

# Understanding canine communication: Setting up the dog-human relationship for success

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APA HAI Webinar

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Veterinary  
Medicine



# My research journey



# My research journey













# Passive Communication

1. A signal
2. A sender
3. A receiver



# Active Communication

1. A signal
2. A sender
3. A receiver

# Human-Dog Communication



# Human-Dog Communication





RUFF!



Hi!



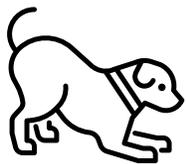
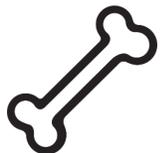
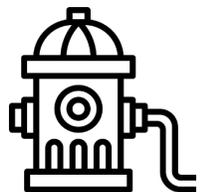
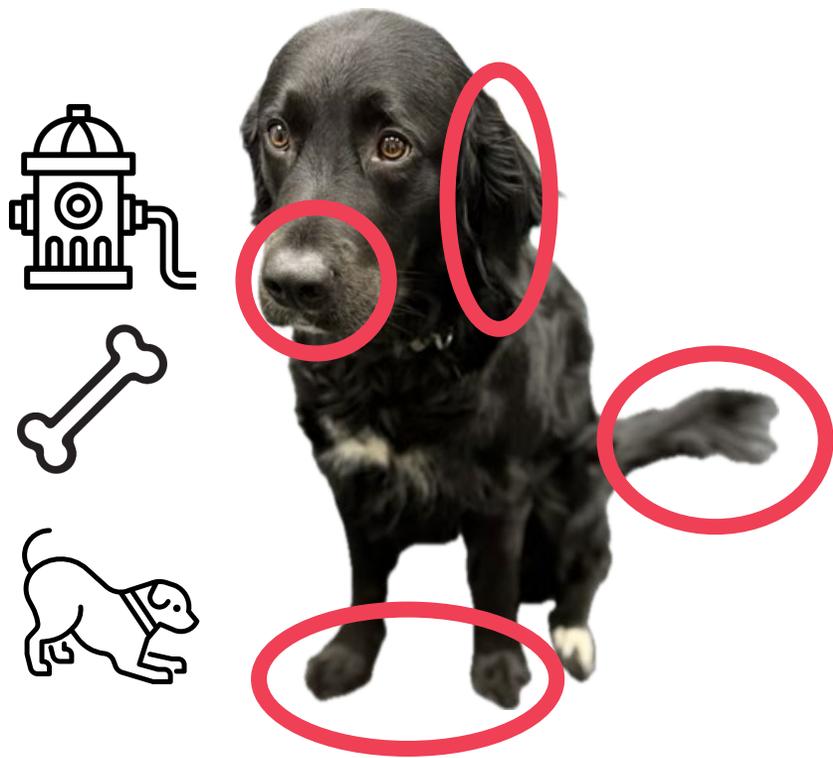
RUFF!



Hi!



RUFF!



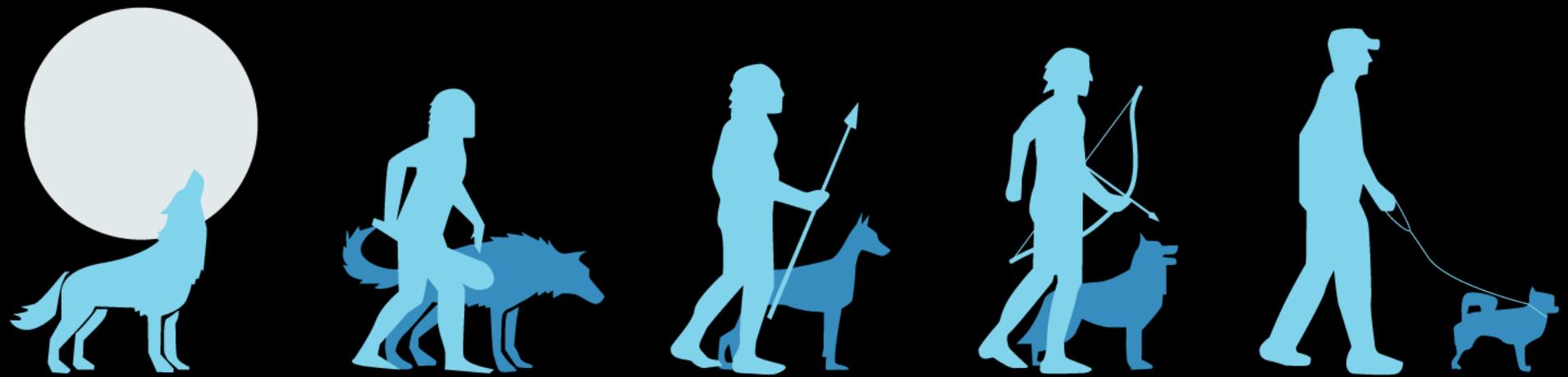
Hi!













Dogs understand us



# Dogs understand us

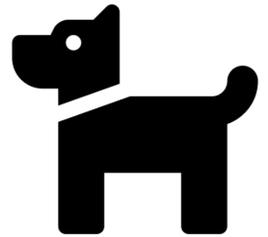
- Dogs can learn a lot about human language



**Sit!**



**Stay!**



**Speak!**







SEARCH  
FOR THE  
**GOD**  
PARTICLE

NATIONALGEOGRAPHIC.COM/MAGAZINE | MARCH 2008

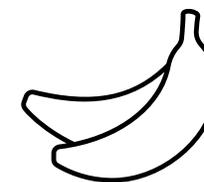
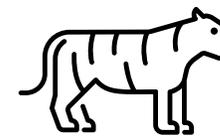
# NATIONAL GEOGRAPHIC

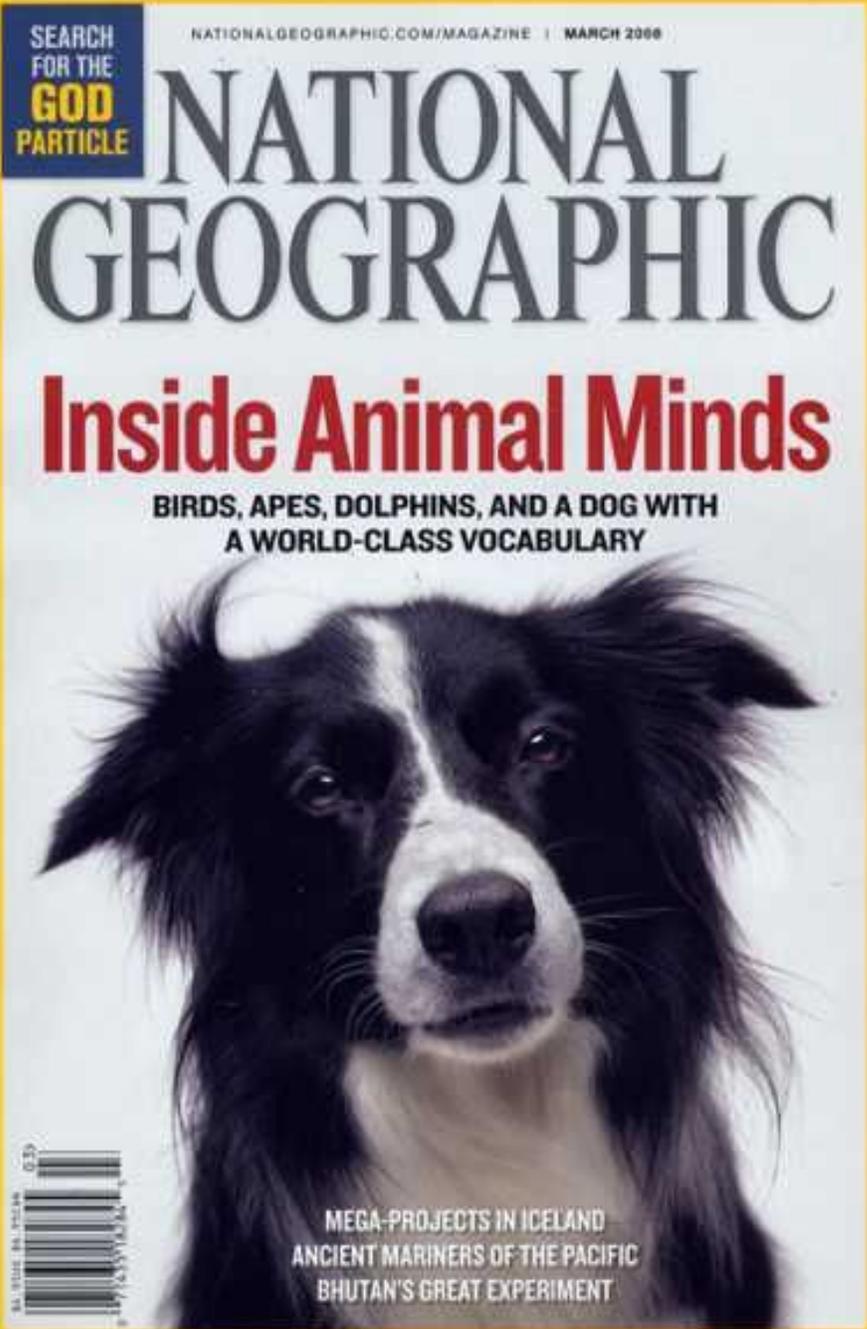
## Inside Animal Minds

BIRDS, APES, DOLPHINS, AND A DOG WITH  
A WORLD-CLASS VOCABULARY

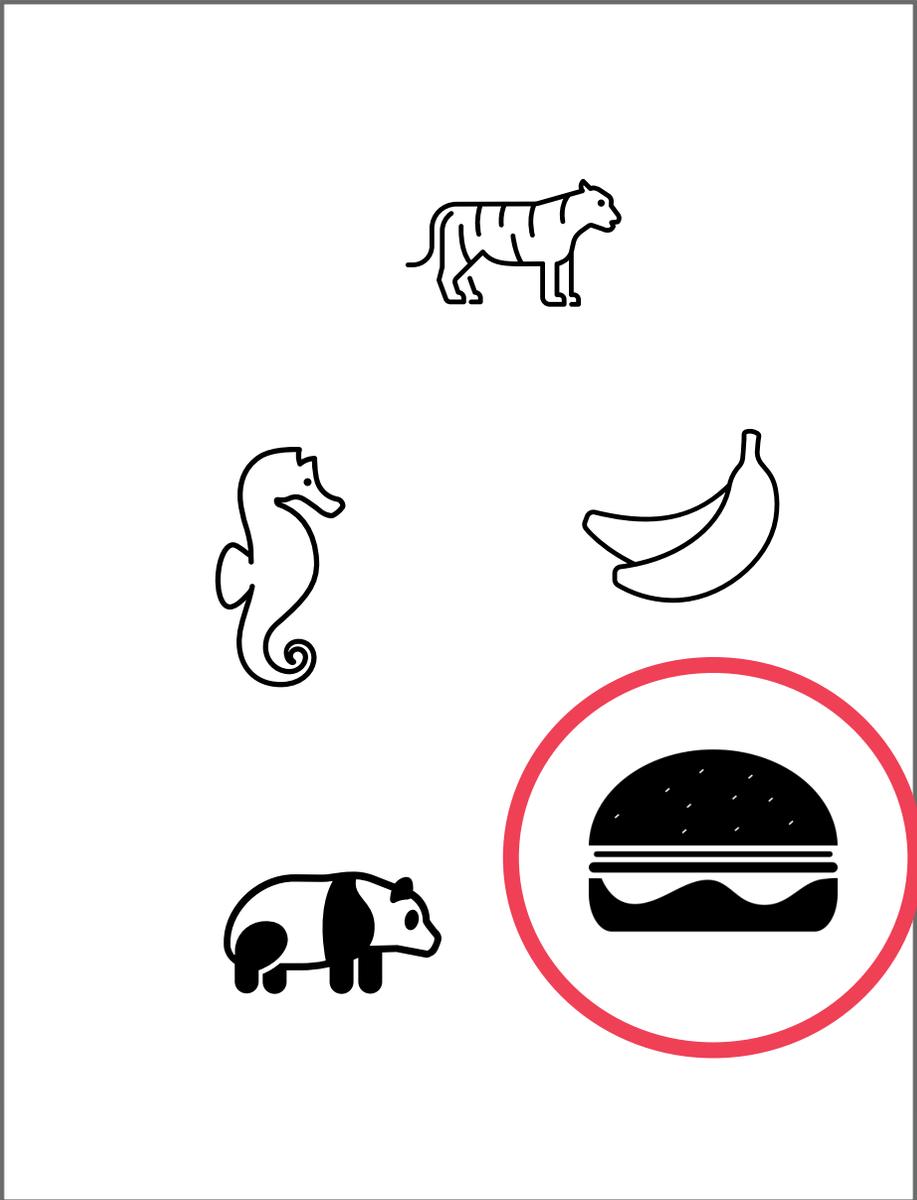


MEGA-PROJECTS IN ICELAND  
ANCIENT MARINERS OF THE PACIFIC  
BHUTAN'S GREAT EXPERIMENT





Fetch the 'Big Mac'



SEARCH  
FOR THE  
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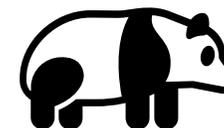
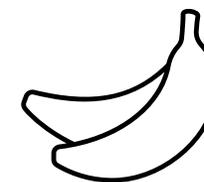
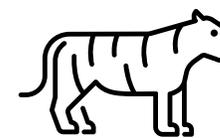
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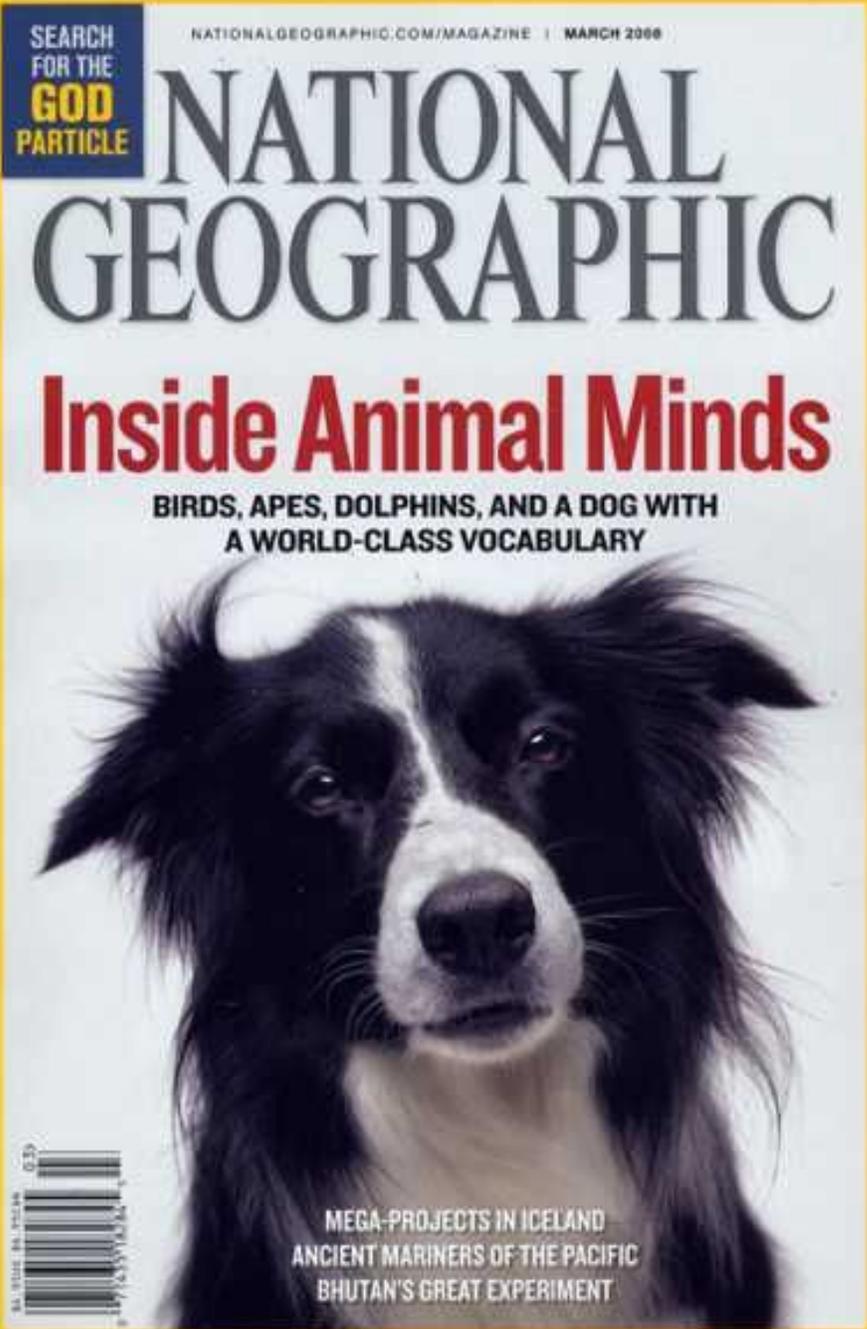
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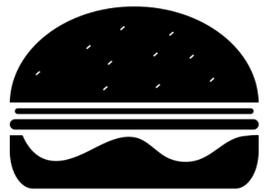
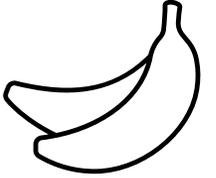
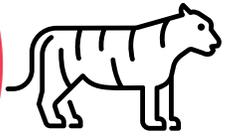
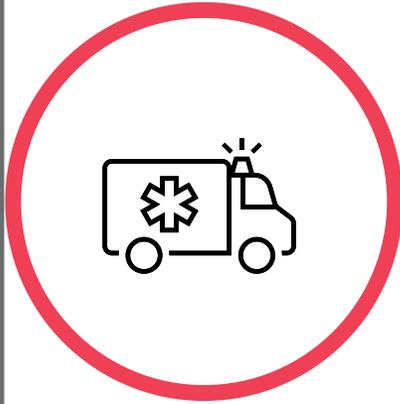


MEGA-PROJECTS IN ICELAND  
ANCIENT MARINERS OF THE PACIFIC  
BHUTAN'S GREAT EXPERIMENT





Fetch the  
'Gazzer'



# Chaser

Unlocking the Genius of the Dog Who  
Knows a Thousand Words



JOHN W. PILLEY WITH Hilary Hinzmann



# Dogs understand us

- Dogs can learn a lot about human language
- **Dogs are receptive to human communication**
- **Dogs are biologically prepared for communication with humans**



