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|  | **12th INTERNATIONAL WORKING DOG BREEDING CONFERENCE: OCTOBER 12 TO 14, 2021** |
|  | **DAY 1: 12 OCTOBER LIVE PRESENTATIONS: Genetics, Selection and Early Development** |
| **Time / Length** | **Presenter** | **Presentation Title** | **Abstract** |
| **10:00 to 10:10** | **Paul Mundell** | **Opening of IWDC-2021** |  |
| **10:10 to 11:00****50 Minutes** | **Dr Fiona Hollinshead****PLENARY** | **A unique perspective of use of breeding strategies and advanced reproductive techniques to optimize development and production of continuously improved generations of specialized canines at the three major working dog breeding programs in New Zealand.** | **Each working dog organisation has different programmatic goals and many have restrictions that must also be considered when developing specific breeding strategies to meet their breeding program objectives and requirements. Strategies developed for the three working dog programs in New Zealand (NZ) focused on production of highly desirable offspring through the use of a number of advanced breeding technologies. Although only a small country, these breeding strategies are examples of when implemented either individually or collectively ultimately facilitated the production of generations of healthier and successful specific working dogs for each of the NZ working dog breeding programs over a 12 year period. Strategies that will be discussed as part of the presentation will include dual sire matings, methods for optimizing the established trans-cervical insemination (TCI) procedure, new developments in semen freezing techniques and extenders, non-intervention whelping facilities, and other opportunities to improve program efficiency and target production numbers.** |
| **11:00 to 11:15** |  | **BREAK** |  |
| **11:15 to 12:00** |  | **Networking – Breakout Sessions** | **International Working Dog Registry (IWDR) discussions: Dr Eldin Leighton and Dr Jane Russenberger** |
| **12:00 to 12:30** |  | **BREAK** |  |
| **12:30 to 12:50****20 Minutes** | Becky Hunt | Improving behaviour monitoring within a working dog programme | Various departments within working dog production programmes have different behavioural data needs. Breeding programmes require heritable temperament information while training departments require information on modifiable behaviours. To address these differing needs, Guide Dogs UK recently designed a new dog behaviour monitoring system. The system combines tandardized behaviour assessments with the ability to record ad hoc behaviour incidents and behaviour development plans, and track dogs through a tandardized training programme. Behavioural observations from a range of primary care givers, including staff and volunteers, ensure a wide range of data are collected on a dogs’ behaviour.The design of the new system was informed by an extensive review of scientific literature, previous Guide Dogs’ research and in consultation with Guide Dogs’ subject matter experts. The behaviour data collected are based on up to date behavioural science and the requirements of a working dog programme. The resulting behaviour data are then available to provide temperament trait information for the breeding department. Furthermore, recording and monitoring more accurate behavioural information supports dog wellbeing; behaviour problems can be identified early, and the data can be used to ensure the correct working role is selected for dogs.The presentation will explain the design of the system including the underpinning research and evidence used, will demonstrate the data that are collected and will highlight examples of the different data outputs available. The system has the potential revolutionise how working dog organisations consider and use their behaviour data to manage their dogs and inform their breeding programmes. |
| **12:50 to 13:10****20 Minutes** | Dr Eldin Leighton  | Estimated Breeding Values in IWDR | The International Working Dog Registry (IWDR) is a subscription service supporting the working dog community by providing a uniform coding scheme and streamlined workflows for entering routine data. For Labrador Retrievers, Golden Retrievers, and German Shepherd Dogs, estimated breeding values are calculated and reported for three health traits: (1.) an overall hip score, (2.) a measure of hip joint laxity based on the PennHIP score, and (3.) a measure of elbow quality. Hip quality scores are predominantly based on the hip extended view. Most scores are based on either an OFA-like score or an FCI-like score, with a smaller number scored using the BVA Kennel Club scheme. All extended view scores were classified into 1 of 5 mutually exclusive ordered categories from least (score 1) to most (score 5) desirable phenotype. PennHIP scores were included in the overall hip score phenotype by ordering values from least to most desirable, then classifying each quintile into the appropriate category. Elbow quality scores were also categorized into 5 mutually exclusive ordered classes. Analyses were completed using AIREMLF90 from the BLUPF90 family of programs. Variance component estimates were obtained for 3 phenotypes in each of 3 breeds. Heritability estimates for Labrador Retrievers, German Shepherd Dogs, and Golden Retrievers, respectively, were: 0.36, 0.51, and 0.21 for overall hip score; 0.69, 0.74, and 0.36 for PennHIP score; and 0.23, 0.26 and 0.20 for elbow quality score. |
| **13:10 to 13:25** |  | BREAK |  |
| **13:25 to 14:05****40 Minutes** | Lucia Lazarowski | Multimodal characterization of detection dog suitability: Combining behavioral, cognitive, and neurological measures for enhancing selection | The growing demand for highly capable detection dogs and a lack of robust selection measures continue to pose a challenge to the industry.  The ability to predict success from an early age is critical to maximizing program efficiency. Since 2000, Auburn University has bred and raised Labrador retrievers to be employed as single-purpose detection dogs, constituting the longest continual running institutional program for producing detection dogs in the United States. Our first aim in this study was to validate a traditional standardized behavioral test for evaluating puppies’ (n= 60) future suitability as a detection dog.  Validation was achieved by demonstrating high inter-rater reliability across observers, convergence with other measures of dog behavior, and prediction of adult outcomes as early as 3 months of age. In subsequent efforts we have explored non-traditional measures to examine the bio-behavioral correlates of successful detection dog phenotypes. Utilizing a reinforcement sensitivity theory approach, we characterized approach-avoidance tendencies in n = 56 adult detection dogs. Metrics included behavioral, cognitive, emotional, and physiological measures. Additionally, neural activity will be recorded in a subset of dogs (n = 18) trained for awake and unrestrained fMRI. Patterns in responding across measures suggests that multi-modal assessments may be useful in enhancing the identification of desirable working dog phenotypes. |
| **14:05 to 14:25****20 Minutes** | Brenda Kennedy | The effect of maternal style on later puppy behavior in Canine Companions dogs | One potentially vital influence in working dogs’ early development is maternal care, which has been shown to exert lifelong effects on offspring phenotypes in other mammals. Previous studies of maternal style in guide dogs and military working dogs have found that levels of maternal interaction experienced during the first few weeks of life are directly linked to puppies’ adult behavior and even success in the program up to two years later. Over the past three years, we observed 60 dams and their litters from Canine Companions’ population of purpose-bred service dogs, videotaping behavior over the first three weeks of life. Then, a subset of puppies from each litter (n = 235) participated in behavioral testing around 8 weeks of age. By quantifying individual differences in maternal style experienced and skill demonstrated on a series of tasks, we were able to assess associations between maternal style and the temperament and cognitive characteristics of 8-week-old puppies. We also compared puppies reared in volunteer homes to those reared in a dedicated breeding center (two models commonly employed by working dog agencies) to assess the effect of these rearing environments on puppy development. This study provides critical new data regarding how maternal style influences offspring cognitive and temperamental development, and the effect of early rearing environment on maternal care and puppy phenotypes. Ultimately, these findings have the potential to inform best practices in breeding and rearing dogs with aptitude for working roles while optimizing dog welfare. |
| **14:25 to 14:45****20 Minutes** | Karen Meidenbauer and David Deglau | The Domestic Breeding Consortium: Odor Detection Canine Selection, Breeding, and Early Training Techniques | Odor detection canines (ODCs) continue to play a critical role in homeland security as primary detectors of potential threats and aiding first responders. As the United States’ need for ODCs continues to grow the Johns Hopkins Applied Physics Laboratory (JHU/APL) has been tasked to ensure that the ODC user community has a sufficient and stable domestic source of quality working canines and advance ODC capabilities through a systems engineering approach of applying selective breeding, genetic and phenotypic evaluation, and early development. JHU/APL in partnership with the Department of Homeland Security, Science and Technology (DHS S&T) has stood up the Domestic Breeding Consortium (DBC). The DBC is focused on establishing and expanding a domestic supply for ODCs, developing lines of canines that are suitable for the user community’s immediate needs as well as long-term demand, and to intentionally take a scientifically based approach that can endure and improve over time. Modern scientific advances in canine theriogenology, genetic selection, neuropsychology, genomics, behavior, and physiology paired with biological and systems engineering should be used to advance traditional selection, breeding and early training techniques for ODCs. A commonality amongst commercial, government, and hobbyist communities of ODC users and stakeholders is the constant need to obtain quality operational ODCs. By defining and aggregating these phenotypes JHU/APL has established the critical foundation for developing metrics that can be used for accurate and repeatable canine selection criteria.**\*Submitted for consideration, sponsor approval required prior to release or publication** |
| **14:25 to 15:00** |  | Wrap up Day 1 |  |
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|  | **12 OCTOBER PRE-RECORDED PRESENTATIONS: Genetics, Selection and Early Development** |
