ANIMAL COGNITION 2

IPAM Tutorials

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TUTORIAL OUTLINES

- Why study animal cognition?
- Historical overview
- Human bias
- Methods for studying animals
- *What* animals learn
- *How* animals learn

- Space
  - (Navigation)
- Number
  - (Approx vs. Exact)
- Objects
  - (Tool use)
- Other animals

- Communication
- Theory of mind
- Episodic memory
- Flexibility
- Metacognition
- Animals vs. AI

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Possible seminar topic?

COMMON DICHOTOMIES

- Innate vs. learned
- Behaviorism vs. cognitive approach
- Implicit vs. explicit knowledge

HUMAN BIASES BIAS THE QUESTIONS WE ASK AND LEAD TO SKEWED CONCLUSIONS

This can result in both over and under-attribution of abilities in other species

DO ELEPHANTS MAKE FUTURE PLANS WITH OTHERS?

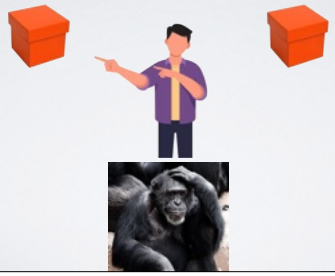
No, they are vocalizing below our hearing range

Payne, K. B., Langbauer, W. R., & Thomas, E. M. (1986). Infrasonic calls of the Asian elephant (Elephas maximus). *Behavioral Ecology and Sociobiology, 18*, 297-301.

CASE STUDY: COOPERATIVE COMMUNICATION

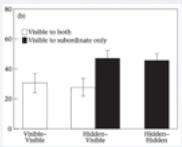
- e.g., man with the hat

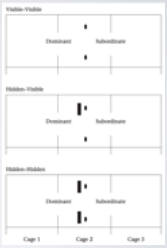
INTERPRETING COOPERATIVE CUES



PERSPECTIVE TAKING IN **COMPETITION**

- Understanding what others can and can't see
- Important in both cooperation and competition
- Examples:
  - Mating/flirting where you can't be seen
  - Hiding things where you can't be seen
  - Competing for food others can't see





Hare, B., Call, J., Agnetta, B., & Tomasello, M. (2000). Chimpanzees know what conspecifics do and do not see. Animal Behaviour, 59(4), 771-785.

OUTLINE

- Why study animal cognition?
- Historical overview
- Human bias
- **Methods for studying animals**

CONDITIONING DEMO

COMPARED TO AI, ANIMALS SHOULD BE EASY TO UNDERSTAND

- Physical bodies interacting in a shared 3D world
- Similar goals (e.g., eat, shelter, mate)
- Similar neural circuitry
- Similar endocrine systems
- Similar perceptual systems

But we often get it wrong!

SUCCESS VS. UNDERSTANDING

Task success but via different understanding

"shortcut" learning

Watanabe, S., Sakamoto, J., & Wakita, M. (1995). Pigeons' discrimination of paintings by Monet and Picasso. *Journal of the experimental analysis of behavior*, 63(2), 165-174.

Wu, W., Moreno, A. M., Tangen, J. M., & Reinhard, J. (2013). Honeybees can discriminate between Monet and Picasso paintings. *Journal of Comparative Physiology A*, 199, 45-55.

CHALLENGES TO ASKING COMPARATIVE QUESTIONS

Wild animals

- Is the task/challenge/learning really comparable?
- Are you capturing all the relevant variables?
- LOTS of natural variation!

Captive animals

- Is the task/challenge/learning really comparable?
- You can develop ***identical*** tasks to test animals across species, but are they analogous?
  - e.g., operating an apparatus with no hands or in water

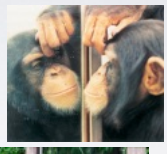
DESIGNING COMPARABLE TASKS

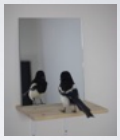
- Non-verbal?
- Require training?
- Similar difficulty?
- Equal access across individuals?
- Bias particular senses?
- Require particular body plan?
- Limited to particular scale?
- Limited to particular domains?

CASE STUDY: MIRROR SELF-RECOGNITION

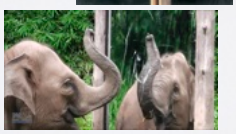
Unusual behavior
- Look at inaccessible parts of body

Mark test
- Touch visible mark but not invisible one





Relies on sight!