# Guiding questions



**What contributes to individual variation in cognition and behavior over the life course?**

# Guiding questions



**How can we set dogs and people up for success in their relationships?**

# Guiding questions



## 1. Prediction of dogs who will and won't graduate

- Save resources
- Maximize impact

## 2. Cultivation of characteristics linked to success

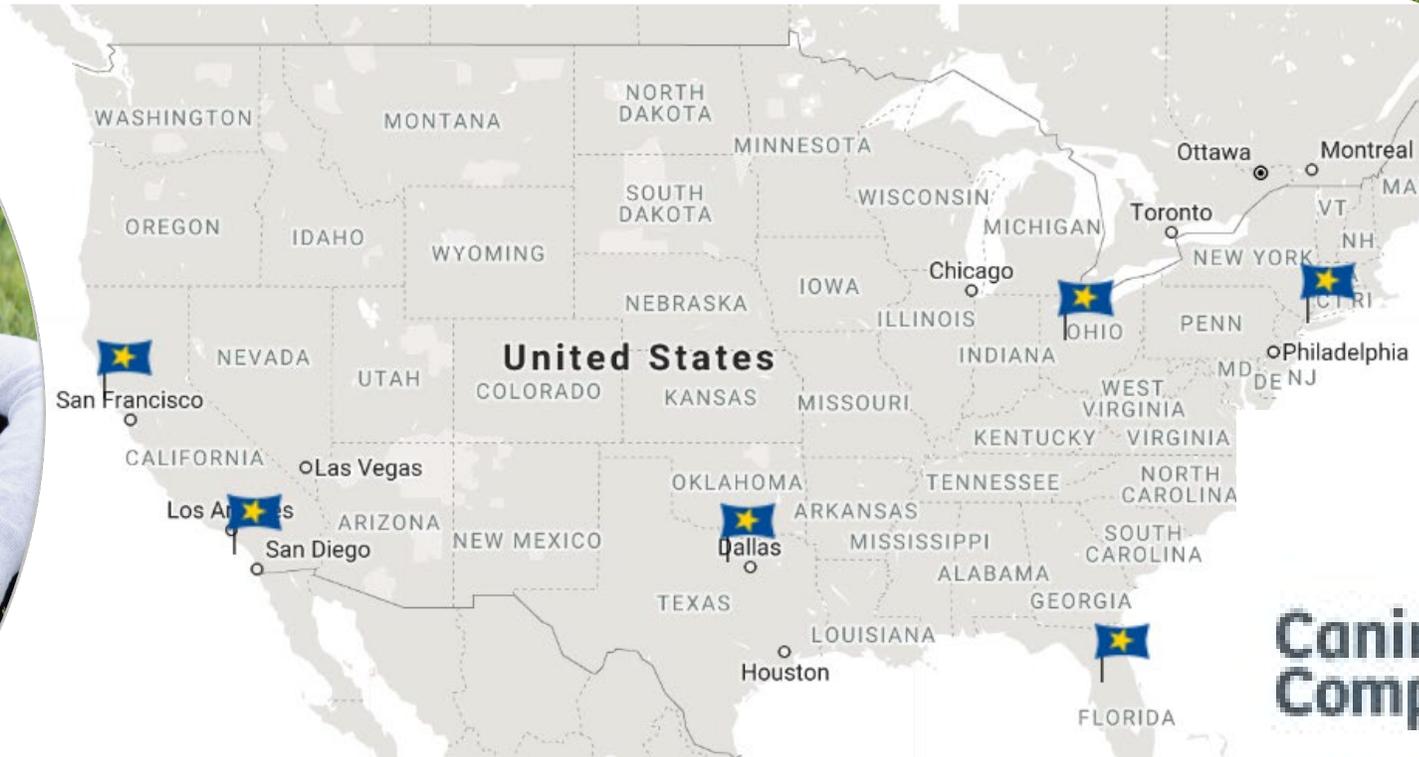
- Selective breeding of traits
- Rearing, socialization, and training may influence some traits more than others

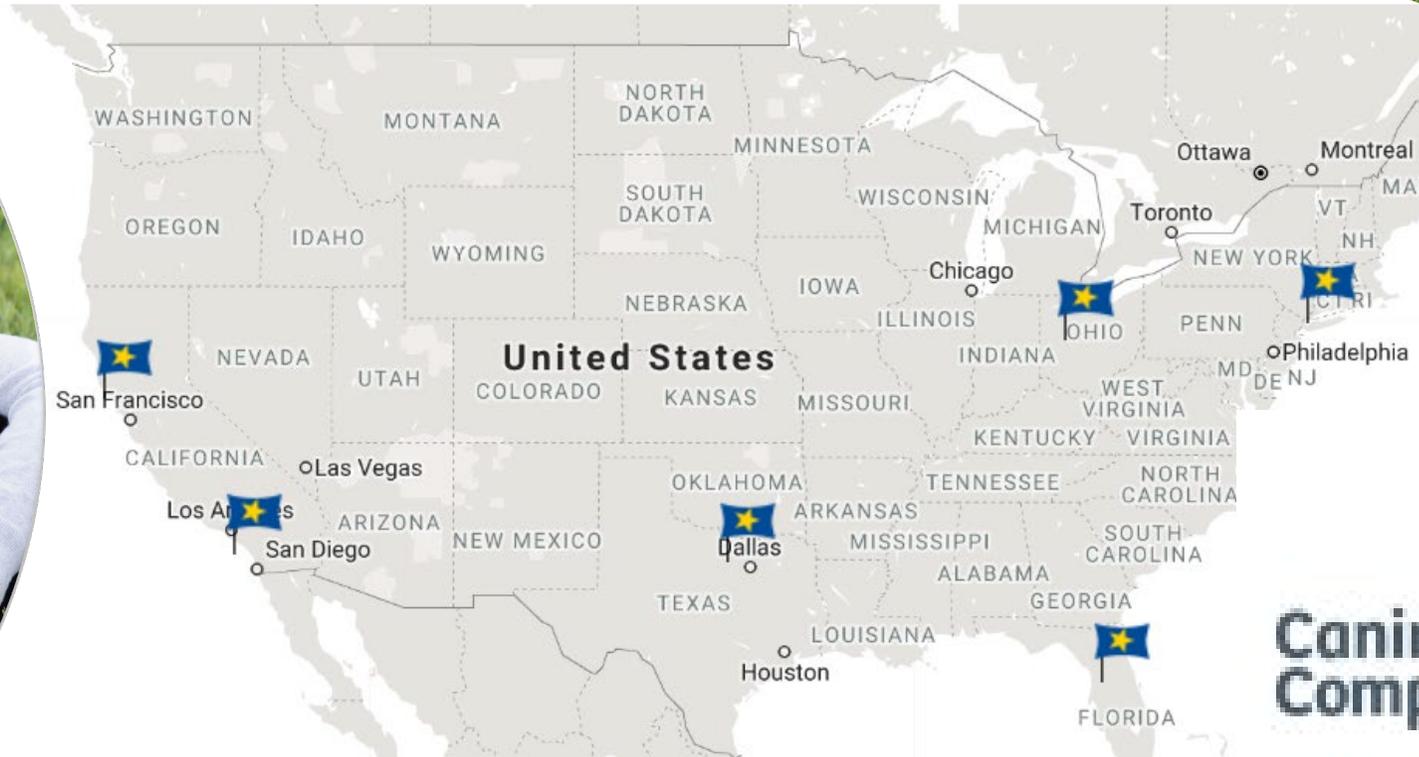


**How can we set dogs and people up for success in their relationships?**

A close-up photograph showing a person's hand, wearing a dark long-sleeved shirt, gently holding the paw of a small, light-colored dog. The dog is looking towards the left. The background is blurred, showing what appears to be a window or a doorway. The text is overlaid in the center of the image.

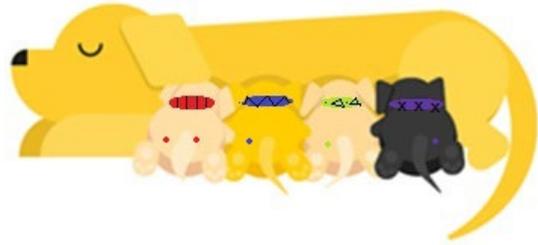
Helping dogs and people  
*help each other*





# A Canine Companions dog's life course

**Birth & Development**



**Puppy Raising**



**Professional Training**



**Service Dog Placement**



**Birth**

**To Puppy Raiser**

**Turn In**

**Graduation**

# Researching across the life course

**Birth & Development**



**Puppy Raising**



**Professional Training**



**Service Dog Placement**



**Birth**

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# Researching across the life course

**Birth & Development**

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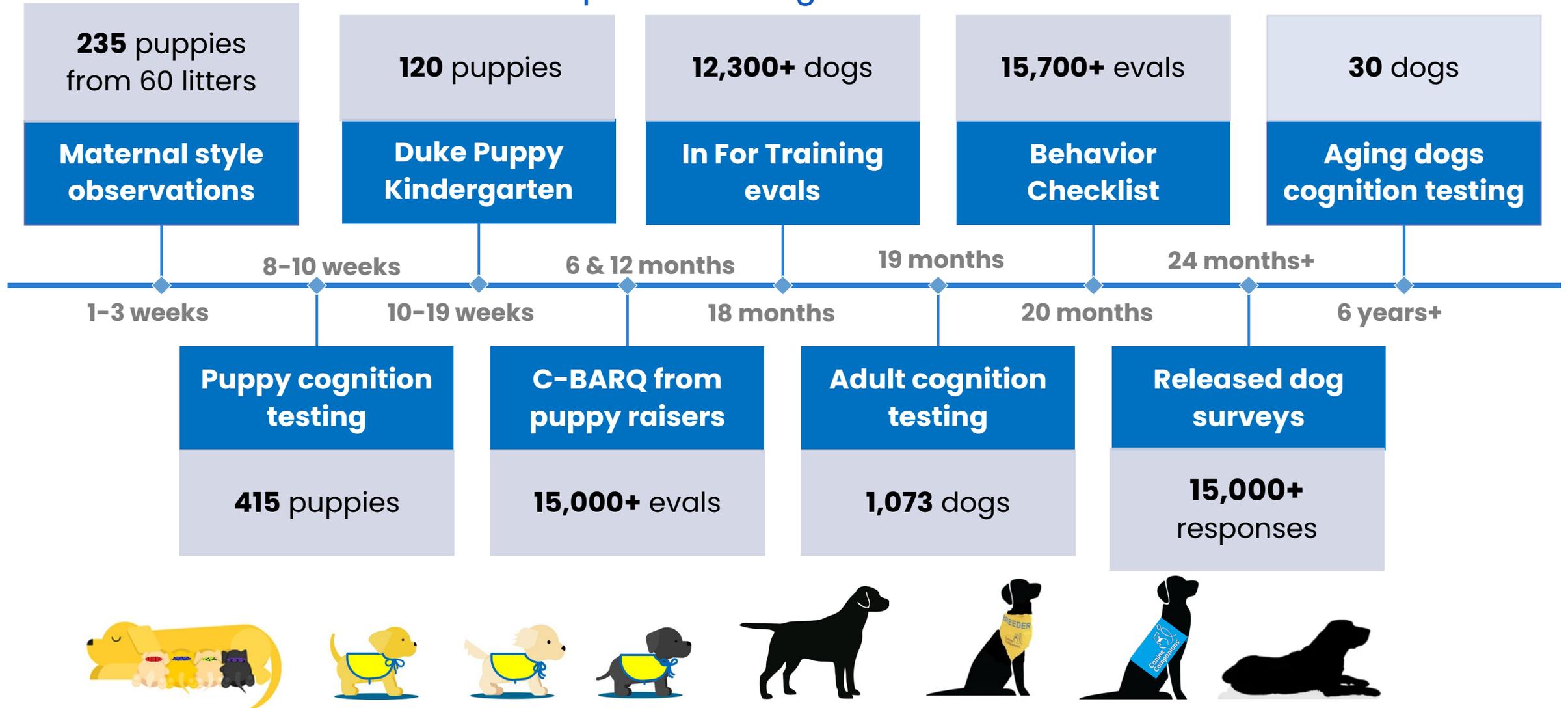
Behavioral Assessment Results (total = 2409)

| Subscale                     | Score | Average | Percentile |
|------------------------------|-------|---------|------------|
| Stranger-directed aggression | 0.00  | 0.02    | 0% - ☆     |
| Owner-directed aggression    | 0.00  | 0.03    | 0% - ☆     |
| Dog-directed aggression      | 0.00  | 0.06    | 0% - ☆     |
| Dog-directed fear            | 0.00  | 0.22    | 0% - ☆     |
| Familiar dog aggression      | 0.00  | 0.06    | 0% - ☆     |
| Trainability                 | 3.00  | 2.79    | 63% - ☆    |
| Chasing                      | 1.50  | 0.97    | 72% - ☆    |
| Stranger-directed fear       | 0.00  | 0.05    | 0% - ☆     |
| Nonsocial fear               | 0.33  | 0.38    | 49% - ☆    |
| Separation-related problems  | 0.00  | 0.22    | 0% - ☆     |
| Touch sensitivity            | 0.00  | 0.30    | 0% - ☆     |
| Excitability                 | 2.33  | 1.11    | 95% - 🚩    |
| Attachment/attention-seeking | 2.00  | 1.33    | 84% - 🚩    |



# Researching across the life course

Data collection is ongoing; number of participants in most studies continues to rise.  
Updated through October 2024.



# Roadmap

## What contributes to individual variation in cognition and behavior over the life course?



- How early do **communicative skills** emerge, and how do they change or stay the same over **development**?



- How much of the individual differences that we see in communicative skills are due to **genetics**?



- What is the role of **contextual factors** in shaping cognition and behavior?

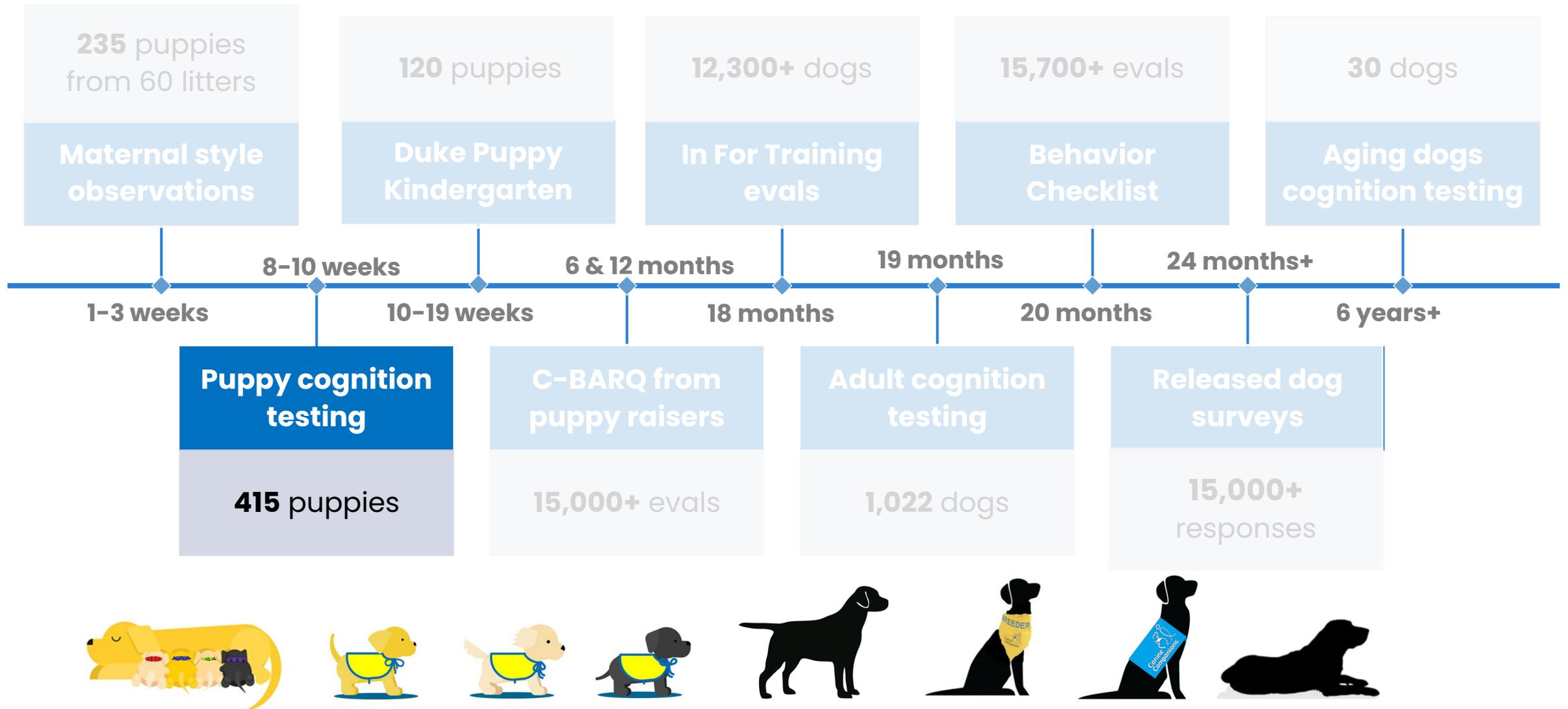
# Roadmap

## What contributes to individual variation in cognition and behavior over the life course?



- How early do communicative skills emerge, and how do they change or stay the same over development?

