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CANINE
OLFACTION LAB

The Critical Role of Research for the Enhancement of Detection Dog Performance

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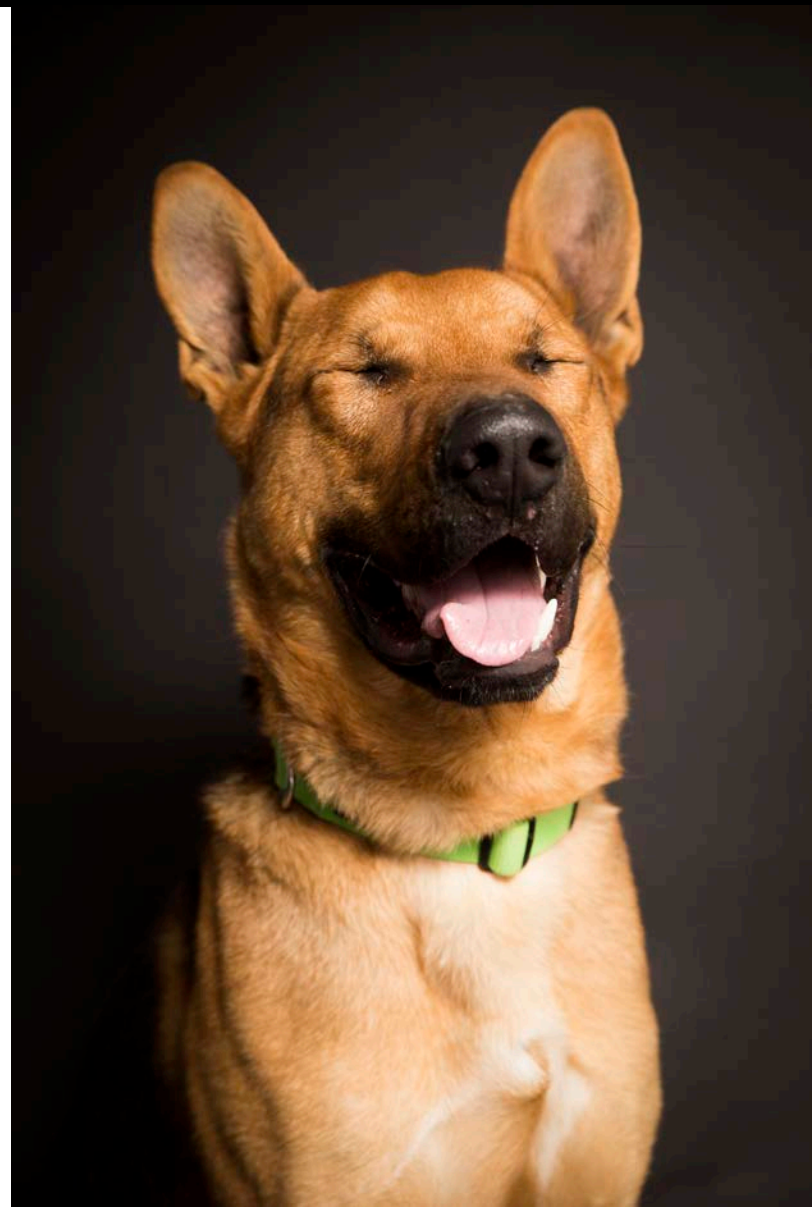
Today's Aims

- Describe a tiered-research model for detection dogs
- Importance of encouraging new ideas
- Importance of testing and confirming/challenging old ideas



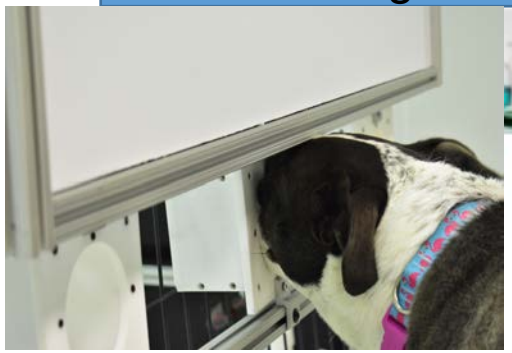
Borrowing from the Medical Model

There are 3 main types of research

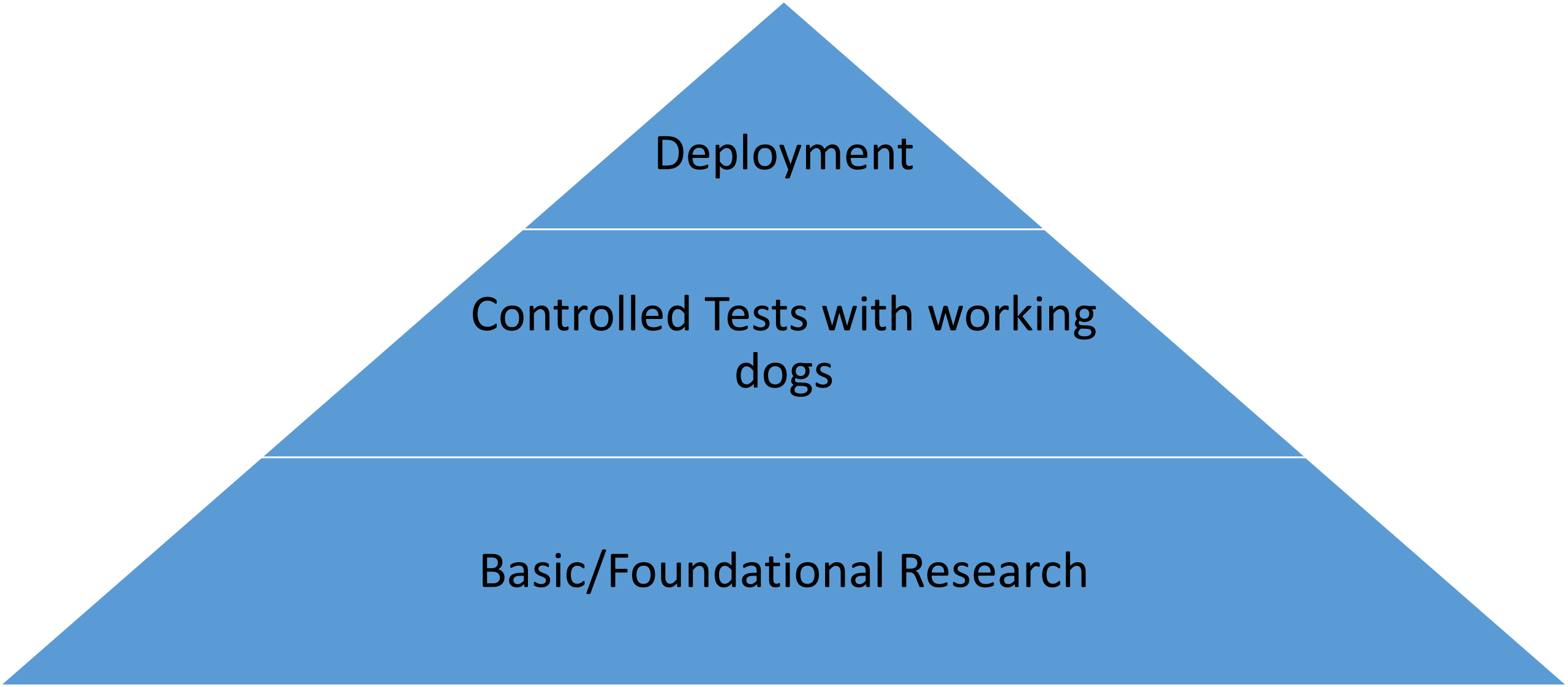
- Limits of Detection
- Process odor mixtures
- Odor navigation

Does this apply to working dogs?

