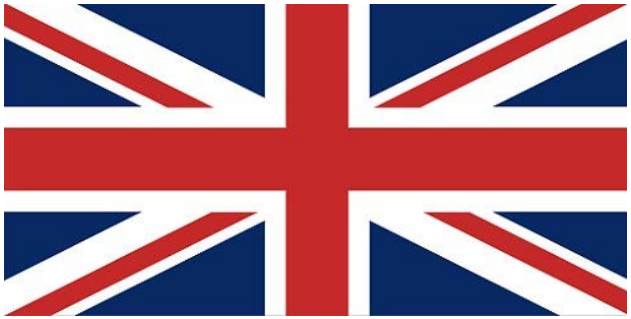
Vigilance of Detector Dogs in Repetitive Searches



Canine Performance Sciences

[dstl]

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AUBURN UNIVERSITY

Study Team

Sponsor

Defense Science and Technology Laboratory, [Dstl] U.K. Ministry of Defense

- Fay Porritt, Dstl (Program Manager & Principal Designer)
- Martin Shapiro, CA State Fresno
- Edward Mitchell & Terry Thompson, OxfordRisk, LTD
- Alex Kacelnik, Oxford University
- Paul Waggoner, Daniel Johnson, and Terry Fischer plus a cadre of 4 dog handlers, 2 observer/scorers, and 1 material handler at Auburn

Canine Performance Sciences

Vigilance of Detector Dogs in Repetitive Searches [Dstl]

Problem: Dogs deployed to conduct repetitive searches of sensitive locations in which use of explosive training aids forbidden

Canine Performance Sciences

Vigilance of Detector Dogs in Repetitive Searches [Dstl]

Because dogs are recognized as most capable tool for detection of explosives, they are deployed to protect most highly sensitive and high-value targets of terrorism

- Presence of explosives at many sites, even for canine training, is highly discouraged!
- Dilemma: Unlike detection instruments, the dog is a highly intelligent detection system, the behavior of which is very sensitive to the context in which it works

sensitive repetitive search work setting

typical off-site training & <u>evaluation setting</u>

- Although sensitive sites are particularly problematic, dogs' discrimination of work vs. training settings is more general problem in employment of detector dogs

***Gazit, I., Goldblatt, A., Terkell, J. (2005). The role of context-specificity in learning: The effects of training context on explosives detection in dogs. Anim. Cogn. 8. 143-150**

Vigilance of Detector Dogs in Repetitive Searches

Experiment

- 21 dogs trained on 3 explosives and 1 non-explosive, non-threat surrogate target split into 3, performance balanced, experimental groups of 7 dogs each
  - —GOLD encountered explosives in work setting
  - —SILVER encountered surrogate target – no Explosives
  - —COPPER encountered no targets in work setting
- Setting was closed elementary school divided into 3 separate search sections for each group
- Training setting performance – no difference in groups
- Work setting performance – how do groups differ?

