



Can AI Ever Be As Creative As Us?

Mark T. Keane, University College Dublin, Ireland

Global Outline

Session 1

- ***Prologue: Me & Background***
- **Human v Machine Danceoff**

Session 2

- **Intent & Motive in Art**
- **Creative Cognition**
- ***Epilogue: Whither AI?***



Who Are They ? (My GenAI Pet Hates)



PetHate #1

Full AI in 1000 years or 2 years !

Geoff Hinton
Nobel Prize (2024)



BIG Claims

MIT
Technology
Review

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ARTIFICIAL INTELLIGENCE

Large language models can do jaw-dropping things. But nobody knows exactly why.

While GenAI focuses on creativity and the generation of new content, AGI aims to achieve cognitive capabilities comparable to humans across various fields. Addressing the ethical challenges and considerations associated with these new forms of AI is crucial to ensure their responsible and beneficial use for society.

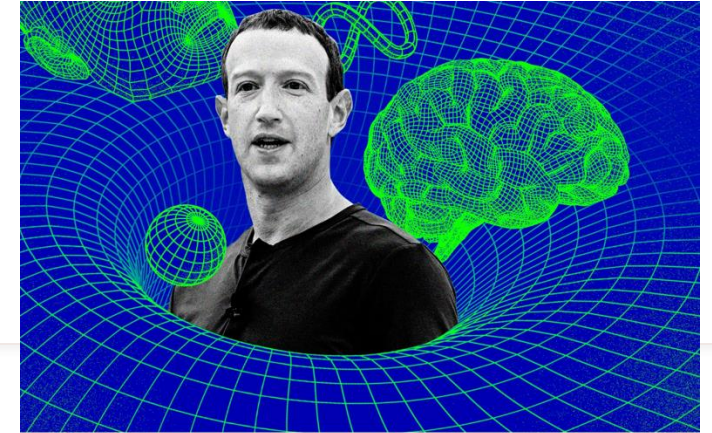


'GPT-4 is the dumbest model any of you will ever have to use' declares OpenAI CEO Sam Altman as he bets big on a superintelligence

News

By [Lloyd Coombes](#) published 22 hours ago

Sam Altman talks at Stanford.



/ The Verge | Photos by Getty Images

Fueling the generative AI craze is a belief that the tech industry is on a path to achieving superhuman, god-like intelligence.



GPT-5 Will Make GPT-4o Look Like a Toddler's Toy!

PetHate #2



Obscene Money...

How Much Companies are Investing in AI (In Billions)



In 2025, \$1B every day, 25% of World R&D Budget!



Dangerous...

PetHate #3

Opinion **The FT View**

The environmental cost of AI

Data centres are becoming some of the biggest consumers of power and water

Google emissions jump nearly 50% over five years as AI use surges

Tech giant's ambition of reaching 'net zero' by 2030 under threat from power demands of artificial intelligence systems

Booming AI demand threatens global electricity supply

Tech chiefs warn that power-hungry data centres are a bottleneck in developing artificial intelligence



FINANCIAL
TIMES

PetHate #4

tech-bro chic

Arrogance...



File This Under *Arrogance*...

- Realising the worst form of Neo-Capitalism...as well a New (Technological) Colonialism
- One encounters many “Young Men in a Hurry”: arrogance in blind pursuit of tech, ignoring personal/social/societal consequences
- No Checks Required: *Guardrails* not *Regulation*

PetHate #5

 power thesaurus

Synonyms for Unscientific

illogical

irrational

fallacious

invalid

unreasonable

Unscientific...

Unacceptable Standards ...

- Unrefereed papers published on blogs, cited heavily ... often subsequently deleted, without explanation !
- The details of these systems are trade secrets and are not revealed; ends up being *look-ma-no-hands* claims
- Blah-blah claims: Chat-GTP-4 will make Chat look stupid !
- No ethical clearance in study scandals...
- Benchmark driven discovery can become superficial



Artificial Intelligence

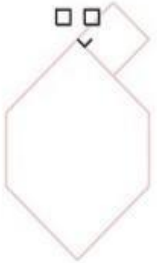
The term artificial intelligence was first coined by John McCarthy in 1956.

Look Ma No Hands...

Draw a unicorn in TikZ (LaTeX package) with ChatGPT vs GPT-4...

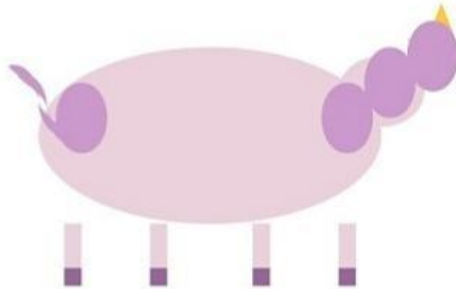
ChatGPT

- Prompt:** Draw a unicorn in TikZ
- ChatGPT:** [Produces LaTeX compiling to following picture]

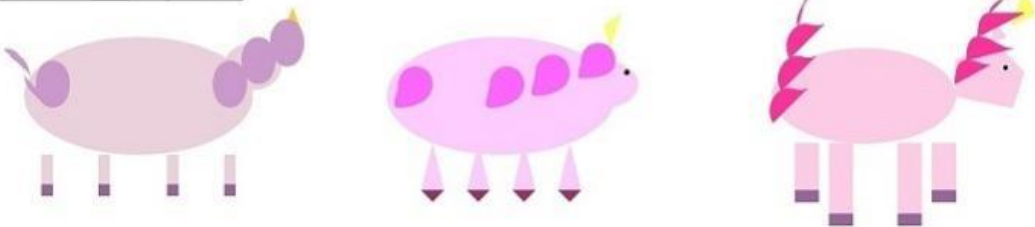


GPT-4

- Prompt:** Draw a unicorn in TikZ
- GPT-4:** [Produces LaTeX compiling to following picture]



GPT-4 Evolution



We queried GPT-4 three times, at roughly equal time intervals over the span of a month while the system was being refined, with the prompt "Draw a unicorn in TikZ". We can see a clear evolution in the sophistication of GPT-4's.

Draw a Unicorn?

Wha...?

Bubeck, S., Chadrasekaran, V., Eldan, R., Gehrke, J., Horvitz, E., Kamar, E., ... & Zhang, Y. (2023, March). *Sparks of artificial general intelligence: Early experiments with gpt-4.* (4k GoogleScholar citations)

Unacceptable Scientific Standards

- Unrefereed papers published on blogs, cited heavily ... often subsequently deleted, without explanation !
- The details of these systems are trade secrets and are not revealed; ends up being *look-ma-no-hands* claims
- Blah-blah claims: Chat-GTP-4 is stupidest ever...
- No ethical clearance in study scandals or lax ethics*...
- Benchmark-driven discovery can become superficial

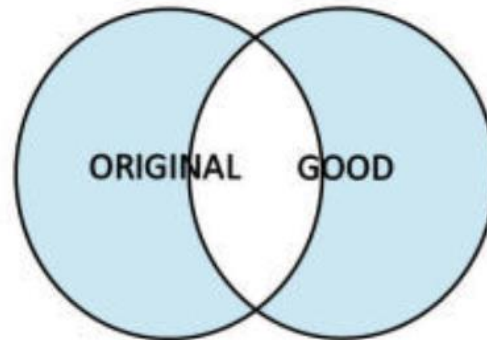
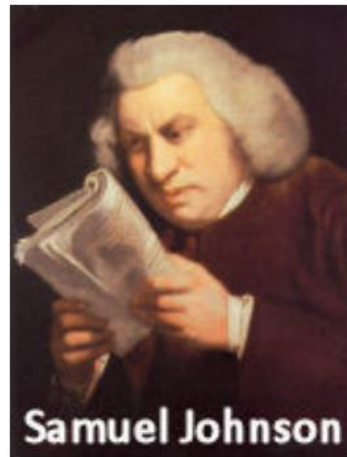


What is Creativity?

Properties of Creative Products

- **Standard Definition** of Creativity mentions *originality* and *effectiveness* (*novel-useful, new-value, unique-utility and so on*)
- Originality: product should be unusual, novel, unique (not mundane, commonplace, conventional)
- Effectiveness: product should be useful, fit or appropriate, has some artistic/practical value
- *Originality* is not sufficient (in itself), nor *Effectiveness*

Your Manuscript Is Good and Original, But What is Original Is Not Good; What Is Good Is Not Original



Dear Quote Investigator: The great lexicographer Dr. Samuel Johnson is credited with a famously devastating remark about a book he was evaluating:

<https://quoteinvestigator.com/2013/06/17/good-original/>

A Few More Properties ...

Recent definitions mentions *intentionality* and *authenticity*

- **Intentionality**: creator intends/originates the product, finds the problem; choices from an intrinsic motivation (incl. problem finding/definition, formulation, construction)
- **Authenticity**: product is an expression of self, of desires, motives, ideals and beliefs (AI can't do this?)

Some argue for: (Macedo & Cardoso 2002; Richie, 2007)

- **Surprisingness**: creative product will be surprising
- **Non-Typical**: creative product will be non-normative

Types of Human Creativity: Cs...

Big-C creativity: unprecedented, renowned, great works of art and science, domain changing; eg. Darwin, Picasso, Kahlo, Curie

Little-c creativity: takes place on a daily basis, novel-to-the-solver solutions to minor problems; eg. combining ingredients from the fridge to make a quick meal, lab studies, jokes



Types of Creativity

- *Normal Thinking* is search in a problem space defined by its operators, constraints, representations
- *Creative Thinking* changes the operators, constraints, representations (can be a type of *meta-search*)

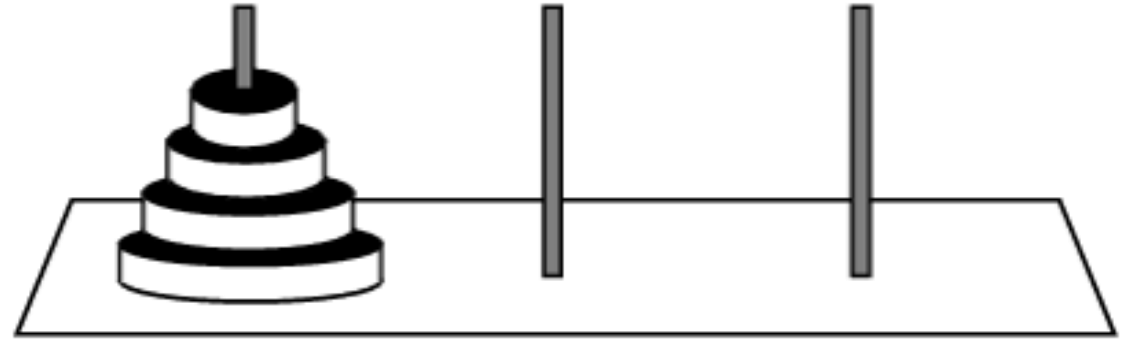


Margaret Boden
(1936-Present)

Boden, M. A. (2004). *The Creative Mind: Myths and Mechanisms*. London: Routledge.

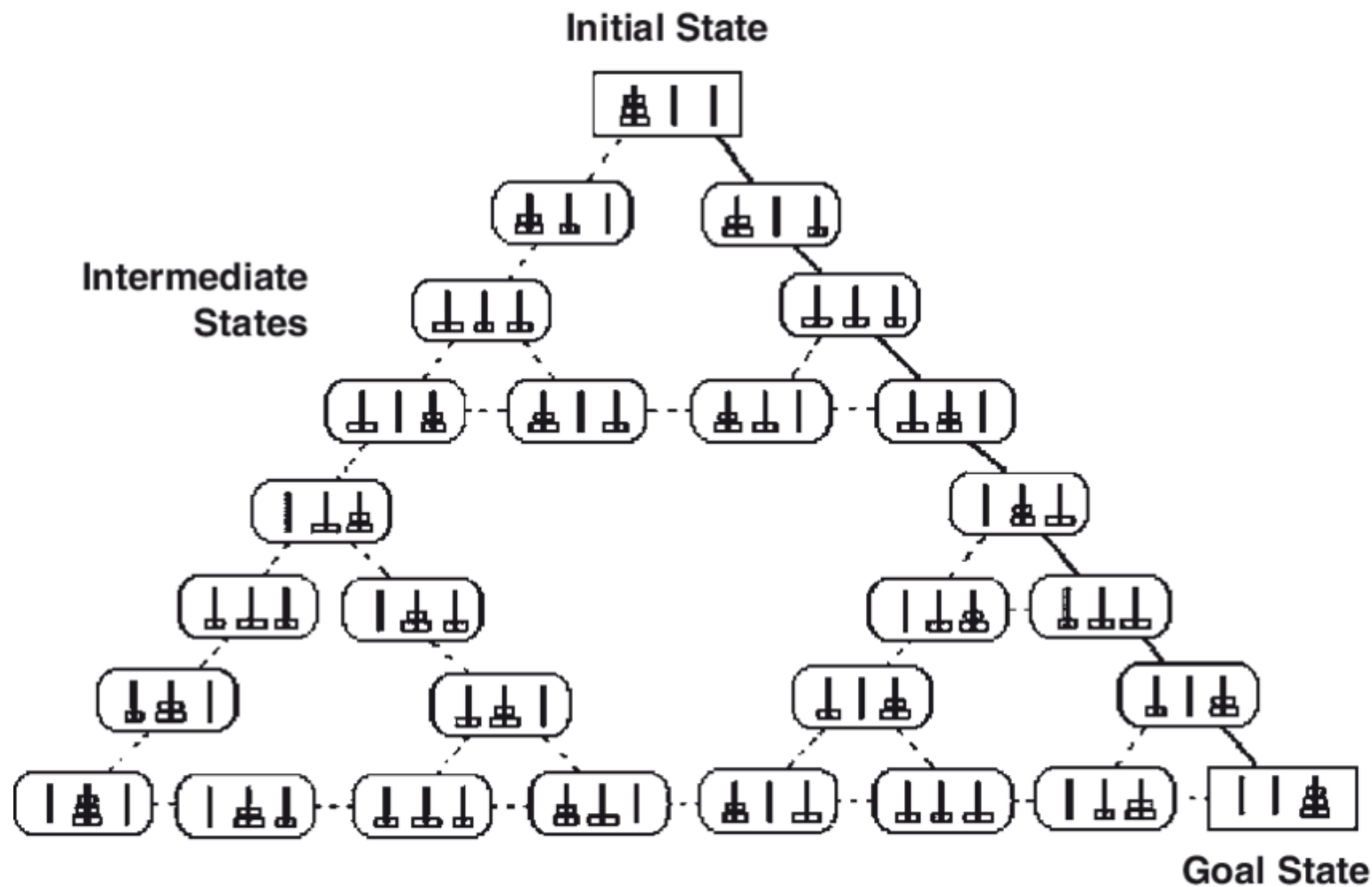
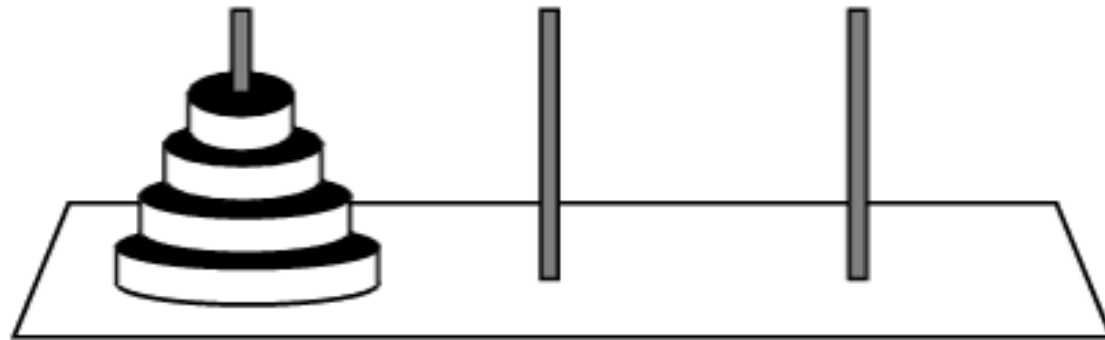
Problem Space

Tower of Hanoi



- Fundamental postulate of human thought (Newell, 1990)
- State representation, operators, heuristic/brute search thru states from initial to a goal state (search strategy can do sub-goal creation; means-ends analysis)
- Problem solving is state-space search (memory may have prior states, metrics to evaluate state goodness, constraints such as no-returning)

Tower Space



Types of Creativity

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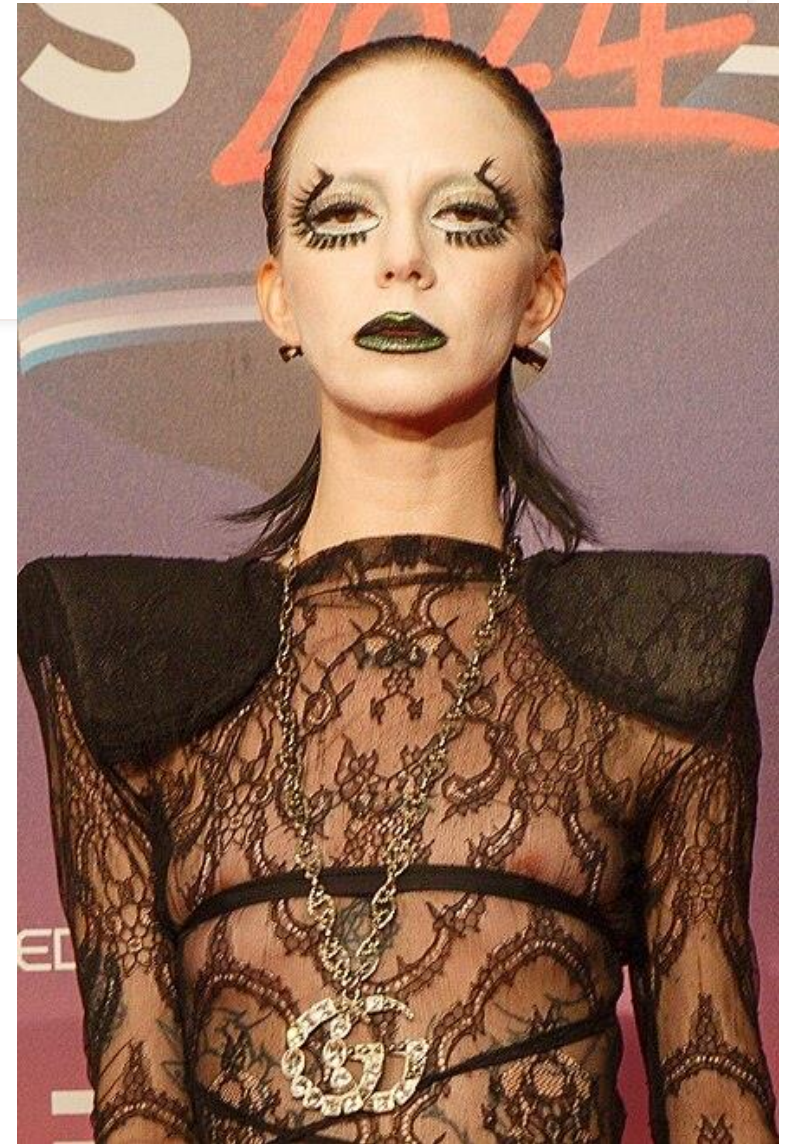


Margaret Boden
(1936-Present)

Boden, M. A. (2004). *The Creative Mind: Myths and Mechanisms*. London: Routledge.

Creative Thinking

- *Combinatorial* combines existing ideas to create something new (Bambi Thug)
- *Exploratory*, smart trial and error in a space of ideas, playful, brainstorming
- *Transformational* genuinely novel ideas, changing paradigms, ways of thinking, changing spaces, constraints, ops



Bambi Thug
(1993-Present)

Boden, M. A. (1998). Creativity and artificial intelligence.
Artificial intelligence, 103(1-2), 347-356.

Transformational Examples

- *Einstein's Relativity Theory*, perhaps all paradigm changes are it
- *Cubism* with geometric abstraction, multiple perspectives and collage
- *Atonality* in Arnold Schoenberg's music, dropping the home-key constraint



Les Demoiselles D'Avignon
(Pablo Picasso, 1907)

Boden, M. A. (2004). *The Creative Mind: Myths and Mechanisms*.



Avoiding Turing Bombs...

Imitation & Mimicry

Let's avoid the
“*My AI Can Do That*” argument...

Caveat Emptor...Turing Test

Alan Turing
(1912-1954)



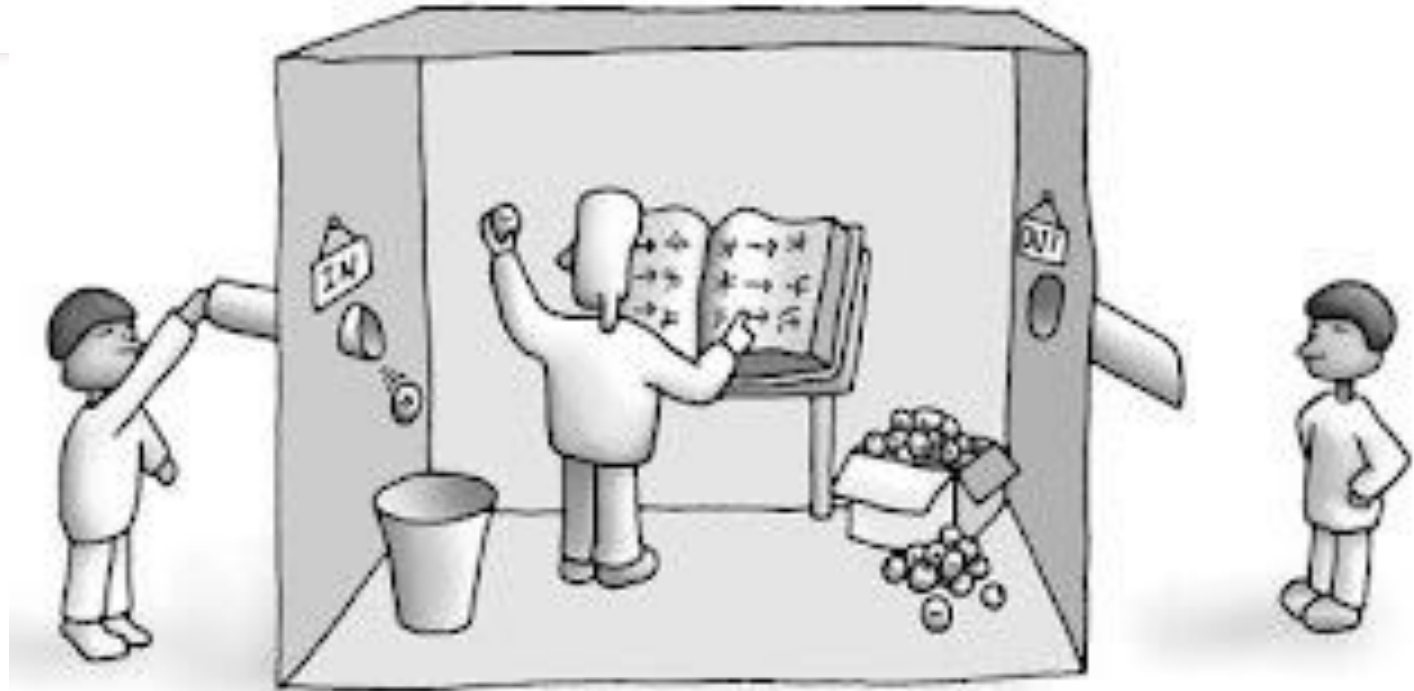
As a veteran of the
Turing-Test Wars
of the 1980s...

