

# The Cognitive Science of Artificial Intelligence

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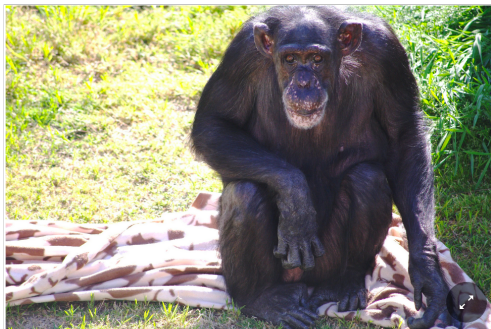
September 6, 2022

# Is a bat 'intelligent'?



Nagel, Thomas (1974). "What Is It Like to Be a Bat?." *The Philosophical Review*. 83 (4): 435–450.  
<https://doi.org/10.2307/2183914>

# Is a chimp 'intelligent'?

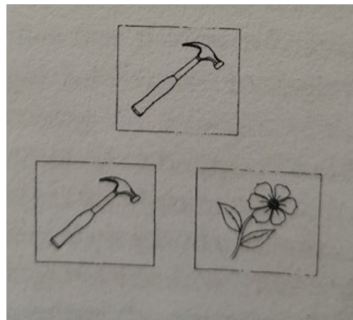
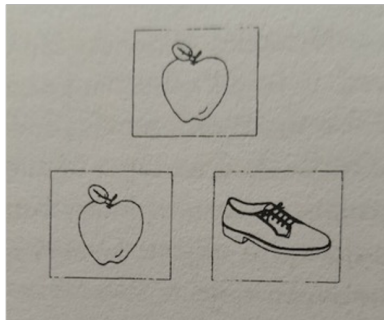


Sarah, among the most studied of chimpanzees, was born in Africa and lived in Missouri, California and Pennsylvania since the mid-1960s. Amy Fultz/Chimp Haven

Tomasello, M. "What is it like to be a chimpanzee?."  
Synthese 200, 102 (2022).  
<https://doi.org/10.1007/s11229-022-03574-5>

# What can humans do that animals can't?

Match to Sample (Holyoak and Thagard, *Mental Leaps*, 1996)

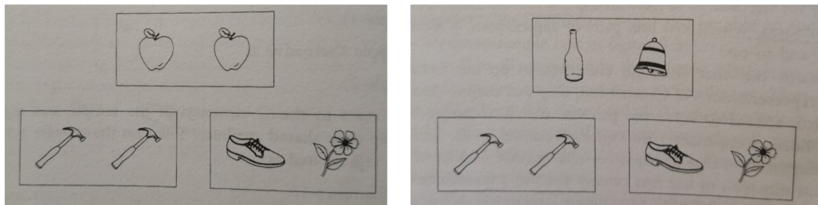


- The simplest type, similarity
- which picture on the bottom matches the one on the top?
- Humans, Chimps, Monkeys and Pigeons can all solve this problem



# Transferring Skills: the basics

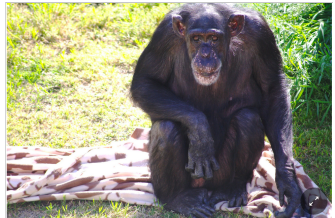
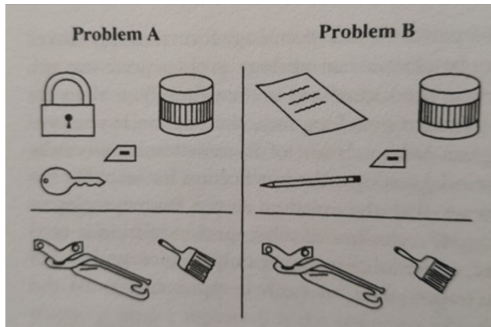
## Matching Relations (Holyoak and Thagard, *Mental Leaps*, 1996)



- Matching relations (left: same; right: different)
- Humans, Chimps, Monkeys can solve this problem
- Pigeons cannot

# Transferring Skills: the basics

## Matching functions (Holyoak and Thagard, *Mental Leaps*, 1996)

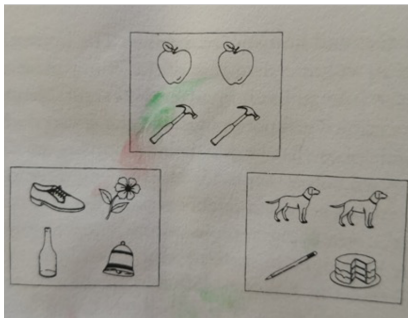


Sarah, among the most studied of chimpanzees, was born in Africa and lived in Missouri, California and Pennsylvania since the mid-1960s. Amy Pulva/Chimp Haven

- Matching functional relations
- left: key is to lock as X is to tin of food?
- right: pen is to paper as X is to can of paint?
- Humans can solve this problem easily
- One chimp (Sarah): only non-human animal to do so
- Monkeys and Pigeons cannot do it

# Transferring Skills: the basics

## Matching relations over relations (Holyoak and Thagard, *Mental Leaps*, 1996)



(ignore smudge)

- “system level”
- Matching relations between relations (above: same-ness)
- Humans can solve this problem, no other animal can
- Chimps show intentionality, (some) rationality, but **no social normativity**



# Goals of Artificial Intelligence Research

- Scientific: Understand the Principles that make intelligent behaviour possible in natural or artificial systems
  - ▶ **analysis** of natural and artificial agents
  - ▶ **testing hypotheses** about the construction of intelligent agents
  - ▶ **building and experimenting with** intelligent agents
- Engineering: **Design** and **build useful** intelligent artifacts

# Conversations

**ELIZA - (1966 Joseph Weizenbaum, Lisp)**

ME: Hi

ELIZA: How do you do? What brings you to see me?