Experimental Groups

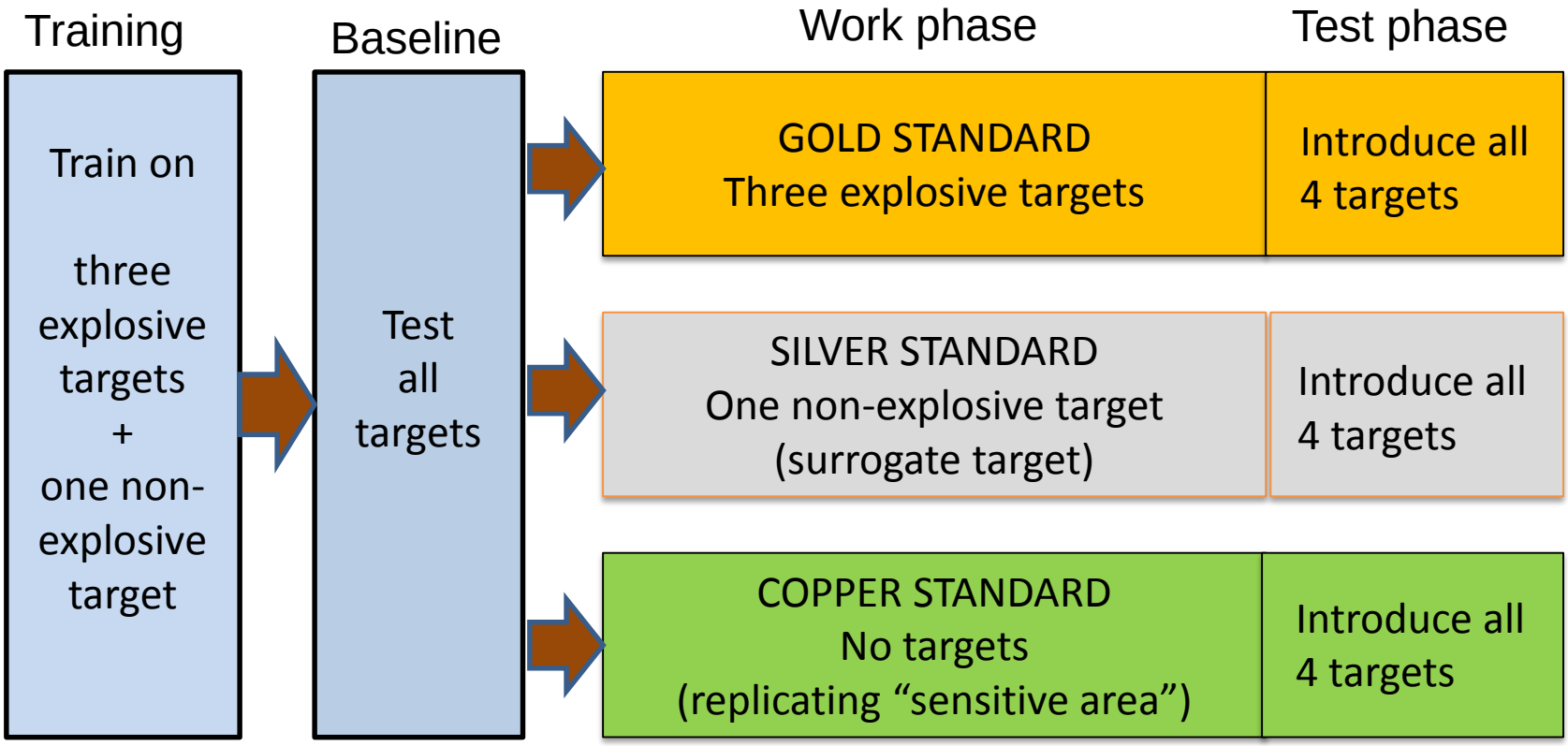
- **Gold Standard** (3 explosive targets in work setting)
  - 0-4 targets + non-targets to = 12 hides per search
  - Random mix of the 3 explosive targets

- Silver Standard (1 non-explosive target in work setting)
  - 0-4 targets + non-targets to = 12 hides per search
  - One non-explosive target only (surrogate training target)

- Copper Standard (0 targets in work setting)
  - Twelve non-targets per search
  - No trained targets (Copper never encounters target in work setting)

