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Abstracts

Wolf ecology, management and conservation in Scandinavia

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The Scandinavian wolf population is small (approx.. 300 animals in 2011/12), isolated and with a narrow genetic basis. The inbreeding level is extremely high. The wolf thus is strongly threatened in Scandianvia, which limits the options for management. Managers have to find a balance between the conservation requirements, demanding a large population, and the conflict with local people, bidding for a strong control of wolves.

As a member of the European Union, Sweden (where 80 % of the Scandinavian wolf population lives) is also restricted by the regulations of the Union´s Species and Habitat Directives. The conflicts consist of competition with hunters for valuable game, especially moose, the killing of domestic dogs, and of livestock, especially sheep. Also personal fear is affecting the attitudes towards wolves. The conflict is especially sharp with the reindeer husbandry, an essential part of the Sami people culture. The Sami strongly argue that is is impossible to combine reindeer husbandry with presence of wolves.

For this reason wolves are excluded from the northern half of Scandinavia. This unfortunately strongly limits the badly needed immigration of genetically unrelated wolves from the only neighboring wolf population, i.e. in Finland/Russia. Here two principles of the European Union clashes, protection of threatened species and protection of the rights of aboriginal people. In this talk I will try to outline how the authorities in the Scandinavian countries are trying to find compromises that will satisfy all stakeholders, including the European Union, in this inflamed conflict, and how well these efforts have succeded.

Interactions between wolves and livestock guarding dogs on a French alpine pasture

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Background

Livestock guarding dogs (LGDs) are one of the most representative working dogs, but few studies have been conducted on them, especially on the interactions with predators and their effect on them. LGDs do not completely prevent losses from wolves and do not avoid them coming back, suggesting that no long-term avoidance learning occurs. They might therefore be assimilated to a disruptive stimulus tool that does not permanently modify wolf behaviour (Shivik 2006). The goal of the present study was to collect information from the field to understand how the presence of LGDs with a flock of sheep affects wolves foraging behaviour.

Methodology/Principal Findings

We video recorded with an infrared camera 23 interactions between 5 and 4 LGDs with wolves on two pastures. Our results showed that : 1) wolves could be active on the same alpine pasture during at least 7h44; 2) the presence of LGDs did not prevent wolves from approaching the flock and a dead lamb or from attacking sheep ; 3) short (4,87s; SD 1,95; n=6), medium (41,52s; SD 8,51; n= 7) and long chases (200,92s; SD 0,77, n = 2) or even a fight followed by a short chase did not prevent wolves from coming back ; 4) the duration of wolves' flight was correlated with the duration of LGDs' chase ; 5) lone LGDs chased wolves for shorter distances than two LGDs, 6) LGDs' barks did not prevent wolves from approaching the flock, did not make them flee and did not even disrupt their behaviour in two thirds of the observations; 7) in 22 out of the 23 observed interactions, LGDs did not engage in physical contact or fight.

Conclusions/Significance

These observations show that LGDs interrupt wolves' ongoing behaviour without making them flee, therefore validating the hypothesis that they act as a disruptive stimulus. Our data also suggest that both LGDs and wolves evaluate the risk of a fight and that the latter put into balance the foraging costs (come back).

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Genetic support from a zoo population can nearly double genetic variation of an isolated, highly inbred wild wolf population

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Keywords: *canis lupus*, conservation breeding, pedigree analysis

The wolf (*Canis lupus*) is classified as Endangered in Sweden. The present wild population descends from only five individuals. It is isolated and highly inbred, with individuals being on average more related to each other than siblings. Inbreeding depression expressed as reduced litter size with increased levels of inbreeding has been documented to occur in the population (Liberg et al. 2005). Also, spinal disorders that are thought to be inherited in some dog breeds have been observed at a relatively high frequency (Räikkönen et al. 2006).

The genetic problems of this population are becoming recognized by authorities and an explicit political goal now includes that inbreeding levels should be considerably reduced. To achieve this goal, 20 unrelated wolves are to be released into the wild. It is currently unclear, however, where wolves for release are to be obtained from. One suggestion is to use a captive wolf population of northern European origin that is bred in a conservation breeding program in European zoos to obtain very young pups that can be placed in dens of nursing wild females using so called cross-fostering tehniques (Kitchen & Knowlton 2006).

We used pedigree data of the wild and captive population to investigate the potential of the captive population to contribute genetically to the wild population. We analyzed statistically levels of variation, inbreeding and kinship of the separate and joint populations to evaluate the extent to which the captive population can be used to support the wild population genetically with respect to increase of genetic variation and reduction of inbreeding levels.

The results show that genetic variation measured as founder alleles and founder genome equivalents can be almost doubled (from 11.2 to 21.1 and from 1.83 to 3.23, respectively) through release of wolves from the zoo population. The average level of inbreeding in the wild population can be reduced from about 0.27 to around 0.15.

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Do dogs detect distress as humans do? A cortisol study

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The present study examined whether dogs show an increased stress response when listening to a human infant crying. When a human hears an infant crying, s/he often responds with an increase in cortisol level (Fleming, Corter, Stallings, & Steiner, 2002; Giardino, Gonzalez, Steiner, & Fleming, 2008). This response is sometimes described as *empathy* (de Waal, 2008). We compared dogs' and humans' responses to three auditory stimuli: a human infant crying, a human infant babbling, and a computer generated "white noise". Two of these sounds (infant crying and white noise) could be considered aversive. In contrast, infant crying generally evokes an empathic response from humans.

Seventy four dogs (M = 5.29 years, 41 females) and 71 young adult humans (M = 21.46 years, 36 females) were assigned to one of the three sound stimuli. There were five different sound clips of each stimulus, and each clip was played back at an average loudness of 82 dB from 3m distance. Saliva samples were taken from both dogs and human participants to determine the cortisol levels prior to and 18 minutes after the onset of the auditory stimulus. Enzyme-linked immunosorbent assay was used to analyse the cortisol concentration in the saliva samples.

A 2x2x3 ANOVA with cortisol levels (before, after), species (young adult humans, dogs) and auditory stimulus (infant crying, infant babbling, white noise) as between-subjects factors revealed a significant interaction $F(2, 139) = 3.13$, $p = 0.04$. For each stimulus, cortisol levels had a significant increase after infant crying stimulus, $p = 0.04$, but not after infant babbling or white noise in young adult humans, but not in dogs. Dogs showed an increasing trend in cortisol levels in both infant crying, and white noise. This trend, however, was not found in young adult humans. From these results, it appears that dogs might understand distress differently from humans, although we are currently collecting more data to determine whether a larger sample might reveal sensitivity in dogs.

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Visual perception in domestic dogs (*Canis familiaris*): global or local preference of stimulus encoding

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Background

Humans process the global features of a visual scene before proceeding to a more fine-grained analysis of local details [2]. A global or local preference has been found in other animals depending on the species [1,3]. In the lack of data about dogs, this study aimed to investigate visual processing of global and local dimensions in this species.

Methodology/Principal Findings

To this aim, family dogs (N=8) were trained to discriminate between two bi-dimensional compound forms (S+ and S-) differing at both their global and local level (GL phase). Afterwards (Test phase), the dogs' global-local encoding preference was assessed, presenting one stimulus with the same global shape and one with the same local shapes as that reinforced in GL. In the last phase (L) dogs were trained to discriminate between S+ (the same used in GL) and S-, differing only for the local shapes. Data were analyzed with non-parametric statistical analysis (Mann-Whitney U or Wilcoxon W).

In GL the number of trials needed to reach the learning criterion was 252±143 (mean±SD) and latency (time between release of the dog and choice of the stimulus) was 4.2±5.0 s (mean±SD). In the Test phase dogs chose the stimulus featuring the previously learned global shape more often than the one featuring the local shape (p=0.017; SE=7.13). In Test trials latency was longer than in GL trials (p=0.001; SE=263.5). In L dogs achieved the learning criterion in an average of 130±67 trials, which were fewer than those needed in GL (p=0.018; SE=5.90). Moreover, latency was shorter in L than in GL (p=0.029; SE=91.43).

Conclusion/Significance

As humans, dogs showed a global preference in the visual processing of hierarchical stimuli. Results of the L phase demonstrated that dogs could perceive local features and use them to discriminate between stimuli. The faster acquisition and shorter latency in L might have been due to a previous reinforcement of the local shape during GL.

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Visual event-related potentials of dogs recorded with fully non-invasive electroencephalography

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Background
Recently, the dog has become a popular model animal in comparative cognition research, but the methods suitable for studying dogs' cognitive processes and their neural background are still scarce. In the previous decades, electroencephalography (EEG) studies with animals have mostly been invasive and they have required sedation or anesthetizing of the animals, whereas in humans studies, EEG is commonly measured using non-invasive scalp electrodes. Because of these methodological differences in human and animal EEG studies, the results are difficult to compare. In the present study, we employed completely non-invasive scalp-EEG in studying the neural correlates of the early visual cognition of dogs. Our aim was to validate the feasibility of this technique in studies of dogs by characterizing the visual N1 components in individual dogs, as well as at the group-level.

Methodology/Principal Findings
The EEG of eight dogs were recorded with 7 electrodes on the scalp while the dogs observed images of dog and human faces. Since muscle movements cause grave artefacts in EEG data, the dogs were trained to lay still using a positive operant conditioning method, but they were neither restrained nor sedated during the measurements. Group-level results demonstrated the visual N1 response around 75 ms, differing from zero at the posterior EEG channels P3 and P4 (across-dogs mean ± SEM -5 ± -1 μV, Student's t-test, $p < 0.001$). The location of the channel depicting the maximum response varied slightly in individual dogs, but the latency and the transient form of the response were similar in all dogs.

Conclusions
Our study is the first to demonstrate the feasibility of scalp-EEG measurements in dogs, and we show the group-level visual N1 response of dogs using ecologically valid visual stimuli. We expect our experiment to pave the way for future neurocognitive studies in dogs, as well as for studies comparing brain processes across species.

Evolution of wild and domestic canids

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Because of their close relationship with humans, there has been a great interest in understanding the origin and evolution of dogs and their closest wild relatives. The reconstruction of the relationships between species depends on the use of unambiguous markers that are not subject to parallel or convergent evolution. The availability of genetic data has provided a large number of such markers. For canids, these data have been available earlier than for other groups of organisms and the study of canid evolution has been one step ahead of the study in other animal groups. This is because dogs have become model organisms in biomedicine and huge resources have been devoted to characterize their genome and the genetic basis of morphological traits and diseases, and these resources are usable across a wide range of species.

The usage of these genetic tools has allowed the construction of a robust phylogenetic tree since the mid 1990's. These tools have also facilitated the study of the origin of dogs and their domestication. We know a little bit more about when and where the domestication may have taken place, but we do not have yet a final answer to these questions. We have also started to understand the origin of breeds (what does it mean for a breed to be "ancient"?), as well as genes of known function that have been under selection. We can identify the impact that dogs could have on the conservation of wolf populations. All together, the recent advances in the study of the genome of dogs and other canids promise to shed light on many disputed questions (such as the existence of an African wolf, a different species around the great Lakes, time of domestication...), although many other questions appear on the way.

Guidelines for Endophenotyping in Behavior Genetics Studies

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Background
A bottleneck in producing high-quality genetic research is phenotyping, often discussed when study results are inconclusive. This methodological aspect will be investigated for behavior genetics studies by discussing guidelines for (endo) phenotypes & results from an ongoing prospective study of positive affect in Alaskan sled dogs.

Methodology/Principle Findings
Guidelines: (1) Focus on phenotyping & analyzing components of complex (latent) behavioral traits instead of using the full construct. (2) Reduce subjectivity in data collection. (3) Aim for good phenotypic resolution. (4) Investigate reliability & validity of data.

Study: Ad (1): >70 sled dogs were phenotyped to measure positive affect, a subcomponent of the personality trait *Extraversion*. Dogs performed two tests measuring the effect of positive stimuli. 3 continuous phenotypes & >30 (qualitative) characteristics of dogs' behaviors were selected. Ad (2): Videotaping of tests allows extraction of objective measurements, quality control of data including analyzing the influence of the video analyst. Ad (3): Two endophenotypes show variation among dogs (intensity & speed when connecting with tester). Ad (4): Reliability of the two endophenotypes is >80% for 12 retested dogs. To test validity of both behavioral tests, 40 people evaluated study-dogs' behaviors & describe their perception of positive affect. Preliminary data analysis shows that variable expression of positive affect could be recognized by the majority of responders (>70%).

Conclusions/Significance
The endophenotype concept, as used in genetic epidemiology, provides an opportunity to obtain continuous phenotypes for genetic behavioral studies that are (1) directly related to their genetic background, and (2) not statistical constructs, but measurements obtained in an objective way. The use of these kinds of phenotypes will allow a higher power for genetic statistical analyses & provide the opportunity to find more clear genetic signals.

Genetic evaluation of temperament traits in the Rough Collie

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Keywords: breeding, temperament, collie

Fear-related problems are common in the Swedish Rough Collie (RC). The aim of this study was to develop a genetic evaluation for temperament, based on the Swedish Dog Mentality Assessment (DMA - a field test used in large scale to characterize temperament traits in dogs), thereby facilitating more effective selection of breeding animals. Genetic analyses were performed on the individual DMA variables, and on five broader composite/personality traits. A traditional quantitative genetic evaluation was used, which relies on using pedigree information and resemblance between relatives to estimate genetic (co)variances and breeding values.

DMA data were available from 2550 RC and the pedigree contained 42,523 dogs. Genetic parameters were estimated using a linear mixed model including fixed effects of sex, age, year and test month, and random effects of litter, judge, test site, breeding value of the individual dog and residual. Heritabilities ranged from 0.05-0.31 – the higher values for the personality traits. Validation of the DMA was done using the C-BARQ questionnaire. Owners of RC aged from 6 mo to 10 years were targeted and information about 1766 dogs was generated (a reply rate of 50%). Of these, 935 had information from the DMA. There were high and significant genetic correlations between the personality traits measured in the DMA, and the everyday behaviour of the dogs as described by the owners. For instance, sociability in DMA was positively correlated with stranger-directed interest (r_g=0.87, SE=0.08), and negatively correlated with stranger-directed fear (r_g=-0.80, SE=0.09). Curiosity/fearlessness in DMA was negatively correlated with stranger-directed fear (r_g=-0.44, SE=0.14) and non-social fear (r_g=-0.70, SE=0.10).

We conclude that selection for temperament in Rough Collie, based DMA data, is possible and could reduce the frequency of fearful dogs in the breed. As from March 2012, BLUP breeding values are available for Swedish Collie breeders.

Immune gene diversity in grey wolves (*Canis lupus*)

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Keywords: Wolf (Canis lupus), MHC, natural selection

Maintaining adaptive genetic variation is one of the key factors in the conservation of small populations. Major histocompatibility complex (MHC) is a gene dense region, where substantial numbers of immune genes are located. Lowered genetic variation in MHC loci can lead to lowered immunity against pathogens which may increase the risk of extinction of the population. Wolf populations have been persecuted all over the world and the species' former large distribution across the Northern hemisphere has diminished and fragmented. This may have led to lowered genetic variation in adaptive genes. Our aim was to study the MHC diversity and natural selection in grey wolf.

We sequenced the second exon from three MHC class II loci; DLA-DRB1, DLA-DQA1 and DLA-DQB1 among 546 wolves from Europe (371) and North-America (175). The second exon codes for peptide binding end of the MHC molecule and is highly variable. This polymorphism is maintained by balancing selection. Parasites are thought to be one of the ultimate selection factors, and thus we have studied the association of MHC class II loci to *Echinococcus granulosus* and *Trichinella* spp. infections among the Finnish wolf individuals.

Our results show that the MHC haplotypes in European and North-American wolf populations are highly differentiated. Altogether 43 three locus haplotypes were found, of which old and new world wolves shared only 5. North-American wolves were markedly more diverse than European wolves (28 and 20 haplotypes, respectively). Allele frequencies in the North-American and two European wolf populations were more equal than expected; Tajima's D and Fu & Li D* and F* tests also gave significantly positive values, implying balancing selection. We also found that homozygosity increased the risk of *Trichinella* spp. infection among Finnish wolves. As a conclusion, we found high differentiation between the European and North-American wolf populations and evidence for balancing selection.

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What makes a dog to spin? An integrated analysis of genetic and environmental factors affecting tail chasing in four dog breeds

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Exaggerated, inappropriate and repetitive behaviour in animals is referred to as stereotypic or compulsive behaviour. Canine compulsive behaviour is often breed-specific and includes various forms such as tail chasing (TC), light/shadow chasing, sucking, licking and chasing "invisible flies".

The potential causes of animal stereotypic behaviour include both genetic and environmental factors (Dodman et al. 2010, Moon-Fanelli et al. 2011,). Our aim was to investigate the genetic and environmental factors associated with compulsive TC in Bull Terrier, Miniature Bull Terrier, Staffordshire Bull Terrier and German Shepherd breeds. We performed a detailed questionnaire survey in a pet population of 368 dogs. A genome wide association study (GWAS) was performed for selected dogs to map the TC loci using canine SNP arrays. We found an early onset and large variation in TC frequency. Dogs that received dietary supplements, especially vitamins and minerals, expressed less TC compared with dogs that did not receive any supplements ($p<0.001$). Neutered females had less TC ($p=0.008$), suggesting an influence of ovarian hormones on TC. Tail chasers also were shyer ($p <0.001$), had been separated earlier from their mothers $p=0.036$) and had experienced lower quality maternal care ($p=0.018$) compared to controls. Our pedigrees suggest a strong genetic contribution in all breeds and our preliminary GWAS data suggest a TC locus in Staffordshire Bull Terriers.

Our study reveals novel environmental correlates for canine TC such as micronutrients, neutering and maternal care. The identification of the associated genetic and environmental factors will provide new important information for the dog owners on the stereotypic behaviour, new tools for breeding programs, and also establish TC dogs for promising models for understanding the canine and human compulsive behaviour.

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Analysis of Y-chromosome DNA suggests a multiple-region origin of domestic dog

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Keywords: *Canis lupus*, Y-chromosome, dog domestication

Background
There is no doubt that the domestic dog originates from the wolf. However, there is some controversy about the geographical region where the dog domestication occurred. Archaeological and autosomal single nucleotide polymorphism (SNP) data have indicated that dogs originate from Europe and/or Middle East. In contrast, mitochondrial DNA (mtDNA) and Y-chromosome DNA data have suggested that dogs originate from Asia South of Yangtze River (ASY). Y-chromosome DNA data from 151 dogs and 12 wolves showed that the ASY region has the highest dog genetic diversity (Ding et al., 2011). However, in this analysis few wolf samples were used in order to obtain the variability range of the universal gene pool.

Methodology/Principal Findings
We sequenced different regions up to 3,216 bp of dog/wolf Y-chromosome -included in the 14,437 bp sequenced by Ding et al. (2011)- in 56 dogs and 20 wolves (from Spain, Italy, Russia, Israel and Mongolia). This made for a total of 207 dog and 32 wolf Y-chromosome DNA samples that were analysed and classified in 7 geographical regions: Africa, America, ASY, East Asia, Siberia, South West Asia (principally Middle East) and Europe.

Even though nucleotide variation was quite similar between dogs and wolves since most of polymorphisms observed were shared and no mutations were fixed, FST showed significant differentiation between populations. We found 12 haplotypes out of the 28 haplotypes as described by Ding et al. (2011) because of the smaller DNA region sequenced. However, the highest number of haplotypes was found in Europe instead of ASY. The haplotype with the widest distribution and shared with dogs (H23) was even observed in Iberian and Italian wolves, in the last case as unique haplotype. Furthermore, we identified one haplotype (H9) shared between wolves from Spain and Mongolia and dogs from Africa and Siberia. Finally, the most common dog haplotype (H1) was found mostly in Europe while the exclusive wolf haplotype (H27) was found among East Asia samples.

Conclusion
Our results do not support the hypothesis that domestication occurred primarily, and maybe exclusively, in ASY as suggested by Ding et al. (2011), but point to a multiple-region origin for the domestic dog.

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Analysis of intraspecific attachment in dogs (*Canis familiaris)*: preliminary results

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Keywords: attachment, dog, intraspecific

Dogs are known to form strong relationships towards subjects of their own kind and other species.

The aim of this research was to assess whether dogs form intraspecific attachment bonds.

Twenty-two dogs (11 females and 11 males; 64.0±70.1 month old) participated in the study. Their behaviour was analysed in a modified version of the Ainsworth's Strange Situation Test, where the stranger was played by a 30 year old woman. The role of the presumed attachment figure was played by a conspecific living in the same household, for whom separation behavior problems were excluded. Eighteen social and non-social behaviours were observed. The two dogs were left free in the unknown room, therefore for social behaviours only those started by the tested dog were statistically analysed. Data was analysed by a Friedman and then a Wilcoxon test (p<0.05).

Dogs in isolation were found to cry more than in the presence of the stranger (p=0.044) or the other dog (p=0.004). Moreover, when dogs were alone, they displayed more behaviours directed to the door (isolation vs stranger: p=0.000; isolation vs dog: p=0.000) and spent more time close to the door (isolation vs stranger: p=0.001; isolation vs dog: p=0.015). For such behaviours, no difference was found when comparing episodes in which the examined dog was with the stranger or with the other dog.

Concerning social behaviours, dogs behaved similarly towards stranger and conspecifics for physical contact (p=0.694), proximity (p=0.543) and attention seeking behaviours (p=0.362).

Unlike previous research on dog attachment to owner (Topál et al., 1998; Prato-Previde et al., 2003), dogs' behaviour related to stranger and cohabitant dogs was quite similar. So the presence of an intraspecific attachment in dogs was not demonstrated. However, results show that dogs were more stressed when in complete isolation than in the company of a familiar dog; and the presence of a human being, although unfamiliar, has a similar ameliorative effect.

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Social Play Behavior in Dogs and Their Wild Relatives: What we know and don't know and directions for future research

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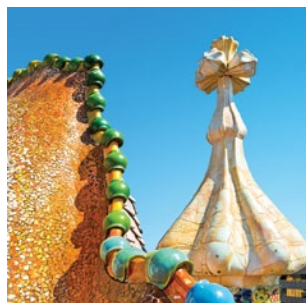
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Social play remains a category of behavior about which we know quite a bit, but there still is much we have to learn about the details of playful interactions. Much of what we already know about the development, evolution, and social dynamics of play has come from detailed research on domestic dogs and their wild relatives. For example, there are marked species differences in the development of play in dogs, coyotes, and wolves that appear to be related to variations in species-typical social organization, and play in these canids follow strict rules of social interaction that center on fairness and trust. The study of play also is related to questions about animal emotions and moral behavior. In my talk I will highlight what we know and don't know about the structure, dynamics, and possible functions of social play, the types of future comparative research that are needed, and why it is important to understand this fascinating behavior. The study of play falls nicely into the scope of the 3rd Canine Science Forum in that it requires interdisciplinary collaboration, involves non-invasive research that can readily be conducted in dog parks and in various captive settings, will generate results that can be used to enrich the lives of individuals, and provides information that can be used to more fully understand and integrate dogs and other canids into society. We also can learn a lot about human play from studies of various canids.

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Wolves, dogs and the human psyche: from Freud to the role of canids in society

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The case of Mr. Pankejeff, a patient of Sigmund Freud, and his dream about being threatened by a pack of wolves was a true highlight in the development of psychoanalysis. Freud interpreted that nightmare as symbolic of the childhood trauma that Mr. Pankejeff, the so-called "Wolf Man", experienced when he witnessed his parents having intercourse. Later in life, Freud developed a very strong emotional bond to a German shepherd dog that was actually named wolf. These early anecdotes from the rise of psychiatry are a reflection of the complex, and often contradictory, attitudes people have of wolves and dogs, which have been considered to be close enough to belong to the same species. The attitudes humans have had toward wolves and dogs are actually a good metaphor of our relationship with nature, where we have been hunters and hunted, dominators and dominated.

With the progression from primitive agriculture, to specialised farming and then into industrialisation, our society has been accused of becoming increasingly detached from nature, with only domestic species and particularly companion animals being part of our everyday lives. Nevertheless, relatively recent modern scientific developments have provided us with the necessary perspective to analyse our relationships with canids in a more objective way.

Wolves and domestic dogs remain animals that are equally capable of polarising opinion. The wolf is admired and respected, but also feared and hated when it becomes a source of ecological competition. Attempts to reintroduce wolves to parts of Europe have been met with enormous opposition, often based in superstition and fear. Dogs have become a true family member for most of us. Their presence in our social networks can relieve our sense of loneliness and provide us with invaluable opportunities to learn how to interact with other people in a better way. On the other hand, fear of dogs, the use of aggressive dogs as weapons or for fighting, and dysfunctional forms of pet ownership, such as animal hoarding, permeate our relationships with dogs.

For all these reasons, over the past few decades more and more professionals working on mental health have become interested in the scientific and interdisciplinary analysis of our relationships with dogs. We start to understand how dogs may influence the behaviour of people, but also how people's attitudes and personality affects dog's behaviour and adaptation to the human society. Furthermore, the study of naturally occurring behaviour problems in domestic dogs have been revealed to be an extremely interesting model to explore the evolutionary roots of human psychopathology.

