SWGDOG SC7 – RESEARCH & TECHNOLOGY

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Statement of Purpose:
The mission of the SWGDOG Research and Technology subcommittee is to identify research and technological approaches, topics, and findings that are relevant to the detection canine and orthogonal detector (primarily instrumental detection) communities. This subcommittee is also charged with identifying areas in need of engagement by the scientific community and topics that should be the focus of the next generation of research efforts. The Research and Technology subcommittee serves as a clearinghouse for the available scientific literature regarding detector dogs and orthogonal detectors, making available a searchable database of up-to-date publications. It encourages research in areas where knowledge gaps exist regarding detection capabilities. In addition, this subcommittee utilizes the latest scientific information to make recommendations on best practices to other SWGDOG subcommittees. In the course of its work, this subcommittee will identify topics that need clarification or a newer, more scientific approach. Research on various topics is expected to focus on facilitating all aspects of detection work and increasing cost-effectiveness of the relevant programs. Additionally, this subcommittee will outline key research concerns and project areas with the intent of establishing potential collaborative relationships between researchers and operational personnel while identifying potential areas of funding.

1. RECOMMENDED RESEARCH

Below are recommended research topics based on feedback from the community and SWGDOG members and a review of the available literature. The following topics are proposed and rated for the desirability of research and potential funding allocation using the following criteria: CRITICAL (potential mission stoppage); ESSENTIAL (can still do the job but this would improve performance); ENHANCING (job can still be done but this is nice to have around) or DESIRABLE (wish list). *This four-point rating scale was added after the public comment period and thus SWGDOG is particularly interested in public comments on the proposed ratings as well as comments on additional areas to be included. Please submit comments at www.swgdog.org.*

1.1. Identification and quantification of target odorants**:** This area focuses on identifying chemicals available to canines from target materials under different environmental conditions and developing and critically evaluating surrogate continuation aids (also referred to as pseudos, simulants, calibrants, mimics) with similar physicochemical properties to real target materials.

    1.1.1. Identification of odorant chemicals present in and above targets (particularly human remains, explosives and drugs) including novel applications (chemical, microbes, etc.). ESSENTIAL

    1.1.2. Evaluation of changes in odorant(s) over time and in differing environmental conditions. ENHANCING

    1.1.3. Evaluation of changes in perception of the odor as a function of changes in concentration of the odorant(s). ENHANCING

1.1.4. Evaluation of optimal storage and handling practices (including containers) to prevent cross-contamination of training aids. ESSENTIAL

1.1.5. Development of methods for monitoring levels of contamination of training aids. Identify when training aids are contaminated, how long it takes to dissipate the contamination odor off the pure odor training aid. CRITICAL

1.1.6. Identification of odor chemicals in non target materials that can potentially trigger false alerts (particularly for drugs, explosives and human remains). ENHANCING

1.1.7. Evaluation of dissipation of odorant(s) after removal of targets. How soon can you reuse an area – time for dissipation/ decomposition of residual odors? ESSENTIAL

1.1.8. Develop a scientifically valid odor list for testing detector dogs (particularly explosives). CRITICAL

1.1.9. Development of reliable surrogate continuation aids (particularly for drugs, explosives and human remains). These must provide controlled delivery of chemicals to allow for an assessment of threshold variance, but not to be used for certification purposes (canine and possibly equipment calibration). This also pertains to emerging threats. CRITICAL

1.1.10. Effect of containment on odor availability. CRITICAL

1.2. Research on olfaction: Focused on laboratory research, either chemical or behavioral. For example, the question regarding the limitation of tracking would be better considered under "dog performance" and not under olfaction. (as supporting section 1.1)

1.2.1. Development of aids. ENHANCING

1.2.1.1. Identifying the optimal numbers, amounts and identities of target odors (particularly for explosives and human remains).

1.2.1.2. Test improved training aids/proficiency test delivering reliable controlled odor amounts (critical evaluation between training aids and real materials).

1.2.1.3. Develop and scientifically validate non-hazardous training materials. Minimize risks and provide reliable amounts of target odors.

1.2.1.4. Determine the ability to trap and release target odors for collection materials and develop "intelligent" materials that are odor specific.

1.2.2. Determination of thresholds. ENHANCING

1.2.3. Comparison of detectors. ESSENTIAL

1.2.3.1. Critical comparisons of capabilities of certified detector dogs and electronic noses to reliably detect target odors in the presence of interfering (distractor) odors.

1.2.3.2. Quantifying cost effectiveness of canine search teams over human searchers (with and without using instruments).

