/without seeking help for the behaviour) more likely to relinquish their dogs than owners who do not report problem behaviour?

This study utilised data from owners of dogs (aged 6 months to 4.5 years), living in the UK and Republic of Ireland, participating in a longitudinal study. Data relating to exposure variables were collected from owner-completed surveys. Relinquishment data were obtained from owners who withdrew from the study and had selected 'surrendered to a welfare/rehoming organisation' or 'rehomed' as the reason. Data were also included from owners who provided free text information citing that their dog had been relinquished. Using causal inference, a directed acyclic graph was created to identify a minimally sufficient set of confounders including owner and dog characteristics.

A logistic regression model tested the effect of owner-reported problem behaviour at age 6 months, combined with whether owners sought help for this behaviour, on the likelihood of relinquishment in dogs aged ≥6 months.

Of owners of 6,331 dogs, 60 (0.9%) reported relinquishing their dogs at ≥6 months and, of the relinquished dogs, 28 (46.7%) were relinquished between 6- and 12-months old. The oldest dog relinquished was aged approximately 4.5 years. Compared to the reference category of owners who reported that their dog was not showing behaviour they found to be a problem, no significant association was found between owner-reported problem behaviour, among owners who sought help, and subsequent relinquishment (OR=0.82, 95%CI 0.61-1.10, P=0.2). Similar results were found among owners who did not seek help for owner-reported problem behaviour, and subsequent relinquishment (OR=1.25, 95%CI 0.89-1.73, P=0.2).

Presence/absence of owner-reported problem behaviour in dogs 6 months or older was not a significant risk factor for relinquishment within this cohort, regardless of any owners' help-seeking activity. Further investigation is warranted as owner-reported problem behaviour at later timepoints may have more significance in the likelihood of relinquishment, particularly for dogs relinquished at older ages. This was a small dataset on a cohort of dogs from a longitudinal study and subsequent analysis will be conducted on a larger dataset.

From streets to homes: Exploring behaviours and dog-human relationship among adopted free-ranging dogs in India

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Feral/village/pariah dog, Behavior, Canine welfare

Free-ranging dogs (FRDs) have always been a part of the society in India. With their superior understanding of human body language and scavenging nature, these urban adapted animals are on the receiving end of a wide spectrum of attitudes from humans. Given that India has culturally different perspectives towards animals from Western countries, we aimed to investigate adopted dogs' at-home behaviours and human-dog relationships.

We hypothesized that adopters of Indian FRDs will report more challenging behaviours in the home and lower human-animal bonds. Alternatively, adopters will not report poorer behaviour nor weaker bonds, suggesting that FRDs can be successful in pet homes.

Participants were recruited using a snowball sampling method through social media and word of mouth. Survey I included owner and adopted FRD demographics along with behavioural assessment of the dogs using C-BARQ (Hsu & Serpell, 2003). Survey II included questions on the dog's lifestyle and Monash Dog Owner Relationship Scale (Dwyer et al., 2006). Exploratory factor analysis was performed on the C-BARQ to understand the subscale structure. The effect of owner and dog demographics on C-BARQ scores (n=1484) was analysed using multiple logistic regression. MDORS subscale scores (n= 427) were regressed against C-BARQ subscales and dog-human relationship indicators. Open answers for reasons for adoption, not sterilizing and cause for behavioral consultation for dog were analyzed for thematic content.

Responses were received from both Indian and international participants. Present age of adopted FRDs ranged from 6 months- 22 years and age of adoption ranged from newborn-18 years. Female FRDs (52.8%) were represented more compared to males. The major sources of adoption were from the "streets" (63.47%), followed by all other sources. Around 59% of the dogs were sterilized, with female dogs having a higher percentage of sterilization. Dogs differed in the CBARQ scores based on sex and neuter status. EFA revealed subscale differences from previous studies on dogs from Global North (Survey I). Participants reported high Emotional Closeness, low Personal Costs and average Dog-Owner Interaction (Survey II). Thematic analyses revealed intentional and unintentional patterns of adoption and varying causes for keeping their dogs intact and consulting a canine trainer. Multiple factors were found to be influential on CBARQ and MDORS subscale scores.

Our study provides a basic framework for exploring the causes of behavioral issues prevalent in FRDs, benefits of multi-pet household on canine welfare, and devising methods for science-backed promotion for adoption of FRDs. This research opens multitudes of avenues for future research, especially in the area of dog keeping and free-ranging dog welfare in India and other countries from the Global South.

Development of a suit-mounted feeder

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Assitance/therapy/working dogs, Canine welfare

Developing technology that improves the efficiency of dogs' training leads to an increase in their quality of life and welfare. We are developing a new feeding device that provides food rewards from a hidden location. In conventional dog training, food is rewarded from feeders placed in the environment or manually. However, with this method we observed persistent behaviors, such as dogs approaching the feeder or people when they saw it, in anticipation of a reward. In order to eliminate the influence of feeders and humans, and to ensure effective training, we develop a device that would feed as a reward from a hidden location.