| **15 Minutes** | Jennifer L. Essler  | Comparing dogs from multiple working careers on the ‘impossible’ task | Recently, the utilization of various behavioral and cognitive tasks used with working dogs has increased, as trainers and researchers aim to quantify what makes a better working dog. One of these tasks, named the ‘impossible task’, places a reward (typically toy or food) inside of a locked apparatus, and analyzes the dogs’ behavior. Though there are many working dog careers, most analyses with this task are with dogs of the same career. In this study, we created an ‘impossible’ task and presented it to dogs slated to go into different careers (search and rescue (USAR), dual-purpose police, single-purpose detection), working puppies in training, as well as pet dogs. The task was presented twice, once with food and once with toy reward. We coded how often the dog looked at the handler and experimenter, vocalizations, pawing, and movement behaviors (laying, sitting, standing, moving). Pets spent a lower proportion of their time interacting with the box when compared to all working careers and both rewards, including puppies (p<0.03). Dogs going USAR spent more time vocalizing compared to all other groups (p<0.02), while dogs going dual-purpose and single-purpose pawed at the apparatus more than pets (p<0.03). All working groups spent more time moving than pets (p<0.03). Consistent with the literature, we found significant differences between working and pet dogs, however, also behavioral differences between working dogs in different careers, suggesting this is an important consideration for analysis of this task. |
| **15 Minutes** | Emily Bray  | Development and heritability of cognitive traits in Canine Companions dogs | Given that most dogs who are released from working dog programs are unsuccessful for behavioral reasons, we have made it a research priority to understand how and why behavior develops. During the past five years, we have tested 415 Canine Companions puppies, as well as over 400 Canine Companions adults, on our Dog Cognitive Development Battery (DCDB). We find that by just 8.5 weeks of age, puppy cognition is highly developed. As a group, puppies can remember the location of hidden treats for up to 20 seconds, use their senses to make appropriate discriminations, follow human-given communicative cues, and even exhibit a certain degree of impulse control. Most of these skills, and especially impulse control, improve with age. However, there are also lots of individual differences when it comes to any given puppy’s cognitive abilities and temperament traits. Some of these differences persist into adulthood, although depending on the skill, a puppy’s performance is not always predictive of their future adult performance. Finally, since we know the pedigrees and thus relatedness of all Canine Companions dogs, we were able to calculate heritability—the amount of variation in a trait due to genetics—for these skills. For certain traits, such as willingness to engage in eye contact or follow a point, much of the variation between puppies can be explained by their genetic makeup. In conclusion, our research is starting to reveal when certain traits emerge, how they develop over time, and how they are influenced by genetic and environmental factors. |
| **15 Minutes** | Scott Thomas  | Observations on observing behavior in working dogs.  | At the first IWDBA conference I attended, I took note of a slide presented. The presentation was being given by Karen Overall and it was a slide of a Dilbert cartoon strip. Karen challenged us all to deal with our “Comfortable misconceptions”. Being brand new to the field and suffering from the Dunning-Kruger effect, I filed the idea away. I find that now, more than ever, I revisit this idea and its continued importance in the field of evaluating canine behavior. It seems with the working dog community there are often many “600 pound gorillas in the room” that we are either compelled or choose to ignore. Funding, bureaucracies, handler impact, and the proverbial statement that “the only thing two dog trainers will agree upon is what the third trainer is doing wrong” are all difficult and complex barriers to advancing our knowledge. The usefulness and accuracy of canine behavior research rests heavily on the “observed” behavior. Observational accuracy, avoiding bias, and use of scientific principles of inquiry must be applied to avoid “comfortable misconceptions”.In this presentation I will draw upon resources of observed behavior across competitive dog sport, zoological and aquarium trained animal behavior, the observations from breeding and raising over 600 dogs for working purpose, work in canine procurement, and from my involvement in animal research projects. I will look at observed behavior based on the observer, the subject being observed, and the context in which the observation took place. |
| **15 Minutes** | Elizabeth Hare | Assessment of the Agreement between Fosters and Trainers Evaluating Behavior with the C-BARQ and Behavior Checklist | Working dog programs have an interest in the early identification of puppies who are likely to succeed in training. The Penn Vet Working Dog Center begins training and fostering puppies at about eight weeks of age while collecting several types of behavioral data. The Canine Behavioral Assessment and Research Questionnaire (C-BARQ) contains 100 items grouped into 14 subscales and is usually completed by fosters. The Behavior Checklist (BCL) contains 44 items which partially overlap with C-BARQ items and subscales. After matching within dog and age group, there were 108 records on 83 dogs. Spearman correlations were calculated as a measure of agreement between the BCL item scores and C-BARQ subscales and individual items using the Holm correction for multiple testing. When testing C-BARQ subscales, BCL and C-BARQ stranger-directed aggression were moderately correlated (0.49, p < 0.001), as were C-BARQ dog-directed aggression and BCL stranger-directed aggression (0.42, p < 0.05). C-BARQ dog-directed aggression was correlated with BCL resource guarding around other dogs (0.46, p < 0.05). When testing BCL items with individual C-BARQ items, C-BARQ dog-directed aggression items were moderately but significantly correlated with seven BCL items including stranger-directed aggression, dog-directed aggression, and resource guarding around dogs. C-BARQ stranger-directed aggression items were correlated with seven BCL items including fear and aggression toward strangers. The moderate correlations for fear and aggression and lack of correlation for other traits suggest that dogs’ behavior may be different in their foster homes than in training or that trainers evaluate dogs differently than fosters. |
| **15 Minutes** | Katy M. Evans | The use of historical health records at The Seeing Eye in genome-wide association studies for canine health traits | A dataset of over 220 thousand genetic markers spanning the canine genome has been compiled for over 1,000 dogs to date at The Seeing Eye with the intention of using genomic markers to inform selection and management decisions. Dogs genotyped include current and former breeders, birth cohorts of individual breeds (German Shepherds, Labrador Retrievers, Golden Retrievers and Labrador/Golden Retriever crosses) and cases and controls of some specific conditions. These genotypes were used in genome-wide association studies (GWAS) for health traits for which dogs could confidently be assigned as cases or controls. GWAS for 37 health traits were performed, the breakdown of which is: dental (13), ocular (8), dermatologic (7), orthopedic (2), gastrointestinal (4), connective tissue (1), cartilaginous (1), and muscular (1). Genomic principal component analysis was conducted to validate individual breed designation and overall population structure. Of the traits passing multiple testing corrections, 9 were dental, 7 were ocular, 1 was orthopedic, 4 were dermatologic, 1 was muscular, and 1 was cartilaginous. Pseudo-heritability estimates ranged from 0 to 0.62 across the varying traits with a mean of 0.16 and median of 0.09. In all, 62% of the health traits showed significant genetic association and are being explored further for candidate genes and considered for fine mapping. The current GWAS highlighted SNPs potentially influencing traits in multiple breeds whereas future studies will seek breed specific associations. These findings increase our knowledge of the genetics of these health traits and provide a foundation for future genomic selection programs. |
| **15 Minutes** | Molly Riser | Using Single-Step Genomic BLUP to Compute Genomic Enhanced Breeding values for Self-Modulation in Working Dogs | The objective of this study was to evaluate the potential of genomic selection to improve behavioral traits in working dogs. Phenotypes of self-modulation on approximately 5000 Labrador Retrievers, a pedigree file containing more than 20,000 records, and the whole genome sequence were available for 463 animals. After selecting variants and removing low call and monomorphic SNPs, a total of 137k SNPs on 457 individuals were available for analysis. The model included the fixed effects of sex, year of birth, contemporary group and breeder ID, and the random additive genetic and residual effects. Heritability was estimated at 0.16, and no differences were observed between variance components with traditional and genomic AIREML. Pedigree and genomic enhanced breeding values were calculated using the complete population, and accuracy was assessed by cross-validation, simulating the selection of puppies. A random sample of 100 individuals with their own phenotypes and progeny had their records removed from the dataset, as well as their progeny’s phenotypes. Breeding values were recalculated in the reduced dataset, and the correlation between the reduced and complete data breeding values was the accuracy estimate. Genomic information provided gains of 10% in accuracy, and reranking of the top animals was observed. Gains in accuracy show that genomic selection can help improve working dogs by more accurately identifying superior animals at younger ages before phenotypes can be collected. Gains are expected to increase as more animals are genotyped, and more phenotypes are collected. Future steps include evaluation of other behavior and health traits. |

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|  | **DAY 2: 13 OCTOBER LIVE PRESENTATIONS: Veterinary Care and Welfare** |
| **Time / Length** | **Presenter** | **Presentation Title** | **Abstract** |
| **10:00 to 10:10** | **Dr Bess Pierce** | **Welcome and opening message** |  |