Does this work in large scale working dog operations?



Tiered-Research Model



Characteristics of each

- Level 1: Basic Research
  - New ideas
  - Creative
  - Challenges convention
  - Fails fast and cheap
  - Tightly controlled laboratory tests with definitive tests of hypotheses
- Level 2: Controlled Test with Working Dogs
  - Does the basic finding apply in controlled working dog settings?
  - Basic research reduces the risk of a failure
- Level 3: Deployment
  - Does it work in the real world?
  - Level 1 and 2 demonstrate it can work and reduces risk of an expensive failure

Why?

- Mechanism for cheap and fast tests of radical ideas and challenges to conventional wisdom
- Limits risk of failure with needed working dogs
- Limits the effects of noise in working dog environments

Case Study #1

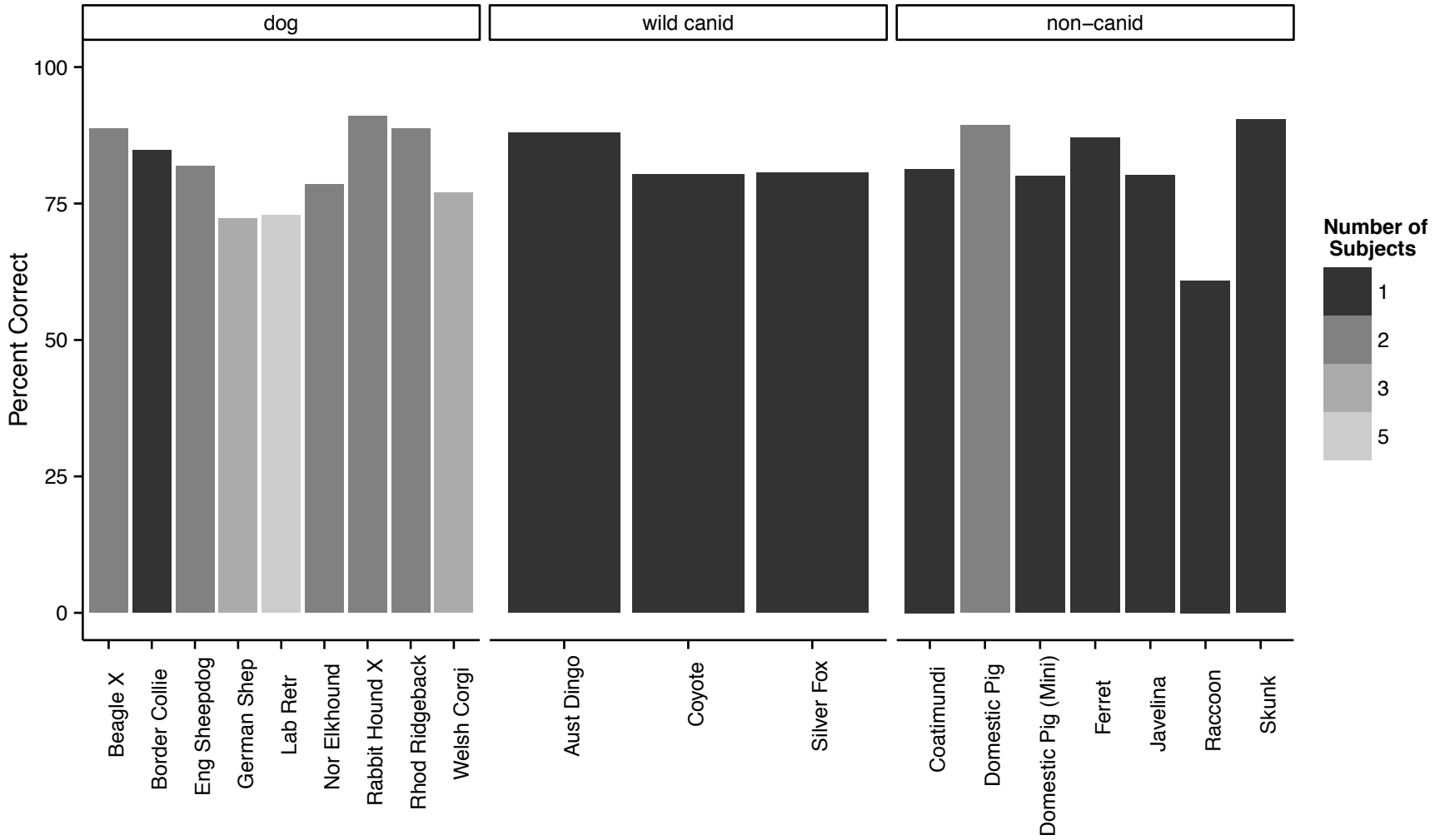
The 10 dog breeds with the best sense of smell

Monday November 18th, 2013

Do some dog breeds have better noses and scent discrimination than others?

Some dog breeds have considerably more sensitive noses than others.

Published on January 15, 2011 by Stanley Coren, Ph.D., F.R.S.C. in Canine Corner



In Hall et al., 2016; re-plotted from Southwest Research Institute 1974

Breed differences in canine olfaction

Behavioral Research

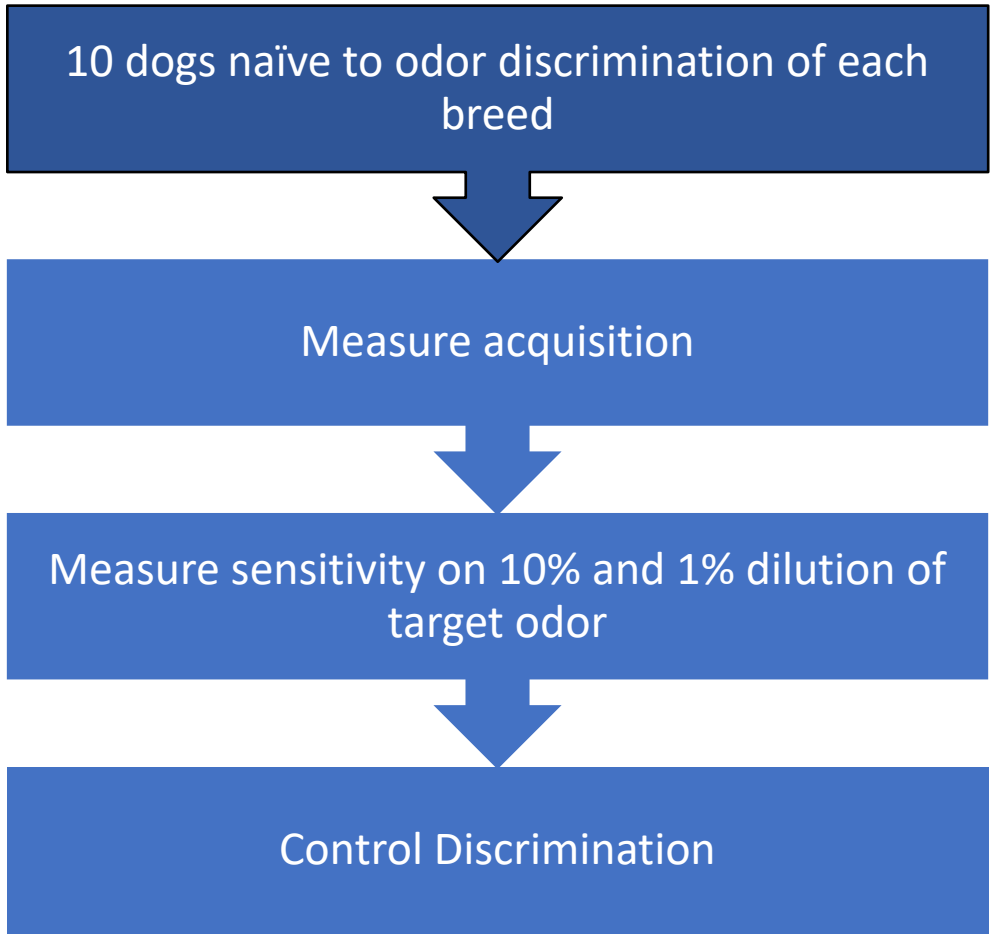
- **Surveys from dog handlers** (Rooney and Bradshaw, 2004; Adamkiewicz et al., 2013)