I accept that anything
that can be specified can
probably be done in a machine...

*Tho', it is a product-not-process-test
and verbally biased...*

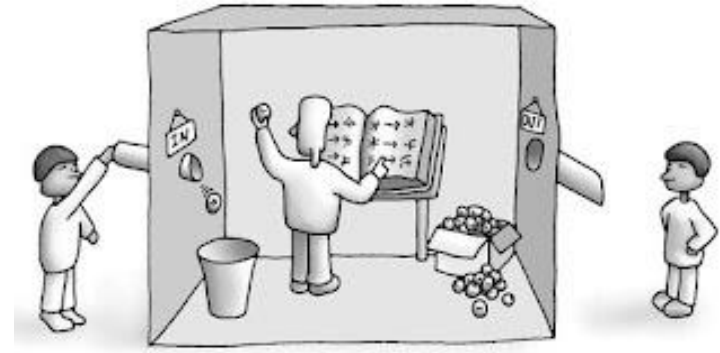
Chinese Room

(John Searle)



Searle, J. R. (1980). Minds, brains, and programs. *Behavioural and Brain Sciences*, 3(3), 417-424.

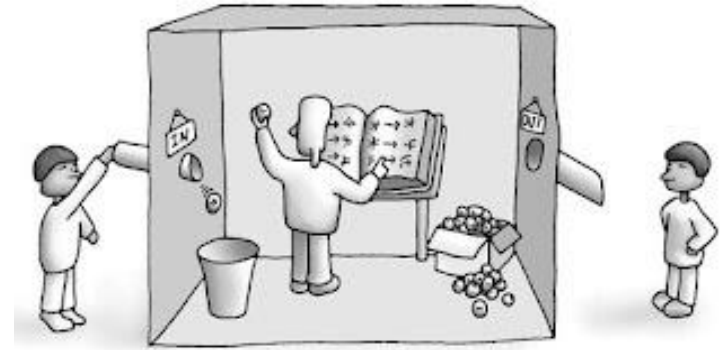
Argument *By Fiat*



- Imitation Game: two entities with the same inputs and outputs may be *different inside* (and this matters?)
- Computer programs are syntactic, symbol manipulators that can never mean/understand
- Brains are neuro-meat-machines, inherently semantical systems that by-definition understand

Dictator Ruled by Fiat: an arbitrary decree, by a person, having absolute authority to enforce it.

But...Note



- Runco contrasts Turing v Lovelace Test, testing the *what* versus *how* (product v originating)
- People tend to impute human abilities to others that “look” like them (eg. consciousness, intelligence)
- Surely, this is not a firm basis on which to claim Creativity in AI Systems?
- But, Chatbots have cynically exploit this weakness

A Half Truth Is Worse than a Whole Lie !



You

what is a semi-factual explanation in XAI



ChatGPT

In Explainable Artificial Intelligence (XAI), a semi-factual explanation refers to an explanation that incorporates both factual information and elements of uncertainty or approximation. It recognizes that certain aspects of the AI model's decision-making process may involve probabilistic reasoning, inherent uncertainty, or approximations rather than exact, deterministic rules.

When AI systems make predictions or decisions, they often operate in complex and uncertain environments. In such cases, it may be challenging to provide a completely factual and deterministic explanation for every aspect of the model's output. A semi-factual explanation acknowledges the presence of uncertainty and attempts to convey a nuanced understanding of the model's reasoning.

This type of explanation can be particularly relevant in scenarios where the AI model uses probabilistic methods, machine learning techniques with uncertainty estimates, or when dealing with incomplete or noisy data. By incorporating both factual and uncertain components, a semi-factual explanation aims to offer a more realistic and transparent view of the AI system's decision-making process, enhancing the interpretability of the model's outputs for end-users or stakeholders.

Hallucinations are Worse



You

This is wrong



ChatGPT

I apologize if my previous response was unclear or not accurate in addressing your question. Could you please provide more context or clarify your question so that I can offer a more accurate explanation of the term "semi-factual explanation in XAI"?

Oh yes, I forgot ... that's what it is!



You

Semi factual explanations are a contrastive explanation technique and a special case of the counterfactual...they are not a half-true explanation



ChatGPT

I appreciate the clarification, and I apologize for any confusion. Indeed, you are correct. In the context of XAI, semi-factual explanations are related to contrastive explanations and are a type of counterfactual explanation. Counterfactual explanations involve providing information about how changes in the input data would have led to different model predictions.

Semi-factual explanations specifically focus on providing insights into the factors that contributed to a model's decision by considering both actual features in the input data and hypothetical changes that could alter the prediction. These explanations aim to highlight not only the presence of certain features but also the importance of those features in the decision-making process.

Thank you for pointing out the error, and I appreciate your understanding. If you have further questions or if there's anything specific you'd like to discuss about XAI or any other topic, feel free to let me know!



Creativity can't (just) be in the eyes of beholder ...

Several other examples of originality that is not creativity can be given. Consider the “creative porpoise” (Pryor et al., 1969). This was the title of an article reporting research which used behavioral procedures to “shape” novel behavior of porpoises. *Shaping* is the method of successive approximations. It begins with a behavior that is already in the repertoire of an organism, and then gradually requires closer and closer approximations to a terminal behavior. In the case of the porpoises, the terminal behavior was novelty.

The behavior of the porpoises was not intrinsically motivated. More generally, the porpoises were not making intentional, mindful choices. The novelty of the porpoises was elicited by trainers. Intrinsic motivation, mindfulness, and choice are enormously important parts of



What I Will Do...

What I Would Like to Do...

... is sketch some aspects of human cognition when we see people being creative/insightful/inventive

... point to how these processes differ from current AI systems engaging in similar acts

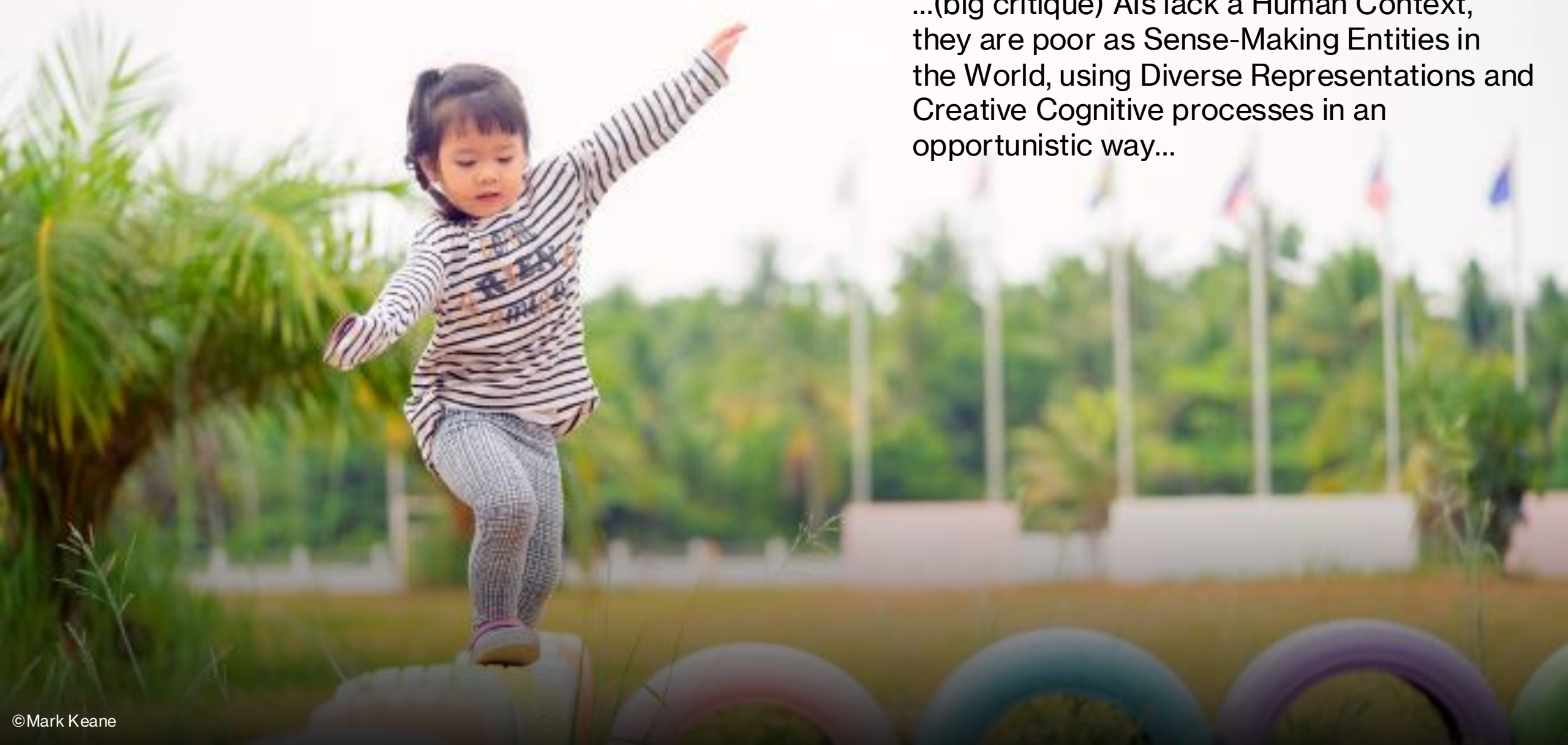
...ask you to reflect on what AI would have to do to have more human-like abilities

Core Issue for Me...

- GenAI is claiming super-human abilities soon...
- Human Creativity occurs in a very different architecture, and fundamentally depends on those differences
- Current AI does not parallel what people do when they are being creative (so what!)
- GenAI may well realise its own form of creativity, but that creativity will *not* be the same as human creativity

We Are Fallible, but Fantastic...

...(big critique) Als lack a Human Context, they are poor as Sense-Making Entities in the World, using Diverse Representations and Creative Cognitive processes in an opportunistic way...



Human v Machine Dance-Off



Mark T. Keane, University College Dublin, Ireland

OpenAI outlines plan for AGI — 5 steps to reach superintelligence

Features By [Ryan Morrison](#) published yesterday

AGI by the end of the decade?

      [Comments \(0\)](#)

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Level 1	Chatbots	AI with natural conversation language abilities
Level 2	Reasoners	AI's with human-levels of problem solving across a broad range of topics
Level 3	Agents	AI systems that can take actions independently or from human instruction
Level 4	Innovators	AI that can aid in the invention of new ideas and contribute to human knowledge
Level 5	Organization s	AI that is capable of doing all of the work of an organization independently

**close to level #2

What We Are Not...

- *GenAI* claims it will do everything; superintelligence, whatever, beyond humans capabilities in 2 years
- Yet, we took millions of years to evolve our abilities, in much richer environments with richer data
- Why should a recent-human-artefact learning from a degraded-data environment do better?
- Rationally, the proposition doesn't stack up !

Human v Machine...



Worlds Apart
Roots of Intelligence
Intentional Autonomy
Semantic Flexibility
NLP Leverage
Cognitive Opportunism

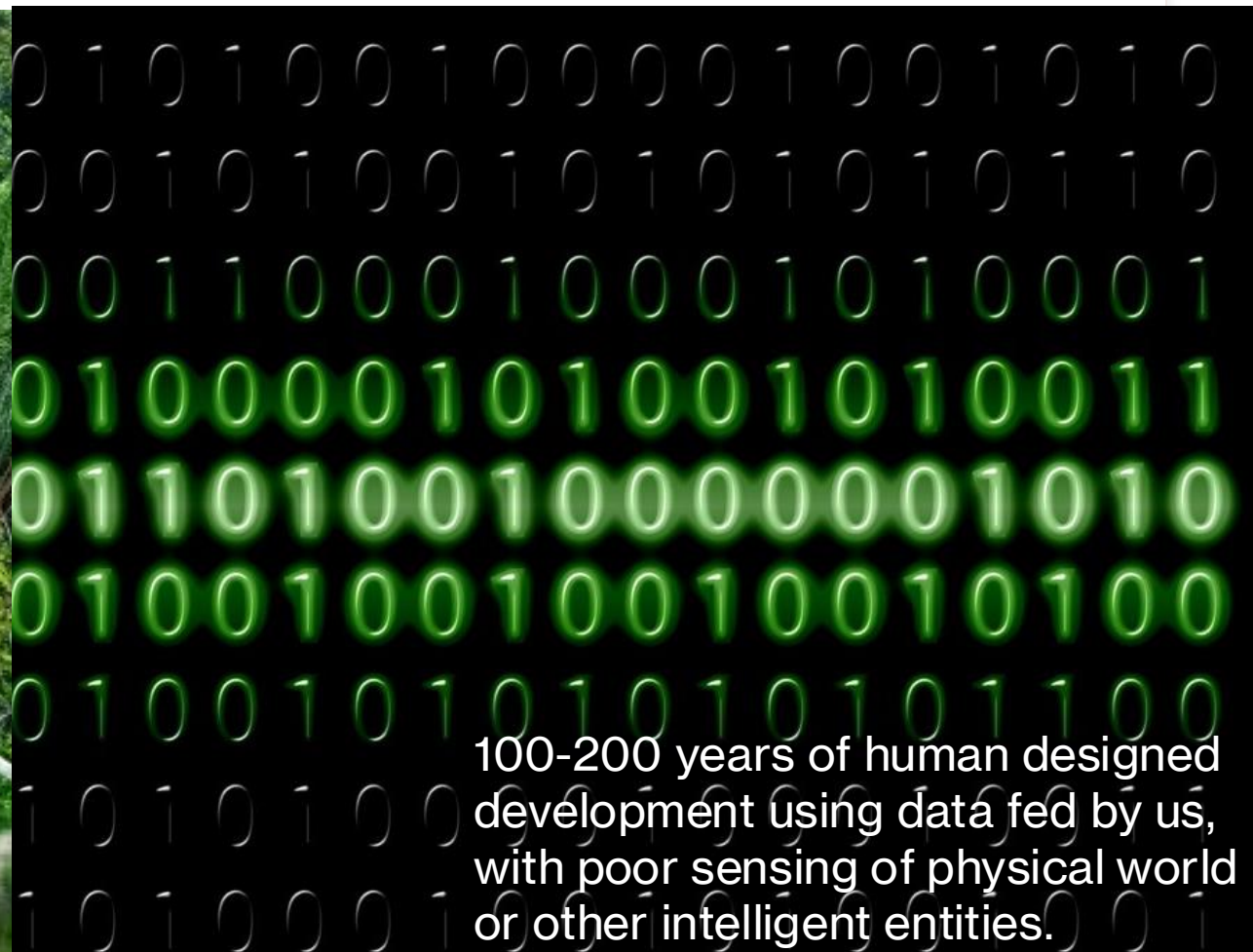
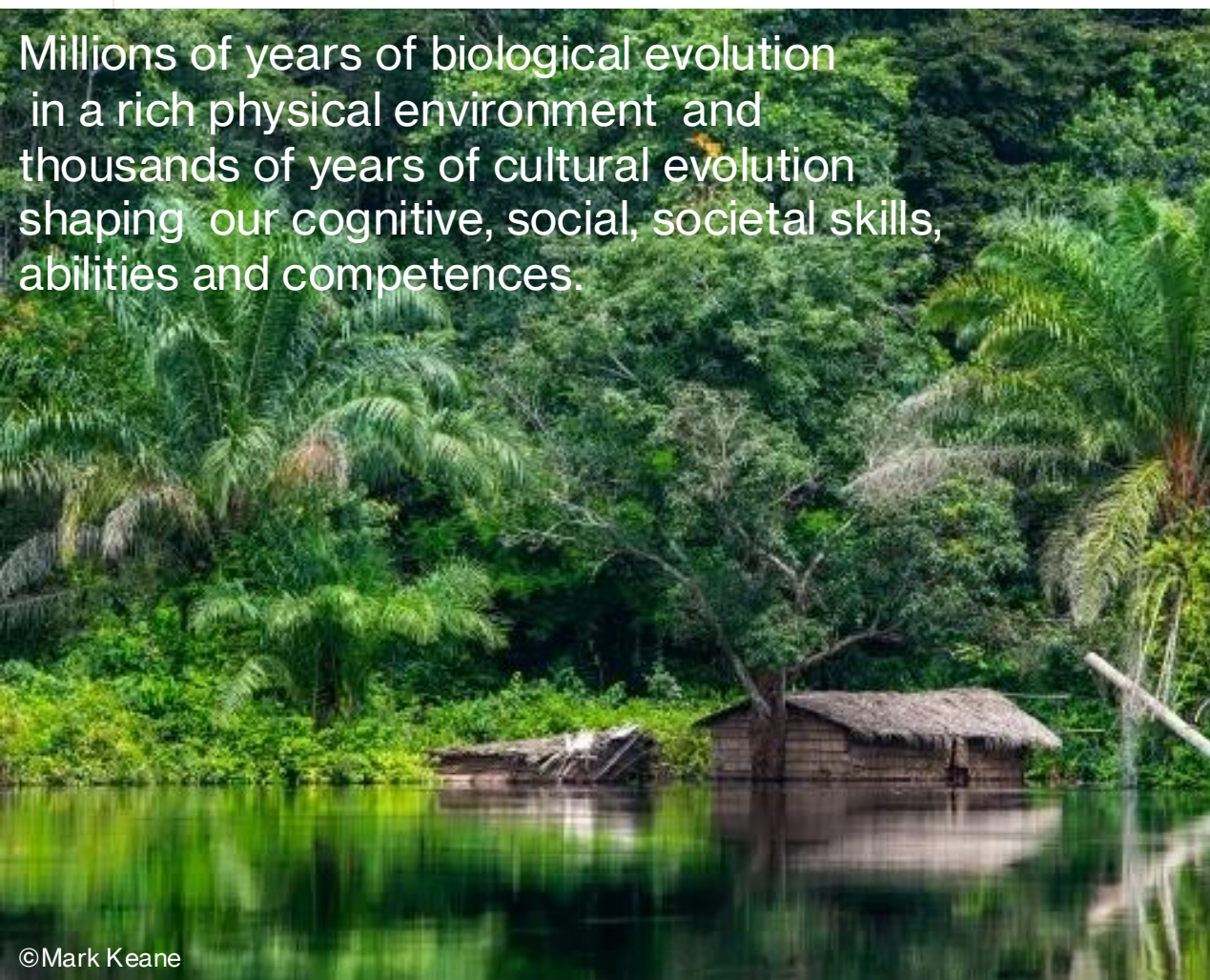




Worlds Apart



Millions of years of biological evolution in a rich physical environment and thousands of years of cultural evolution shaping our cognitive, social, societal skills, abilities and competences.



100-200 years of human designed development using data fed by us, with poor sensing of physical world or other intelligent entities.

Human v Machine...



Worlds Apart
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Roots of Intelligence



Human intelligence is a rationalist-empiricist program, understanding the innate bases for human learning and how they interact with the encountered world.



Artificial intelligence is an empiricist program, the machine's blank slate is written on by machine learning methods acting on text, image, video and other data





Roots of Intelligence



Human intelligence is rich interplay of nature and nurture.

Nature: evolved genetic inheritance of humanity supplies deep schematic knowledge; informs us about the world gives expectations that aid in constrained learning.

Nurture: The knowledge of the world built up empirically from experiential and vicarious learning.

Artificial intelligence is all nurture with little nature.

Nature: Machine is given little other than the learning method, base data, and fills that blank slate; few “inductive biases”, so causal learning remains an issue.

Nurture: Is the machine learning done, over datasets to build-up knowledge empirically from experiential learning.

Chomsky's LAD v Skinner's Slate



Chomsky	Skinner
Because children have an innate ability to develop language, it will happen naturally. <i>(tho note critical periods)</i>	Children need stimulus to develop their language.
Children are not influenced by 'adult' language use. Their pattern of development will be the same.	The language used around children will determine how they develop their language.
The adult role is not so importance, as, even if children are corrected, they will still develop language in the same way.	The adult role is critical to support language through correction and reinforcement.
Language is distinct ability/module, may be dissociated from intelligence.	Language is just another human ability learned through conditioning.

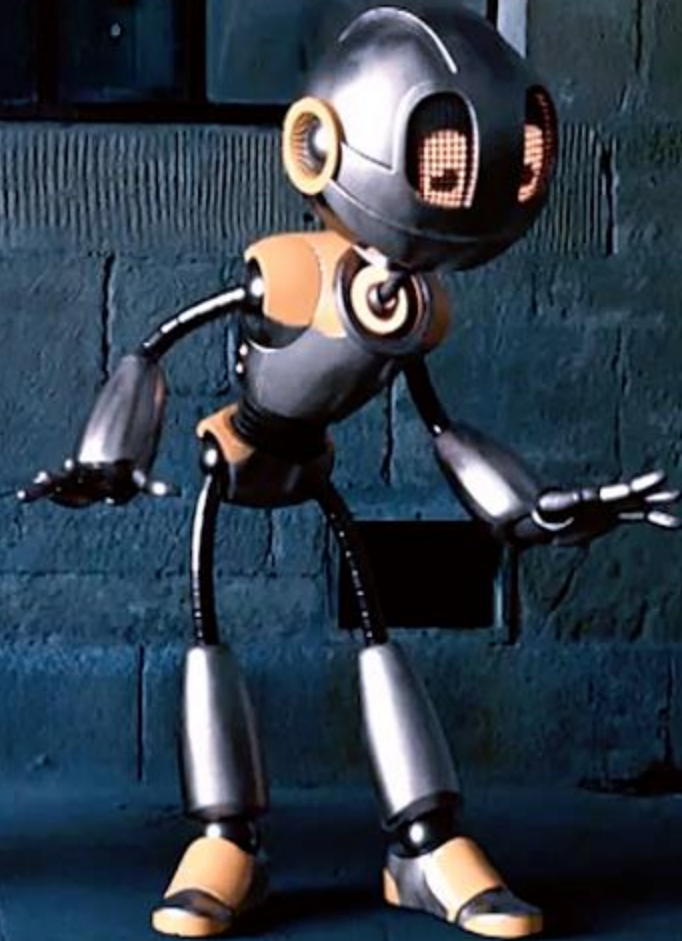
Human v Machine...