We propose the hypothesis that by using a suit-mounted feeder to provide food rewards from a hidden location, we can achieve a feeding system that does not induce attachment to humans or devices. By equipping dogs with such a feeder, they can receive food rewards from a distance of over 10 meters without becoming fixated on the feeder or person.

We have developed a feeding device that can dispense food from a dog's back, which is a blind spot for canines. We tested the device on multiple dogs to assess its ability to provide food rewards. Following the handler's instructions, food was launched from the feeder in the dog's forward direction after the dog had stood or walked for a specific duration. The success rate of food capture was evaluated against the total number of feeding attempts.

Feeding was conducted with three dogs, all of which exhibited high feeding success rates without displaying attachment to the device after feeding. Feeding success rates for each dog are 86.7% (13/15), 94.1% (32/34) and 93.9% (46/49). Additionally, two of the dogs showed high adaptability to training induction using light stimuli, with feeding success rates of 100% (19/19) and 86.4% (19/22) for each dog. Variations in feeding success among individual dogs were found to be statistically insignificant (N=3, p=0.660).

This paper confirms that rewards can be given continuously from a back-mounted feeder without the dog being aware that the reward is off its back in three dogs. It was also shown to be adaptable to light-stimulated induced training in two dogs.

Comparing companion pigs' and dogs' reactions to negative human emotional vocalizations - A citizen science study

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Companion dog, Comparative research, Behavior

Emotional vocalizations, especially those of negative valence, are believed to form vocal emotional universals. This suggests that such vocalizations encode an animal's inner state similarly across species. Consequently, conspecific and heterospecific individuals can process these vocalizations similarly. Hearing emotional vocalizations can lead to emotional contagion, an automatic inner state matching between the caller and the receiver. Emotional contagion has been observed not only within but also across species, in family dogs after being exposed to human distress vocalizations. However, whether this interspecific emotional contagion is promoted by dogs' selection for cooperation with humans or it is generally rooted in the universals of vocal emotion coding, is unclear. One way to investigate this question is by comparing the reactions to human distress vocalizations of different species kept in similar conditions. Domestic pigs are increasingly popular as companion animals and occupy a similar social niche as the family dog. However, due their domestication purpose as meat stock, their common past with humans lacks selection for cooperation.

We hypothesized that if the universals of vocal emotional coding together with general domestication and intense human socialization are sufficient for vocal emotional contagion to emerge, then pigs and dogs would exhibit similar stress behaviours in response to human negative sounds. Conversely, if selection for cooperation is essential for this phenomenon to occur, then only dogs but not pigs would display more stress reactions to negative sounds.

Here we compared the reactions of intensively socialized companion dogs (N=30) and pigs (N=22) to human sound playbacks: a) negatively valenced: crying, and b) emotionally neutral: humming, in a citizen science study.

Dogs showed a higher level of stress reactions (p<0.001) and vocalized more (p<0.001) to crying than to humming. In contrast, pigs showed more stress signals (p<0.001) and vocalized more (p<0.001) to humming than to crying.

The finding that dogs showed a more negative emotional state when exposed to human crying, compared to human humming, suggests that emotional contagion may be induced in dogs through exposure to negative human vocalizations. While companion pigs could also differentiate between different human sounds, their reaction of exhibiting higher stress levels when exposed to neutral sounds compared to negative sounds cannot be attributed to emotional contagion but rather to sensitivity to the novelty of the sound (neophobia). These results suggest that selection for cooperation with humans may play a critical role in promoting human sound-induced emotional contagion in domestic mammals.

Assessing autism-like behaviour in dogs: the distracting effects of social and non-social stimuli on the touch screen task performance

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Companion dog

The dog has been proposed as a model of numerous human psychiatric diseases, including autism spectrum disorder (ASD). A recent account of the mechanisms underlying autistic behaviour in humans (social motivation theory) suggests that the core social symptoms of autism are rooted in impaired social motivation.

Here we aimed to investigate the predictions of this framework in dogs – that is, to study whether ASD-like behaviours in dogs are related to a decrease in social motivation, specifically, in the attentional weight assigned to social stimuli

Based on the diagnostic criteria of ASD we have developed an owner-reported questionnaire to assess those aspects of social skills in dogs, that may relate to the ASD-like behaviours. Data from completed questionnaires (N=1343) were subjected to exploratory factor analysis. This analysis produced a three-factor solution accounting for 41,3% of the total variance (F1: contact seeking and synchronization; F2: behaviour toward strangers; F3: attention to human communicative signals). A subsample of subjects (N=20 dogs with varying factor scores) were then trained to use a touchscreen in a visual cue-choice association task until the criterion is reached. Pre-training was followed by 10 baseline trials (without the use of any distractor stimuli). During the test phase, however, dogs had to perform the same nose-poke task while exposing them to non-social and social distracting stimuli (N=2x5 trials in a semi-random order).