- **Recent assessment of many working dogs of various breeds** (Jezierski et al., 2014)
  - GSD>Labs & Terriers

Question: Are there Important Breed Differences?

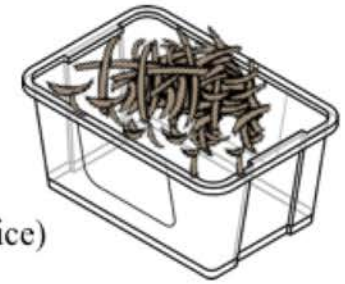
Versus

Design


10 dogs naïve to odor discrimination of each breed
Measure acquisition
Measure sensitivity on 10% and 1% dilution of target odor
Control Discrimination

Observer #2

Anise (correct choice)



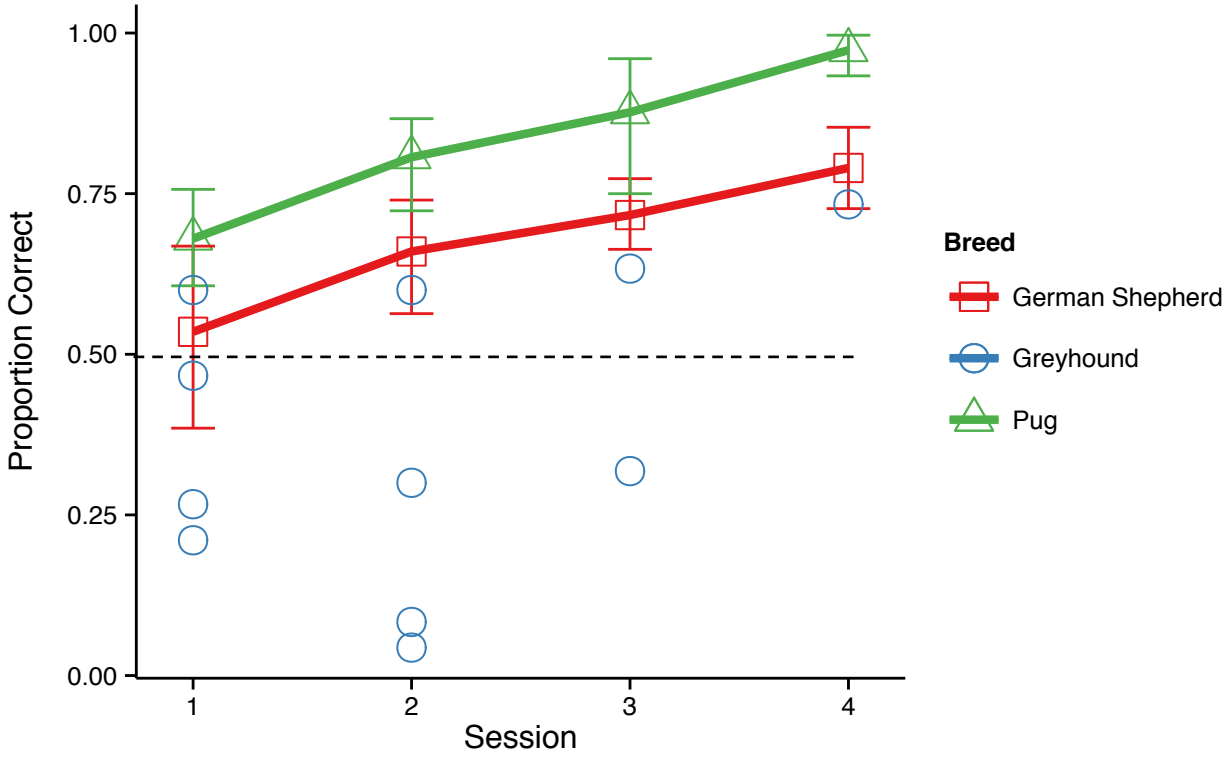
Unscented (incorrect choice)

