

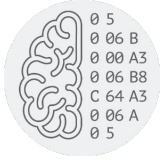


Computational creativity and law: some results from novel concept generation

Lonneke van der Plas, Idiap

Joint work with Inga Lang and Prajit Dhar

29.3.2022



Who am I?

AI researcher > specialized in
language-related tasks > NLP

Currently leading the Computation, Cognition & Language Group
at Idiap in Martigny

MPhil University of Cambridge

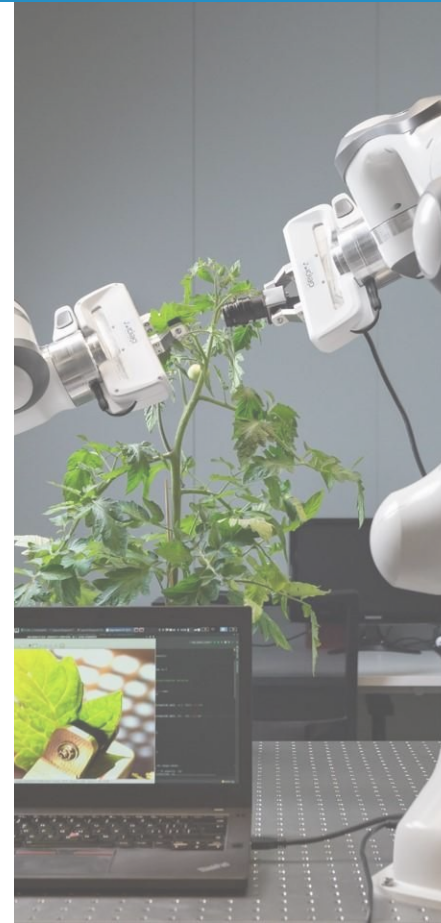
PhD University of Groningen

Junior Professorship
University of Stuttgart

Postdoc University of Geneva

Associate Prof. University of Malta

- Independent not-for-profit Research Foundation, created in 1991
- A dedicated R&D engineers team bridging the gap between academia and industry
- Master in Artificial Intelligence □ a business integrated university training program





Expertise

Signal Processing

Computer Vision

Robotics

Machine Learning

Speech & Language

Human Computer Inter.

Privacy & Security

Data Science

Data types

Text

Speech and Audio

Images

Video

...

Application domains

Health and

Life Sciences

Energy

Security

Manufacturing and

Industry 4.0

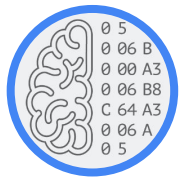
Media and

Entertainment

Devices



+150 employees, +65 research projects and +120 publications per year



Computation, Cognition & Language Group

Boundaries of current AI system with respect to language:

- Cross-lingual transfer for language technology
- Modelling **human cognitive abilities** that are underexposed, such as **creativity**

Text mining /
analysis



Question
Answering

Multilingual
news aggregation

Content
creation

[Image adapted from Gerd Altmann from pixabay.com]

Why computational creativity?

- Recent trend has been to feed more and more data to learning methods
- This has led to impressive results in several tasks
- Also, awareness of limitations of these systems
- They are brittle, data-hungry, task-specific/narrow, and not learning in a flexible way as humans do, opaque
- All-in-all they lack many aspects of human intelligence

Threats of current AI systems

- Brittleness
- Data-hungriness
- Bias
- Lack of explainability
- Narrowness

> The threats of the latter have been under-explored

How narrowly defined AI systems threaten society

Work with Michele Loi, during research fellowship DSI Zurich

- Society is governed by processes that allow for diversity and innovation (e.g., market dynamics, natural evolution)
- A society which is highly informed by intelligent systems that are trained in a supervised fashion with narrowly defined objective functions will not exhibit the same exploration power as a system based on the individuals' judgments
- Fewer agents will be taking over the decision making that was previously done by many more individuals
- More and more impoverished data in training cycle

Filter bubbles and echo chambers

Bias in automatic candidate selection

(Loi & Van der Plas, SDS 2020) (Loi et al., ICCV 2020)



Computational Creativity

Computational Creativity (CC) is a recent but burgeoning area of creativity research that brings together academics and practitioners from diverse disciplines, genres and modalities, to explore the potential of our machines to be creative in their own right (Veale et al., 2019)

Has a dedicated community and annual conference (ICCC)

Several systems have received public attention:

The next Rembrandt, GPT-3 screenwriting tools, Dabus (and the patent application for an AI-generated invention)



Computational creativity

Forecast: The global computational creativity market size to grow from USD 204 million in 2018 to USD 685 million by 2023, at a CAGR of 27.4% during 2018–2023