Physiological correlates of canine behavior with age

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Keywords: beta-amyloid, brain, neuron loss, neurogenesis, oxidative stress

Aging dogs naturally develop cognitive decline in many different domains (including learning, memory, and spatial attention) with some cognitive functions showing stability with age (simple learning ability). In addition, like people, not all aged dogs become cognitively impaired and there is increasing individual variability with age.

The neurobiological basis for cognitive dysfunction may be related to progressive neuropathology. We observe structural changes in the brain by *in vivo* imaging that may reflect neurodegeneration. Neuron loss, reduced neurogenesis and reduce growth factor support can contribute to structural changes in the brain. Aged dogs show a progressive accumulation of the toxic beta-amyloid (Aβ) protein in diffuse plaques and in the cerebral vasculature, similar to that observed in patients with Alzheimer's disease. In addition, neuronal dysfunction may occur as a consequence of mitochondrial dysfunction and cumulative oxidative damage. By correlating cognitive changes with brain pathology we can establish possible links and potentially identify treatments to reduce cognitive decline.

Our laboratory is focused on identifying treatments that may slow or halt neurodegeneration that target many of these pathological pathways in aged dogs and may provide cognitive benefits.

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Influence of social relationships on leadership behaviour in free-ranging dogs

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Keywords: affiliative relationships; dominance; leadership

It has been suggested that domestic dogs retain little of features of wolves' social behaviour such as leadership, dominance, affiliation and group coordination (Boitani et al. 2007; Bradshaw et al. 2009). In wolves group activities are usually led by dominant breeders (Peterson et al. 2002). Here, we investigated leadership as a mechanism to coordinate collective movements in suburban free-ranging dogs, and its relation to social dominance and affiliation.

The research focused on three packs (ranging in size from 9 to 27 individuals) during the period April 2005 to September 2008. We defined a leader as the first individual that started to move in a direction followed by at least two group companions within ten minutes (244 collective movements recorded *ad libitum* in correspondence of group activity shifts). We assessed dominance based on directionality of submissive behaviour, and social affiliation based on resting associations (*focal animal sampling*, 396.75 h). We found that, in each pack, a few individuals emerged as "habitual leaders" (animals leading in more than half of collective movements in which they took part). The individual frequency of leading was positively affected by a linear combination of "age" and "dominance" (pack 1: $t = 10.41$, $P < 0.0001$; packs 2 and 3: $t = 5.86$, $P < 0.0001$). During resting followers associated more closely with habitual leaders than with other followers (pack 1: $T = 29$, $P < 0.003$; pack 2: $T = 1$, $P < 0.007$; pack 3: $T = 2$, $P < 0.05$). Although packs comprised multiple breeders, both female reproductive success and male copulation rate increased with the frequency of leading.

These results stress the importance of social affiliation in promoting group coordination, and suggest that social mechanisms regulating leadership in free-ranging dogs may be to some extent similar to those operating in wolves.

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Dominance and its behavioural measures in a pack of domestic dogs

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Keywords: dogs, dominance, rank order

Constructing dominance hierarchies is widely accepted to describe and explain an important aspect of the social organisation in group living animals, justifying the use of dominance as an intervening variable. Dominance refers to a consistent fundamental asymmetry between individuals regarding competitive power and/or status, reflected by specific behaviours as well as in biologically relevant outcomes of dyadic interactions. Recently, this concept for dogs has been debated (e.g. Bradshaw et al., 2009), resulting in a growing consensus that dominance is not applicable to domestic dogs. However, quantitative data is scarce. In the present study, in total 16 intact dogs of both sexes (3 adults, 2 subadults, 7 juveniles, of which 4 litter mates, and 4 pups) were group housed (outdoor enclosure: 273 m2) during observations. The patterns of distribution of 7 postures and 25 behaviours exchanged within 4874 dyadic interactions were observed over a period of 12 weeks. Data of the last 4 weeks were used for dominance analysis. We researched three properties (Van Hooff & Wensing, 1987): coverage, linearity (h') of the resulting rank order, and unidirectionality or directional consistency index (DCI). Two postures ("low" and "low-on-back") and two behaviours ("body tail wag" and "lick mouth", as included in Schenkel's active submission) showed to be good dominance indicators: medium coverage and h' > 0.70 (p<0.003), relations were 1-way within at least 2/3 of the dyads, and DCI's were between 0.96 and 0.99. The best indicator was "lowering of posture", evaluated by comparing the beginning and ending of the interaction for posture display, with good coverage and h' = 0.94 (p<0.0001), 1-way within ¾ of the relations, and DCI = 0.97.

These findings show the construct of dominance to be valid in this pack of domestic dogs. Our results are in agreement with the findings of Van Hooff and Wensing for wolves (1987) and Cafazzo et al. (2010) for free-ranging dogs, and contradict the base for rejections of Bradshaw et al. (2009). It indicates that the ethogram for dogs is best redefined by distinguishing postures from behavioural activities. Also this can be helpful in properly interpreting and diagnosing problem behaviour.

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Stress during certification testing in prison drug detection dogs and their handlers

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Background

Working dogs perform tasks with their human handlers, often under stressful situations. Are the stress and success of prison drug detection dogs influenced by the stress of their handlers, and if so, are there behavior cues that can be identified and modified to mitigate the effects of this stress on the canine partners?

Methodology/Principle Findings

Fifteen drug detection teams were studied on a certification day and a control day. Certification testing may act as a stressor for search dog teams1. Saliva for cortisol (C); heart rate (HR), and blood pressure (BP) were collected from handlers, and salivary C and HR were measured in dogs (K9s), before and after searches on both days as indicators of stress. Salivary testosterone (T) was measured in handlers, as it had been shown to vary with K9 C in agility trials2. Handlers completed the State-Trait Anxiety Index (STAI) each day. Searches were scored for proficiency of K9 and handler. Searches were recorded for later coding. No differences were found between control and test days in change in K9s or humans in C or HR, BP or search success. No correlation was seen between handler baseline C, BP, or HR and K9 C change scores on the control day. Baseline handler C and T were negatively correlated with K9 C change scores on the test day (p=.039, p=.041). A positive correlation was found between handler HR before and K9 C after the search on the test day (p<.001).

Conclusions/Significance

Testing was not found to be a stressor in this population, but relationships exist between handler baseline C, T, HR and post-search K9 C levels and changes from pre-search. There is evidence that dogs react to their handlers' stress levels, but this is a complex interaction. While physiological measures are correlated with canine hormone levels, it is likely that these are also related to interspecies behavioral cues. Further evaluation of the behavior in handlers in dogs may provide more clues to these interactions.

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Age effects on interspecific communicative abilities of domestic dogs

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Keywords: ageing, joint attention, executive function

Age related changes of cognitive abilities, including accelerated early and slower later development, as well as cognitive decline in the senior years are well-reported in humans. In dogs our understanding of age-related cognitive changes is limited to the study of ageing in laboratory kept beagles, which have been recognised as a useful animal model for cognitive ageing in humans since their measures of learning, memory, and executive function decline with increasing age, similarly to humans. However there have been very few studies examining cognitive development and ageing in pet dogs living in variable environments provided by human families over their lives. In this study we investigated age related changes in latency to attend to the gaze of a human experimenter and dog's spontaneous gaze following skills.

We tested 60 dogs ranging in age from 6 months to 14 years, in their joint attention skills (the ability to coordinate one's attention to a target with another individual) using clicker training for eye-contact, and spontaneous gaze following tests. As a consequence of dogs' domestication history, dogs readily engage in eye-contact with humans, which can be the basis for a wide range of communicative and cooperative interactions (Miklósi et al 2003).

We predict that interspecific communication skills in dogs will follow a similar pattern to general cognitive abilities - including accelerated early and slower later development, as well as decline in the senior years. These age-related variations in social cognitive abilities may be due to changes in dogs' executive functioning. Thus, as dogs age, they may suffer from impairments in their ability to coordinate with humans visually, which in turn can affect their quality of life, trainability, learning and problem solving abilities, and the human-animal relationship.

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Personality, social behaviour, and cortisol in dogs: Personality predicts behaviour in a dog park, while cortisol is unrelated to personality or behaviour

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Keywords: dog personality, cortisol, social behaviour

What are the relationships among personality, cortisol levels and social behaviours in companion dogs? Sixty (60) dogs were recruited at a local dog park. Dogs were videotaped and saliva samples taken after 20 minutes of social interaction. Videotapes were coded for time budget states (time alone, in dyad, in group, with humans, and in mixed groups), and frequency of play signals, aggression, stress behaviours, and mounting. Personality was assessed with the Monash Canine Personality Questionnaire (MCPQ-R)[1]; owners rated their dogs along five personality dimensions (Extraversion, Motivation, Training Focus, Amicability, and Neuroticism). Saliva samples were analysed for cortisol by Salimetrics LLC[2].

Cortisol in focal dogs was not significantly related to either the dog's behaviours or personality scores. Dog park visit frequency explained 11% of the variation in cortisol, with infrequent visitors showing higher levels (p = .01). Dog park dogs had Extraversion scores that were 13% higher than those reported for a more general sample[3]. Amicability and Training Focus were positively correlated (p = .001), while Amicability and Neuroticism correlated negatively (p = .04), as did Neuroticism and Training Focus (p = .04).

Dogs rated high in Amicability displayed more play signals (p = .007), and tended to exhibit fewer stress-related behaviours (p = .054). Extraversion scores negatively correlated with time spent in mixed groups (p = .04). Total number of changes in time budget activity states were positively associated with Extraversion scores (p = .001). Play signal frequency and mounting were positively correlated (p = .007). In summary, focal companion dogs in a dog park setting demonstrate relationships among personality dimensions and social behaviours, which are independent of cortisol levels. Further investigations are examining dyadic interactions and concurrent cortisol measurements of dyadic partners.

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'Are you growling to me?' – Assessment of inner state and context recognition from dog growls by human listeners

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Background

Recent research results showed that dog (*Canis familiaris*) growls (short and repetitive or elongated, broadband, low frequency [80-300 Hz] vocalizations with low frequency variability and high amount of noise but with still visible harmonic structure used in agonistic and playful contexts) carry information for conspecifics about the caller's size, affective state and the social context of interaction (1). Experimenting with artificially assembled growl sequences Taylor and co-workers found that human listeners are able to assess the size of the growling dog and rate the growls aggressiveness (2). At the same time humans could not categorize the social context of the artificial growls (3). In the present study we used natural growl sequences and three different contexts, attempting to test whether humans will be more successful in categorizing and rating the emotional valence of these.

Methodology/Principal Findings

We recorded sequences of growls in three different contexts: during play, guarding a bone from another dog, and reacting to a threatening human. We played these sequences of natural growl samples to 40 adult humans and asked them to rate each growl on emotional scales. We also asked them to guess the possible context of the growls in a second set of playbacks. Our results showed that humans could categorize correctly the growls above chance, although they often confused the two agonistic growl types. They rated the growls' emotional background in accordance with the assumed inner states of dogs. Interestingly they found the food guarding growls significantly more aggressive than the growls from the other agonistic context, in spite of their close acoustic structure. We also found that between contexts, temporal characteristics like the length of the growls and inter growl intervals affected their ratings the most, while the fundamental frequency affected only the ratings of playfulness.

Conclusions/Significance

In sum, we showed that humans are able to recognize the emotional background and the contexts of dog growls based on their acoustical and temporal structure, suggesting that growls can have an important role not only in the inter-, but in the intraspecific communication, too.

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Clinical characterisation of noise sensitivity in dogs

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Keywords: phobia, canine, scale

Introduction
It is estimated that nearly 50% of adult dogs exhibit some degree of fear of loud noises (Blackwell, et al 2005). However, little is known about the range of behavioural responses within this sound sensitive population, and whether it contains discrete subpopulations of more, or less, severely affected individuals. There is clinical interest in being able to categorise individual cases based on severity, so that appropriate behavioural and chemotherapeutic treatments can be chosen.

Methodology and principal findings
In this study a population of 417 dog owners completed a previously validated sound reaction scale (SRS) online (Calvo et al, 2011). Principal components analysis (PCA) and hierarchical cluster analysis (HCA) were used to identify subpopulations with mild, moderate and intense behavioural responses to noise events, as well as different styles of coping strategy. Validity and significance of the findings were demonstrated using projection to latent structures discriminant analysis (PLS-DA). These subpopulations were further characterised with respect to anticipation of noise events, recovery after noise events, and response to noises of different intensity.

Finally, we used receiver operating characteristic (ROC) analysis to show that it is possible to use an abbreviated scale, derived from a single factor of the original scale, to reliably classify individual cases according to this model of severity.

Conclusions
The SRS can therefore provide valuable clinical information for the evaluation of dogs with a fear of loud noises.

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Automated identification of behaviour in freely moving dogs by accelerometer and gyroscope

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Background
Having continuous information about the behaviour of a working dog that is out of sight, increases the effectiveness of Canine Search and Rescue teams.

Methodology/Principal Findings
Our objective was to assess the efficacy of a multiple sensor data-logger device (accelerometer and gyroscope) and software application as means of automated identification of freely moving dogs' behaviour.

Each dog (Malinois: N=12; Labrador Retrievers: N=12) was equipped with a multiple sensor data-logger device and was guided through a predetermined series of standard activities, which was also recorded on video camera. The whole process was repeated twice with each dog. We defined 7 non-overlapping behavioural units (lay, sit, stand, walk, trot, gallop, canter) and coded each video recording accordingly. At the end we have obtained two data sub-sets; the coded video recording and the corresponding sensor data for each individual. Evaluation of the data was made by SVM classification. During the analysis we used different combinations of data sub-sets for software training and testing.

With the joint sensors and software application system we reached an overall of 87% recognition success of the defined 7 behavioural units when both training and testing were done with the same data sub-set, but the performance decreased significantly (KW=28.3, p<0.001) to 49% if we used data of dog A for training and data of dog B for testing. However, this performance could be improved significantly (KW=14.83, p>0.002) by using the data of at least three dogs for training (63%). Higher percentages were achieved when the behaviour was categorised on the basis of activity status; active versus passive. In this case, the success of recognition increased to 96% if tested on the same data sub-set, and was 90% in all the other above conditions.

Conclusions/Significance
Our results indicate that a multiple sensor data-logger device and software application system could serve as a good potential method for automated identification of freely moving dogs' behaviour.

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Measuring attachment and other aspects of affiliative behaviour in the domestic dog

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Owners largely differ in their relationship with their dogs but dogs seem to show specific attachment behaviour toward their owners. The Strange Situation Test (SST), originally developed for studying mother–infant relationship in humans, was applied to assess dog attachment in many studies. The behavioural patterns observed in owner-dog dyads fulfilled the operational criteria of attachment.

Dogs' use of the owners as secure base is clear manifestation of a specific, individualised attachment relationship that is analogous to the mother-infant bond. The security providing role of the owner was also supported by less response in the dogs' HR level to threatening social stimuli in the presence of the owner than in separation.

Test results with shelter dogs challenged the concept that owners should develop a bond with their puppies otherwise no attachment can be built. The increased need for social contact with humans in shelters can lead to a relatively rapid formation of attachment to a potential attachment figure even in adult dogs.

Significant species-specific behavioural differences towards their human caregivers were found between dogs and extensively socialized wolves in the SST, which could be best explained by selective processes of domestication. Similar differences between dog and wolf pups make unlikely that the dog's attachment toward the owner can be derived directly from the pup-mother relationship in wolves, but rather due to dogs' specific attachment system that is functionally analogue to that present in humans.

Finally, the dog may help us to explore brand new areas of 'interspecific' interactions in social robotics. Being able to adapt to the complex human environment due to its effective cooperating and communicative skills with humans, the dog seems to be the most successful human 'product' for both functional and social purposes. The dog is a promising model for designing social behaviours for our future non-humanoid robotic helpers.

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String pulling in dogs revisited: spontaneous performance and learning in novel setups

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Keywords: means-end connections, string pulling, lateralization

String pulling tasks are commonly used to investigate recognition of means-end connections. Previous string-pulling studies suggested that dogs base their choice on proximity, rather than connectivity (Osthaus et al. 2005), yet Range et al. (2011) found that dogs are able to consider means-end relationships in the support problem. Here, we tested a cohort of Border collies repeatedly in string pulling tasks of increasing difficulty. Moreover, as lateralization has been associated with cognitive advantages in many species (Reddon & Hurd 2009), we analysed lateralized paw usage in the task and related it to success.

Following successful performance in tasks with single strings, subjects were required to choose from two strings, one straight and one bent. The reward attached to the bent string was an equal distance away from the ends of both strings so that choosing by proximity did not lead to success. None of the dogs performed above chance level in this task at the age of 6 months. At 12 months, the same dogs were first trained to select one baited string out of four parallel strings. Group level performance in this task was significantly above chance the first time it was presented. The individual criterion was set at 6 or more correct choices in two consecutive sessions of 10 trials. Half of the dogs reached this criterion within 60 trials and were subsequently presented with the 2-string task as a transfer task, receiving intermixed trials with the straight or the bent string baited (10 trials each). Most subjects achieved 8 or more correct choices when the straight string was baited, but only 4 out of 17 dogs reached this level with the bent string. Group performance was significantly above chance level for both conditions, suggesting that at least some dogs were attending to the connection between string and reward. We conclude that even though dogs may not demonstrate spontaneous means-end understanding, they can learn to pay attention to connectivity.

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Sensitivity to Unequal Rewards in the Domestic Dog: Fair is Fine, but More is Better

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Keywords: inequity aversion, fairness, justice

The history of domestic dogs suggests that the species might have a highly developed sense of what is called "fairness" or "justice" in primate literature. Dogs are descended from highly social Canids, they have been bred for cooperative tasks with humans, and they act cooperatively in social play. In this research we ask if dogs perceive and respond to unfairness or injustice. The protocol is a revised test of inequity aversion modeled on a classic study of justice with humans (Pritchard et al., 1972) which looked at both "advantageous" and "disadvantageous" inequity. Thirty-eight subject dogs and a control dog together approached two trainers in turn: one who rewarded them equally for sitting on command, and one who rewarded them unequally -- either over-rewarding or under-rewarding the control dog. After familiarization with the trainers, subjects chose which trainer to approach by themselves.

Subjects preferred the over-rewarding trainer over the fair trainer ($\chi^2(1) = 10.13$, $p = .001$); they had no preference between the under-rewarding and the fair trainer ($\chi^2(1) = .03$, $p = .86$). Further analyses using generalized estimating equations found that age and cooperative work experience reversed the approach preference. These results suggest that the precursory sensitivity which dogs showed to inequitous outcomes in prior research (Range et al., 2008) does not extend to both advantageous and disadvantageous inequity, nor when the subject is continually rewarded. Dogs selected a trainer who had treated them "unfairly" yet who presented a potentially greater opportunity for future rewards. Dogs showed a greater sensitivity to the quantity of a reward than to the fairness of a reward. The results have both conceptual implications -- demonstrating the salience of concepts of quantity and fairness for dogs -- and methodological implications, highlighting the need to be sure of the dog's interpretation of the experimental task.

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Matching pictures with the appropriate sound: results from an eye-tracking study of dogs and 14-month-old infants

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Keywords: eye tracker, looking preference

Background

Recent studies of gazing behaviour have shown that dogs prefer the facial images of conspecifics over human faces (Somppi et al. 2012), they can correlate the photographs and voice of their owner (Adachi et al. 2007) as well as they are able to distinguish the facial images of two individual humans or dogs (Racca et al. 2010). Until recently, however, dogs' cognitive capacities have rarely been explored by eye tracking technique and studies directly comparing dogs' and human infants' ability to match human or dog facial images and auditory signals (bark, human voice) by tracking the eye gaze are lacking in the literature.

Methodology/Principal Findings

In this study looking behaviour of adult pet dogs (N=27) and 14-month-old infants (N=19) were recorded, data were collected at 50 Hz by a Tobii X50 Eye Tracker (Stockholm, Sweden). Two pictures, a human and a dog face images were presented simultaneously for 14.000 msec. on the LCD monitor. The left/right positions of dog and human images were balanced across subjects. During stimulus presentation we played back both dog bark (7.000 msec. – bark-replay condition) and human talk (7.000 msec. – voice-replay condition) in a balanced order while the speaker was placed behind the monitor in central position. Results show that both dogs and human infants looked longer at the image congruent with the replayed auditory stimulus (bark/human voice). However, we found species-specific differences in terms of subjects' first look: while dogs looked first towards the image congruent with the replayed auditory signal, infants first tended to explore visually the dog image and looked more frequently at this picture in both the 'bark-replay' and 'voice-replay' conditions.

Conclusions

These results showed that when human and dog faces are presented simultaneously, instead of displaying a gaze bias towards conspecific image, dogs show sophisticated ability to match auditory and visual stimuli. The unexpected results of the infants' initial preference for dog image can be explained in terms of a novelty/attractivity effect; the 'novelty value' and/or the attractivity of an unfamiliar dog image may be higher than that of the unfamiliar human.

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Persistence and elaboration of communicative signals about inaccessible food in dogs (*Canis familiaris*)

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Persistence and elaboration of communication when attempting to manipulate the receptor of a message failed is one of the 6 characteristics for functionally referential and intentional communication (Leavens et al. 2005). In Gaunet (2010), dogs presented partially this characteristic when communicating about an inaccessible toy. The present study applied to an inaccessible piece of food, included more dogs and the protocol was rendered more difficult.

29 dogs participated in three conditions: *Success* (a 30-sec pre-delivery phase, in which the dog could request its owner food placed on an inacessible shelf, followed by a 30-sec postdelivery phase, after receiving food); *Partial success* (after an identical pre-delivery phase, the dog received half-food); *Failure* (after an identical pre-delivery phase, the dog received an undesirable food). The three conditions were randomized together with the other three conditions described in our second abstract. The number of gaze alternations between the owner and food (GA) was recorded to evaluate the persistence ability. For the elaboration ability, the dogs were classified as having exhibited multiple communicative behaviors or not (MCB: Gaze Owner or Food combined with other communicative behaviors).

For GA, pre-delivery phases did not differ among conditions (p=0.478, Friedman test); pre and post-delivery phases did not differ (Wilcoxon test) for *Partial* (p=0.592) and *Failure* (p=0.551), but this variable decreased for *Success* (p=0.004). The proportion of dogs that exhibited MCB differed between the three post-delivery phases (p=0.024, Cochran's Q test): more dogs exhibited MCB for *Partial* than for *Success* (p= 0.011, McNemar test), and there was a tendency in the same direction when comparing *Failure* and *Success* (p=0.058, McNemar test). Evidence that dogs persist and elaborate their communication when the attempt to manipulate the receptor was not completely achieved or failed was confirmed in this upgraded study.

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Intentionality as measures in the persistence and elaboration of communication by chimpanzees (Pan troglodytes). Child Dev., 76(1), 291-306.

Referential communication in dogs (*Canis familiaris*)

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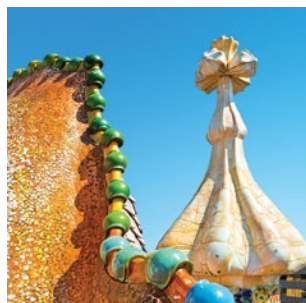Keywords: intentional, referential, dog-human communication

Dogs display functional referential and intentional behaviours to communicate about an inaccessible toy (Gaunet & Deputte 2011; cf. Leavens et al. 2005 for the corresponding criteria). The present study addressed the same question with an inaccessible food. Three of the 6 criteria were analyzed: audience effect, successive visual orienting between the owner and a 'desired' target (i.e. gaze alternation-GA), attention-getting behaviours.

29 dogs participated. During Food+Owner condition (F+O), an unfamiliar person took the dog to the experimental room with food, she put the food on one of two shelves and left the room throughout main-entrance door (ED). The owner entered the room via another door, remained quietly standing equidistant from the two shelves following visually the dog for 30- sec. During Absence of Owner condition (AO, 30-sec), the dog remained alone in the room in the presence of food, and during Absence of Food condition (AF, 30-sec) the dog remained with the owner in the room without food. Conditions were adapted from Miklósi et al. (2000) and allow to test all three hypotheses stated. Durations of gaze at the owner, at food, at the shelves (in AF) and at the ED were measured. Frequencies of GA between food and owner was evaluated in F+O, and between shelves and owner in AF.

Dogs gazed longer at the owner in F+O than in AF (Wilcoxon, p=0.043), and, they gazed longer at the food in F+O than in AO (Wilcoxon, p=0.037). The duration of gazing food in F+O was longer than that spent gazing at the shelves in AF (Wilcoxon, p<0.001). Similarly, the frequency of GA between food and owner in F+O was greater than GA between shelves and owner in AF (Wilcoxon, p<0.001). Finally, the time spent gazing at the food in the F+O did not differ from that spent gazing at the ED in the AF (Wilcoxon, p=0.908). Results are consistent with the hypothesis that dogs use functionally referential and intentional behaviors, reinforcing the validation of the three criteria in that species.

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Behavioral differences between dogs acquired from pet stores and those obtained from noncommercial breeders

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Background
The goal of the study was to compare the prevalence of behavioral problems in dogs obtained as puppies from pet stores with that of dogs acquired as puppies from non-commercial breeders.