ME: I'm thinking of taking a course in artificial intelligence.

ELIZA: Why do you say that?

ME: I'm worried about it

ELIZA: Are you worried often?

ME: when I take AI courses

ELIZA: What happened when you take ai courses?

ME: I usually spend long nights doing assignments

ELIZA: Earlier you said you felt worried?

ME: about AI courses

ELIZA: Maybe your plans have something to do with this.

ME: no

ELIZA: Why not?

ME: because I think you are a computer

ELIZA: Is it because you think I am a computer that you came to me?

# Loebner Prize

CONFEDERATE: Hello, my name is Sam and I am the human

JUDGE: Hi Sam, tell me which is larger, a TV screen or Belgium.

CONFEDERATE: Belgium is a little bit larger.

JUDGE: Wljso lwjejo wleje elwjeo wjeol, isn't it?

CONFEDERATE: Is that Polish?

...

JUDGE: Which is further away from this apartment, Queens or the Queen of England?

CONFEDERATE: If the Queen is visiting Manhattan, she is closer.

JUDGE: If the Queen is visiting Manhattan, won't she want to abdicate?

CONFEDERATE: I would.

JUDGE: You would rather not be Queen, then, right?

CONFEDERATE: I'd like to be Queen, but England's damp. How about you?

# Loebner Prize

Jabberwacky (Rollo Carpenter)

JABBERWACKY: Hello, my name is George and I am the human.

JUDGE: If Isjkel lwehlx wouldn't you say?

JABBERWACKY: No, he's still good.

...

JUDGE: Which is further away from us, Queens or Inner Mongolia?

JABBERWACKY: HA! HA! That was stupid. Tell me a GOOD joke this time.

...

JUDGE: Which is larger, your brain or Belgium?

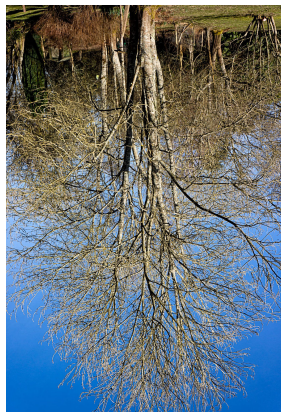
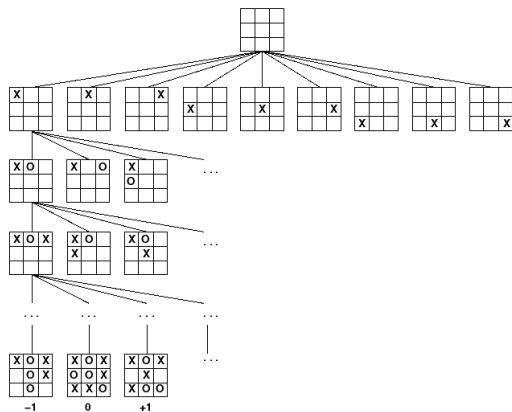
JABBERWACKY: Oh the one on the far left without a doubt.



# Game Playing

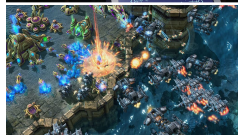
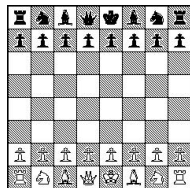
Two person, Zero-Sum games (competitive)

Game tree:



# Chess, Go, Atari, Starcraft...

- **Tic-Tac-Toe:**  $10^5$  nodes
- number of neurons in the brain:  $10^{11}$
- Number of electrons in the universe:  $10^{80}$
- **Chess:**  $10^{100}$  nodes: IBM Deep Blue
- **Go:**  $10^{360}$  nodes: Deep Mind AlphaGo
- Number of distinct 1Kb files:  $10^{2466}$
- **Starcraft:**  $10^{3600000}$  nodes +  $10^{200}$  actions: Deep Mind



# Machines can match humans, or can they?

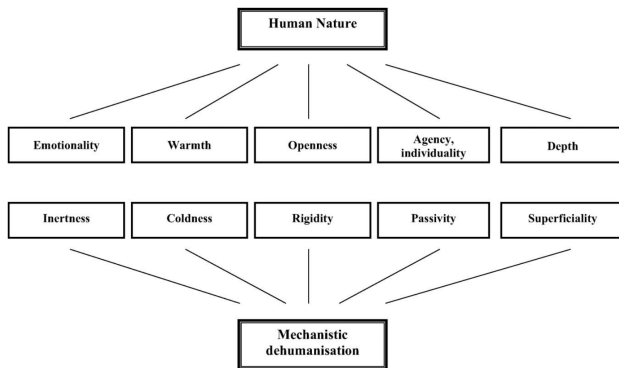


[theoatmeal.com/blog/google\\_self\\_driving\\_car](http://theoatmeal.com/blog/google_self_driving_car)