| **10:10 to 11:00****50 Minutes** | **Prof Holger Volk****PLENARY** | **Epilepsy in Working Dogs** | **Most veterinary surgeons will describe epilepsy as a pure seizure disorder. However, epilepsy is far more. Epilepsy is a brain disease(1) with seizures being the clinically most prominent sign. Most will recognise a generalised tonic-clonic convulsion, but relatively few will be able to spot focal motor or sensory seizures (ictal behaviour changes). However, apart from the seizures other clinical signs of epilepsy, which are increasingly recognised affecting the interictal period, are changes in cognition and behaviour(2-4). It is thought that there are shared pathophysiological pathways explaining the bidirectional relationship between neurobehavioural disorders and epilepsy(5); for example in human medicine, a patient with depression is more likely to develop epilepsy and a patient with epilepsy depression(6, 7). It is yet unknown if this bidirectional relationship exists in our veterinary patients.****Neurobehavioural comorbidities are been taken more and more serious in human patient, as they can have a bigger impact on health related QoL (HRQoL) than seizures. This is the case especially for inter-ictal anxiety and depression(8). Only few studies have studied interictal behaviour changes in dogs with epilepsy. In the first study, around two-thirds of dogs developed a behaviour change during the course of their idiopathic epilepsy(9). Drug-resistant dogs were found to have greater amount of unfavourable behavioural changes than drug responders in the same study(9), a finding also been seen in rodent models of epilepsy, where drug-resistant rats had greater behaviour changes(10).  *Not surprisingly, anxiety is the main behaviour change reported in dogs with IE* (9, 11), and in two more recent studies changes in impulsivity and other clinical signs comparable with attention deficits hyperactivity disorder in people have been noted (12, 13). An increasing level of evidence also exists that dogs with idiopathic epilepsy might have changes in trainability, spatial memory and accelerated memory loss(3, 14, 15). As such, epilepsy management should in the future not only focus on reducing seizures, but also consider on reducing the effects of potential behavioural comorbidities(16).** **In conclusion, epilepsy is a complex disease which might not also cause seizures but also behaviour and cognition changes which might limit their use as a working do. Management needs to be tailored to the individual patient and the focus should be not only on getting better seizure control, but also on improving comorbidities.** |
| **11:00 to 11:15** |  | **BREAK** |  |
| **11:15 to 12:00** |  | **Networking Breakout Session** | 1. **IWDR Discussions: Dr Eldin Leighton and Dr Jane Russenberger**
2. **Dr Bess Pierce and Dr Kelly Mann**
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| **12:00 to 12:30** |  | **BREAK** |  |
| **12:30 to 12:50****20 Minutes** | Dr Nicola Cotton  | Incidence of enteric pathogens versus presence of gastrointestinal symptoms in a working dog training facility  | Gastroenteritis is a common challenge in kennel facilities, and test results can be spurious in their correlation to the underlying cause of the symptoms. Gastroenteritis symptoms can be interruptive to training, work and problematic for clients to manage.Increasingly, research is directing treatment of gastroenteritis (specifically ecogniz), away from firstline antibiotic use, towards more holistic approaches to addressing the underlying cause of gastrointestinal disruption.In kennel facilities, these considerations are paramount, and traditional disease management protocols have a close interrelationship with dog mental wellbeing, and can be resource intensive for staff.Seeing Eye Dogs has analysed faecal PCR test data from over 100 dogs, comparing the incidence of positive results in symptomatic versus asymptomatic dogs, as well as comparing the prevalence of pathogens in the population across 3 years.From this analysis, a revision of management protocols for gastroenteritis in the kennel facility were implemented, and outcomes reviewed against the incidence of gastroenteritis symptoms. |
| **12:50 to 13:10****20 Minutes** | Katherine M. Lytle, DVM, MPH, MS  | Liquid biopsy screening for early cancer detection in working dogs | Cancer is the leading cause of mortality in dogs, and working dogs are no exception. A novel technology called liquid biopsy may offer an effective, non-invasive screening test for safe and early detection of cancer in working dogs, maximizing the chances of a favorable clinical outcome with the goal of extending the working dog’s life and career. Blood samples from an all-comers cohort of 191 cancer-diagnosed dogs and 188 presumably cancer-free dogs were subjected to DNA extraction, proprietary library preparation, and next-generation sequencing. Sequencing data were analyzed using an internally developed bioinformatics pipeline to detect genomic alterations associated with the presence of cancer. The overall sensitivity in cancer-diagnosed subjects was 48% (92/191). Of 188 samples from presumably cancer-free dogs, 180 tested negative (putative ‘true negatives’) and 8 tested positive (‘putative false positives’, pFP). In at least 2 pFP cases, patients were diagnosed with cancer 6-7 months following blood collection and were excluded from final performance analyses, resulting in a minimum test specificity of 97%. A novel, multi-cancer early detection (MCED) liquid biopsy test has demonstrated performance comparable to commercially available MCED testing options in humans. This test has shown the potential for detecting genomic markers of cancer months prior to the development of clinical signs. Early detection and treatment of cancer are key determinants of optimal clinical outcomes. When employed as a screening tool in the annual workup, a liquid biopsy test has the potential to extend the working dog’s career.  |
| **13:10 to 13:25** |  | BREAK |  |
| **13:25 to 14:05****40 Minutes** | Meghan Ramos | Penn Vet Working Dog Center Fit To Work program foundational fitness development and training. | The implementation of a data driven, clinically based, and time efficient working dog fitness program has been a goal within the community for several years. The Penn Vet Working Dog Center Fit To Work (PVWDC FTW) program is a foundational fitness program designed to combine scientific merit and practical training efficiency. The PVWDC FTW program is a formalized circuit training program performed for twenty minutes three times a week to complement a working dog’s career specific training. The program consists of posture development, warm-up and cool-down routines, and two circuits of Squats, Planks, Pivots, and Back-up exercises. The foundational PVWDC FTW exercises target the abdominal, spinal, and hindlimb musculature that are frequently underdeveloped and contribute to premature career altering injuries. The quantifiable FTW program enhances individualized monitoring for progression, early injury recognition, and return from injury rehabilitation. The PVWDC FTW program has been implemented with greater than one hundred dogs across three working dog disciplines producing quantifiable data that will be used to establish standards for working dog physical fitness. Handler reported subjective FTW benefits include improved canine confidence and performance during training such as ladder climbing, rubble navigation, prolonged apprehension times, and stronger initial decoy engagement. Ongoing research is focused on validation of training methods, career skill set specific progressions, and correlation of physical fitness with career performance. |
| **14:05 to 14:25****20 Minutes** | Marty G. Roache, Karen L. Overall | Investigation of tail injury at Lackland Air Force Base Training Kennels for Military Working Dogs | Tail injuries have been reported as an important cause of removing Military Working Dogs (MWDs) from operational work or training due to the need for medical treatment. Such removals adversely affect resource use and operational schedules. The aim of this study was twofold. Our first goal was to retrospectively identify demographic factors associated with tail injury in MWDs. Our second focus was a prospective clinical study investigating the association between the presence of tail injury, the stage of training and kennel location. Results of the retrospective study showed a significant correlation between purpose-bred dogs, sex, and breed with increased occurrence of tail injury. Results of the prospective study demonstrated a significant correlation between purpose-bred dogs and stage of training and tail injury. These findings are intended to be used to guide for future management to help prevent tail injury, reduce treatment time, and improve overall health and welfare of the entire MWD population, and other types of ecogniz dogs, such as shelter and research dogs. |
| **14:25 to 14:45****20 Minutes** | Debra Lynn (Deb) Zoran | Nutrition for Search & Rescue dogs: tailoring needs to the job | All working dogs are athletes but their type of work, physical demands, and level of fitness can vary widely. The nutritional needs of working dogs must be tailored to not only provide the appropriate amount of energy to meet the specific demands of their job, but must also be adjusted individual mission demands. This abstract will discuss the essential aspects of nutrition of a specific segment of working dogs: including energy needs, protein levels and diet selection for Search and Rescue detection canines. In addition, the talk will discuss the critical need for careful assessment and adjustment of each canine’s diet to maintain healthy muscle and body condition but also to meet the sometimes very extreme demands placed on them during deployments. |
| **14:45 to 15:00** | **Dr Bess Pierce** | **Wrap up Day 2** |  |
|  | **13 OCTOBER - PRE-RECORDED PRESENTATION: Veterinary Care and Welfare** |
| **15 Minutes** | Desiree Broach | Military Working Dog Aggression and Welfare | Historically in the US Army Veterinary Corps, the department of Veterinary Behavior has been made up of one single person. We have only increased to two people since 2016; however, our outreach and mission has started to gain momentum. Aside from managing case consultations for private pets and military working dogs (MWDs), it is also our mission and vision to increase education and training on animal behavior. Because our momentum and outreach have increased, we have noticed an increase in the number of bite incidents from MWDs or case consultations reported for handler-directed aggression. When investigating the circumstances of these incidents, it became apparent that the underlying issue is not simply an MWD aggression issue. This presentation will discuss the problem of MWD aggression, how it turned into a focus on guidelines for MWD welfare, and the current initiatives the Veterinary Behavioral Medicine department have underway. |