The performance of the dogs with different levels of social competence varied in terms of how they responded to the distracting stimuli (measured by looking times). F1 and F3 scores were significantly associated with task-related looking times (i.e. looking at the touch screen): comparing the first social to the first non-social trial, dogs with higher F1 and F3 scores looked more at the screen in the presence of the non-social (as opposed to social) distractor, indicating that they were more distracted by the social stimulus (F1: p=0.037, β=0.468; F3: p=0.015, β=0.547).

These results seem to indicate that the social nature of task-irrelevant distractor stimuli differently affect the task-performance of dogs with low- and normal social competence. Our findings correspond to those previously found in human ASD studies and further confirm the idea that dogs represent promising model for the study of human-analogue forms of social-motivational deficits. Funded by NKFIH (K-128448).

Does every speech sound in a word matter to dogs? – an fMRI study

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Companion dog, Cognition

Recent advances in dog neuroimaging revealed remarkable similarities in how dog and human brains process spoken words. Among others, there is neural evidence for speech sound discrimination, for the recognition of known speech sound sequences, and for sensitivity to word meaningfulness in the canine brain. However, it is debated whether dogs have similar abilities to humans in accessing the phonetic details of words during lexical processing. While a behavioural study has suggested that dogs may attribute a meaning-changing role to a single speech sound in a word, an electroencephalography (EEG) experiment has suggested that dogs may not realize that every sound of a word matters. It is also an open question whether the previously identified brain areas involved in lexical processing are sensitive to the phonetic details of words.

The aim of our study was to investigate speech processing in the canine brain, with a particular focus on phonetic sensitivity during lexical processing.

Twenty awake, unrestrained dogs were presented with commands (WORD), phonetically similar (SIM- differing in only one vowel) and dissimilar nonsense words (NONW) during the experiment, while the elicited brain activity was measured using functional magnetic resonance imaging (fMRI).

In a whole-brain analysis, we found extensive bilateral auditory cortex activity when comparing all vocal stimuli to silence (pFWE<0.001). Using region of interest analyses, we also found that within certain brain areas involved in lexical processing (as identified in previous fMRI studies), the original commands and their phonetically similar forms were processed differently than dissimilar nonwords (mid ectosylvian gyrus - SIM vs. NONW: p=0.026, WORD vs. NONW: p=0.028; caudal ectosylvian gyrus - SIM vs. NONW: p=0.03). However, the activity elicited by words and phonetically similar nonwords did not differ.

These findings confirm the presence of lexical representations in the dog near-primary and secondary auditory cortex, but also shed light on the limited capacity of these brain areas to access the phonetic details of words.

Do dogs rely on their experience with a novel cue to predict how others would respond to it?

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Companion dog, Comparative research, Cognition

Theory of Mind (ToM) – the ability to impute mental states to oneself and to others, has been extensively studied in nonhuman animals, but current findings remain controversial. Dogs have been found to behave in accordance with what humans see or know, however, it is unclear whether they do so by attributing mental states such as knowledge (a ToM behavior), or by relying on how they saw humans behave in similar circumstances in the past.

Do dogs rely on their own experience with a novel auditory cue to predict how others would respond, specifically without ever having ever observed them do so?

Experiment 1: seven dogs learned to use a sound to find a hidden reward. In the absence of the sound, the probability of reinforcement was 20%. The dogs also learned to approach one experimenter (the Agent) if she retrieved a treat from its hiding place, and a second experimenter (the Baiter) if the Agent failed to retrieve the treat. Dogs were then presented with 20 test trials – ten in which the sound was presented and ten in which it was not. We then tested whether the dogs would rely on their experience with the sound to predict the Agent's response to it – that is, predict that the Agent would retrieve the treat when the sound was presented, and fail to do so in the absence of the sound, like the dogs did. Experiment 2: Identical to Experiment 1 except for two differences: first, in the absence of the auditory cue, the probability of reinforcement is 0. Second, instead of learning to approach either the Agent or the Baiter, the dogs learn to approach the Baiter when the Agent retrieves the treat, and to approach the mat under which the treats are hidden if the Agent fails to get the treat.

Experiment 1: The dogs' performance was not significantly different than chance level (n=7, p>.05 in binomial tests for individual performance). Instead, most dogs consistently approached one of the two experimenters throughout the 20 test trials. Experiment 2: Data collection is expected to be completed by the end of May 2023 (n=12).

This study has implications for our understanding of dogs' cognition and behavior and the dog-human relationship. Additionally, the novel method implemented here may be used to comparatively study ToM-related behaviors in other non-human animal species.

Working memory capacity of dogs in a self-ordered search task

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Cognition, Behavior

Working memory (WM) is a central cognitive ability that enables individuals to maintain and update information and to use it in the execution of cognitive tasks. WM, however, has a limited capacity, and it is an interesting question how this storage capacity varies with different ecologies and has been affected by evolutionary processes. In order to investigate this question, radial maze tasks have been used to make comparisons across non-human animal species.