Observer #1

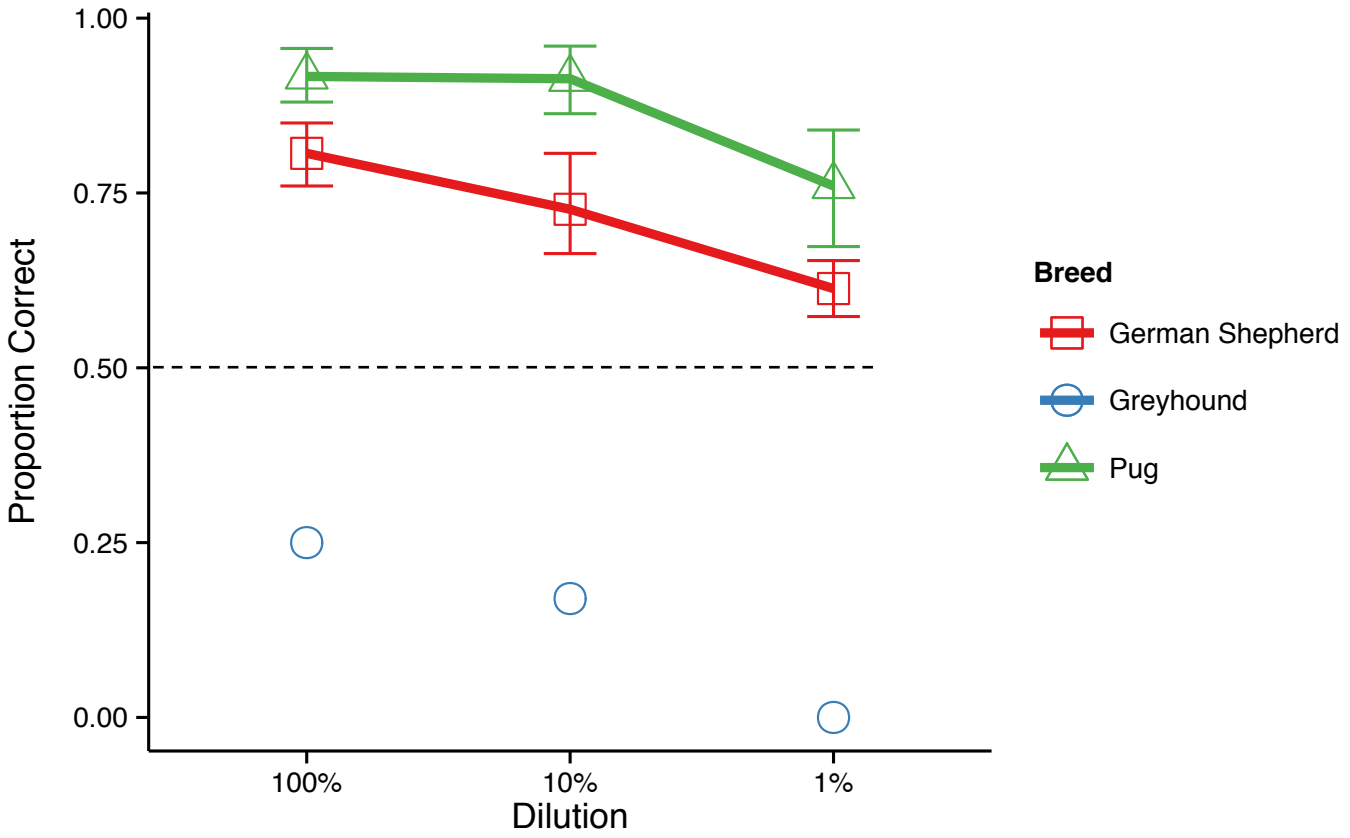
Procedures

- Acquisition:
  - Standard two-choice training procedure for 4 sessions
- Dilutions:
  - Trials with the diluted and training strength odors were interspersed across two sessions
- Control discrimination:
  - Simple visual discrimination (14 cm cup vs. 4 cm cup)
  - 4 blocks of 20 trials

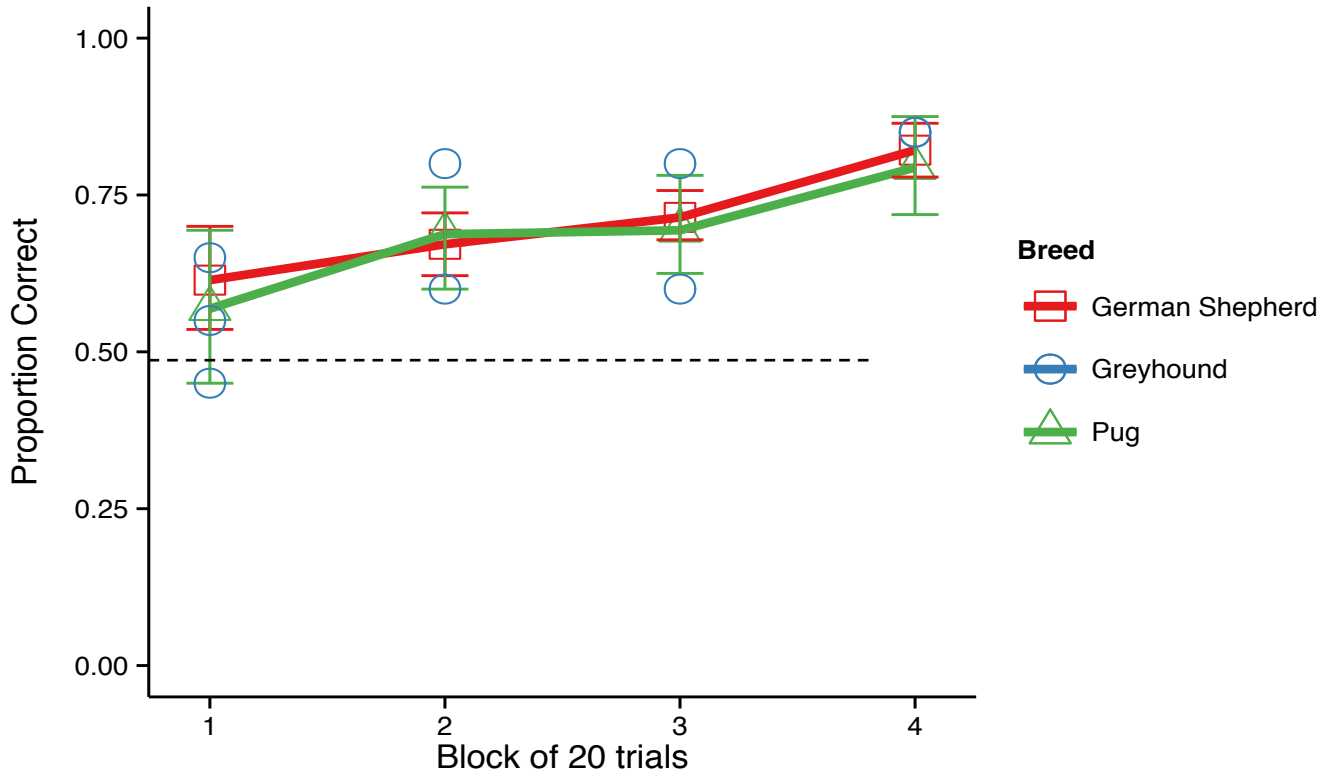
Acquisition



Dilution


1.00
0.75
0.50
0.25
0.00
Proportion Correct
100%
10%
1%
Dilution
Breed
German Shepherd
Greyhound
Pug

Visual Control



Conclusion

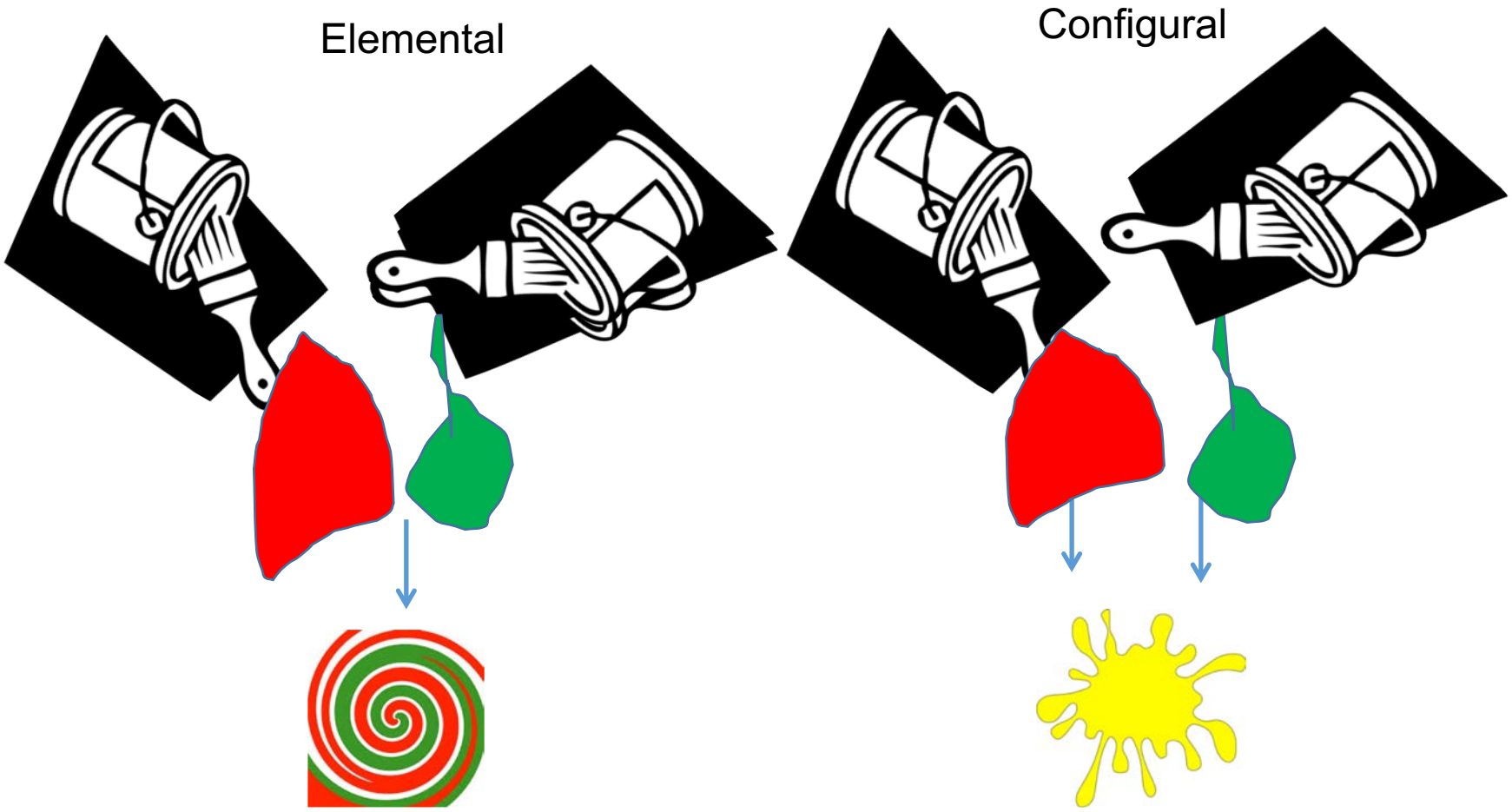
- Pugs outperformed German Shepherds
  - Breed assumptions regarding olfaction are largely untested
- Greyhounds didn’t work for food