Methods/Principal findings
C-BARQ behavioral evaluations (Hsu & Serpell, 2003. *JAVMA*, 223: 1293-1300) were obtained from a convenience sample of current owners of dogs obtained from either pet stores (n=413) or non-commercial breeders (n=5657). Hierarchical linear and logistic regression models were used to analyse the effects of source of acquisition on behavioural outcomes when various confounding and intervening variables were controlled for. Dogs acquired from pet stores differed significantly from those acquired from breeders on 12 out 14 of the C-BARQ behavioral subscales. In every case, pet store dogs tended to obtain less desirable subscale scores. For example, sexually intact pet store dogs were three times more likely to display owner-directed aggression than intact dogs acquired from breeders (Odds Ratio 3.13, $P < 0.001$). Pet store dogs in general were also much more likely to display aggression toward unfamiliar dogs (OR 1.96, $P < 0.001$) and unfamiliar people (OR 1.59, $P < 0.003$).

Conclusions/Significance
The findings suggest that obtaining puppies from pet stores versus non-commercial breeders represents a significant risk factor for the development of a wide range of undesirable behavior. Possible reasons for these differences are discussed.

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The role of oxytocin in shelter dogs' ability to bond to humans

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Keywords: oxytocin, stress, bonding

Background

The peptide hormone oxytocin has been postulated to underlie the human-dog bond [1]. Oxytocin function is known to be affected by stress [2]. This study explores the effects of stress and the acute administration of oxytocin on bonding behaviour of shelter dogs to an unfamiliar person, across four days.

Methodology/Principal Findings

Heart-rate measures of stress were taken on day 0 of the experiment. On days 1-4 of the experiment the dogs were taken to a room where the researcher petted the dog calmly for up to 10 minutes while behaviour was continually recorded. Before the interaction on day two, group one received 20 international units (IU) of oxytocin dissolved in a saline solution which was injected into the nostrils of the dog (50μl in each)whilst group two received intranasal saline as a control. On day three no treatments were administered and on day four, treatments were reversed, with group one receiving intranasal saline and group two receiving intranasal oxytocin. Preliminary findings of the effect of oxytocin on stress and bonding behaviour are reported.

Conclusions/Significance

Findings from this study will improve our understanding of canine bonding behaviour and its interaction with stress.

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Canine Brain Aging and Cognitive Dysfunction Syndrome: Lessons Learnt from Alzheimer's Disease

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Background

Canine and human aging share many commonalities. In fact, the aged dog is a model for Alzheimer's disease due to parallels that include brain deposition of amyloid-beta (Aβ) and domain specific cognitive decline, which provides important insight into understanding and potential treatment options for cognitive dysfunction syndrome.

Methodology/Principal Findings

The Aβ protein is identical between the two species and the pathology is remarkably similar. Like humans, dogs demonstrate cholinergic dysfunction, increased oxidative stress, hyperphosphorylated tau, dystrophic neurites and brain atrophy. Aged dogs also show specific patterns of cognitive decline that includes deficits in executive function, memory, and selective attention. Over the last two years, the clinical failures of disease modifying drugs and concerted efforts to characterize biomarkers predictive of Alzheimer's disease has resulted in a paradigm shift in attempts to develop therapeutics for the disease. The disease progression is now thought to begin decades earlier than the formal clinical diagnosis of Alzheimer's disease, and the prodromal stages of the disease are becoming tangible therapeutic targets. Current thinking proposes the following chronological occurrences of events in disease progression: amyloid deposition, which may be evidenced by in vivo imaging or decreasing CSF $A\beta_{1-42}$; neuronal / synaptic dysfunction, which may be evidenced by increasing levels of CSF tau, decreased fluorodeoxyglucose uptake on PET, or cerebral atrophy on MRI; cognitive decline; and global deficits. We now know that aged dogs show similar biomarker patterns as that seen in Alzheimer's disease progression, specifically decreasing CSF levels of $A\beta_{1-42}$ and increasing CSF levels of tau. CDS likely follows a similar progression and the current diagnosis of CDS probably represents the late stages of the disease.

Conclusions/Significance

These findings suggest that a similar paradigm shift should be considered for clinical diagnosis and treatment of CDS. Specifically, the incorporation of non-behavioral Alzheimer's biomarkers into the diagnosis of CDS and testing of CDS therapies should be considered.

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Does training experience affect dogs' performance in a problem solving task?

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Keywords: problem solving, effect of training

Background

Clicker trained dogs perform better than other dogs in problem solving tests (Osthaus et al. 2003) and highly trained dogs for sport perform better than untrained or basic trained dogs (Marshall-Pescini et al. 2009). However, Marshall-Pescini et al (2009) did not discriminate untrained and basic-trained dogs and Osthaus et al (2003) provided no information about the training level of dogs that did not experienced training with clicker. We wanted to find out whether there untrained dogs, basic trained dogs and clicker-trained dogs perfom differently in a novel problem solving task.

Methodology/Principal Findings

We have compared three groups of dogs: untrained dogs (UT: N=23) with no experience of dog schools; basic trained dogs (BT: N=24) that have visited or have been visiting a dog school, and have not been involved in any dog competition and clicker training; clicker trained dogs (CT: N=25) which were used to the clicker training method. All dogs were confronted with the Spiny Toy (Nina Ottosson ®). This toy consists of a disc which is uncovering hidden holes when rotated around. One piece of food was hidden in each trial, and dogs had 30 seconds to manipulate the toy in order to get a piece of food. Learning was observed in 20 trials. Trained (BT + CT) dogs were more often successful (UT/BT: U = 175.0; p = 0.03, UT/CT: U = 179.5 ; p = 0.01), more focused on the toy (UT/BT: U = 168.5, p = 0.02; UT/CT: U = 135.5, p = 0.001), faster to manipulate it (UT/BT: U = 154.0, p = 0.01; UT/CT: U = 140.0, p = 0.01) than untrained dogs (UT). There were no significant differences between CT and BT dogs considering performance in solving the problem.

Conclusions/Significance

Marshal-Pescini et al (2009) suggested that highly trained dogs acquired the skill to 'learn to learn". We suggest, however, that trained and untrained dogs differ also in their motivation for food and/or work. More interest toward the reward will make the apparatus more attractive for the dog, and this is why trained dogs achieve better performance in contrast to untrained dogs.

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Recognition of familiar human faces in domestic dogs

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Using the face to differentiate between conspecifics is widely spread among the animal kingdom, from humans to paper wasps. Distinguishing faces from other species than its own, however, is much more challenging. Recently, Racca and colleagues (2010) showed that domestic dogs can discriminate between pictures depicting the heads of unknown humans. The aim of the present study was to assess whether dogs can recognize familiar humans based on the picture of their face solely, that is, without other features relative to the head such as face outline and hair style.

The preferential looking procedure was used with 60 dogs, assigned to either a test group or a control group (N=30 for each). After attracting the dogs' attention to the middle of a screen we projected 2 pictures side by side and observed dogs' visual attention towards them. In the test group the pictures showed 2 familiar humans: the owner and another familiar person (same sex and age). In the control group the exact same pictures were presented as in the test group, except dogs did not know the people shown (to control for preferences based on low-cognitive information inherent to the pictures in the test group). In order to present only facial features a balaclava was artificially added to the faces, leaving only the eyes, nose, mouth and their configuration visible. Our results revealed a significant visual preference for the other familiar person's face over the owner's in the test group, as early as dogs' first fixation (P=0.016). The control group had no preference for one or the other face.

This study show that dogs can recognize familiar human faces from pictures and that "internal facial feature" are sufficient to do so.

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Discrimination of human and dog faces and inversion responses in domestic dogs (Canis familiaris). Anim Cogn, 13 (3). pp. 525-533.

Physical prompts to anthropomorphism of the domestic dog (*Canis familiaris*)

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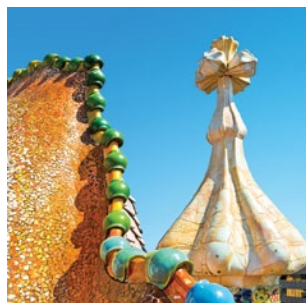Barnard College, Columbia University, New York, NY, USA
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Humans readily anthropomorphize dogs, assigning them human characteristics. Theories of which physical characteristics prompt anthropomorphism usually invoke neoteny or features involved in the "cute response" (Horowitz & Bekoff, 2007). In this study, those theories are explicitly tested by comparing the inherent "likability" of visible physical features (Linsen et al., 2011). Human subjects (N=124) participated in an aesthetic preference test in which they saw computer-modified image pairs of mixed-breed adult dogs. In each image-pair presentation, one of fourteen features associated with neoteny, the cute response, or other physical characteristics was modified.

The results reveal that some, but not all, characteristics of neoteny were preferred: larger eyes were selected over smaller ($p < 0.001$); but a larger forehead ("cranial vault") was not ($p = $ n.s.). Nor were other features consistent with the theory of neoteny preferred, such as small nose or big paws. Subjects also evinced a preference for images of dogs with smaller jowls, larger distance between the eyes, distinct and colored irises, and a mouth approximating a smile ($p < 0.001$). By contrast, symmetry of ears and piebald facial coloration, as well as size of ears, eyebrows, tongue, and nostril, did not lead to uniform subject preference ($p = $ n.s.). Sub-analyses found that subjects' selections varied by life experiences with and perceptions of animals.

These findings demonstrate that this long-theorized human behavior — anthropomorphizing animals — can be analyzed and tested not only in connection with behavior (Mitchell & Hamm, 1997) but also physical features. Neoteny does not consistently explain subjects' preferences, nor are other theories sufficient. A catalogue of physical features which lead to anthropomorphizing could be used to design expressive robots, elicit aid for threatened species, advertise adoptable shelter animals or re-consider dog-breeding practices.

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Animal abuse: exploring dysfunctional pet ownership

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Animal abuse takes many forms and occurs in a variety of contexts. Recently published surveys, in the United States and Australia, of intimate partner violence (IPV) survivors who have pets reveal that over half of these women report that their pets were hurt or killed by their adult partner, often in the presence of their children. This experience is rare or absent for women who also have pets but who do not report intimate partner victimization.

A substantial minority of these survivors report delaying going to a shelter out of concern for their pets' welfare. I describe the implications of these findings for the safety of women, children, and animals facing IPV and the programmatic, policy, and legislative changes, based in part on this research, designed to address the needs of women, children, and the companion animals they cherish. These changes are directed at reducing the future likelihood of violence to people and animals.

Future research should examine the severity of IPV, animal abuse experiences reported by IPV survivors, the degree and forms of children's exposure to IPV, children's perpetration of animal abuse, and the relations of these variables to children's behavior problems, callous-unemotional traits, empathy, and children's attachment to their pets. Research should also explore effective interventions for children or adults who abuse animals.

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Dogs as 'natural' models for human psychiatric conditions: information gained from purely behavioral or physiological studies, versus studies that combine both approaches

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Background
Natural animal models of human behavioral conditions are rare. All animal models are constrained by factors such as assessment of pathology using potentially underlying weak correlates (eg, verbal responses), and the lack of characterization of animal behaviors as analogous/homologous for humans. Rodent models of anxiety are flawed because, as prey species, chronic anxiety/wariness is adaptive. Anxiety disorders occur naturally in dogs, mirroring equivalent human conditions. The dog's behavior provides both an animal model and the ability to study canine behavior that is naturally pathologic, without preconceptions of mechanism/outcome, and without coupling a trait, mechanism, or outcome to a homologous one in humans. As such, dogs may be excellent translational models for humans.

Methodology/Principal findings
We review 3 approaches for the use of dogs as potential models for anxiety-related conditions: (1) fearful laboratory dogs evaluated solely through observation, (2) fearful laboratory dogs evaluated solely using physiological responses (lactate infusion) and (3) patients with 3 diagnoses (unaffected, separation anxiety, noise phobia) evaluated using both techniques. For purely fearful dogs (N=1,225 dogs), one behavior identified behavioral group: puppies who approached the observer were not fearful ($P<0.0001$ and adults who withdrew were ($P<0.0001$).The use of the lactate test in laboratory dogs with fear and patients with canine anxiety disorders indicated that dogs could be sorted into their behavioral groups on the basis of their physiological reactions to lactate. Any combination of 2 of these measures unambiguously identified group ($P<0.05$). Behavioral findings also assorted on the basis of diagnosis and the only dogs who slept during lactate testing (N=27) were unaffected ($P<0.0001$).

Conclusions/Significance
Dogs are excellent natural models for fear/anxiety disorders. The most robust results result from a combination of behavioral/physiological data that account source for population.

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Social Referencing in dog – human interactions

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Keywords: social-referencing, behavioural regulation, dogs

Social referencing is the seeking of information from another individual to form one's own understanding and guide action. In this study 54 adult dogs (mean age 4,7 y) were tested in a social referencing paradigm involving either a known or unknown informant and a potentially scary object (13 dogs in the owner – positive group, 14 dogs in the owner – negative group, 12 dogs in the stranger – positive group and 15 dogs in the stranger – negative group). The aim of the study was to evaluate the presence of referential looking towards the owner vs. stranger, and of behavioural regulation based on the owner's/ stranger's (vocal and facial) emotional message towards the object.

Results showed that 85% of dogs tested with the owner and 77% of dogs tested with the stranger exhibited referential looking. Thus, when confronted with a strange object, dogs appear to seek information from people regardless of their familiarity. Furthermore, when the owner was the informant, we found that dogs in the positive group spent longer walking towards (p=0.002) and in close proximity of the fan (p=0.004) compared to dogs in the negative message group, whereas the latter spent longer reaching the area around the fan (p=0.001) and interacting with it (p=0.002). When comparing dogs tested with the stranger we found that dogs in the negative group spent longer close to the door and exhibiting static behaviors (sitting, standing or lying motionless) (p=0.01) than dogs in the positive group.

Results clearly show the presence of Social Referencing in dog – human dyads, although the identity of the human may influence dogs differently depending on the message being conveyed.

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Can dogs relax? Work-related cortisol levels vary in dogs during animal-assisted interventions

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Introduction

Positive effects of human-animal contact on human health have contributed to the wide distribution of animal-assisted interventions (AAIs). While considerable effort has been devoted to the research on human welfare associated with AAIs, potential effects on therapeutic animals have received little attention (Hatch, 2007). Therapeutic dogs that undergo special training are required to cope with stressful conditions, deal with unfamiliar people and strange situations (Serpell et al., 2010). The aim of this study was to determine baseline and work-related levels of cortisol, a glucocorticoid hormone that is known to vary with physiological arousal, in therapeutic dogs (Glenk et al., 2011).

Material & Methods

14 certified therapy dogs aged 5.3 ± 3.9 (Mn ± SD), 7 dogs in AAI program 1 (P1; dogs on-lead during work) and 7 dogs in AAI program 2 (P2; dogs off-lead during work), participated in the study. Pre-post experimental (on 2 working days) and baseline (at home) salivary samples were collected and analyzed with enzymimmunoassay. Activity and behavioural variables were video-recorded as additional objective measures of stress.

Results

There were no differences between P1 and P2 dogs according to home and working baseline. However, significant differences between P1 und P2 were found during AAI-related work ($p=0.01$). Monitoring of activity and behaviour during five consecutive therapeutic sessions in P2 dogs indicated no significant changes. However, declines in cortisol were positively correlated with behavioural variables lip licking and body shaking.

Conclusion

Analysis of the results revealed that cortisol levels in dogs performing AAI P1 and P2 vary significantly during therapeutic work. These insights suggest that P2 dogs which are off the lead during intervention show decreases in cortisol and hence, seem to be more relaxed. A combination of physiological and behavioural measurements may be useful for welfare monitoring in dogs.

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Barking up the Right Tree: Developing Education Resources that Work in Remote Indigenous Contexts

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In remote Aboriginal communities, both professionals and community residents have called for increased knowledge sharing to support dog health initiatives (1). Animal Management in Rural and Remote Indigenous Communities (AMRRIC) is working to find the best ways to meet this need. UNE supports these objectives and, through collaborative research and voluntary activities, staff and students benefit from shared learning and cultural exchange.

Western style education has been found to be relatively unsuccessful in remote Indigenous contexts in terms of content, process and worldviews (2). Further, focusing on children at the exclusion of parents can create social and intergenerational conflict and rejection of new ideas. Past studies have found that involving community members in locally relevant and culturally appropriate dog health education initiatives are associated with significant improvements in dog health indices such as decreased signs of mange and increased body condition score (3). Further, carefully constructed programs, whilst centred on dog health education, can address multiple priorities such as supporting culture, language and literacy, generating employment and self-esteem, as well as achieving measurable improvements in dog health and wellbeing.

A recent development in our dog health education resources for remote Indigenous contexts has been the use of 'Talking Books'. Combining traditional knowledge-sharing techniques with newer technologies, these books have refillable pages connected to a sound card with voice recordings for each page. This allows the combination of visual and auditory learning styles and the ability to present knowledge in local language. Community members are engaged in the production of these resources by taking photos and creating the artwork and logos. This increases relevance and initiates communication through local social networks, delivering shared learning even before the resource is complete.

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Humans attribute emotions to a robot that shows simple behavioural patterns borrowed from dog behaviour

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Attributing intentions or emotions to an individual requires considering the other as a socially competent agent. Recently, in social robotics it has been a crucial issue to determine the minimal set of relevant behaviour actions necessary for social competencies in human-robot social contexts. Here we propose using the dog as a novel, natural model for developing simple expressive behaviours for service robots.

In our study human subjects were presented with short video sequences aimed to represent five basic emotional/mental states (joy, fear, anger, sadness and attention) enacted by a people-bot robot and a dog sequentially in a neutral environment. The actions of the robot were developed applying or adapting dog expressive behaviours that had been described in previous studies of dog-human interactions.

Subjects attributed emotions to both the robot and the dog even in the open-ended part of the questionnaire, when they did not have any guidance about the nature of the study. Moreover, in a multiple choice task subjects could successfully match all dog videos, and all but one robot videos to the correct emotional/mental state. Importantly, experience with dogs did not help at identifying the emotional/mental states presented either by the dog or the robot, however, the gender of the evaluator seemed to have some effect.

We conclude that when there is a need to integrate function and sociality, using the dog as a model may be a promising approach to develop emotional displays for social robots with various embodiments and capacities.

Who is more tolerant? Cofeeding in pairs of pack-living dogs (*Canis familiaris*) and wolves (*Canis lupus*)

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Keywords: tolerance, co-feeding, dog, wolf

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Domesticated species are thought to be less aggressive compared to their wild relatives (Hemmer 1990). In dogs, increased tolerance has even been proposed to explain successful cooperation with humans ('emotional reactivity hypothesis', Hare & Tomasello, 2005). However, so far the hypothesis that dogs are less aggressive than wolves has not been tested directly. In this study, during food competition we compared pack-living dogs and wolves that were raised and kept in the same way at the Wolf Science Center.

Food-associated rank positions and distances were established in each pack by calculating David's scores based on observations of all dominant and submissive behaviors during normal feeding sessions. Tolerance was established by testing each individual repeatedly with every pack member in pair wise tolerance tests with either a big bone or a bowl of meat pieces. We analyzed the amount of co-feeding and aggression as well as the influence of age, sex, kinship, affiliative relationship, rank position and rank distance in both species. We found that the animals co-fed more when eating meat pieces than a bone (p<0.001). Moreover, in contrast to wolves, the high-ranking members of the dog dyads monopolized the food more often than low-ranking ones (p <0.001), whereas in wolves we found no such difference. Analyzing the occurrence of aggression, we found an interaction between rank distance in the test dyad and the species (p<0.001): more high- than low-ranking dogs showed aggression, whereas in wolves we did not find such an effect. If aggression occurred during a test, the wolves showed a higher rate of aggression than the dogs (p<0.04).

Our results call into question whether domestication increased tolerance in the dog. We suggest that domestic dogs evolved a steeper dominance hierarchy than wolves, thus dogs do not readily challenge higher-ranking pack-members. This change is likely to help also humans in keeping their control and leading role in interactions with dogs.

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The effect of social factors on object exploration in captive wolf packs

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Exploratory behavior plays an important role in gathering information about objects or other aspects of the environment even if it does not satisfy immediate needs. Approaching and exploring novel situations, however, can be risky. Thus, how animals deal with these situations can, have important consequences on their fitness.

Several studies have shown that, apart of their personality, also the social context influences how animals approach and explore novel objects. Here, we investigated whether the presence of pack members influences neophobic reactions to and exploration of novel objects in timber wolves (Canis lupus). Furthermore, we evaluated the influence of various social aspects (rank, affiliation) as well as the personalities of the interacting partners on the exploratory behaviour of the individual wolves.

We tested 9 hand-raised timber wolves in novel object tests in three different conditions: 1) when the subject was alone, 2) when it was paired with another pack member and 3) when the entire pack was together. Wolves approached the novel objects faster ($p = 0 0.001$) and explored more ($p = 0.024$) during the pair and pack conditions than in the alone condition. Furthermore, animals explored novel objects longer in the pair condition if paired with an adjacently ranked partner than if paired with a not adjacently ranked partner ($p = 0.013$). Neither the sex, the absolute rank of the subjects nor the affiliative relationship between the partners had an influence on their approach or exploration behaviour.

These experiments show that wolves' exploration behaviour is enhanced by the presence of a partner independent of their social relationship. Whether this facilitative effect of a partner is of a cooperative or competitive nature is currently unclear. The fact, that partners ranked adjacently explore longer than non-adjacently ranked partners and that affiliation does not matter, points towards a competitive rather than a cooperative attitude.

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Leash walking as a cooperation paradigm in wolves (*Canis lupus occidentalis*) and dogs (*Canis lupus familiaris*)

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Humans are closely associated with wolves and dogs probably since the late Palaeolithic, and this association and domestication process was quite spread over time and space (von Holdt 2010). The initial association between humans and wolves may have been facilitated by basic similarities between the two species in social functions (i.e. cooperation over hunting and raising offspring within their clans and fierce territorial defence of a group territory between clans), as well as by the animistic spirituality of hunter-gatherers. Compared to wolves, dogs seem to be more attentive towards humans and more willing to cooperate, although such differences may not be as pronounced as initially thought (Range & Viranyi 2011). Dogification from wolf ancestry may have been achieved via direct selection for these cooperative traits, or more indirectly, as by-products of selection for docility and tameness.

To test the cooperative behaviour of equally raised and kept wolves and dogs with humans, we employed leash walking as an experimental paradigm (Naderi et al. 2002). We expected less attentiveness to the walking human, more strained leash and more leadership conflicts with wolves as compared to dogs. Also, we predicted that cooperative performance of wolves would be more dependent on dyadic social relationship than in dogs. A total of 11 hand reared wolves and 9 identically raised and kept dogs were walked on a 10m leash a number of times when they were approx. one year of age, by each of a number of colleagues, who were generally the hand raisers of these animals, but were differently acquainted with them. In each trial the walker led the animals four times back and fourth along one of three 80m long standard tracks. Walkers were asked to behave "as usual", as they would on a routine walk with a wolf/dog on the leash and to make the animals "sit" and "down" two times each. Interactive behaviour of wolves/dogs with the walker were coded from video tape, with an emphasis on mutual attention, leadership, strained leash and the interaction style of the walker. Data were analysed by Linear Models.

Results generally met our expectations, but the differences between our equally raised and kept wolves and dogs were not as great as could have been expected.

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Dogs and wolves looking back to humans: species difference already at 2 months?

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Domestic dogs are exceptionally sensitive to human communicative cues and also use gaze alternation as a communicative tool when interacting with humans. These abilities appear to be superior in dogs when compared to their closest living relatives, wolves (Miklosi et al. 2003). It has been hypothesized that this difference may be due to domestication (Hare et al 2005). However, recent results have challenged the early forms of this domestication hypothesis, since adult wolves socialized with humans appear to perform equally to dogs in a pointing task (Udell et al. 2008, Gacsi et al. 2009).

The present study investigated potential differences between dogs' and wolves' use of gazing when facing an unsolvable problem (Passalacqua et al. 2011), comparing two groups of animals raised in an identical manner at the Wolf Science Center. 10 mongrels and 8 wolves were tested at the age of 2 months. Test consist in a first part where animals have to overturn a container in order to obtain food, and a second part where the container is blocked and thus the task become "unsolvable". We found no significant species difference in the number of animals that solved the task in the first trial ($p = 0.177$) nor in the latency to success ($p = 0.173$). In the unsolvable trial, no differences emerged in the duration of gazing ($p = 0.409$) and interacting with the person ($p = 0.822$), nor were there differences in the latency to gazing ($p = 0.559$) and interacting with the person ($p = 0.409$) between the dogs and wolves. These results are in contrast with Miklosi et al. 2003 and suggest no effect of domestication on gazing at the experimenter or the needing of training to develop this behaviour in dogs. However, the dogs alternated their gaze between the person and the bowl significant more often than wolves ($p < 0.001$). This suggests in dogs a specific predisposition for this form of gazing (or its faster development) towards humans. In humans gaze alternation is considered as intentional and referential communication, thus it is possible that humans favoured dogs showing this behaviour during the course of domestication.

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The crucial information in social learning tasks: differences between wolves and dogs

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Domestication is thought to have strongly influenced dogs' cognitive abilities to communicate and interact with humans. However, studying other aspects of social cognition might reveal further insight in our understanding of the selective forces shaping domestication.