Vigilance of Detector Dogs in Repetitive Searches

Experimental Plan



All dogs trained on explosives: TNT, PE4, & AN

Each dog trained on one of three non-explosive targets: Vanillin, DMDNB, & PC

Aims of Study

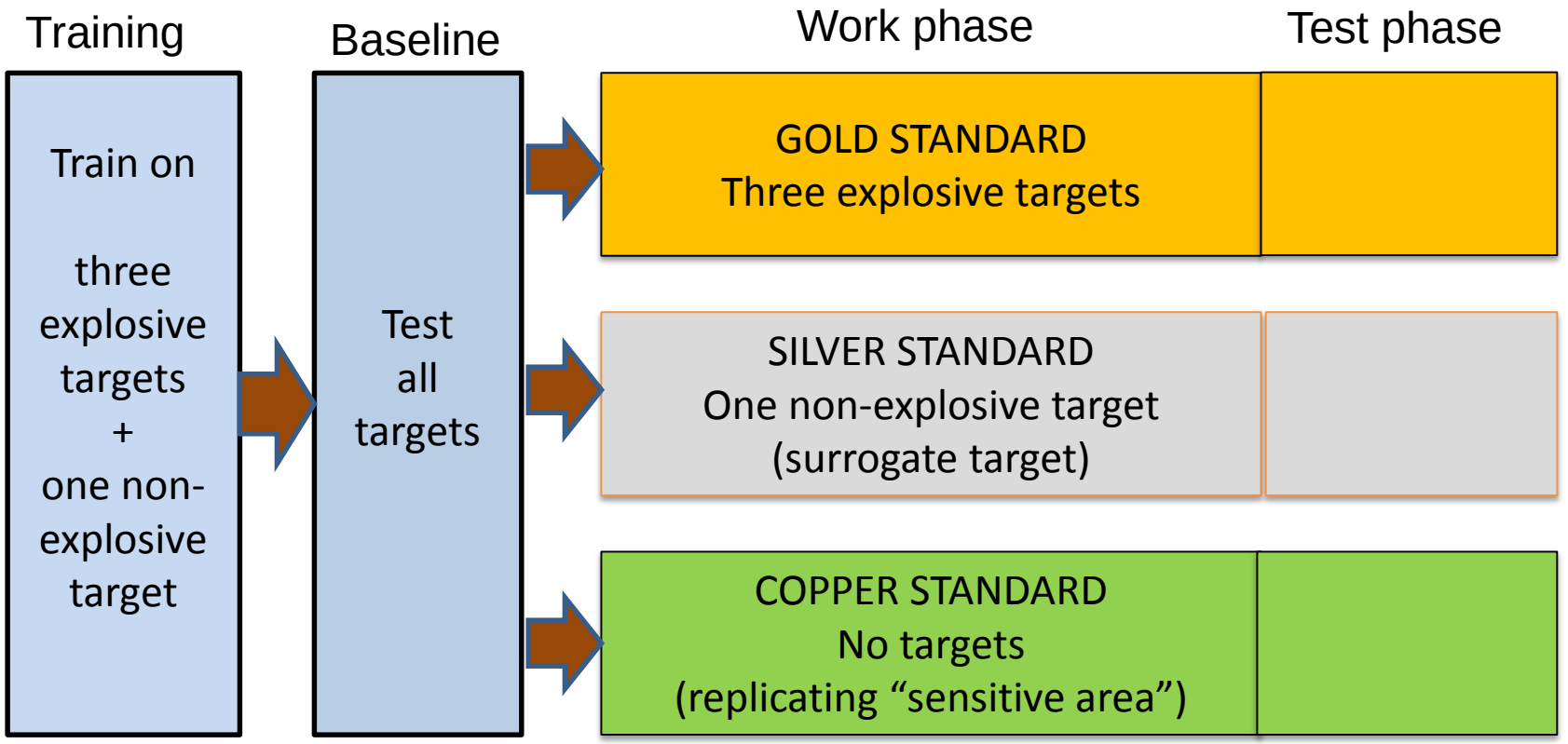
- Does performance decrease if actual explosive training aids are not used in operational search site?
  - If so, how quickly
  - Context dependent forgetting of odors or change in search vigilance?
- Can performance be maintained by training on 1 non-threat odor at operational site?
  - If so, does prolonged use affect detection of threat odors? ("backward blocking" – "learned inattention" / "search image" all suggest possible ineffectiveness)
- Full-scale replication of operational setting for ecological validity & user community acceptance

Work Phase

- All dogs search their area once or twice per weekday for 6.5 weeks
  - Four rooms per search - approximately 20 minutes
  - Searched each room off-lead than on-lead
- All searches contained 12 “hides” of different target and non-target (distractor) odors
- Material handler placed all hides - handlers blind
- Observer/scorers recorded dog responses and “visits” to “vigilance points”.
- Sampling of trials observed by both observers for measure of inter-observer agreement