Tiered-model approach

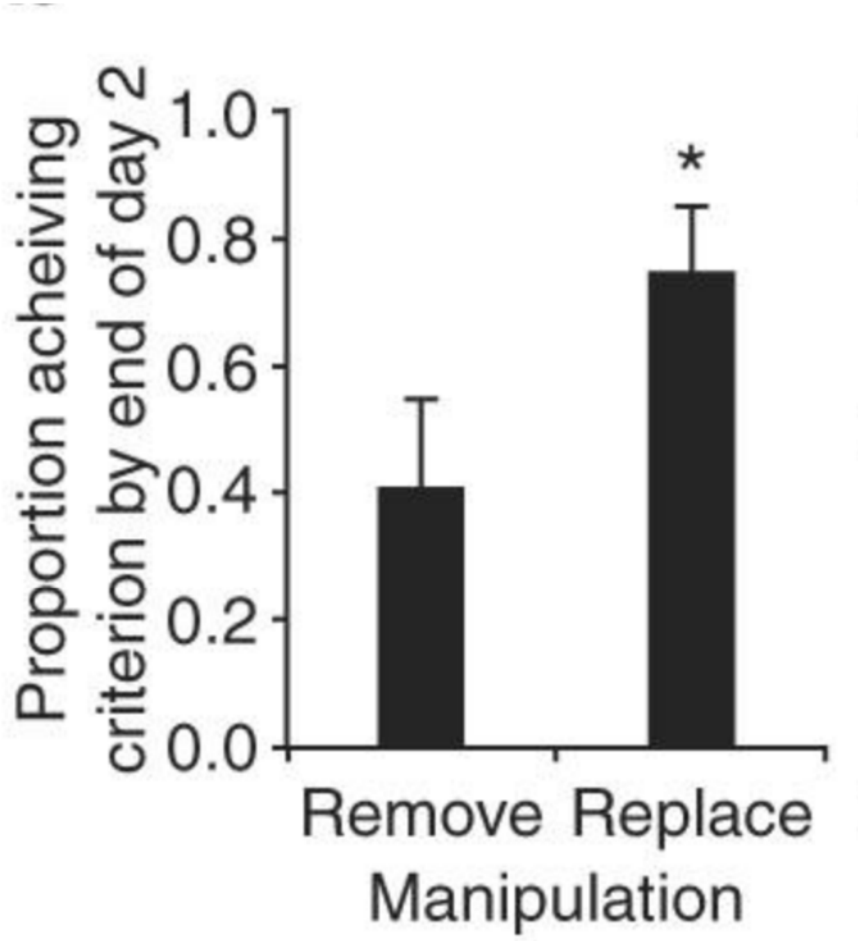
- Level 1-> Are there performance differences, and can we identify mechanisms of these differences?
- Level 2 -> Can working dogs be selected for enhanced detection performance?
- Level 3 -> Can a quick screening for detection performance be done before purchasing working dogs?

Case Study # 2
Processing Odor Mixtures

Odor processing



Filling in missing pieces



Barnes et al. Nat Neurosci. 2008 Dec; 11(12): 1378–1380.

Background

- Humans quite poor at identifying individual odors in mixtures (Laing & Francis, 1989)

- Important for animals to categorize target and non-target odors and also have perceptual consistency across irrelevant variations

Generalization in dogs

- Dogs trained on one form of AN do not readily generalize to other forms (Lazarowski et al., 2015)

- Dogs trained on pure chlorates do not generalize to chlorate mixtures unless trained on the mixtures (Lazarowski and Dorman, 2014)

Background

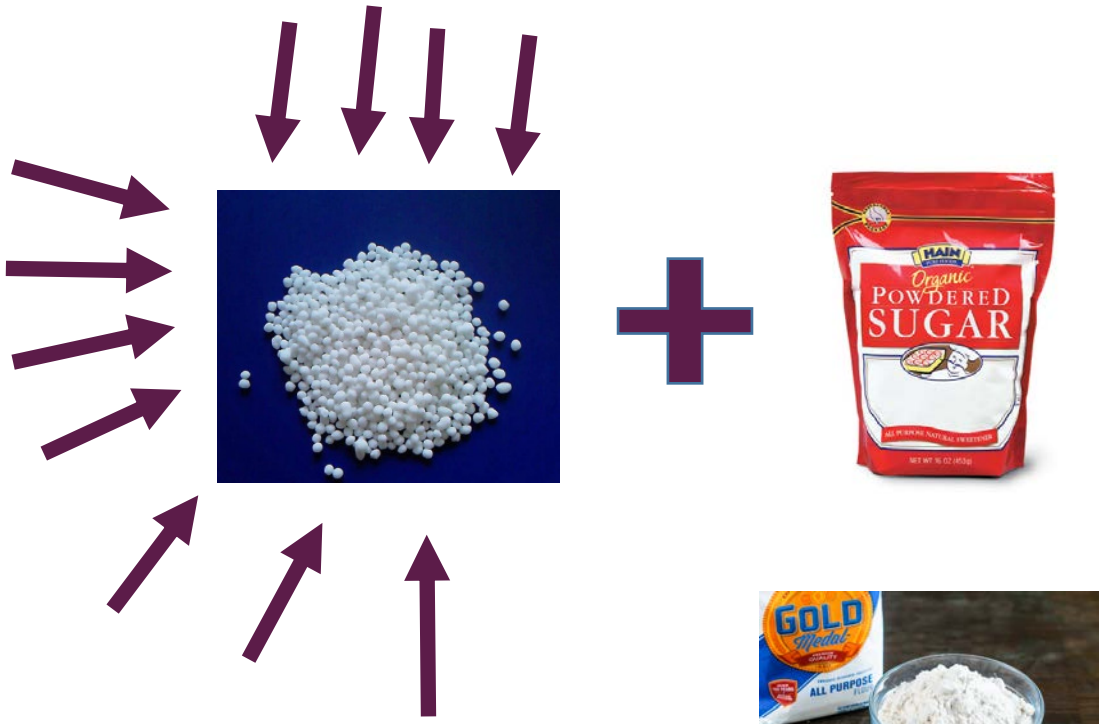
- HME’s can have highly variable odor profiles

Background

- HME’s can have highly variable odor profiles

Background

- What is the best method to focus the dog on a specific odor component?