Here, we tested how the demonstration of a familiar dog influenced the performance of 6-months old wolves (n = 11) and mongrel dogs (n = 9) in a social learning task using a two-action imitation test. The wolves and the dogs were hand raised and kept in packs in identical conditions at the Wolf Science Center, ensuring that they had similar experiences and similar relationship with the 'conspecific' models of this study. We found that wolves were significantly better than dogs in the manipulative task (p< 0.001) and tended to imitate the action demonstrated by a conspecific.

These results suggest that the higher interest towards conspecifics benefits wolves in a difficult task, where they have to pay attention to the exact action of a conspecific demonstrator. This interest towards conspecifics might be the results of higher dependency on intra-specific cooperativeness and close coordination during daily life in wolves compared to domestic dogs, which while being very cooperative with humans, usually do not intensively cooperate with conspecifics.

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The relationship between stress response of guide dogs and their temperament traits in peripubatal period

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There are increasing evidences that stress endocrine system has a pivotal role for behavioral development in many species, however, little has been known in dogs. We previously found that endocrine stress response of guide dogs in socialization and peripubatal periods was correlated each other (Mogi et al., 2010).

In the present study, we investigated the relationship between stress response of about one hundred guide dogs and their temperament traits in the peripubatal period. At first, stress response of dogs at the age of 1 year was assessed by urinary cortisol levels during 2 weeks immediately after transferring into a training center from puppy raiser's houses. The temperament traits were then assessed twice by the professional dog trainers; about 2 months after starting training (Task Performance 1:TP1) and 2 month after TP1 when basic training was almost completed (TP2). As results, in terms of cortisol levels, factor analysis and following cluster analysis showed that dogs were divided into 3 groups. Group 1 had low levels of cortisol throughout the days of analysis. In group 2, cortisol levels were high in the first half and low in the second half. Cotrisol levels in group 3 had been in high levels. Each assessment for temperament traits was analyzed by factor analysis, and each obtained factor was compared among 3 groups by ANOVA followed by post hoc test. We found that the factor representing learning ability had a trend to be higher in group 1 than in group 2 in TP1. In TP2, the factor representing sensitivity and anxiety was significantly lower in group 1 than in group 2.

These results suggest that endocrine stress response of dogs was related to some of their temperaments in prepubertal period. This finding is not only important in biology of dogs but also support training and promotion of guide dogs.

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Reciprocal communication and neuroendocrine response in human-dog interactions

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Dogs are now the closest domestic animals to humans. These 2 species show social buffering for reducing stress responses, which suggests the existence of inter-species biological bonding. We have demonstrated that humans and dogs share common social cues and these social cues change the neuroendocrinological response in both humans and dogs (1,2). In the present study, we examined whether the nasal administration of oxytocin, which is an important hormone to develop bonding and to produce social buffering, changes the dog's social behavior in a context of dog-human interactions.

We conducted a 30-minute interaction among a house dog, his/her owner, and 2 strangers (13 males, 10 females, 5.7±0.7 year age). Just before the interactions, oxytocin (OT) or saline (S) was administrated to the nasal cavity of the dog by a spray bottle. We recorded the dog's behavior and analyzed the duration of gaze, face direction, touch, and proximity towards humans. A heart rate monitor was attached to the dog and the owner during interactions.

In females, the OT treated group showed longer duration of gaze to their owners than the S treated group ($p<0.05$). However there was no such difference in males. In the duration of dog's face direction, although there was no difference in males, OT treated female dogs showed longer face direction to their owners than the S treated group ($p<0.05$). On the other hand, male dogs touched the stranger longer in OT administration than S administration ($p<0.05$), and the proximity to the owner decreased in OT treated group than S treated group ($p<0.05$).

In conclusion, the OT administration enhanced the dog's social behavior and this effect was specifically observed in female dogs towards their owners. In our previous study, gaze from dogs increased urinary OT in humans (1). Therefore, these results suggest the possibility that the OT system enhances humans and dogs reciprocal communication and biological bonding.

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The effect of castrating male dogs on their use of the vomeronasal organ when investigating conspecific urine deposits

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Castrating male dogs (*Canis familiaris*) is a common management practice for dogs kept as pets (poster CSF 2010), but its impact on the species' social behaviour is poorly understood. Male dogs have been reported to investigate conspecific urine mainly by sniffing, sometimes licking the urine source followed by teeth chattering and salivating (Dunbar 1977). These flehmen-like behaviours (FLB) are believed to move heavier non-volatile molecules to the vomeronasal organ (VNO) where the information is decoded. In a variety of species castration has been reported to bring about a reduction of FLB. Since in other species the volatile and non-volatile molecules code for two different types of information (e.g. mouse *Mus musculus*; Hurst & Beynon 2004), castrated male dogs may only perceive part of the available message. The effect of castration on male FLB was investigated in three settings.

Data were gathered during a short long-line walk with dogs in a shelter environment. Instances of FLB were observed significantly more often (Chi-square; $p<0.0001$) in intact (n=20) than castrated male dogs (n=20). In the subject dog's garden significantly more intact (n=12) than castrated (n=10) males exhibited FLBs (Fisher's Exact $p=0.39$) upon exposure to two urine stimuli from an intact and a castrated male. In those instances only urine of castrated male dogs, not intact, elicited FLB. Moreover, during behavioural assays involving urine stimuli of only castrated donor dogs, significantly more intact than castrated male dogs engaged in FLB (Chi-square; $p=0.002$).

Considering the potential division of information between the volatile and non-volatile components of urine, only dogs using olfaction and VNO may gain access to the full message conveyed through urine marks. Due to the high proportions of castrated male pet dogs the proper functioning of dog scent communication may considerably be affected by this routine medical intervention.

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Heart rate and heart rate variability of dogs (*Canis lupus familiaris*) during physical and mental activities

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Heart rate and heart rate variability are used, in many studies, to show the response of an animal to environmental or social stimuli (Maros et al., 2008; Palestrini et al., 2005), and both are influenced by a variety of factors (bodily movement, cognitive processes, etc.). As heart rate is said to be more affected by physical activity while heart rate variability seems to be affected more by psychological processes (Maros et al., 2008), it is important to separate these effects.

This study compared differences in heart rate and heart rate variability of dogs (*Canis lupus familiaris*) during physical and mental activity in three different test situations: (1) a leash walk (physical movement), (2) a cognitive test that required only limited movements and was considered mentally challenging (a two-choice task working on a touch screen), and (3) a cognitive task (two-choice task) that included physically active (stepping towards the right object) and passive periods (waiting for the two objects to be put down) and was considered to show an interaction between physical and mental activity. All three situations included comparable handling and interactions with three animal trainers that had slightly variable relationships with the animals. Six adult male dogs of mixed-breeds participated in the experiments, kept in two packs at the Wolf Science Center. All animals were raised and socialized by humans from 10 days of age. The heart rate measurements were performed with the noninvasive Polar RS800CX heart rate belt. We recorded the individuals' heart rate, heart rate variability, and their behaviour. We expected an increase in heart rate from the cognitive test (with limited movements) towards the leash walk (physical movement) and higher heart rate variability in cognitive tests than in the physical task.

This study is one of the first that investigates how different factors simultaneously influence the heart rate and behaviour of dogs.

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Heart rate and heart rate variability in owners and their dogs

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Keywords: stress coping, human-dog-attachment

Humans and dogs engage in mutual social relationships, potentially resulting in physiological effects and health benefits for both partners. The quality of such a partnership is, among other factors, also characterized by the mutual effects of "emotional social support", i.e. the stress dampening effect due to the presence of the partner during or after a stressful situation.

This may be shown, for example, in how quickly heart rate (HR) returns to baseline level after arousal and may also be manifested in heart rate variability (HRV). Thus we investigated HR and HRV changes in owners and their dogs during and after a mild threat situation. 120 owners, aged 18 to 60 years, with their intact dogs 1.5 to 8 years of age, are tested. HR and HRV are measured from owners and dogs by using the non-invasive HR monitoring belts (Polar-RS800CX). We investigate whether there is a synchrony in owner and dog HR and HRV before during and after a mild threat situation.

Do cortisol and testosterone levels covary with social role in domestic dogs?

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The scientific knowledge applied to domestic dogs (*Canis lupus familiaris*) in the area of social organization and hierarchy is heavily influenced by previous research done on gray wolves (*Canis lupus*). While feral dogs do appear to exhibit what is described as submissive behaviour to defuse conflicts, they do not seem to adopt a wolf-pack-like social system that focuses around a dominant breeding pair. In popular culture, the idea of "top dog" is widespread; however, there has not yet been a study to examine whether pet dogs living in a permanent social group take on consistent social roles, and what factors may be related to such.

Using animals from multi-dog homes volunteered by their owners, the present study uses three different methods for measuring social status: (1) owner impressions as evaluated by a questionnaire about related behaviours; (2) toy possession test conducted during a visit to the multi-dog home and (3) tail base position and social behaviours during the toy possession test assessed from video footage obtained during the visit. Saliva samples are collected before, during and after the visit to obtain cortisol and testosterone levels. Both hormones have been linked to social status and seem to jointly regulate whether an animal comes out as more dominant or more submissive after a conspecific agonistic interaction. It is hypothesized that both baseline and changes in testosterone and cortisol levels can predict the outcomes of social interactions between cohabiting dogs. If cohabiting dogs form a consistent social rank structure, these outcomes may be predicted by owner questionnaire responses.

Our objective is to examine whether pet domestic dogs form a social hierarchy with cohabiting dog(s) through analysis of the social status measurements and to evaluate the role of cortisol and testosterone levels in predicting a dog's social status. The data collection is ongoing.

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Ability of scent identification dogs to detect individual human odors

Santariova

Scent identification line-up is a forensic method used in the Czech Republic as well as in other countries. Specially trained dogs are used to match human odors collected at the crime scene to the odors collected from detained suspects. Over this study the ability of specially trained dogs to match odors exposed to high temperatures was tested and thereby the possibility to collect odor samples from items exposed to extreme conditions such as fire or explosion. Scent samples were collected on steel tubes.

The experimental person was asked to held the tube in hand for one minute. Metal tubes carrying human scent were subsequently exposed to temperatures 100, 600, 700, 800, 900 and 1000 °C for thirty minutes. After cooling down the tubes were placed into sterile glass jars containing special fabric sorbent ARATEX™, that was closed with twist off lid. Thus the scent from the metal tubes was transferred to the fabric sorbent. Target scent samples were collected from the body of the same experimental person. The fabric sorbent was placed on the belly region of the person for a twenty minutes and then closed in a sterile glass jars. Non target odors were collected from the subjects of the same sex and approximately of the same age. For scent identification procedure were used five specially trained police dogs. During the scent identification procedure we followed the same protocol and regulations as through real criminal investigation. In accordance with police regulations we considered matching procedure to be accomplished successfully, if the dog tree times responded to target scent repeatedly and methodologically placed in the line-up of glass jars. All dogs used in the experiment flawlessly identified scent exposed to temperature of 100, 600, 700, 800 °C. Only two dogs were able to identify scents exposed to the 900 °C and none of dogs could identify scent exposed to 1000 °C. Data were processed by logistic regression ($\chi 2(2) = 42,73$ $P < 0.0001$).

The results suggest that human scent exposed to extremely high temperatures such as eight and nine hundred degree can be identified by specially trained scent identification dogs.

Inherited Osteosarcoma in a Family of Irish Wolfhounds

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Keywords: canine osteosarcoma, irish wolfhound, pedigree analysis

Background

Osteosarcoma (OS) is a highly aggressive primary tumour of the bones that causes extensive local bone lysis, which results in significant pain and can lead to pathological fractures. Metastasis occurs early, and prognosis is poor. OS is more common in large breeds of dog. Irish Wolfhounds have one of the highest incidences of all dogs, with OS causing 20-25% of deaths in the breed. The cancer has been shown to be hereditary in the St. Bernard and the Deerhound; however, no such studies have been conducted in Irish Wolfhounds so far.

Methodology

Clinical data from a family of n=61 Irish Wolfhounds from n=9 litters spanning a period of 29 years and 8 generations were compiled by GG. OS was diagnosed by radiographs; 10 cases were confirmed by biopsy by the Bristol Bone Tumour Registry. Pedigree data over 30 generations were supplied and analysed by SRU. Inbreeding coefficients were calculated in Pedigree Explorer; statistical analysis was performed in The SAS System®.

Conclusions

20 dogs (32.7%) developed OS, which was above average for the breed. Mean age at OS-related death was 7.9 ± 2.3 years. Age at death from all causes ranged from 1.8 to 11.9 years; age at death from non-OS causes was 7.6 ± 2.4 years. All but 3 OS cases were euthanised, one OS case died of unrelated causes. Neutering was a significant risk factor for OS. Inbreeding did not increase OS risk, but decreased life expectancy. OS cases occurred in every generation and followed an autosomal dominant mode of inheritance with incomplete penetration.

Our findings provide evidence that OS has an inherited component in Irish Wolfhounds. The underlying mutations could be identified through molecular methods, such as a genome-wide association study. 60% of dogs that developed OS were over 7 years old. This contrasts the higher incidence of human OS seen in young people, but agrees with other studies that show a higher OS incidence in older dogs. The incidence of OS in dogs may be underestimated overall.

Teaching dead dogs new tricks: Right censored data in canine lifespan studies

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Background
The domestic dog is commonly used as a model for human disease and aging due to the easy availability of veterinary data and the fact that its environmental situation in a domestic setting is similar to the situation in which humans live. However, studies of canine lifespan are commonly based on databases of dead animals that are grouped by year of death. While this seems to be an obvious choice at first glance, it also presents an inherent problem due to right censored data, which results in an artificially short lifespan during analysis.

Methodology
Right censored data can be expected to occur in all populations where a significant number of individuals from the birth cohorts studied are still alive at the time when death data are collected. Animals that are still alive at this point will obviously be older than their dead contemporaries, yet will not appear in the data. Thus, the measured lifespan will be too low when analyzing data from dead animals in this way. This artificial decrease in lifespan can be easily demonstrated by taking the death data and grouping them by year of birth instead of year of death.

Conclusions
Unfortunately, the great majority of published lifespan studies in the domestic dog ignore this problem, meaning that most such studies can be shown to have varying degrees of bias due to right censored data, which in turn can be expected to make comparisons between different studies considerably more difficult.

This conribution discusses the problem and effects of right censored data in canine lifespan studies using practical examples from the literature and presents some possible approaches to omitting the problem, such as the exclusion of individuals from censored birth cohorts, the analysis of animal years at risk or the use of Kaplan-Meyer analysis.

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Evolution of copy number variants in wolf-like canids

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Keywords: CNV, wolf, domestication

Structural variation in general, and copy number variants (CNV) in particular, has emerged as an important source of genetic variation. The genetic history and the extraordinary morphological, physiological and behavioral variation of dogs, make them an ideal mammal in which to study the effects of CNV on biology and disease. The dog genome revealed the existence of more than two thousands of CNV that overlap ≈ 400 genes, which are enriched for defense/immunity, oxidoreductase, protease, receptor, signaling molecule and transporter genes. Furthermore, CNV can have significant impacts on a wide range of phenotypes including breed-definiting traits and showed to be appropriate markers to analyze genetic relationships between dog populations. This finding implies that most of the surveyed CNVs were present in the pool of canine breed founders.

In order to understand the ancestral dog genome organization, we designed a high density custom 720K probes NimbleGen aCGH chip based on all known dog CNV and segmental duplication and genotyped 23 wolves from 11 populations, with a wide distribution (including Europe, Asia and America), a dingo, two coyotes and two jackals (employed as outgroups).

The analysis of ≈ 1700 CNV in 89 wolf-like canids (28 characterized in the current work and 61 dogs previously reported) shows a considerable genome-wide CNV variation at the population level in gray wolves. As predicted, large and/or expanding populations had high levels of CNV variability and the lowest levels were found in historically bottlenecked populations. These results further support the use of CNV data to infer demographic history of canids.

A major interest in undertaking CNV discovery in wolves relates to provide insight into mechanisms of canine genome evolution and generate a valuable resource for future evolutionary and phenotypic studies.

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Dogs show right facial lateralization to stressful stimuli

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Domestic dogs have shown to demonstrate behavioral laterality to emotional stimuli. Previous studies showed the tendency of the left behavioral laterality to the stimuli eliciting stress responses (1, 2). In the current study, we examined whether such emotional stimuli evoked facial laterality in dogs.

We presented social stimuli and non-social stimuli that elicited an avoidance response or an approach response to 14 house dogs (11 males and 3 females; 5.92 ± 3.07 year age). The social stimuli were an "unfamiliar person (UP)" and the "dog's owner (OW)". Non-social stimuli were objects that the dogs disliked (ODL) or liked (OL) which the owners brought. The dogs' facial expressions were recorded by a high-speed video camera while presenting each stimulus, and the acceleration rate of their ears and eyebrows were analyzed.

As the results, with regard to the social stimuli, the left ear moved more when the UP was presented as compared to when the OW was presented ($p = 0.004$). With regard to the non-social stimuli, after presenting ODL, the movement of the right ear increased significantly compared to when OL was presented ($p = 0.003$).

In summary, our results clearly demonstrated that emotional stimuli eliciting stress response evoked facial laterality in dogs. Contrary to previous studies, after presenting stimuli that dogs disliked, dogs showed the right laterality in the current sample. Dog's behavioral laterality may depend on the type of stressful stimuli, such as innate (previous studies) or conditioned (present study) stimuli.

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DO.C.: a behavioural test to evaluate dogs' suitability for working in the classroom

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Keywords: behavioural test, classroom, dog

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Many dogs are involved in didactic projects where they work into classrooms. The current study aimed at preparing and evaluating a behavioural test to assess dogs' suitability to work with children in a classroom.

Twenty-nine pet dogs (19 females and 10 males; 36.8±20.4 month old; 18 purebred and 11 mix-breed; 12 trained for different jobs) were examined.

All dogs underwent a purposely prepared behavioural test called DO.C. (DOgs in Classroom), divided into three steps: environmental stimuli (exploration of an unknown room, going up and down stairs, motivation for food and toys, response to noises, novel object, cleaning trolley and bike); social stimuli (contact with an unknown woman and man, passing through a silent group of people, passing through a screaming group, contact with a group, response to an unknown dog, and response to a walking child, a running child and a running and screaming child); and training (sit, down, stay, recall and walking on the leash). All tests were recorded and observed by two trained people who assigned for each stimulus a 1-4 score (1 corresponding to the least and 4 to the most desirable behaviour). Dogs were considered as suitable when all responses to social stimuli were 4, while the minimum accepted score for environmental stimuli was 3.

Dog owners had to fill in a questionnaire regarding how their dogs, in daily life, responded to the stimuli administered in the DO.C. test.

According to the test, only 5 out of 29 (17.2%) tested dogs resulted suitable at the involvement in didactic projects.

The average agreement between the two observers was 80.2%. The results of DO.C. agreed with the owners' response to the questionnaire for 80.0% of suitable dogs. Among dogs who did not pass the test, 9 out of 24 (37.5%) were reported to be suitable by their owners.

These preliminary data, to be confirmed by testing more dogs, suggests that DO.C. test may be used to assess dogs' suitability to be involved in didactic projects within the classroom.

Problem solving games as a tool to reduce fear in dogs: preliminary results

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Keyword: dog, fear, problem solving

Problem solving games are often advised in the behavioural therapy of fearful dogs. The aim of the current study was to assess their effectiveness in reducing fear in dogs. Dogs' fear was evaluated through four subtests of the Dog Mentality Assessment (Fält, 1997; Svartberg & Forkman, 2002), focused on dog behaviour towards people. The first subtest consisted of a social contact with a stranger (test leader, TL) who approached the handler and then tried to walk the dog. In the second, another TL was hooded and encouraged the dog to play, moving and shaking a rope. In the third a manikin suddenly appeared in the dog's path. In the last subtest a third TL spent 3 minutes talking to the dog handler without interacting with the animal. In each subtest a score varying from 1 (extreme fear) to 5 (no fear) was assigned by two trained observers.

Dogs resulted fearful were divided into an experimental group (5 dogs, 2 males and 3 females, 45.2±23.3 month old) and a control group (4 dogs, 2 males and 2 females, 61.0±48.0 month old).

The experimental group underwent problem solving sessions carried out by experimenters (different from TL) in a room, with games of increasing complexity, in which they had to gain the tasty food hidden by: upside down glass, bin, rolled towel, cage, twister, doggy brain train cube, roulette, inclined tube, and pull-the-plate. The number of sessions needed to solve all the games was 6.6±2.6.
Sixty day after the first test, all dogs were blindly assessed by repeating the Dog Mentality Assessment.

Data was statistically analyzed by using a Wilcoxon test (p<0.05).

Dogs of the experimental group statistically increased their scores after the problem solving sessions (16.29 vs 21.58; W=91.0; p<0.022), meaning that they appeared less fearful. Scores of the control groups did not show any change compared to the first trial.

These preliminary data suggest that problem solving sessions where dogs are successful may be effective in reducing fear.

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Montessori–Method for Dogs

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My former practice in the Montessori Method and my long lasting work and experiences with dogs of all ages prompted me to investigate the application possibilities of M`s concepts of "Sensitive Phases SP" and "Prepared Environment PE" for the education of growing dogs. I tried to integrate Montessori`s doctrines with the up to now valid fundamentals of education for dogs.

The observation of dogs during their development from puppies to adults and their education in a respectful and loving way is a big challenge for breeders, owners and trainers though.

The need of knowledge about the "SP" in the development of dogs and consequential recognizing the needs they have is essential. A careful observation is the key to make aware for the "SP" to facilitate environment and prosperous development. This is in best accordance with requirements of a natural environment in which puppies can make important experiences and practice their skills. The "PE" and the conscious dog handler should emulate a natural situation. Within the "PE" sensorial materials (for the development and refinement of the senses) like boxes with different smells, boxes with different sounds (filled with different matter) and toys with different surfaces as well as materials to facilitate muscles and the sense of balance like an inclined plane, stones to scramble, a tiny hill or a balance board and various conditions of soil (cattle grid, cement, wood) are necessary. It should be pointed out that that each puppy requires individual assistance at individual time.

Due to this method I expect the dog handlers' attitudes towards their dogs will change into a more respectful and loving one. Dogs that developed like their inner path demanded will be integrated, self-confident and contended and will love to work with and for their handlers.

In my study I tried to work out the importance of the "PE" and the role of breeders and handlers for the development during the "SP" for dogs. A few examples will be presented.

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Dogs hunting bears - what do they really hunt?

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Keywords: hunting, tracking, bear

Animals wounded in accidents or in hunts should be found and killed as soon as possible. To do this it is vital that hunters have access to dogs that are capable of hunting and finding the specific animal. When hunting for wounded animals the task is more complex than in a normal hunt - it is a question of finding a specific individual. The typical hunt starts with the dog being shown the beginning of the track, the dog then tracks the prey while on leash, the dog is let go and is expected to pursue the prey and finally to start baying so that the hunter can find and kill the prey.

In the current study the tracking behaviour of 22 experienced hunting dogs was studied. Fourteen of the dogs had previously been used for hunting bears (other species hunted included mostly moose and lynx). Wild bears with gps collars were used as prey animals. All hunting dogs had gps collars as well, this enabled us to find a recent bear track as well as gathering data on how closely the dog was following the bear. Out of the 22 dogs, seven did not start tracking or showed a very weak interest in the track. Only two dogs found the bear and kept it at bay until the dog could be recovered by the hunter. Eleven of the dogs had participated in tests designed to assess the dogs capability of tracking bears. The dogs having succeeded in these tests did not show a better result than those had failed them. The results indicate that other training and testing methods than the currently employed should be used.

"Beware, I am big and non-dangerous" – Dogs communicate themselves bigger than real size in their play-growls

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Keywords: growl, body size, play

Background
Sending misleading or out-of-context signals are thought to be essential for maintaining the playful context (1).

Recent experiments revealed that dog growls convey size information of the caller (2). Formant dispersion is known to be a reliable index of the caller's body size in multiple species. An acoustical analysis of contextually different growls showed that 'Play' growls ('PG') were shorter and had a narrower formant dispersion than 'Food guarding' ('FG') growls (3).

Methodology/Principal Findings
By the means of our cross-modal matching experimental design (2), we tested dogs' sensitivity to the size factor encoded in the play growls, using simultaneously projected dog pictures and playbacks of growls.

Adult companion dogs (N=48) were tested in two groups, one with FG, the other with PG playbacks. Each test consisted of two phases: a 10 s 'Projection only' (PO) phase (projection of two dog pictures), and a 20s 'After Sound' (AS) phase (after a short growl playback, the projected pictures remained visible). One of the projected dogs always matched in size to the growling dog, the other was 30% larger or smaller. Looking preferences were analyzed by (1) comparing the relative duration of looking at the pictures; (2) number of dogs performing gaze shifts from one picture to the other after hearing the growl.

In both the FG and the PG groups we found no preference for any of the pictures in the 'PO' phase. However, in the 'AS' phase dogs stared significantly longer at the larger dog after they heard the PG playback. In the FG group significantly more dogs shifted their gazes to the picture of the matching dog when the growl playback started.

Conclusions/Significance
Here we found evidence that growling sounds emitted during play correspond to a larger-than-actual body size. This may function as maintaining the non-agonistic playful context for longer duration.