1.2.3.3. Comparison of standoff capabilities of canines and instrumentation.

1.2.3.4. Examination of complementary instrumentation for integration with operational deployment of canines.

1.2.3.5. Comparison of dogs to other biological detection entities.

1.2.4. Environmental, toxicological and medicinal alterations (decrease or increase) in

olfactory ability. ESSENTIAL

1.3. Research on Learning: This section will include actual experimentation on training methodologies, types of reinforcement, relationship between training and operations performance and questions on generalization and concept formation. The following topics are proposed:

1.3.1. Research on the effectiveness of training aids. Does extensive experience with the training aid help or hinder the later detection of the real odor? CRITICAL

1.3.2. What is the optimal way to utilize training aids? Start easy (i.e., most volatile) or start hard (i.e., least volatile). Start with mixture of odors ("cocktail" or "beef stew" approach) or with individual odors. ESSENTIAL

1.3.3. Masking effects and training to overcome them. ESSENTIAL

1.3.4. Memory for previously trained odors. DESIRABLE

1.3.5. Effects of extinction on olfactory search and detection. ESSENTIAL

1.3.6. Context effect. ENHANCING

1.3.7. Search images (history: define in more detail). ESSENTIAL

1.3.8. Generalization versus concept formation on the response to novel odors. ESSENTIAL

1.3.9. Effects of different types of reinforcement (positive or negative) on performance. ESSENTIAL

1.3.10. Effects of reinforcement schedules on performance. ESSENTIAL

1.3.11. Effects of odor quantity on detection. What is the difference in training on 10 g. of TNT versus 10000 g. of TNT and why? ESSENTIAL

1.3.12. Effects of additional cues on target detection (such as the odor of the human placing the target and the odor of newly dug holes). ESSENTIAL

1.4. Dog Performance: An important goal when training working dogs is to determine the performance envelope of the dogs so that there is a correct understanding of their capabilities and limitations. Only when we know how the dogs are presently working will we be able to determine the effectiveness of new manipulations. Basically, the goal is to obtain a clear understanding of how the current working dogs actually work and what variables affect their probability of detection. Some of the most important variables to be considered in this topic are:

1.4.1. Environmental variables. ENHANCING

1.4.1.1. Temperature, humidity, and barometric pressure.

1.4.1.2. Type of terrain and altitude.

1.4.1.3. Effects of wind and rain.

1.4.1.4. Effects of time since target was planted.

1.4.1.5. Effects of target micro-niche, buried, in trees, under water, in ice/snow etc. (With a focus on interactive effects.)

1.4.1.6. Characterization of structures of odor plumes.

1.4.2. Behavioral variables. ENHANCING

1.4.2.1. Maximum and optimal search times.

1.4.2.2. Effects of target density.

1.4.2.3. Effects of knowledge of the area being searched, previous experience in the same area.

1.4.3. Trainer/handler variables. ENHANCING
    1.4.3.1. Differences in dogs' performance when worked on-leash versus off-leash.
    1.4.3.2. Reinforcement history.
1.4.4. Physical and physiological function of the dog as related to performance. ESSENTIAL
1.4.5. Investigate the physiology of the canine olfactory system to gain insight into olfactory mechanisms. DESIRABLE

1.5. Selection, development, and early canine experience. This is a somewhat related collection of topics. The overall goal is to determine how to optimize the development of detector dogs. Suggested topics include:
1.5.1. Early olfactory experience and later detection of that odor. ENHANCING
1.5.2. Does environmental enrichment help prepare dogs for harsh and different environments? ENHANCING
1.5.3. Rearing in a kennel versus home environment - which is better? DESIRABLE
1.5.4. What is required during development to get a good working dog? ESSENTIAL
1.5.5. Developing and validating selection and assessment instruments. CRITICAL
1.5.6. Identifying genetic markers associated with success. ESSENTIAL
1.5.7. Identifying behavioral characteristics in young dogs that predict success or failure. ESSENTIAL
1.5.8. Investigate physiological and psychological impacts on breeding canines within a closed breeding colony. DESIRABLE

1.6. Veterinary issues.
1.6.1. Orthopedic problems. DESIRABLE
1.6.2. Breed problems, etc. DESIRABLE
1.6.3. Evaluation of transmitting thermometer to determine heat stress in dogs. One handler/supervisor can immediately see on a receiver the internal body temperature of all the dogs and determine if any are becoming hyperthermic or hypothermic. ENHANCING
1.6.4. Development and dissemination of emergency/field medical procedures for canines. DESIRABLE
1.6.5. Physical (nutritional) and environmental conditioning of canines. ENHANCING
1.6.6. Behavioral problems and management. ENHANCING
1.6.7. Physiological effects of environmental, toxicological and medicinal alterations (decrease/increase) in operational ability. ESSENTIAL
1.6.8. Effects of altitude and terrain (e.g., altitude sickness). CRITICAL
1.6.9. What light spectrum do dogs see in? What is the optimal light spectrum? ENHANCING
1.6.10. Hearing deficits in working dogs exposed to loud noises. Do they need hearing protection? ESSENTIAL