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Intentional Autonomy



“I chose to dance...”

`do (x, dance52.pr)`



Intentional Autonomy



DEFINITION

Autonomy refers to the capacity of a person or entity to make decisions and act according to their own rules or principles, free from external control or influence. It emphasizes self-governance, independence, and personal freedom. In various contexts, it can pertain to individuals, groups, or machines. Many moral philosophies hold that it's a fundamental human right.

www.helfulprofessor.com

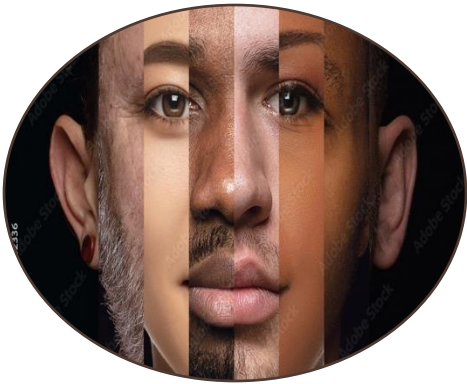
WHAT IS INTENTION?

Intention is like your plan or purpose behind doing something. It's what you want to achieve or happen when you take an action.



www.happiom.com

www.happiom.com



Autonomy



We appear to be self-directed entities, goal-driven, but responsive to changing environments.

They are entities directed by goals (given by us) and can be brittle in changing environments.



Why iid matters

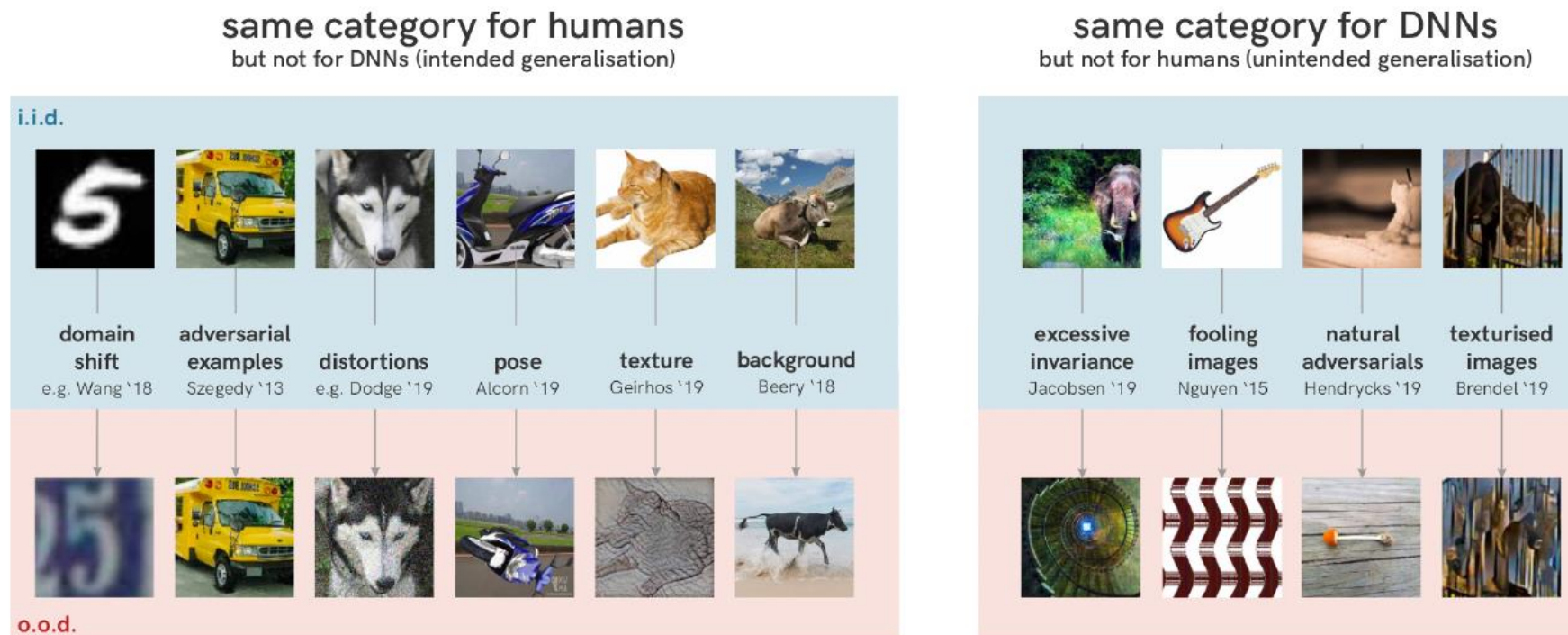


Figure 4. Both human and machine vision generalise, but they generalise very differently. Left: image pairs that belong to the same category for humans, but not for DNNs. Right: images pairs assigned to the same category by a variety of DNNs, but not by humans.

OOD Still An Issue

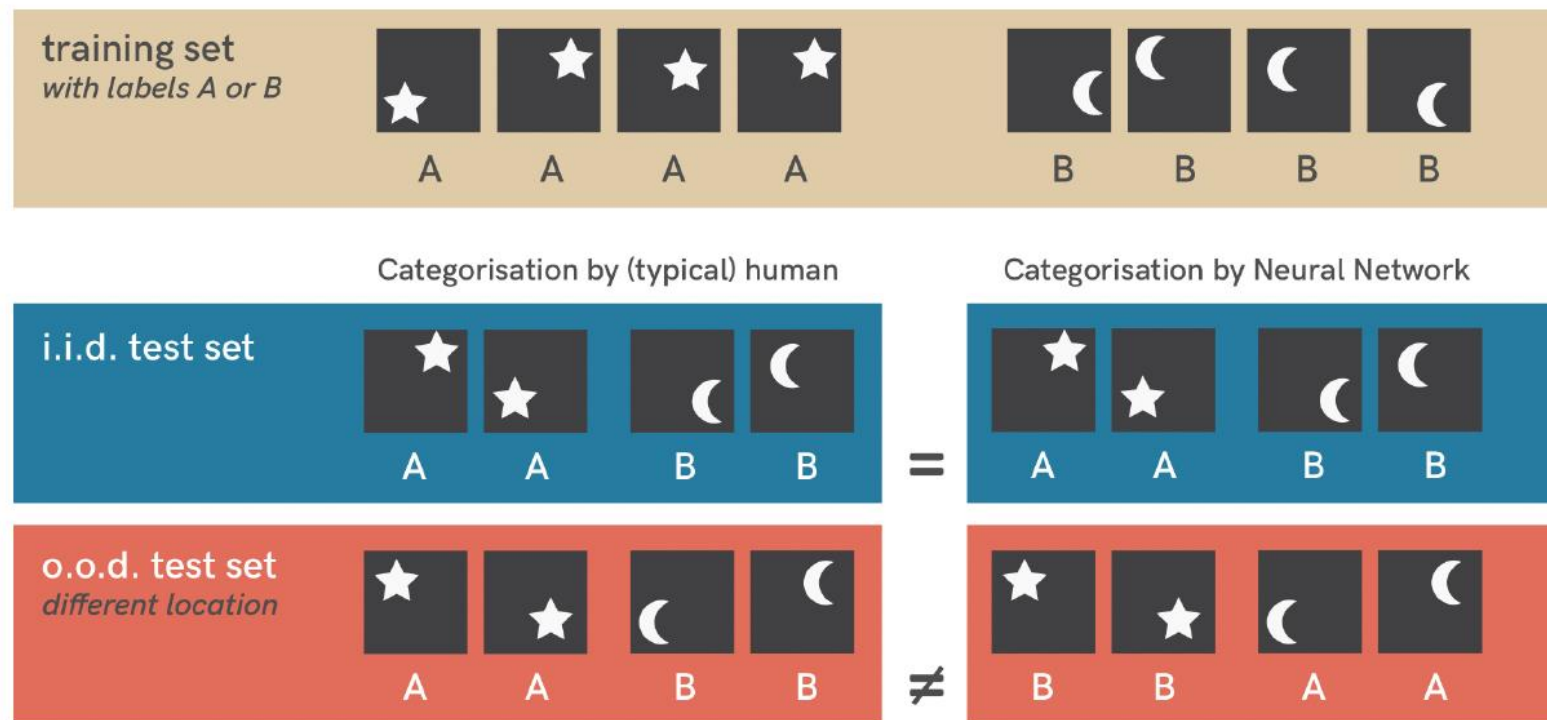
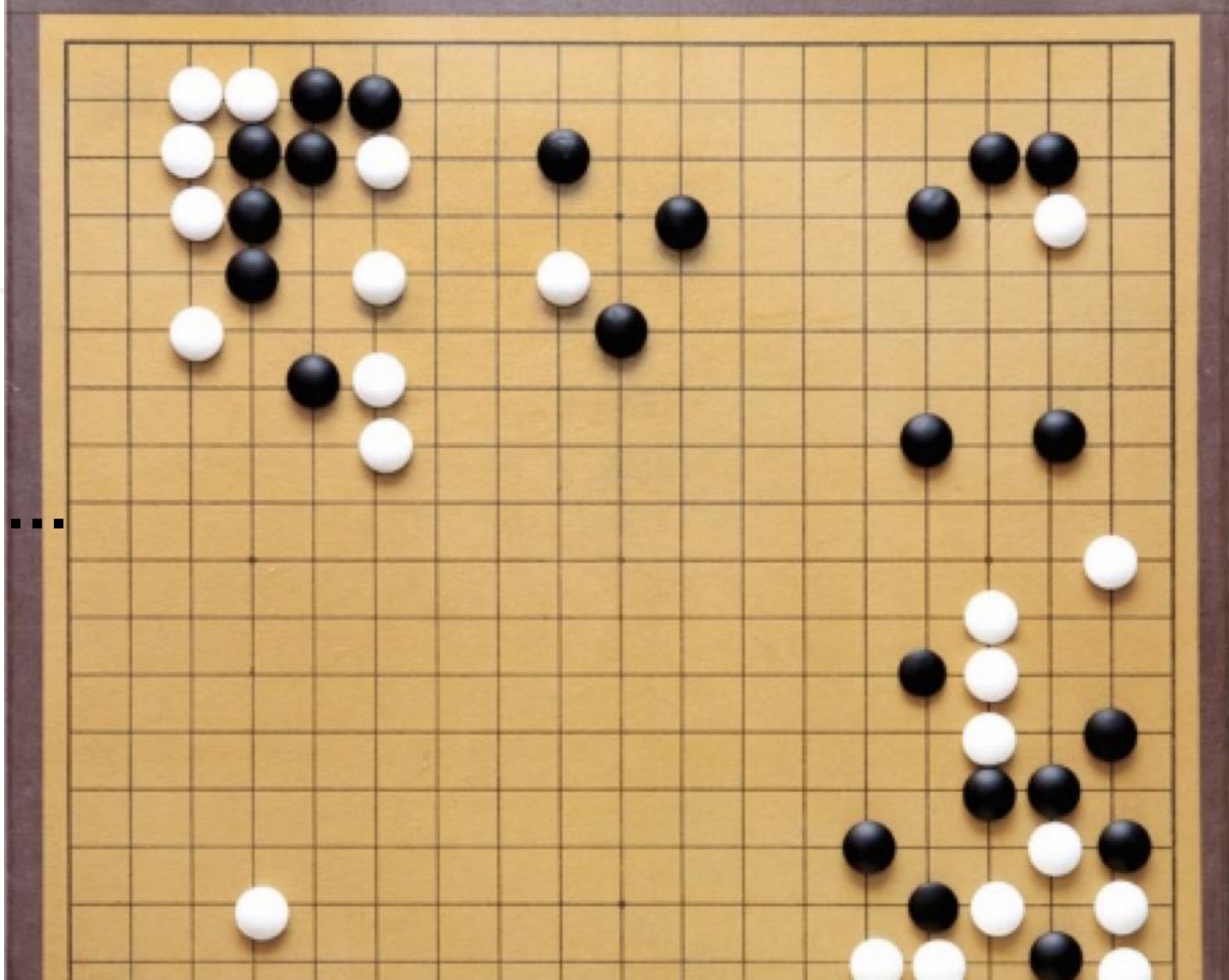
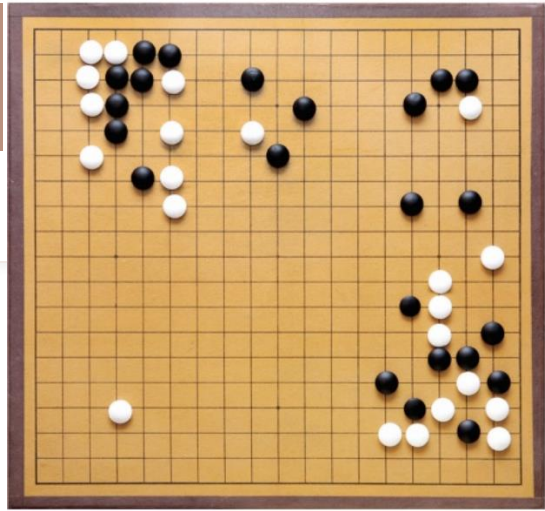


Figure 2. Toy example of shortcut learning in neural networks. When trained on a simple dataset of stars and moons (top row), a standard neural network (three layers, fully connected) can easily categorise novel similar exemplars (mathematically termed i.i.d. test set, defined later in Section 3). However, testing it on a slightly different dataset (o.o.d. test set, bottom row) reveals a shortcut strategy: The network has learned to associate object location with a category. During training, stars were always shown in the top right or bottom left of an image; moons in the top left or bottom right. This pattern is still present in samples from the i.i.d. test set (middle row) but not in o.o.d. test images (bottom row), exposing the shortcut.

AlphaGo
is hugely
impressive ...
and *looks*
creative in
its play...





AlphaGo

Move 37

With the 37th move in the match's second game, AlphaGo landed a surprise on the right-hand side of the 19-by-19 board that flummoxed even the world's best Go players, including Lee Sedol. "That's a very strange move," said one commentator, himself a nine dan Go player, the highest rank there is. "I thought it was a mistake," said the other. Lee Sedol, after leaving the match room, took nearly fifteen minutes to formulate a response. Fan Gui—the three-time European Go champion who played AlphaGo during a closed-door match in October, losing five games to none—reacted with incredulity. But then, drawing on his experience with AlphaGo—he has played the machine time and again in the five months since October—Fan Hui saw the beauty in this rather unusual move.

Silver, D ... & Hassabis, D. (2016). Mastering the game of Go with deep neural networks and tree search. *Nature*, 529(7587), 484-489.

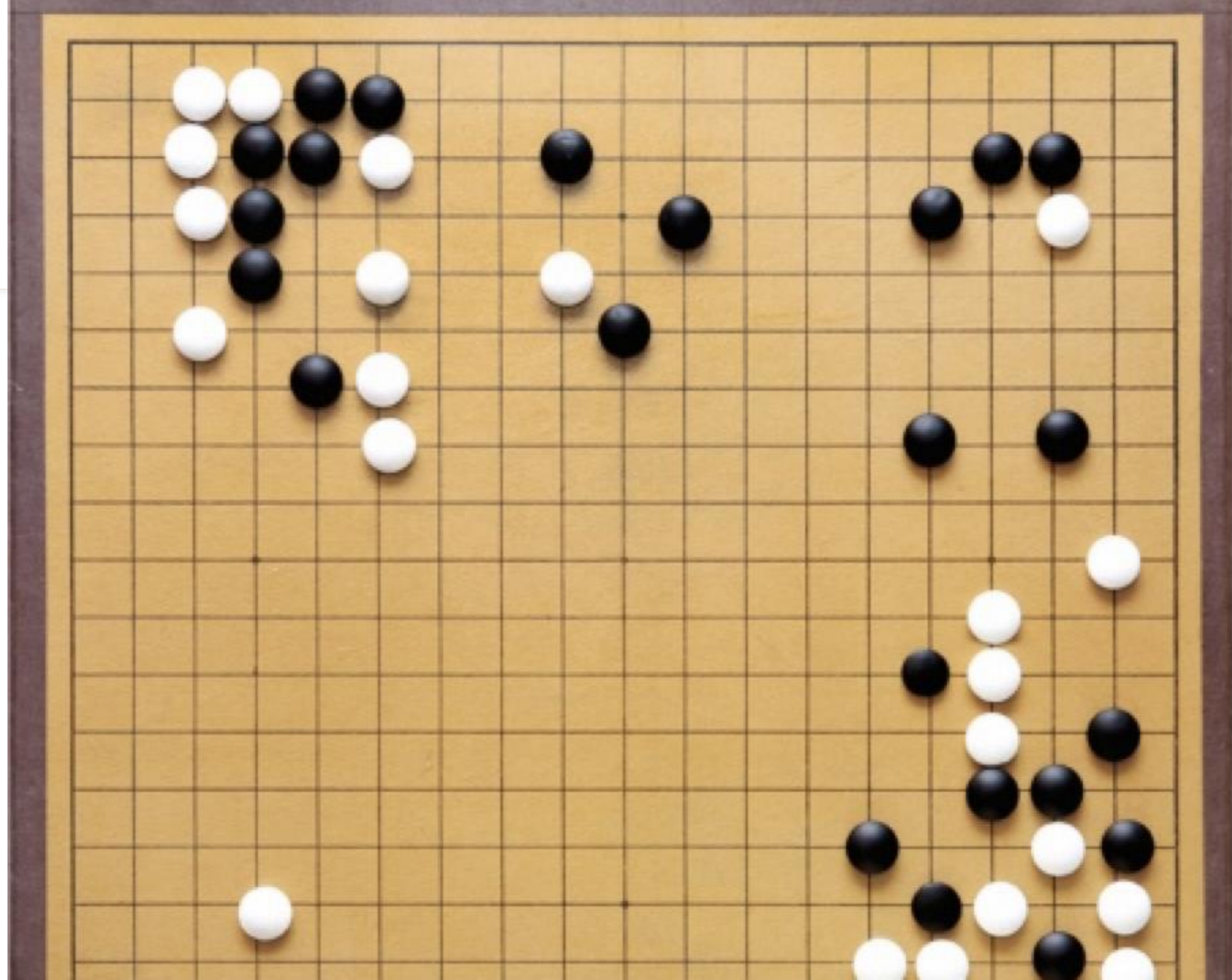
AlphaGo is ...

... given goals
of game

... starts from
human games

... uses
human
evaluations

and can't
make a cup of
tea



Training to Given Goals...is not Creative



Several other examples of originality that is not creativity can be given. Consider the “creative porpoise” (Pryor et al., 1969). This was the title of an article reporting research which used behavioral procedures to “shape” novel behavior of porpoises. *Shaping* is the method of successive approximations. It begins with a behavior that is already in the repertoire of an organism, and then gradually requires closer and closer approximations to a terminal behavior. In the case of the porpoises, the terminal behavior was novelty.

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Like Swifts...

- ML typically optimizes on a single-goal/objective, like swifts eating bugs
- Multi-objective learning is a hot topic, cos of challenges juggling >1 goal



We're More Like Tits...



- People maintain multiple goals at different levels (bodily, social, existential)
- *Parus Major* is an opportunistic feeder, eats everything, and plans accordingly



We Are Intensionally Autonomous...

Human v Machine...



Worlds Apart
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Cognitive Opportunism





Semantic Flexibility



Primary, sensed representations,
structure-preserving plus natural language

Secondary, non-sensed representations,
often NLP derived (e.g., text)



Meaning from Diverse Representations...

- We know the world through all our senses; meaning what we see, hear, smell, touch and proprioception
- Semantic flexibility relates these senses to one another, crossmodally to represent objects in multi-dimensions
- “bowl” is not just the text token `bowl`



Water Carriers

- Diverse representations allow us to flexibly re-conceptualize objects...
- A multi-sensed world can be re-interpreted to meet goals, and creative solutions ...



Ballet Dancers, & Rugby Players





Pollack's Art...

...is as much about movement as it is about paint, color and form....



*Semantic Flexibility in Human Creativity comes from
the Interplay 'tween Diverse Sensory Representations*

Human v Machine...



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For us language is a separate
representational system for
communication, description, and
reflection...a mental *lingua franca*.
It can leverage creativity...



NLP

The central graphic features the letters 'NLP' in a large, glowing blue font. A wireframe hand, composed of blue lines and dots, is shown from the wrist up, with the index finger pointing directly at the 'N'. The hand and text are set against a background of concentric blue circles and various icons: a gear, a robotic arm, a globe, a speech bubble, a code symbol (</>), and a microchip.

Natural language
processing



For them its often the sole
representational code,
ungrounded symbols in a
processing vacuum...

Words & The World

- We know words do not describe everything...
 - A picture paints a thousand words
 - Emotions: “I could not describe how I felt...”
(use metaphors, *bursting*)
 - Poetry tries to express the inexpressible
- Language is usefully vague... *the same words can describe many different real-world states...*

B...B..Bowl



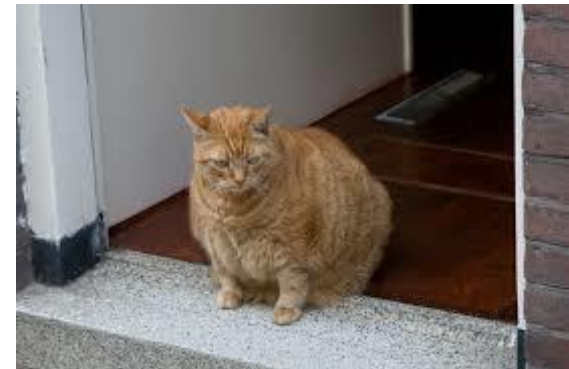
BOWL as a multi-sensed object referred to by the word “bowl”

B...B..Bowl



BOWL as the text token `bow1`

“The Cat Sat on the Mat.”



Every Sentence...

Describes a near infinity of states !

Every Sentence...

An infinity of different specific cats
sitting in different ways on an infinity
of different specific mats in different
contexts at different times...