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Developing a simple behaviour test battery for family dogs (FIDO)

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Background

Dogs are popular pets and they cooperate with humans in various ways. Despite this close relationship little scientific evidence has been gathered on individual differences in dogs. In such research questionnaire studies and behaviour tests are utilised for collecting behavioural data (e.g. Dog Mentality Assessment test: Svartberg and Forkman, 2002; Socially Acceptable Behaviour test: Planta and De Meester, 2007.

Methodology/Principal Findings

In our study the main aim was to develop a test battery for family dogs (FIDO) which consist of short and easy-to-execute test elements focusing on the social interaction between humans and their dogs and there is no need for highly trained experimenters or complex equipments.

In our study we tested two dog breeds: border collies (N =50) and retrievers (N=50). In our study we used FIDO test and questionnaires to validate FIDO. Dogs were characterized by three instruments: (1) Dog-ADHD Rating Scale assessing Activity-impulsivity and Inattention; (2) The Dog Big Five Inventory (DBFI) assessing Energy, Affection, Neuroticism, Intelligence and Conscientiousness; (3) sociability test for family dogs (FIDO) which consists of 14 subtests.

From the behavioural variables recorded in the FIDO we developed three behaviour scales: Sociability, Activity-impulsivity, Trainability and playfulness. We found negative correlation between the Trainability and playfulness behaviour scale and the Inattention questionnaire scale. And also found a difference between the two breeds: border collies got higher points on Trainability and playfulness behaviour scale than retrievers.

Conclusions/Significance

Our results show that FIDO is an easy to use and appropriate mean for studying the individual differences in dogs, which could be applied at different locations and laboratories, and offers the possibility to compare different dog populations and breeds.

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Visual communication with humans in Japanese Akita Inu

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Dogs' visual contact with humans is a key aspect of dog-human communication. Previous studies have suggested that canine gaze behavior to humans is influenced by domestication history from wolf to dogs as well as by recent selective breeding process of working dogs (Miklosi et al. 2003; Passalacqua et al. 2011). To test the impact of genetic closeness to wolves on such communicative performance in dogs, the current study focused on Japanese Akita Inu, which is one of the most primitive-type dog breeds native to Japan.

We examined gazing behavior of Akita Inu (n = 15) by comparing it with those of hunting/herding breeds (n = 28, e.g. Labrador retriever, Poodle) and other dog breeds (n = 14; mongrels). Subject dogs completed the 'problem solving task' and the 'visual contact task' used by earlier studies (Passalacqua et al. 2011; Jakovcevic et al. 2010). In the problem solving task, we found a significant difference of gaze behavior among the three dog breed groups (Kruskal-Wallis test, $\chi2 = 8.80$, df = 2, p =. 01), with Akita Inu gazing at humans for shorter periods of time than both hunting/herding breeds (Mann-Whitney U = 70, Z = 2.93, p = .00) and other dog breeds (Mann-Whitney U = 43, Z = 2.16, p = .03). In contrast, gaze duration during the visual contact task did not differ between Akita Inu and other dog breed groups (Mann-Whitney U = 104, Z = 1.40, p = .16), indicating that Akita Inu was able to spontaneously produce communicative cues towards humans in the context of interspecific interactions.

Our results suggest that initiation and maintaining of gaze in primitive-type dogs might be dependent of particular problem solving situations, and that canine predisposition for visual communication with humans may be partially associated with genetic similarity to wolves.

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Fake hands, true bites?

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The general aim of this study was to test and analyse the behaviour of dogs aggressive towards people. A second group of dogs, non-aggressive according to their owners, was tested to compare behavioural responses, stress and fear levels in an Aggression Test developed for behavioural evaluation of pet dogs. A specific goal of the study was to compare the effect of an artificial hand used by the owner and by a stranger in the "feeding bowl test": is the dog's aggression a reaction against a tool or is it influenced by the quality of its relationship with the person handling it?

At present the study group consists of 65 pet dogs (32 aggressive; 33 non-aggressive), age range: 5 months - 7 years. The aggression test consists of 6 subtests, focused on the dog's reaction to an unfamiliar person, a doll, and the owner.

Overall, aggressive dogs showed significantly higher levels of fear, contacts with the owner, aggressive behaviours and vocalisations (bark-growl; growl), and staring (for all behaviours Mann-Whitney U Test $p<0.05$). The control group showed significantly higher levels of stress (MWU $p<0.05$). On a 0-4 scale of aggressiveness, aggressive dogs obtained higher scores than non-aggressive dogs in all sub-tests (MWU $p<0.002$). In the feeding bowl sub-test, aggressive dogs' scores were significantly higher with the stranger (mean= 3,1) than with the owner (mean=2,3) (Wilcoxon test, $p=0,0007$). No difference emerged for non-aggressive dogs.

In our study group, aggressive dogs displayed significantly higher levels of fear than controls, thus suggesting that fear might play a considerable role in aggression towards people. In the feeding bowl sub-test, the dogs' behaviour and levels of aggression differed significantly whether the fake hand was operated by the stranger or the owner, hence the dog's reaction appears to be influenced by the relationship with the handler rather than being a sheer reaction to the tool.

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Ethological study of Labrador Retrievers' water interaction and relative preference

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Labrador Retriever is a breed of domestic dog (*Canis familiaris*) with great importance in our current society. It was primarily selected to be an excellent water dog and work with the fishermen (Wiles-Fone, 2003). They are also very sociable dogs that approach and seek human contact (Wilsson and Sundgren, 1997), besides contact with other dogs.

Our modern society tends to move this breed away from the water and we don't know how this stimulus is important for the animal. In order to initiate a scientific understanding on this matter, the objective of this study was to understand whether the group of Labrador Retrievers in study would show a relative preference for aquatic environments. To achieve this goal an arena test with a swimming pool (water stimulus) and two other stimuli - a friendly dog and a friendly human - was designed. The three stimuli are considered positive and non-aversive to this specific breed. The dogs were raised together on a farm kennel, having regular contact, thus being familiar to one another. In addition, the dogs had regular contact with humans and with water fountains or pools, where they could play. The frequency of the approaches and the duration of interactions of Labrador Retrievers towards the different stimuli were measured; the consistent selection of one over the others can suggest us the animal's relative preference (Hemsworth et al., 2011). This was measured during 2 min periods for each of the ten Labrador Retriever studied, in three trials in three non-consecutive days, with all of the stimuli present at the same time in the arena.

Results showed that the dogs approached significantly more times the water stimulus than the dog ($p < 0.01$) and the human ($p < 0.05$), and spent more time interacting with water than with the dog ($p < 0.05$) or the human ($p < 0.05$). Results suggested a relative preference from this group of Labrador Retrievers for water stimulus, which may indicate the importance of aquatic environment to this breed.

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Evaluation of a diet supplement on anxiety signs on dog

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Keywords: anxiety, dog, diet supplement

Behavioural problems represent one of the main causes of death and relinquishment of pets and often shown an underlying anxiety (Overall, 1997).

Behavioural dysfunctions can compromise biological functioning and as a consequence impair welfare and quality of life in pet (Ohl, 2008).

A randomized, clinical trial was designed to evaluate the effect of a dietary supplement composed by Valeriana officinalis, Melissa officinalis and tryptophan (Equilibria®) and a diet associated, on signs of anxiety and stress in dogs.

15 dogs were administered with the dietary supplement and the diet associated (hereafter defined "therapy group") and 15 dogs didn't receive the dietary supplement and didn't change the diet (hereafter defined "control group"). Dogs were randomly assigned to each group, balanced for age, sex and anxiety level. The owners were recruited as volunteers and the dogs were selected by a pre-treatment questionnaire to identify signs of anxiety. No information was conveyed about the presence of the two groups, nor about the anxiolitic effects of the supplement.

After 2 months a follow-up questionnaire was administered to evaluate eventual changes in signs of anxiety. No behavioural therapy was associated. For every dog was calculate a score coming from the frequency and intensity of anxiety and stress signs (0 for no changes; -1 for worsening; +1 for improvement) after the 2 months scheduled. Mann-Whitney test was used to compare the global score and chi-square test was used to identify differences in single signs shown by dogs between the two groups.

The global score of the "therapy group" (1.50±0.51) was significantly lower as opposed to the "control group" one (8.93±10.14) (P<0.005), showing statistically significant improvements in frequency and intensity of several anxiety signs (P<0.005), like follow the owner, aggressive behaviours, house soiling, restlessness, excessive vocalizations, destructions and coprophagia. Moreover, owners reported an improvement on noise, thunderstorm and wind fear behaviours.

Helping to decreasing the anxiety, the dietary supplement tested in this study, could support the behavioural therapy. In Europe the dietary supplements are not considered drugs and the lack of side effects make them easy to suggest and administer.

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Analysis of behaviour changes in 65 pet dogs after gonadectomy

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Keyword: dog, gonadectomy, behaviour

Background
Gonadectomy is one of the most common surgical procedure on small animals (Mahlow, 1999). Its necessity, and in particular the timing, is still controversial.

Methodology/Principal Findings
This study aims to evaluate possible changes in behaviour after gonadectomy. 65 dogs of different breed and age took part in this study. Before gonadectomy, the owners were asked to fill out a baseline questionnaire including information on the dog's characteristics and history. The behaviour changes were evaluated by questionnaires administered at 10, 30, 90 and 180 days after gonadecomy. Questionnaire answers were scored, absolute and relative frequencies were calculated and expressed as percentage. Wilcoxon's and χ^2 tests were used to identify differences in behaviours, as perceived by owners.

77% of dogs involved in the study were females and 23% males. About half (42%) of female underwent surgery between 7 and 12 months of age and the most of the male (80%) between 1 and 5 years of age.

No significant changes were perceived in feeding and drinking behaviour, elimination, grooming, sleeping, playing behaviour, aggression and dog's behaviour during owner absence. 40% of male dogs showed mounting at baseline and just 6.7% at 180 days (p<0.05), while the percentage of females decreased from 28% at baseline to 22.4% at 180 days. At baseline 38% of females showed vocalizations, panting, attention seeking behaviour and excessive vigilance and no dogs trembled, hided and attempted to escape during laud noises; at 180 days the percentage respectively change to 16.33% and 20.41% (p<0.05). The percentage of males kept similar trend.

Conclusions
In conclusion owners reported that, after gonadectomy, behaviour of dogs remain unchanged for the most part except for mounting behaviour and reaction to loud noises, as reported in literature (Maarschalkerweerd et al, 1997; Spain et al, 2004). To confirm these results, we are planning a control group study with a larger sample and a longer monitoring period.

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Effects of owners' attachment style and personality on their dogs' separation-related disorder

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Keywords: separation, dog, attachment

Background

Separation-related disorder (SRD) is a common behavior problem in dogs, when the problematic behaviour occurs in the owner's absence. Symptoms consist of destructive behaviour, excessive vocalization or inappropriate elimination. Based on our previous findings (Konok et al, 2011) we have assumed that SRD dogs have an insecure attachment style. In humans a concordance has been shown between parental attachment security and the child's security (Fonagy et al, 1991). As dog-owner relationship shares many features with mother-child relationship, we have hypothesized that the owners of SRD dogs are more likely to have an insecure attachment style. We assumed also that SRD dogs and their owners are more neurotic than typical dogs and their owners.

Methodology/Principal Findings

317 owners of family dogs responded to four questionnaires: the Separation Questionnaire to determine if the dog has a separation-related disorder; the Human Big Five Questionnaire and the Dog Big Five Questionnaire to observe dogs' and owners' personality; the Adult Attachment Scale to reveal owners' attachment style. We found that owners of SRD dogs are more likely to show insecure, avoidant attachment style in comparison with owners of non-affected dogs (Mann-Whitney test, $U=9371$, $p=0.018$). SRD dogs were also reported to be more neurotic than typical dogs ($U=2337$, $p<0.001$) and their owners are less conscientious than the owners of non-affected dogs ($U=3549$, $p=0.033$).

Conclusions/Significance

Our results show that separation-related disorder in dogs may be the consequence of their owner's insecure attachment style. Owners' own attachment style may influence the dogs' attachment style and behaviour problem through their caregiving behaviour, which mediates also between mothers' and children's attachment (van Ijzendoorn, 1995). Van Ijzendoorn (1995) found that insecurely attached humans showed less consistent responsiveness to their children's needs. This is in accordance with our finding, that the owners of SRD dogs are less conscientious.

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Development and implementation of a unique online portal for collecting data from a standardized behavior evaluation with shelter dogs

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Keywords: shelter dog, behavior evaluation

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Background
Systematic evaluation of dog behavior in animal shelters has been advocated as an essential component of addressing the behavioral needs of dogs in shelters and for helping make appropriate placement decisions. Yet there is little information available about the prevalence of behavioral responses observed in these evaluations. Conducting evaluations in a standardized fashion and collecting results in a centralized database would yield prevalence estimates of behaviors and common patterns, helping shelters make more informed decisions regarding in-shelter enrichment, behavior modification, and placement.

Methodology
The Match-Up II Behavior Evaluation, a standardized test battery, was developed based on analysis of 668 evaluations, follow-up survey results with owners of adopted dogs, and multiple rounds of applied testing and revision. In order to make the data collection as standardized as possible, we developed an online portal to allow users to enter data and automatically score results. More information about the research and process that went into developing the Match-Up II Behavior Evaluation as well as the online portal will be presented.

Principal Findings
Currently, there are 15 shelters actively using the Match-Up II Online portal to enter and score their behavior evaluation data, amounting to 4100 dogs. Of these 44% were female, 56% were male. 36.7% displayed jumpy/mouthy behavior; 27.8% displayed fear of people, and 8.3% displayed food-related aggression. Additional demographic data will be presented.

Conclusions/Significance
Using an online portal for collecting and scoring shelter dog behavior evaluations is feasible in real world shelter settings. Pooling of data from multiple shelters will allow initial estimates of prevalence of common behavioral responses to various sub-tests, thereby allowing shelters to plan appropriate resources for their canine populations. Moreover, these findings will help shelters identify and manage problematic behaviors of individual dogs before and after adoption thereby preventing unneeded euthanasia.

Attention to social and non-social stimuli in family dogs

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Keywords: social attention, non-social attention, dogs

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Background
We previously demonstrated that family dogs preferentially pay attention to their owner than to an unfamilar person, when the two are simultaneously presented [1]. The current experiment was aimed at studying the allocation of attention to diverse social and non-social stimuli.

Methodology/Principal findings
Twelve family dogs underwent a test as described in Mongillo et al. [1], which involves the simultaneous presentation of two stimuli. In the present study, the test was run with three different pairs of stimuli: two strangers (SS); two strangers, one of which visibly carrying the dog's leash (SL); a stranger and the owner (SO). Moreover, a fourth test was run with the owner as the only stimulus present (O).

The length of gaze bouts (GBL) and the total time of looking (% of task time, TLT) to the different stimuli were taken as measures of attention. A generalized linear mixed model with post-hoc pairwise tests was used to compare attention between the two stimuli within each condition and to the relevant stimulus (the owner or the leash) between conditions.

In the SS condition attention was equally distributed between the two stimuli (GBL: p=0.712; TLT:p=0.624), with an average GBL of 2.0±1.2s and a TLT of 45.9±18.8%. By contrast, a preferential attentional response towards the relevant stimulus was observed in both the SL (TLT: p=0.005) and the SO condition (GBL: p<0.001; TLT: p<0.001).

Between conditions, attention to the relevant stimulus was lower in the SL than in either the SO (GBL: p<0.001; TLT: p<0.001) or the O condition (GBL: p<0.001; TLT: p<0.001). No difference was found in attention to the owner between O and SO (GBL: p<0.93; TLT: p<0.11).

Conclusions/Significance
The results suggest that dogs give preferential attention to social and non-social relevant stimuli, although social ones are more effective in eliciting a preferential response. Moreover, attention to relevant social stimuli seems scarcely affected by the presence of distractors.

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Assessing dogs' adaptive capacities at the vet

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The goal of our study was to assess pet dogs' adaptive capacities during a visit to the vet. We measured dogs' behavioural, heart rate and salivary cortisol responses to a standardized procedure performed in the vet exam room and show that these parameters can be used as indicators of their adaptive capacity, i.e. coping ability.

A standardized procedure was developed: 1) all dogs were placed on the vet's exam table and were fitted with a non-invasive Polar® heart-rate monitor which recorded R-R intervals. 2) A "5 minute observation" immediately followed this procedure: dogs stayed on the exam table next to their owners and were videotaped the whole time. Owners were allowed to interact with their dogs but the veterinarian did not interact with the dog during the observation. 3) At the end of the observation period, the dog's rectal temperature was measured. 4) Finally, 10-15 minutes after the start of the procedure a saliva sample was collected from the dog.

105 dogs in 11 different Dutch vet clinics were observed in this way over a period of four months. Dogs exhibited variable responses to the standardized procedure displaying both behaviours previously reported as being "stress indicators", such as licking lips (97%) and panting (55%), and exploratory behaviours, such as sniffing table (47%). The rate/duration of these behaviours during the 5 minute observation varied among dogs and three different 'coping responses' were observed: 1) a rather invariable high response (non-copers); 2) a high response only in the first few minutes diminishing over time (copers); and 3) a low or null response (non-responders). Preliminary findings show that 'panting' is significantly ($p<0.05$) positively correlated, while 'sniffing table' is negatively correlated ($P<0.05$), with salivary cortisol values.

Measuring individuals' coping responses under specific conditions (e.g. a "stressful" environment) is important in animal welfare assessments. We believe these findings have implications for assessing dog welfare.

The relationship between age, sensory problems and behavioural changes in dogs: an online survey study

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Keywords: dog, behaviour, cognitive, aging

Background

Dogs are important species in studying cognitive aspects of aging because large numbers of individuals live to advanced age. Our aim was to track behavioural changes in dogs of different ages as perceived by their owners in the Hungarian dog population.

Methodology/Principal Findings

We used a questionnaire by Golini et al. (2009) inquiring about the physical and mental condition of the dogs. The survey collected demographic data on the dog and about possible sensory impairment (hearing, seeing and smelling). We investigated whether the dogs' (age between 1 to 24 years) condition changed with age and looked at the effect of size (small, medium, large), gender and keeping condition (garden, flat). A Principal Component Analysis performed with 21 questionnaire items revealed three components (Spatial orientation; Disinterest and House training) which explained 58.84% of total variance.

Our analysis found that older dogs are more likely to be sensory impaired according to their owners. General Linear Models showed that Spatial orientation is influenced by relative age and presence of sensory impairment. Disinterest (decreased activity, impaired learning and working ability) can emerge as early as 50-75% of the lifespan and dogs kept indoor and/or without sensory impairment showed fewer problems, independently from their age. House training related problems usually occur only in very old age, and owners of small and young dogs report more problems.

Conclusions/Significance

We argue that the effects of age on dogs' behavior can be validated only if there are data representing the younger members of the population. Furthermore, the estimation of sensory impairment and housing condition of the dogs is also important in the studies on aging. Based on some of our present findings (e.g. emerging disinterest in aged dogs) we will perform behavioural tests to study cognitive aging in pet dogs.

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Dependent dog is ready to starve

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Background
Recent experiments (Prato-Previde et al., 2008, Marshall-Pescini et al., 2011) showed that 1) human preference can bias the dogs' choice when they have to choose between different quantity/quality of food, and 2) this behaviour is possibly related to the dogs' attachment to the owner. However, in both experiments the dogs were rewarded independently of their choice.

Methodology/Principal Findings
Here we tested 64 dogs with a modified protocol, when they had to choose between a piece of food and an empty plate. In the second phase, the owner mimicked eating above the empty plate before the dogs' choice. After the test, the dogs were left alone in an unfamiliar room to test their separation behaviour which is related to the attachment to the owner.

Dogs chose the baited plate above the chance level in the free choice phase but at the chance level in the second phase, similarly to the results of the studies mentioned above. Positive correlation was found between the dogs' tendency to choose the empty plate in the second phase and their orientation to the hiding owner's direction in the separation test. In case of dogs which preferred the owner's choice (the empty plate, N=19), we also found a relationship between the dogs' separation behaviour and their latency of choice. The faster the dog approaches the plates in the second phase (compared to the first phase), the more time it spends standing by the door, looking at the owner's direction and the less time it spends exploring the room in the separation test.

Conclusions/Significance
Thus, our results show that dogs are willing to follow the owners' preference even if it is not rewarding for them. This willingness is indeed related to their separation-related behaviours and it seems that the more dependent the dog is, the less it loses the motivation to choose the owner-preferred non-rewarding plate.

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Breed differences in the expression of 'Boldness', a personality super-trait

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Background

Previous studies have identified 'Boldness' [1] as a super-trait in dogs that is believed to represent the shy-bold axis. Boldness differs between breeds, providing evidence for breed-specific behaviour [2,3], but grouping breeds on the basis of similar behavioural tendencies has proved elusive. This study investigated differences in the expression of Boldness between dog breeds, kennel club breed groups, and sub-groups of kennel club breed groups.

Methodology

An online survey of dog owners in Australia harvested 1054 useable responses. A principal components analysis was run on the survey results and one component was retained. This component had numerous characteristics that align it with 'Boldness' in dogs as reported in previous studies[1] and it was labeled accordingly. Linear mixed models and ANOVA were used to investigate Boldness in different breeds. Breed had a significant effect on Boldness (df=272, F=1.63, p<0.001). Breeds were categorised into United Kennel Club groups with an additional mixed breed group. Breed group had a significant effect on Boldness (df=8, F = 10.655, p<0.001). Seven of the nine groups were significantly different to each other in Boldness. Herding and gundog groups were broken into sub-groups based on historic breed purpose. Retrievers were significantly bolder than flushing and pointing breeds (N=101; Effect=2.148; S.E=0.593; p<0.001), and tending and loose-eyed herding breeds were bolder (N=23; Effect=1.744; S.E=0.8660; p=0.045 and N=56; Effect=1.842; S.E.=0.6928; p=0.0084 respectively) than heading and cattle herding breeds.

Conclusions

This study supports the existence of the shy-bold continuum in dogs. Particularly bold breeds were among the most popular breeds in Australia based on registration statistics, which raises questions about the interactions between breed popularity and temperament. Differences in Boldness between groups and sub-groups suggest behavioural tendencies may be influenced by historical purpose regardless of whether that purpose still factors in selective breeding.

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Imitation recognition and its effect on subsequent interactions between pet dogs (*Canis familiaris*)

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It has been argued that imitation might facilitate social interactions and may increase affiliating emotions between individuals [1]. Hence imitation recognition can be considered as the recognition of matching actions performed by other individuals with those of the self and also importantly it is thought to foster sensitivity to social contingencies. Imitation recognition has mainly been associated only with humans, though more recently a few studies have demonstrated this skill in others animals, namely in great apes and in southern pig-tailed macaque (Macaca *nemestrina*) [2,3,4]. Although phylogenetically distant from humans, dogs might provide a useful model for understanding the evolution of imitation recognition and its effects on affect. Range et al. (2007 and 2010) have demonstrated that, though it is not their characteristic way of learning socially, dogs are capable of imitation. Therefore, imitation recognition may also play a role in the social interactions of dogs.

In order to investigate this question, we had an experimental set up where two dogs (subject and "imitator" or in the control situation subject and "non-imitator") would work simultaneously on two identical apparatuses for which they had been previously trained to operate either using their paw or mouth. In this way, we could control whether the two dogs preformed matching or non-matching actions. We measured the attention level that the subjects paid to their partners, and examined their emotional attitude towards them in two subsequent tests. Firstly, we studied whether dogs could locate food more successfully based on gazing cues given by an individual who had performed a matching action rather than when the cues were given by an individual that used a non-matching action. Secondly, we also studied whether in a free interaction test subjects showed more affiliating behaviours towards an "imitator" partner in comparison to a partner that preformed a non-matching action.

Henceforth, adding dogs to the growing range of species tested in this paradigm is an important contribution to establishing the evolutionary origins of imitation, imitation recognition and empathy.

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Can dogs use a mirror to find hidden food?

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Keywords: dog, cognition, mirror test, problem-solving

Perfect reflections are rare in nature, but many dogs live in human homes, where mirrors are common and may be used to locate desired items. The aim of this study was to examine whether dogs (*Canis familiaris*) could use a mirror to find hidden food.

For 10 minutes, dogs ($n = 44$), with their owner and the experimenter present, were able to freely move around a laboratory in which there was a large mirror with a barrier attached to it at a 90° angle. Food treats were placed out of the dog's sight and reach throughout the room, and two fans were employed to disperse the scent of the food. Following the acclimation period, the owner, experimenter, and dog left the room and the dogs were taught to associate food with a particular bowl. Before the dog returned to the laboratory, the baited bowl was placed behind the barrier, which obscured its view upon re-entry to the room. The dog and owner were recalled to the laboratory. Dogs were positioned in front of the mirror so they could see the reflected food. Dogs were pseudo-randomly assigned to either the experimental group or a control group (where the mirror was covered before the dogs were returned to the laboratory).

Within a three-minute time frame, dogs in the experimental group were significantly more likely to find the treat than those in the control group, $p = 0.032$. There was no difference between groups in the amount of time spent in each area of the room during the first minute of the exposure period, so preference for exploring the part of the room with the treat is not likely to be the reason for this different result. Among dogs which found the treat, there was no significant difference in latency to find the treat between groups. These findings suggest that dogs may have used a mirror to locate hidden food; further research is needed to clarify the conditions under which they are successful.