# Puppy behavior: Emergence and basis of communicative cognitive skills



# How early do cognitive skills emerge in dogs?



Bray et al., 2020, *Animal Behaviour*; Bray et al., 2021, *Animal Cognition*

# How **early** do cognitive skills emerge in dogs?



# Subjects

## 8- to 10-week-old puppies



## Dogs in professional training



Longitudinal study

Feb 2017 – July 2017

**$N = 168$  puppies**

- 40 Labrador retrievers
- 6 Golden retrievers
- 122 Lab-Golden Crosses

Mean age = 9.2 weeks

Aug 2018 – April 2019

**$N = 160$  dogs**

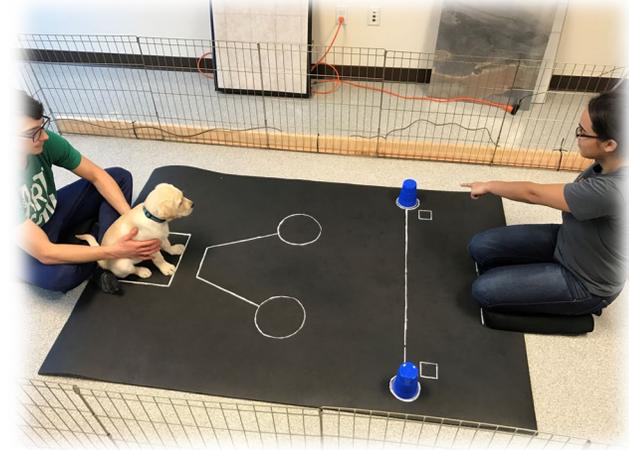
- 37 Labrador retrievers
- 5 Golden retrievers
- 118 Lab-Golden Crosses

Mean age = 1.79 years

# Dog Cognitive Development Battery

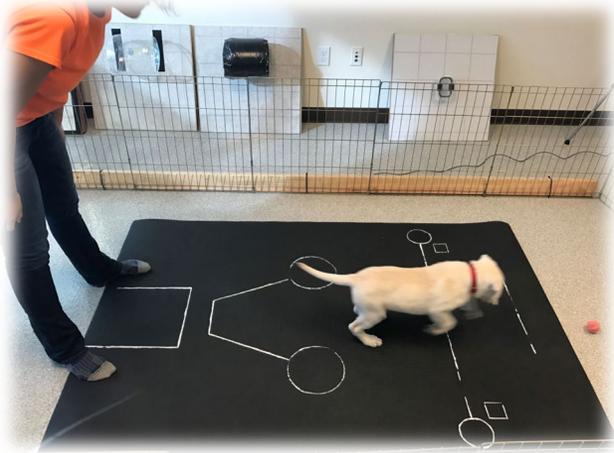


# Dog Cognitive Development Battery



Bray et al., 2014, *Animal Cognition*; Bray et al., 2015, *Animal Cognition*; Bray et al., 2017, *Animal Cognition*; Bray et al., 2017, *PNAS*  
Bray et al., 2020, *Animal Behaviour*; Bray et al., 2021, *Animal Cognition*; Bray et al., 2021, *Front Vet Sci*; Bray et al., 2021, *Current Biology*

# Dog Cognitive Development Battery



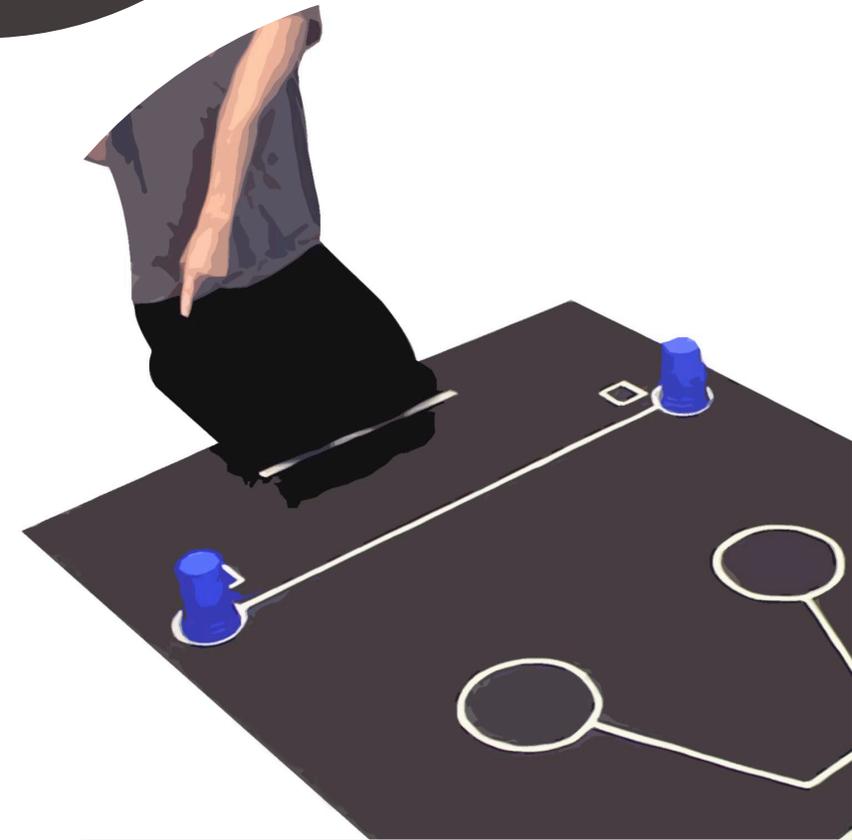
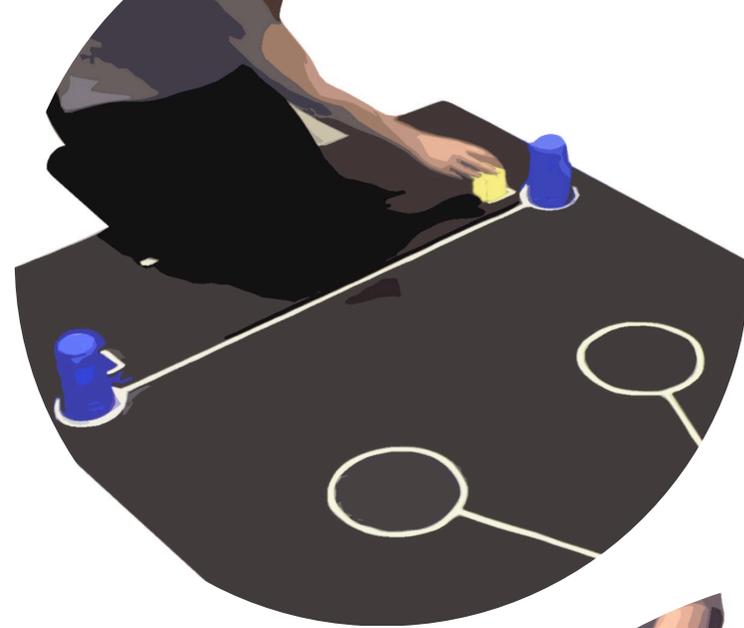
Bray et al., 2014, *Animal Cognition*; Bray et al., 2015, *Animal Cognition*; Bray et al., 2017, *Animal Cognition*; Bray et al., 2017, *PNAS*  
Bray et al., 2020, *Animal Behaviour*; Bray et al., 2021, *Animal Cognition*; Bray et al., 2021, *Front Vet Sci*; Bray et al., 2021, *Current Biology*



Enhanced Selection of Assistance and Explosive Detection Dogs Using Cognitive Measures  
MacLean & Hare, *Frontiers in Veterinary Science*, 2018

# Methods

- Tested participants on the Dog Cognitive Development Battery
  - Comprehension of social cues



Communicative marker

Arm pointing

# Methods

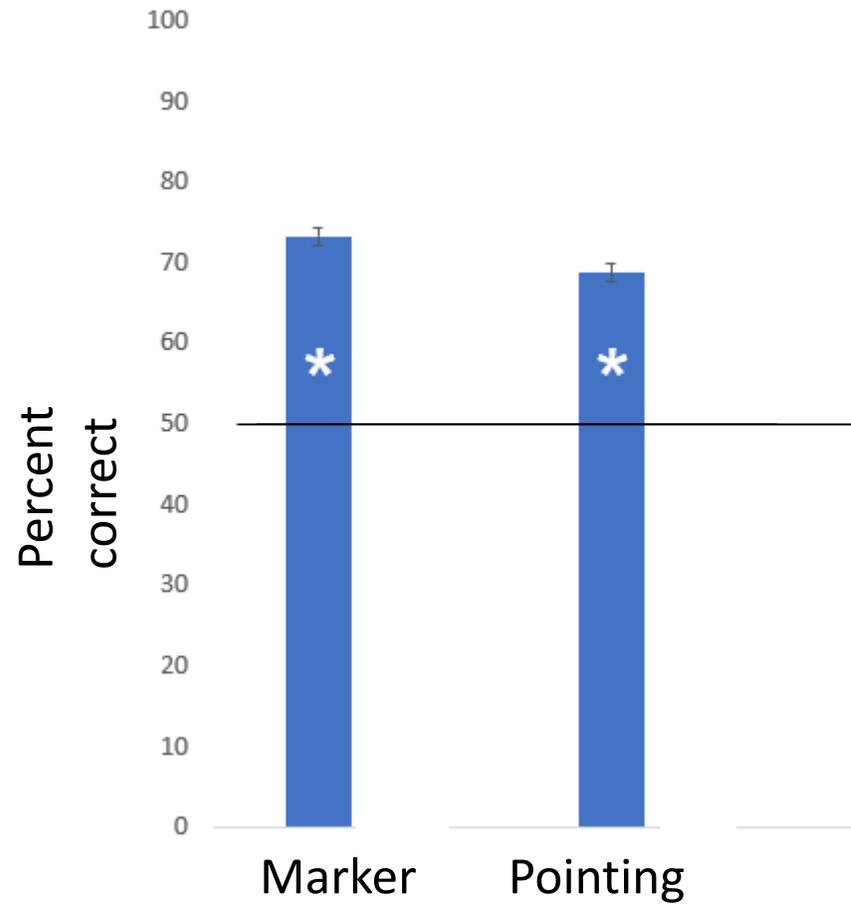
- Tested participants on the Dog Cognitive Development Battery
  - Comprehension of social cues
  - Interaction with and orientation toward humans



Human  
Interest

Unsolvability

# 8-week-old puppies comprehend social cues

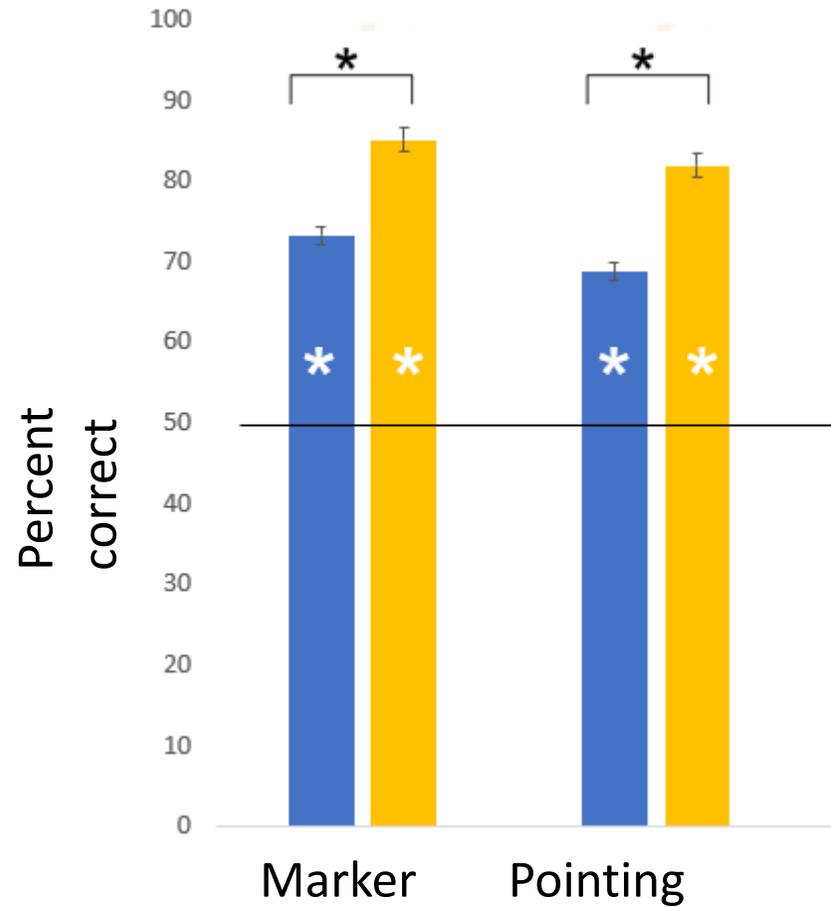


\*  $p < 0.001$

■ Puppy scores



# 8-week-old puppies comprehend social cues



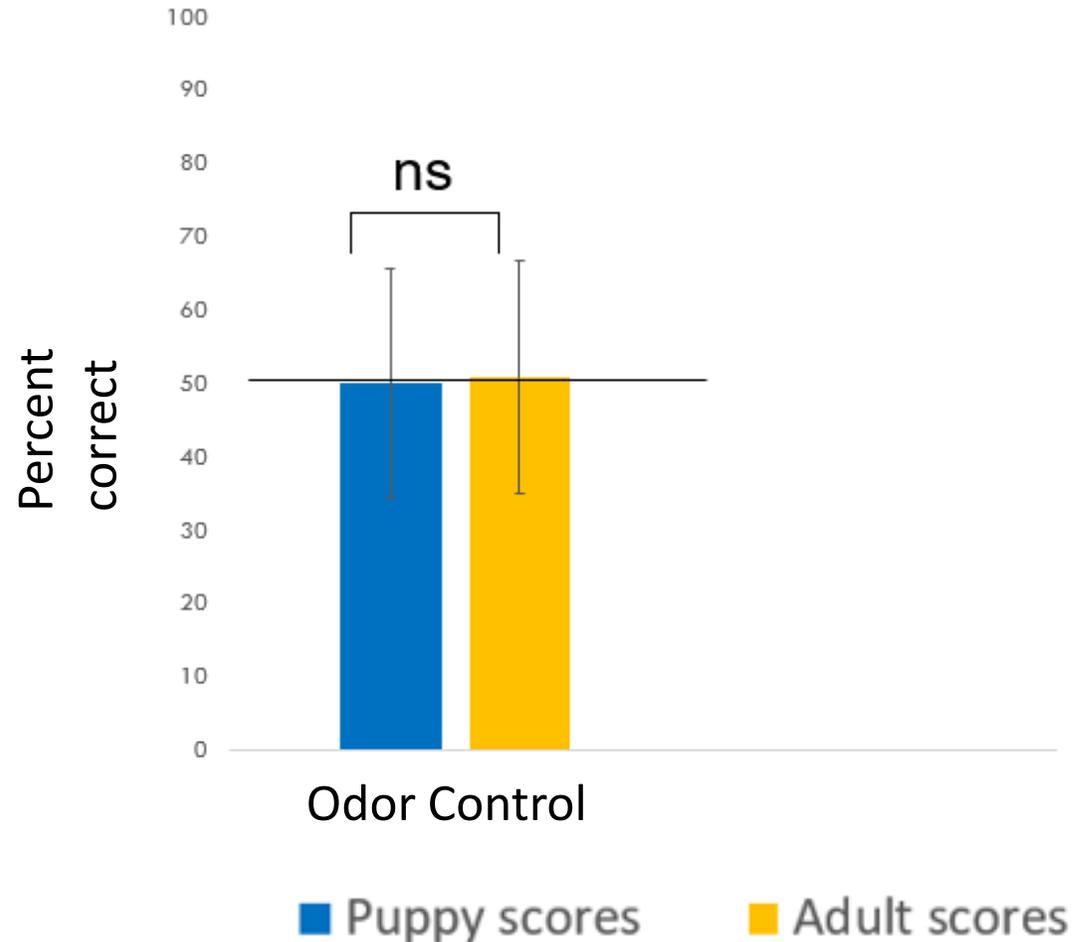
\*  $p < 0.001$

■ Puppy scores

■ Adult scores

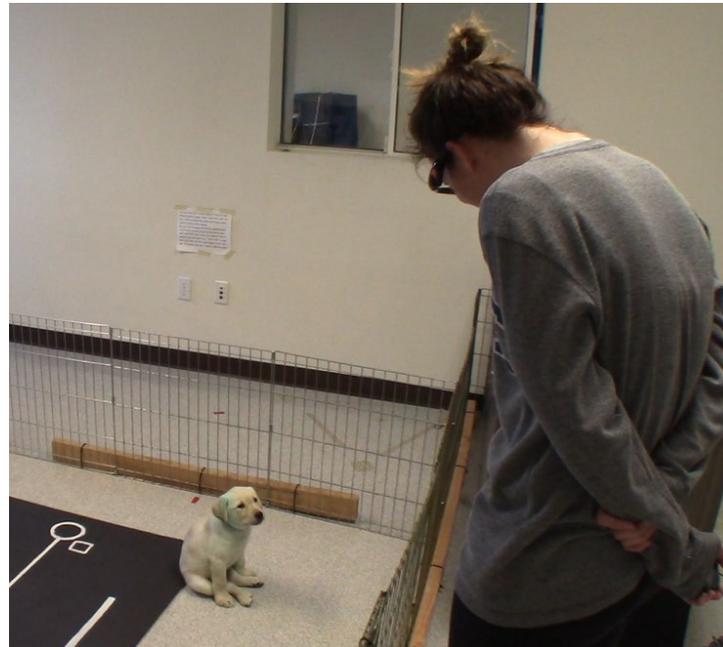
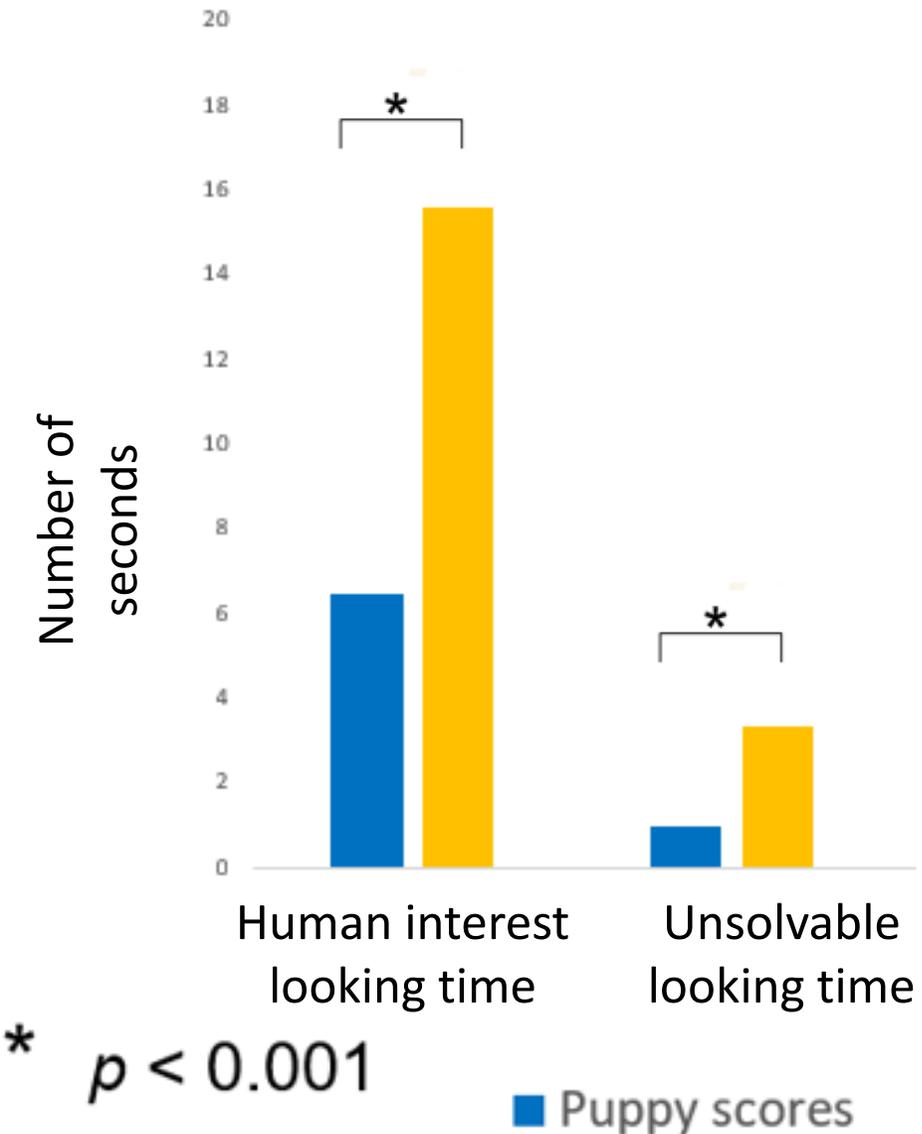
Bray et al., 2020, *Animal Behaviour*;  
Bray et al., 2021, *Animal Cognition*