In this study, we examined the WM capacity and updating abilities of dogs (Canis familiaris) in a radial maze task. We predicted stable individual differences in WM capacity, and expected that dogs remember and avoid multiple, previously visited and now depleted food locations.

At the beginning of each trial, we placed an opaque container baited with food at the end of each of 8 arms of a radial maze. Dogs (N=58) could search for rewards in these containers while continuously updating their mental representations in order to avoid revisiting depleted food locations.

We aim at estimating dogs' WM capacity by comparing their performance to different stochastic models generated to simulate the performance with different memory sizes. Additionally, we aim at analyzing the test-retest reliability of individual dogs' maze performance to evaluate the psychometric qualities of our WM updating task. (Data collection is currently ongoing; the results will be available at the conference).

With our results, we hope to establish a measure for WM capacity in dogs that can be used to compare this core executive function with that of humans and other non-human animals.

Does the sex of the human demonstrator influence the performance of dogs during an observational learning task? Preliminary results

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Companion dog, Cognition, Interaction with humans

Dogs can learn to perform actions through the observation of human demonstrators. Moreover, they behave differently when interacting with men or women. While they present more stress-appeasement behaviors towards men, they may prefer women due to more positive verbalizations and gentler pets.

The objective was to evaluate the effect of demonstrator's sex on observational learning. It would be expected for dogs with female owners to perform better.

The sample comprised 43 adult dogs, of both sexes and various breeds. Dogs had to learn to open the lid of a container using their paw or snout to obtain food. Dogs from the experimental condition (N = 29) observed their owner opening one of two containers, while dogs from the control condition (N = 14) received no demonstration and observed the baited container already opened. The owner was male for half of the dogs on each condition, and female for the other half. There were two phases of four demonstration trials and one test. The evaluation was carried out virtually through Zoom.

Generalized Linear Mixed Models were used. Compared to control, in the experimental condition dogs chose (F $(1,19)$ = 318.18, $p < 0.001$) and opened (F $(1,32)$ = 5.83, $p = 0.022$) the target container more frequently. Likewise, they exhibited greater contact with the target container in the first test (condition *phase: F $(1,41)$ = 7.10, $p = 0.011$), and less contact with the non-target container in both tests $(1,12)$ = 9.15, $p = 0.011$. In addition, dogs in the experimental condition looked longer at the target container's area during the demonstration phase (F $(1,23)$ = 79.36, $p < 0.001$). Finally, dogs with female owners chose the target container more frequently in the experimental condition than the control (condition*owner's sex: F $(1,14)$ = 224.70, $p < 0.001$). In contrast, male-owned dogs chose the correct container more and looked longer at the target container's area during the demonstration phase than female-owned dogs (F $(1,14)$ = 256.56, $p < 0.001$), regardless of the condition.

Dogs were able to learn to solve the task by observing a human. Only those with a female owner benefited from the demonstration, showing a moderate effect of the demonstrator's sex on said learning. These findings are relevant in applied settings and for the selection of research samples, as female owners are often more prevalent.

Post conflict consolation towards humans in domestic dogs: A pilot study.

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Companion dog, Cognition, Interaction with humans

Consolation is defined as a set of affiliative behaviors that an observer directs towards another individual expressing a negative emotional state. In the post-conflict paradigm, consolation towards the victim by an uninvolved bystander is observed. Dogs console conspecifics when they're victims of a conflict. However, this ability remains to be studied in human-to-human conflict.

We aim to evaluate if dogs show consolation to their owners after witnessing a fight between them, and whether stress levels and the role of the main owner (aggressor or victim) modulate the phenomenon.

19 family-owned adult dogs, from both sexes and various breeds were assessed remotely via Zoom. The dogs were exposed to experimental and control conditions, in two different sessions, counterbalancing the order. Experimental condition: Phase 1 (20s): one of the owners (aggressor) shouted at the other (victim) who remained silent. Phase 2 (90s): they sat opposite to each other, facing down in silence. Control condition: Phase 1 (20s): one owner spoke calmly to the other, who remained silent. Phase 2: identical to experimental condition. The dog was unleashed during the test. Both affiliative (proximity, gaze, latency to approach and which owner the dog approached first) and stress-related behaviors (crouching, ears down, lip licking, panting, tail lowering, vocalizations, yawning) were recorded.

Generalized Linear Mixed Models were used. Compared to control, in the experimental condition dogs showed a shorter latency to approach one of the owners during the second phase (p=0.032). They approached the victim first during phase 2 only when the main owner was the aggressor (p=0.047). They gazed at the victim more on both phases (p=0.000, p=0.046) and less at the aggressor on phase 2 (p=0.025). Dogs were less in proximity with the victim in phase 1 (p=0.011), and more in proximity with the aggressor during phase 2 (p=0.028). Dogs showed more stress on the experimental condition during phase 2 (p=0.022). All other comparisons were not significant.