Hemispheric Specialization in Dogs for Processing of Acoustic Stimuli

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Keywords: acustic stimuli, brain lateralisation, hemispheric specialization

Being widely spread among various species lateralization focuses the scientists' attention. Generally, the left hemisphere is thought to process familiar or learned stimuli, moreover, it plays a role in communication. Conversely, the right hemisphere works on new and emotional information. There is little data considering the lateralization in Canis familiaris so far.

The aim of our research was to check the dog's reaction to diverse acoustic stimuli. The group of 50 animals were given 4 different sounds from the loud speaker behind their heads. The acoustic stimuli differed in character were: the dog's barking, the cat's miaowing, the human orders 'sit' and 'wir' (meaning: whirl). The last command was supposed to be control stimulus as it should be meaningless for the dogs. Each dog was presented each stimuli only once. The orienting reaction together with the direction of the dog's head movement was recorded. 91% of the dogs reacted to the barking, 100% to the miaowing and 78% to the command 'sit', while only 43% did react to the control order 'wir'. The rotation of the dog's heads only partly agreed with our expectations. While the dogs statistically most often rotated their heads left to the barking (chi-square=4,67, df=1, p=0,031) and the miaowing (chi-square=5,57, df=1, p=0,018), they haphazardly listened to the orders 'sit' (chi-square=2,79, df=1, p=0,096) and 'wir' (chi-square=1,8, df=1, p=0,18).

The dominance of left ear during the perception of the barking and the miaowing can be easily explained through the evoking of emotions by such stimuli. However, it was expected that the command 'sit' in contrary to 'wir' would activate the left hemisphere. Although, some of the dogs were obedient to the order 'sit', the research did not show the dominance of left hemisphere. It seems to be necessary to continue the research on the reaction to the stimuli with the different values in Canis familiaris.

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Do dogs discriminate between pro-social and anti-social human behavior?

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The aim of this study was to examine whether dogs discriminate between egoistic and altruistic human behaviors. The experiment was conducted on 32 dogs of both sexes. Each dog observed three persons who were dressed identically and were seated in a row, 5 meters away from the dog, 1 meter away from each other. Each person was holding a bowl containing food. Their gaze was directed towards the floor to avoid eye-contact with the dog. Each person was asked to behave in a certain consistent manner towards the fourth person who was approaching each of them soliciting food. One person always shared food (the altruist), the second person responded randomly (ambivalent) and the third person always refused (the egoist). The begging person approached each of the three sitting persons three times and then left the room. The handler released the dog which could then approach any of the three seated persons.

For each dog, such trials were performed three times, so that the seated persons would relocate to sit in a different order. Results revealed that dogs attempted to solicit food from the egoist significantly less frequently than from the other two persons, as examined both for the results of the dogs' first choice (chi-square=8,31, df=2, p=0,016) and for all three decisions (chi-square=9,929, df=2, p=0,07). There was no difference in the preference for altruists or persons behaving in the ambivalent way. This result indicates that dogs tend to remember egoists, while the predictability of pro-social behavior is not of major importance to them.

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The Mirror Project: a dog training method based on social learning

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In the last years much attention has been paid to social learning in dogs. The "Do as I do" (Topál et al., 2006) is a protocol developed to study it, where behaviours are initially taught by traditional techniques.The aim of the Mirror Project is to suggest a training method, developed to be used in the field, where dogs reproduce behaviours demonstrated by the owner since the beginning.

The training protocol is formed by 7 phases: 1) spontaneous reproduction of 6 behaviours after demonstration (sit, go to a mat, jump over an obstacle, touch an object, give a paw, and take an object); 2) random reproduction of the previous 6 behaviours; 3) reproduction of other known behaviours; 4) reproduction of sequences of known behaviours; 5) reproduction of unknown behaviours; 6) reproduction of mixed sequences; 7) reproduction of different behaviours referred to the same object.

Besides the training process, owners were advised to practice, in daily life, some activities thought to be useful in developing dog ability to reproduce observed behaviours: e.g. doing things together (jumping an obstacle together, catching objects together etc.), encouraging dog interest for owner behaviours and using pointing gestures (going to a place, touching an object etc.).

The Mirror Project was carried out on 7 dogs (4 males and 3 females; 23.8±13.1 month old). Its effectiveness has been evaluated by behavioural tests. For all behaviours of each phase, the number of exact reproductions in 5 seconds of the observed behaviour, on a total of 10 (or 12) repetitions, has been counted. The test was considered successful when at least 75% of behaviours were correctly reproduced. A low number of test repetitions was needed to reach the success rate. In detail: phase 1 1.4±0.5; phase 2 1.0±0.0; phase 3 1.6±0.7; phase 4 1.5±0.6; phase 5 1.5±0.5; phase 6 1.4±0.4; phase 7 1.7±0.5.

Data suggests that the Mirror Project gives good results, and the use of social learning should be implemented in dog training.

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Effect of inhibitory control on problem solving in dogs

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Keywords: physical cognition, inhibitory control, *canis familiaris*

Much work in the last decades has addressed the question to what extent animals understand physical rules governing their environment. In a series of studies, evidence has accumulated that some mammals and birds can successfully solve physical problems, suggesting that they take into account aspects like physical support or connectedness in their behavioural decision making.

The results of most studies, however, feature large variation in performance between individuals. Such marked inter-individual differences are likely to be caused not only by differences between individuals' problem-solving skills, but also by other factors, such as differences in inhibitory control. Here, we tested a cohort of dogs with a series of classical physical cognition tasks, including the Support problem, the Blocked-tube task as well as a Size-constancy task. Additionally, all subjects were tested with three tasks assessing their level of inhibitory control, the Middle cup task, a Delay-of-gratification task and a Leash-detour task.

Our results provide important insights into factors influencing performance in physical cognition tasks, in particular whether better inhibitory control has a positive impact on performance in these tasks.

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Why does the dog choose the less amount of food reward? The priming effect of pre-sensitization with social stimuli

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Keywords: food choice task, pre-sensitization, social susceptibility

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Background

Prato-Previde et al. (2008 *Anim. Cogn. 11, 167-174*) have recently shown that in a task – where dogs could choose between a large and a small amount of food reward – subjects, after having seen the owner choosing the small amount of food in a communicative manner, tended to change their own extant preferences for the large quantity. We may assume that this counterproductive change in dogs' choice behaviour might be associated with dogs' 'infant-like' susceptibility to signals of intentional communication. Results from other studies suggest that social-communicative signals can guide the dogs' (as well as infants') attention, influence their inferences and interpretations in object search tasks. These 'key stimuli' may be capable of facilitating a socially receptive attitude ('ready-to-learn" mode) through stimulation of neurohormones and this might have a critical impact on subjects' subsequent behaviour.

Methodology/Principal Findings

In the present study we tested the hypothesis that dogs' pre-exposure to social stimuli (eye contact, petting) exerts a social priming effect leading to enhanced tendency to follow a human demonstrator's behaviour, even if it goes against their own previous preferences. After a 10-minute-long social (owner strokes, keeps eye contact and physical contact with the dog) or non-social (the dog plays with a toy) pre-treatment adult pet dogs (N=60) participated in Prato-Previde et al.'s (2008) two-way food choice task. Results show a significant effect of pre-treatment conditions: dogs receiving social stimulation before the test trials were more likely to change their own preferences for the large quantity and tended to follow the human demonstrator's choice in comparison with dogs pre-exposed to non-social pre-treatment (p< 0.05).

Conclusions

This is the first evidence to show that like in infants, social stimulation might take a priming effect on dogs and these stimuli are able to raise their susceptibility for social cues. Our study points to a critical, although largely neglected methodological point of studying dogs' (and infants') social cognition and provides some insight into the hidden aspect of social sensibility.

Dogs (*Canis familiaris*) evaluate humans on the basis of direct experiences only

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Reputation is a key component of cooperative interactions. Several studies have shown, that reputation plays an important role in human societies (e.g. Wedekind and Milinski 2000). The two main source of information for individuals are: direct interaction and experience with the target, and indirect experience from observing the target interacting with third parties (Maynard Smith and Harper 2004).

In the current study we investigated whether dogs use direct and/or indirect experience to choose between two human interactants. In the first experiment, twenty-four dogs had several direct interactions with a "nice" human (played with, talked to and stroked dog) and an "ignoring" experimenter, who ignored the dog completely. In the following test trial, both experimenters were seated on the floor in different corners of the room and the subject could move freely about in the room. We investigated which experimenter dogs approached first and how long dogs stayed in vicinity of each experimenter. Results showed that dogs preferred to stay close to the "nice" than to the "ignoring" human. ($T = 208.50$, $N = 23$, $P = 0.036$). In a second experiment, thirty-two dogs observed the "nice" and the "ignoring" human interacting with another dog. During the demonstration trials subjects stayed behind a Plexiglas barrier and therefore had no direct interactions with the experimenters. The procedure of the test trials, however, was the same as in experiment 1. In this experiment we found that indirect experiences led to no preferences between the two humans ($T = 146.50$, $N = 21$, $P = 0.284$).

These results suggest that the dogs in our study evaluate humans on the basis of direct experiences only.

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Eye-tracking the gaze of dogs and humans in a pointing gesture study

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Keywords: eye-tracking, dogs, pointing gesture

Eye-tracking technology has been widely used to gather data about human subjects in cognitive psychology and cognitive neuroscience experiments, providing valuable information about the focus of visual attention during cognitive tasks and the timing of gaze switches. Data from eye-tracking experiments have revealed much about the cognitive processes underlying behavior.

Eye-tracking systems have been used with nonhuman animals as well, primarily monkeys, but also recently with dogs (Teglas et al. 2012; Somppi et al. 2011; Williams et al. 2011). However, existing approaches all suffer from various drawbacks if one is interested in studying the naturalistic behavior of these animals. For example, the animal's natural mobility is an important issue when researchers are aiming to study behaviors in a naturalistic fashion. The use of head-mounted systems is especially important for studying the communicative and social behavior of canines including play with fewer spatial and visual constraints than other methods.

Here we present our approach to solving this current problem in animal cognition. DogCam is a head mounted eye-tracking system that consists of a set of goggles made for dogs (modified with extra stabilizing straps and custom machined mounting hardware) and two cameras attached to the mounting hardware with bendable, solid copper wire (12 awg): a mini camera mounted in front of the right eye was used to capture eye movements and a mini pinhole camera positioned directly above the frame of the goggles recorded the gaze video. The video data from both cameras was recorded at approximately 30 fps with 720 x 480 pixels per frame.

The present work shows the eye-tracking validation study with preliminary data testing whether dogs track human social gestures similarly to how humans track each other in a social context. We will show data from both dogs and humans measuring their focus of visual attention in a pointing gesture study.

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Social referencing: Dogs' use of emotional signals from an unfamiliar person

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Dog owners often claim that their dogs understand human emotions. For example, the dog places its head on the owner's lap when the owner is crying. Merola, Prato-Previde and Marshall-Pescini (2011) claimed that dogs referenced their owners before responding to an ambiguous stimulus. In their study, the dogs explored the stimulus when the owner's expression was happy, but not when the owner was fearful. However, there is a possibility that the owner's fearful expression might have been unknown to the dog, thus causing the dog to become confused. This confusion may have resulted in the dogs' reluctance to explore the stimulus.

In our study, we included a control expression in addition to the happy and fearful ones, to test for this possible confusion. Our control expression had the experimenter pretending to be a chicken, presenting a likely unfamiliar expression to the dog. This expression should be confusing to the dog, but unlike the fear expression, does not communicate meaningful information about whether to explore the object. We tested 32 dogs, without their owners present, with all three expressions, which were displayed by the experimenter for 20 seconds each. Then the experimenter left the room for one minute. Each dog received all expressions in a random order.

Dogs' recorded responses were analysed both while the experimenter was present in and absent from the room. In the former case, dogs looked at the experimenter's face the longest and had more interest in the experimenter compared to the toy in the control compared to the fearful and happy expressions, both ps < .01. After the experimenter had left the room, dogs spent longer time in close proximity to the toy in happy compared to fearful and control expressions, p <.05. We found that dogs looked longer at the experimenter's face in control condition which is consistent with *confusion*, and were trying to gain information. When left alone, dogs spent longer time in close proximity to the toy, which is consistent with *confusion* and general anxiety. However, it is still unclear if dogs understand fearful expression, for they may be confused , anxious and/or avoid exploring the environment when anxious.

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Application of Cognitive Neuropsychiatric Testing of Senior Dogs for the Development and Validation of Therapeutic Agents for Cognitive Dysfunction Syndrome

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Background
Over the last decades, our laboratory, in conjunction with others, has developed and employed a battery of neuropsychiatric tests to determine the benefits of various therapeutics for the treatment of cognitive dysfunction syndrome (CDS) in senior dogs. The purpose of the current abstract is to present data demonstrating pharmacological validation of this approach for veterinary products for the treatment of CDS.

Methodology/Principal Findings
The cognitive tests require dogs to solve various problems for a food reward. Various protocols have been established that permit dissociable domain specific cognitive functions to be assessed (Stuzkinski et al 2006; Christie et al, 2005; Tapp et al, 2003; Head et al, 1998). Using tests that detect age-related cognitive deficits, we have evaluated a number of therapeutic agents which are presently marketed for the treatment of cognitive dysfunction in senior dogs. Presently each of selegiline (Anipryl, Pfizer Animal Health; 7 day duration), Prescription diet Canine b/d (Hill's Pet Nutrition; 2 year duration), an MCT supplemented senior diet (Purina One Vibrant Maturity 7+ Formula, Nestlé Purina PetCare; 8 month duration), Senilife (CEVA Animal Health; 70 day duration), apoaequorin (Neutricks, Quincy Animal Health; 33 days) and a S-adenosylmethionine supplement (Novifit, Virbac Animal Health; 70 day duration) have been found, in comparison to control or placebo groups, to improve one or more of the following cognitive domains: discrimination learning; reversal learning; delayed non-matching to position (DNMP) performance; and attention (Pan et al, 2010; Cotman and Head, 2008; Head et al, 2008; Araujo et al, 2008; Milgram et al, 2004).

The collective results demonstrate that cognitive domains can be independently affected by different treatments and treatment duration. For example, during the initial studies on the Hill's Canine b/d, we found the most significant improvements on reversal learning in dogs that had been on both the supplemented diet and a program of environmental enrichment at one and two years following treatment, compared to the effects of diet or enrichment alone. By contrast, effects on DNMP performance were evident only after two years on treatment. Treatment differences will be highlighted.

Conclusions/Significance
The findings indicate that neuropsychological tests demonstrate an age related cognitive decline in senior pets which, in conjunction with clinical evidence can be used to determine potentially beneficial therapeutics for the treatment of CDS in senior pets.

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Delayed Reinforcement – Does It Affect Learning?

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Research on other species (e.g. rats and pigeons) has shown that although delays in reinforcement can still result in trained behaviour, delays can compromise both speed of task acquisition and rate of responding (Dickinson, et al., 1992; Lattal & Gleeson, 1990; Schlinger & Blakely 1994). Timing of reinforcement does not appear to have been studied with dogs. The aim of this study was to examine the effects of delaying reinforcement when training pet dogs.

The first experiment examined delayed reinforcement with a shaping procedure. Dogs were shaped to nose-touch a wand in home and field environments. Dogs were pre-trained to use a feeding device that delivered positive reinforcement (food) at delays of 0 s and 2 s. Training sessions were limited to 30 minutes, and the task was considered learned when performed 10 times in a row, with ≤ 12 s between responses. Eight of 13 dogs learned the task with 0 s delays, whereas only one of 13 dogs learned the task with 2 s delays.

The second experiment examined training a novel task with delayed reinforcement, without shaping, under more-controlled laboratory conditions. Pre-training was done in an experimental pen to familiarise dogs with a feeding device and to condition them to the sound of a beep (secondary reinforcement) preceding delivery of food treats (primary reinforcement). In the experiment, dogs were led into the pen and allowed to explore. The target behaviour was the dogs sniffing inside one of two containers. When the dogs sniffed inside the correct container and broke infra-red beams, positive reinforcement (beep and then food) was delivered at a range of delays. Sessions finished after 30 minutes or when 200 reinforcers were delivered. The behaviour was considered learned when the dogs performed the behaviour 10 times in a row, with ≤ 5 s between responses. The control group (0 s delay) comprised nine dogs; six learned the behaviour in 4-18 minutes and then responded steadily, and three dogs did not learn the target behaviour.

These are preliminary results; results from delay conditions will be discussed.

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Can Dogs Count?

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Although true counting and arithmetic ability are unique to the human species, an evolutionarily more primitive system for non-verbal numerical discrimination has been shown to exist in humans as well as non-human animals. These numerical competencies have been thoroughly examined in several species, yet relatively few studies have examined such processes in the domestic dog.

In an initial experiment, procedures from numerical studies of chimpanzees (Beran, 2001; Beran & Beran 2004) were adapted for use with domestic dogs, as well as a small sample of wolves. Subjects in these experiments watched as different quantities of food were sequentially dropped by a human experimenter into each of 2 containers. The subjects were then allowed to select and consume the contents of one of the containers. While dogs excelled in a condition in which one bowl contained 1 piece of food and the other bowl contained no food, their performance failed to significantly surpass chance on all other ratios, and their performance on the various ratios (4:1, 2:1, 3:1, 2:3) did not conform to Weber's law. With limited trials, the performance of one wolf was significantly better than that of the dogs. The poor performance of the dogs on this task are interesting because they are in stark contrast to numerical studies of chimpanzees as well as other species, in which these animals typically perform well in tasks of numerical discrimination.

In a second experiment, the procedure was revised so that non-food stimuli (circular magnets) were presented simultaneously to dogs on two magnet boards, without the presence of the human experimenter. If dogs chose the board with the majority of the magnets, they were rewarded with a piece of food. If they chose incorrectly, however, they received nothing.

There are three important differences between the first and second experiments: first of all, in Experiment 1, sequential presentation of the numerical cues (food) was used, while simultaneous presentation of the numerical cues was used in the second experiment. Secondly, in Experiment 1, the items being discriminated were food objects, and the dog received reinforcement (except in the 1:0 category) regardless of which bowl it chose. In Experiment 2, the items being discriminated were magnets, and the dog only received a food reward if it correctly chose the box with the most magnets.

Finally, in Experiment 1, a human experimenter sequentially presented the dogs with the objects to be discriminated. In Experiment 2, however, the human experimenter was out of sight and thus could not be a focus of the dogs' attention. Interestingly, when the second procedure was implemented, dogs performed much better in the numerical discrimination task. Procedural implications of these experiments for the study of numerical discrimination in domestic dogs will be discussed.

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Is the Clever Hans effect in dogs a myth or fact? Results of a pointing study

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Keywords: clever hans effect, object-choice task, communicative gesture

Domestic dogs are exceptionally successful in responding to human given cues like diverse pointing gestures to locate hidden food in one of two containers. It has been questioned whether the success of dogs reflects their extraordinary skills to respond to these human-given communicative cues or instead, subtle, probably unintentional cues of the handler (typically the owner) drive their behavior (Hauser et al., 2011) – known as the Clever Hans effect (Sebeok & Rosenthal, 1981). Although the Clever Hans effect has often been used as a possible 'kill-joy hypothesis' (Heyes, 1998), it has not been explicitly investigated yet whether owners influence the behavior of dogs in social cognitive experiments.

Hence, in the first experiment we investigated whether owners can unintentionally influence the success of dogs in a two-way object-choice task. Four groups of owners were informed differently about the location of food and the usual behavior of dogs expected in this test. The owners believed that their dog should either follow or not follow the pointing gesture of the experimenter. There were no significant differences in the performance of dogs across experimental groups with a pointing gesture – the performance of dogs did neither increase (p=0.960) nor decrease (p= 0.665) depending on owners' belief. This suggests that the owners' unintentional cues – if there were any – did not influence the choice of the dogs.

In the second experiment, we investigated whether owners are capable to influence the choice of their dog by actively commanding the dog to one of the containers. Owners successfully directed their dogs as long as the experimenter was not pointing. However, as the experimenter presented a pointing gesture, owners were less successful in their attempts to influence their dogs (p=0.005). In conclusion, the study indicates that the owners' potential unintentional behaviors might have only a minor influence on the behavior of dogs in a two-way object-choice task.

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Incidental memory in dogs: adaptive behavioral solution at an unexpected memory test

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Memory processing in nonhuman animals has been typically tested in situations where the animals are repeatedly trained to retrieve their memory trace, such as delayed matching to sample, serial probe recognition, etc. In contrast, how they utilize incidentally formed memory traces is largely unknown.

We examined whether domestic dogs could solve an unexpected test based on a single past experience. In Experiment 1, leashed dogs were led to 4 open, baited containers and allowed to eat from 2 of them (Exposure phase). After a walk outside for more than 10 min, during which time the containers were emptied, the dogs were unexpectedly returned to the site and unleashed for free exploration (Test phase). Eleven out of 12 dogs first visited one of the containers from which they had not eaten (p=0.006, binomial test). This result appears to be against what is expected by reward learning, which is returning to where they collected a reward. Instead it implies the dogs' reasonable choice based on the retrieval of their one-time experience. Experiment 2 examined whether the dogs could retrieve "what" information as well as "where" at the Test phase. Two containers had food in them, one had a nonedible object, and the last one was empty. Dogs visited all 4 containers and were allowed to eat one of the food rewards in the Exposure phase. In the Test phase, 20 unleashed dogs out of 39 first visited the previously baited container from which they had not eaten (p=0.001, binomial test).

These results demonstrate that in an unexpected test dogs can retrieve "what" and "where" information about seen (now invisible) items from incidental memory formed during a single past experience.

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Factors affecting drugs and explosives detection by dogs in experimental tests

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Keywords: detection; drugs; explosives

The aim of this work was to assess the effects of dog breed, kind of material, searching place and training stage, on drug and explosives detection in experimental tests. 57 German shepherds (GS), 69 Labrador retrievers (LR), 26 Terriers (TE) and 10 English cocker spaniels (SP) were used for experimental detection of drug samples (amphetamine hashish, marijuana, cocaine, heroin) and another 50 GS and 30 LR dogs were used for detection of explosives samples (dynamite, TNT, Semtex, blasting powder). The samples were hidden in rooms known or unknown to the dogs and inside or outside cars. Searching tests were conducted during final stage of the training, during examination and during annual attestations. The time limit for searching was 10 min. Altogether 1501 individual tests have been conducted in which only one kind of material was hidden. Mean detection time for drugs was 64 sec and for explosives 93 sec. The percentage of false alerts and misses was 5.27 and 6.96 for drugs and 20.4 and 7.71 for explosives respectively. The ranking of drug detecting dog breeds according to decreasing detection accuracy (time to find and correctness) was: GS, SP, LR, TE. The explosives detecting LR dogs found the samples quicker than GS dogs but showed significantly more false alerts ($P < 0.001$). The ranking of drugs according to increasing detection difficulty was: marijuana, hashish, amphetamine, cocaine, heroin and for explosives the respective ranking was: dynamite, Semtex, blasting powder, TNT. The dogs made less false alerts in rooms and outside rooms than in cars ($P < 0.01$), whereas the explosives were detected more accurately in cars than in rooms ($P < 0.01$) due to less misses. Drug detecting dogs made more false alert ($P < 0.01$) in tests during examinations compared to the final stage of the training and periodical attestations.

This results may be useful for evaluation of performance of drug and explosives detection dogs during training and real work.

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The role of therapy dogs in the treatment of a phobia to dogs (cynophobia): a case report

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Introduction

Animals are one of the most common stimuli implicated in specific phobias in humans. Among people who seek professional help, around one third present a phobia to dogs and cats, which is indeed the one that interferes most with the person's normal routine. Few studies have been published on the treatment of cynophobia. In vivo exposure techniques have proven to be effective but the control of the dog's behaviour is usually referred as a limiting factor for this technique. A case report is presented where the use of therapy dogs facilitated behavioural therapy.

Case report

A 24 years old woman was attended in a referral anxiety unit for a problem of cynophobia. A diagnosis of specific phobia of the animal type was made based on DSM-IV-TR criteria. No other comorbid psychiatric disorders were identified. The onset of the problem was related to an incident where a dog jumped on her inducing a panic attack. A similar incident was reported some days after. Since, the patient showed avoidance behaviours that clearly interfered with her normal routine. Other clinical signs included general anxiety, irritability, tiredness, sleep disturbances and lack of concentration. An in vivo graded exposure with response prevention treatment protocol was applied on a weekly basis. In the first stage of treatment, when a highly controlled contact was needed, two therapy dogs intervened in three sessions delivered on a weekly basis. The second stage was carried out in public places frequented by dogs. Anxiety levels were measured through a subjective anxiety scale. Follow up showed a marked improvement up to the point where the problem was no longer interfering with the patient's routine. The patient was discharged 4 months after the initial consultation.

Discussion/Conclusions

The use of therapy dogs could be considered a standard part of the behavioural treatment protocol for cases of cynophobia.

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Deferred imitation of novel and known actions in domestic dogs

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Background

A cognitive interpretation of imitation presumes that the subject is able to reproduce the demonstrated action after a delay, relying only on its memory ("deferred imitation" Klein & Meltzoff 1999). Such evidence excludes alternative explanations of behavioural conformation between demonstrator and observer, such as contagion or response facilitation where the demonstration primes similar behaviour in the observer shortly after the demonstration.