| **15 Minutes** | Dr Richard A. Vargus | Global Threats to the Animal Community | The military, law enforcement and first responders rely heavily on canines as the olfactory detection tools to mitigate multiple threats. However, how do we ensure the safety, health and welfare of these olfactory heroes after they have been exposed to toxins, possible zoonotic diseases and hazardous materials. The same is true in the mitigation of post natural disasters. During canine operations in Iraq and Afghanistan we deployed more than 9,000 dog teams without the benefit of protective equipment from toxins, or chemical biological threats. In New York post 911 hundreds of animals were retrieved covered with toxins, taken from the area without veterinary assessment or decontamination. The possibility for a zoonotic pandemic and exposure to chemical biological agents presents an insurmountable challenge. How can we strategically meet this global threat?Keywords: Zoonotic, COVID, Capabilities, , Olfactory |
| **15 Minutes** | Dr Mia Cobb | Working Dog Welfare: Where are we now and where are we going? | Working dogs are widely used by people around the world in roles as diverse as detection, mobility, and asset protection. The physical health and mental wellbeing of working dogs are important to their performance and program efficiency, with economic, social, and legal implications for operators where animal welfare is compromised. The field of animal welfare science has rapidly developed in the last decade, with important updates to our understanding of animal welfare and its relevance to the sustainable participation of dogs in working roles. This presentation will provide an overview of recent scientific advances that are relevant to working dogs, situated in the context of changing community attitudes. This will include defining what animal welfare is, explaining the modern theoretical framework for assessing animal welfare including identification of opportunities for improvement and examining the ways in which working dog welfare can be measured. In addition, research exploring the public’s perceived welfare of working dogs and implications for social license to operate will be discussed, using relevant case studies. Finally, this presentation will identify opportunities and roles for all working dog industry stakeholders toward clear communication, continuous improvement, and transparency to enable good animal welfare for working dogs in the 2020s and beyond. |
| **15 Minutes** | Brian Farr | Assessing working dog fitness with the Penn Vet Working Dog Center Fit To Work program | Working dogs require a high level of strength, stability, proprioception, and mobility to perform their jobs safely and effectively. Regularly assessing a working dog’s fitness enables monitoring of their performance over time, comparison of their performance to a peer group or standard, and evaluation of their readiness to return to work after an injury, illness, or gap in training or utilization. The Penn Vet Working Dog Center Fit To Work program incorporates four assessments suitable for working dog handlers, trainers, and organizations. The assessments are simple to perform, safe for working dogs, and can be completed in a short period of time with limited resources. The Sprint Test is a measure of whole-body power and primarily hindlimb extension strength. The Progressive Plank Test is a measure of core stability and primarily resistance to spinal extension. Together, these tests can be completed in approximately 30 minutes and require no additional behaviors beyond those common to working dogs. For a more specific assessment of hindlimb fitness, the Progressive Pivot Test measures hindlimb stability, and the Progressive Squat Test measures hindlimb extension strength and muscular endurance. The Penn Vet Working Dog Center has completed over 250 assessments on over 100 working dogs and has collaborated with military, law enforcement, and search and rescue organizations to assess their dogs. The results of these assessments can inform fitness standard development, enable performance enhancement research, and guide retirement decisions. |
| **15 Minutes** | Dr Mia Cobb | Digital innovation for working dogs | The use of smart technologies in industries reliant on animals is growing rapidly. From applications such as precision livestock farming, drones for remote animal guidance, wearable technologies, artificial intelligence, robotics, to animal-computer interaction, various opportunities to support our working dogs exist through digital innovation. Our understanding of the implications of these technologies for human physical and mental wellbeing is new, and is far less advanced for animals. Working dog performance and welfare can be impacted, both positively and negatively, by these interspecies technologies. This presentation will provide an overview of emerging digital technologies and their implementation relating to animals. An animal-centered approach to the design process for digital innovation will be described, including consideration of individual animals, operational goals, context constraints, and opportunities to improve working dog welfare. Assessment of the opportunities and risks of digital innovation for animals will be presented in relation to people’s attitudes toward technologies, including attention to how this may shape our future relationships with working dogs. The importance of a strong cross-disciplinary approach with researchers and practitioners working closely to innovate in collaboration will be highlighted for this exciting and swiftly progressing field. |
| **15 Minutes** | Erin Perry | Canine decontamination in the field: Lessons learned from the Champlain Towers building collapse. | Health concerns surrounding hazardous material exposure for working canines during deployment are common. Decontamination procedures in working dogs are frequently insufficient and inconsistent. This is particularly concerning as prior work has shown how deployment-related exposures can negatively impact canine health at many levels. This presentation will feature a discussion of observations from the Champlain Towers building collapse. Canine decontamination efforts conducted in the operational environment will be discussed at length. Health risks to canines, cross-contamination risk to human teammates, and routes of exposure will be highlighted. Current recommendations for canine decontamination procedures, a suggested matrix for selecting decontamination methods, and solutions to ensure consistent application of these strategies will be presented. Finally, recommendations for future research to optimize development of canine decontamination standards will be explored. |
| **15 Minutes** | Heather J. Huson | A novel risk locus on canine chromosome 18 is identified for congenital laryngeal paralysis in Alaskan sled dogs | Congenital laryngeal paralysis (CLP) is a hereditary disease, causing loss of movement of the arytenoid cartilage and focal folds in the larynx during inspiration. This reduced function causes varying degrees of respiratory distress which can negatively affect a dog’s physical ability and become life-threatening. The congenital form, commonly diagnosed within 1 year of age has been described in multiple breeds but is less common than the acquired form, often an age-related disease. For Alaskan sled dogs (ASD), bred specifically for endurance, CLP can drastically affect their growth and performance. To this end, 20 CLP affected, and 198 unaffected ASD were used in a genome-wide association study to explore the genetic regulation of CLP in ASD with the intention of developing a genetic test. 120,296 single-nucleotide polymorphisms spanning the canine genome highlighted a novel risk locus on chromosome 18 (Bonferroni corrected p<4.5x107) and suggestive associations (p<8.3x106) on chromosomes 4, 23, and 31. Focusing on chromosome 18, the markers of highest association identified a 3.2KB region of the genome comprising the EXT2 (exostosin glycosyltransferase 2) gene. Nearby regions of linkage highlighted by significantly associated markers identified the tumor protein TP53I11 (p53 inducible protein 11), TSPAN18 (tetraspanin 18), and SHANK3 (SH3 and multiple ecogni repeat domains) genes. Mutations in EXT2 and TP53I11 have been associated with skeletal and muscular developmental disorders and tumors, while mutations in TSPAN18 and SHANK3 have been implicated in neurological disorders. Further investigations are ongoing to identify the most plausible candidate gene and causative mutations of CLP in ASD. |
| **15 Minutes** | Jayne McGhie | Prevalence of Canine Degenerative Myelopathy SOD-1 Mutation in Working Shepherd Dogs across Australia and New Zealand |  | Canine degenerative myelopathy (CDM) is a progressive degenerative, inevitably fatal neurologic disease in dogs. Well ecognized in German shepherd dogs, CDM contributes to the loss of working dogs from service due to spinal disease. Because the average age of onset of clinical signs in afflicted dogs is 8-9 years, natural selection against breeding with dogs carrying the mutation does not occur. A genetic test for the linked gene mutation SOD1:C.118G>A is available. This study identified the prevalence of the SOD1:C.118G>A gene mutation in police and military working dogs within Australia and New Zealand (a relatively genetically isolated population). 606 dogs: 469 German shepherds, 137 malinois were tested on a custom genetic test panel. The overall prevalence of the ‘A’ allele was 21.7% with 32% of dogs being heterozygous carriers (GA) and 6% of dogs homozygous affected (AA). Forty-seven percent of German shepherds carried the mutant allele (39% heterozygous; 8% homozygous affected) compared with 6% of malinois (6% heterozygous; 0% homozygous affected). This cohort of working dogs showed a significantly lower prevalence of homozygous affected dogs than recorded in UK and USA populations, and significantly more carrier dogs than reported in USA populations. |

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|  | **DAY 3: 14 OCTOBER LIVE PRESENTATIONS: Training and Deployment** |
| **Time / Length** | **Presenter** | **Presentation Title** | **Abstract** |
| 10:00 to 10:10 | Dr Kelly Mann | Opening and welcome |  |
| **10:10 to 11:00****50 Minutes** | Dr Cynthia OttoPLENARY | Pandemic or pandemonium? Creating standards for medical detection dogs | The SARS-CoV-2 pandemic lead to an international effort to employ odor detection dogs for the screening of individuals for COVID-19. It was documented across many platforms that the dogs were capable of discriminating odor of people that tested positive for SARS-CoV-2 from those that tested negative. The rapid nature of canine screening and urgency of the pandemic led to multiple organizations training dogs, with some dogs being deployed into operational settings. One of the key components of a valid test is to have documentation of training and testing standards. The process of standards development relies on scientific data and expert opinion to generate recommended methods for training, testing and operational usage. In the US, the National Institute of Standards and Technology supports the development of standards relevant to forensic science. This presentation will address the rationale for and the process of standards development as it relates to medical detection dogs for conditions like COVID-19 that impact biosecurity. |