1.7. Human scent.
1.7.1. Determine the optimal materials and procedures for the collection and storage of

human scent. CRITICAL

1.7.2. Quantify the influence of environmental factors (particularly time) on human scent composition and detection (incorporate into optimal training protocols). ESSENTIAL

1.7.3. Evaluate which chemicals make human scent unique and the influence or correlation to state of health and genetic factors (MHC influence). ENHANCING

1.7.4. Evaluate which components of human scent dogs use to detect live humans. ENHANCING

1.7.5. Quantify the amount of human scent required for dogs to trail and to identify. ENHANCING

1.7.6. Conduct critical evaluations of the limitation of human scent dogs (aged trails, versus fresh trails, no scent article, large contamination). CRITICAL

1.7.7. Evaluate the difference between live and deceased human scent and the timing and chemicals characteristic of human remains. ENHANCING

1.7.8. Critically evaluate contamination issues. (If humans shed skin cells 24/7 from their entire bodies, for example, does a pair of gloves stop the human odor from transferring to the training aids?) CRITICAL (also included in the training aids section)

1.8. Technology

1.8.1. REST/RASCO (RASCARGO)/MEDDS/Alternative Remote Sampling, etc. (Remote Explosive Scent Tracing). Need independent scientific evaluations of the capabilities and limitations of the REST systems. ESSENTIAL

1.8.2. Canine body armor. ENHANCING

1.8.3. Mechanical devices used for the collection of scent. ESSENTIAL

1.8.4. Canine-mounted camera. ENHANCING

1.8.5. Use of GPS and other sensor data in forensic examination of canine performance. ENHANCING

1.8.6. Communication with canine through remote signaling device (e.g., audio, tactile vibration/pressure, etc.). ENHANCING

1.8.7. Use of bio-physiological sensors for detecting and correlating changes in dog physiology and behavior in the presence of specific environmental cues for the purpose of supporting canine training and operation. ESSENTIAL

1.8.8. Construction of domain ontology (terms, properties, and relations between them) from SWGDOG terminology, documents, and relevant scientific and technical literature and data in order to support the development of a knowledge base. A knowledge base is a specialized sort of database that can answer sophisticated sorts of queries and assist in analysis. ENHANCING

1.8.9. Use of digitized historical canine performance and other data (e.g., weather) in a knowledge-based expert system for making training and deployment recommendations supporting canine maintenance training and/or tactics. ENHANCING

1.8.10. Canine cooling systems and methods while the dog is operational. ESSENTIAL

1.9. Handler selection and training.

1.9.1.   Instructional technology. ENHANCING
1.9.2.   Determine the appropriate functional competencies - Knowledge, Skills and Abilities (KSA). ENHANCING

1.10. Optimal deployment considerations such as behavioral analysis, concealment techniques, and trends. ENHANCING

2. POTENTIAL FUNDING SOURCES

The table below lists some potential US funding agencies, websites, and the foci/interests of the agencies.

Agency	Website	Foci
NIJ	www.ojp.usdoj.gov/nij	State & Local Law Enforcement
TSWG	www.tswg.gov	Combating terrorism
DARPA	www.darpa.mil	Stealthy sensors
NIH	www.nih.gov	Basic science
HSARPA	http://www.hsarpasbir.com	Security/First responders
CBP	http://www.cbp.gov	Customs and border protection
ONR	http://www.onr.navy.mil	Warfare and combating terrorism
DHS/S&T	www.dhs.gov/scienceandtechnology	Technology to protect the homeland
NIST/OLES	www.nist.gov	Forensic investigations

Veterinary	American Kennel Club
Sources	The Morris Animal Foundation
	Waltham Foundation

Note: Annually send letter of critical and essential recommended research to appropriate agencies.

APPENDIX 7-1 - DATABASE OF PUBLISHED LITERATURE

Using a collect list of key words and topic areas, a detailed literature database has been constructed using Reference Manager® and is available on www.swgdog.org. The database includes reviewed journal articles, edited chapters and technical reports with explanation of how these reports may be requested. There will also be a selected list of books focusing on those with an underlying scientific basis and detailed references.