Two independent studies showed that dogs are able to functionally match their behaviour to an action demonstrated by an experimenter (Topál et al. 2006; Huber et al. 2009). In Huber et al. the dog was not able to reproduce the demonstrated action after delays longer than 5 sec.

In the present research, using a modified version of the "do as I do procedure", we investigate dogs' ability to encode the demonstration and recall it after retention intervals.

Methodology/Principal Findings

We trained and then extensively tested dogs (n=9) using the "do as I do procedure". In the preliminary training phase, subjects got used to the testing procedure, that is, they were required to reproduce a demonstrated action after a short delay. Dogs were then tested with different retention intervals on the imitation of familiar and novel actions. Dogs were typically able to perform a familiar matching action after retention intervals from 45 sec. to 10 min. and to imitate a novel action after 1 min. Dogs were also able to recall the demonstration if distracted during the retention interval.

Conclusions/Significance

These preliminary results suggest that dogs are able to recall and reproduce a demonstrated action after a delay and to imitate novel actions without previously practicing them (declarative memory). This implies that facilitative processes cannot exhaustively explain the observed behavioural similarity and that dogs' imitative abilities may be rather based on an enduring representation of the demonstration. This study suggests, for the first time, evidence of deferred imitation in dogs.

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What are you or who are you? The emergence of social interaction between dog and self-propelled objects

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Keywords: dog-robot interaction, social behaviour

Background

The use of autonomous robots might offer new possibilities in the study of animal interactions, if the subject recognises it as a social partner. Recent evidence suggests that dogs willing to interact with an animal-like robot (Kubinyi et al 2004) if it has artificial fur with puppy smell, and they prefer the self-propelled agent which motion is goal-directed (Tauzin et al 2012 manuscript). In the present study we wanted to investigate, whether dogs show different interactive behaviour toward a self-propelled object (toy car) depending on its movement pattern and shape.

Method/Principal findings

In our study a remote controlled toy car provided food for the dog in a problem solving task, in which dog was prevented from getting the food. The situation was repeated six times in a row, and we looked at the behaviour of the dog shown towards the toy car. In the "Mechanical Group" (N=15) the car was moving mechanically (rolling along the same route, stopped in the same locations) and remained motionless for 30 seconds. In the "Simulated Group" (N=15) the car had two eye spots, followed different paths, stopped in different points in the room, responded to the dog's behaviour (started to go when the dog looked at the car). We found that dogs in the "Mechanical Group" were looking longer at the car, and went to the car sooner after repeated trials. Results also showed that gaze alternations between the car and the unreachable food are more frequent than gaze alternations between the owner and the food. We found also that dogs looked sooner and sniffed more in the "Simulated Group".

Conclusion

This results support the notion that dogs willing to initiate interaction with a simple self-propelled agent, and this behaviour can be affected by 'alive-like' features. This is the first evidence that dogs may be sensitive for 'alive-like' cues like interactivity, varied movements and presence of the eye spots displayed by a self-propelled object that are also important for infants in discriminating animate and inanimate agents (Rakison & Poulin-Dubois 2001).

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Behavioral assessment and owner perceptions of behaviors associated with guilt in dogs

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Dog owners ascribe guilt to dogs, and we explored this attribution with pet dogs (N = 64) and their owners. Like others, we found that the majority of owners perceive dog behavior as guilty in certain situations (Morris et al., 2008). As a novel finding, dog presentation of guilty behavior could lead owners to scold dogs less.

The experiment investigated the owner-reported anecdote that dogs sometimes greet owners displaying guilty behavior. Owners claim to be unaware of a dog's misdeed and assert it is the presentation of guilty behavior that informs them of the dog's infraction. We studied whether dogs that were disobedient in owners' absences showed associated behaviors of guilt — "ABs" as coined by Horowitz (2009), upon owners' return to a room and whether owners could determine their dog's disobedience by relying solely on the dog's greeting behavior.

Behavioral analysis revealed no significant difference between obedient and disobedient dogs in their display of ABs after having the opportunity to break a rule in owners' absences ($z = -1.512$, $P = 0.131$). However, analyses at the individual level revealed a significant increase in cross-situational presentation of ABs only by dogs that transgressed in owners' absences ($z = -2.335$, $P = 0.02$). While owners appeared able to determine whether or not their dogs ate in their absences ($P < 0.001$), a subset of owners — those whose decisions were most likely based solely on dog greeting behavior and not earlier experiment-generated behavioral cues — were not better than chance in their determinations ($P = 0.623$).

Taken together, our findings suggest that dog presentation of ABs during greetings is not necessarily a reliable indicator whether or not a dog engaged in a misdeed. The investigated phenomenon appears sensitive to the social condition, which includes owner prior experience with their dog in specific contexts.

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The need for transparency in methodological design: A new web-based tool for sharing protocols and data

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Keywords: methodology, data sharing, dog research

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Background

Data sharing has become a pressing issue in behavioural sciences. However, it contrast to biochemical, genetic or taxonomic data, the collection of behavioural data is more context dependent. This means that sharing the raw numbers (frequencies, durations etc.) is meaningless without presenting in detail the context in which these data were collected. We argue that there is a need to establish a methodology for sharing the protocols (experimental observations) which were in place when behavioural data were gathered.

Methodology/Principal Findings

In this paper we describe our efforts towards a Comparative Mind Database (CMD) (www.cmdbase.org) and discuss an available component, the video sharing and deep tagging system. A first prototype in beta version will be also available at the meeting via Internet connection. The CMD video platform is a community platform that offers several different functions, these include: registration, video upload, video editing (in particular, tagging, annotation and deep tagging), timeline control, video (as well as annotation) search and video playback (in various sizes). It takes the form of a video sharing system on a backbone similar to that of YouTube. Deep tagging involves the use of temporal tags and a timeline that positions these tags over the duration of the video. Video annotation goes even one step beyond. The idea is to allow users to place marks, even drawings (including simple shapes, text, and hand drawing/writing to frames or intervals of the video. Our realized tool has a flexible management system that allows various policies for both tagging and annotation: from owner-only to general access. The tool is open source and will be freely available for the research community.

Conclusions/Significance

We argue that the CMD provides a useful web-based surface for ethologists to share experimental protocols and data with fellow colleagues, and it can also enrich publications, and facilitates the establishment of data bases.

Do dogs rely on human emotional expressions in a three-way choice test?

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Keywords: emotion recognition, object choice, communication

Background

Dogs' substantial socio-cognitive abilities are well known, especially those relating to human-dog communication. Dogs are able to discriminate between human facial expressions (Nagasawa et al., 2011) and are willing to rely on human indications when they face an unknown object (Merola et al., 2012). Our test aimed to investigate whether dogs base their choice on the owners' emotional expression in a three-way object-choice test.

Methodology/Principal Findings

In our test, 69 dogs could choose between three uniform plastic bottles, which were previously marked by the owner with a positive (happy), a negative (disgust) and a neutral emotion (in a counterbalanced order). The emotions of happiness and disgust were expressed by facial, verbal and body gestures, whereas the neutral emotion was expressed only by a blank facial expression. We hypothesized that dogs would prefer the bottles that were marked by either the happy emotion or emotion of disgust compared to the neutral control.

Contrary to our expectations, the dogs did not prefer any of the emotions (p=0.568), their choice showed a random distribution. Moreover, the dogs' choice was related neither to the rank of the emotions nor to the spatial location of the bottles (p=0.438, p=0.568, respectively).

Conclusions/Significance

It seems that, although dogs watched the owners during the demonstration (>80% of the time), they do not rely on the emotional behaviour of the owners in their choice. This result is surprising because owners often display such emotional behaviours as communicative signals toward their dogs in the everyday life (e.g. during play, training or walk). Dogs' utilisation of human emotions may be context dependent, that is, in the present situation dogs may not have perceived the human emotion as relevant for their choice. Alternatively, emotional behaviours were overshadowed by the touching of the bottles and the gaze alternation.

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A comparative study of recognition of their body size in dogs and cats

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It is essential for animals to have correct knowledge about their size and movability to locomote adaptively in the environment. When humans walk at a normal speed, the size of the aperture they try to pass through without postural change such as shoulder rotation is approximately 1.3 times of their shoulder width (Warren & Whang, 1987). However, little is known about nonhuman animals' recognition of their bodies in relation to the environment.

We restrained dogs and cats in the arena surrounded by the fence and systematically changed the size of the aperture as an exit. The sizes of the aperture were 0.48, 0.58, 0.69, 0.83, 1, 1.2, 1.44, 1.73, and 2.1 times of the animal's shoulder width (2.1 was just for dogs). We observed their behaviors when they tried to pass through there. In dogs, the latency before they tried to pass through the aperture from the trial start was longer when the width of the aperture was narrower than their shoulder width (p<0.01, ANOVA), and the aperture they went through without hesitation was over 1.2 times as wide as their shoulder.

This result was similar to the human case. This may imply that dogs sharing the environment with humans had learned to locomote safely in order to avoid contact with artificial, often inflexible, objects. By contrast, cats forcibly tried to extend the aperture by the face to go through there even when the aperture was narrower than their face (not shoulder) width. Cats might have body-recognition adaptable to both artificial and natural environments. This may be because cats maintain their wild nature as a hunter equipped inherently despite their life with humans. These differences between the two domesticated animals may imply that animals' body-recognition is flexibly determined by both their genetic characteristics and their living environments.

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Do dogs prefer pointing gestures by trustworthy person?

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We investigated whether dogs prefer to follow pointing gestures by a trustworthy human over those by an untrustworthy person. When children learn from others, they are known to monitor the accuracy of their adult model's previous behavior and make use of it to gauge future trustworthiness of the model. In other words, children track the reliability of the person. Dogs, as well as children, learn from humans They have strong sensitivity to human communicative gestures and use them to find hidden food in the object choice task. Dogs are influenced by human ostensive gestures even when they do not lead dogs to a reward. But they do not always follow human pointing gestures. How dogs use such past accuracy or inaccuracy to gauge the person's future trustworthiness is still unknown.

We examined whether dogs could change their behavior based on their past experience with the human model. In the observing phase, dogs watched the Experimenter (E) opening a lid of one of two boxes. In the HR (high reliability) group(n=22), E opened the box with food in it. In the LR (low reliability) group(n=24), E opened the empty box. Neither fed the dog but the owner did instead. In the test phase, dogs in the HR group preferred to follow the pointing gesture of E, but dogs in LR group did not.

The results suggest that dogs are not only able to monitor the reliability of an unfamiliar person from the interaction between the person and the dog (without food reinforcement from the person) but also use it to gauge future trustworthiness of the person.

Ability of dogs to respond to the pointing gestures of a human and movements of a dummy

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Although the ability of various animal species to use human pointing cues is tested in comparative studies by many different methods, it is clear at present that dogs generally perform very well in these tasks. However, the processes by which the dogs acquire these skills and the possible factors affecting these processes still remain largely unknown. It is still unclear which mechanisms participate in these skills. Many authors (Hare and Tomasello, 1999; Miklósi et al., 2003; Hare et al., 2010) are of the opinion that these skills are the result of the process of domestication and are independent of learning processes.

The aim of this study was to show the effect of associative learning on these skills and to refute the opinion that high-level cognitive processes are necessary to explain them. It was assessed whether the dogs are able to follow the pointing cues given by a person better than the pointing cues given by a dummy.

Fifteen dogs were cross-tested to the cues given by a person and by a dummy within this study. For the testing we used the momentary distal pointing gesture which is considered to be the standard testing method, thus our results can be compared with the results of other experiments. Statistical calculations were performed and analyzed on the level of both individuals and groups. On neither level was found a demonstratrable difference in choices, i.e., the dogs chose the correct dish with equal success based on the cues given by the dummy and on the cues given by the person. Our experimental results show the importance of the effect of learning in the use of human pointing cues by dogs. We conclude that dogs basically follow those cues that allow them to obtain a reward. The dogs create an association between the movement of the person or the dummy and the presence of food.

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How dogs process familiar and inverted faces, an eye movement study

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Key words: domestic dogs, eye movement tracking, face processing

Face perception plays important role in communication and identity recognition in social mammals. Various behavioral studies have shown that domestic dogs have a special tendency to exploit human facial cues. Still, the face processing mechanism of dogs is weakly understood. In this study, face viewing patterns of two dog populations living in diverging social environments was examined by eye tracking.

The eye movements of 25 pet dogs and 8 laboratory dogs were tracked while digital images were presented at the monitor in front of a lying dog. During two test days, subjects viewed a total of 120 repetitions of face images of familiar dogs and humans (e.g. family members), strange dogs and humans, and their inverted versions. Dogs were trained to perform the task without human presence and were not trained to discriminate images.

The number (fix) and duration (ms) of fixations targeted to face and eyes area were analyzed (mean ± SEM). Faces of dogs attracted more fixations (1.3 ± 0.3 fix; p=0.02) and longer fixation duration (247.7 ± 40.4 ms; p=0.02) compared to human faces (1.2 ± 0.2 fix; 209.1 ± 40.7 ms). Faces of familiar individuals were fixated more than strange individuals (1.7 ± 0.3 fix vs. 1.3 ± 0.3 fix; p=0.02). Upright and inverted faces were fixated same duration, but in upright faces the eyes area gathered longer fixation time than in inverted faces (111.1 ± 27.2 ms vs. 93.4 ± 27.2 ms; p=0.02). Laboratory dogs fixated shorter duration to face area than pet dogs (145.3 ± 68.8 ms vs. 311.7 ± 40.4 ms; p=0.05). However, familiarity and inversion of faces affected similarly on gazing patterns in both groups.

The results suggest that eye movements of dogs are guided not only by physical properties but also semantic information of the image. Even if dogs have been raised in very different conditions, their strategies of face processing seem to be similar. Eye tracking is a promising method for the further exploration of processes of cognitive skills of dogs.

Social perception of a dog shelter and its functioning in the neighbourhood. Case study

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The project was aimed to provide one of dog shelters in Warsaw with data about its functioning in the immediate urban context. The diagnosis was performed on two levels - the micro level of the building and its immediate surrounding and the meso - level of the neighborhood.

The exploratory character of the study was reflected in the choice of qualitative methodology which allowed for detecting and understanding various issues which affected the way the shelter was perceived. Several data collection techniques were used, including: participatory ethnographic observation, individual interview, focus group interview, content analysis, transect-walk and photo-story.

The image of the shelter at the micro-level was strongly shaped by the physical appearance of the building and its immediate surrounding – such as trash, gray bare walls, randomly mixed construction materials and elements which evoked feelings of despair, sadness and depression. Solid, shut entry doors disheartened potential visitors. These results are consistent with general findings regarding the image of the city (Nasar, 1998).

The image of dog shelters in Poland is generally very negative, as confirmed by results of our focus group interviews. The presence of a dog shelter in a residential neighborhood resulted in a local conflict of the NIMBY-type (Not In My BackYard) (Dear, 1992). Based on the model of Circle of Conflict (Moore, 2003) we identified three major types of conflict around the examined dog shelter which included the conflict of interests, the conflict of information and the conflict of relationship.

Our recommendations revolved around managing the public image of the shelter at different levels. The shelter is an actor in the social realm of the neighborhood and communicates with its users and neighbors both with images and with words. We advised introducing physical changes in the building and adopting more pro-active attitude towards communicating with neighbors and the wider public opinion.

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Canine Facilitated Human Learning: Taking canine-human interactions to another level

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Background

The starting point for the project was my disquiet with the lack of an evaluation base for various types of animal assisted work, in this case, work with dogs (Fine and Beck, 2010), despite "fringe status" (Kruger and Serpell, 2010) it has grown exponentially.

This project, funded by a Catalyst Grant, Royal Society of Arts, UK to pump prime novel social interventions. The project, Working Dogs, Working Lives, developed a methodology for working canines with adult women, substance mis-users, offenders and victims of domestic violence in an intervention which could provide substantive evaluated outcomes and move human-canine work beyond descriptors of therapy or dog training to harness the unique properties of canines and stimulate human learning.

The problem
Disquiet with some research on and observed practices of animal assisted activities and therapies.

The question
How can work within the affective domain of the canine-human bond generate substantive demonstrable and evidenced outcomes?

Methodology

The project was undertaken as a researcher led action research case study, a social science qualitative methodology used to investigate and change social systems, in this case to explore how work within AAI/AAT might be developed and generate demonstrable outcomes. The project was therefore both a program of canine facilitated human learning and a research project. The programs were run between October 2011 and May 2012 involving 18 women, 10 semi-trained dogs and 5 student dog handlers. Learning from one program was used to refine the operation of the next.
The programs adopted a cognitive behavioral frame for working on the development of human cognitions and behavior change.

The steps included
1. researcher and human participants generated a list of identifiable and problematic issues experienced by the human participants related to their substance misuse and offending behaviors. These became in part measures for the effectiveness of the program.

2. the researcher developed human-canine activities to target human cognition and self-awareness this included facilitated group-work practices, structured experiential learning opportunities working with the dogs, Pryor's clicker training was used with people and dogs.

3. human participants working with the dogs for weekly two hour sessions in cuing and shaping canine behaviors, developing handling skills in nose work, agility and working on joint problem solving tasks.

4. the development of reflexive skills within the human participants to find parallels in their work with dogs and other humans, parallels with and a focus on participants developing self-reflection.

5. evaluation was integrated into the programs and undertaken at program close and in participant follow-ups.

Findings

Canine Facilitated Learning does fast track socially and emotionally damaged participants to develop aspects of their emotional and social literacy. CFL promotes self-awareness, self-regulation, interpersonal education and appropriate expectation setting for self and others. It develops understandings of motivation, coaching, reward, co-operation, trust and effective communication skills.

There are profound similarities between working with CFL and day-to-day living, for example, including parenting. Participants become curious as to why this is so, this opens up discussions of inter-species communication, behavior, cognition, issues of compassion and post-humanism.

Significance

1. a developing methodology that can add a new element into the current continuum of AAI/AAT starting with pet or animal therapy and ending with service animals. Evaluation is an integrated component.

2. a way to work with canines where they are less passive than may AAI/AAT work and humans can be cued to their cognitions and communications to develop their own learning.

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Is dog ownership related to a reduced anxiety in human mothers?

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Keywords: anxiety, dog, mother.

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The presence of a dog in a family with a child is considered dangerous by many people for hygienic reasons and possible accidents, while other people believe it is very important for the child's psychological development. It is possible that the dog has a positive effect on the mothers too.

The aim of the current research was to assess whether owning a dog could be related to a reduced anxiety in human mothers.

The sample was formed by 50 primipara mothers of 0-6 year old children; 25 women owned a dog and 25 did not at the time the survey was carried out. All mothers filled in a STAI-Y questionnaire (State-Trait Anxiety Inventory – Y form created by Spielberger et al., 1983), measuring both temporary or emotional state anxiety and long standing personality trait anxiety in adults. The results of the two groups were compared using a Mann-Whitney test ($p < 0.05$).

Mothers owning a dog were found to have a statistically lower level of state anxiety (median values: 38.0 versus 45.0; $Z_T = 2.245$; $p = 0.025$) and trait anxiety (median values: 36.0 versus 46.0; $Z_T = 2.537$; $p = 0.011$) compared to the mothers who were not dog owners.

This preliminary data suggests that owning a dog is related to a reduced degree of anxiety in primipara mothers of young children. Further research should investigate whether the dog reduces the anxiety or rather dogs are adopted by less anxious people.

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The relation between empathy and the interpretation of dog (*Canis familiaris*) behaviour

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Keywords: empathy, animal behaviour

Humans interpret the behaviour of dogs everyday. But interpretation of behaviour beyond sheer measurement of behaviour is becoming part of research as well. It is reasonable to expect that the interpretation of another individual's behaviour is affected by how well we can put ourselves in the place of that other individual. To test this we compared the results of an empathy questionnaire given to students with their interpretation of dog behaviour. Fiftyseven veterinary students participated in the study. Each student filled out a printed questionnaire on their experiences with dogs, and then completed the Animal Empathy scale (Paul, 2000). They were shown five two-minute videos of dogs, and asked to cross off 19 visual analogue scales after each video clip, assessing 19 adjectives for each of the dogs.

Principal component analysis (PCA) was performed on the total VAS scorings for two videos showing dogs playing, for three videos showing dogs being mentality tested and for each of the five videos separately. For every PCA, one of the components retained related to aggressiveness. Empathy for animals showed a significant negative correlation with the aggressiveness-component for the two play-videos ($r=-0.35$, $p=0.0175$), and two of the single videos ($r=-0.33$, $p=0.0230$; $r=-0.39$, $p=0.0071$). When looking only at subjects with little actual dog experience (zero years of responsibility for a dog), empathy significantly affected 6 out of 7 aggressiveness-components negatively. Empathy did not show any significant correlation with components related to other types of emotion or behaviour.

These results indicate that people with a low level of empathy for animals assess dog behaviour and emotion related to aggressiveness as more pronounced than people with a high level of empathy. Our findings are important in the understanding of human-dog interaction, in relation to self-reports of dog behaviour and research on dogs involving qualitative assessments.

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Dogs travelling with people: how owners take care of their dogs during car transportation in Italy

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Keywords: car, dog, transport

This study aimed at assessing owners' behaviour regarding dogs' transportation by car and how it may affect dogs' response to the journey.

A sample of 907 dog owners filled in an 8 multi-choice item questionnaire. Possible predisposing factors to travel-related problems were examined by a X^2 test (p<0.05). Dogs usually responded positively to car transportation (76.2%). For problematic dogs (23.8%), few owners administered substances like drugs (1.3%), pheromones (1.1%), Bach Flowers (1.1%), or homeopathy (0.2%).

Almost half (43.5%) of respondents claimed not to use any means of restraint in the car; the most used were: net/grating (34.2%), kennel (22.4%), and seat belt/leash (15.9%).

Owners more frequently transported dogs alone (60.6%) rather than with dogs (18.3%) or other animals (1.7%). The company of other dogs did not seem to affect the negative response to car transportation (5.6% vs 6.0%).

Most owners (65.8%) did not administer anything to the dog before travelling. Dogs responding always positively were more likely to be provided with food (3.8% vs 9.3%, χ^2=5.19; p=0.023) or water (4.2% vs 10.2%, χ^2=8.14; p=0.004).

While travelling, dogs were provided with: blanket (47.9%), water (27.0%), toys (13.1%), or food (3.5%). Dogs not provided with anything more frequently displayed problems (29.0% vs 20.7%; χ^2=8.79, p=0.003). Administering water (14.3% vs 27.3%, χ^2=13.52; p=0.000) or a blanket (20.3% vs 27.1%, χ^2=9.49; p=0.002) seemed to be related to a good response to travel, but not toys (26.9% vs 23.4%) or food (6.8% vs 9.2%).

The majority of dogs (86.0%) were used to travelling by car as puppies; this made them less likely to develop problems (6.3% vs 24.1%, χ^2=19.89; p=0.000).
Using the car solely to go to veterinary clinics was related to display travel-related problems (46.4% vs 22.7%, χ^2=7.24; p=0.007).

As travelling with dogs is a growing occurrence, understanding how people take care of dogs during car journeys can improve owners' knowledge and animal welfare.

Dogs in Animal Assisted Interventions: better with the owner

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Keywords: animal welfare, enrichment program, therapy dogs

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The presence of dogs in Animal Assisted Interventions (AAI) sessions is becoming increasingly frequent. Dogs participate in sessions in a wide range of facilities such as prisons or residences for elderly people. Too often dogs live permanently in the facilities where the sessions are carried out. Other dogs live in shelters, from where they are taken to go to the facility for the session of AAI.

Residences, shelters and prisons are not good places for dogs to live: human-dog relationship is low quality, there is a lack of relationship with other dogs and no specific environmental enrichment programs exist. These deficiencies of the physical and social environment of the dog have an adverse impact on its quality of life and induce high levels of stress and all the related physical and emotional problems.

In our AAI programs, dogs live at home with their owner, who also participates in the AAI session. The owner, who has participated in our education program, is who can better provide the basic needs of the dog. Before and after the session, he provides the optimal conditions to live: human contact, social contact with other dogs, and a real enriched environment. The active participation of the owner in the session allows extending these optimal conditions to the AAI session. Dogs feel as relaxed and confident during the session as they feel at home.

AAI organizations must be aware that dogs living in facilities are animals in captivity. Thus, a scrupulous environmental enrichment program and a careful monitoring of the welfare of the dogs have to be carried out. If possible, dogs in AAI should live at home, in a family environment. The owner of the dog should be present in the session.

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Animal Assisted Therapy for autistic children: a pilot study of the evolution of dog/child relationship

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A growing body of evidences supports the efficiency of Animal Assisted Therapy to improve social skills of individuals with autism (Nimer & Lundahl, 2007). However, what dog's behavioral specificity is responsible for this result remains unclear. Our work is part of a study of the benefits of introducing a dog in autistic children therapy. Low-functioning autistic children received 20 individual occupational therapy sessions in alternated blocks of sessions with and without a dog. All sessions were video-recorded.