- Method 1: Target only Training

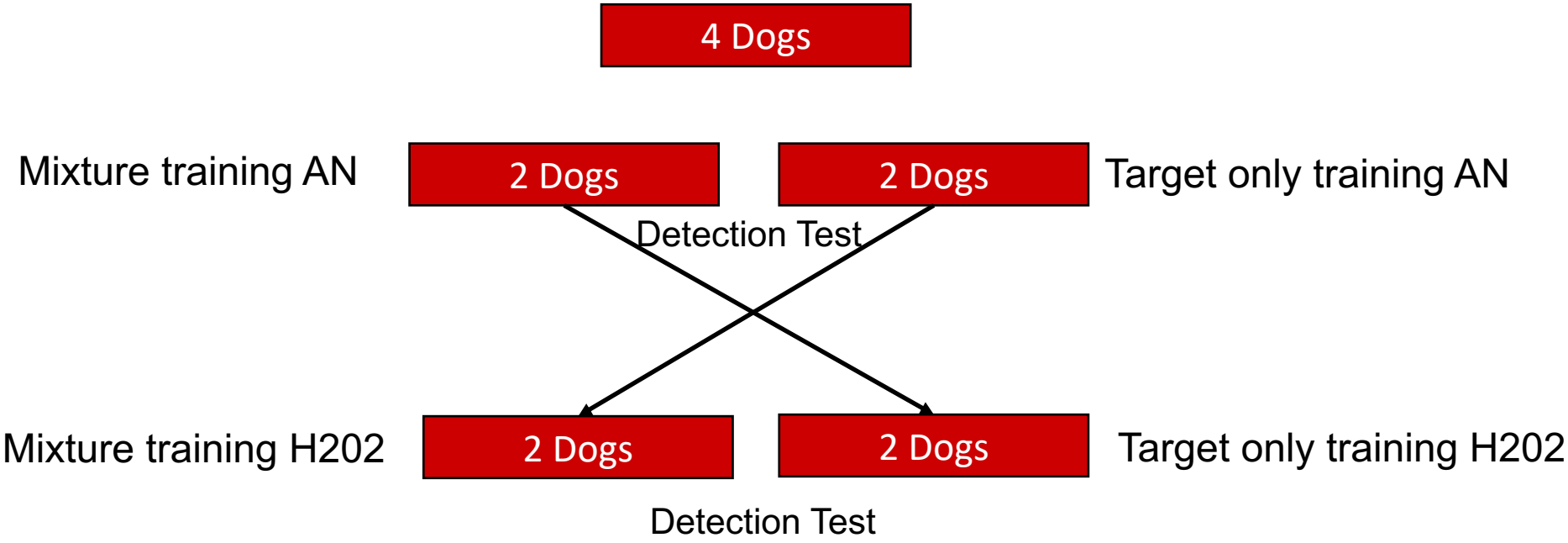
- Method 1: Target Only Training

Versus

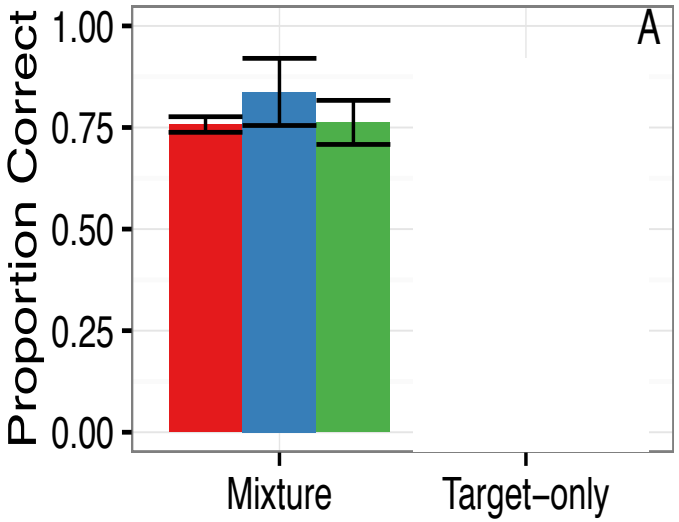
- Method 2: Mixture Training

Versus

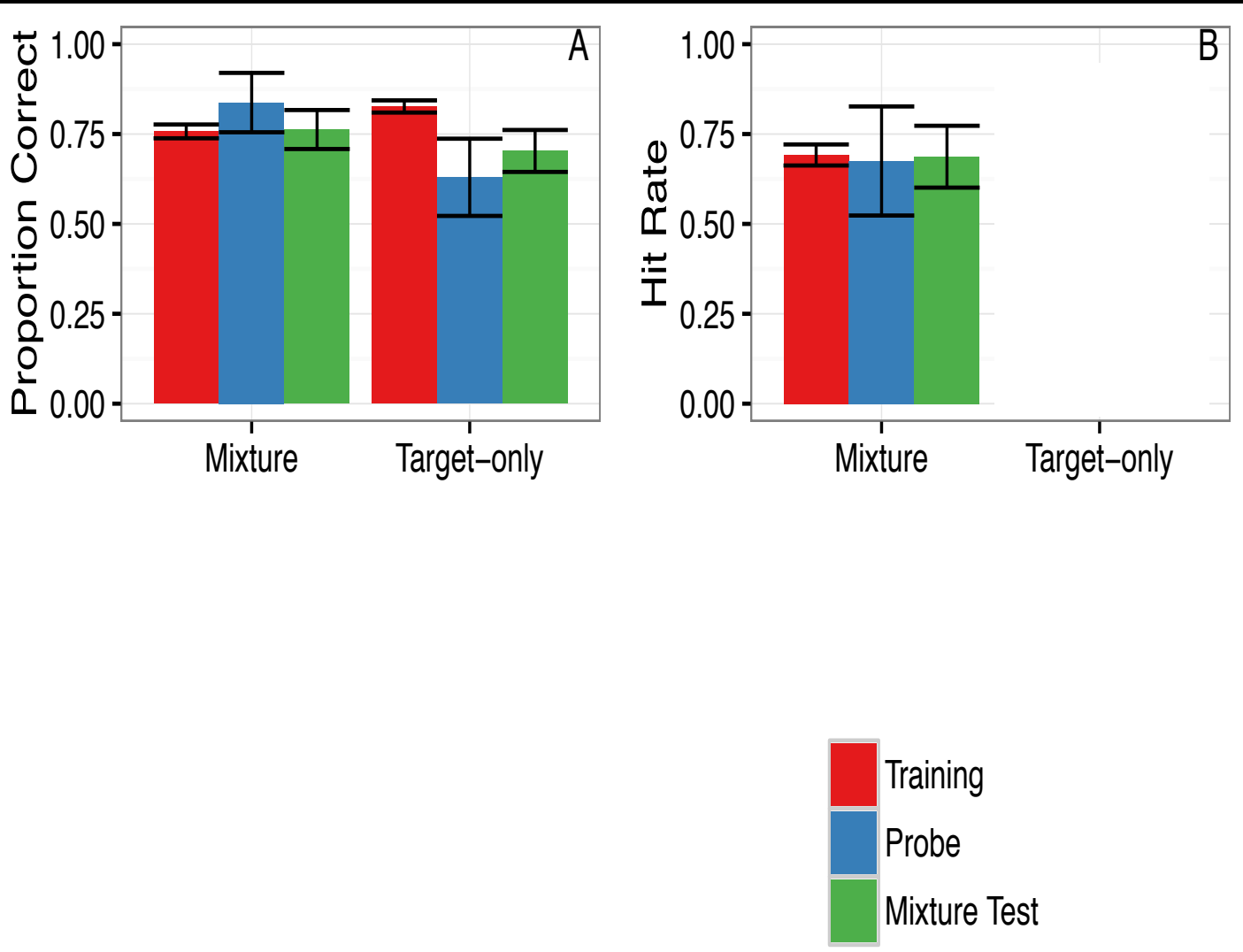
Method



Mixture Test Trials: Mixture with and without target of familiar components
Probes: Included unfamiliar distractors


