

Lecture 3 - Metaphor

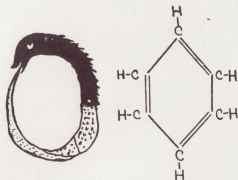
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Readings:

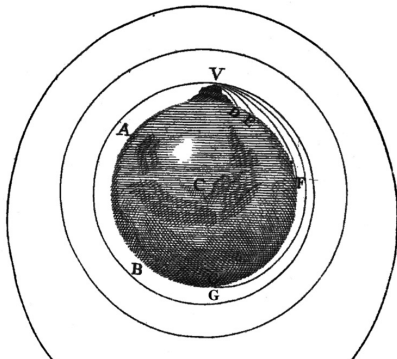
- George Lakoff and Mark Johnson *Metaphors we Live By*, 2nd edition (afterword), 2003.
- Keith J. Holyoak and Paul Thagard *Mental Leaps*, MIT Press, 1995, chapter 3

Analogy in Science



Friedrich August Kekulé perceived the structure of the benzene ring after dreaming of a snake biting its own tail.

- Benzene is a snake
(Kekulé 1865)



- Planets are projectiles
(Newton 1687)
(the mountain would be 800km high)

Analogical innovation

transferral of skills and knowledge



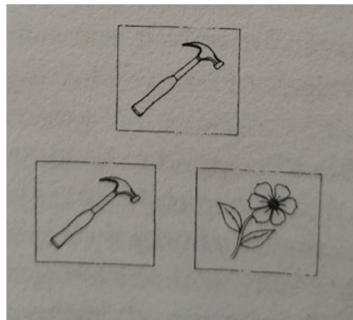
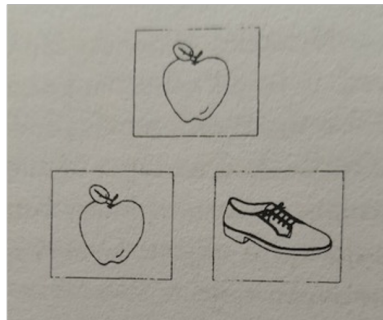
- A plane is a bird:
needs wings, etc



- A mind is a computer:
needs symbols, etc

Transferring Skills: the basics

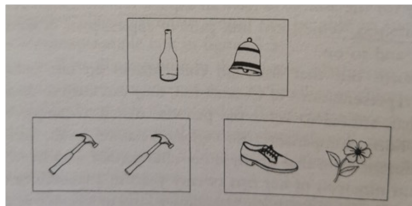
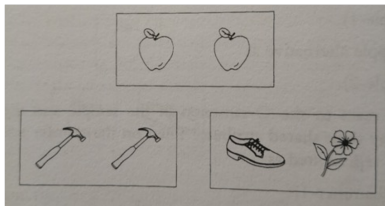
Match to Sample (Holyoak and Thagard, *Mental Leaps*, 1996)



- 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

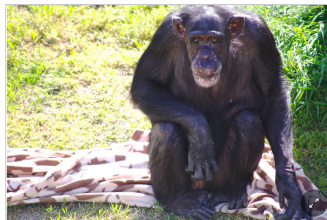
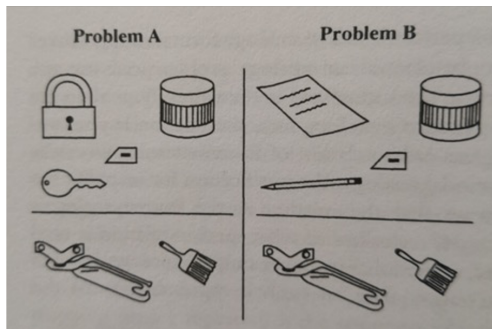
Matching Relations (Holyoak and Thagard, *Mental Leaps*, 1996)



- 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)

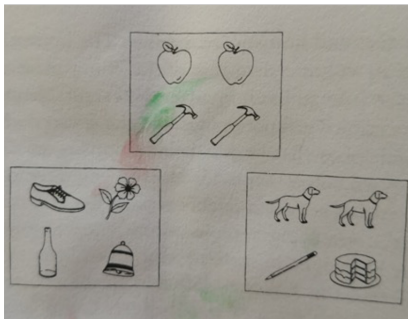


Sarah, among the most studied of chimpanzees, was born in Africa and lived in Missouri, California and Pennsylvania since the mid-1960s. Amy Pulz/Chimp Haven