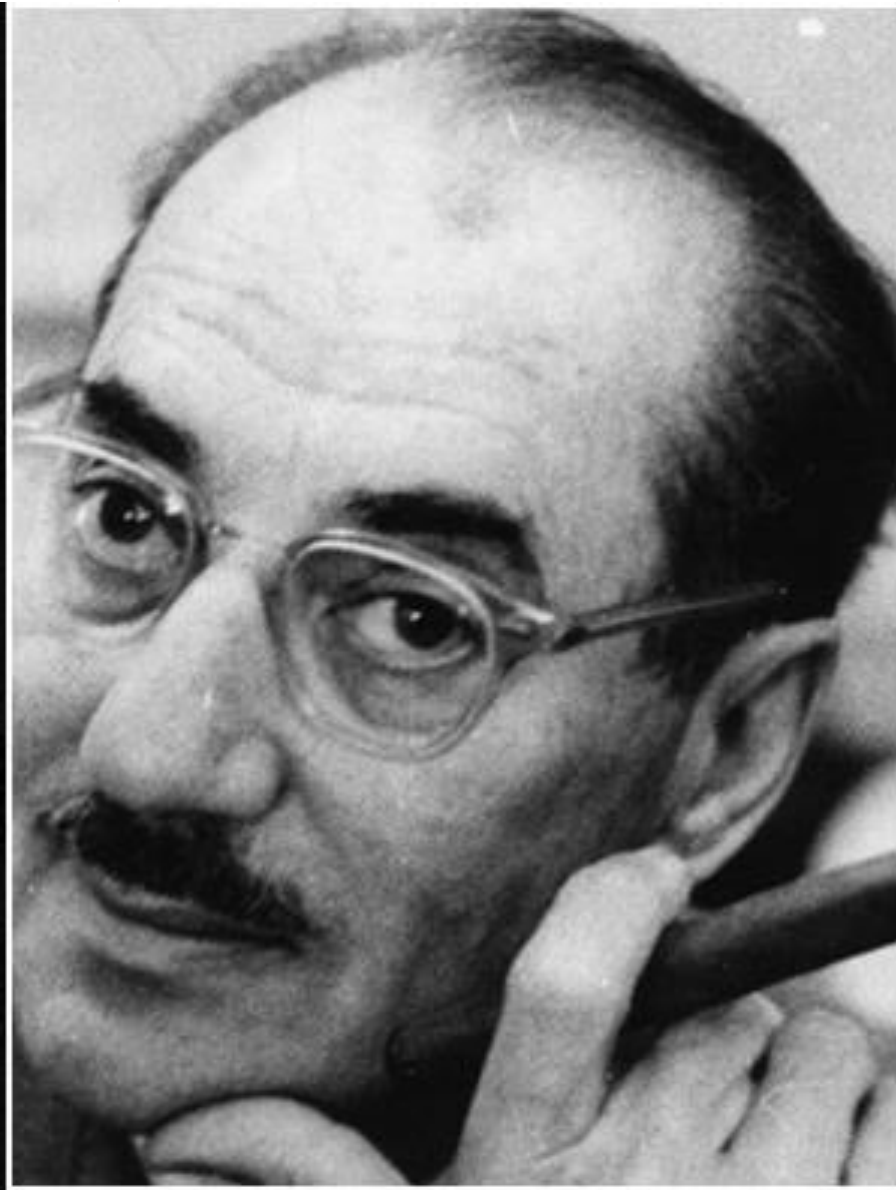
Words & Knowledge

- So, why should text analysis yield knowledge?
 - At best, it may be selective
 - At worse, it may be misleading or biased
- Yet, GenAI treats text as sufficient for:
 - World Knowledge
 - Artificial General Intelligence
 - SuperIntelligence

Plus ... Ambiguity !

I shot an elephant in my pajamas.

*...many very different states
may be indicated ...*



One morning I shot an elephant in
my pajamas. How he got into my
pajamas I'll never know.

— *Groucho Marx* —

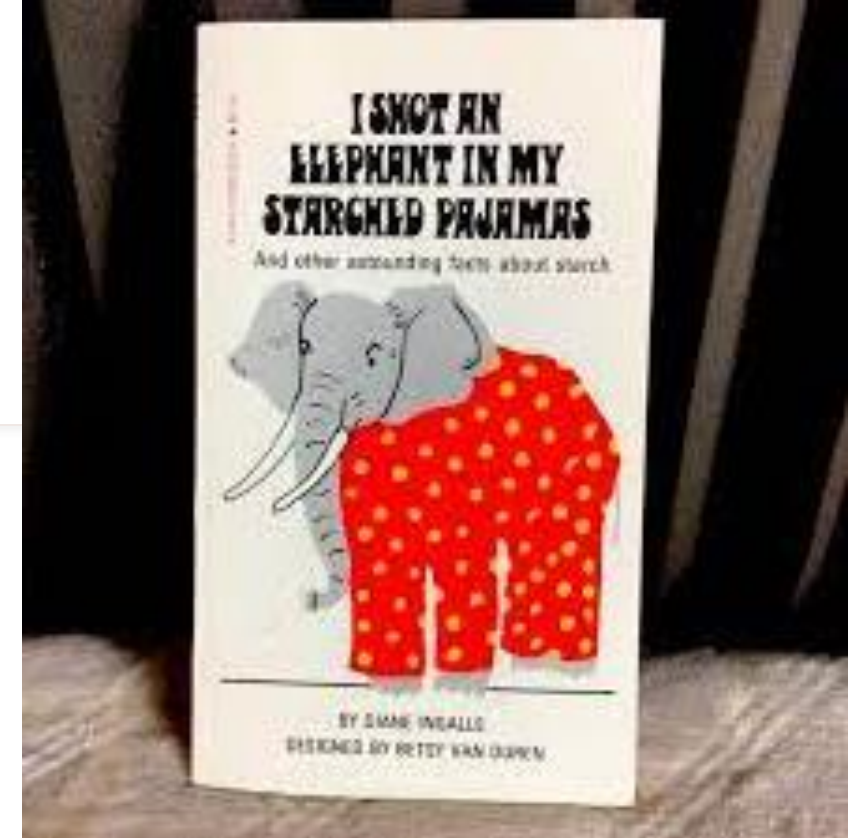
AZ QUOTES

ning...



morning I
elephant in
nas. How
into my
I'll never
ow."

roucho Marx
ican comedian
1890-1977



- I shot an elephant in my pajamas
- I shot (an elephant) in my pajamas
- I shot an elephant (in my pajamas)
- I shot (an elephant in my pajamas)

What's World Knowledge...

- It's our basic knowledge about things, people, places and their relative properties in the world
 - ~ elephant is too big to fit in the leg of my pjs
 - ~ elephant is too big to wear my pjs
 - ~ shooting elephants is supported...

And Yet...

- LLMs assume that a co-occurrence analysis of “mere” words will deliver all the language, knowledge, and intelligence people show....
- Why would/could/should this work ? And, if it appears to work, what are the things it doesn't work for?
- Indeed, we know it can fail on world knowledge...

For Us, NLP Can Leverage Creativity

- Because we know words can be ambiguous, meaning is not fixed...
- There is a gap between words and what they can mean, interstices that can be exploited
- I can syntactically re-arrange words to create new meanings, concepts I have never thought of before (Cavan Fever)...

Keane, M. T. (2010). Creativity: a gap analysis.

International Conference on Cognition, Experience & Creativity, IIT Gandhinagar, India.



*Human Creativity Leverages
Language Indeterminacy*

Human v Machine...



Worlds Apart
Roots of Intelligence
Intentional Autonomy
Semantic Flexibility
NLP Leverage
Cognitive Opportunism





Foraging Opportunism





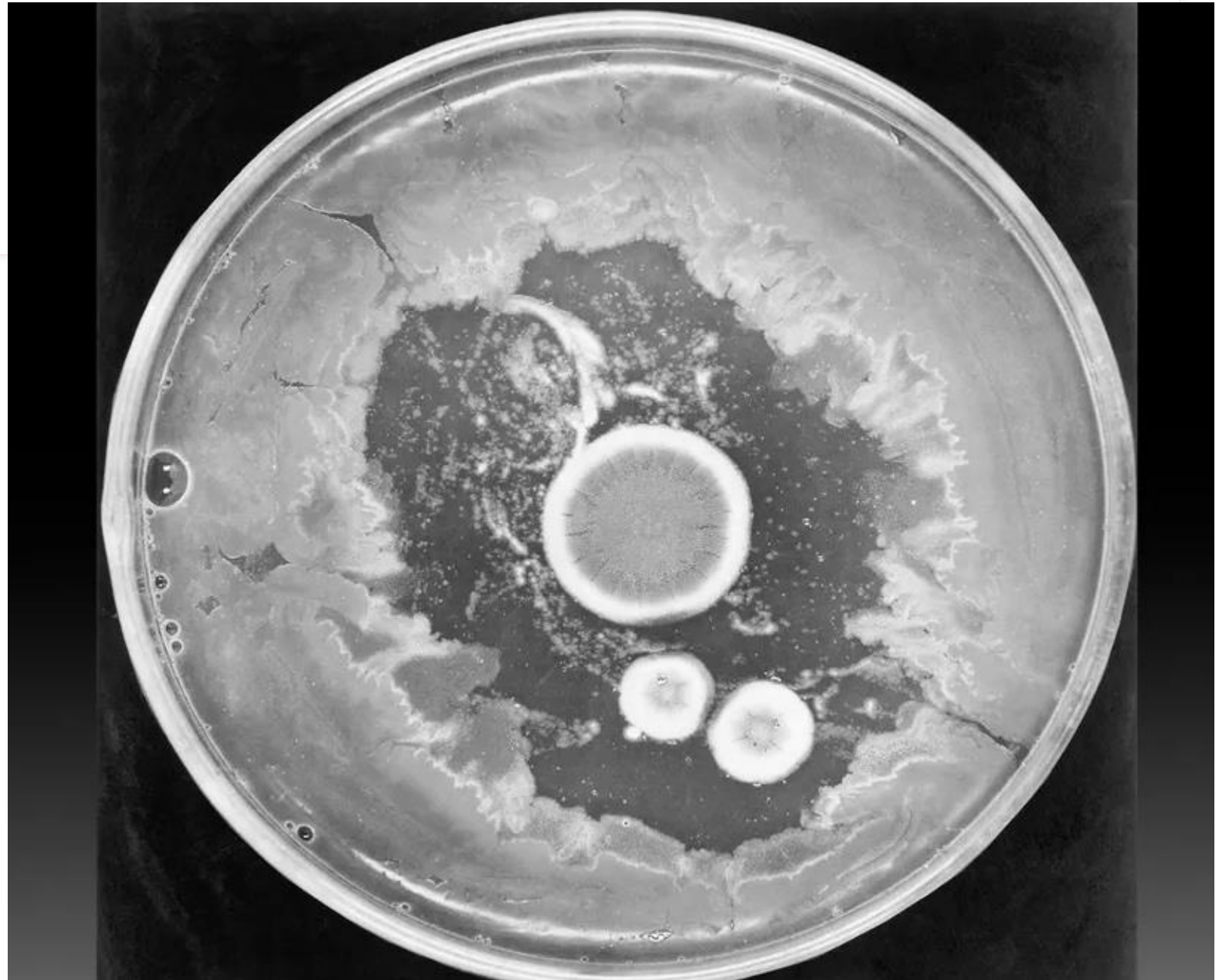
Cognitively Opportunistic



- Blessed are scavengers for they shall find ideas
- People are opportunistic in their creative acts
- We benefit from accident and serendipity
- Facing a problem, I may reason a bit, generalise the case, use an analogy, self-explain what I am doing...or just let the world suggest something !

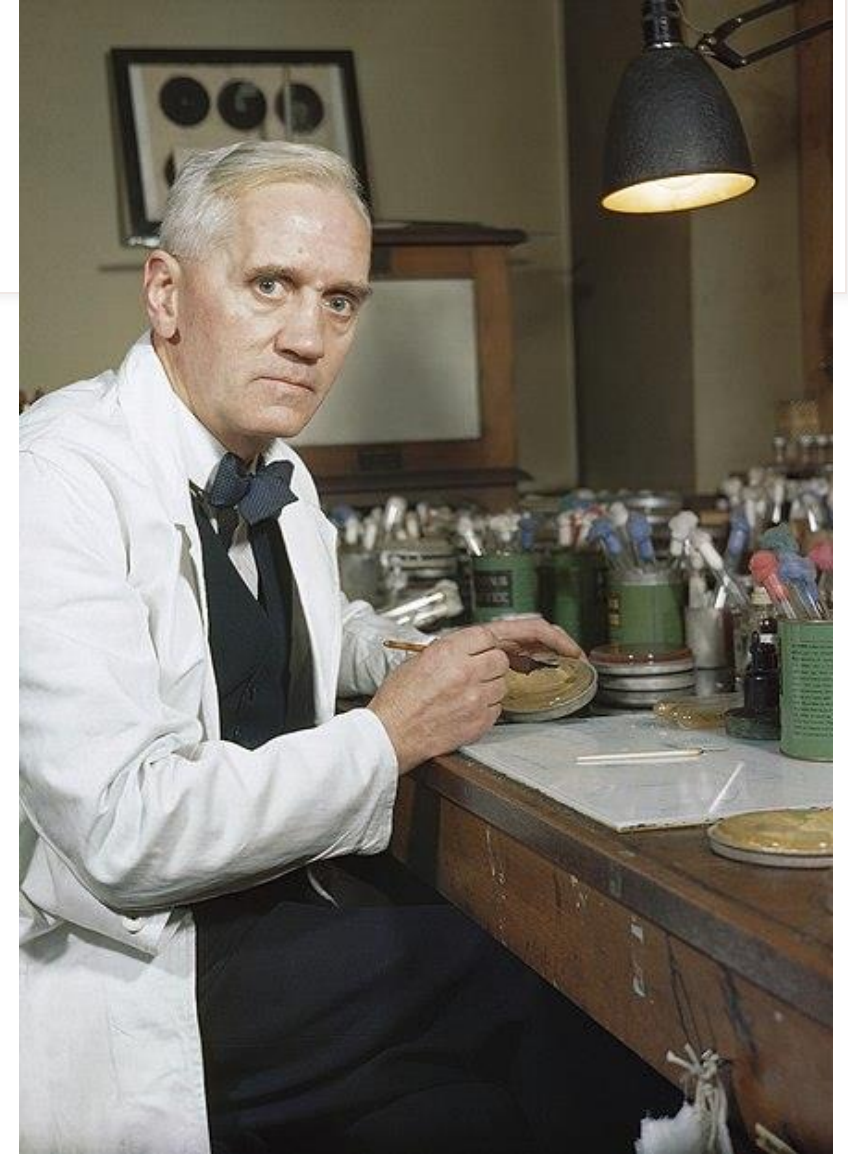
Discovery in Science

“that’s funny”



Serendipity Really?

- First antibiotic (penicillin); saw antiseptics kill injured soldiers in WWI, noticed tears/lysozyme killed (some) bacteria...
- Agar plate left in low temp for months, rare mold grew, on cleaning “That’s funny!”
- Others not interested, 9 yrs after Florey & Chain revisited (for Nobel)



Alexander Fleming
(1881-1955)

“Chance favours the prepared mind...”

There is no doubt then that a great deal of luck was involved in the discovery of penicillin. Yet it still needed creativity and insight on Fleming's part to seize the opportunity which chance had presented to him. Nothing shows this more clearly than a comparison of Fleming's reaction to the contaminated plate with that of his colleagues in the laboratory (including the head of the laboratory, Sir Almroth Wright) when he showed it to them. With characteristic candour, Hare describes the complete lack of interest shown by himself and the others (1970, p. 55):

‘The rest of us, being engaged in researches that seemed far more important than a contaminated culture plate, merely glanced at it, thought that it was no more than another wonder of nature that Fleming seemed to be forever unearthing, and promptly forgot all about it.

The plate was also shown to Wright when he arrived in the afternoon. What he said, I do not recollect, but ... one can assume that he was no more enthusiastic – he could not have been less – than the rest of us had been that morning.’



Cognitively Opportunistic



- We realise that the environment is important
- Hanging goals, amongst the many other goals...
- Memory is organized around environmental cues
- Permits us to survive as limited capacity processors
- It also makes us very responsive to chance/accident

Human Creativity fundamentally depends on the World that we evolved to live in, and how we make sense of that World and understand it...





Intent & Motive in Art

Mark T. Keane, University College Dublin, Ireland



Human Creativity Has Intentional Autonomy



Runco Again

“Creativity does not rely on chance - large number of choices, decisions, judgments that creative individuals make depend on intentions and ... systematic efforts..”

A decorative element consisting of a vertical brown bar on the left and a thin horizontal line extending from its base across the top of the slide.

Is this *Art* ?

Conceptual Blending:

chicken-man



A thin, vertical, light brown rectangular bar is positioned on the left side of the slide, near the top.

Is this *Art* ?



A thin, vertical, light brown rectangular bar is positioned on the left side of the slide, near the top.

Is this Art ?



DALL-E prompted picture in the style of ...

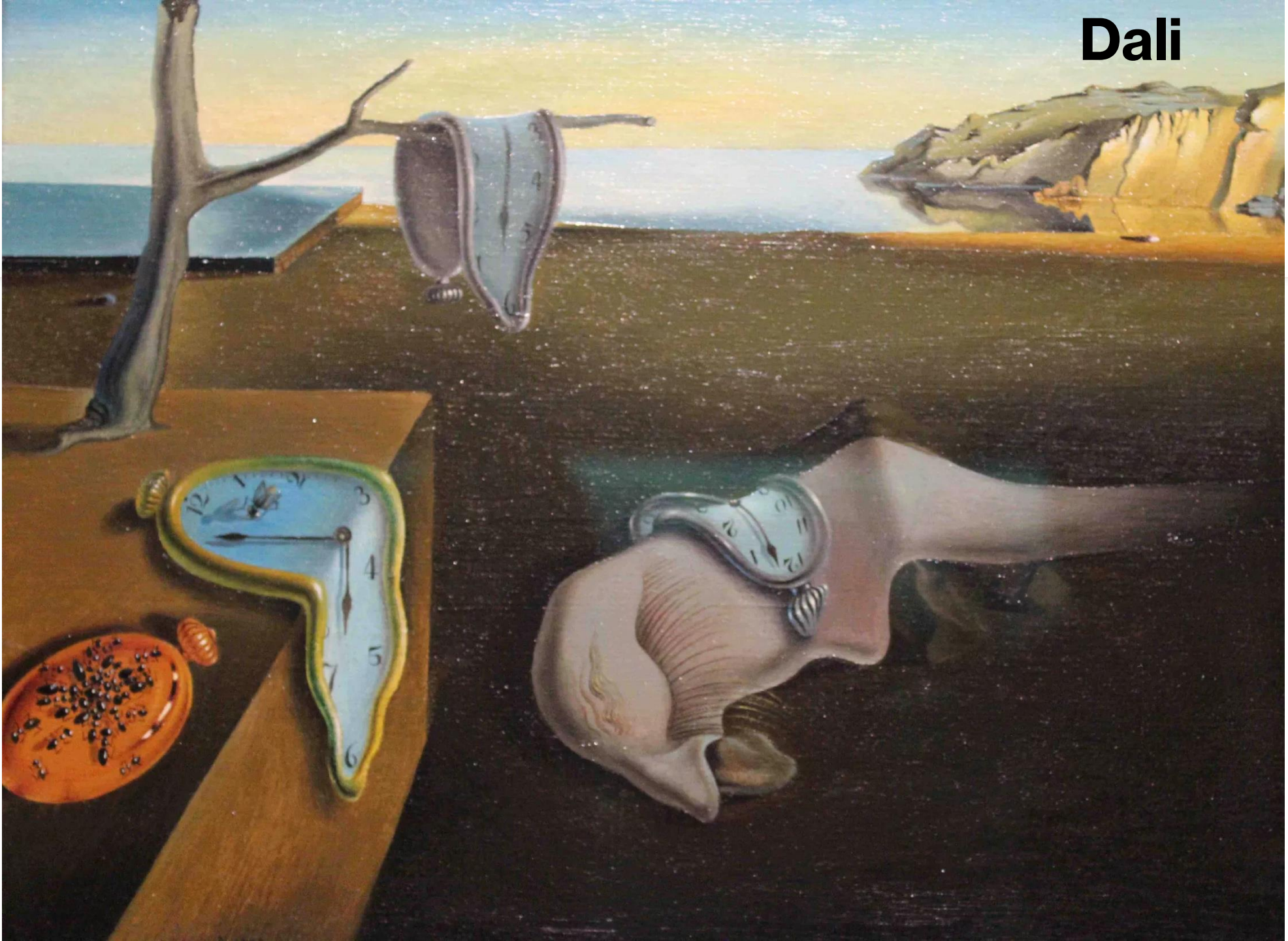
**Van Gogh
defined the
style !**



A thin, vertical, light brown rectangular bar is positioned on the left side of the slide, near the top.

Is this Art ?

Dali



DALL-E



What's the difference between Dali and DALL-E

 DALL-E 2



DALL-E



DALI



AI Prompted Pics
US not copyrightable!

Artists Can Intend to be Random!



Bowie's "Cut Up" Technique

Aleatoricism or **aleatorism**, the noun associated with the adjectival **aleatory** and **aleatoric**, is a term popularised by the musical composer [Pierre Boulez](#),^[*not verified in body*] but also [Witold Lutosławski](#) and [Franco Evangelisti](#), for compositions resulting from "actions made by [chance](#)", with its [etymology](#) deriving from *alea*, Latin for "[dice](#)".^[1] It now applies more broadly to art created as a result of such a chance-determined process.^[*citation needed*] The term was first used "in the context of electro-acoustics and information theory" to describe "a course of sound events that is determined in its framework and flexible in detail", by Belgian-German physicist, acoustician, and information theorist [Werner Meyer-Eppler](#).^{[2][3]} In practical application, in compositions by

<https://www.youtube.com/watch?v=m1lnCrzGIPU&t=3s>

But, is it Art !





J. Pollock (1948) No. 23

Much Dripping...

- *Jackson Pollock's* drip paintings as Abstract Expressionism
- *Actor* defines inputs, actions, chosen colours, constraints, evaluations
- Expressing a new space adding action, emotion, spontaneity to abstract art
- Pollock is realising an art movement



No. 23
(J. Pollock, 1948)

Fractal Analysis of Pollock...

Taylor, R. P., Micolich, A. P., & Jonas, D. (1999). Fractal analysis of Pollock's drip paintings. *Nature*, 399(6735), 422-422.

Our analysis of a film of Pollock while painting shows that the fractal patterns occurring over the lower range are determined by the dripping process, whereas the fractal patterns across the higher range are shaped by his motions around the canvas.