Given this promising forecast, it is still an underexplored topic. Evaluation of creative systems is challenging

[Source: www.researchandmarkets.com/

Machine Translation to grow only 15%, chatbots 28%]

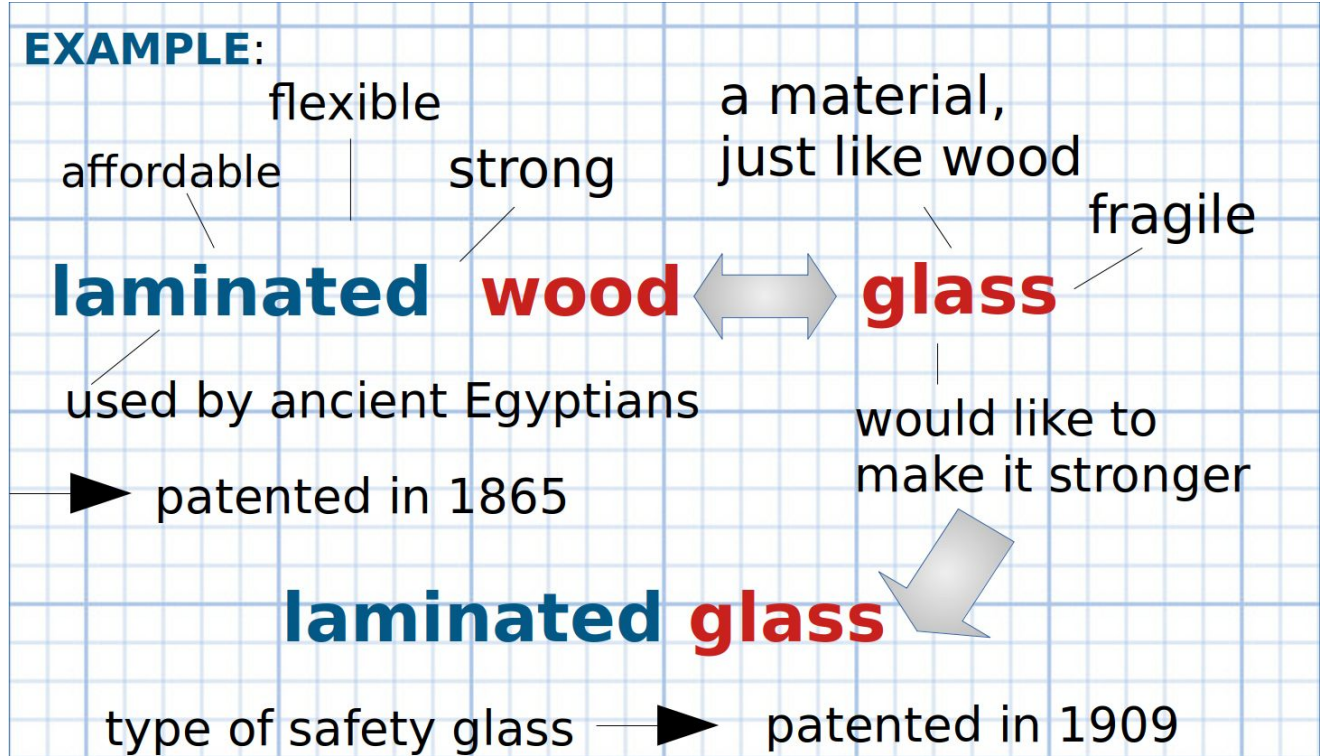


Novel concept creation

Creative thinking follows certain patterns

Can be learned by machine

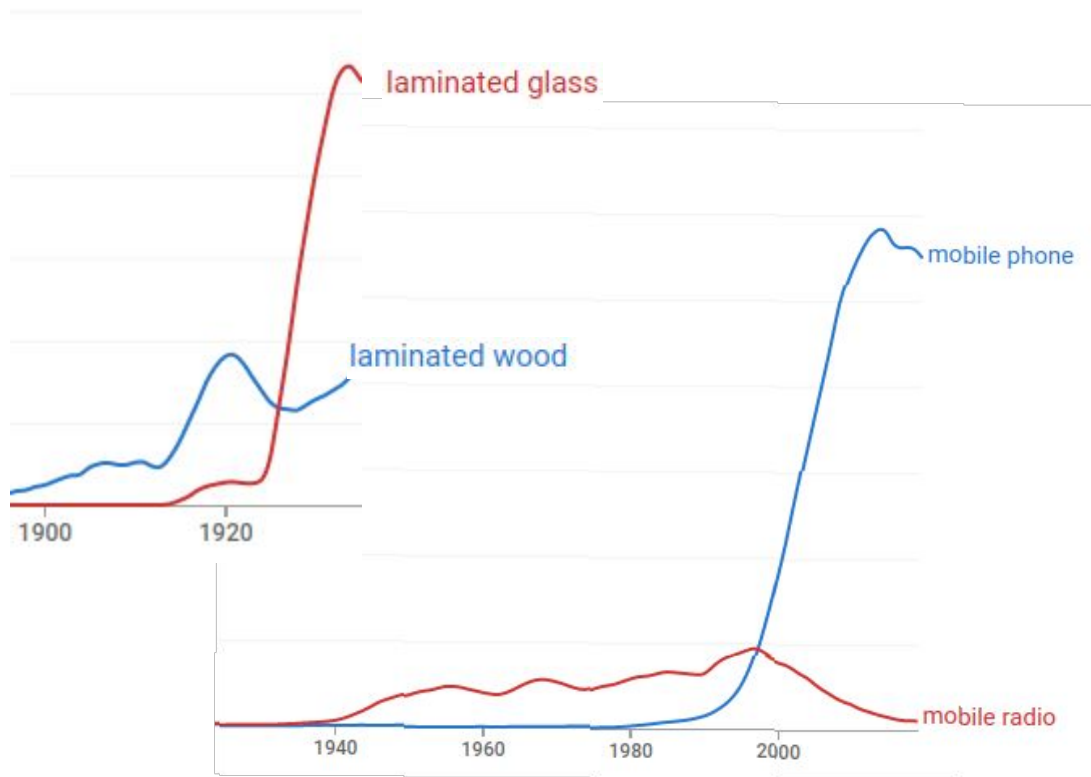
Need to process large amounts of text





Novel concept creation

We can trace the emergence and success of new ideas in texts



Examples: vaccination certificate, flight schedule, stress management, PCR test, quarantine hotel...

Compounds

- The formation of a new lexeme by adjoining two or more lexemes (Bauer, 2003:40)
- Compounding is a very productive word formation process
 - English-speaking children can create novel compounds in spontaneous speech from a very young age (Clark, 1981)
- A very flexible word formation process (relation between lexemes is not specified)

Implicit relations in noun-noun compounds

leather jacket	→	jacket <i>made of</i> leather ‘veste en cuir’
leather scissors	→	scissors <i>used to cut</i> leather ‘ciseaux pour le cuir’
kitchen knife	→	knife <i>used in the</i> kitchen ‘couteau de cuisine’
cheese knife	→	knife <i>used to cut</i> cheese ‘couteau à fromage’