The aim of this pilot study was to assess the feasibility of studying the establishment of dog/child relationship by coding a few interactive behaviors in videos focusing primarily the child. We analyzed five minutes (from min 08 through min 13 of the session) of the second and the last dog/child meetings of two different dyads (D1 = 13 year old girl and 2 year old female Belgian Malinois; D2 = 8 years old boy and 7 year old female Labrador Retriever) chosen to represent two different types of interaction both with positive effects on the social interaction of the child with the therapist: While in D1 the girl avoid contact with the dog, D2 interacted harmoniously. We recorded frequency (f) and duration (d) of direction of the snout and relative position of dog and other participants, as well as frequency of friendly behaviors (fb) such as tail wagging, liking some part of the body of a participant, touch a participant with snout or paw. As expected, in D1 the frequency of friendly behaviors directed to the girl decreased from 9 to 0 between the first and the last session although both frequency and duration of "snout directed" (sd) at her remain similar. In D2 we observed an increase both in duration and frequency of both categories (sd: $f_1 = 7$, $f_2 = 19$, $d_1 = 2s$, $d_2 = 70s$; fb: $f_1 = 2$, $f_2 = 5$).

These very first results support the relevance of the selected behaviors for the establishment of a social relationship between an autistic child and a dog.

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Leaving the Dogs Alone: The Evolution and Purpose of Doggy Daycares

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Within the last ten years, the doggy daycare industry has grown across the United States, advertising that they are the solutions to leaving dogs at home. These daycares claim they provide a safe and enriching environment for dogs while their owners are at work or busy. But what are they really providing? This study aimed to examine how quickly the doggy daycare industry has evolved and if the industry is indeed fulfilling the needs of dogs.

In order to perform this study, more than thirty doggy daycares around the country were visited. The owners of these daycares were interviewed, particularly about their routines in taking care of the dogs. The study concluded that about 98% of the people who owned doggy daycares did not have a background in canine care or psychology. The study also found that the daycares did not fulfill dogs' needs in the following ways: 1) The environments of these places were mostly sterile, warehouse-type buildings that did not look like environments that the dogs were used to; 2) These spaces were often too small to accommodate the amount of dogs in daycare, resulting in overcrowding; and 3) The dogs were separated by size, not taking into account the dogs' temperaments and how these temperaments could positively or negatively affect the dogs. As a result of these inadequacies, this study found that many dogs were more stressed out at daycare than alone at home and that many of these places were producing behavioral problems in dogs.

The implications of this study are far-reaching. They show that there needs to be doggy daycare regulations in regards to who can operate and own doggy daycares, emphasizing that these owners need to have some kind of educational and experiential background in the care of animals. Furthermore, standards in the doggy daycare industry need to be created that cater to the needs and well being of the dogs.

How Varying Societies View the Human-dog Relationship

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Different cultures and societies have always varied in their view of the human-dog relationship, but what does this actually mean in today's society? The goal of this study was to assess and understand the societal differences that humans have in interpreting and understanding dog behavior. Furthermore, this study also examined how these differences affected dog adoption when dogs from one society were placed in a different type of society.

Communities in the United States, England, India, Kenya, Thailand, Mexico, Austria, and Germany were visited, and the way they viewed and treated dogs was documented through discussions and photographs. In addition, communities in rural America and ones in urban America were also visited. The study found that communities in rural America and ones in the eastern world treated dogs differently than ones in urban, western areas. Rural, eastern societies viewed dogs as animals, rather than children. For example, in rural Alaska, dogs worked and their needs were fulfilled through that work. Often times, dogs in rural and eastern areas weren't touched as much as dogs in urban, western areas. People in urban, western areas felt as if they were fulfilling their dogs' needs by giving them physical affection.

The study also examined dogs that grew up in rural areas and were adopted to urban areas, and vice-versa. Researchers performed case studies on rural rescues and their operations in Alabama, Georgia, Ohio, Kansas, North Carolina, South Carolina, and Virginia. The urban areas that were studied were located in New York, California, Colorado, and Florida. The transport of the dogs to different places was documented and the resulting dog behavior was observed. Dogs that grew up in urban areas and then were adopted to rural areas thrived; however, dogs who grew up in rural areas, particularly the older puppies and young adult dogs (five months to three years of age), and were taken to urban areas exhibited signs of behavioral problems, leading us to believe that the move was not healthy. The dogs' needs to hunt, roam, play, and interact amongst groups of dogs and practice of living in packs were disturbed when shifting to urban areas, resulting in anxiety, stress, boredom, destruction, confusion and their resistance to co-exist with humans.

The implications of this study suggest that dogs are evolving according to where they are being raised. Because of this, sending homeless dogs from rural to urban areas is becoming detrimental to the dogs welfare. People need to be more educated about the human-dog relationship and how it differs in varying societies so that we may better care for these dogs.

Shelters and Rescues: Are We Running out of Good Dogs?

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Shelters and rescues are popular places that people go to adopt dogs, but what exactly are rescues and shelters? And what is the quality of life for a dog in these facilities? The aim of this study was to examine the purpose and routines and rescues and shelters and assess the quality of life that dogs have at these facilities.

In order to obtain data for this study, 6 kill, no-kill, and animal activist rescues and shelters were visited across the United States. The dogs were observed in their environments, and the facilities' routines were evaluated. Researchers created a guideline for puppies (ages 8 to 20 weeks) and adult dogs (over 5 months of age) that determined how often they should be let out. For puppies, this was determined by calculating their age in months and adding 1, indicating the time in hours that they could be left in a crate or pen, and for adults researchers agreed on every five hours. All dogs, researchers agreed, needed to be let outside for a break that lasted no less than 10 minutes after the dogs had eliminated or after 5 minutes of being let out and have access to fresh water outside. 2 out of the 6 facilities did not have outdoor fenced areas and were let out on 30-foot nylon non-retractable leashes for their breaks.

Researchers assessed dog contentment by recording and observing 1) the dogs' response to treats (if they would take them vs. if they would not); 2) the dogs' willingness and cooperation to go back into the shelter (if they resisted, needed to be carried back, or walked in willingly); 3) the amount of time it took the handlers to re-leash dogs at the end of play time; and 4) the dogs' behavior within the first two minutes of being crated or in a pen after play time.

Only 1 out of the 6 facilities visited was able to provide the researchers' criteria for care. In the other facilities, dogs were left in crates and cages for extended periods of time, not allowing them to get the exercise and mental stimulation that they needed to be healthy, adoptable dogs. The researchers also found that this was because the facilities were overcrowded with dogs and did not have the volunteers and staff to maintain a healthy environment for the dogs.

This study begs for us to re-examine shelter and rescue practices across the United States. Furthermore, minimum guidelines that go beyond a dog's need for food, water, and shelter need to be set and regulated. These guidelines should include exercise needs, mental stimulation, and socialization practices so that dogs can be adoptable and healthy.

What Dog Owners Read: A Review of Best-selling Books

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The provision of dog training advice is important, and there is a wealth of non-academic, popular dog training literature. Many owners have no formal behavioural training. Thus it is important that learning principles are presented so their relevance and application are clear. Because dogs are receptive to human cues, owners may benefit from understanding how to use cues during training.

This study reviewed a sample of best-selling dog training books. An Internet search in 2009 on three major online bookstores' websites, using search terms "dog training", selected the five best-selling books. The authors were Millan & Peltier; Fennell; Stilwell; Pryor; and Monks of New Skete. The books were examined for their use of learning theory, and for references to human-given cues. This information was sought in their general discussions of dog training, and in reference to training dogs to sit, down, and come. The training techniques recommended varied across the books, from reinforcement-only (Pryor), a combination of reinforcement and punishment (Stilwell, Fennell, Monks of New Skete), and predominantly punishment (Millan & Peltier). Pryor's book provided the most comprehensive explanation of learning principles, focusing on reinforcement; Millan & Peltier, Fennell, and Stilwell all omitted explanations of either reinforcement or punishment. Precise, replicable instructions were given by Stilwell and Pryor regarding timing of reinforcement, and by Millan & Peltier on when to deliver punishment; Fennell discussed timing infrequently, and The Monks of New Skete gave generally imprecise directions. Although most books referred to human cues throughout, Stilwell's and The Monks of New Skete's books provided the most detailed advice with regards to which cues owners should use when training sit, down, and come.

This review found that these best-selling texts are not necessarily instructional manuals for dog owners. Clear, replicable information was not presented in all books.

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Advancing the welfare of Australia's iconic working dogs

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Australia's working dogs are valued to the point of being iconic but paradoxically the working dog industry is unsupported by cohesive research and development. The Australian Animal Welfare Strategy (AAWS) was developed by the Australian Government in consultation with state and territory governments, animal industry organisations, animal welfare groups and the general public.

The AAWS have funded two projects to advance the welfare of dogs in the Australian Working Dog Industry. The inaugural Australian Working Dog Survey[1] was conducted in 2009. Benchmarking information was collected about the sourcing, breeding, assessment, training, housing and veterinary care of 4195 Australian working dogs from private industry, government, assistance and sporting dog sectors. These preliminary findings were extended in the follow up project, The Australian Working Dog Industry Action Plan - a strategic plan that will now be used to advance the canine welfare and productivity measures of the Australian Working Dog Industry. What differs between working dog sectors is the task that the dogs are trained to perform. In this sense, the working dog industry sectors have much in common. High standards of animal welfare underpin both industry productivity and sustainability. It is recognised that not all members of the working dog industry will be motivated to change their current practices solely to improve animal welfare standards. However, it would be cognisant for the industry to recognise that market expectations are moving toward higher standards of animal care and greater transparency of processes. Industry-wide adoption of an ethos of continuous quality improvement, voluntary welfare accreditation and certified training qualifications will result in a degree of difference occurring between service providers. Market forces will influence the adoption of best practice by this industry.

The Australian Working Dog Industry should acknowledge the need to increase the understanding of factors affecting working dog welfare and it is recommended that a multi-disciplinary research program is pursued to deliver the best welfare and productivity outcomes from cradle to grave.

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A plausible way for analysing interspecific interactions: Owner-dog dyads as units

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Recent theoretical proposals about human-robot interaction argued for human-dog dyads being a very useful modell.

In this paper we described the social interaction in a large number of owner-dog dyads (N=78) during a short and simple behavioural test using multivariate statistical methods. Besides observing and coding the behaviours of both parties, the personality of the owners and their dogs was also assessed by a questionnaire. We found positive association between the owners' and dogs' general behaviour ($r_M = 0.11$). Furthermore the owners' personality influenced the dyad's performance: redundancy analysis showed that owners scoring higher on neuroticism used more commands when making their dogs accomplish a task and their dogs obeyed with higher latency. More extraverted owners' dogs looked more at the humans during the test.

Our findings provide qualitative information about owner-dog interactions and these findings might also contribute to a better understanding of the human-companion relationship in a broader sense.

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Is dog ownership the same for men and women, parents and non-parents?

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Introduction
The characteristics of the human-animal bond can be influenced by both owner-related and dog-related factors. Owner attitude towards dogs and the perceived costs of pet ownership are recognized as factors implicated in dog abandonment and relinquishment. A study was designed to explore differences between family members in the patterns of interaction, emotional closeness and perceived costs of the family dog.

Methodology
Thirty-four dogs were independently scored by one male and one female adult member of each household using the 3 subscales of a Spanish language version of the validated MDORS scale (Dwyer et al, 2006). Statistical methods included Wilcoxon matched-pairs signed rank test, Spearman non-parametric correlation and orthogonal projection to latent structures multivariate analysis (OPLS).

Results
Female owners showed more interaction (subscale 1, p=0.0003) and emotional closeness (subscale 2, p=0.0462) than male owners, but there was no difference for perceived costs of the dog (subscale 3). Parents had significantly less interaction and less emotional closeness with the dog than those not having children (p=0.0034 & 0.0029 respectively). Non-parents had significantly higher scores for perceived cost than parents (p=0.0029). There was a negative correlation between interaction and duration of ownership (r=-0.48, p<0.0001). This relationship was stronger in females (r=-0.62, p=0.0001) than in males (r=-0.37, p=0.0291). In OPLS models, in female owners only the variable "my dog costs too much money" showed a weak positive loading with duration of ownership, whereas in male owners a mix of variables showed a strong positive loading with duration of ownership, including "my dog is there when I need to be comforted", "my dog would still be there for me if everyone else left me" and "there are many aspects of owning a dog I don't like".

Conclusions
These preliminary results suggest that patterns of interaction, emotional bonding and perceived costs of dog ownership differ between men and women, parents and non-parents. Additionally, level of interaction with the dog decreases with duration of ownership. Further studies are needed to fully elucidate all factors that can be influencing the bond and perception of the dog of the family for each of the owners.

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Experimental analysis of dog-human relationship in the family-network

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Keywords: dogs, family-network

In the course of the domestication dogs have adapted to the human social environment and nowadays are often viewed as important family members by people who live in the city (Albert and Bulcroft, 1987). It is already described that at the level of behavioural interactions pet dogs develop an attachment relationship with humans (e.g. Topál et al. 1998), moreover they also share functional similarities with pre-verbal infants in communicative behaviour (Lakatos et al. 2009).

Living in this challenging human environment dogs may encounter complex social interactions, where it is important to discriminate between the interacting partners varying in familiarity. Recent studies have shown that dogs can clearly discriminate between their owner, a familiar, and an unfamiliar person and they show a preference towards their owner compared to the unfamiliar person (Kerepesi et al., unpublished data). However, there is little knowledge on the question whether they behave differently with different family members. Hereby, in the present study we analysed whether dogs discriminate between the family members in different situations. Dogs were observed in six situations, testing 24 dogs together with three family members in both attachment and obedience related tasks. Besides, the ownership was examined also by using questionnaires.

Results showed that dogs discriminated between the family members and this discrimination was context-specific as it was stronger in the attachment related situations. Behavioural results were strengthened also by the family members' belief regarding the ownership.

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Correlation between assessment, selection and training outcomes of a puppy to be used as a diabetic alert dog

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Background
Litters of puppies were assessed in order to select a puppy to be trained to an emergency alert and response dog for a person with Diabetes. The puppy is required to indicate to the person when her blood sugar levels drop, interrupt any ongoing behaviour, bring a sugar source and ensure that she is conscious and aware enough to take the sugar. Due to the owner's lifestyle (traveling internationally and lecturing) the puppy was required to be adaptable to change, to be moderately sociable with people, to be highly interested in odours, and of medium activity level and small to medium sized.

Methodology
Three litters of unrelated breeds of puppies between the age of seven weeks and ten weeks were assessed for their resilience to sudden startling noises or unpleasant experiences, social attraction and acceptance of restraint, interest in odours as well as a tendency to investigate and to follow a scent. One puppy was selected from a litter of six week old Cavapoo (Cavalier King Charles Spaniel mix Miniature Poodle) puppies. Foundation training began with the breeder after selection and was continued once the puppy was placed in the home of the owner. Owner and a volunteer assistant continued training. Samples from sweat, urine, breath and blood were taken to be used in training. Puppy was assessed for temperament and socialisation at five months of age and Scent Discrimination and Indication training was initiated. Response to this training was evaluated and ongoing training was planned. Assessments and training were videoed,

Conclusions/Significance
The correlation between the behavioural aptitude for which the puppy was tested and assessed and the resulting behaviour and training responses was observed. Requirements of attentiveness to people, calmness during training, extended focus, strong interest in odours, speed of learning were all evidenced during the evaluation and subsequent training process. The assessment is relatively straightforward, valid, and adaptable to a range of more or less suitable environments. Unsuitable puppies are eliminated through the tests and only the puppy that meets the criteria is selected. This is a useful assessment for selecting potential Diabetic Alert dogs.

Breeds previously assessed and trained successfully – Border Collie, Affenpinscher, Tibetan Terrier, Shi Tsu.

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Shelter dogs in online adoption adverts - The Bold and the Beautiful versus Les Misérables

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Keywords: shelter dogs, adoption

The success of adoption of shelter dogs depends to much extent on the match between needs and dispositions of the dog and the new owner. This study is aimed to examine how dogs are advertised for adoption by identifying the emotional valence of online adverts and their content, including information which was found to affect adoption success, such as dog's personality traits (Dowling-Guyer, Marder, & D'Arpino, 2011), age, sex, reason for relinquishment, breed, purebred status, and injury status (Lepper, Kass, & Hart, 2002).

Three hundred randomly selected adverts from a major Polish dog adoption advertising service were analyzed using the qualitative approach of grounded theory which involves coding fragments of text and then analyzing presence and coincidence of various types of information.

The results revealed that most adverts contained basic information about the size, breed and age of the dog and nearly all of them also mentioned the dog's name. Three major types of adverts were identified. The adverts based on negative emotions reported the history of abuse or neglect, often described the dog as fearful, handicapped or ill, sometimes aggressive. Positive stories of friendly and outgoing dogs, easy to manage and train, usually contained quite detailed records of their skills and dispositions. The third type of adverts were brief announcement, containing little information and little emotional load, often posted by current owners who decided to relinquish their dog.

Results of this study can be further employed in the analysis of the impact that different types of adverts have on the probability of successful adoption. It may be expected that the practical information allows for a better informed choice and a better match between the dog and the human. Secondly, the personalized, detailed descriptions may help to overcome negative stereotypes of shelter dogs, as demonstrated by research on other types of stereotypes (Yueh-Ting, Jussim, & McCauley, 1995).

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The role of gender differences in the adoption process of shelter dogs

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Many factors play a role when finding a new owner for a shelter dog. If dogs show behavior problems, it becomes much more difficult to find someone to adopt them.

Working in a shelter you get the impression that there is a gender difference as far as potential adopters for dogs with behavior problems are concerned.

The evidence for gender differences would be of value for the management of the shelter because it should allow predictions about the adoption opportunities for dogs. Are men more willing to adopt a dog that has bitten before? Or are women more accepting of a dog that cannot stay alone?

Over a period of 20 years (1991-2011) more than 40.000 dogs were adopted from the Vienna shelter. 7.617 of these dogs could be categorized because of behavioral problems.

The following behaviors were recorded:
- dog growls (n= 78)
- dog barks (n= 499)
- dog bites / has bitten (n = 692)
- dog is generally aggressive (n= 74)
- dog is not compatible with cats (n= 1382)
- dog is not compatible with other dogs (n= 1000)
- dog cannot stay alone (n=2858)
- dog is not housetrained (n= 1034)

The new owners of these 7.617 dogs were then analyzed statistically.

3.107 dogs (40.8%) were adopted by men, 4.245 (55.7%) by women. 265 married couples (3.5%) adopted a dog from the shelter.

The acceptance to take on a dog with behavioral problems from a shelter was shown by 14.9% more women compared to men.

5.001 dogs from a total of 7.617 were male (65.7%), 2.616 female (34.3%), so 31.4% more male dogs were available for adoption.

55.7% of dogs with behavior problems in general were adopted by women, while the percentage of those that had bitten and were adopted by women is 2.8% lower than the total: only 52.9% of those that had bitten were taken on by women (compared to 55.7% total).

40.8% of dogs with behavior problems in general were adopted by men, while the percentage of those that had bitten and were adopted by men is 2.6% higher than the total: 43.4% of those that had bitten were taken on by men (compared to 40.8% total).

The percentage of couples choosing a dog that had bitten is 3.8%.

57.4% of dogs that cannot stay alone found a new female owner: 1.7% more compared to 55.7% of dogs with behavior problems in general that were adopted by women.

39.1% of dogs that cannot stay alone found a new male owner: 1.7% less compared to 40.8% of dogs with behavior problems in general that were adopted by men.

The percentage of couples choosing a dog that cannot stay alone is 3.5%.

Our findings indicate that there is generally a greater willingness by women to adopt a shelter dog with behavioral problems. Men are more willing to take a dog with aggression problems while women´s acceptance of „moderate behavior problems" tends to be higher.

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Factors that influence adopters' preference of shelter dogs

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Millions of dogs worldwide live in animal shelters/rescue centers. Adopters overlook many dogs in these facilities that are fit for adoption. We examined if shelters can influence which dogs are adopted by marketing the dogs in different ways. This study investigated the influence of five factors on the selection of shelter dogs. We predicted that these factors might serve as indicators of an owned dog (and thus a more desired dog): wearing a collar (vs. no collar), not in a kennel (vs. kenneled), sitting in a chair (vs. no chair), seen in the presence of a toy (vs. no toy) and identified as having been surrendered (vs. stray). Previous work has demonstrated people's preference for shelter dogs housed with toys and their aversion to dogs labeled as stray (Wells & Hepper 1992, 2000).

We surveyed subjects at Gallatin County High School (Junction, IL USA, n=50) and the Knox County Humane Society (Galesburg, IL USA, n=50). Subjects were shown one of two sets of ten paired photographs of dogs that were counterbalanced across condition. Subjects were asked to indicate for each pair the dog that they would most like to adopt. Each subject also provided demographic information.

Subjects preferred dogs not in a kennel (71.5%, X^2(1, N=200) = 36.98, p<0.0001) and dogs wearing a collar (60%, X^2(1, N=200) = 8, p=0.004). All other factors (toy, chair, stray/surrender) had no significant effect on dog selection. High school students selected dogs not kenneled (75%, X^2(1, n=100) = 25, p<0.0001), and dogs wearing a collar (63%, X^2(1, n=100) = 6.76, p=0.009). Shelter visitors chose dogs that were not in a kennel (68%, X^2(1, n=100) = 12.96, p=0.0003), but had no significant preference for dogs wearing a collar (57%, X^2(1, n=50) = 1.96, p=0.162).

Our results suggest that shelter dogs are more likely adopted when seen wearing a collar out of the kennel. These results would apply directly to photo advertisements (petfinder) and may apply to in person adoptions as well.

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Cross-cultural differences in domestic dogs' interactions with humans – preliminary results from Ainsworth's Strange Situation Test

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Keywords: dog-human relationship, attachment, cross-cultural differences

The relationships of domestic dogs and their human owners show many remarkable similarities to the infant-caregiver bond in humans. In humans it is known that these relationships are strongly influenced by the interaction style of the caregiver, leading to considerable cross-cultural differences in these bonds due to differences in parenting styles (van IJzendoorn & Kroonenberg 1988). In dogs, however, experimental investigation of cross-cultural differences in their interactions with humans is largely missing. The aim of this study was to explore possible differences in dogs' interactions with both their owners and a stranger in three European countries: Austria, Hungary, and Italy.

Dogs from the three countries were tested in a modified version of Ainsworth's Strange Situation Test (Ainsworth & Wittig 1969). In this test, the dogs had the possibility to interact both with their owners and with a stranger. To minimize variation, the procedures were exactly the same in all three countries and the same experimenter acted as the stranger. We analyzed dogs' proximity and greeting intensity (e.g., approaching, tail wagging) towards the owners and the stranger. Results from 90 dogs (Austria: N=30, 14M/16F; Hungary: N=30, 18M/12F; Italy: N=30, 12M/18F) showed that while there was no difference in how much time dogs spent in the proximity of their owners during the test, there was a significant difference between dogs' proximity to the stranger in the absence of the owner (p≤0.05): the dogs from the Hungarian sample spent more time close to the stranger than both the dogs from the Austrian and the Italian sample. However, there was no difference in the intensity of greeting the stranger between dogs from the three different countries.

This study provides the first experimental evidence of cross-cultural differences in dogs' interactions with humans. Possible reasons for those differences are discussed in relation to variation in dog keeping practices in the three countries.

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Yawn contagion in dogs as a possible expression of empathy

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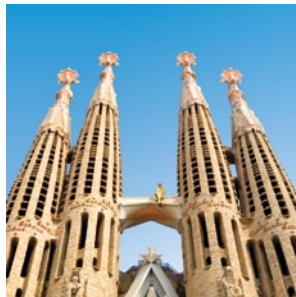[2] Japan Society for the Promotion of Sciences, Tokyo, Japan
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Contagious yawning in humans has been theoretically and empirically related to our capacity for empathy. Because of its relevance to evolutionary biology, contagious yawning in non-human species has been the focus of recent investigations. However, up to date only one study has been able to demonstrate that the observation of yawning elicits yawning in a non-primate species. Joly-Mascheroni and colleagues [Biol Lett 4:446–448, 2008] documented that human yawns stimulated contagious yawning in domesticated dogs (Canis familiaris). The link to empathy, though, was unclear since the authors could not rule out alternative explanations (i.e. yawn as a mild distress response).

The present study aims to replicate contagious yawning in dogs and to discriminate between the two possible mediating mechanisms (i.e. empathic vs. distress related response). Twenty-three dogs observed familiar (dog's owner) and unfamiliar human models (experimenter) acting out a yawn or control mouth movements. Concurrent physiological measures (heart rate) were additionally monitored for nineteen subjects. The occurrence of yawn contagion was significantly higher during the yawning condition than during the control mouth movements (Generalized Linear Mixed Models, $\beta = 1.556$, $P = 0.007$). Furthermore, the dogs yawned more frequently when watching the familiar model than the unfamiliar one (Linear Mixed Models, $\beta = 1.061$, $P = 0.024$) demonstrating that the contagiousness of yawning in dogs correlated with the level of emotional proximity. Moreover, subjects' heart rate did not differ among conditions (General Linear Models, $F_{(3,54)} = 1.16$, $P = 0.333$) suggesting that the phenomenon of contagious yawning in dogs is unrelated to stressful events.

Our findings are consistent with the view that contagious yawning reveals an emotional connection between individuals and may indicate that rudimentary forms of empathy could be present in domesticated dogs.