| **11:00 to 11:15** |  | BREAK |  |
| **11:15 to 12:00** |  | Networking –Breakout Sessions | 1. International Working Dog Registry (IWDR) discussions: Dr Eldin Leighton and Dr Jane Russenberger
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|  |  |  | 1. AKC Detection Dog Task Force Program: Working with AKC Breeders to Improve Breeding, Development and Availability of Explosives Detection Dogs: Sheila Goffe and Stacey West

Abstract/OverviewThe American Kennel Club (AKC) is a club of clubs and the world’s largest all-breed registry. It is the primary breed registry ( canine studbook) in the United State. AKC works with 5,000 all-breed and breed-specific affiliated dog clubs throughout the U.S., and sanctions some 20,000 competitive canine events in the U.S. each year (in non-pandemic years.) There are numerous AKC -affiliated breeders who specialize in breeding high quality Labrador Retrievers and sporting dogs of the breeds most sought after in the U.S. (as elsewhere) for explosives detection dogs. Demand for explosives detection dogs has skyrocketed in the U.S. and worldwide in the last 20 years. However, More than 85% of dogs obtained for U.S. clients – law enforcement, DoD, DHS/TSA and other government agencies or private entities are bred and raised overseas. Lack of a consistent, high quality supply of purpose-bred detection dogs represents a security weakness for the U.S. This is ironic considering that the preferred breed for detection dog training in the U.S.—the Labrador Retriever –is the most commonly registered breed with AKC. In 2016, TSA reached out to AKC for assistance in obtaining green dogs for advanced training as detection dogs. This inspired creation of AKC’s Detection Dog Task Force (DDTF) to identify areas in which AKC could help address the shortage crisis. DDTF works with expert breeders and trainers, industry experts, government officials, academics and others to better understand the causes of the shortage and ways to address it by encouraging breeding and development – as well as final deployment of high-quality U.S.-bred detection dogs. Further study revealed that the cause of the shortage isn’t production capacity or quality; but rather, numerous barriers to entry, including lack of institutional transparency with respect to requirements, poor communication between buyers and potential producers, and the economics of dog breeding and rearing. To address the structural issues underlying the shortage, the DDTF has focused on policy advocacy, raising awareness, educational programming and outreach. To complement these efforts, it created the Patriotic Puppy Program, which provides direct educational and one-on-one training assistance to incentivize existing AKC breeders and trainers to raise some of their puppies to one year of age and prepare them to the point where they would be high quality green dogs ready for purchase and future advanced training. The Patriotic Puppy Program guides breeders/puppy raisers in best practices from pedigree analysis through placement so the dogs they raise for future careers as working dogs are purposefully prepared for that work and will have higher than average deployment and success rates. Breeder/Puppy raiser mentoring by one or more subject matter experts plays an important role, as these relationships offer multiple approaches for successful training as well as opportunities for participants to develop relationships with brokers, buyers and other important industry participants. The AKC’s Patriotic Puppy Program does not acquire or broker puppies. Instead, it offers a framework to develop and establish best practices that are passed on to breeders and puppy raisers so that they can establish successful, sustainable and scalable programs and industry relationships of their own, thereby setting them up for success and helping to address a structural shortage of DDs, long after participation in the AKC program has concluded. Hosts Sheila Goffe and Stacey West will describe the efforts of the AKC Detection Dog Task Force, the Patriotic Puppy Program, and encourage broader discussion of how this program and/or other initiatives can help reduce the canine shortage and improve the median quality of detection and other working dogs in both the U.S. and around the globe as well as identify continuing structural and logistical impediments to improving the supply of working dogs worldwide. |
| **12:00 to 12:30** |  | BREAK |  |
| **12:30 to 12:50****20 Minutes** | Esther Schalke | Scent dog identification of SARS-CoV-2-infections- a double blind study | The COVID-19 pandemic has rapidly spread across the globe. Rapid testing remains one of the main strategies to contain the spread. Scent dogs are capable of detecting disease-specific volatile organic compounds emanated from infected body cells and could support current testing strategies.**Methods – Results:**In a pilot study ten dogs were trained to detect SARS-CoV-2 infections in beta-propiolactone inactivated saliva samples. They were able to discriminate between samples from infected patients and negative controls. The cognitive transfer performance for the recognition of non-inactivated sample material and detection accuracy were tested on three different non-inactivated body fluids (saliva, urine, sweat) in a randomised, double-blind controlled study.Dogs were tested on a total of 5242 randomised samples. Dogs detected non-inactivated saliva samples with an average sensitivity of 84% (95% CI: 62·5–94·44%) and specificity of 95% (95% CI: 93·4–96·0%). In a subsequent experiment to compare the scent recognition between the three non-inactivated body fluids, diagnostic sensitivity and specificity were 95% (95% CI: 66·67–100%) and 98% (95% CI: 94·87–100%) for urine, 91% (95% CI: 71·43–100%) and 94% (95% CI: 90·91–97·78%) for sweat, 82% (95% CI: 64·29–95·24%), and 96% (95% CI: 94·95–98·9% ) for saliva respectively.**Conclusions**Detection dogs were able to transfer the conditioned scent detection of inactivated saliva samples to non-inactivated saliva, urine and sweat samples, with a sensitivity >80% and specificity >94%. All three fluids were equally suited for SARS-CoV-2 detection by dogs and could be used for disease specific recognition. Detection dogs may provide a reliable screening method for SARS-CoV-2 infections. |
| **12:50 to 13:10****20 Minutes** | Nele ten Hagen | Discrimination between SARS-CoV-2 infection and other viral respiratory infections by working dogs | In the SARS-CoV-2 pandemic testing of symptomatic and especially asymptomatic individuals is one of the main strategies to stop infection chains. Because of their outstanding sense of smell, dogs could be an essential asset in mass screening testing strategies. Previous research demonstrated dogs’ ability to detect SARS-CoV-2- infections but has not investigated whether dogs can distinguish between SARS-CoV-2 and other viral infections. To address this question, a study was performed with swab from individuals and samples from cell culture, each infected with one of 15 viruses causing acute respiratory symptoms. We trained twelve dogs to detect SARS-CoV-2 positive samples. In the first test (scenario I) swabs from individuals with a variety of viral respiratory tract infections were presented and the dogs achieved a mean diagnostic sensitivity of 73.8% (95% CI: 66.0–81.7%) and a specificity of 95.5% (95% CI: 92.6–97.7%). When using cell culture supernatant from different coronavirus infections (scenario II and III) the dogs detected SARS-CoV-2 samples with a mean diagnostic sensitivity of 61.2% (95% CI: 50.7–71.6%) and 75.8% (95% CI: 53.0–98.5%), respectively. The specificities were 90.9% (95% CI: 87.3–94.6%) and 90.2% (95% CI: 81.1–99.4%), respectively. The results demonstrate dogs’ ability to differentiate viral respiratory tract infections by their odor. Nevertheless, compared to earlier studies the diagnostic sensitivities were found subpar. To deploy COVID-19 detection dogs, as a reliable screening method, a variety of samples from different viral respiratory tract infections should be included in dog training to ensure a successful discrimination process. |
| **13:10 to 13:25** |  | BREAK |  |
| **13:25 to 14:05****40 Minutes** | Robert Dougherty Jr and Alena C. Heyer | Implementation of a plan to decrease arousal and increase motivation | The Penn Vet Working Dog Center raises and trains dogs for Law Enforcement (LE) and Urban Search and Rescue (USAR) careers. High motivation for work is critical for success. Dr. Esther Schalke at the 2019 IWDC presented the difference between arousal, (high emotional alert) and motivation (controlled desire).For patrol dogs, over-arousal can result in redirected aggression, difficult or impossible for suspects to hear warning announcements leading to missed opportunity of surrender, decreasing use of force. Dogs that work from a state of arousal are more difficult to control, exert valuable energy prior to working, are less controlled, less clear-minded and focused on the task, and can be a liability to their handlers.In a group of young dogs (15-20) training for LE or USAR, we controlled arousal by requiring a calm response from the dog prior to work or reward was introduced. The dogs were evaluated for any reduction in motivation to perform a task. In our experience, implementing a calm response in various phases of training did not decrease their ability to perform a task at a high level of training expectations and carried over to operational expectations. We also discovered that by establishing controlled motivation early in the dogs’ training, we were able to increase external stimuli that heightened arousal levels yet still maintain motivation and control of the dog through clearly communicating to the dog what was expected of them. Concerns that reducing the level of arousal would reduce motivation to work were unfounded. |
| **14:05 to 14:25****20 Minutes** | Nathaniel Hall | Learning to Smell: Impacts of Training and Experience on Detection Dog Performance | Odor detection and perception is often considered a static and/or innate canine capability with a set capacity, This view promotes that detection dog training largely involves communication of which odor to detect. In this talk, I will review the scientific literature across a variety of species, and detection dogs that indicates that olfactory perception is fluid and dependent on experience and learning. I will argue that training influences both the "what" and "how" a dog perceives target odorants and that purposeful planning and training with target odor variations can have important and consequential impacts on detection dog performance. |