# Machines can match humans, or can they?



# Animals, Machines and Humans

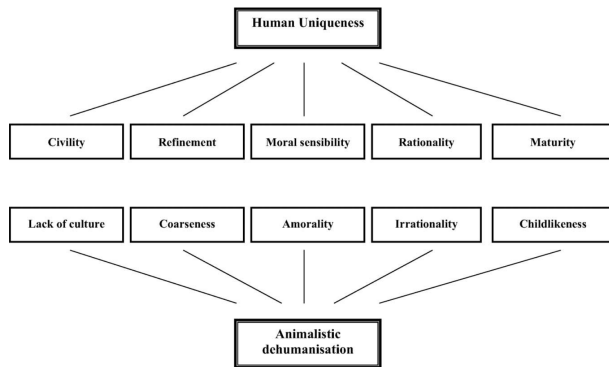


**Figure 3.** Schematic representation of human nature and mechanistic dehumanisation (adapted from Haslam, 2006).

From: Nick Haslam, Stephen Loughnan, Yoshihisa Kashima and Paul Bain (2009). Attributing and Denying humanness to others. *European Review of Social Psychology*, 19:1, 55-85,

<https://doi.org/10.1080/10463280801981645>

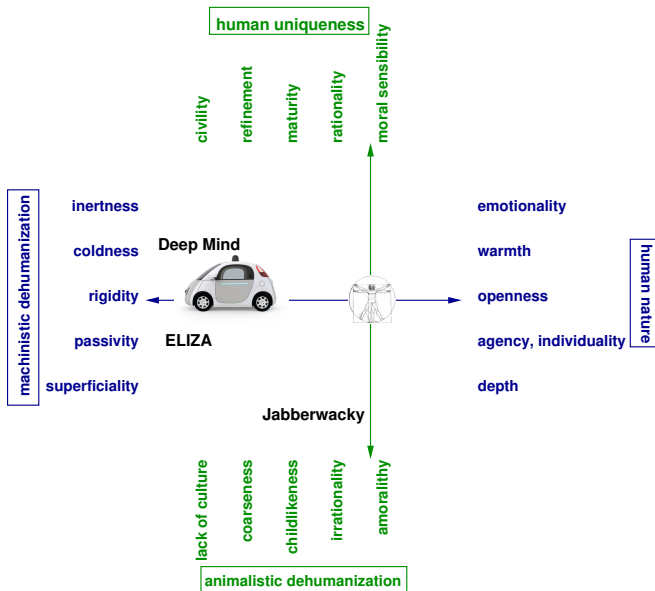
# Animals, Machines and Humans



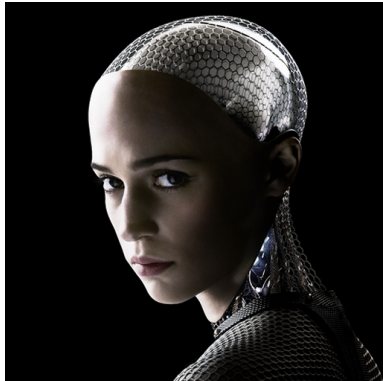
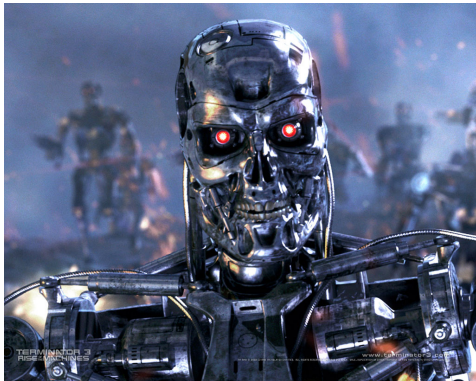
**Figure 2.** Schematic representation of human uniqueness and animalistic dehumanisation (adapted from Haslam, 2006).

From: Nick Haslam, Stephen Loughnan, Yoshihisa Kashima and Paul Bain (2009). Attributing and Denying humanness to others. *European Review of Social Psychology*, 19:1, 55-85,  
<https://doi.org/10.1080/10463280801981645>

# Animals, Machines and Humans



# The Singularity (von Neumann/Ulam)





# The Future of AI...



I'm sorry Dad, but Siri made me do it.....



someecards  
user card

## Funding:

- American Alzheimer's Assoc.
- Research Institute for Aging
- AGEWELL Canadian NCE
- Trans-Atlantic Partnership (TAP)
- Cheriton Faculty Fellowship
- Graham Faculty Fellowship
- NSERC
- SSHRC
- CIHR
- MITACS
- CCNA



## More Information:

- Bayesian Affect Control Theory: [bayesact.ca](http://bayesact.ca)
- Jesse Hoey: [jhoey@cs.uwaterloo.ca](mailto:jhoey@cs.uwaterloo.ca)