Dogs were able to differentiate between the two conditions, with the experimental condition being more stressful. However, the results are mixed regarding the presence of consolation, as although they gazed more at the victim in the experimental condition, they stayed closer to the aggressor for longer periods of time. It is possible that this is due to the conflict's short duration and intensity. Currently, we're collecting data for a derivative study increasing the salience of the conflict.

Are dog owner's perceptions of their pets' intelligence accurate?

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Cognition, Behavior, Interaction with humans

Dog owners regularly comment on their dogs abilities, such as intelligence. But how much do these beliefs correspond to their pets' actual ability? Exploring owners' beliefs about their dogs' intelligence can highlight where public perceptions match or diverge from formal intelligence assessments.

Our study investigates whether dogs' perceived intelligence correlates with performance on a battery of cognitive tasks, predicts overall task battery score, and predicts performance on social or nonsocial tasks. We hypothesize that perceived dog intelligence will correlate with dogs' performance on social tasks, with high (social) performers being perceived as smarter. We also hypothesize that owners who are strongly attached to their dogs will rate their dogs as smarter.

Our task battery assesses both social and non-social aspects of intelligence: memory, executive function, communication, physical reasoning, and social motivation. We measure dog-owner perceived closeness (Development of the Monash Dog Owner Relationship Scale) and intelligence (The Perceptions of Dog Intelligence and Cognitive Skills Survey) via survey.

Data collection is ongoing.

Data collection is ongoing, and by the time of the conference we will have enough data to form a discussion and conclusion.

Dogs' perform better and more consistently in the Natural Detection Task in an indoor setting

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Companion dog, Behavior

Research into dogs' sense of smell is growing rapidly. However, it is difficult to generalize about dogs' olfactory ability because studies are usually conducted on a few specially trained dogs. Further, these trained detection or search dogs are required to work in a variety of environmental conditions and locations in which their performance is rarely compared.

We investigated whether temperature, dog demographics (age, sex, neutering status), test location and repetition of the test affect the olfactory performance of untrained family dogs of various breeds.

Subjects were tested in two locations (outdoors vs. indoors) using the Natural Detection Task, a simple food search situation with increasing difficulty (three levels). The effect of temperature and dog demographics on olfactory performance were examined in dogs tested outdoors (N=231). The effect of test location was examined using both between- and within subject designs (N=462 and N=72 respectively). The effect of repetition (test order) was examined using the within-test design. Dogs' performance was measured using three variables: number of levels passed and the number of trials needed to pass Level 2 and Level 3.

Temperature did not affect olfactory performance within the applied range of -5-25 C outdoors. Age, sex, and neutering status also did not influence olfactory performance. Dogs tested indoors passed a higher level (p<0.001) and needed fewer trials to pass Level 2 (p=0.003) than dogs tested outdoors. In the within-subject design, dogs passed a higher level indoors (p<0.001) and also during their second test occasion (p=0.021). Further, in the within-subject design, dogs tested indoors needed fewer trials to pass Level 2 than dogs tested outdoors (p=0.023).

We demonstrated in a very large and diverse sample of family dogs that the temperature (in the examined range) and dogs' demographics did not affect their olfactory performance outdoors. Dogs performed better indoors, which was likely due to less distracting stimuli. Dogs' better performance during the second test occasion suggested learning, i.e. by that time they were familiar with the test situation. Our findings can help guide the proper investigation of dogs' olfactory ability in future studies, as well as practical applications in which detection dogs are tested and used in operational contexts.

Comparing the identity-diagnosticity of acoustic cues in different dog and human vocalizations

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Comparative research, Interaction with humans

Vocalizations provide a wide range of information about the vocalizer, such as its sex, emotional state, or individual-identity. The ability to recognize the vocalizer plays an important role in social interactions of many species. Previous studies revealed individually distinctive identity cues in dog barks and human vocalizations. These identity-diagnostic vocal cues are also associated with emotions or other static features like body size, or in case of humans, sex of the speaker.

However, it remained unclear whether the identity-diagnosticity of certain vocal cues changes based on the vocalizer species, sex of the vocalizer or the type/context of the vocalization. We hypothesized that the identity-diagnosticity of vocal cues is influenced by (1) morphology, and that (2) certain vocalization types might have evolved to be more distinguishable.

Here, we investigated the identity-diagnosticity of mean fundamental frequency (f0), formant dispersion (dF), jitter (ppj) and harmonics-to-noise ratio (HNR) in vocalizations (dog barks, growls, whines and human speech) from different recording contexts of dogs (N=18/type) and humans (non-verbal signals towards the dogs in encourage, recall, chase away, inhibit contexts; N=36/context). The different acoustic cues in the same vocalization context and the same acoustic cues between the different vocalization contexts within and between species were compared with permuted Discriminant Function Analysis.