A
Proportion Correct
1.00
0.75
0.50
0.25
0.00
Mixture
Target−only

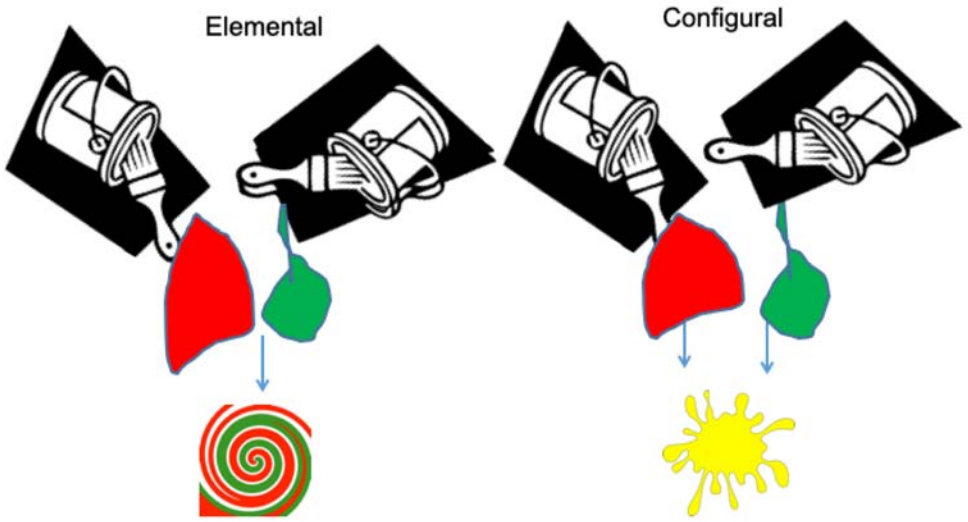

Training
Probe
Mixture Test



Hall et al., 2018

Complex Odor Processing

- Dogs, like rodents and humans
  - Configural processing is likely
- Unless you train them to specifically identify the addition or absence of a target component
  - Training with mixtures is critical for this



Tiered-model approach

- Level 1-> identify parameters needed for generalization and optimize training
- Level 2 -> does this enhance working dog performance compared to standard practice
- Level 3 -> Can this training be deployed to a large facility with community acceptance and improved performance?