# Puppies solve using **social cues**, not odor cues



Bray et al., 2020, *Animal Behaviour*;  
Bray et al., 2021, *Animal Cognition*

# 8-week-old puppies show gazing tendencies



Bray et al., 2020, *Animal Behaviour*;  
Bray et al., 2021, *Animal Cognition*

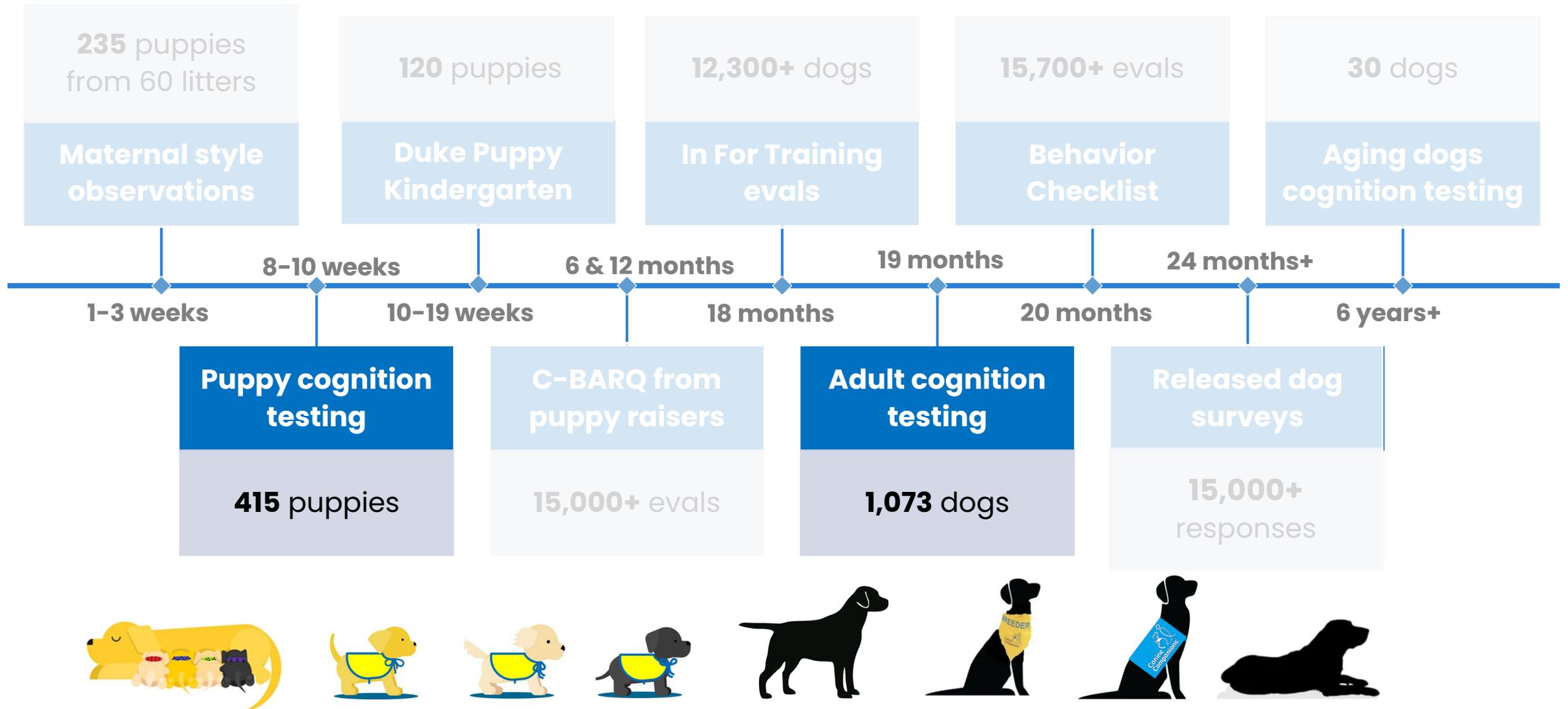
# Roadmap

## What contributes to individual variation in cognition and behavior over the life course?



- How early do communicative skills emerge, and how do they change or stay the same over development?

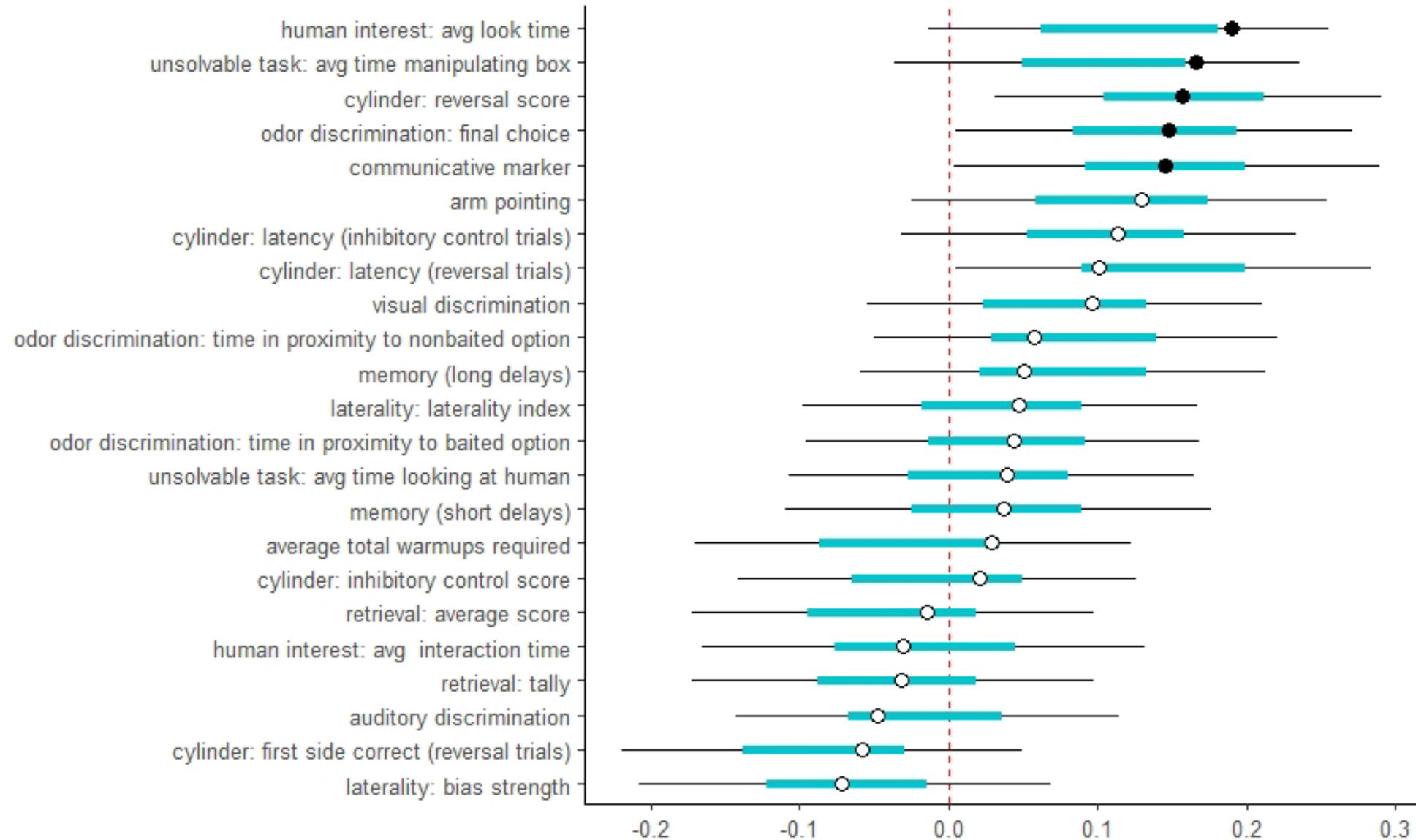
# Puppy to adolescent behavior: Impact of development



# Are puppy cognitive profiles **stable** over development?



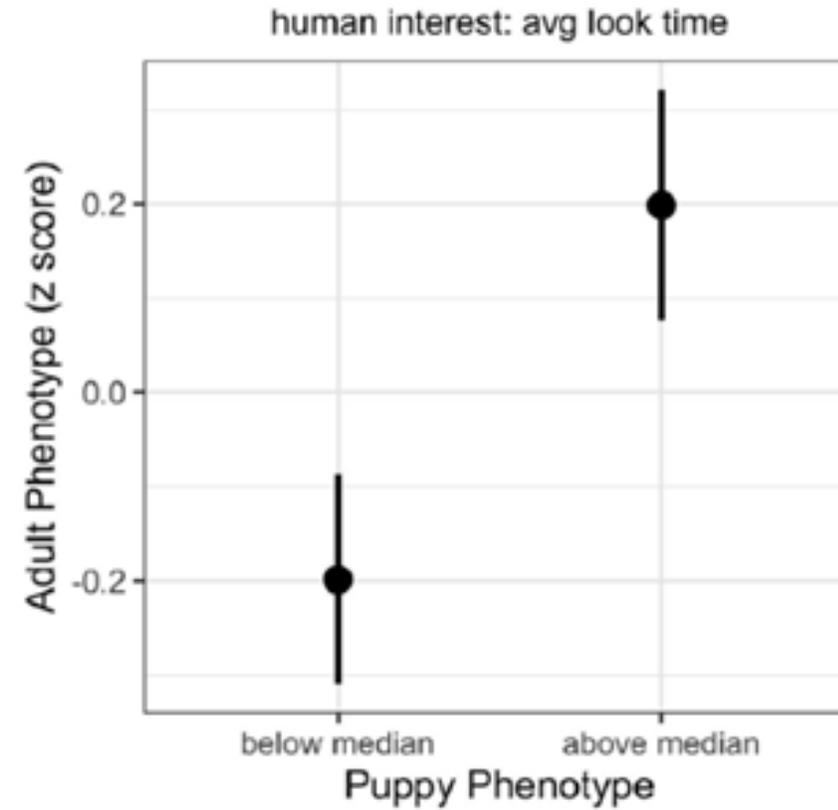
# Puppies generally exhibit **stability** over time



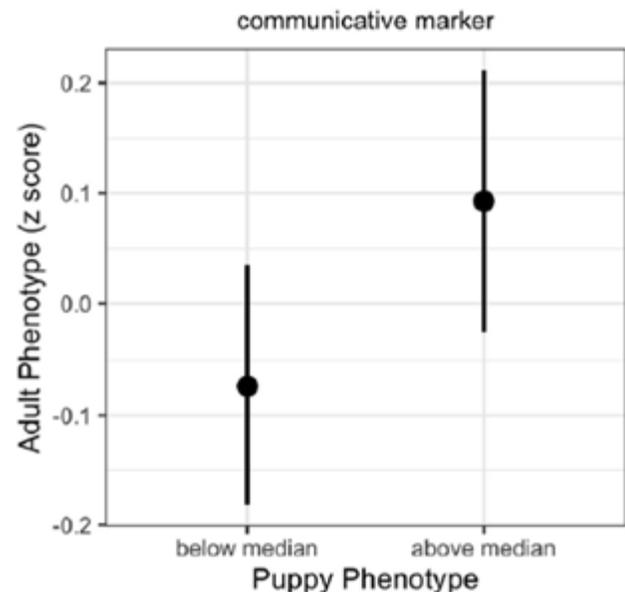
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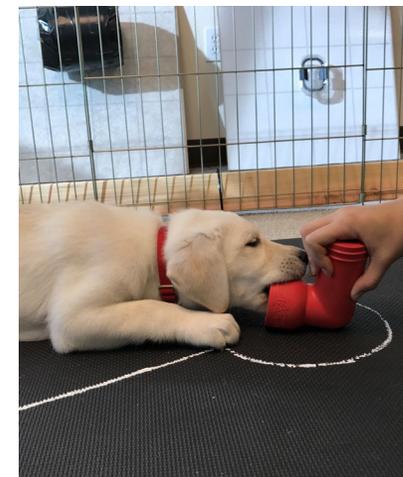
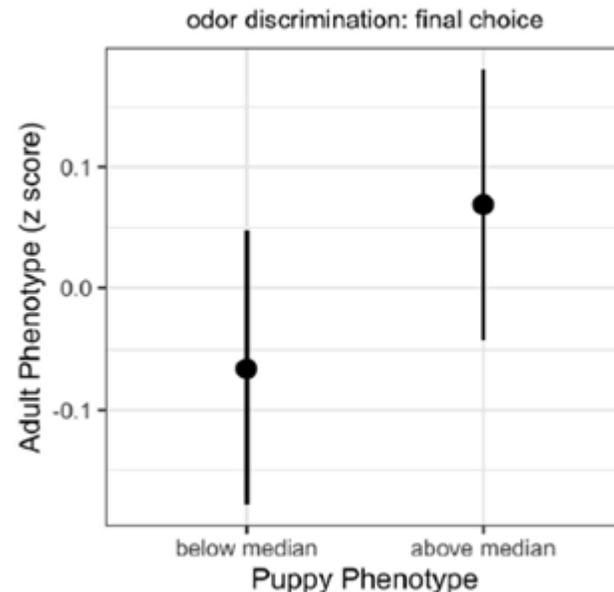
**Social gaze during human interest**



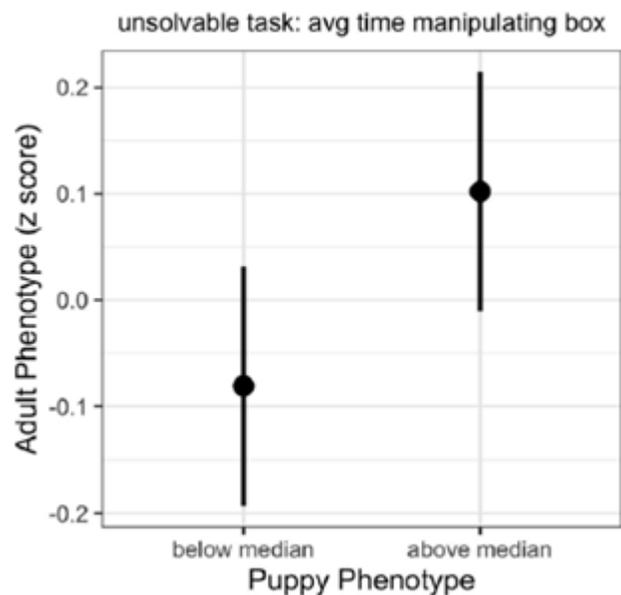
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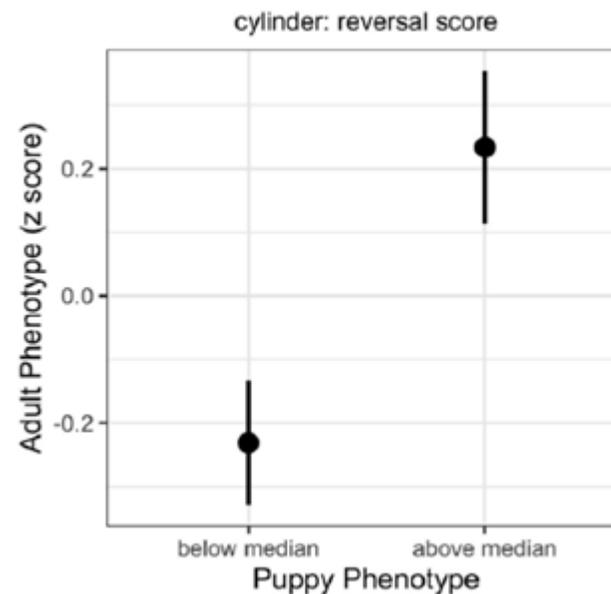
Use of human communicative signals