Our preliminary results show that, in growls, dF is more identity-diagnostic than any other cues (ps<0.007) and f0 is also more identity-diagnostic than ppj (p=0.011). We also found that dF is more identity-diagnostic in growls than in the contextually comparable chase away context of humans (especially males, p=0.003), suggesting that dF is a more reliable cue than other acoustic cues for dogs (and than for humans) to recognize the identity of their conspecifics based on withdrawal-eliciting vocalizations. Furthermore, the identity-diagnosticity of f0 was greater in the chase away context for female than male vocalizations (p=0.033). Finally, for male vocalizations, the identity-diagnosticities of f0, HNR and ppj in the inhibit context were all greater than in the recall context (ps<0.045).

Together, our results revealed the primary role of dF in dogs' vocal identity cuing, indicating the effects of much more variable morphology (e.g., size, head shape) in dogs compared to humans. Furthermore, the results showed the effect of vocalizer species and sex on the identity-diagnosticity of HNR. These findings also provide evidence that the identity-diagnosticity of certain vocal cues can depend on the vocalization context, even within same-sex humans.

Effects of pet ownership on mental and physical health, and well-being of young single professionals – implications on pet welfare

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Companion dog

The growing tendency of pet ownership in young single professionals has been extensively documented, with special focus on the impact of this phenomenon on the pet industry. Conversely, there is a gap in scientific knowledge about drivers of the "pet-boom" and effects on owners' well-being and social skills. Although positive effects of pet ownership in general are debated, we also have evidence that this trend may be driven by considerable positive effects, thus this issue remains to be investigated.

Our objective was to study the effect of pet ownership on physical and mental health, addictions, stress, depressive tendencies, social isolation and loneliness in the 25-35 age group. We hypothesized that pets contribute directly and indirectly to mental well-being, general physical health, and may reduce loneliness and depression in the target cohort, outweighing the undoubtable costs of pet ownership.

We conducted data collection from the target cohort using an anonym on-line survey (N=423) and principal component analysis of questionnaire data, developed mental and physical well-being scores for subjects and welfare scores of their pets. We investigated the relationship between pet ownership and mental and physical well-being scores, as well as assessed welfare status of pets belonging to members of the target cohort and possible correlations with owners' well-being scores.

We found a significant positive correlation (corr. coeff: 0.388; p=0.003) between pet ownership and mental well-being in our target group, while no such correlation was found regarding physical well-being. Pet welfare was found to above average as reported in the questionnaire, and no correlation on owner well-being scores and animal welfare score was found.

Our results are in line with previous findings that pet-keeping may have a positive effect on owners' perceived mental well-being, which may explain the drive behind increasing pet ownership tendencies in young single professionals. Physical well-being scores are not affected by pet-keeping in this group, however the general health of 25–35-year-olds may underlie this finding. According to our data, the welfare of pets owned by members of our target group is not compromised.

The effect of companion animals on the social network as appears in social media

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Companion dog

While, among young people, there is a worldwide decreasing tendency of marriage, having children and home ownership in western societies, pet ownership – on the contrary – is increasing at an unprecedented rate. The underlying mechanisms behind these trends, however, are largely undiscovered. It is not established but may be hypothesized that the lack of social embedding drives the need for pet ownership. Also, the effect of acquiring a pet may be twofold, as time spent with caring for the pet may limit time spent on forming human relationships, but pets could also be mediators for forming new relationships between owners.

In this study our aim was to establish if information appearing on publicly available social media profiles could be used to answer questions regarding social status, social embedding and the effect of pet-keeping on these. Our hypothesis was that the amount of active relationships (as shown by number of "friends", "likes", "comments" and "shares") may be effected by pet ownership, and may also be mediated by parenthood.

To investigate the feasibility of using this type of data in research, we have anonymously collected information from 100 publicly available social media profiles (51 males, 49 females), half pet owner and half non-owners. In a designated timeframe, we have collected information on number of relationships, number and topic of posts and number of likes, shares and comments received as a response to those posts. We investigated whether pet ownership influences any of these variables.

We haven't found a significant difference between pet owners and non-owners in the number of relationships ($p=0.13$), in general, however dog owners were found to have more relationships then subjects without dogs ($p=0.043$). We found that pet related posts are shared more likely by pet-owners ($p=0.001$). Pet ownership status does not seem to affect the number of self-related post, however, has a significant effect on the number of pet related posts ($p=0.001$).

The present study was exploratory and subject numbers were low. However, based on our results we can say that the method proposed is feasible, and data collection from public profiles may be a valuable source of information in studying social networks and pet ownership. Some of our results were in line with expectations, while others have highlighted interesting questions for future research, such as the possibly different effect different pet species may have on the social circle.