- 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

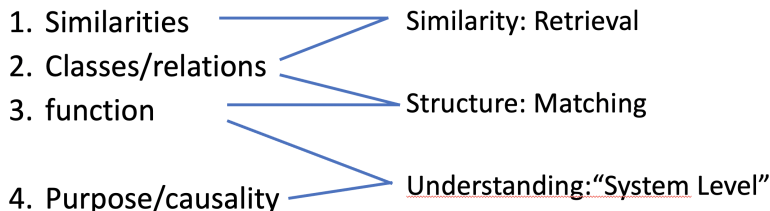
Matching relations over relations (Holyoak and Thagard, *Mental Leaps*, 1996)



(ignore smudge)

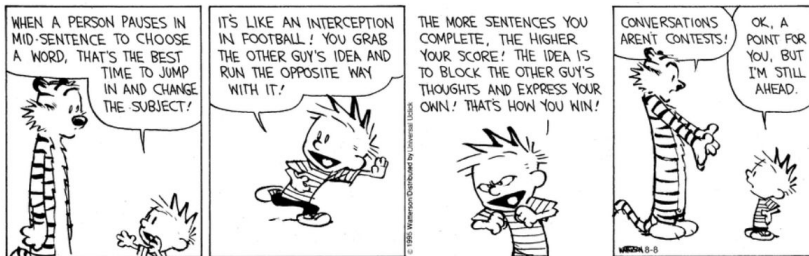
- “system level”
- Matching relations between relations (above: same-ness)
- Humans can solve this problem
- no other animal can

Levels of Analogy



- More complex levels of abstraction: broader categories of meaning that can be transferred
- machine learning: does not tackle "system" level analogy
- merge logic and probability? – limited success
- first order (relational) reinforcement learning may be one way to accomplish "system" level transfer learning,
- can it be done without any symbolic representations?
- involves understanding similarities in relations between relations (of categories of things) using only sparse reward signal

Metaphor: conversations are Contests



Metaphor



"The squeaky wheel gets the grease"

Metaphor



"Im gonna be under the wire"



Metonym



"The ham sandwich wants his check"

- Alices's birthday is **close to** Easter
- Food prices **rose**
- Bob and Alice are **on the rocks**
- Waterloo is a **half hour from** Guelph
- Hank is going **flat out**
- I've got **new wheels** – also a synecdoche
- A's theory is a **cow with no milk**
- The **crown** will **not stand** for this trespass
- The **pen** is mightier than the **sword**

Metaphor:

- connects things across domains
- explains the complex, unique in terms of the simple, universal
- explains the qualitative in terms of the quantitative

Metonym:

- connects things within a domain
- explains things of the same complexity
- explains the quantitative in terms of the quantitative
- explains the qualitative in terms of the qualitative

Heart of Metaphor

The heart of metaphor is inference. (Lakoff & Johnson, p244)

- inferences in sensory domains used to draw inferences about subjective domains
- sensory domains (reality):
space, objects – perceptible, non-symbolic
- subjective domains (language):
justice, love – imperceptible, symbolic
- behavioural choices are based on those inferences
- metaphors matter for human behavior
- as in any mathematical theory: symbols are meaningless without an interpretation in the real world

Historical Fallacies

- metaphor is words, not concepts
- metaphor is based on similarity
- all concepts are literal, none are metaphorical
- rational thought is not shaped by brains and bodies

all these statements have been disproved

Historical Fallacies

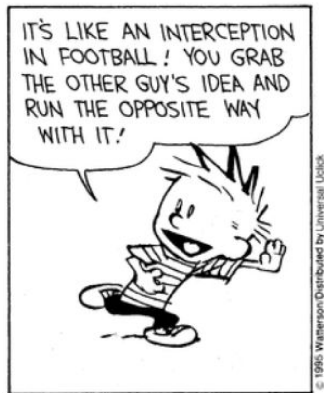
- metaphor is words, not concepts
conceptual, not linguistic
- metaphor is based on similarity
based on cross-domain correlations in our experience
- all concepts are literal, none are metaphorical
time, events, causation, morality, and mind are understood
metaphorically
- rational thought is not shaped by brains and bodies
shaped by shared bodies and environments

all these statements have been disproved

- we systematically use inference patterns from one conceptual domain to reason about another conceptual domain.
- metaphorical mappings are not abstract and arbitrary: shaped and constrained by our bodily experiences that link domains
- A great deal of everyday, conventional language is metaphorical, and the metaphorical meanings are given by conceptual metaphorical mappings that ultimately arise from correlations in our embodied experience.