Odor discrimination



Independent persistence



Impulse control

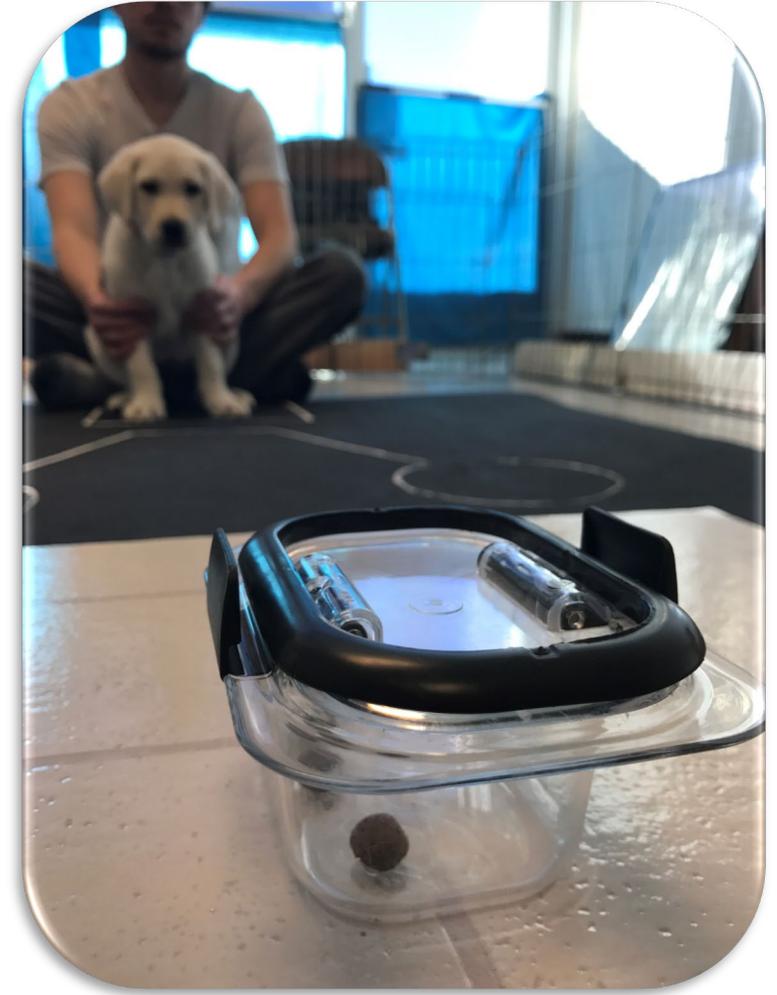
# Conclusions

- Sensitivity to human communication is early emerging, and improves over time



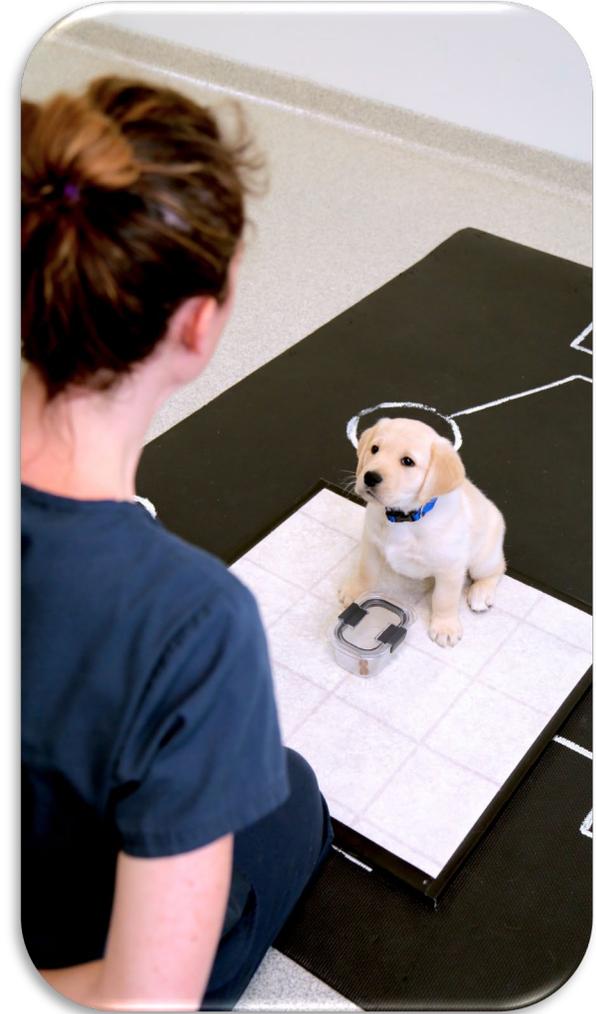
# Conclusions

- Sensitivity to human communication is early emerging, and improves over time
- Communication comprehension precedes production



# Conclusions

- Sensitivity to human communication is early emerging, and improves over time
- Communication comprehension precedes production
- Some evidence for stable cognitive profiles



# Meet Daisy (x 2)



# Meet Daisy (x 2)

## Effects of maternal investment, temperament, and cognition on guide dog success

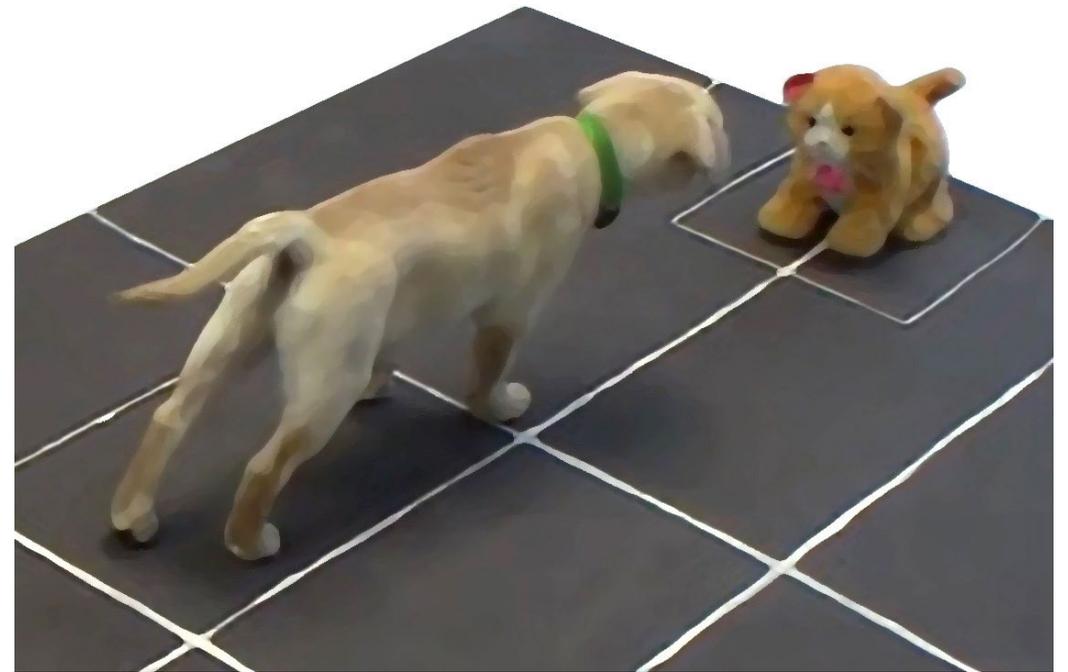
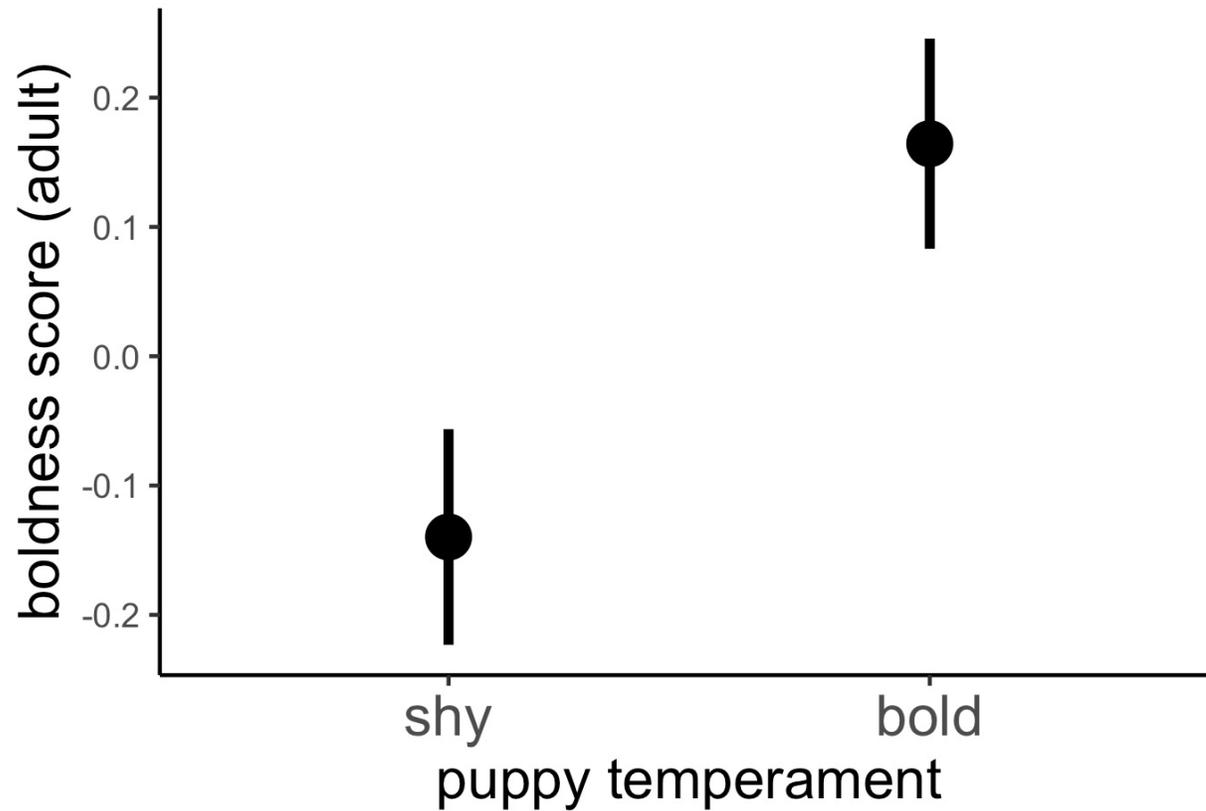
Emily E. Bray<sup>a,b,1</sup>, Mary D. Sammel<sup>c</sup>, Dorothy L. Cheney<sup>d,1</sup>, James A. Serpell<sup>e</sup>, and Robert M. Seyfarth<sup>a</sup>

Proceedings of the National Academy of Sciences of the United States of America

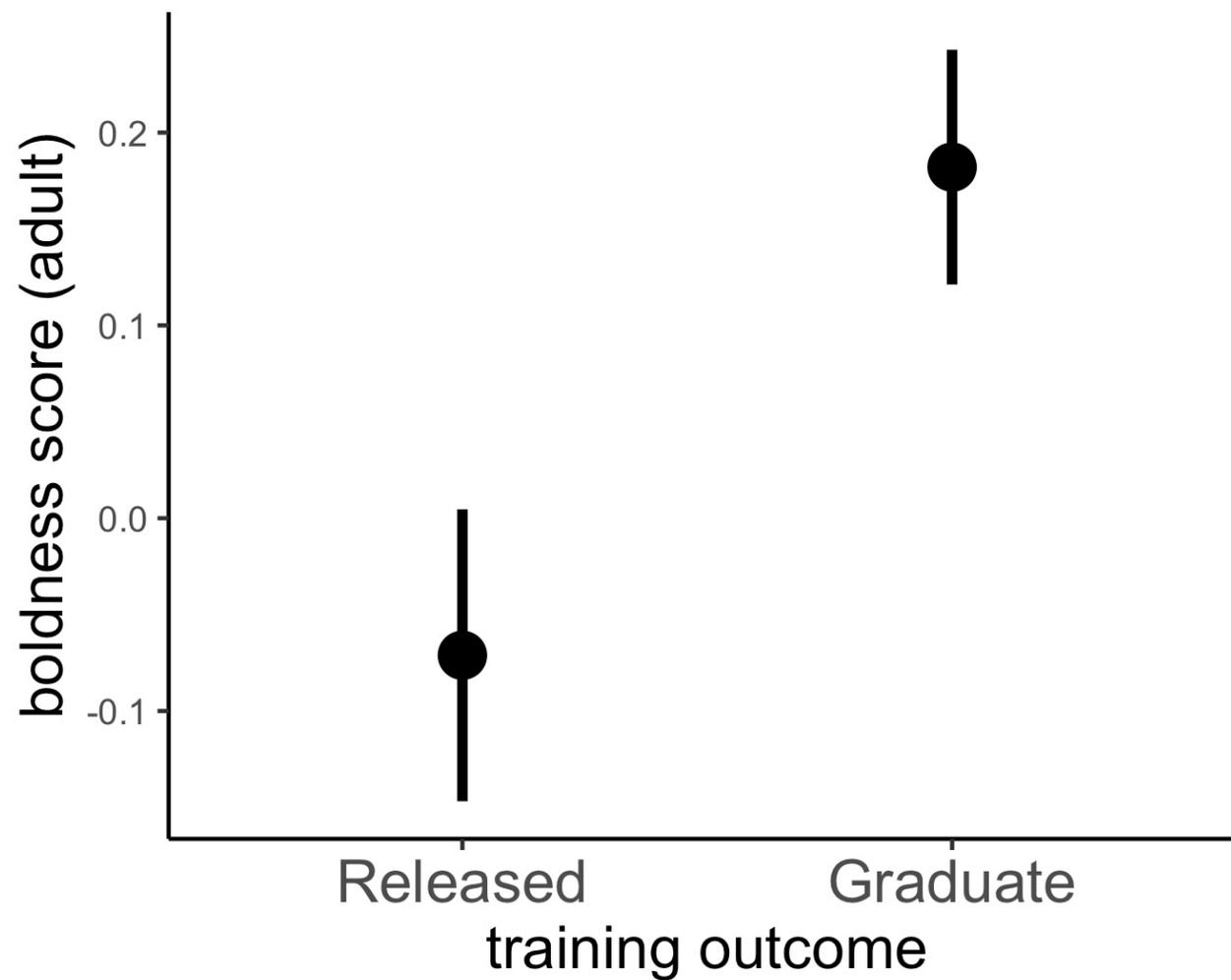
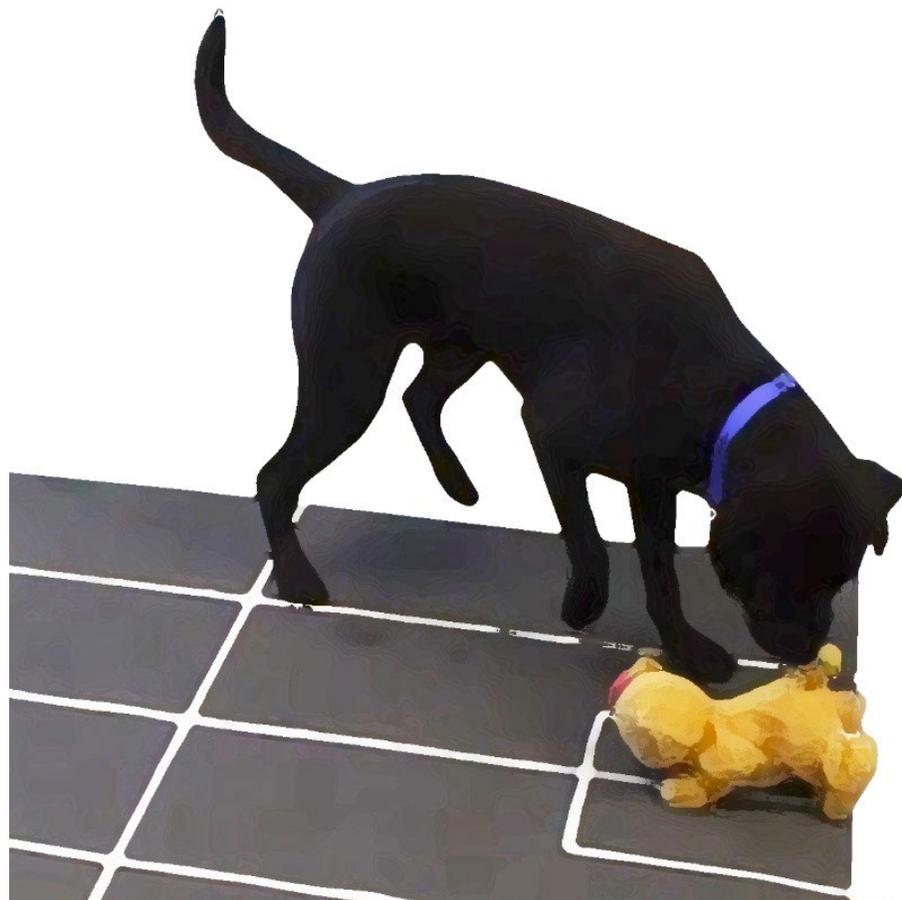




# Do puppy profiles predict adult characteristics?



# Does boldness relate to **training success**?



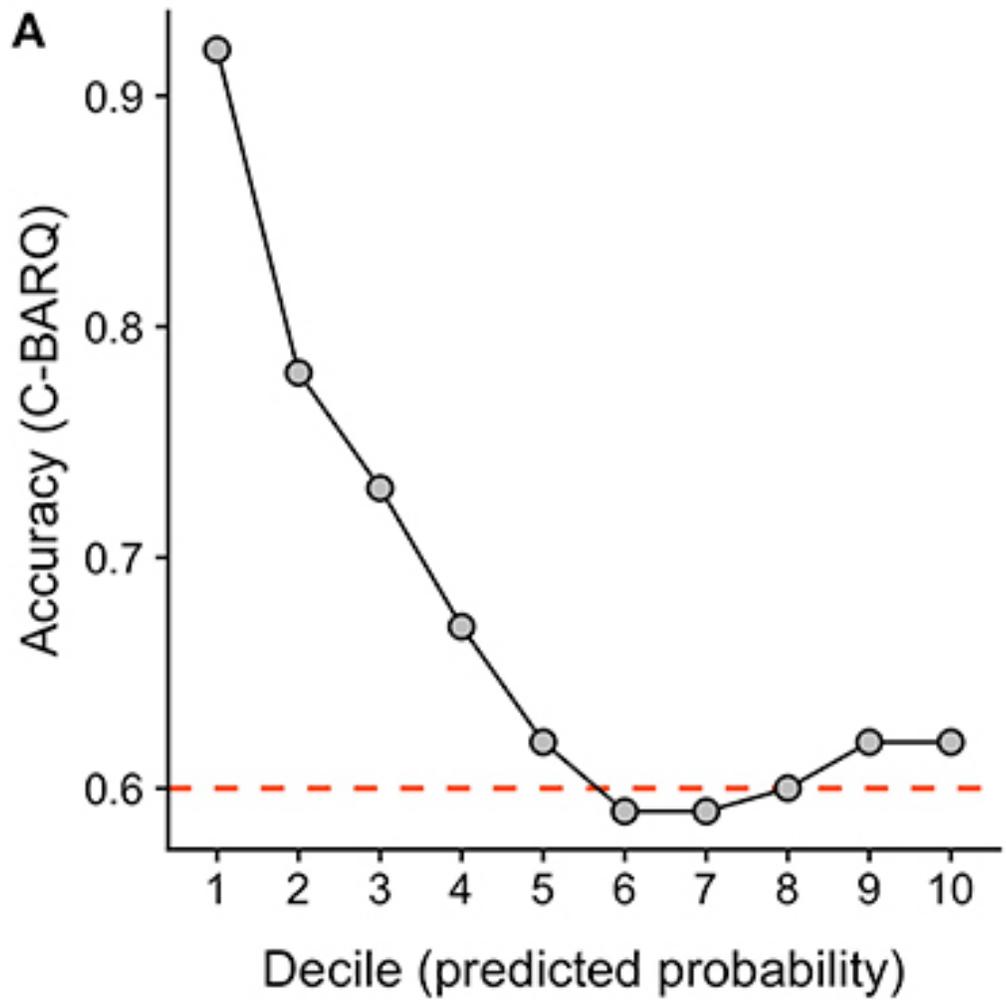
# Future directions

- Can measures of cognition taken early in development predict outcome in a working dog program?