An epidemiological study on the life expectancy of Turkish companion dogs

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Companion dog, Comparative research, Interaction with humans

Companion dog lifespan data has exclusively been studied in developed economies; however, large numbers of companion dogs are kept in developing economies, and environmental and socioeconomic circumstances are not necessarily comparable. Here we report results from a survey-based study of lifespan in Turkish companion dogs.

Owner survey data of companion dogs can be used to show environmental and other effects on companion dog lifespan in a Turkish dog population.

We performed a survey of n=1,321 Turkish companion dogs based on online owner questionnaires, including lifespan, dog and owner demographics, living circumstances, socioeconomic status, preventative care, and various other factors. Data were analyzed through Kaplan-Meier analysis and Cox proportional hazard models.

Median survival time (MST) was 13 years. Most common causes of death were viral infections (n=126), cancer (n=60), and cardiovascular disease (n=36). Desexing ($\chi2$=31.6, P=2E-8), being a mixed breed ($\chi2$=6.4, P=0.01), and regular preventative care ($\chi2$ = 5.3, P = 0.02) significantly increased lifespan. Roaming freely significantly decreased lifespan ($\chi2$ = 19.5, P = 1E-5). Dogs living in duplexes and single-family homes lived longer than dogs living in apartments and houses on acreage ($\chi2$ = 10.5, P = 0.01). Owner income or education levels did not correlate with lifespan. In a Cox model, only desexing (HR=0.478, P=0.0006), living in a house on acreage (HR=2.30, P=0.0064) and being allowed to roam freely (HR=1.59, P=0.041) remained significant.

To our knowledge, this is the first study of companion dog lifespan in an emerging economy. While much of our findings correlate with those from developed economies, our sample also lets us study the effects of factors not commonly found in developed economies on dog lifespan, such as being allowed to roam freely.

Big boss of balls - validation of the Dog Rank Questionnaire

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Companion dog, Behavior

In groups of social animals, the main function of hierarchies is to regulate individuals' access to limited resources and to minimize conflicts within the group. For companion dogs, essential resources such as food are not limited but controlled by the owner. Still, dominance hierarchies have been observed in temporary groups of companion dogs. Hierarchies have also been found in cohabiting family dogs using questionnaire methods but so far no empirical tests were conducted to validate these questionnaires.

The aim of this study was to validate our questionnaire about the hierarchy between cohabiting family dogs using a resource competition test called the Toy-possession-test.

We tested 30 dog pairs for whom the owners completed an 8-question instrument about their behaviour and interactions. From the responses to these questions we calculated a Rank score for each dog in each household and also determined their ranks - the dog with the higher Rank score was the dominant one and the one with the lower Rank score was the subordinate one.

The Toy-possession-test had six trials with two different toys: a squeaky ball and one filled with treats. There were 3 trials with each toy, and the toys alternated between trials. Both dogs had equal chance to get a hold on the toy in each trial.

Dominant dogs grabbed the toys first ($p < 0.001$) and kept it more often ($p < 0.001$) than subordinate ones regardless of the dogs' age or the type of the toy.

Our results suggest that the Rank score derived from our questionnaire corresponds to actual resource related behaviours, thus reliably refers to dogs' rank.

The creation of a systematic framework to identify differences in dog laws across the nations of the United Kingdom

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Companion dog, Integration of dogs into human society

Law is an integral part of daily life of humans and their dogs and is the key method used by governments to integrate dogs into the human world. As law aims to reduce harm, who is being protected by legislation can highlight governments' prioritisation of various groups' interests. Dogs are popular in the United Kingdom (UK) where 33% of households have dogs. However, this popularity varies across the 4 nations (England, Scotland, Wales and Northern Ireland) which also vary politically, demographically and culturally. Because dog law is often enacted at this regional level, who these governments prioritise is also likely to vary. However, there is no method currently used to systematically compare different jurisdictions. The perception of difference makes campaigning for legislative change challenging for dog charities with finite resources.

This study aimed to create a systematic, conceptual framework to compare laws across jurisdictions by measuring the level of protections key groups gain.

Using content analysis, we analysed 332 laws identified through a systematic search of legislation.gov.uk, the official database of UK law hosted by The National Archives. We categorised the law area and if legislators intended to benefit dogs and their owners or the general public.

The framework was successful in enabling jurisdiction comparison. Results indicate that there is little difference in the prioritisation of beneficiary group interests across UK nations. Devolved nations often duplicated existing laws passed by the central government. All nations legislated similar proportions of law that manage dogs in public (7% difference across nations), dog protection (5% difference) and economic activity (4% difference). A similar pattern was found for law protection (difference between 1%-7% across nations).

These results have implications for organisations who wish to lobby governments by identifying the government that leads law creation. The framework enables future studies to create systematic understandings of dog law in countries with different governmental systems that can then be compared internationally.