Vigilance of Detector Dogs in Repetitive Searches

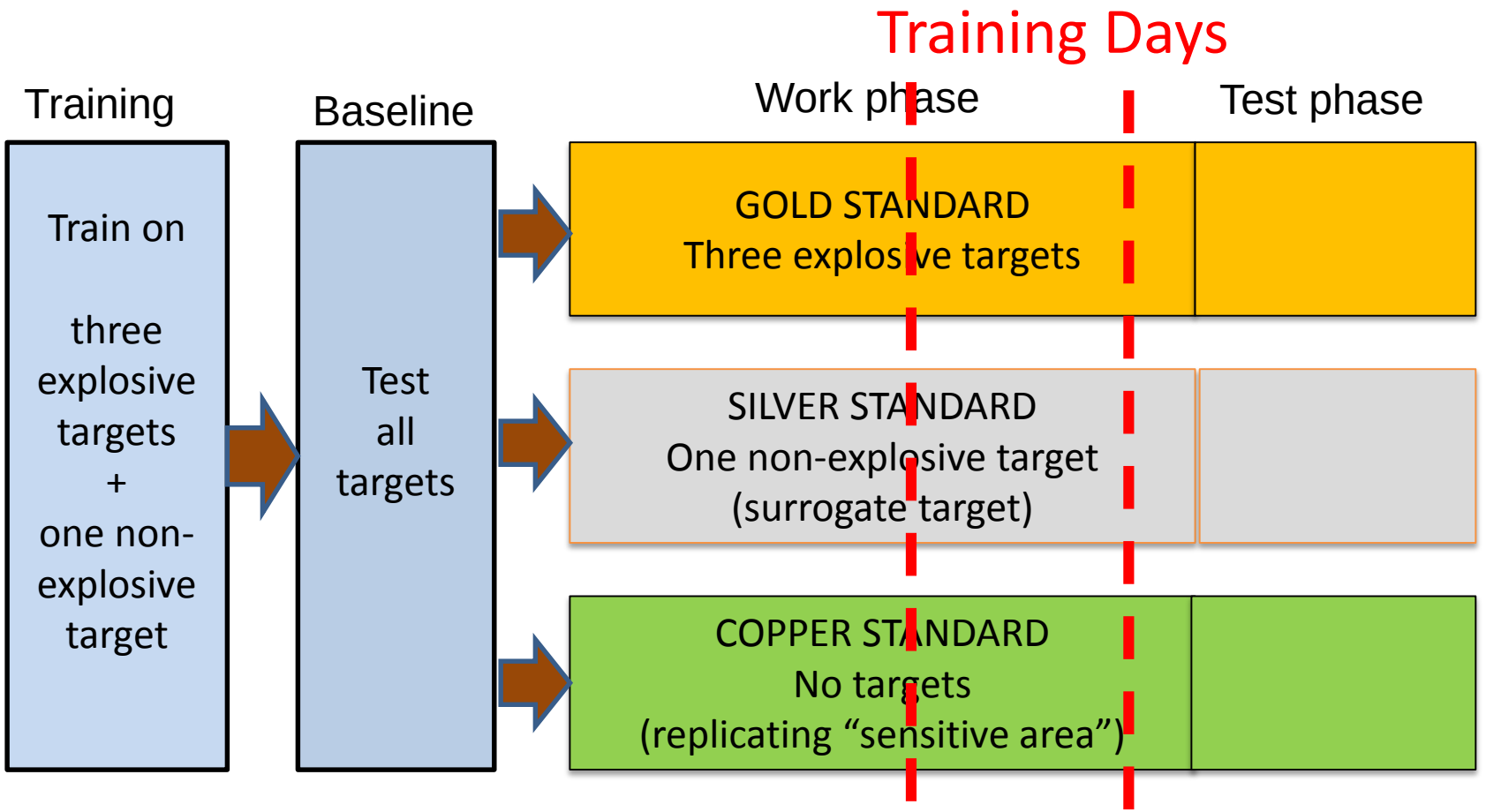
Experimental Outline



Training Days during Work Phase

- Dogs given two training days throughout work phase back in original training location at week 3 and week 6
  - This simulates fairly common practice for maintenance training of detector dogs
- Dogs receive training on all 4 targets (3 explosive and 1 non-explosive surrogate training aid)
- Odor recognition test followed by building search
  - Area for recognition test and building used for original training, so dogs familiar with finding targets in these settings
  - Allowed for testing odor memory separate from search performance