| **14:25 to 14:45****20 Minutes** | Edgar O. Aviles-Rosa  | Case Study: An Evaluation of Detection Dog Generalization to a Large Quantity of an Unknown Explosive in the Field  | Two explosive detection dogs were deployed to search a suspicious bag, and failed to detect 13 kg of explosive within. The aim of this research was to further evaluate this incident. First, dog teams (N = 7) searched four bags in a similar scenario. One bag contained the same 13 kg of explosive, two bags were blanks, and the other contained the training sample that the agency routinely used for training. All dogs detected the training sample, but most (5/7) did not alert to the 13 kg sample. Subsequently, dogs received two trials in a line up with a 30 g subsample of the explosive to evaluate whether they could generalize to a smaller quantity of the same explosive. Most dogs (6/7) alerted to the subsample at least once. Finally, dogs were trained with the 30 g subsample and later tested with the 13 kg sample. Only three dogs spontaneously generalized to the large sample after training with the small subsample. Dogs’ alert rate to the 13 kg sample was improved with training in subsequent trials with the 13 kg sample. This result indicates that explosive detection dogs may not generalize to a target odor at a significantly higher quantity relative to the one used in training, highlighting the importance of conducting such training. |
| **14:45 to 15:00** | Mr Paul Mundell | Closing 12th IWDC | President IWDBA |
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|  | **DAY 3: 14 OCTOBER PRE-RECORDED PRESENTATIONS: Training and Deployment** |
| **15 Minutes** | Brian Farr | Explosive detection canine operational requirements and performance degradation: expert perspectives | The explosive detection canine (EDC) team is currently the best available mobile sensor capability in the fight against explosive threats. While the EDC can perform at a high level, the EDC team faces numerous factors during the search process that may degrade performance. Understanding these factors is key to effective selection, training, assessment, deployment, and operationalizable research. The utilization of and research on EDCs is often based on personal experience or incomplete knowledge. EDC practitioners (handlers, trainers, and leaders) possess the institutional knowledge necessary to understand EDC operational requirements. This study leveraged the perspectives of these practitioners to describe EDC operational requirements and determine the factors that degrade performance. The study utilized a qualitative approach with semi-structured interviews of EDC experts from across the employment spectrum. Analysis of the data revealed commonalities across all EDCs and utilization-specific differences. To be effective, the EDC team must function well on both ends of the leash, and the handler likely has the greatest impact on the EDC’s performance. Common requirements include expectations to perform at a high level in a variety of manmade and natural physical environments and under a range of climate conditions. EDCs must work through the visual, olfactory, and auditory challenges of the operational environment and the countermeasure efforts of those utilizing explosive devices. Utilization-specific differences like patrol or assault training and utilization add additional requirements for some EDCs. This study’s results can help improve EDC selection, training, assessment, and deployment and further research into sustaining performance. |
| **15 Minutes** | Dominique Grandjean | The application /practical implementation pros/cons of COVID-19 olfactory detection dogs | Biodetection dogs can definitely represent a robust diagnostic tool, when correctly trained and validated, in the fight against COVID-19. They are efficient, non-invasive, and way cheaper than any other test. Such dogs have already been deployed in airports (Finland, Lebanon, UAE, Chile, Italy, Russia…), at road borders (UAE), for clusters (France), in nursing-houses or for sport-events (USA), and the UAE has set up mobile units involving specially equipped trucks. The economic benefits from such a screening would be great. Fast results, and the sensitivity, specificity and overall success rates reported by all early COVID-19 scent dog detection studies appear to be at least equivalent to the standard RT-PCR and better than the antigen testing methods.Pros and cons still can be discussed |
| **15 Minutes** | Kat Janczur | A novel method for the detection of Japanese knotweed (Reynoutria japonica) using specially trained canines.  | Detection dogs are increasingly used in conservation efforts to find endangered and invasive species, as effective detection is crucial for the implementation of successful management techniques. Japanese Knotweed (Reynoutria japonica) poses a significant risk to biodiversity, protected/endangered species, can cause erosion to riverbanks and is hazardous for building structures. Although it can be identified by sight during the growing season, the plant poses a significant and costly risk to surveyors, homeowners and building companies due to its pervasive nature and ability to lie dormant for over 20 years.Japanese knotweed presents unique training challenges, as working dogs to a living plant adds complexity for training and operational practice. As knotweed grows within the environment, it is crucial to ensure that the scent picture remains clean for the dogs. Training to a live plant involves careful consideration of the changing nature of knotweed throughout the seasons, with dogs required to be confident in recognising the plant at each stage of its life cycle. This significant variation is reflected in dog’s varying responses to the plant during different seasons, which will be demonstrated with video examples.Although our dogs are operationally effective, it is important to test and evidence their ability to detect knotweed in a scientific way; we are therefore developing a research project exploring this. Two dogs will perform a double-blind odour identification test containing 30 target plants each, against control plant species. Initial data collection will be complete by July, ready to share analysis and insights at the conference. |
| **15 Minutes** | Linzi Williamson | Examining the Role of Significant Others in Canine Welfare within the Context of Veterans Working with Service Dogs | A growing body of literature has shown the efficacy of Service Dogs (SDs) in aiding Veterans with their posttraumatic stress disorder (PTSD) and comorbid substance use (SU), but SD welfare has received less attention (e.g., health, comfort, nourishment, safety, ability to express innate behaviour, and freedom from suffering, pain, fear, and distress). This qualitative analysis examined aspects of animal welfare within the context of Canadian Veterans working with SDs from the perspective of their significant others. This analysis is part of a larger body of patient-oriented research (POR) which examined the experiences of 5 Veterans over a 1.5-year period as they acquired and were involved in the training of their SD. Veterans’ spouses (n = 3) and close friends (n = 2) shared their perceptions of the Veteran and SD interactions via semi-structured interviews conducted at 7 time-points (i.e., baseline to 18 months). Themes were developed following Braun and Clarke’s (2006) six-step analysis guide. Four key overarching themes relating to SD welfare were developed: (1) Veterans’ significant others acting as allies to the SDs, (2) SD welfare contributing to zooeyia for Veterans, (3) Veteran training challenges disallowing the SD to perform tasks and meet their potential, and (4) public access issues generating risks to SD teams’ comfort and welfare. The present analysis contributes to an on-going conversation of canine welfare in the animal-assisted intervention literature, and how recognizing the welfare of both Veteran and SD are equally vital to the success of the team and SD training programs. |
| **15 Minutes** | Edgar O. Aviles-Rosa,  | A detailed evaluation of Spotted Lanternfly (Lycorma delicatula) detection dog training and performance | Spotted Lanternfly (SLF) is an invasive foreign insect that is currently threatening U.S. forestry and agriculture. Current eradication efforts consist of removing egg masses before they hatch. However, finding egg masses is difficult because the SLF camouflage its egg with the bark. A recent study found that dogs can detect dead SLF egg masses, suggesting that dogs could be used as an in the filed detector to eradicate SLF. The aim of this study was to further evaluate dogs’ capability to detect and discriminate SLF egg masses from different environmental distractors. Seven mix-breed dogs were trained to operate an automated olfactometer. Subsequently they went through a 9 phases training program where they were tested with different environmental distractors or SLF samples. At each training phase we evaluated dogs’ performance to assess how it was affected by the introduction of new distractors or samples. All dogs were able to detect SLF egg masses. We observed an increase in false alerts when we introduced tree bark and insects as distractor, but this decrement in performance was recovered quickly. Most dogs were able to generalize to different samples and to a sample of SLF egg on bark without explicit training. The data outlined the importance of training dogs with relevant environmental distractors and that dogs can generalize to different samples of SLF without explicit training. Although field trials still need to be conducted, the results indicate that detection dogs could be a valuable asset in SLF eradication efforts. |
| **15 Minutes** | Astrid Concha | Effect of impulsivity and core effect on training performance in dual purpose military working dogs | Military working dogs (MWDs) are rigorously selected and highly trained to be able to perform diverse roles in the field, but a significant number of the MWDs fail to achieve their training goals on time or to make full operational status, mainly for behavioral reasons.Impulsive behaviors and changes in emotional states occur in response to stimuli or situations that potentially are, rewarding or punishing in the environment. There is some evidence, in humans and dogs, that many cognitive processes such as, attention, working memory and learning responses are modulated by impulsivity and core effect. However, very little is known about how individual’s differences in impulsivity, as well as rewards (e.g. positive distractions – temptations), and aversives (e.g. negative distraction - anxieties) may influence performance in MWDs.The aim of this study was to assess whether there would be differences in terms of scores on theDog Impulsivity Assessment Scale (i.e. impulsivity, aggression and responsiveness); and on the Positive and Negative Affect Scale (i.e. energy, persistence and excitement; and negative activation) on the detection and patrol performance in U.S. Department of Defense Military Working Dogs.Results showed a significant association between psychometrical tests scores and performance factors such as reward release, detection sensitivity and specificity, but also scores predict the number of days in training to reach detection and patrol qualification. |