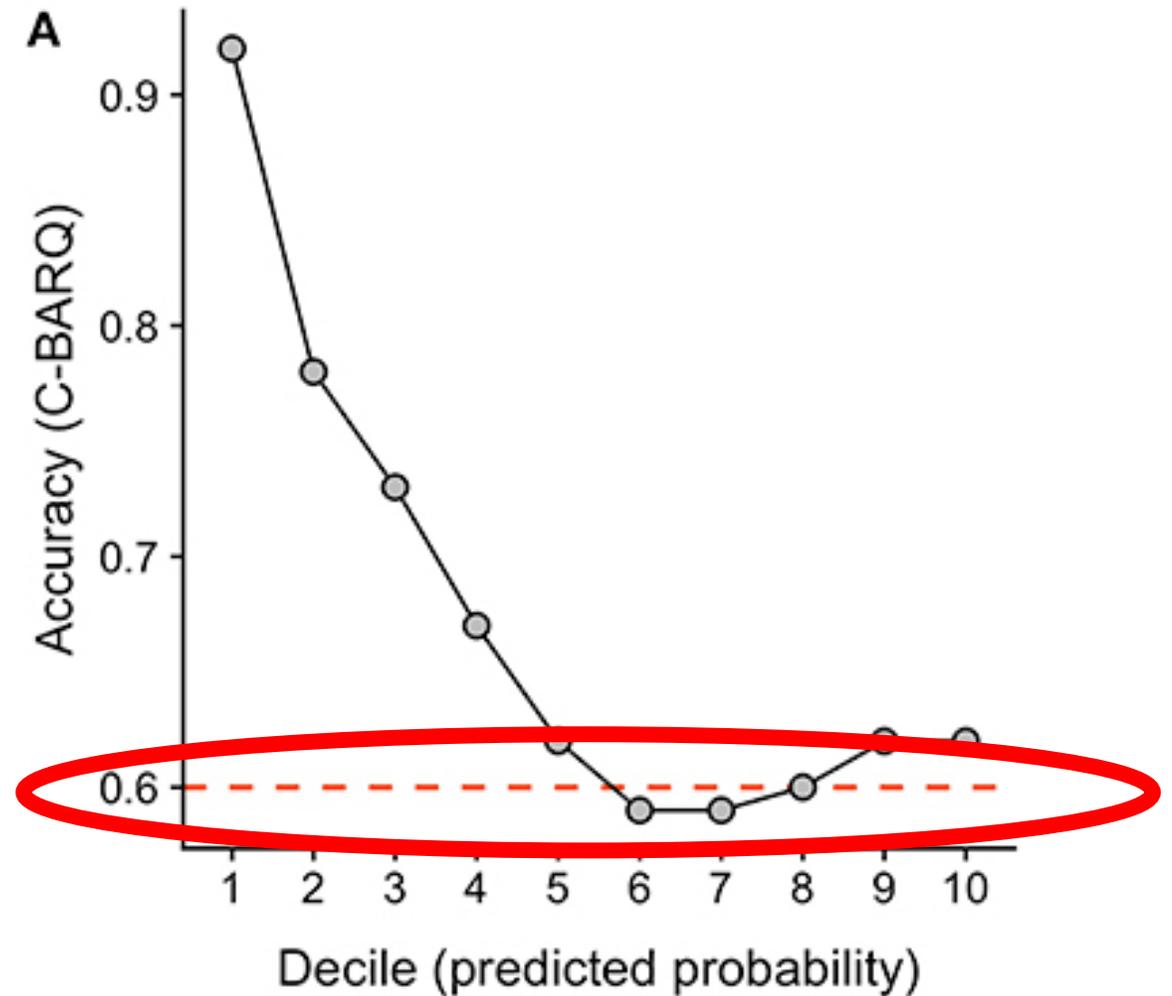
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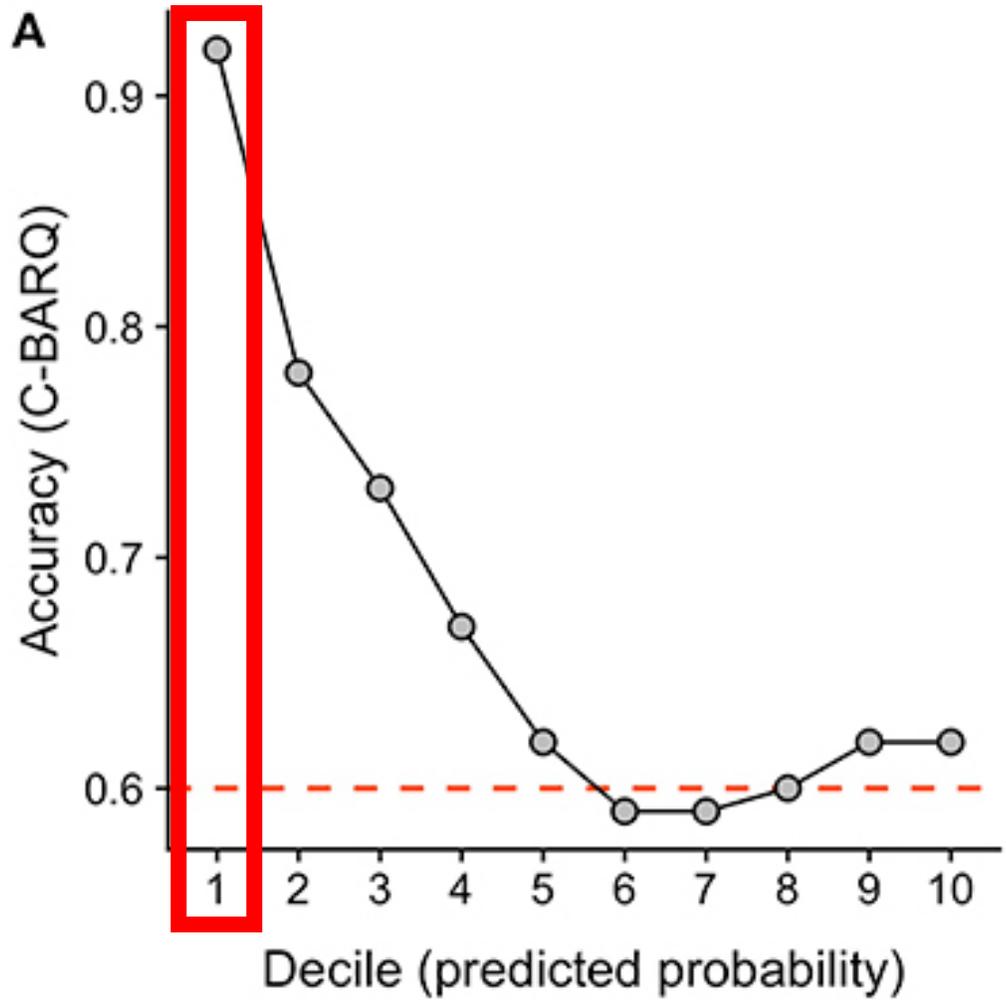
# Future directions

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- Can measures of cognition taken early in development predict outcome in a working dog program?



# Roadmap

## What contributes to individual variation in cognition and behavior over the life course?



- How early do communicative skills emerge, and how do they change or stay the same over development?



- How much of the individual differences that we see in communicative skills are due to genetics?

# Are social cognitive skills **biologically prepared?**



Bray et al., 2021, *Current Biology*;  
Salomons et al., 2021, *Current Biology*

# Heritability: Proportion of variance accounted for by genetic factors

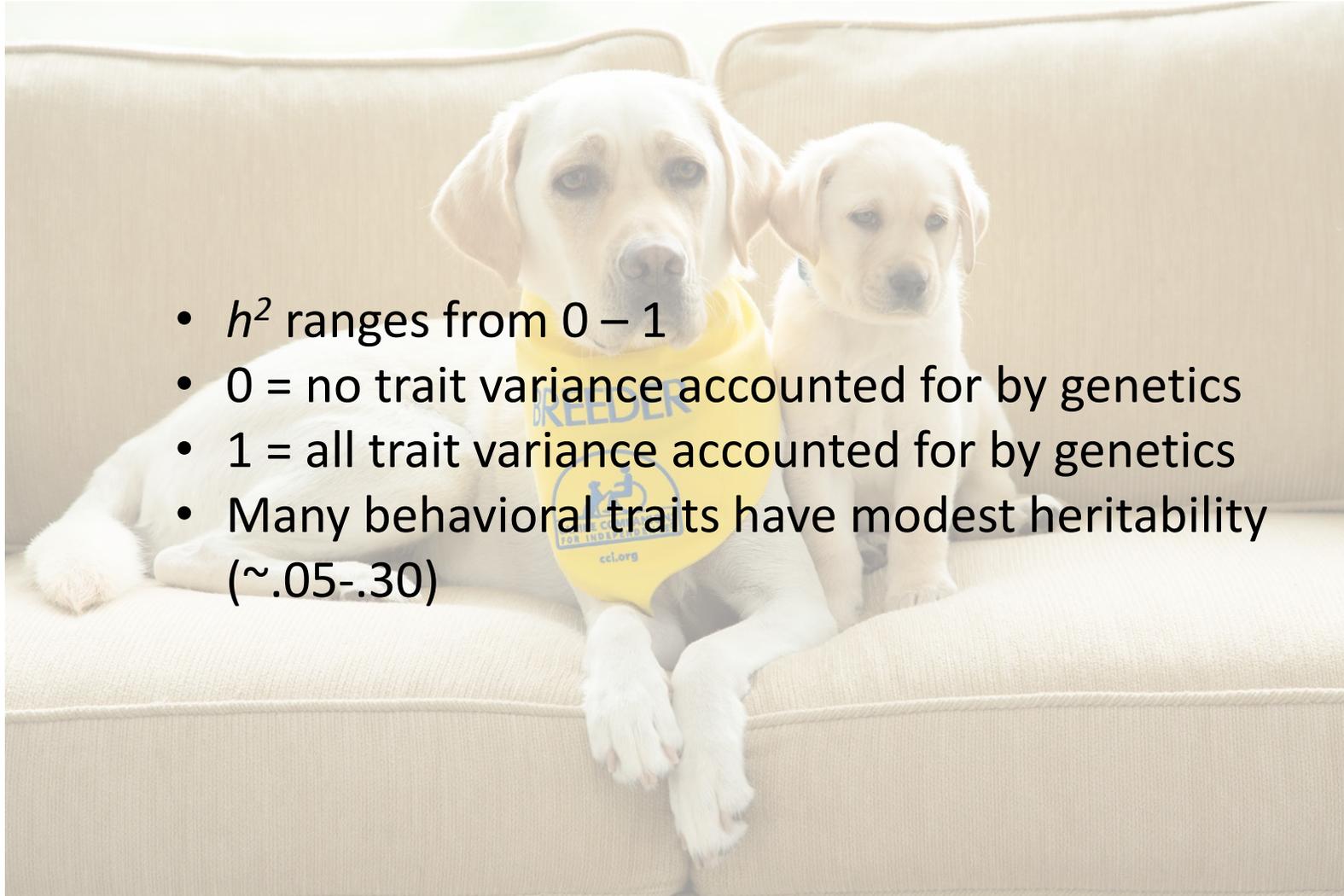
Proportion of variance attributable to genetic factors

$$h^2 = \frac{\sigma^2_G}{\sigma^2_G + \sigma^2_E}$$

Genes  $\nearrow$  Environment  $\uparrow$



# Heritability: Proportion of variance accounted for by genetic factors



- $h^2$  ranges from 0 – 1
- 0 = no trait variance accounted for by genetics
- 1 = all trait variance accounted for by genetics
- Many behavioral traits have modest heritability (~.05-.30)

# Subjects

## Original dataset



Feb 2017 – July 2017

**$N = 168$  puppies**

- 40 Labrador retrievers
- 6 Golden retrievers
- 122 Lab-Golden Crosses

Mean age = 9.2 weeks

## Maternal style study puppies



March 2018 – June 2020

**$N = 207$  puppies**

- 58 Labrador retrievers
- 17 Golden retrievers
- 132 Lab-Golden Crosses

Mean age = 7.9 weeks

+

=

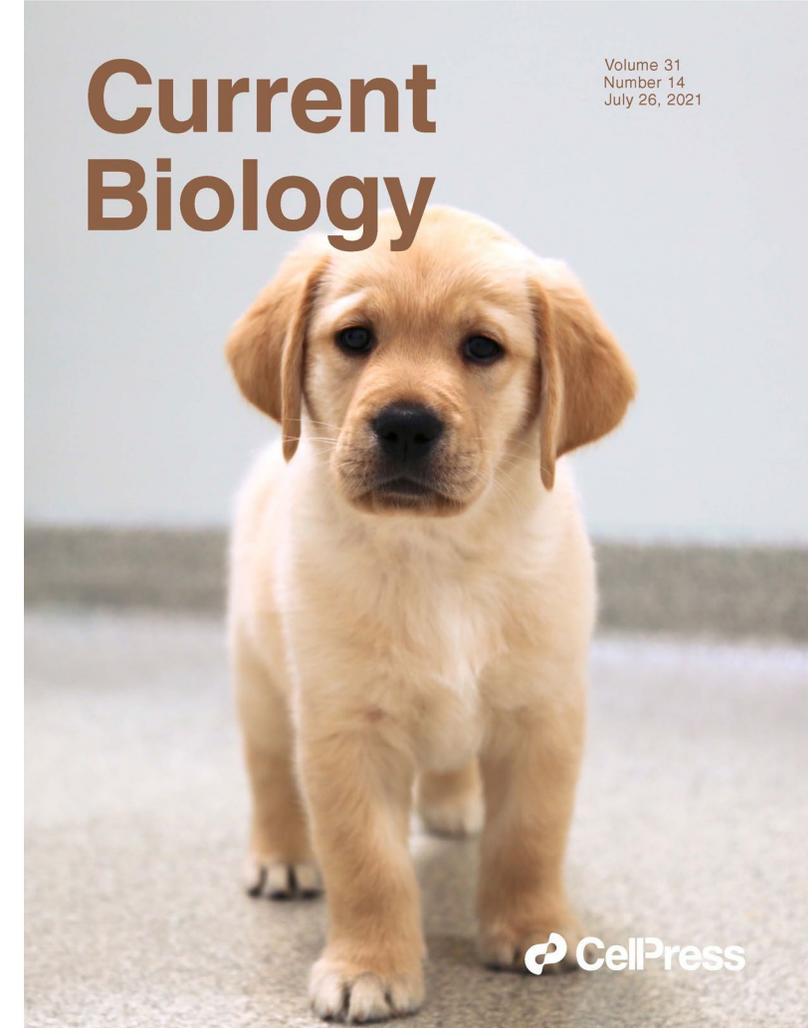
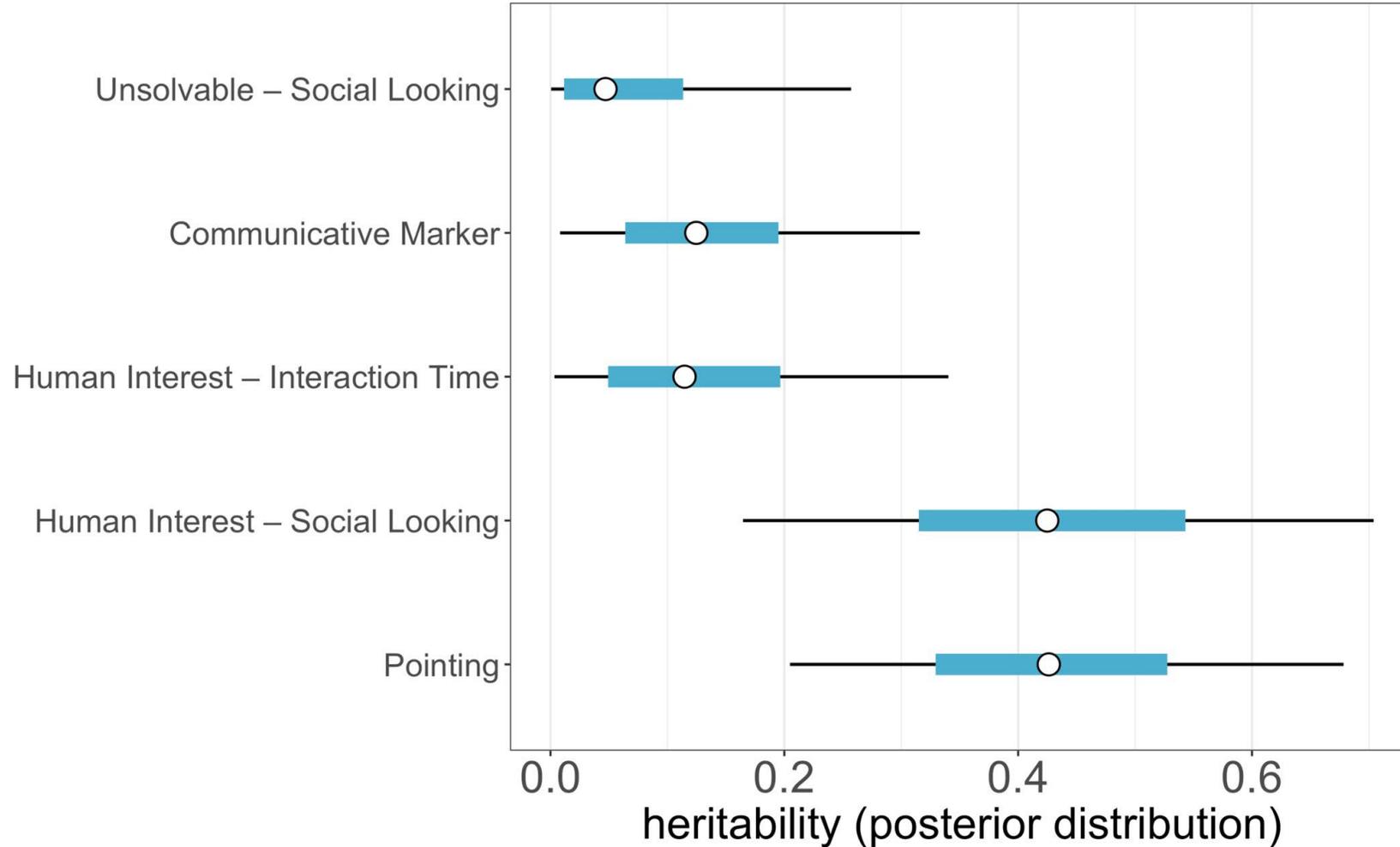
Feb 2017 – June 2020