Vigilance of Detector Dogs in Repetitive Searches



Test Phase

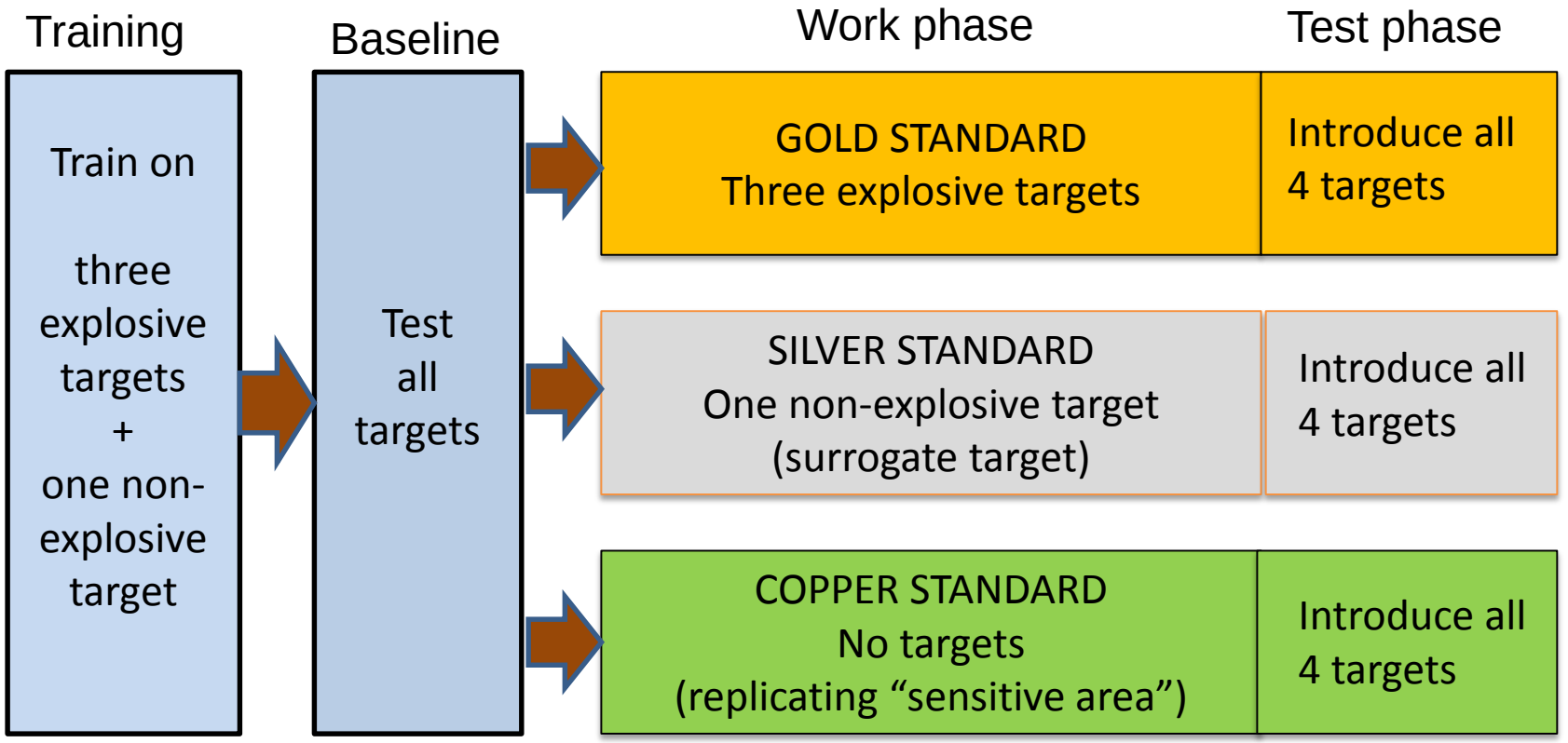
- Following 6.5 weeks of searching work area, test phase within that work area began
  - Handlers unaware of change in phase (at least initially)