Compounds as vehicles for creative thought

- Compounds allow us to do conceptual recombination
- Using known concepts in combination to create novel ones
- Very flexible, no need to specify the relation between the constituents



A system for novel concept creation

time-stamped
text data
(COCA corpus)

TRAIN

DEV

EVALUATE

1990

2000

2005

2010

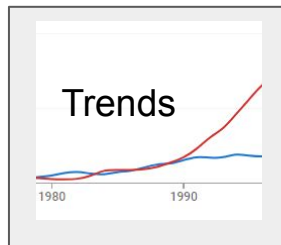
2015

2019

Time →

tea
coffee — water

Vector-based
semantic model
of words and
their relations



coffee machine = good
coffee mouse = bad

Train model
to learn what are
good combinations

Predict
new ideas



Example system output

Found in evaluation set
2015-2019

Predicted by system

riesling sauce
cheeseburger spread
kevlar jacket
waistband blouse
boy food
healthcare burden
hashish store

brain sculpting
knee-length glove
light-emitting lamp
melting cloud
heron tooth
porky dog
mucous defect

vaccination law
infection outbreak
authentication method
verification code

tilapia skin
horseradish juice
loot box
pork burger

software school

township law
evidence need
toxicity datum
lineup spot

assistance community
summer trial

jail worker
day candidate

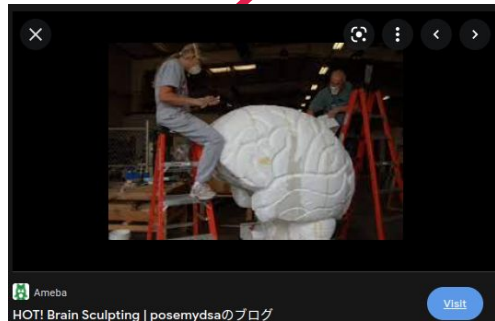


Example system output

Found in evaluation set
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Predicted by system