**$N = 375$  puppies**

- 98 Labrador retrievers
- 23 Golden retrievers
- 254 Lab-Golden Crosses

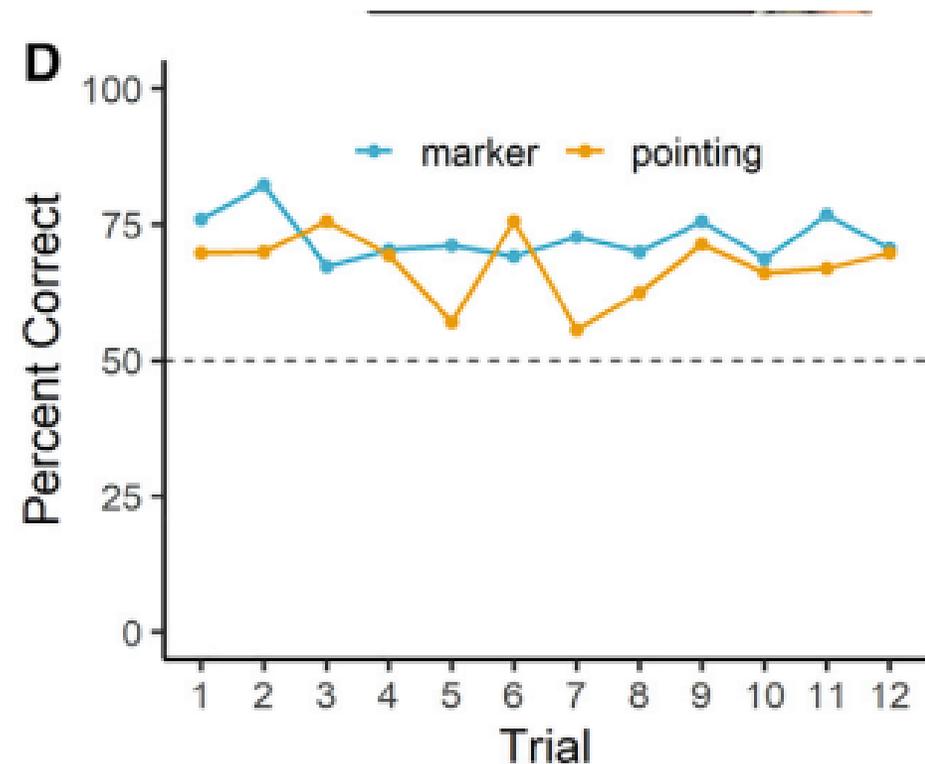
**Mean age = 8.5 weeks**

# Heritability estimates across social tasks



# Further evidence for biological preparedness

- Dogs performing above chance at a very young age
- No evidence of learning over the trial
- All dogs tested very young, shortly after weaning and prior to one-on-one puppy raising experience



# Further evidence for biological preparedness

- Dog puppies outperform wolf puppies on social but not nonsocial tasks



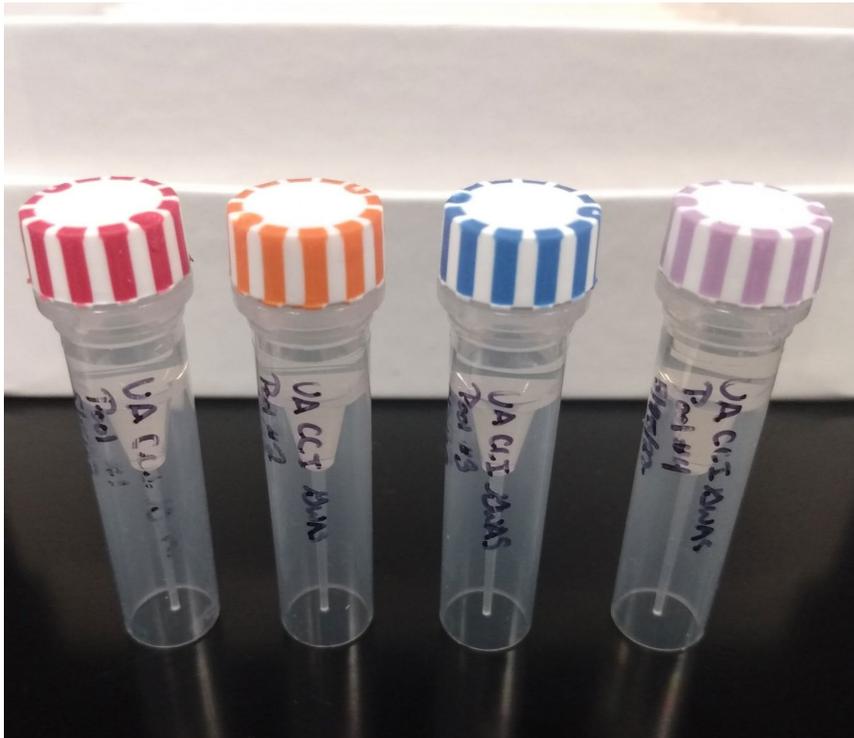
# Conclusions

- First direct evidence that social skills are heritable, and therefore could have been selected for over the course of domestication



# Which **genes** influence social skills?

- We're pursuing this question through a **genome-wide association study**



1,073 dogs with whole genome sequences

~6.5 million sites with good representation and variability between dogs

**Analyses are underway – stay tuned!**



# Which **genes** influence social skills?



# Roadmap

## What contributes to individual variation in cognition and behavior over the life course?



- How early do **cognitive skills** emerge, and how do they change or stay the same over development?

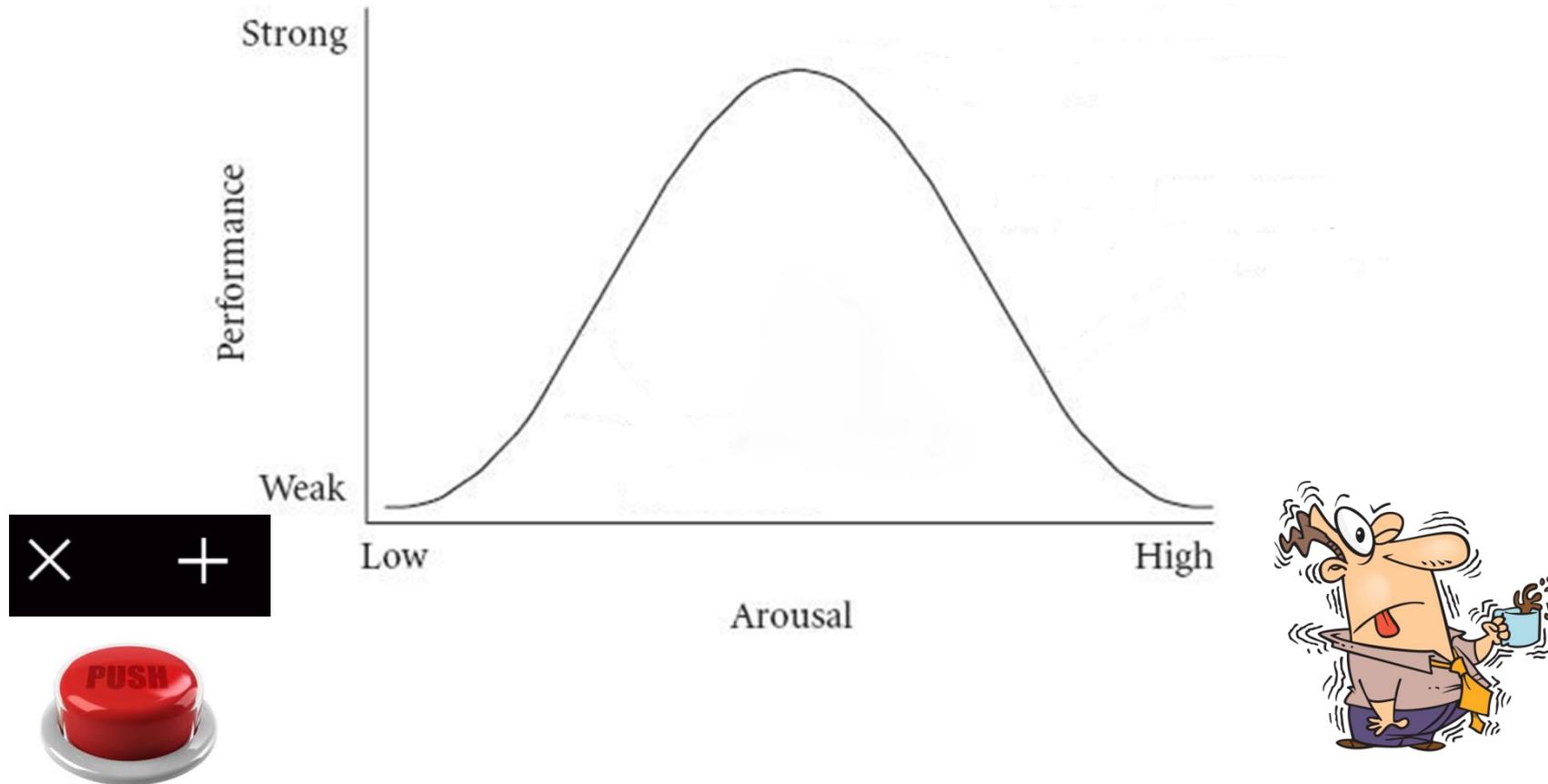
- How much of the individual differences that we see in cognitive skills are due to **genetics**?

- What is the role of **contextual factors** in shaping cognition and behavior?

# How does arousal level impact inhibitory control?



# The Yerkes-Dodson Law



van der Meere JJ, Stemerding N, Gunning, B. (1995)

Revelle, Amaral, Turriff (1976)

# How does arousal level impact inhibitory control?

Who were the subjects?

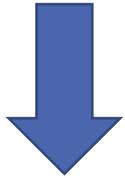


Pet  
Dogs  
(N = 30)

Assistance  
Dogs  
(N = 76)

# How does arousal level impact inhibitory control?

Who were the subjects?

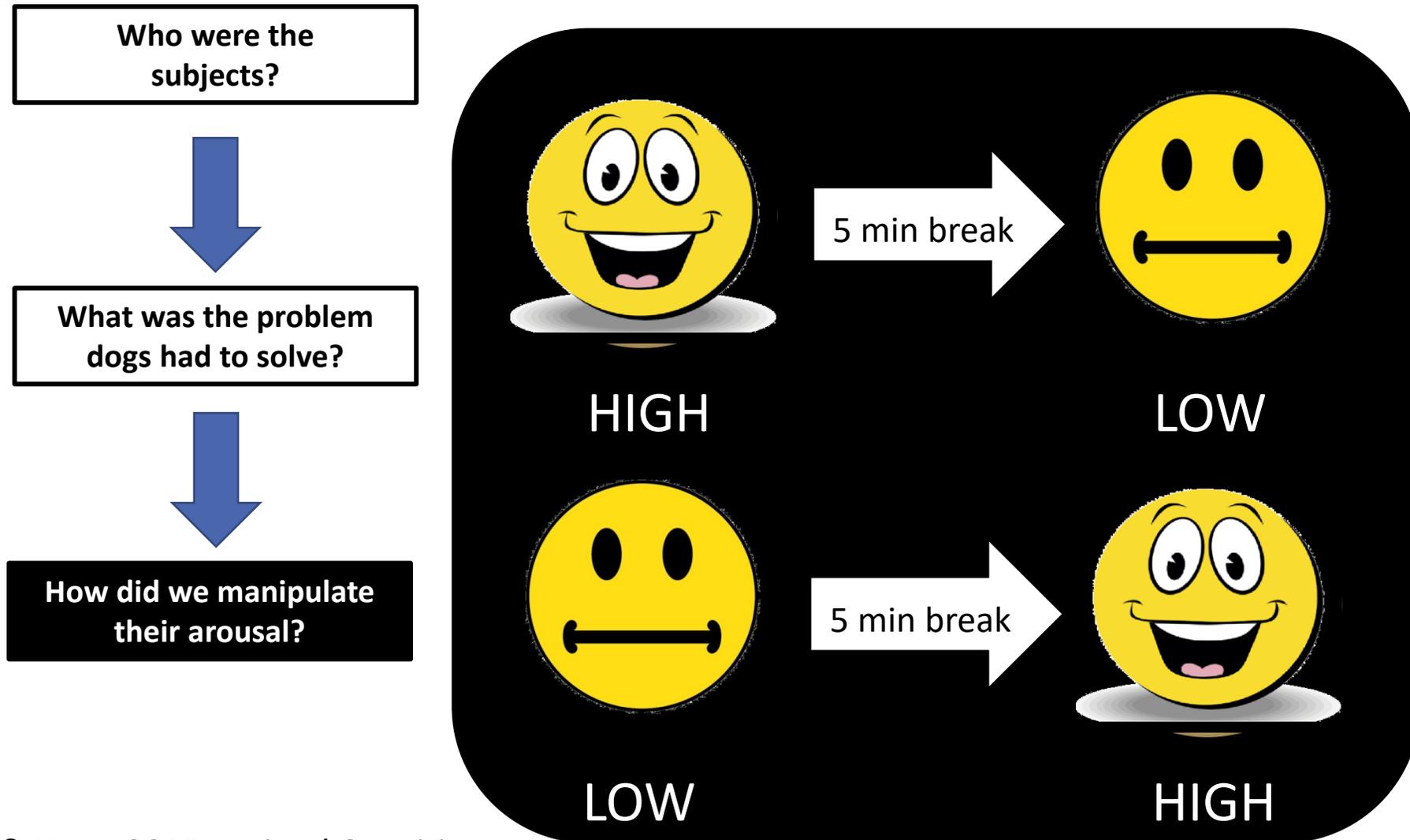


What was the problem dogs had to solve?

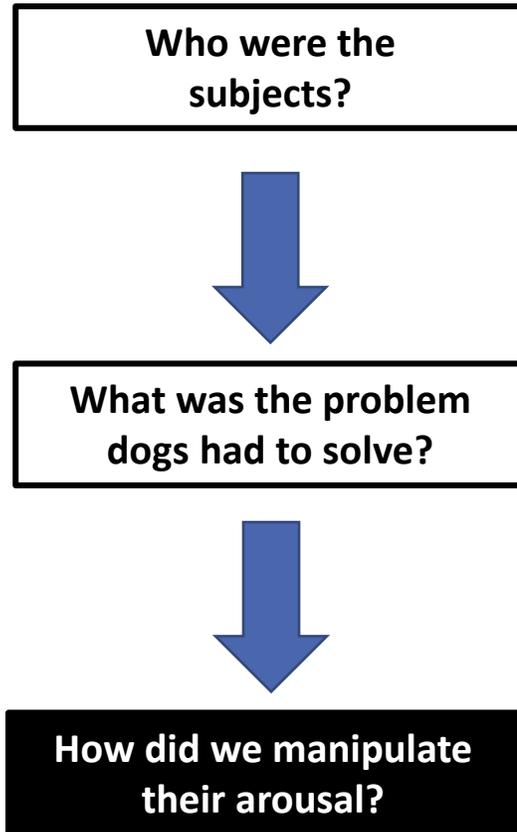


Performance on a detour task

# How does arousal level impact inhibitory control?



# How does arousal level impact inhibitory control?



Arousal Detour Task:  
Familiarization Trial

Bray, MacLean, & Hare 2015

# How does arousal level impact inhibitory control?

Who were the subjects?



What was the problem dogs had to solve?



How did we manipulate their arousal?



**Composite score =**

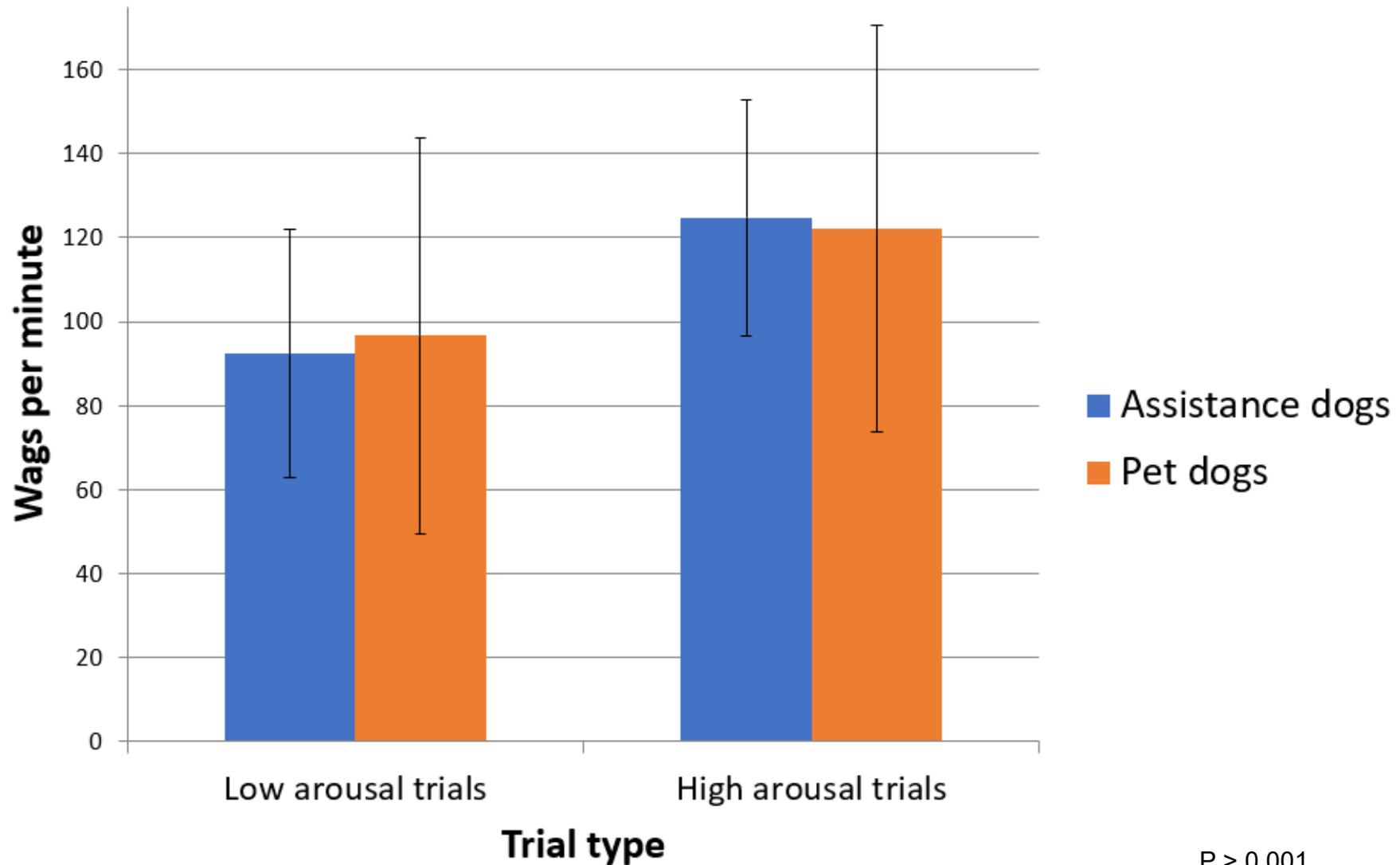
Time to Success (seconds/120) +

Touch (Yes/No = 1/0) +

Pathway (Front/Around = 1/0)