- All dogs in all groups encountered trained targets in work setting
  - 0-4 targets + non-targets = 12 hides per search
  - Test duration 2.5 weeks

Analysis

- Average detection rate for each group for each 3 consecutive searches
- Measurement of search vigilance
- Repeated measures ANOVA on work and test phase data

Vigilance of Detector Dogs in Repetitive Searches



Results Overview

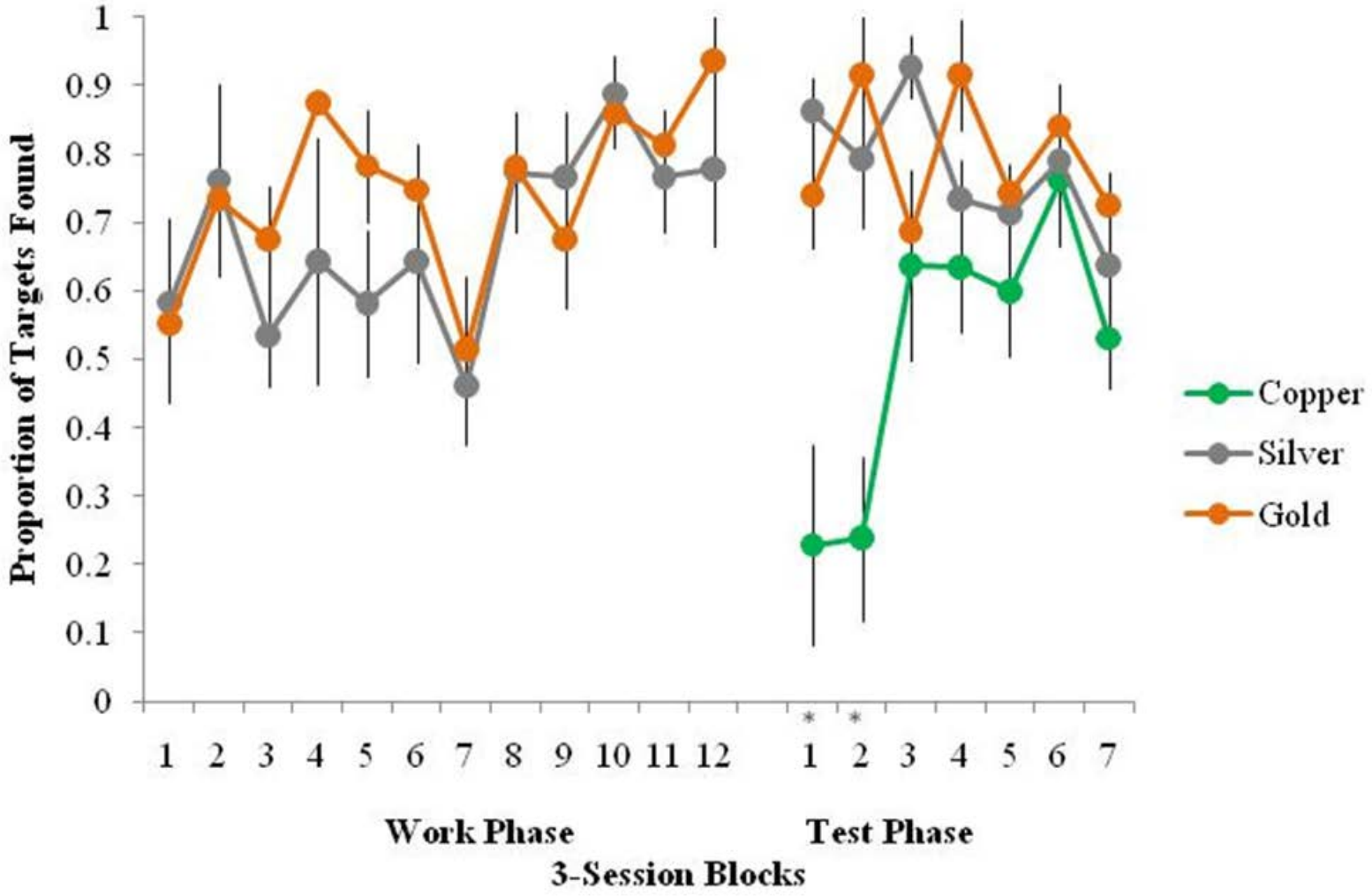
- Baseline and training session detection rates outside of repetitive search work setting same across groups