HOW CAN WE KNOW WHAT OTHER MINDS UNDERSTAND?

Animal cognition experiments use **iterated control conditions** and **transfer tasks** to rule out "shortcut" solutions

INFERENTIAL REASONING

Example study designs

Inferring presence from physical cues

Inferring presence from auditory cues

Inferring presence from absence

Call, J. (2004). Journal of Comparative Psychology, 118(2), 232.
Call, J. (2006). Animal cognition, 9, 393-403.
Hill, A., Collier-Baker, E., & Suddendorf, T. (2011). J Comparative Psychology, 125(1), 91.
Mikolasch, S., Kotrschal, K., & Schloegl, C. (2011). Biology Letters, 7(6), 875-877.
Völter, C. J., & Call, J. (2012). Animal Cognition, 15, 923-936.

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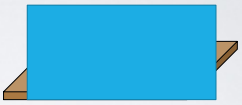
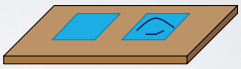
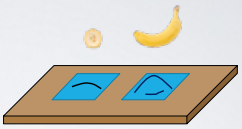
Inferring presence from absence

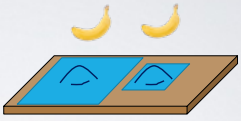






Understanding Check:

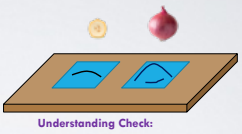
CHOOSE LARGER?



Understanding Check:

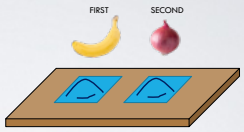
CHOOSE LARGER MAT?

CHOOSE RELATIVELY LARGER LUMP?



Understanding Check:

CAN THEY INHIBIT LARGER AND CHOOSE MORE VALUABLE?



Understanding Check:

CHOOSE FIRST/LAST SEEN?

Example study designs

Inferring presence from physical cues

Inferring presence from auditory cues

Inferring presence from absence

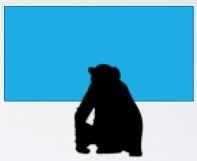
RATTLE

Example study designs

Inferring presence from physical cues

Inferring presence from auditory cues

Inferring presence from absence



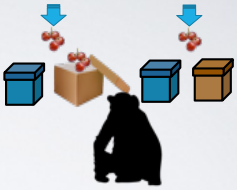
Understanding Check:

AVOID OPENED BOX → CHOOSE NEXT ONE?

Understanding Check:

AVOID EMPTY BOX → CHOOSE FARTHEST AWAY?

AVOID EMPTY BOX → CHOOSE NEXT ONE?



PHYSICAL VS. SOCIAL COGNITION

WHAT COUNTS AS SOCIAL LEARNING?

2021 paper on social learning in AI

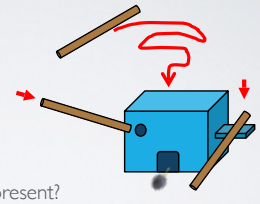
Is it really *SOCIAL?*

Animal cognition distinguishes learning **from** others vs. learning **around** others

Ndousse, K. K., Eck, D., Levine, S., & Jaques, N. (2021). Emergent social learning via multi-agent reinforcement learning. In International Conference on Machine Learning (pp. 7991-8004). PMLR.

LEARNING FROM OTHERS

- Imitation
- Emulation
- Affordance learning
- Stimulus enhancement
- Do they need a model?
- Do they need a social partner present?

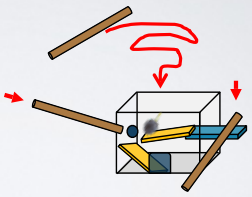


Whiten, A., Spiteri, A., Horner, V., Bonnie, K. E., Lambeth, S. P., Schapiro, S. J., & De Waal, F. B. (2007). Transmission of multiple traditions within and between chimpanzee groups. Current Biology, 17(12), 1038-1043.

Horner, V., & Whiten, A. (2005). Causal knowledge and imitation/emulation switching in chimpanzees (Pan troglodytes) and children (Homo sapiens). Animal cognition, 8, 164-181.

Call, J., & Carpenter, M. (2002). Three sources of information in social learning.

LEARNING FROM OTHERS



WHOM DO THEY LEARN FROM?

- Prestige
- Expertise
- In-group
- Personal relationship
- Model demographics (e.g., language)
- Model characteristics (e.g., trustworthiness)
- Others' preferences