An adaptation of the goggles experiment for dogs

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Companion dog, Cognition, Interaction with humans

Theory of mind like abilities in animals, such as understanding another's visual perception, still lacks definitive evidence. Previous research has found that dogs are sensitive to humans' attention while stealing food and might, to some extent, have the ability to infer that another individual's line of sight is blocked (Level 1 perspective taking). Here we investigate the extent to which domestic dogs take another individual's perspective into account. We adapted the famous goggles experiments (Heyes, 1998), to test level 2 perspective taking abilities in domestic dogs. Here we set up a situation during which the dogs not only have to understand when the other individual's line of sight is blocked, but have to infer the other individual's visual experience based on their own previous experience with the same object.

Can dogs use their own previous experience to infer the visual perspective of a human even when it differs from their own?

Dogs gained experience with two food containers and learnt that food could be accessed from one end of the containers. The opposite end of the containers were covered with lids, one lid transparent, the other opaque. This meant that when stealing the food, dogs would be visible on the transparent lid side, but hidden on the opaque side. After an experience period during which dogs had the opportunity to learn about the properties of the boxes, dogs then entered the experimental phase. Here food was placed in both containers, and the human then told the dog not to take it, establishing a competitive context over the food. A second non-social condition was used where the human left the room after giving the same command. We then observed (i) whether the dog would make the decision to take the food, (ii) which box the dog would approach first and (iii) latency to approach.

Results show that dogs (N=24) had no preference to steal food from the concealed, opaque side. However, the latency to approach was longer and more dogs chose not to steal when a human was present.

Our current results indicate that in this situation dogs do not take the human's perspective into account when deciding which piece of food to steal. However, the dogs were sensitive to the competitive nature of the study. It is possible that the setting was overall too challenging and future research should look for simplified procedures to address the question of dogs' understanding of others' perspective.

Automated recognition of emotional states from canine facial expressions: the case of positive anticipation and frustration

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Companion dog, Cognition, Behavior

In animal research, automation of affective states recognition has so far mainly addressed pain in a few species. Emotional states remain uncharted territories, especially in dogs, due to the complexity of their facial morphology and expressions.

AI can be used to classify emotional states of negative/positive valence from dogs' facial expressions.

A dataset of videos from (n = 29) Labrador Retrievers assumed to be in two experimentally induced emotional states: negative (frustration) and positive (anticipation) was collected. The dogs' facial expressions were measured using the Dogs Facial Action Coding System (DogFACS). Two different approaches are compared in relation to our aim: (1) a DogFACS-based approach with a two-step pipeline consisting of (i) a DogFACS variable detector and (ii) a positive/negative state Decision Tree classifier; (2) An approach using deep learning techniques with no intermediate representation.

The approaches reach classification accuracy of above 71% and 89%, respectively, with the deep learning approach performing better.

The use of deep learning approaches requires investigation of explainability due to their `black box' nature. We address this issue using heatmaps reflecting regions of focus of the network's attention, which in some cases show focus clearly related to the nature of particular DogFACS variables. These heatmaps may hold the key to novel insights on the sensitivity of the network to nuanced pixel patterns reflecting information invisible to the human eye.

List of presenters

Presenter

Dr Judit Abdai

Dr Attila Andics

Dr Amin Azadian

Dr Victor Azariev

Ms Viktória Bakos

Ms Flavie Bensaali-Nemes

Miss Paula Berg

Dr Anindita Bhadra

Dr Sharyn Bistre Dabbah

Dr Magdalena Boch

Ms Zsófia Bognár

Ms Marianna Csilla Boros

Dr Annika Bremhorst

Miss Anna Broseghini

Miss Chiara Canori

Dr Camila Cavalli

Miss Emma Cox

Ms Melitta Csepregi

Miss Barbara Csibra

Dr Laura Verónica Cuaya

Mrs Iuna Decourtias

Dr Joni Delanoeije

Dr Alessia Diana

Miss Petra Dobos

Presenter

Shany Dror

Dr Tamás Faragó

Dr Jaume R Fatjó

Dr Claudia Fugazza

Dr Udo Gansloßer

Dr Anna Gergely

Ms Karoline Gerwisch

Miss Cécile Chantal, Catherine Guérineau

Dr Márta Gácsi

Dr Erin Hecht

Ms Pauline Heinze

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Dr Ivaylo Borislavov Iotchev

Dr Eleanor Jordan

Miss Saara Elviira Junttila

Dr Griffin Karen

Haruka Kasuga

Miss Rachel Kinsman

Anna Kis

Dr Akitsugu Konno

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Ms Kinga Kovács

Ms Édua Koós-Hutás

Dr Eniko Kubinyi

Dr Miiamaaria Kujala

Mr Akash Kulgod

Ms Lívia Langner

Dr RUBINA MONDAL

Miss Louise Eleanor Mackie

Miss Chloe Maher

Dr Jennifer Meadows

Miss Anna Morros-Nuevo

Boglárka Morvai

Ms Madison Swonk Murray

Mr Shoichi Nezu

Ms Jori Noordenbos

Dr Zoe Parr-Cortes

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