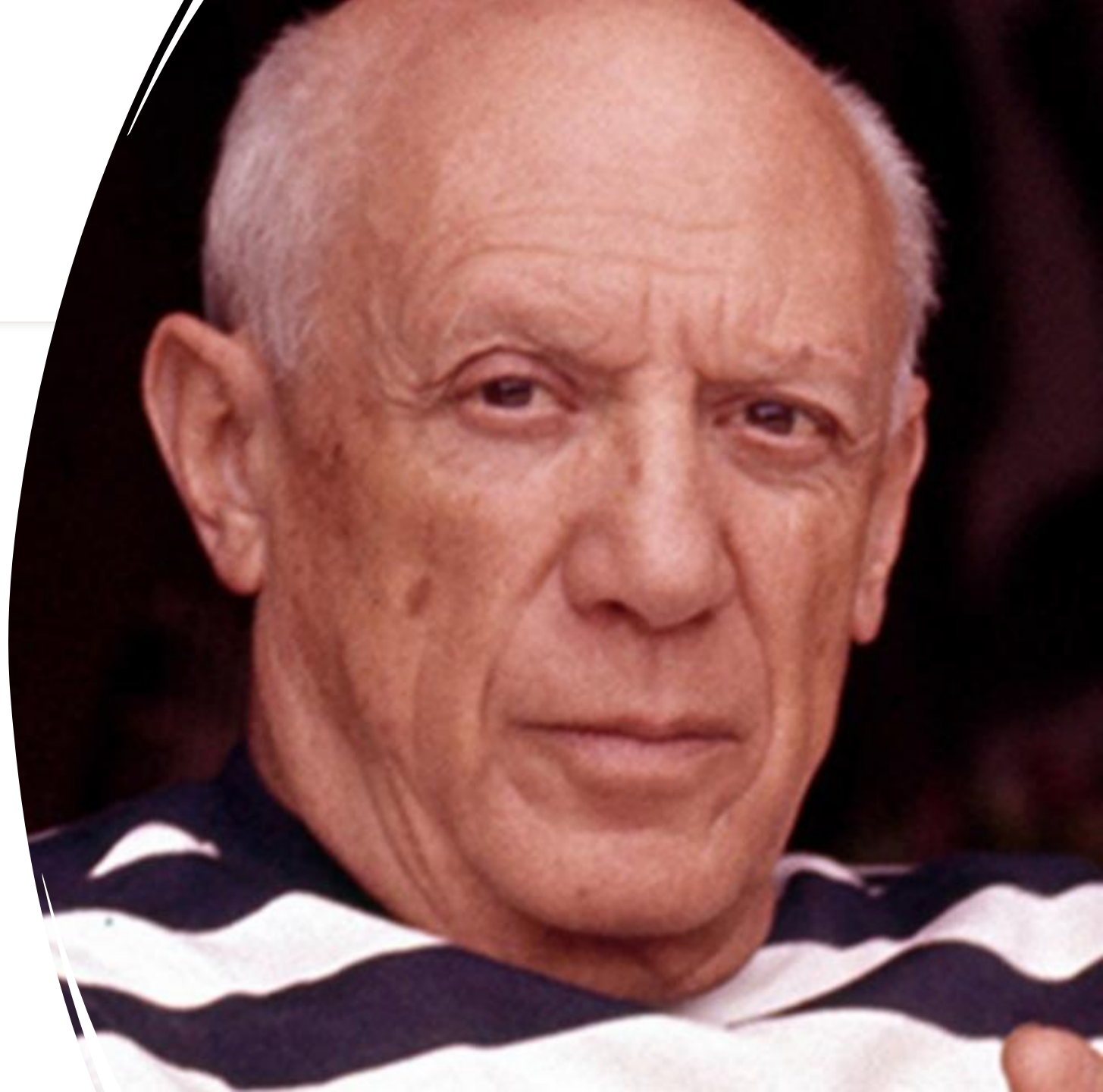
Our analysis shows that Pollock refined his dripping technique: the fractal dimensions increased steadily through the years, from close to 1 in 1943 to 1.72 in 1952.

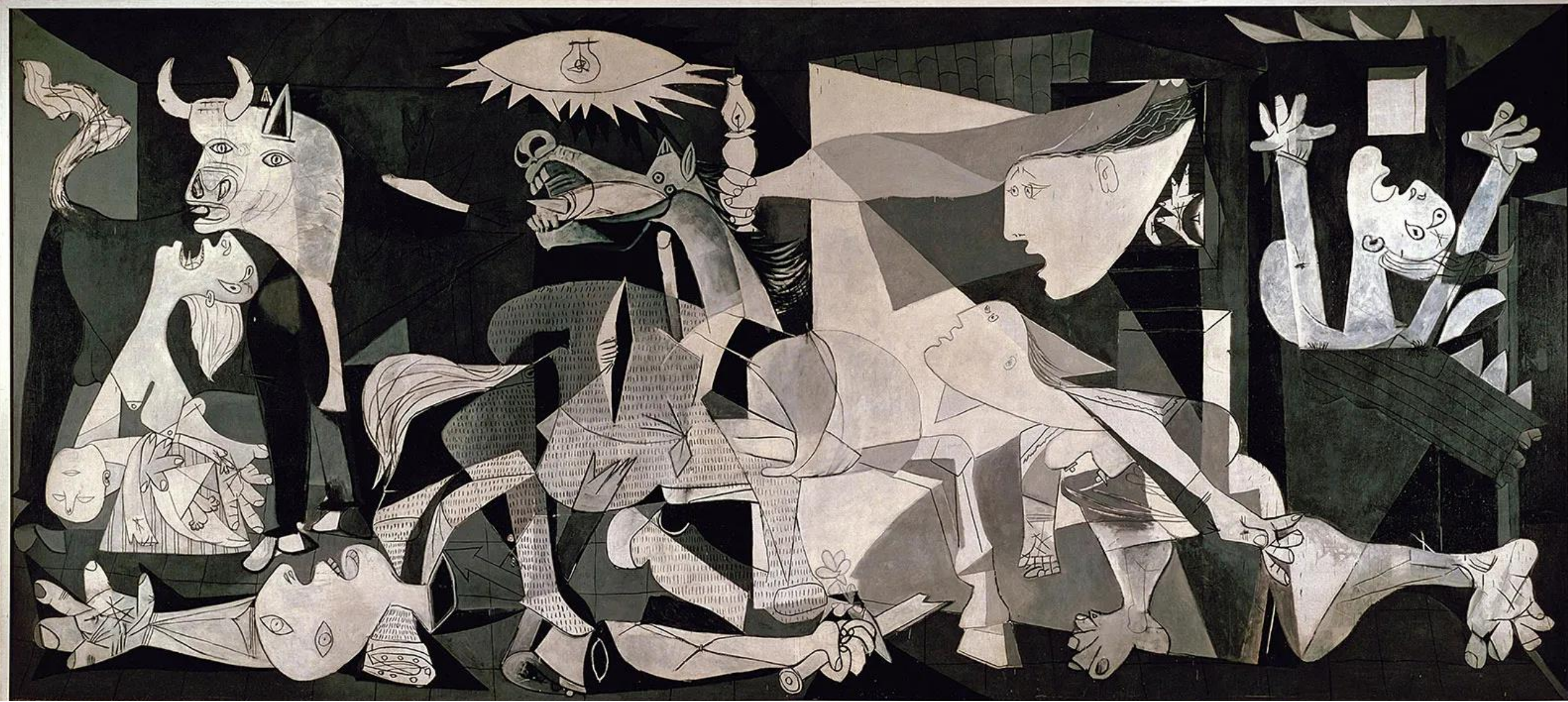


Intending to be Random can be an Inherent Motivation for One's Art

What Was Picasso Doing?

Pablo Picasso (1881-1973)



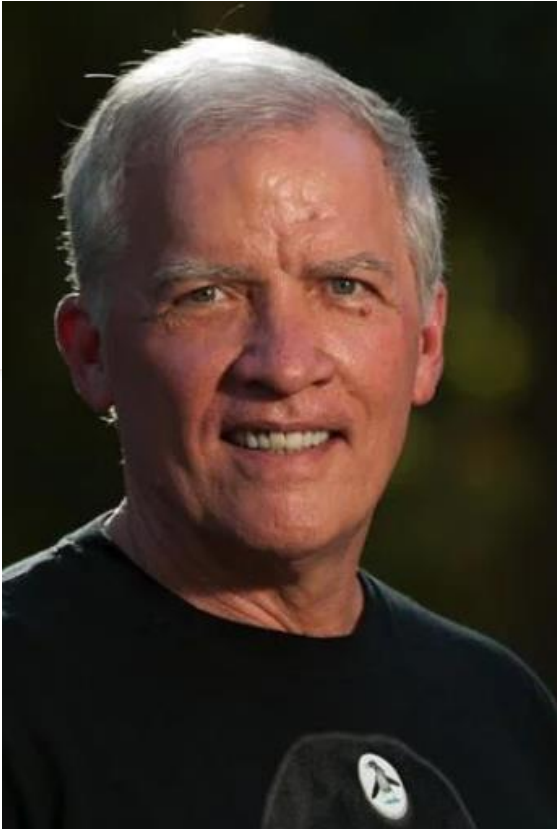


Guernica (Pablo Picasso, 1937)



Runco Again

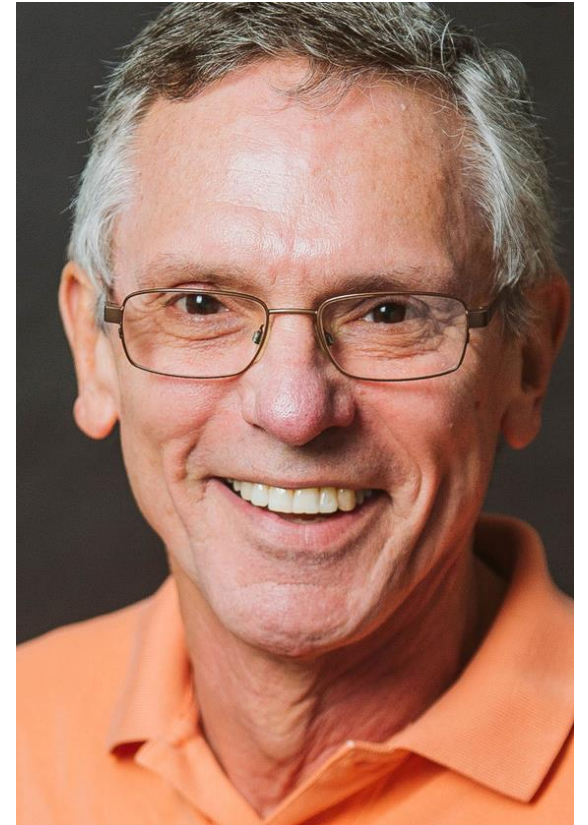
“Creativity does not rely on chance - large number of choices, decisions, judgments that creative individuals make depend on intentions and ... systematic efforts..”



“Picasso’s sketchbooks are replete with false starts and wild experiments” (Simonton 1999)



“placed in the context of his career and in the history of art ... [the] creation of Guernica was based on what one might call a simple or direct extension of his work at that time” (Weisberg 2004, p. 24)



Many Old Oppositions

Intentional, Planned, Top-Down	Random, Blind Chance, Trial & Error
Rationalist (innate traits)	Empiricist (all experiential learning)
Gestalt Psychology (thinking as insight, restructuring)	Behaviourist Psychology (thinking as trial & error, learned responses)
Good Old Fashioned Logic-Based AI (inductive biases as axioms)	Neural to Deep Learning Networks (learning from patterns in data)
Pre-Loaded Evolved Adaptations	Blank Slate (<i>Tabula Rasa</i>)
People have many goals, free will and an ability to decide their destiny..	People are conditioned by environment, responding to the latest cue...



Trial & Error...

- Art is Blind Variation
- Free Association with Selective Retention...
- Remote Association and Artistic muddling thru'

Dean Simonton



Systematic & Driven

- Directed Exploration
(composition v character)
- Few false starts; the structure & characters are there at start
- Kernel idea from earlier work...

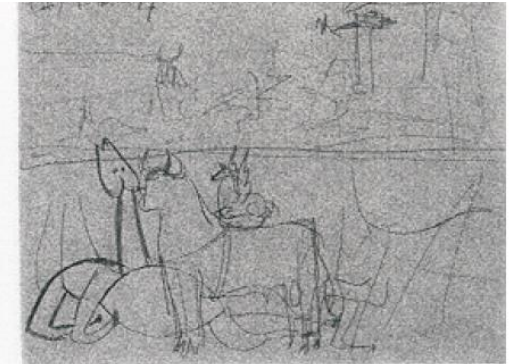
Robert Weisberg

Guernica Sketches

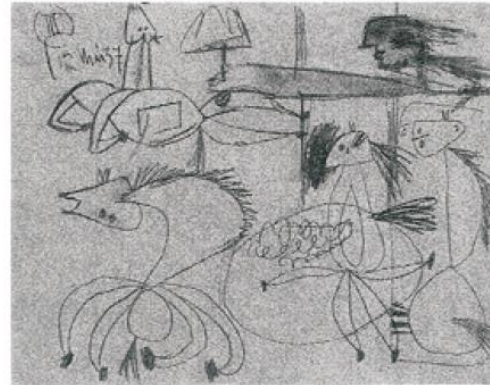
- Picasso numbered and dated 45 sketches
- Sketches are composition and character studies
- Sketching starts May 1st and ends June 4th, painting May 11th to early June



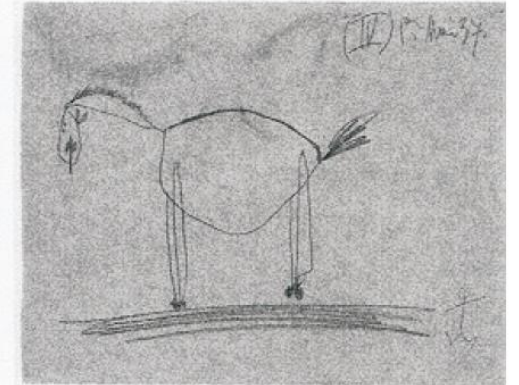
1



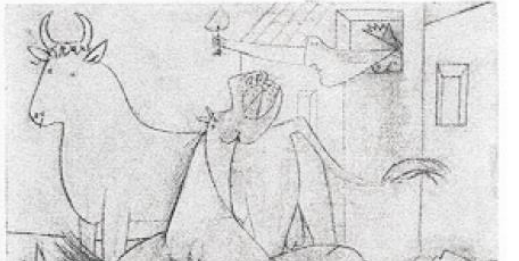
2



3



4



Guernica Sketches

- Picasso numbered and dated 45 sketches
- Sketches are composition and character studies
- Sketching starts May 1st and ends June 4th, painting May 11th to early June



18



19



21



23



22

Characters ...

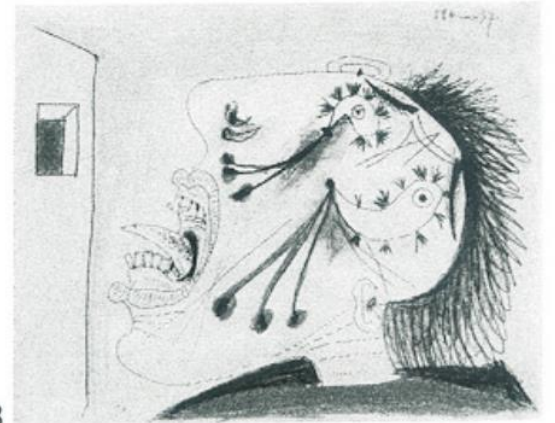
Similar patterns of development of character...

Focused on small set, not exploration of whole universe...

37



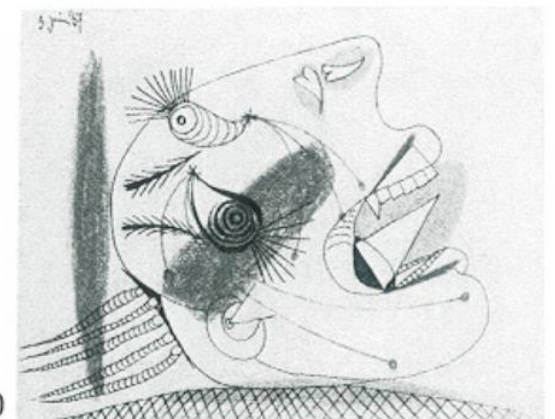
38



39



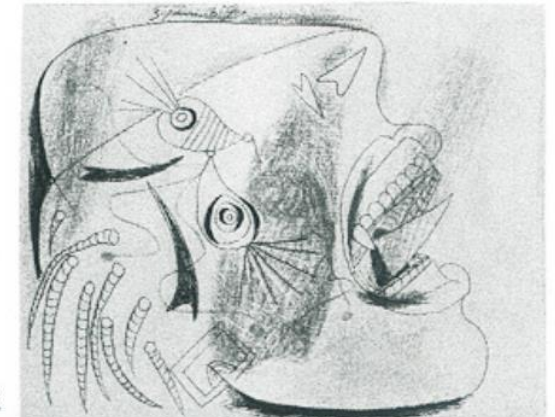
40



41



42



Kernel ...





Kernel ...



Minotauromachy is also often referenced as an important precursor to Picasso's famous 1937 painting *Guernica*, which was created in response to the [bombing of Guernica](#) in the [Spanish Civil War](#). The two images share a number of similar elements and symbols. Both contain depictions of aggression in the right side of the composition.^[3] They also both depict a lightbearer, though *Minotauromachy*'s is a little girl and *Guernica*'s is larger, almost superhuman, and bursts into the image.^[3] Additionally, the bull in *Guernica*, though it resembles the Minotaur, is just a head and not a Minotaur at all.^[9] The wounded horse is also depicted in both *Minotauromachy* and *Guernica*.^[11]



Conceptual Blending

chicken-man



In the Style of ... Van Keane !

- CNNs have been used for Nice Pictures... with prompting people call them Creative !
- This type of *conceptual blending*, is a form of Combinatorial Creativity

Image Blending

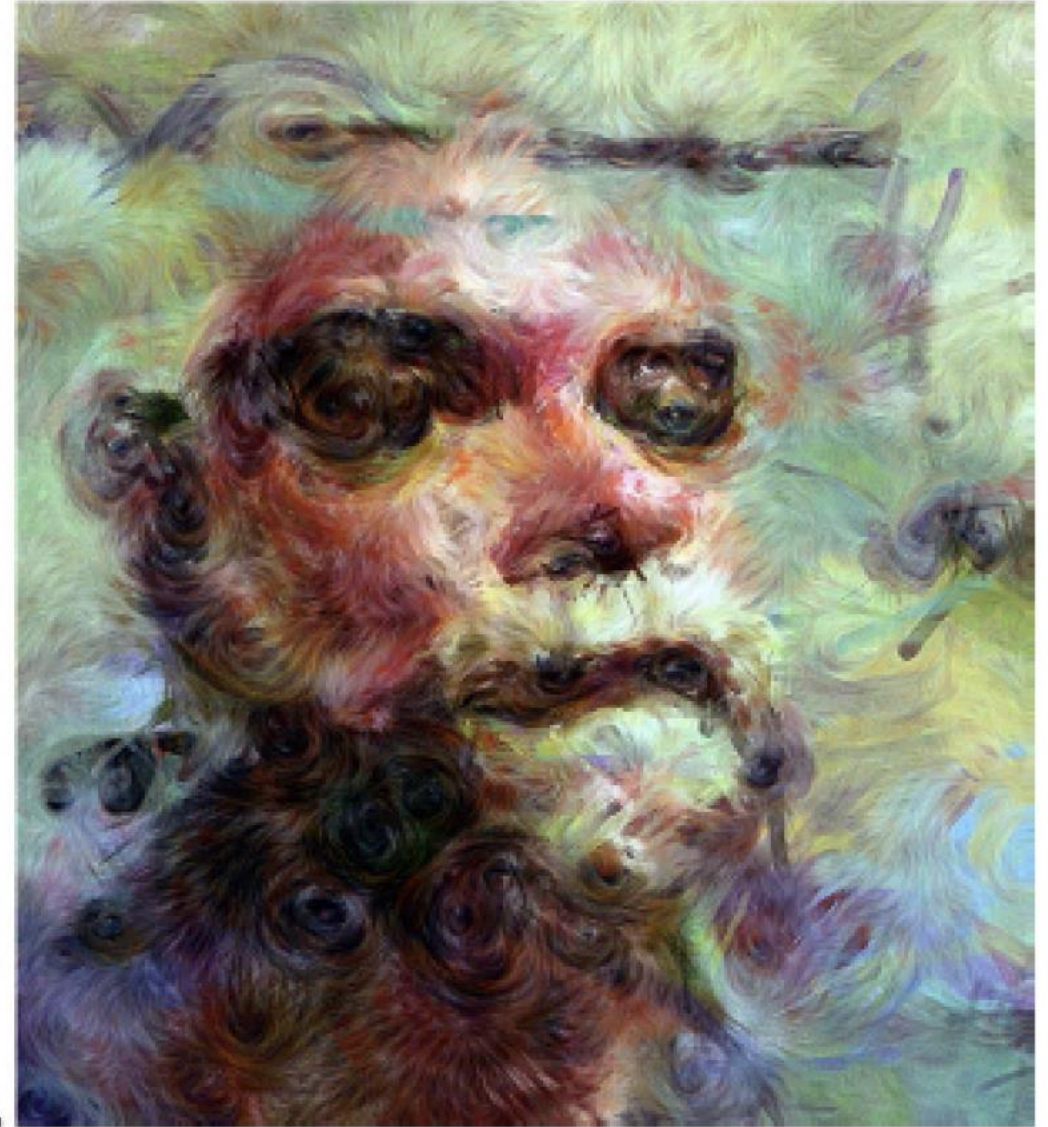
McCaig, G., DiPaola, S., & Gabora, L.
(2016, June). Deep Convolutional
Networks as Models of Generalization
and Blending Within Visual Creativity.
*In Proceedings of the Seventh
International Conference on
Computational Creativity.*



a.



b.



c.

Figure 1. Using Deep Dream, the bird image (b) is used as a guide with source (a), thereby conceptually blending the two (c).

Complex CNN Model...