| **15 Minutes** | Ben Carey | Transitioning a Therapy Dog Program Online: What\'s In It For the Dog? | Therapy dog programs on university campuses have become more commonplace in recent years, with literature suggesting that these programs may promote wellness and reduce stress amongst students. Less well-known is whether therapy dog programs have similar benefits online, especially given the Covid-19 pandemic. In response, this presentation focusses on findings from a program evaluation of the PAWS Your Stress Therapy Dog online program at the University of Saskatchewan.Since 2015, PAWS Your Stress Therapy Dog program has offered student participants feelings of comfort and support on the University of Saskatchewan campus. In response to the COVID-19 Pandemic in March 2020, this program moved online with two goals: 1) for student participants to connect virtually with therapy dogs towards feelings of comfort and support; and 2) to increase student’s knowledge of pandemic-specific, evidence-informed mental health.There were three key findings identified by the process and outcome evaluation related to: 1st, how the online activities contributed to the program’s goals; 2nd, best practices related to program personnel, handler training and support, and online expertise; and 3rd, working/therapy dog-specific ethical considerations. Specifically, what are the ethical concerns of transitioning a dog that was trained to do in-person therapy to an online format. We conclude with how these findings have informed our work and how the evaluation will inform our online therapy dog program in the 2021 semester. For example, our initial program findings were used to fine-tune the program for the fall 2020 semester; implementing interactive zoom sessions with several therapy dog teams. |
| **15 Minutes** | Margot Perez | Solving cold-cases: Dogs can match human scents collected several years apart | Human scent identification line-up is a forensic technique using the remarkable olfactory abilities of dogs to compare trace scents (TS) collected at crime scene with the body scents (BS) of suspects. The validity of this method relies on the hypothesis that the human scent is stable over time, as suspects are usually apprehended after the crime commission. In addition, the procedure requires the TS and the BS to be simultaneously presented to the dog, therefore the TS must be stored, awaiting the suspect’s BS collection. To our knowledge, the ability of dogs in matching time-lagged human scent collections has never been formally demonstrated and little is known about the effect of scent ageing on dogs’ identification performances. Aiming at filling these gaps, we used human scents differing, or not, in terms of collection time, and we subjected dogs to scent identification line-ups early or late after the scent collections. The experiments were carried out with comparisons of TS with BS and with comparisons of BS with BS. We found that a delay between scent collections decreased the dogs’ success rate in the former but not in the latter case and that scent ageing lowered the identification performances in both cases. Yet, the dogs’ success rate was above chance in all conditions. Taken together, our results provide strong support for the use of canines in the forensic analysis of human scent as they illustrate the stability of human scent over time and the capacity of dogs to succeed in such comparisons. |
| **15 Minutes** | Mark Gabriele | PBED Training Guideline: An interactive tool for up training | Since 2012, the Department of Homeland Security (DHS) Science and Technology Directorate (S&T) Person-Borne Explosive Detection (PBED) Canine Initiative has sponsored an effort to stand up several canine operation cadres with frontline practitioners to better understand the effectiveness of canines as they are trained to protect soft targets and crowded venues from explosive threats. DHS S&T has been assessing canines specifically trained for PBED to understand the strengths and limitations of this canine discipline. To date, hundreds of data points have been collected over more than 7 years during hundreds of individual assessment events involving federal, state, and local law enforcement partnering agencies. The Johns Hopkins Applied Physics Laboratory (APL) has developed a training guideline that incorporates the experience and lessons learned of DHS S&T’s law enforcement canine training partners since the inception of this program. This guideline is presented for the purpose of providing the national canine community with a resource that can support canine handlers and their trainers in the development of PBED canines. The resource is a HTML based interactive guideline that allows the user to read and review images, sketches, and videos in order to optimize implementation and retention for the handlers and to act a stand by reference for continued training.\***Submitted for consideration, sponsor approval required prior to release or publication** |
| **15 Minutes** | Mallory DeChant | Training with Varying Odor Concentrations: Implications for Odor Detection Thresholds in Canines | Detection dogs are required to detect trace quantities of substances, many times in the parts per billion or parts per trillion concentration range. Frequently, detection of trace quantities is not explicitly trained but rather assumed when dogs show proficiency at higher concentrations to which they are trained. The aim of this study was to evaluate the effect of the odor concentration of the training sample on the minimum concentration dogs will subsequently detect. We expected that dogs may not spontaneously generalize to trace odor concentration when trained with higher concentrations, but when trained to a range of lower concentrations, dogs will show superior detection to lower untrained concentrations. A total of 11 dogs were randomly assigned to 2 groups and were trained to alert to isoamyl acetate at 0.01% odor dilution (v/v with mineral oil) using a 3-alternative forced choice test. Once reaching proficiency, odor detection threshold was assessed using a 2-down 1-up descending staircase procedure. Next, experimental dogs received training with systematically lower concentrations of isoamyl acetate and threshold re-assessed. Control dogs were yoked to experimental dogs in terms of training time, but only received training to the 0.01% dilution between threshold assessments. Experimental dogs showed significantly improved detection thresholds, outperforming control dogs by detecting an average dilution about 100-fold lower. Results suggest that explicitly training for lower concentrations is critical for generalization for trace odor detection. |
| **15 Minutes** | Dr Claire Guest and Prof James Logan | Using trained dogs and organic semi-conducting sensors to identify asymptomatic and mild SARS-CoV-2 infections. | A rapid, accurate, non-invasive diagnostic screen is needed to identify people with SARS[1]CoV-2 infection. We investigated whether organic semi-conducting (OSC) sensors and trained dogs could distinguish between people infected with asymptomatic or mild symptoms, and uninfected individuals, and the impact of screening at ports-of-entry. Odour samples were collected from adults, and SARS-CoV-2 infection status confirmed using RT-PCR. OSC sensors captured the volatile organic compound (VOC) profile of odour samples. Trained dogs were tested in a double-blind trial to determine their ability to detect differences in VOCs between infected and uninfected individuals, with sensitivity and specificity as the primary outcome. Mathematical modelling was used to investigate the impact of bio-detection dogs for screening. 3,921 adults were enrolled in the study and odour samples collected from 1097 SARS-CoV-2 infected and 2031 uninfected individuals. OSC sensors were able to distinguish between SARS-CoV-2 infected individuals and uninfected, with sensitivity from 98% (95% CI 95-100) to 100% and specificity from 99% (95% CI 97-100) to 100%. Six dogs were able to distinguish between samples with sensitivity ranging from 82% (95% CI 76-87) to 94% (95% CI 89-98) and specificity ranging from 76% (95% CI 70-82) to 92% (95% CI 88-96). Mathematical modelling suggests that dog screening plus a confirmatory PCR test could detect up to 91% of SARS-CoV-2 infections, averting up to 2·2 times as much transmission compared to isolation of symptomatic individuals only. Our findings demonstrate that people infected with SARS-CoV-2, with asymptomatic or mild symptoms, have a distinct odour that can be identified by sensors and trained dogs with a high degree of accuracy. Odour-based diagnostics using dogs and/or sensors may prove a rapid and effective tool for screening large numbers of people. |
| **15 Minutes** | Kelvin J. Frank | The Detection of Volatile Organic Compounds released from Mass Storage Devices utilizing Headspace Solid-phase Microextraction and its Implications for Canine training | Canines have been well known for their odor detection capabilities of materials such as explosives, narcotics etc. In recent years, they have also been trained to successfully locate mass storage devices (MSDs) that may be contraband or contain forensic evidence. These devices may often be very small (e.g. secure digital (SD) cards), and therefore very difficult to find. A famous example was the home of former Subway spokesperson, Jared Fogle, where a canine detected a hidden universal serial bus (USB) drive containing incriminating pornographic material that was not previously found by investigators.These canines have now found regular use within law enforcement and correction facilities. However, the method of training these canines varies greatly, with limited scientific studies to validate these methods. Theories as to the target material to be used for canine training are numerous, from training on entire devices for detection, to training on only portions of the devices. There has also been anecdotal reports of the use of two compounds, 1-hydroxycyclohexylphenyl ketone (HPK) and triphenylphosphine oxide (TPPO) for training canines to locate MSDs.The volatile organic compounds (VOCs) that canines are alerting to in MSDs remain to be scientifically determined. This study utilized Headspace Solid-phase microextraction (HS-SPME) to analyze the VOCs of a wide variety of MSDs including cellular phones, hard drives, USB drives, SIM cards, SD cards and compact disks (CDs). Additionally, the validity of HPK and TPPO was also investigated. These results will aid the canine community in developing optimal training protocols for the detection of MSDs. |