Emotion

conversations: **contests** or **journeys**?



- because they **feel** the same - either antagonistic, or collaborative
- **feeling/emotion** is what underlies the metaphor, what connects the two concepts together
- **innovation** and novelty are built through metaphorical thought
- **economic growth** is based on innovation

therefore, **economic growth is emotional**

Do the same for **love is a journey** vs. **love is a battlefield**

Primary Metaphor

- based on emotional states (e.g. warmth)
- e.g. affection is warmth
- *"she warmed my heart"*
- neural mappings
- complex metaphors built from the primary metaphors

Structural and Enacted

- inferences: **structural** and **enacted**
- structural: who is doing what to who?
"France fell into a recession and Germany pulled it out"
- enacted:
"John fell in the ditch and Harry pulled him out"
- **Metaphors:**
 - ▶ Nations are people;
 - ▶ Economies are entities that move up or down
 - ▶ a recession is a hole
 - ▶ economic force money.
- **Metonym:**
 - ▶ A nation stands for its economy.
 - ▶ "France" = French economy.

- metaphorical language used constantly by politicians
- political beliefs structured by metaphor
- Conservative: strict father
 - ▶ independence
 - ▶ self-worth
- Liberal: nurturing parent
 - ▶ nurture
 - ▶ care
- constructing emotional metaphors that work is critical in politics
- the metaphorical framing of science may be a big part of data analytics and machine learning

Postmodern thought and LLMs

- “[conceptual metaphor is]...fundamentally **at odds** with certain key tenets of **postmodernist** thought, especially those that claim that meaning is ungrounded and simply an arbitrary cultural construction.”
- Large Language Models are inherently postmodern:
no grounding at all
- LLMs can **interpret** metaphors
 - ▶ Large Language Model Displays Emergent Ability to Interpret Novel Literary Metaphors Nicholas Ichien, Dušan Stamenković, Keith J. Holyoak, 2023
<https://doi.org/10.48550/arXiv.2308.01497>
- can LLMs **generate and use metaphors**?

GPT metaphor generation

USER

A: I am really sad today.

B: Why?

A: I lost my earrings.

B: <insert inventive metaphor that has never been seen before>



ASSISTANT

B: It's like a constellation losing one of its twinkling stars, dimming the night's embrace.

how did you make this metaphor?

To create this metaphor, I drew from the similarities between the qualities of a river and life itself. Here's the thought process:

1. **Identify the subject:** Life.
2. **Find a familiar comparison:** A river is something most people can visualize, and it has characteristics that can align with experiences in life.
3. **Match key attributes:**
 - **Movement:** Life and rivers both have constant motion, symbolizing growth and change.
 - **Twists and turns:** Just as rivers have unpredictable curves, life often throws unexpected challenges and shifts.
 - **Calm vs. turbulent:** Life has both peaceful and chaotic phases, much like the river flowing gently or rushing through rapids.
 - **Progress:** Even when life seems stagnant, there's always some kind of internal or hidden progress, similar to the undercurrent in a river.

By weaving these parallels together, the metaphor connects abstract experiences of life to a natural, more concrete image.

Mark Chen and Yuzhe He

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- How long would it take you to do that analysis?
- Did you have to do that when reading the metaphor?
- Do you have to do that when generating a metaphor?
- Did GPT really go through all that to come up with the metaphor?

Mark Chen and Yuzhe He

GPT metaphor generation

"I'm sad because I lost my earrings"

GPT "interpretations" and other possibilities:

- **subject**: life (loss, sadness, jewelery...)
- **familiar comparison**: river (journey, challenge, veil,...)
- key attributes to analyze the comparison along:
 - ▶ **movement** (stability,...)
 - ▶ **twists and turns** (straight and simple,...)
 - ▶ **calm vs turbulent** (rich vs. poor,...)
 - ▶ **progress** (depression,...)
- how can this comparison be made?
- evidence is that metaphor is **NOT** cognitive like this
- **emotional** interpretations are fast, comparable, non-interpretable
- explanations are **post-hoc** for humans
- explanations are ?? for GPT?

Next Lecture

- Values
- Kahneman Chapters 1-3
- optional: Bales, Mercier and Sperber, Schwartz, etc.