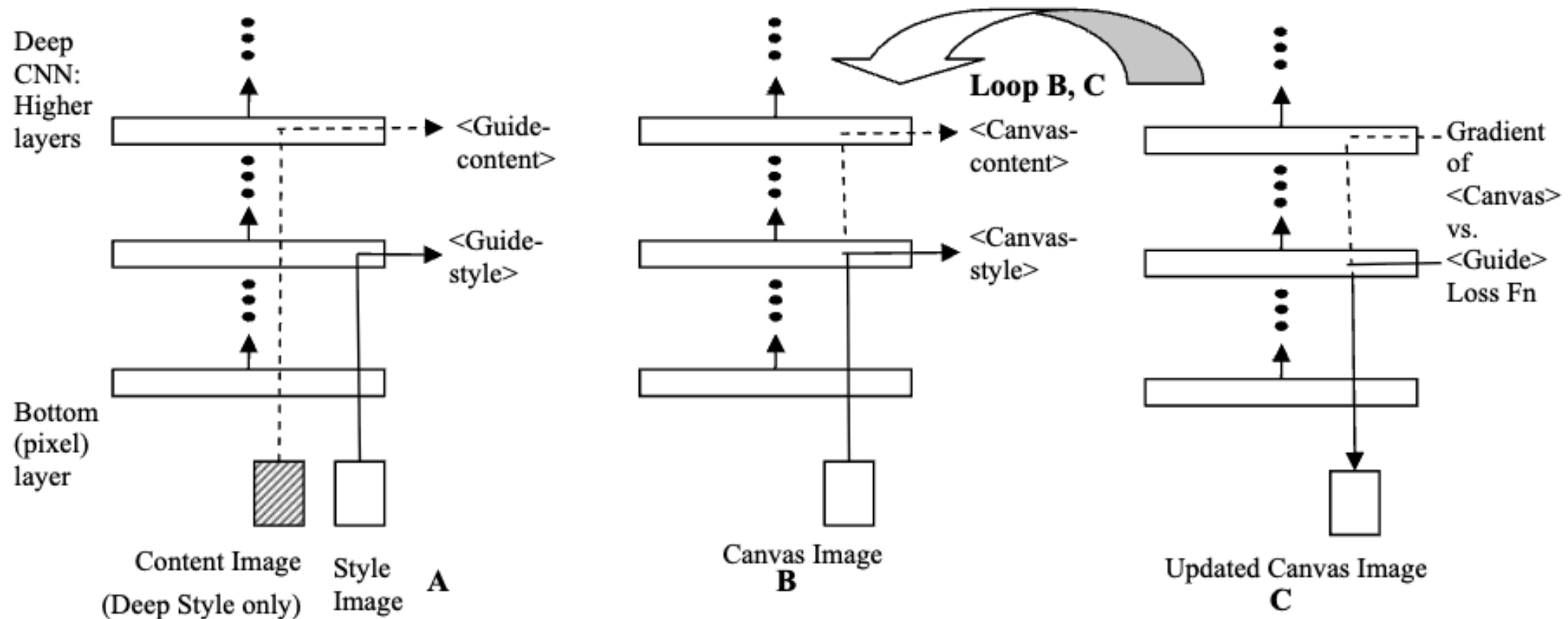


Figure 2. Schema illustrating the operation of Deep Dream and Deep Style algorithms. Dashed lines apply only to Deep Style.

choice of guide image matters...

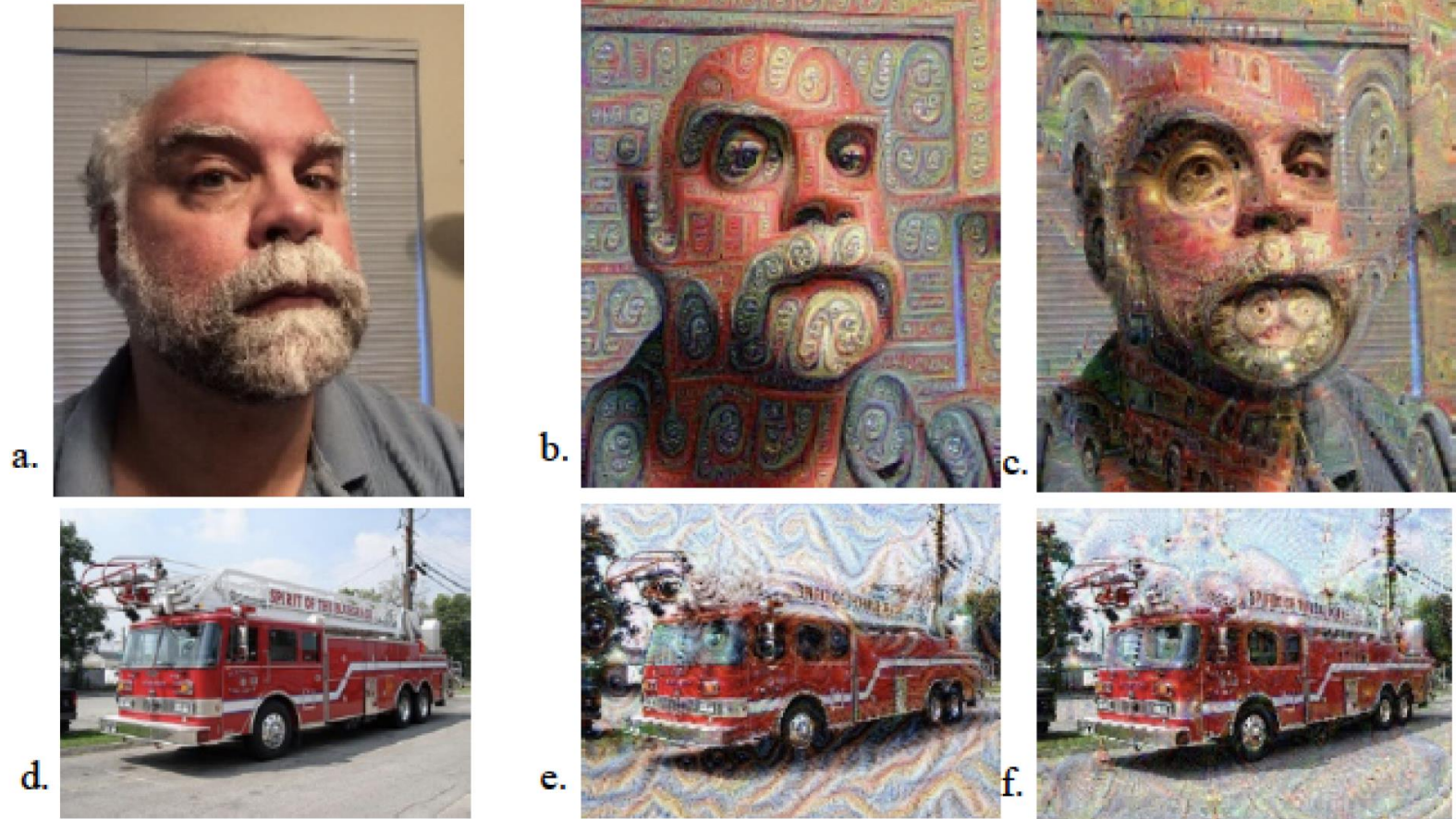


Figure 5. Deep Dream. Top row: face (a) as source with fire engine (d) guide; bottom row: fire engine source with face guide. (b,e) use lower net-layer, (c,f) use higher net-layer.

McCaig, G., DiPaola, S., & Gabora, L. (2016). Deep Convolutional Networks as Models of Generalization and Blending Within Visual Creativity. *ICCC-16*.

choice of
layers
matters...



Figure 3. Comparing no-guide output of Deep Dream for low to high network layers (a-e), and alternate training set (f).

McCaig, G., DiPaola, S., & Gabora, L. (2016). Deep Convolutional Networks as Models of Generalization and Blending Within Visual Creativity. *ICCC-16*.

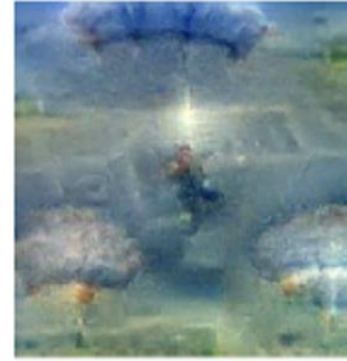
dataset
drives
features...



Anemone Fish



Banana



Parachute



Screw

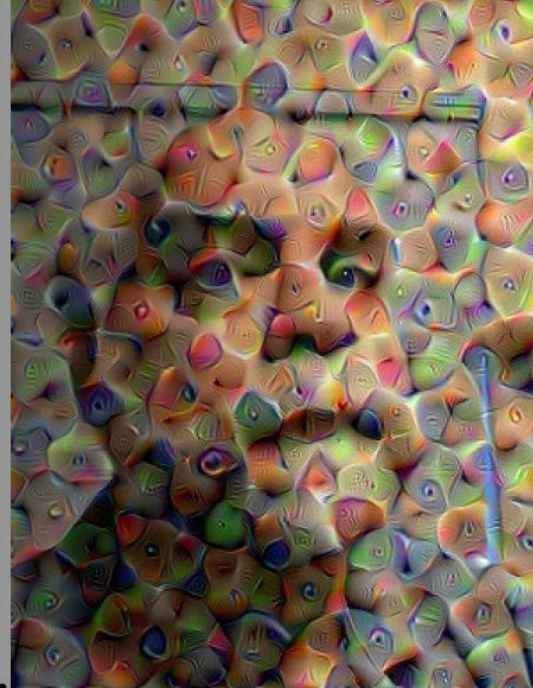


Dumbbells !!!

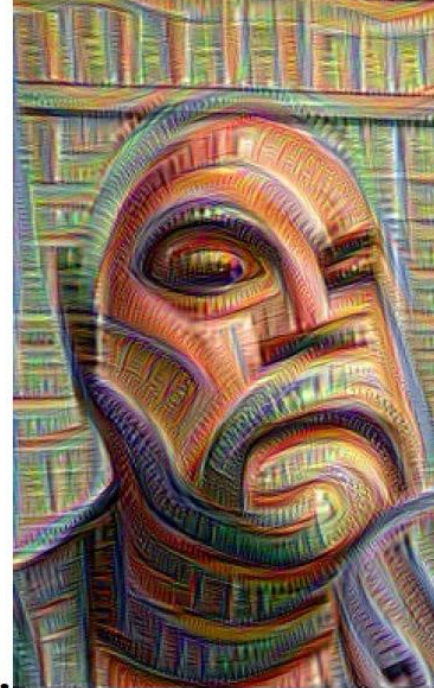
“dog faces
everywhere”
problem



a.



b.



d.



e.



Critique of Chicken-Man

- A generic, generative process with with human-given goals and decisions (no novelty?)
- Human choices of inputs/layers/datasets affect outputs and are human-judged (no autonomy?)
- Has a very specific task/domain focus (so it lacks generalisation?)
- **Creative** product cannot (purely) in the eyes of the beholder (not good enough; hit rate?) and needs to be intended by the creator...



Human Creativity Has Inherent Motivation

Intrinsic Motivation...to Find Problems

[Telling robots] ...to formulate hypotheses...dramatically detracts from their autonomy, at least during the problem finding stage of the creative process. Actual problem finding on the part of AI would involve allowing them to scrape the web for information, and then simply leaving them to their own devices (pun intended)...

Schmidhuber's RL Suggestion....

Intelligent agents can become more effective learners by being **intrinsically motivated** to explore unknown, interesting, or surprising aspects of their environment. Rather than relying solely on external rewards, these curiosity-driven rewards push agents to seek new information, resulting in learning and adaptation even when traditional rewards are sparse or unavailable...agents can become highly efficient learners with minimal external guidance, driven by the intrinsic motivation to learn and understand.

Schmidhuber, J. (2010). Formal theory of creativity, fun, and intrinsic motivation (1990–2010). *IEEE transactions on autonomous mental development*, 2(3), 230-247.

Comes Back To...

How do you decide what is interesting, what is the thing that grabs you, that becomes the target for your motivation... (not solved?)

For people, the motivation comes from who they are...the creative act becomes fundamental to their expression of one's "self" (hmmm...)*

Pollock...Van Gogh...Kahlo...had to create...

Runco's Authenticity: product is an expression of self, of desires, motives, ideals and beliefs



Humans intend to create in many different ways; they are inherently motivated to create, often in the face of overwhelming odds...



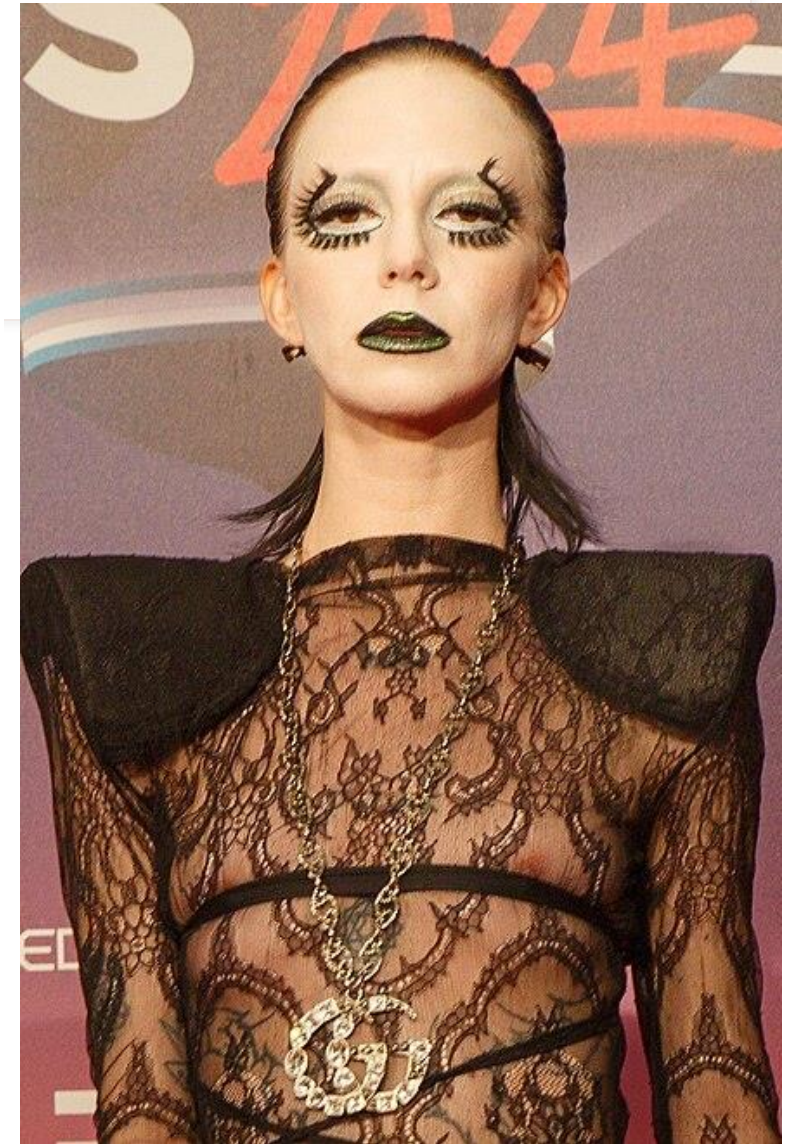
Creative Cognition in People

Mark T. Keane, University College Dublin, Ireland

Creative Thinking



- ~ *Combinatorial* combines existing ideas to create something new (Bambi Thug)
- ~ *Transformational* genuinely novel ideas, changing paradigms, ways of thinking, changing spaces, constraints, ops
- ~ *Exploratory*, smart trial and error in a space of ideas, playful, brainstorming



Bambi Thug
(1993-Present)

Boden, M. A. (1998). Creativity and artificial intelligence.
Artificial intelligence, 103(1-2), 347-356.

Creative Thinking



Concept
Combination

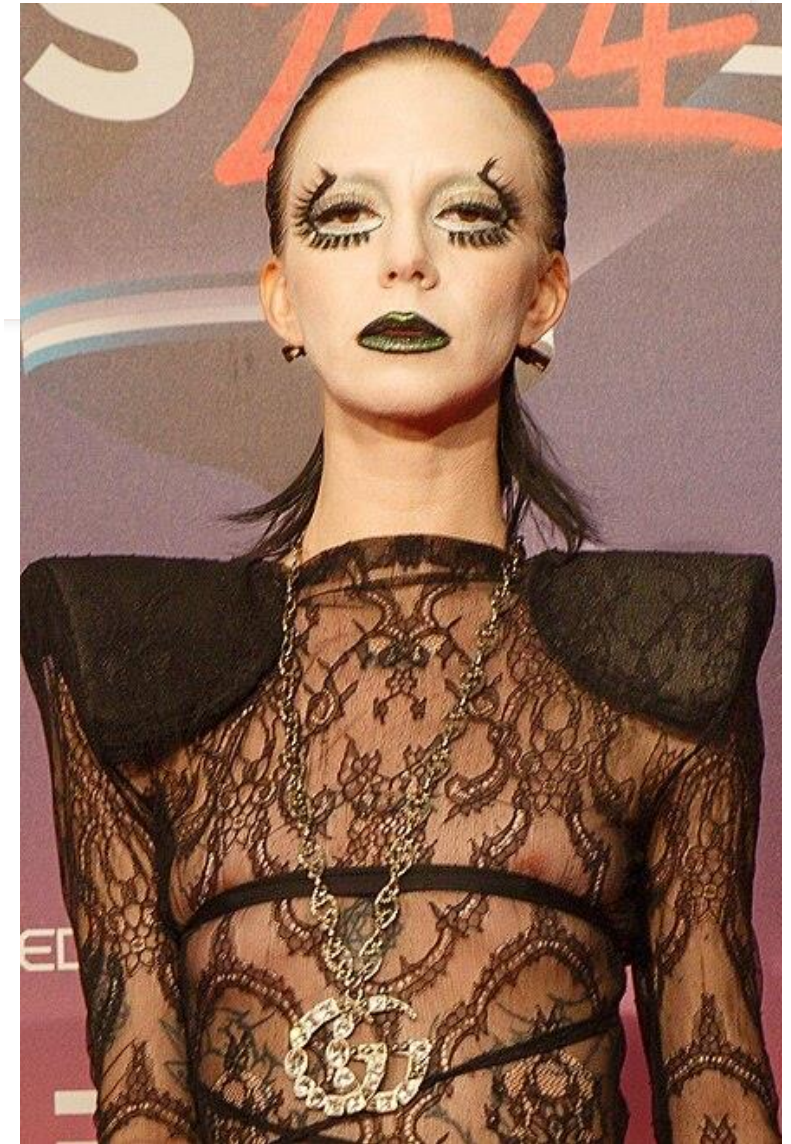
Analogical
Thinking

Insight &
Serendipity

Combinatorial combines existing ideas to create something new (Bambi Thug)

Transformational genuinely novel ideas, changing paradigms, ways of thinking, changing spaces, constraints, ops

Exploratory, smart trial and error in a space of ideas, playful, brainstorming



Bambi Thug
(1993-Present)

Boden, M. A. (1998). Creativity and artificial intelligence.
Artificial intelligence, 103(1-2), 347-356.



Leveraging Language to Create New Meanings

THEY ARE
BAMBI THUG !

Concept Combination





Creative Language Extension

- People use language to extend the meanings in the language; concept combination for new products (laptop computer, bum bag)
- So, it can be Big-C and Little-C creative; I suffered from *Cavan Fever*, when I moved to the country !
- Depends on specific, *creative* cognitive processes that combine existing knowledge in new ways

Concept Combination (of Nouns)

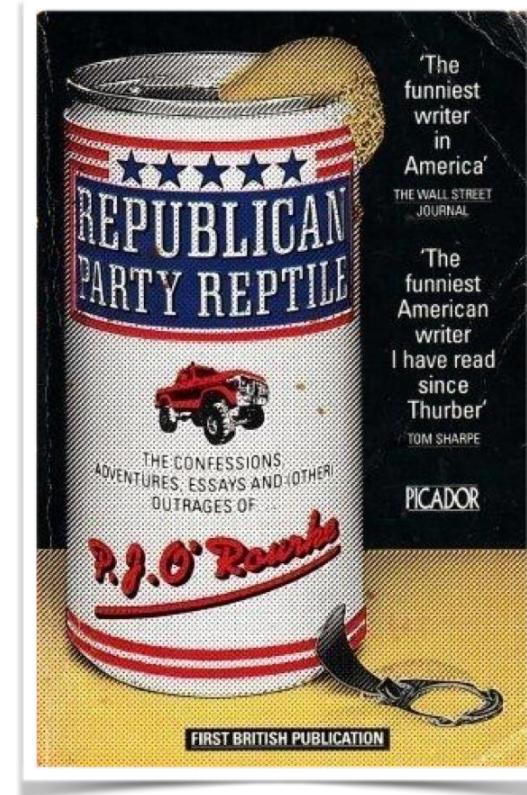
Pork Barrel President Line Veto

Republican Party Reptile

Trump Gate

Water Frame

Finger Cup



Finger CUP



FINGER cup

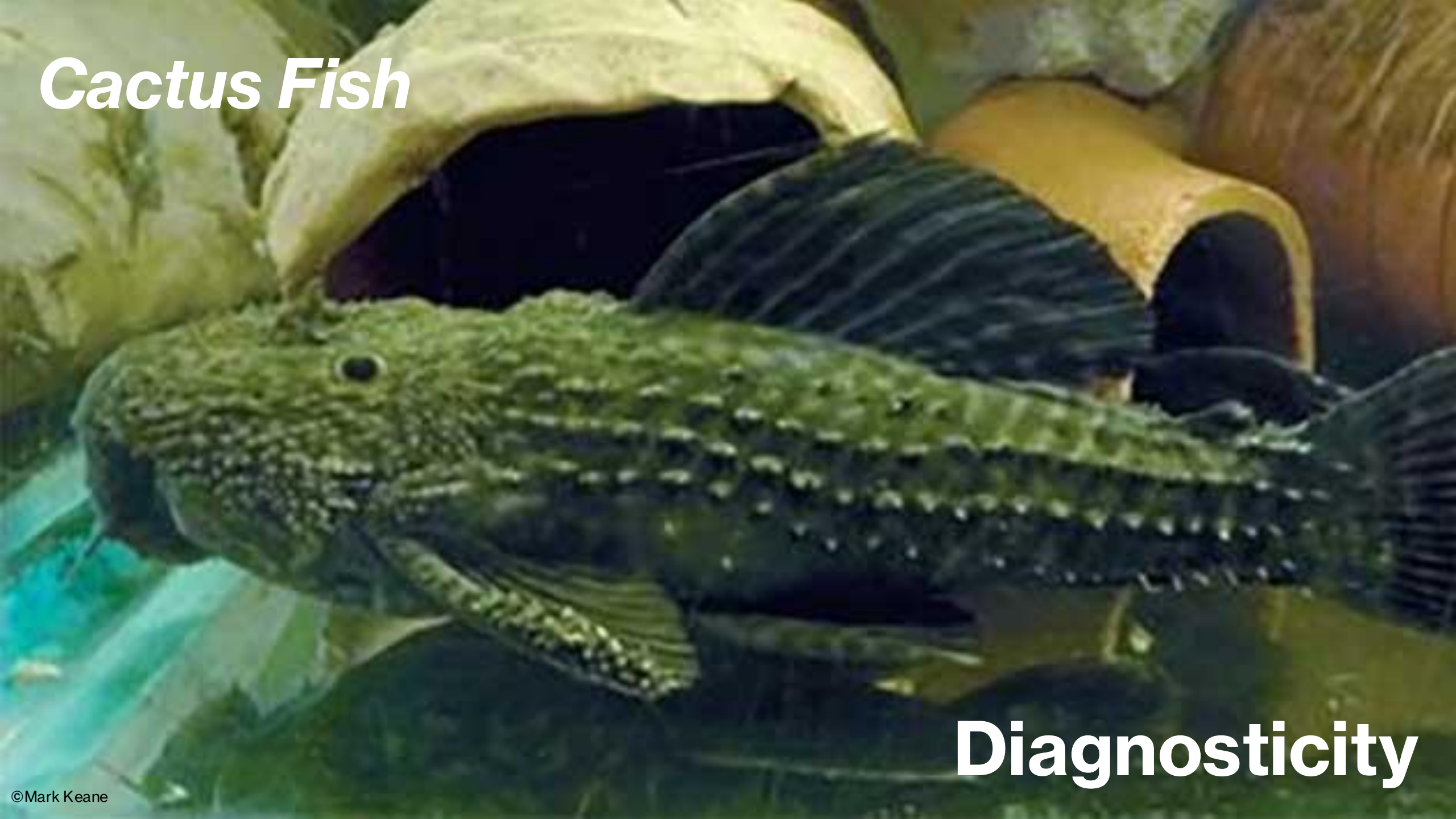


Pragmatic Constraints

Hearer expects *Speaker* to obey these conversational rules:

- **Diagnosticity**, given words are sufficient to understand the idea and use diagnostics features (eg. *cactus fish* is “prickly fish”, not a “green fish”)
- **Informativeness**, new information must be conveyed (eg. *head hats* and *pig pork* seem odd)
- **Plausibility**, needs to be something more-or-less known (eg. *shoveler duck*, *bird pig*)

Cactus Fish



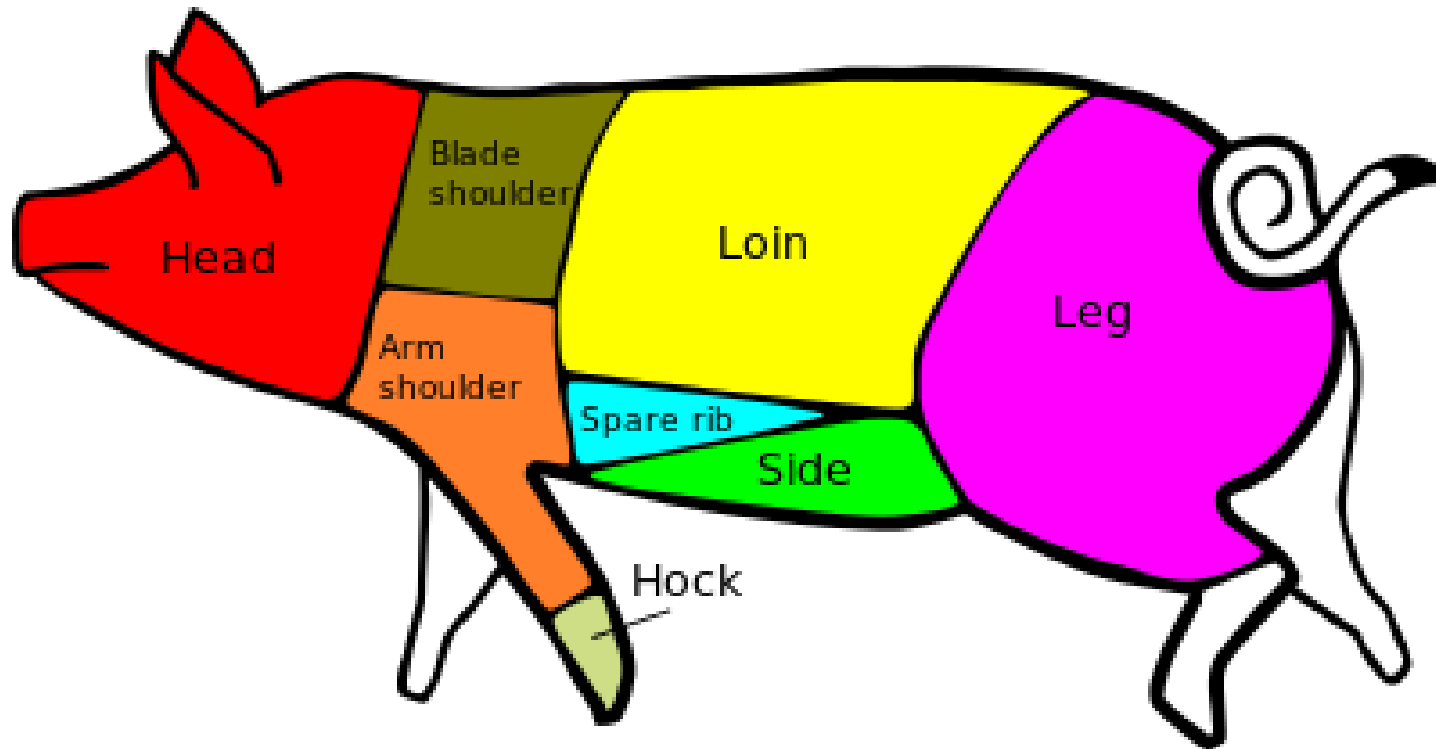
Diagnosticity

Pragmatics Constraints

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Pig Pork



Informativeness

Pragmatics Constraints

Hearer expects *Speaker* to obey these conversational rules:

- **Diagnosticity**, given words are sufficient to understand the idea and use diagnostics features (eg. *cactus fish* is a “*prickly* fish”, not a “*green* fish”)
- **Informativeness**, new information must be conveyed (eg. *head hats* and *pig pork* seem odd)
- **Plausibility**, needs to be something more-or-less known (eg. *shoveler duck*, *angel pig*)

Angel Pig



Plausibility

***Plausibility* is Important**

- *Plausibility* is a knowledge-driven judgement about whether something fits with prior experience (C&K, 2006); note, how different sense-sources like shape, motion, visual attributes are exploited flexibly
- GenAI computational ideas about it are poor:
 - ~ Falling within a distribution (fine if well modelled)
 - ~ Is the product is close to things we know already?
- Ironically, *GenAI* is now cautiously poor at it (*ChatGTP 3.5*)

ChatGPT



You

Can generative Ai do creative concept combination



ChatGPT

Yes, generative AI can excel at creative concept combination. By leveraging large datasets and sophisticated algorithms, generative AI models can merge, remix, and innovate upon existing concepts to generate entirely new and unique ideas. This ability to combine and synthesize concepts from diverse sources often leads to surprising and creative outcomes. Whether it's generating art, music, stories, or even scientific hypotheses, generative AI can offer novel combinations that human creators might not have considered.





The term "bird pig" does not correspond to any known animal species or commonly recognized concept. Here are a few possibilities for what it might refer to:

1. **Slang or Colloquial Term:** It could be a slang term or a colloquial nickname for something specific within a certain community or context.
2. **Fictional or Artistic Concept:** It might be a fictional creature or an artistic creation, perhaps from a story, movie, game, or artwork that combines features of both birds and pigs in a whimsical or imaginative way.
3. **Hybrid Animal:** It could be a term used in a humorous or metaphorical sense to describe a hybrid or chimeric creature, possibly in a creative or satirical context.
4. **Miscommunication or Typo:** It could simply be a mistaken term or typo, where "bird pig" was used instead of another intended phrase.

If you have more context or specific information about where you encountered the term "bird pig," I could provide a more accurate explanation.



A "cactus fish" is not a recognized term in biology, ichthyology (the study of fish), or botany. It seems like a combination of two very different things: a cactus, which is a type of plant, and a fish, which is an aquatic animal. There might be a few possible explanations for this term:

1. **Miscommunication or Typo:** It could be a mistaken term or typo. Perhaps it was meant to refer to a specific type of fish or a cactus plant separately.
2. **Fictional or Artistic Concept:** It might be a fictional creature or a concept from a story, game, or artwork where creative combinations of different organisms are imagined.
3. **Slang or Colloquial Term:** It could be a slang term or a colloquial name used in a specific community or region for something unrelated to actual cacti or fish.
4. **Marketing or Branding:** Sometimes unusual combinations of words are used in marketing or branding to create a unique product name or concept.

If you have a specific context or additional information regarding the term "cactus fish," please provide more details so I can give a more accurate explanation.





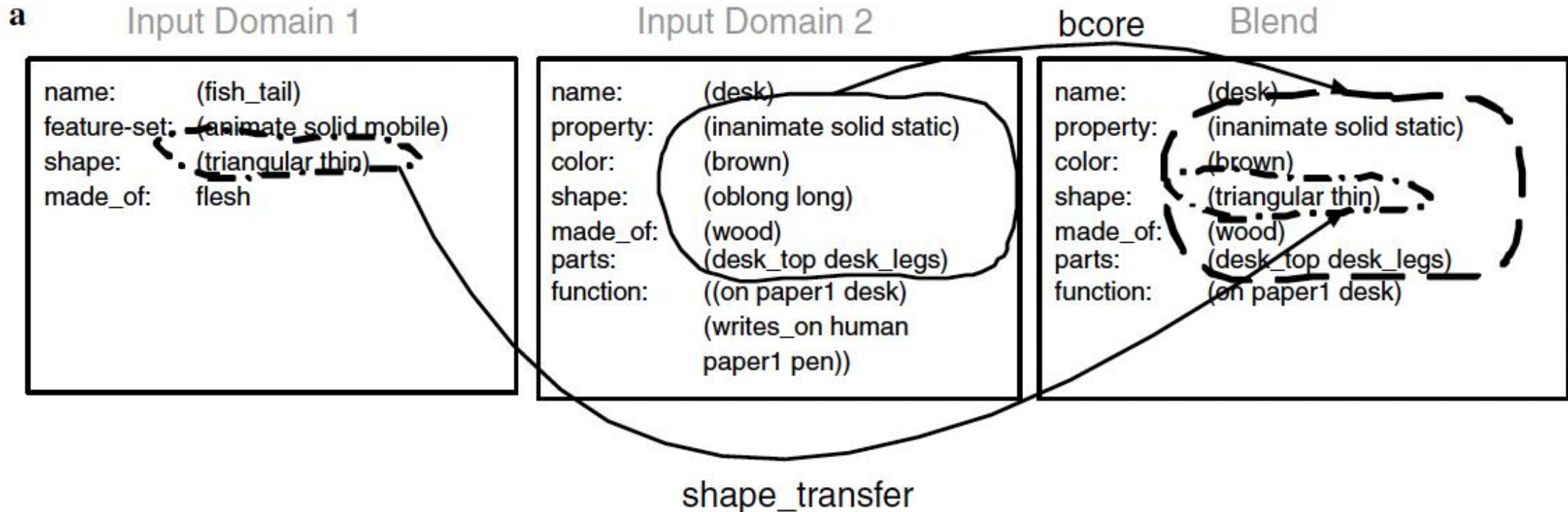
A "finger cup" is a small vessel, typically found in more formal dining settings or during multi-course meals, particularly in historical or elegant dining traditions. Here are its main characteristics and uses:

1. **Purpose:** The finger cup, also known as a finger bowl, is used for rinsing fingers between courses, especially when eating foods that might be messy or involve the use of hands, such as shellfish or fruit.
2. **Appearance:** It is usually a small bowl, often made of glass, porcelain, or silver. It may contain warm water, sometimes scented with a slice of lemon or a sprig of mint to enhance the cleansing effect and add a pleasant aroma.
3. **Usage:** When presented, diners typically dip the tips of their fingers in the water, then dry them with a napkin. Proper etiquette involves doing this discreetly and only with the fingertips, avoiding making any splashes.
4. **Cultural Significance:** The finger cup is more common in certain cultural and historical contexts, often associated with European or Asian fine dining traditions. It emphasizes cleanliness and refinement in the dining experience.

In modern dining, finger bowls are less common but still found in high-end restaurants or during formal events. It follows traditional dining customs.

Older CC Work Does Better !

Fish-tail Desk



REGULAR ARTICLE



Meaning creation in novel noun-noun compounds: humans and language models

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^aDepartment of Psychology, New York University, New York, NY, USA; ^bCenter for Language, Music, and Emotion (CLaME), New York University, New York, NY, USA; ^cErnst Strüngmann Institute for Neuroscience, Frankfurt, Germany

ABSTRACT

The interpretation of novel noun-noun compounds (NNCs, e.g. “devil salary”) requires the combination of nouns in the absence of syntactic cues, an interesting facet of complex meaning creation. Here we examine unconstrained interpretations of a large set of novel NNCs, to investigate how NNC constituents are combined into novel complex meanings. The data show that words’ lexical-semantic features (e.g. material, agentivity, imageability, semantic similarity) differentially contribute to the grammatical relations and the semantics of NNC interpretations. Further, we demonstrate that passive interpretations incur higher processing cost (longer interpretation times and more eye-movements) than active interpretations. Finally, we show that large language models (GPT-2, BERT, RoBERTa) can predict whether a NNC is interpreted by human participants and estimate differences in processing cost, but do not exhibit sensitivity to more subtle grammatical differences. The experiments illuminate how humans can use lexical-semantic features to interpret NNCs in the absence of explicit syntactic information.

ARTICLE HISTORY

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KEYWORDS

Noun-noun compounds;
lexical-semantic features;
verb diathesis; eye-tracking;
language models

Overall, in these experiments we demonstrated that human participants rely on distinct and mostly non-overlapping lexical-semantic features of NNC’s word constituents to build grammatical relations and to devise verb semantics. Subtle structural differences between interpretations produced by human participants were not captured by large language models, pointing to a sophisticated and unique ability of humans to form novel meanings in the absence of explicit syntactic information.

See also: *Ichien, N., Stamenković, D., & Holyoak, K. J. (2023). Large language model displays emergent ability to interpret novel literary metaphors. arXiv preprint arXiv:2308.01497.*



Moving Between Domains

ANALOGICAL THINKING

Koestler's "Bisociative Thought"

Koestler, A. (1964). *The Act of Creation*. Penguin, NY

Arthur Koestler

THE ACT OF CREATION

Koestler affirms, that all creative activities have a basic pattern in common, and all creatures have the capacity for creative activity.

©Mark Keane

Structured Mappings of Knowledge

Arts and Science use analogies to think about unfamiliar things or create new conceptual perspectives

SpeechPauses::Music
Atoms::Solar-systems
Snake-Biting::BenzeneRing
2D::3D

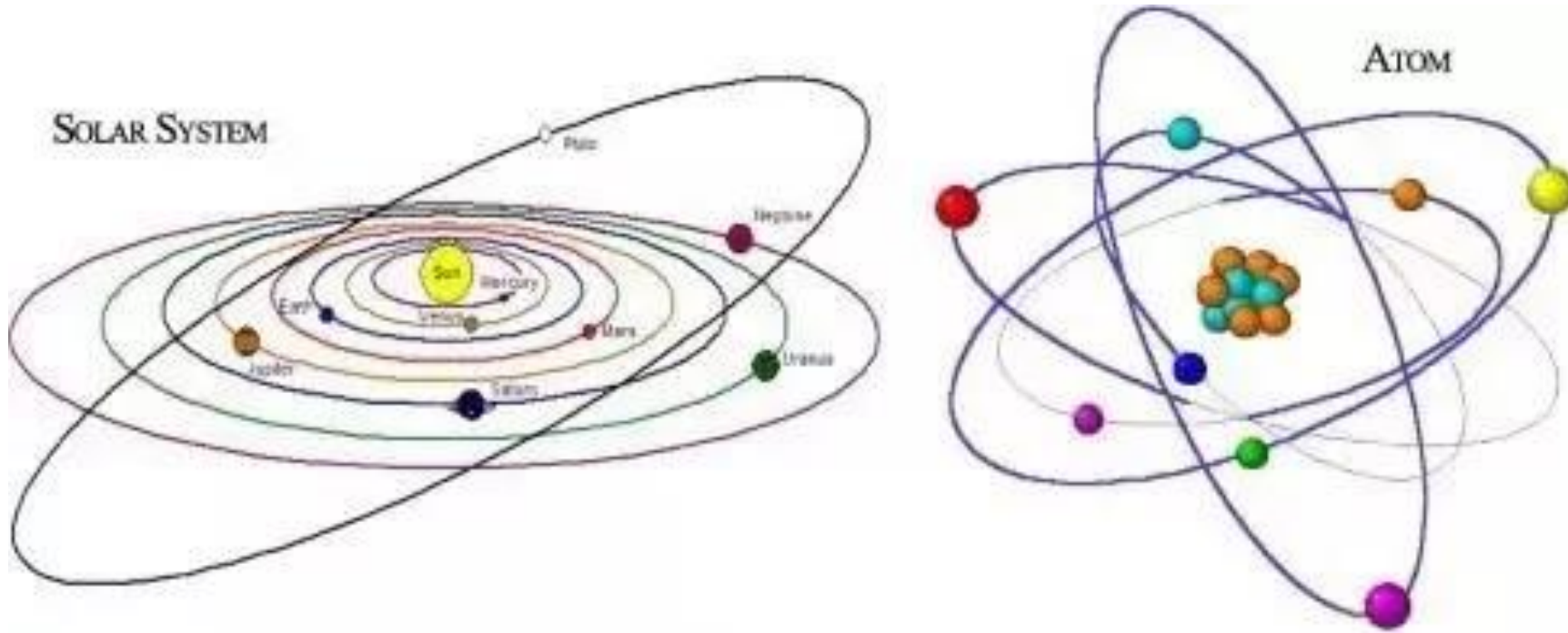


DIAGRAM OF THE SOLAR SYSTEM AS COMPARED TO THAT OF AN ATOM

Inter-Domain Transfer

- Most current GenAI works within an albeit large, defined, single domain (eg. AlphaGo), with IID and OOD
- People also learn within single domains but also creatively transfer between domains
- Notating the tempo of pauses in language, as if it were music !

Samuel Beckett

Analogue Thinking

- Analogies are quintessential creative process; allows cross-domain projecting of old knowledge into new area
- Analogies allow us to think about things we don't know anything about, on the assumption they are relationally/structurally similar (which may not hold)
- Peirce called it *abductive reasoning*; Koestler, *bi-sociative thought* (in creativity, humour, science)

Graph Matching & Maps

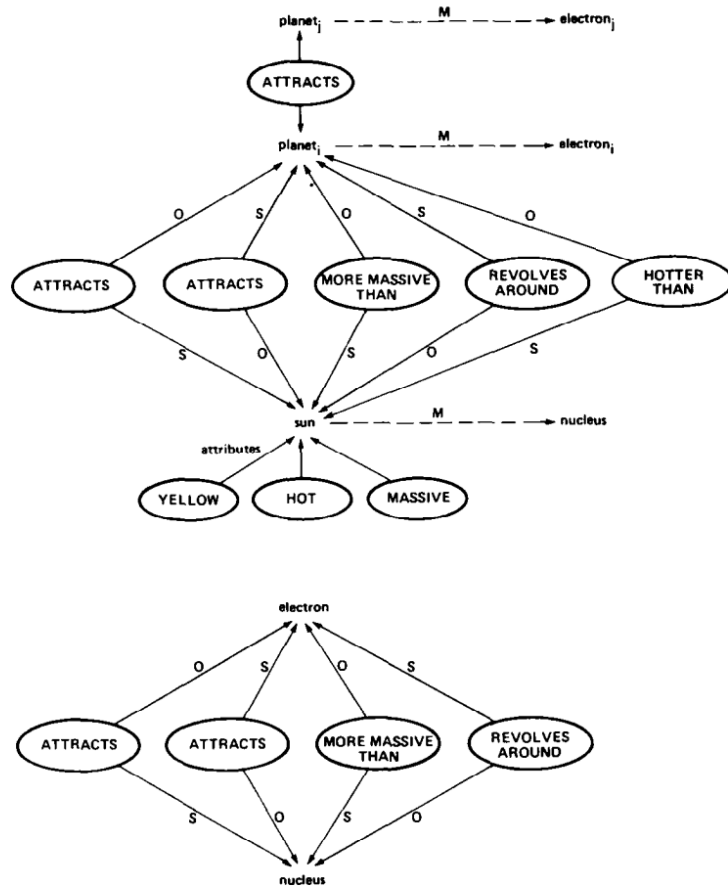
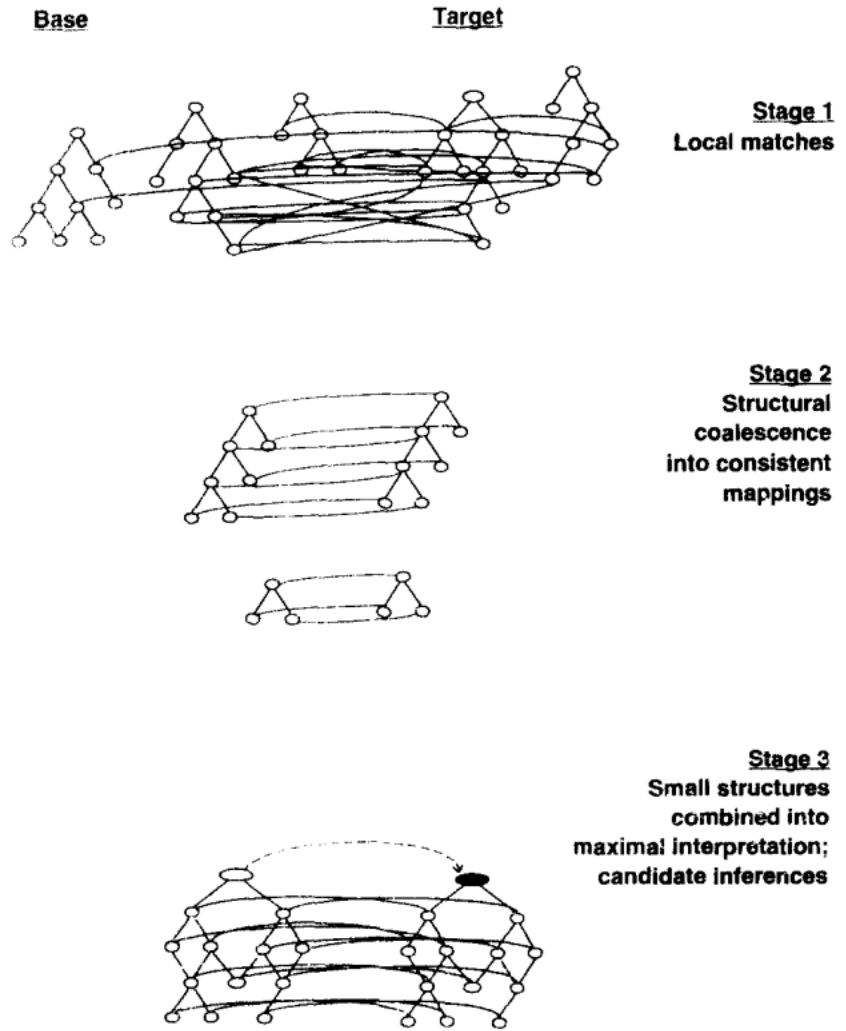


Figure 1. Structure-mapping for the Rutherford analogy: "The atom is like the solar system."