Detection Performance Testing in Work Setting:

- Detection rates of groups that encountered target(s) in work setting steadily improved and remained unchanged during testing
- Explosives detection rate during testing of group that only encountered surrogate target in work period equal to that of group that encountered explosives during work period
- Detection rate of group with **no** targets in work setting was substantially lower than that of other 2 groups during testing

Vigilance of Detector Dogs in Repetitive Searches

Detection Rates



Conclusion

Dogs searching same location with no training targets: Copper

- Had significantly reduced vigilance after just 3 searches
- Significantly reduced detection rate when targets re-introduced after 6.5 weeks (23% detection)

Dogs given opportunity to indicate on a non-explosive target in the operational search venue: Silver

- Maintained high detection rate on the explosive targets that they had not encountered in the operational search venue equal to Gold Group which had encountered explosive targets

Vigilance

We also recorded a measure of "vigilance" of searching in work setting for all dogs. How well dogs searched areas.

- The vigilance of groups that encountered the explosive targets or the single surrogate target was high & stable
- No difference in vigilance of Explosive and Surrogate Target groups
- Group without any targets showed decline in vigilance across time in work setting but began to recover during test phase when explosive targets re-introduced
- Vigilance was significantly correlated with detection rate

(repeated measures ANOVA & pair wise analysis)

Odor Memory

- All 3 groups had similar detection rates in baseline tests and in training sessions outside the "repetitive search" work setting up to 1 week prior to testing.
- Performance decline of group that encountered no targets in repetitive work setting was **not** due to "forgetting" target odors or loss of alert response repertoire
- Project suggested many questions about odor memory that would be useful to examine

F. Porritt, M. Shapiro, P. Waggoner, E. Mitchell, T. Thomson, S. Nicklin, & A. Kacelnik (2015). *Performance decline by search dogs in repetitive tasks, and mitigation strategies.* Applied Animal Behavior Science 166 pp. 112-122

Conclusion

Dogs remember odors, but searching and alerting to them is context and economy dependent; thus, emphasis on them training regularly on all targets is less important than maintaining search performance in work setting

- *Surrogate non-explosive co-trained targets have utility where live (explosive) targets can not be used*
- *Need to maintain the dog's expectation of target presence*