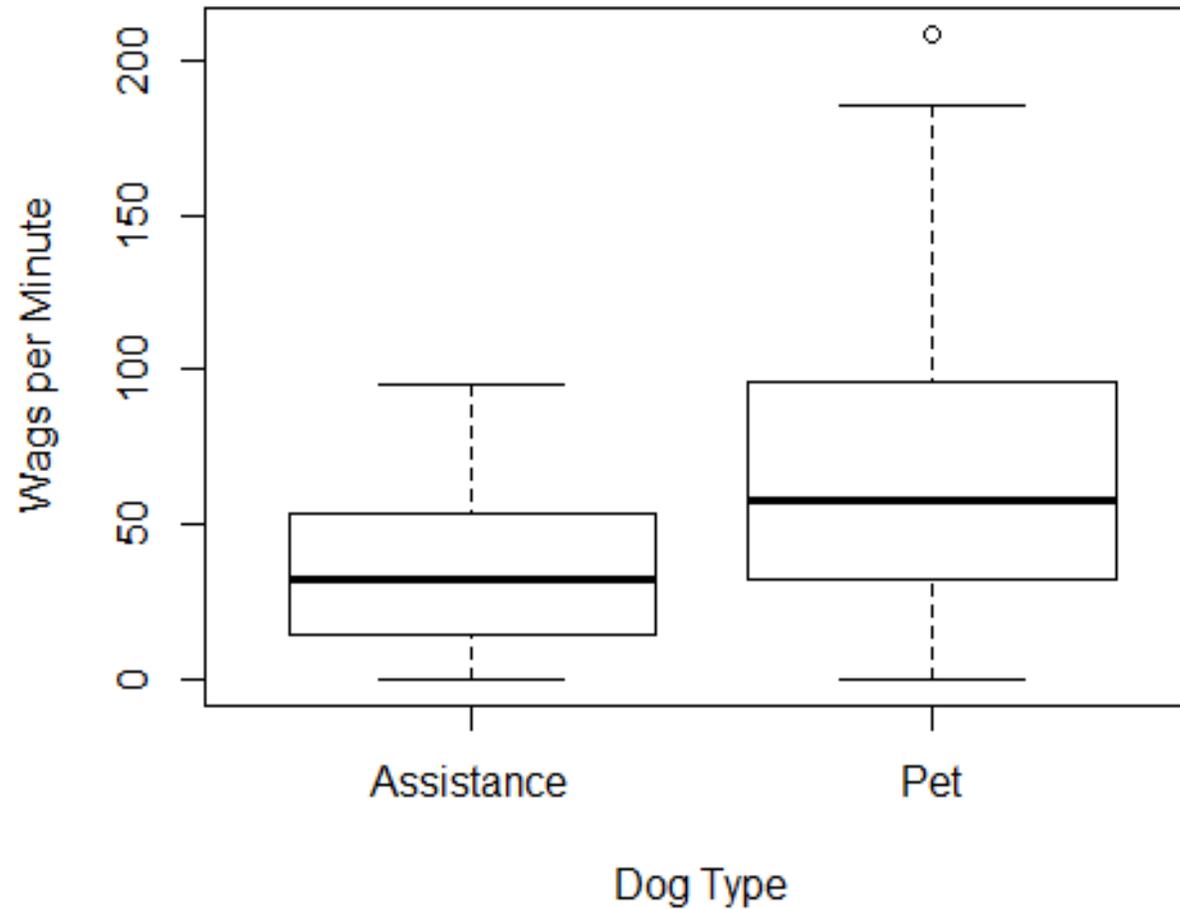
LOWER score = BETTER performance

# Our manipulation was effective



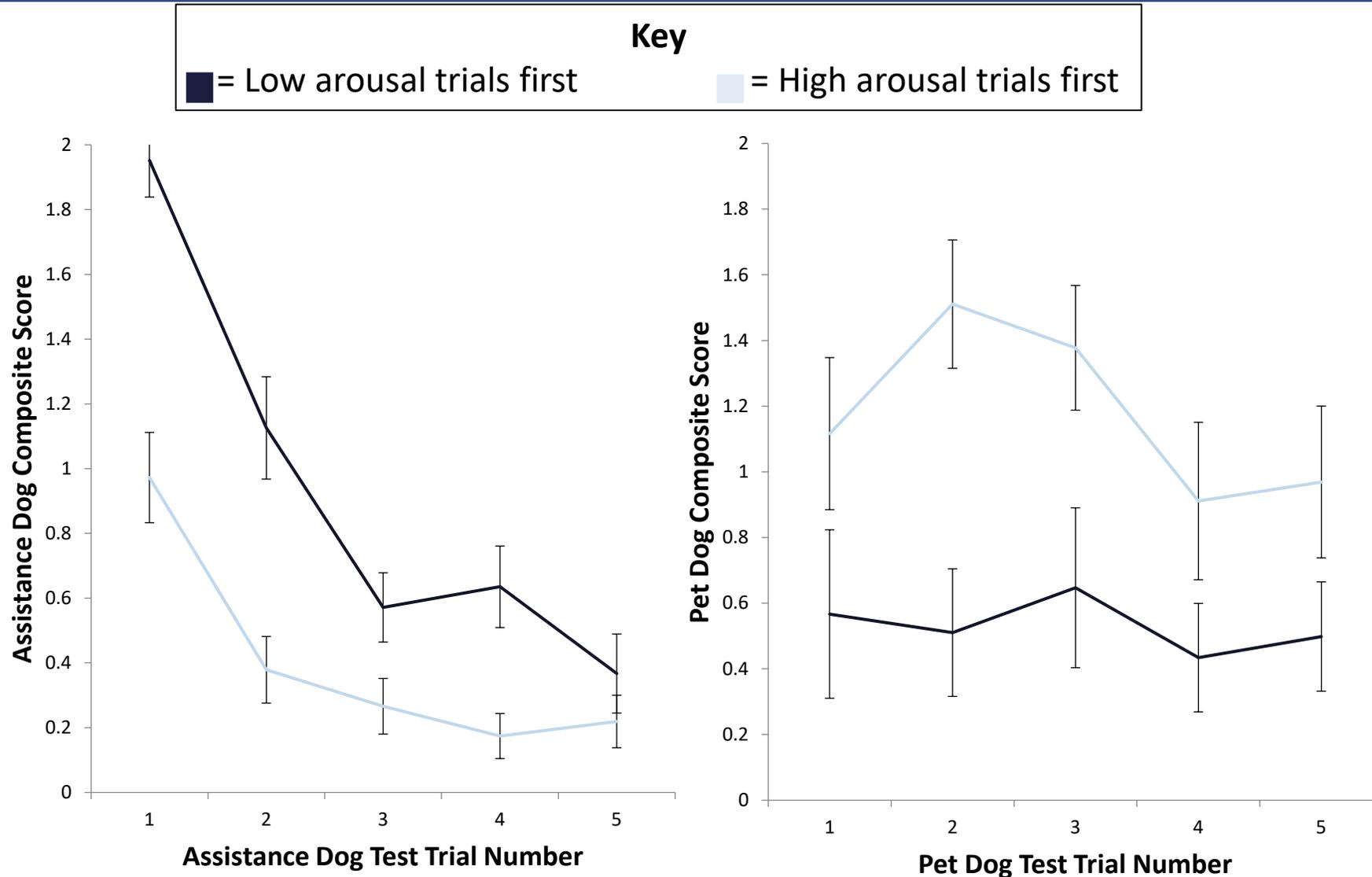
P > 0.001  
Paired-sample t-test

# Baseline tail wagging rates differed across groups

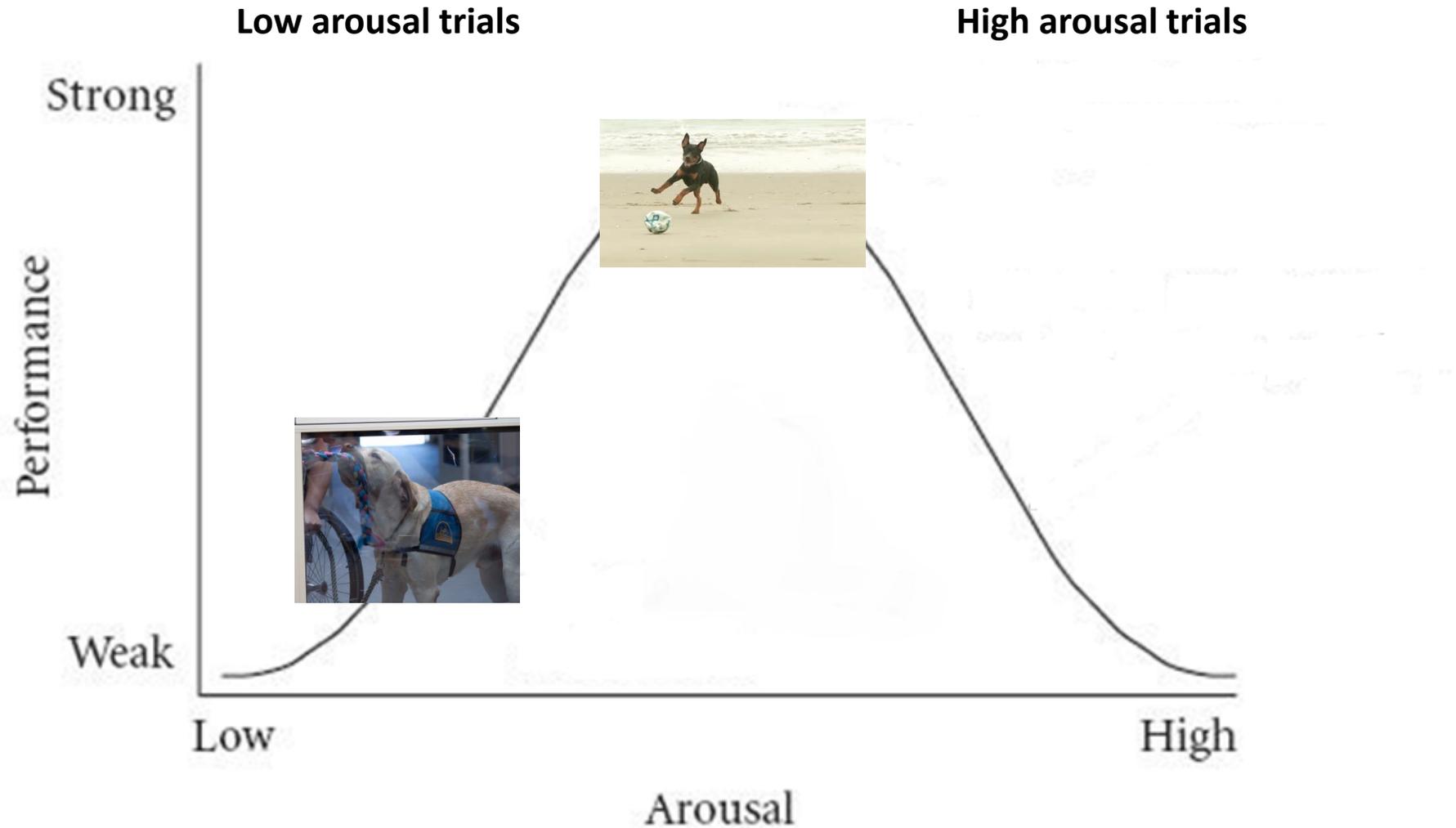


P > 0.01  
Two-sample Independent t-test

# So what did we find?



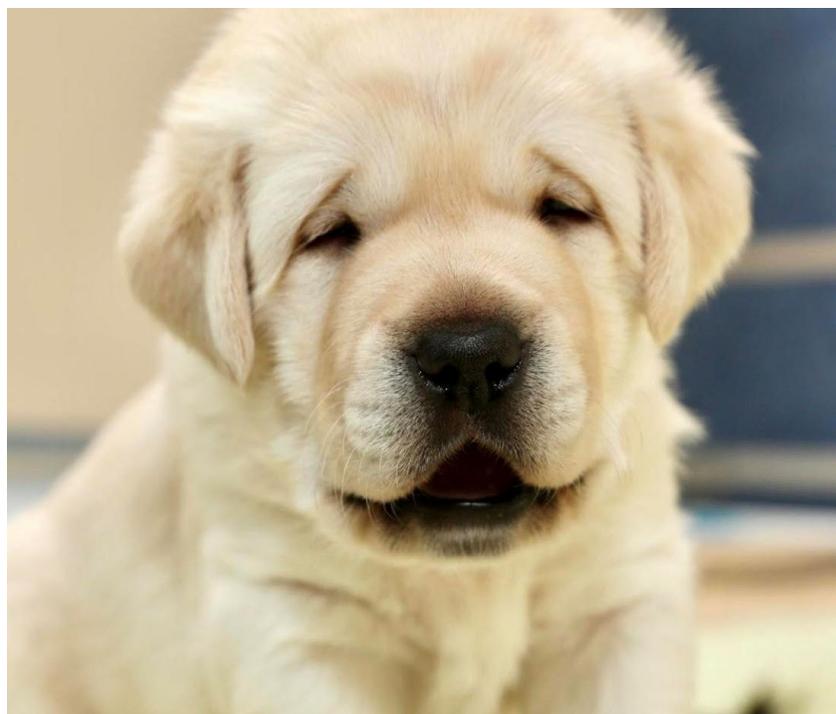
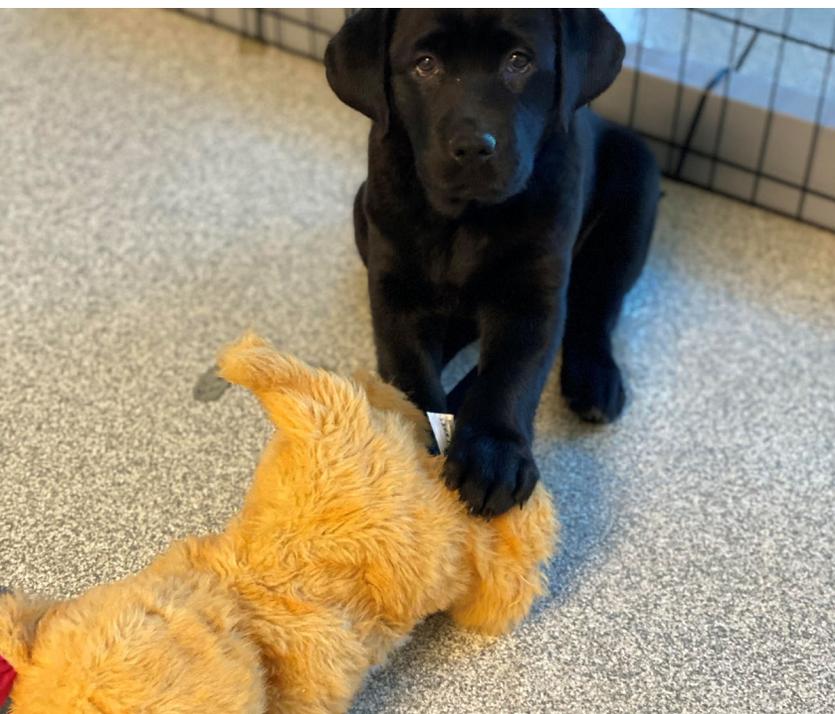
# Yerkes-Dodson applied to the arousal detour task



# Conclusions

- Optimal problem-solving conditions varied between the groups of dogs









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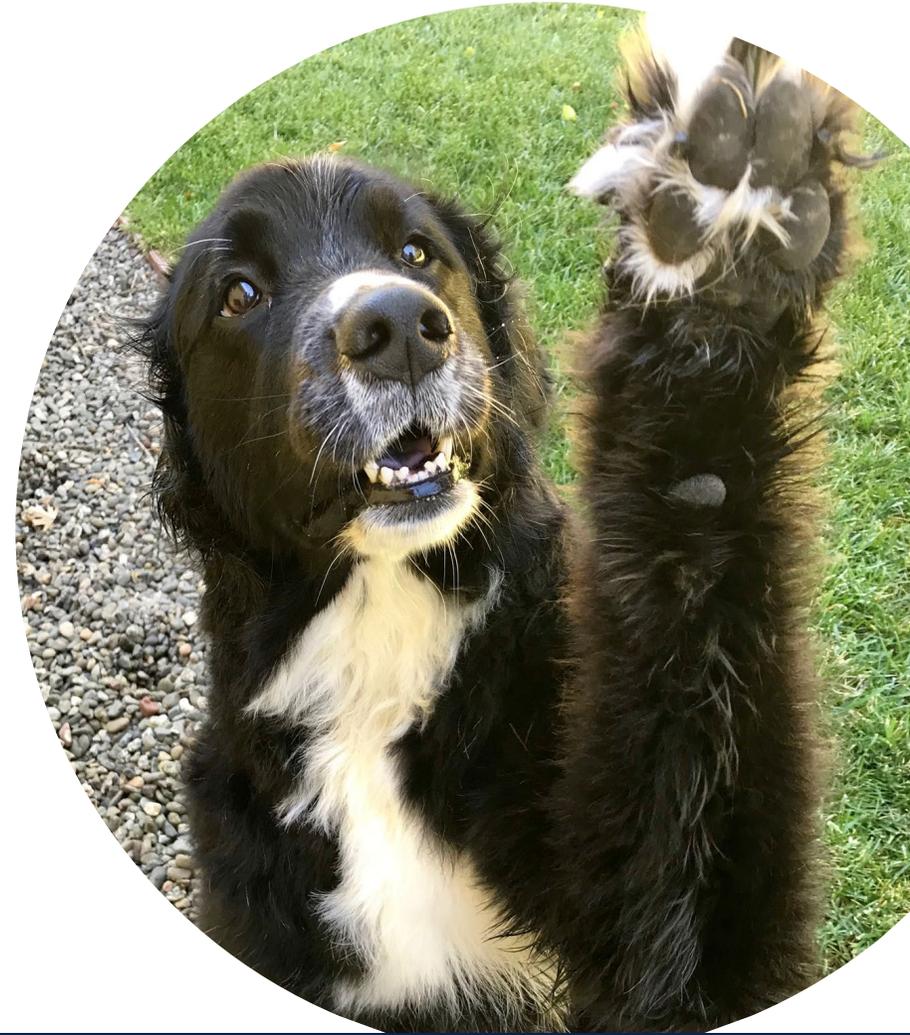
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# Questions?



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