Figure 2
Overview of the Algorithm Used by the
Structure-Mapping Engine



Word Embeddings & Small Analogies

Word embeddings (ala Word2Vec) got word analogies:

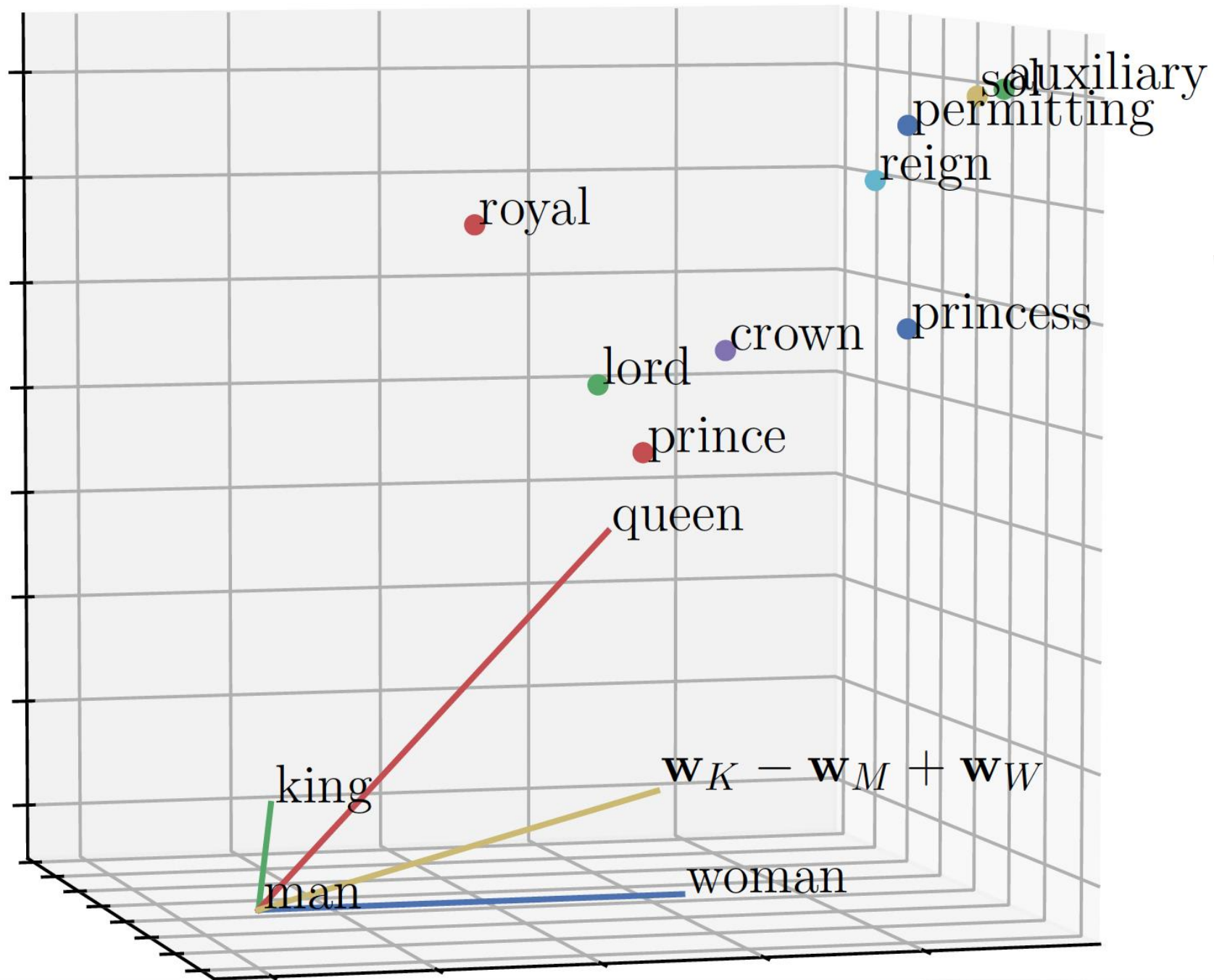
~ **Man : King :: Woman : ?** **Queen**

~ **Paris : France :: London : ?** **Britain**

Mikolov, T., Yih, W. T., & Zweig, G. (2013). Linguistic regularities in continuous space word representations. In *ACL-13*

Fournier, L., Dupoux, E., & Dunbar, E. (2020). Analogies minus analogy test. In *CoNLL-20* (pp. 365-375).

Allen, C., & Hospedales, T. (2019, May). Analogies explained. In *ICML-19* (pp. 223-231). PMLR.



Word Embeddings & Small Analogies

Word embeddings (ala Word2Vec) got word analogies:

~ **Man : King :: Woman : ?** **Queen**

~ **Paris : France :: London : ?** **Britain**

But, complex issues around whether it really works and why it seems to work... (paraphrase, offsets, pairings)

Mikolov, T., Yih, W. T., & Zweig, G. (2013). Linguistic regularities in continuous space word representations. In *ACL-13*

Fournier, L., Dupoux, E., & Dunbar, E. (2020). Analogies minus analogy test. In *CoNLL-20* (pp. 365-375).

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Creating Small Analogies Hard

- Building databases of previous analogical-matches: *composes->writes*
- Using ChatGPT to find meta-relations (*CEO~President = Head_Of_Organization*)
- Still only partially works!

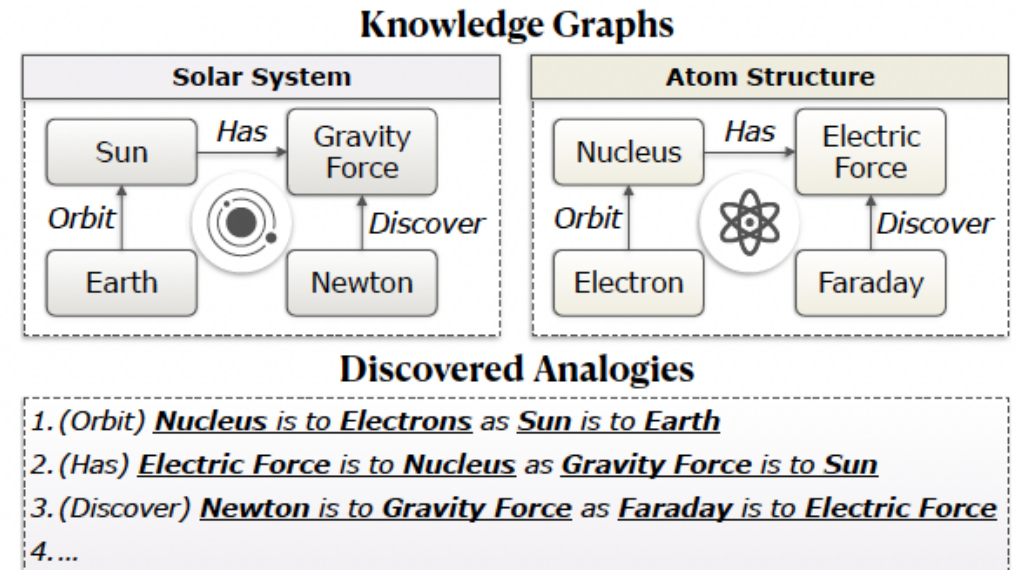


Figure 1: An example of acquiring analogies from KGs. Based on the relational knowledge triples from KGs, *i.e.*, facts about the *solar system* and an *atom structure*, we can discover new analogies using the corresponding relations between concepts.

Dodgy Type-Hierarchy Problem

Veale, T. (2006) An analogy-oriented type hierarchy for linguistic creativity. *Knowledge-Based Systems*, 19.

To resolve this contradiction, authors such as Eileen Cornell Way [\[23\]](#) have argued for the importance of a dynamic type hierarchy (DTH) as a taxonomic backbone for conceptual structure. Such a taxonomy would dynamically reorganize itself to reveal new types in response to appropriate metaphors. For example, Way [\[23\]](#) gives as an example “**Nixon is the submarine of world politics**”, and suggests that this metaphor is resolved by the dynamic type *Things Which Behave In A Secret Or Hidden Manner*. However, as useful as a dynamic hierarchy would be for metaphor and analogy, Way does not suggest an empirical means of constructing a DTH capable of generating such ambitious types, leaving unresolved key issues of exhaustiveness and computational tractability.

GenAI Challenges

- Making small analogies still hard
- Co-ordinating large analogical mappings, runs into planning issues for GenAI (not GOF AI)
- This is before you consider existing OOD issues, waiting in the long grass



How Do People Do It?

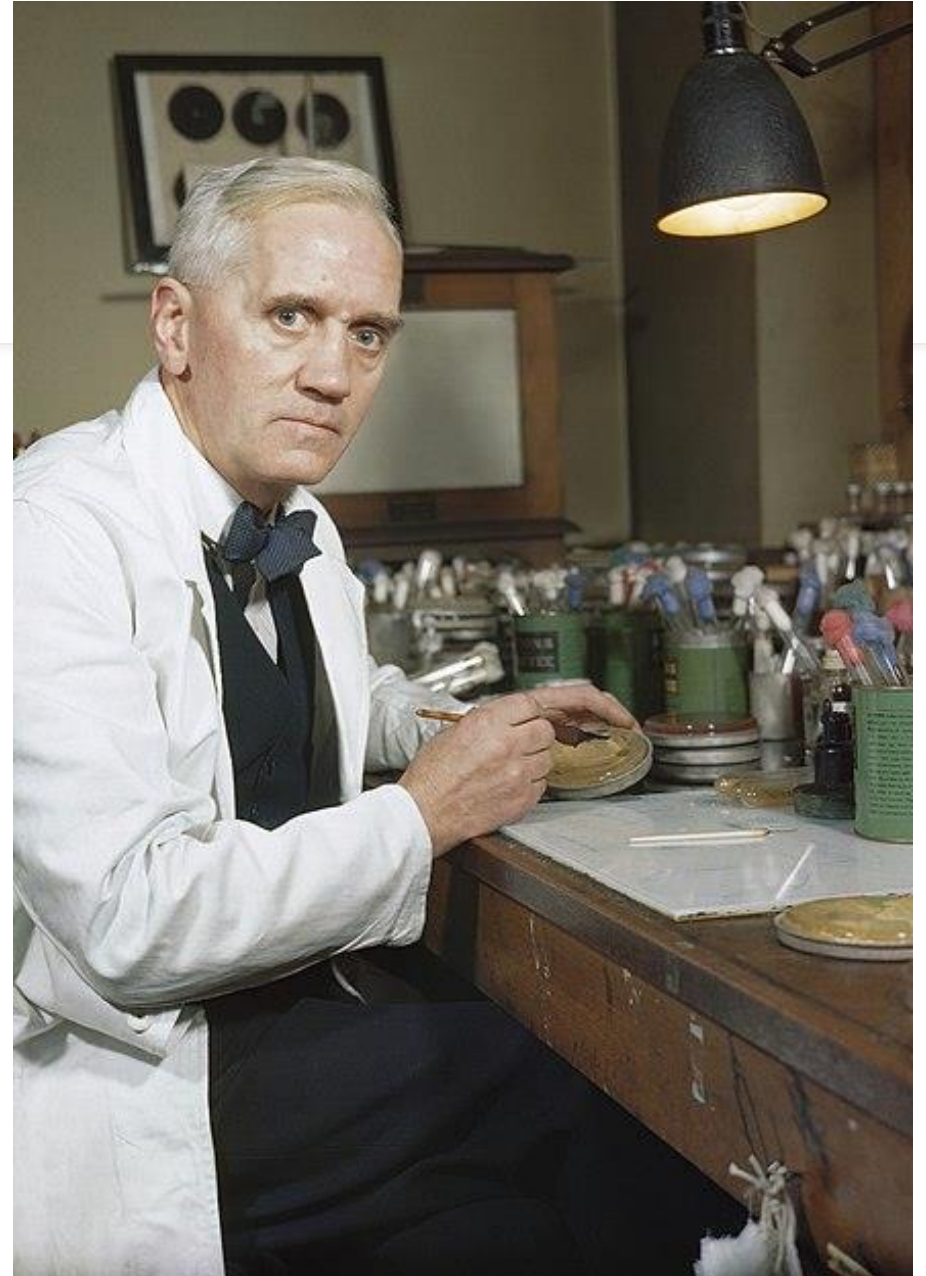
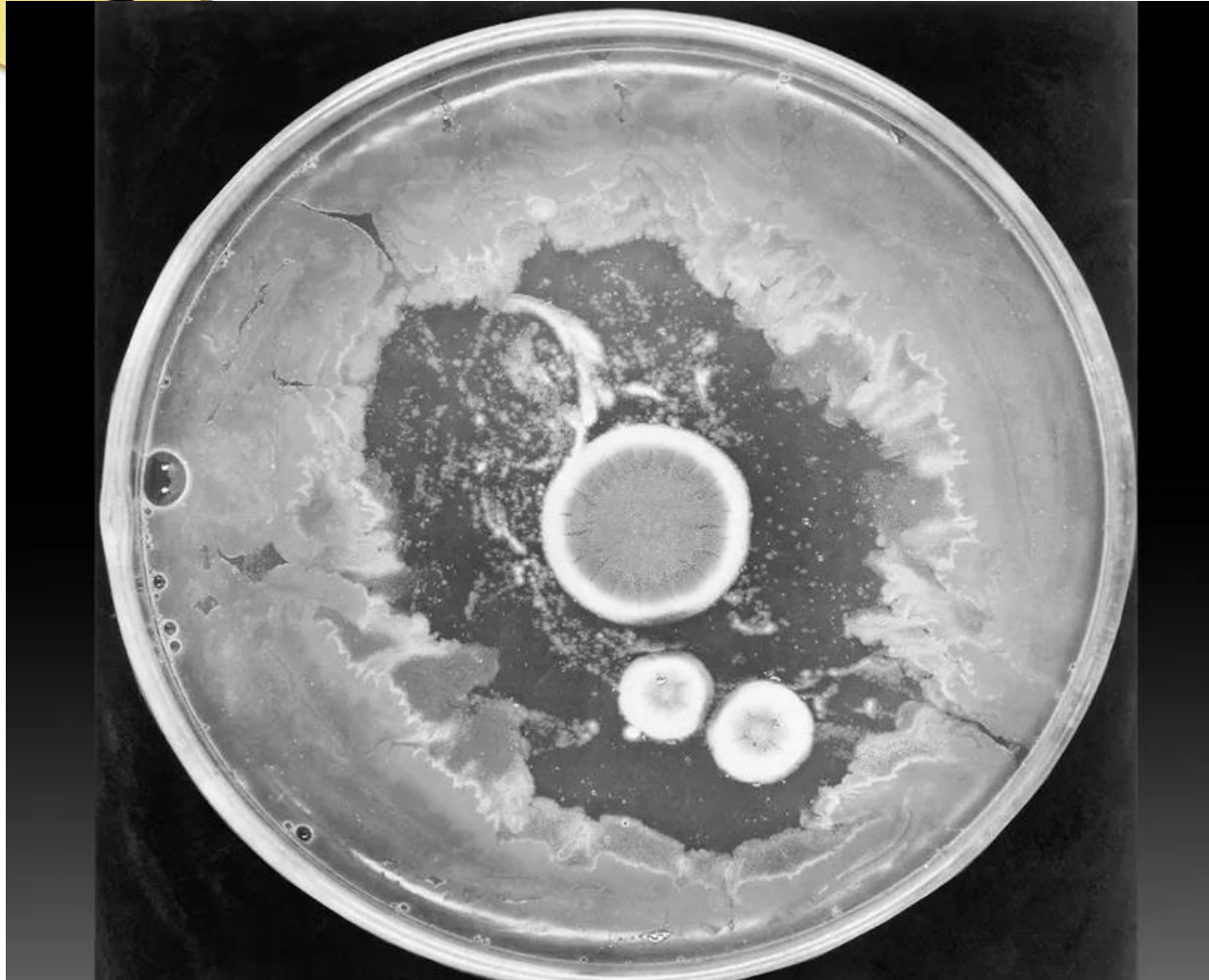
- People do large analogies really fast (spatial scaffolding?)
- They can create new meanings between entities using slippage and flexible relations...(metaphorical kicks)
- Must depend on between multiple sense codes and representations; unclear that purely text can do this...



Opportunistic Insights

Context Sensitive, Contingent, Opportunistic

- *Insight* shows a pre-disposition to opportunism, using accidental info that arises...serendipity
- Creativity system seems to be waiting and watching; insights can arise from *hanging goals*
- Again, this makes sense as we are context-sensitive entities in a complex, contingent World with limited knowledge access



People Have Lots of Goals !

- We maintain several levels of goal-directed behaviour every day; needing a sandwich, getting to work, worrying about family, research ideas, and so on...
- Some, “Ah Ha!” experiences occur after unconscious working out (incubation) or maybe even forgetting...
- But, other insights realise *hanging goals*; we have a “watching brief” for things of interest (eg Fleming)

Two String: Insight Problem



Maier, N. R. (1931). Reasoning in humans. II. The solution of a problem and its appearance in consciousness. *Journal of Comparative Psychology*, 12, 181.

Two String: Insight Solution



Maier, N. R. (1931). Reasoning in humans. II. The solution of a problem and its appearance in consciousness. *Journal of Comparative Psychology*, 12, 181.

Swinging Hints...

- Part of the problem is overcoming the usual uses of objects in the world (*functional fixedness* on scissors)
- But, part is realising that the string can swing...
- Experimenter gave subtle hints, walking across the room and (accidentally) brushing off the string
- Many people solved problem soon after...fabricating other sources for the solution (not noticing hint !)



Swinging Hints...

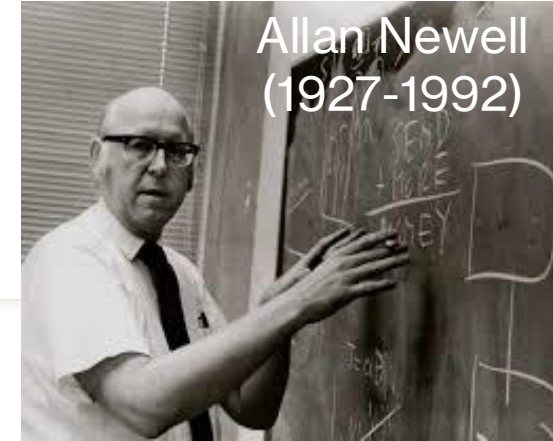
Something in the World is captured by a hanging goal, instituting access to a new problem space (of weights and swinging objects) that in turn delivers the operators needed to solve the problem...

Hanging Goals...Admit Accident

- Meta-cognition for insight problems shows no feeling of closeness to solution, sudden and unpredicted
- Unresolved hanging goals show an opportunistic mind prepped for accident and serendipity
- Exploiting opportunities seems to be a *modus operandi* for the system, not a epiphenomenon
- World is used as a cue access to solve problems; we are always poised and watching...

SOAR

- *State Operator And Result (SOAR)*
- Search in problem, operator, memory spaces when impasses occur create a new space (find-new-operator space)
- Ohlsson's Insight theory says changing the representation can change the whole problem



Allan Newell
(1927-1992)



Stellan Ohlsson

Laird, J. E., Newell, A., & Rosenbloom, P. S. (1987). Soar: An architecture for general intelligence.

Artificial intelligence, 33(1), 1-64.



Whither AI & Creativity?

Mark T. Keane, University College Dublin, Ireland

Whither AI & Creativity?

- Hard to argue that GenAI will *never* be creative...
- But, if it develops a different SuperHuman Creativity, how would we know?



We Differ from LLMs

- What is ChatGTP's intrinsic motivation? Its high-level goals for survival? How does it adapt to its environment? How does it respond to past experience?
- We are multi-sense, multi-representational opportunistic learners with complex goal-tracking, goal-selection, problem-definition

Language Writ Large:

LLMs, ChatGPT, Grounding, Meaning and Understanding

[Stevan Harnad](#)

Department of Psychology
University of Quebec/Montreal

ABSTRACT: Apart from what (little) OpenAI may be concealing from us, we all know (roughly) how ChatGPT works (its huge text database, its statistics, its vector representations, and their huge number of parameters, its next-word training, etc.). But none of us can say (hand on heart) that we are *not* surprised by what ChatGPT has proved to be able to do with these resources. This has even driven some of us to conclude that ChatGPT actually understands. It's not true that it understands. But it is also not true that we understand how it can do what it can do. I will suggest some hunches about benign "biases" -- convergent constraints that emerge at LLM-scale that may be helping ChatGPT do so much better than we would have expected. These biases are inherent in the nature of language itself, at LLM-scale, and they are closely linked to what it is that ChatGPT *lacks*, which is *direct sensorimotor grounding* to connect its words to their referents and its propositions to their meanings. These convergent biases are related to (1) the parasitism of indirect verbal grounding on direct sensorimotor grounding, (2) the circularity of verbal definition, (3) the "mirroring" of language production and comprehension, (4) iconicity in propositions at LLM-scale, (5) computational counterparts of human "categorical perception" in category learning by neural nets, and perhaps also (6) a conjecture by Chomsky about the laws of thought. The exposition will be in the form of a dialogue with ChatGPT-4.

Human Creativity: Desiderata

- *Autonomy*: creators use their knowledge/skills to frame the problems and judge the products produced
- *Intentional & Motivated*: creative act is directed, intentional, and motivated; not brute search, not random or side-effect
- *Diverse Processes*: are used in creative act (eg. experimentation, explaining, evaluating) as well as some specialised, creative ones (analogy, counterfactuals)
- *Meaning*: relies inherently on multi-sensed representations
- *Surprise, Insight & Accident*: are an inherent part of the creative process not just things that happen to happen

Human Stance

- People have an inherent need to make sense of the world and are partially successful at it !
- The human stance notes discrepancies, anomalies, oddities and tries to explain them
- We also keep a “watching brief” on issues of concern to be resolved (with hanging goals)



Different Architectures

- GenAI and Human Architectures are very different
- People are fallible creatures evolved to deal with a messy, ill-defined, contingent (and dangerous) World (like small birds we are opportunistic idea feeders)
- GenAI has not really been exposed to that sort of World (yet) and typically works off single-goals in an internalised Virtual World (its data, lots of it)

Human Creativity fundamentally depends on the World that we evolved to live in, and how we make sense of that World and understand it...



To A Child Dancing In The Wind

Dance there upon the shore;
What need have you to care
For wind or water's roar?
And tumble out your hair
That the salt drops have wet;
Being young you have not known
The fool's triumph, nor yet
Love lost as soon as won,
Nor the best labourer dead
And all the sheaves to bind.
What need have you to dread
The monstrous crying of wind!

William Butler Yeats (1865-1939)





*Really
The End*