| **15 Minutes** | Kenneth G. Furton | Preliminary Accuracy of COVID-19 odor detection by canines | The novel coronavirus SARS-CoV-2 has led to a worldwide pandemic. As with any outbreak, there is a general strategy of detection, containment, treatment and/or cure. This study explored and successfully demonstrated the use of canines to detect COVID-19 disease in exhaled breath from persons infected with SARS-Cov-2.Volatile organic compound (VOC) markers from exhaled breath of diseased patients have been widely reported as a means by which certain diseased states may be identified. Analytical instruments have been tested and shown promise for their use as effective screening tools. However, for the detection of breath VOCs, sensitivity limitations still exist with these instruments reporting sensitivity levels in the parts per billion (ppb) range. It has been reported that VOCs in human breath are released in concentrations of ppb to parts per trillion (ppt), in comparison to human blood and urine where VOCs are released in the parts per million (ppm) to ppb range. One method to combat this limitation has been the use of trained scent detection canines as research has shown odor detection capabilities in the ppt range.Using face masks obtained from hospitalized patients who tested positive for the COVID-19 disease, four canines were trained and evaluated for their ability to detect the disease. Masks from patients who tested negative for COVID-19 were also used to train canines to discriminate between breath VOCs from patients that were both positive and negative for COVID-19. All four canines obtained an accuracy above 90% validated with both double-blind trials and canine deployments. |

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|  | **POSTERS** |
| **5 Minutes** | Amritha Mallikarjun  | Canine olfactory detection of COVID-19 in sweat samples: Performance differences in lab and operational settings  | SARS-CoV-2 (COVID-19) is an easily transmissible virus that causes serious upper respiratory infections (Hu et al., 2020). COVID-19 is difficult to control, as some positive individuals, capable of transmitting the disease, can be asymptomatic. These individuals can potentially transmit the disease to higher-risk individuals (Hu et al., 2020). While COVID-19 vaccines are accessible to the public in some countries, including the U.S., some countries do not have readily available vaccine access. Additionally, some individuals are not ideal vaccine candidates (Yale Health, 2021). Thus, it remains critical to create noninvasive, inexpensive COVID-19 screening systems. Trained detection canines are one option for such a screening system. Canines have been shown to detect COVID-19 in urine, saliva, and sweat in laboratory settings (Essler et al., 2021; Granjean et al., 2021; Vesga et al., 2021). However, the ability of these dogs to work in operational settings to detect SARS-CoV-2 is crucial to the current public health effort. In this study we trained five dogs using sweat samples from worn t-shirts collected from a diverse population spanning age and race. The dogs varied in performance, with the top two dogs averaging an 88% sensitivity and 96% sensitivity over five double blind tests, while the three lowest performing dogs averaged a 44% sensitivity and 86% specificity. We are currently training these dogs to detect COVID-19-positive individuals outside the lab setting. We will assess the dogs’ performance in this operational setting and compare it to their lab performance, addressing whether lab performance is analogous to operational performance. |
| **5 Minutes** | Dakota Discepolo | An investigation on the efficacy of a novel canine-specific footbath technique vs standard wiping methods. | Research lacks for decontamination methodologies addressing areas of the canine at greatest exposure. The objective of this study was to evaluate oil-based contaminant reduction using dilute 2% chlorhexidine scrub (1:4 dilution) as a saturated wipe or a footbath. Ten canines (n=10) were recruited for this single day crossover study. An oil-based fluorescent marker was used as a surrogate for contamination, and topically applied to each of the four paws. Treatments were randomly assigned to each paw with each dog receiving each treatment. Wiping procedures utilized disposable, lint-free chlorhexidine saturated towels followed by a second wipe saturated only with water. The footbath method utilized dilute chlorhexidine scrub at a depth of 4” with immersion of the paws 30 seconds followed by two subsequent footbaths of only water to remove any soapy residue. The water only method assessed contaminant reduction via the use of a running garden hose used to spray the paw for 30 seconds. The fourth paw received no decontamination efforts and was used as a positive control. Three trained observers scored each decontamination effort for fluorescence reduction utilizing a previously published scoring method. Data were analyzed using Proc Freq Chi Square tests in SAS version 9.4. Significance was established at P < 0.05. Both the footbath and wipe methods were similarly effective ((P = 0.26) and both methods were significantly more effective than water only at contaminant removal (P < 0.0001). Decontamination efficacy may be improved via the use of a wiping method or a canine-specific footbath method. |
| **5 Minutes** | Joshua Bailey | An Investigation of Force Potential Against the Canine Neck Associated with Collar Use | Despite the potential for serious injury, pulling behavior in canines remains a common problem. The objective of this study was to measure force potential for collars as compared to harnesses when dogs were presented with common environmental stimuli. Client-owned companion dogs (n = 28) were recruited for participation in this crossover study. Dogs were grouped by size, fitted with a collar or harness and traversed a standardized circuit with three common environmental stimuli (unfamiliar dog, food, thrown toy) commonly encountered during a walk in the park. Variables of interest included: mean pulling force; peak force, and time spent pulling. Data were analyzed using PROC GLM Two-way ANOVA using (SAS Version 9.4) with significance set at P<0.05. Interestingly, although time spent pulling was similar (P > 0.05) for both harness and collar, dogs pulled with greater mean force (P = <0.0001) while wearing a harness as compared to a collar (6.12kg and 3.87kg, respectively). Furthermore, peak pulling force was also greater in the harness (20.25kg) as compared to the collar (16.6kg) (P = 0.03). It is also interesting to note that when peak pulling force was expressed as a % of body weight, the smallest group exerted the largest force (112 % BW) when compared to the larger groups (P = 0.03). Surprisingly, environmental stimuli were all equally enticing and did not differ in any measured response (P > 0.05). These data provide much needed data to develop guidelines and better educational materials for dog owners related to leash-pulling behaviors. |
| **5 Minutes** | Bridget Ringenwald,  | Assessing pet dogs’ ability to detect ovarian cancer in blood plasma after eleven weeks of training | Medical detection dogs can detect and signal the presence of diseases via volatile organic compounds (VOCs) in blood plasma (Murarka et al., 2019). Their skills are extremely valuable for the development of early detection tests for diseases. Medical detection dogs are often extremely expensive to train and there is a significant number that do not succeed in training. This study assessed whether pet dogs who had taken a scent detection class at the Penn Vet Working Dog Center could detect and alert on ovarian cancer in blood plasma samples after twelve weeks of training. Additionally, we are assessing what behavior characteristics of the dogs might contribute to their performance using the Impossible Task (Mendes et al., 2021) and behavioral surveys (Vas et al., 2007; McPeake et al., 2019). We predicted that the dogs who share similar behavioral qualities with working dogs would perform better than those who do not. Eleven pet dogs, who were previously trained on the scent detection wheel, volunteered to be a part of this study. Blood plasma samples were used from patients with normal, benign, and positive ovarian cancer blood plasma. The results thus far show a range in performance across dogs. One dog achieved 100% sensitivity on initial judgement of positive cancer samples over 3 sessions, while other dogs varied from 0 correct on initial judgement of positive samples to 60% sensitivity. Specificity ranged from 33% to 100%. Further research will assess whether the behavioral assessments correlate with dogs’ difference in performance on the wheel. |
| **5 Minutes** | Amanda Collins | Canine scent detection of sinonasal inverted papilloma (SNIP) in blood plasma and nasal secretions | Sinonasal inverted papillomas (SNIP) are rare growths found on the surfaces of the sinonasal tract. The tumors require surgical intervention and are typically not diagnosed until they have evolved to stages 3 or 4 (Lisan et al., 2016). Though these tumors are inherently benign, they are prone to malignant transformation and recurrence after resection (Re et al., 2017). The key to successful recovery after treatment lies in early diagnosis and intervention. This solution remains difficult to implement, however, without the identification of a biomarker that indicates the presence of malignant SNIP. This study is investigating the ability of four privately owned dogs—only one of which is an officially trained scent detection dog— to detect the presence of malignant SNIP in patients based on blood plasma samples. This approach to medical detection is currently being used to develop early diagnostic tools for other types of cancer, which suggests promising results for the outcome of this study (Moser et al., 2010). The double blinded testing phase will assess the dogs’ ability to generalize the target odor from blood plasma samples to nasal secretion samples and discriminate between malignant SNIP plasma and relevant controls. Current results suggest that there is variability in dogs’ ability to detect this odor and variability in odor detection strategy - one dog averaged a 90% sensitivity and 60% specificity over the past 2 weeks (4 sessions), while another dog averaged 50% sensitivity and 86% specificity. It remains to be seen how further training will affect their performance. |