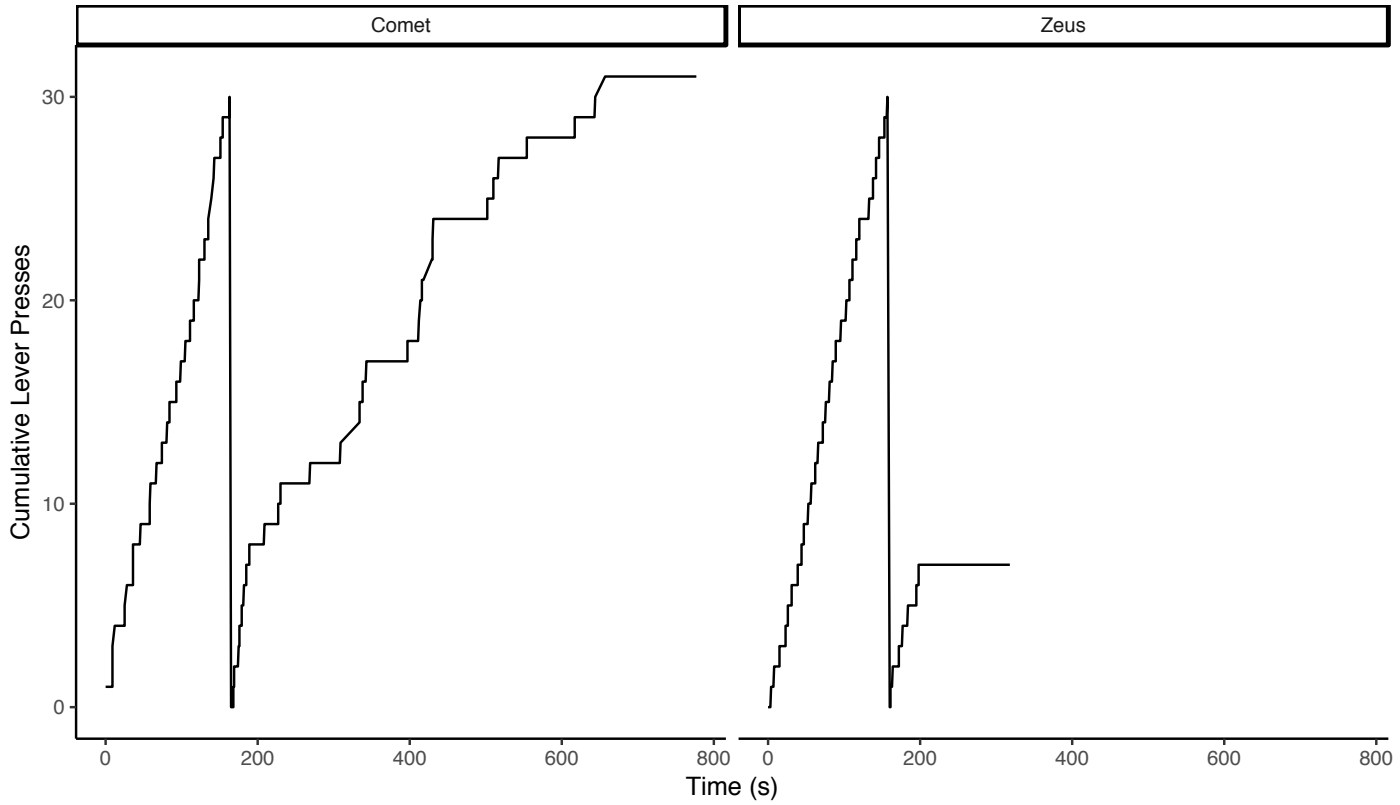
Case Study # 3

Behavioral Persistence and Detection Learning

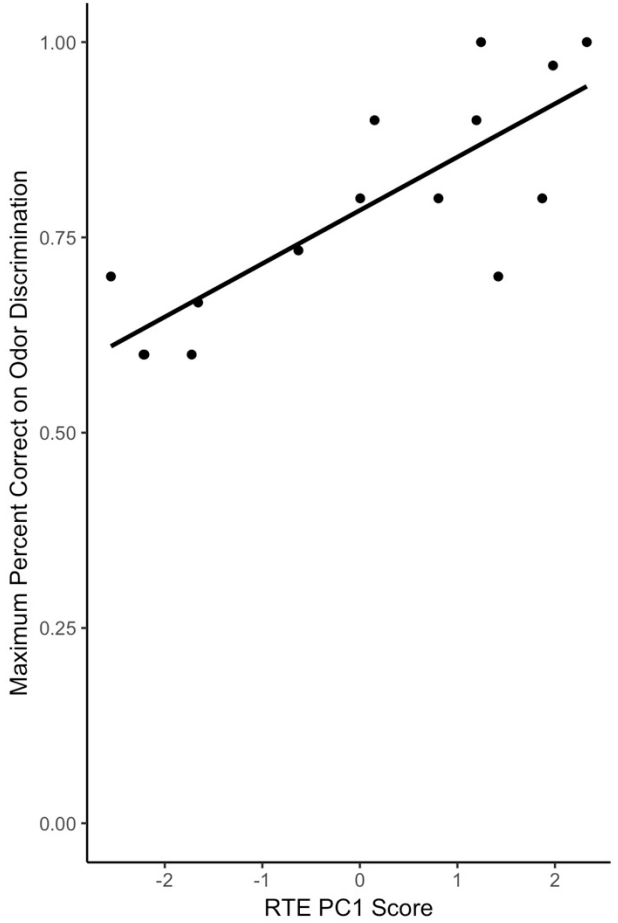
Persistence

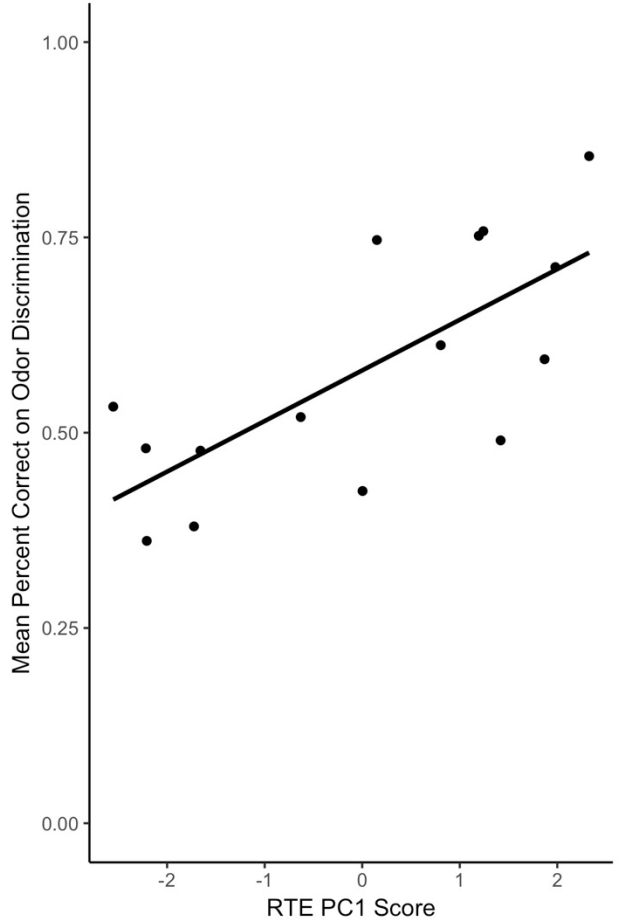
- Behavioral Persistence is associated with: stereotypic behavior and behavioral inflexibility
- Behavioral Persistence may predict working dog aptitude
  - High levels of persistence associated with behavioral inflexibility and difficulty learning under changing contingencies
- Simple measure of persistence is resistance to extinction

Resistance To Extinction



Results



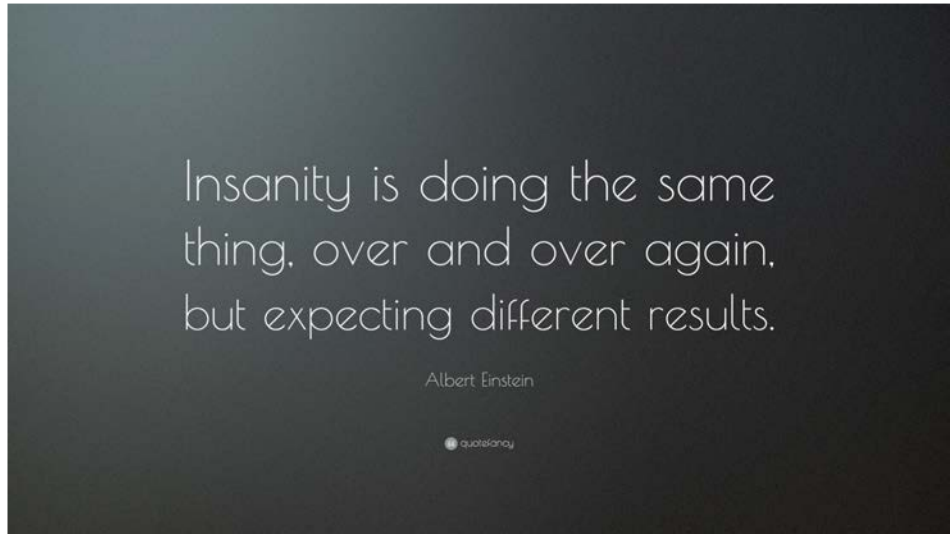


Dalal, S. & Hall, N.J. (2019). Behavioral persistence is associated with poorer olfactory discrimination learning

Conclusions

- High levels or resistance to extinction led to poorer detection performance

- High levels of persistence may indicate difficulty learning complex tasks and be indicative of difficult to train dogs



Tiered-model approach

- Level 1-> Extend unexpected results to evaluate the effects of reward sensitivity
- Level 2 -> Does this enhance working dog selection?
- Level 3 -> Can this be added to large level selection?

Concluding Remarks

- Optimizing working dog performance will take engagement from basic researchers all the way to end users
- Advancing a research framework that allows for quick screening of novel hypothesis under controlled conditions will help speed up improvements and limit risks of detrimental effects to working dogs

- It takes a village to advance working dogs

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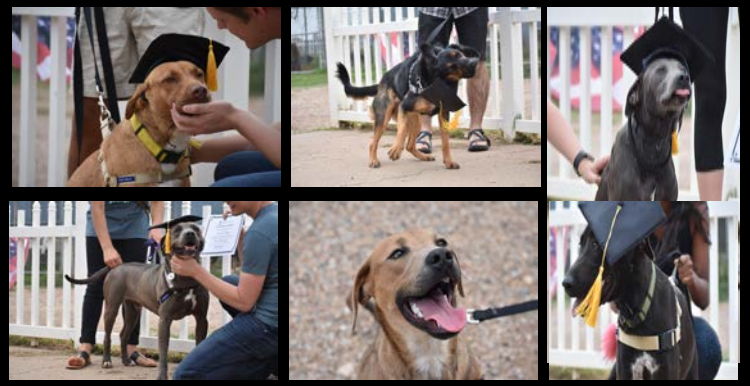
Summer 2018



My Lab:
Eddie C.
Aaron T.
Annie S.
Armando M.
Astrid C.
Claire B.
Claire L.
Christina L.
Hunter N.
Jaylen A.
Julia S.
Katherine J.
Kelby R.
Keleigh C.
Mallory D.
Margaret B.
Megan T.
Micah A.
Micaiah B
Michael L.
Pamela G
Rachel W
Riley B.
Sean S.
Shivani D.
Shyenne H
Stephanie S.
Tatjana J.
Thy N.

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