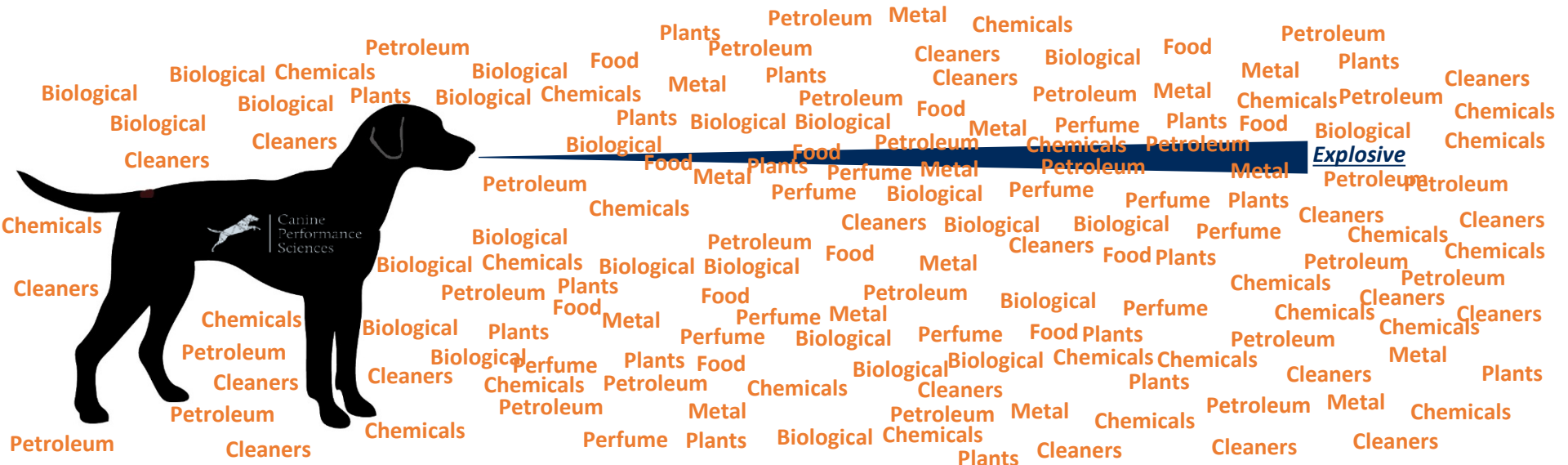
The trained detection dog is a mobile sensing technology that exceeds the capability of any operational instrumental device for detection of threats – We need to better understand its behavior and underlying cognitive processing of information to take full advantage of this capability

Understanding Odor Memory: A multi tier problem

[dstl] + DEPARTMENT OF THE NAVY ONR Science & Technology → Canine Performance Sciences

- **Dstl & ONR have engaged Auburn to examine characteristics of odor memory in dogs as follow-up to vigilance study**
- **3 Experiments, 27 detector dog subjects, 10,000+ detection observations**
  - **Maintaining performance with single surrogate target across 12 months**
  - **Effects of training on increasing numbers of targets on detection performance**
  - **Long-term odor memory**

Thousands of odors in the air, dogs must use olfactory navigation and **odor memory** to locate and respond to the threat



Odor Memory: Projected Project Outcome

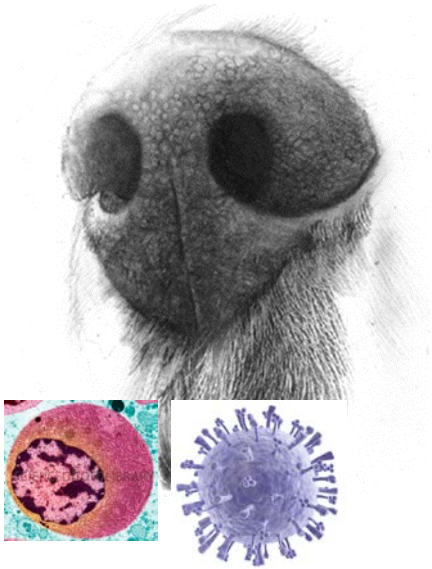
Project Objective: To understand better how dogs remember odors, how long dogs commit those odors to memory, and how learning many odors affects detection performance

- **National Security**: Double or Triple the number of threats dogs can detect
- **Finance:** Decrease the maintenance cost by extending odor refreshment periods
- **Logistics:** Decrease time and work to maintain canines on multiple threats
- **Policies and Procedures**: Not currently validated by science: Enhance detection technology through science

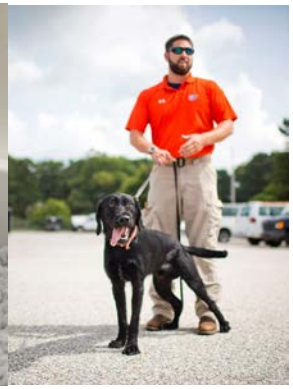
Canine Performance Sciences

CPS Mission

To innovate canine detection technology by exploring basic and applied research frontiers in olfaction, behavior, genetics and physical performance



Cancer & Virus Detection



Detector Dog Production Science & Technology

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Thank You

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COLLEGE OF VETERINARY MEDICINE

The War Dog Memorial, sits in front of Auburn University's College of Veterinary Medicine