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brain sculpting

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Exam

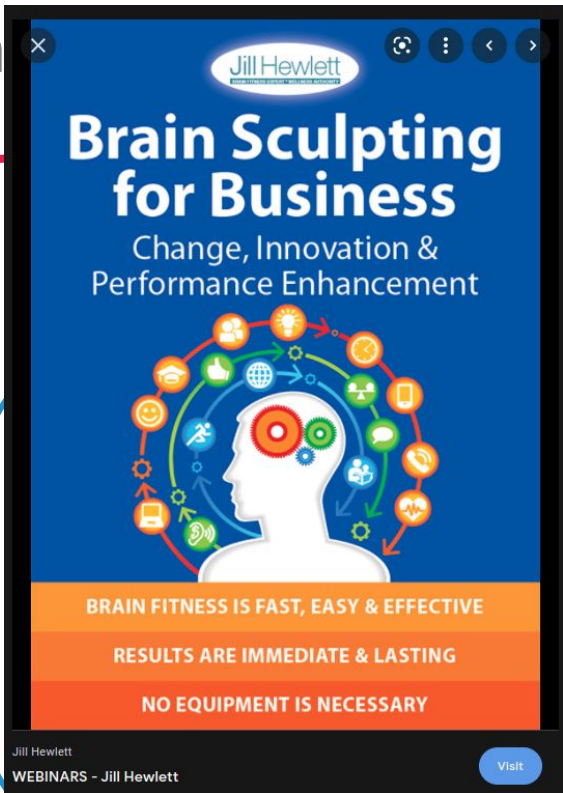
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Visit

ICC'21: InnovAltor, a tool for business innovation



Industry partners

Pharma company
Beverages and food company

Informants & support

Educational publisher
Information science non-profit
ICC mentors
IDIAP technical staff
FoodHack



InnovAltor, a tool for business innovation

Disruptive innovations wipe out entire businesses

- Need to innovate fast, ahead of competition
- Out-of-the-box thinking is hard under time pressure
- Consumer needs are quickly changing



Innovation is vital!

What if you had someone, who could:

- Read all your **internal data**
- Process all relevant **social media** content
- Discover **trends**, find new ideas in data
- **Predict trends for the future**
- **Present** everything in an orderly fashion
- And all of that by **tomorrow!**





So let us use
computational
methods to do
that!





International Create Challenge '21



time-stamped text data

Scientific articles

Social media data

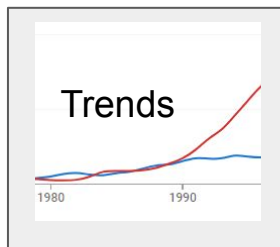
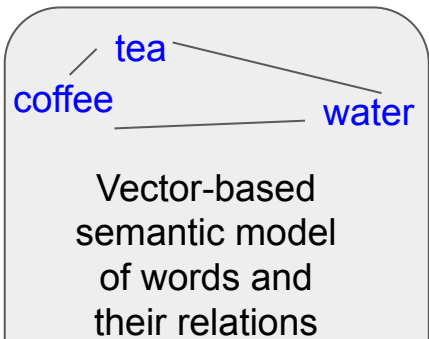
Company-internal data

TRAIN

EVALUATE

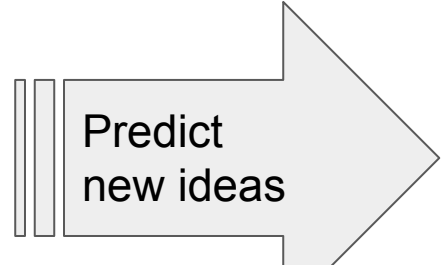


Time →



coffee machine = good
coffee mouse = bad

Train model to learn what are good combinations



Create an interface that allows for topic-specific browsing



C-LING : towards Creative systems with LINGuistic modelling

Project has **just been accepted** by the Swiss National Science Foundation (SNSF)

Plan to continue the work on novel concept generation while including **more structured knowledge, going from two-word concepts to more complex ideas.**

Also including **cross-domain and cross-lingual models**



Leading into the discussion

- Computational Creativity is a young but expanding field
- Quite some attention from general public recently
- I have shown some first results of a system that generates new ideas/concepts
- We have worked on its application as a business innovation tool at the ICC last summer
- What are the legal implications? The issue of copyright was brought up during the ICC by the transfer office

Some discussion points

What if my system takes concepts written down by some person on **social media**, evaluates it and sees it as a promising new product, and it becomes one...**should this person be the owner of the idea?**

Data (social media, news paper data, wikipedia, ...)

System

There is a general feeling of **WOW** with what current systems based on neural networks create, but a lot of it is quite predictable (by nature). Does **originality** play a role?

System builders

I often hear that systems nowadays are creative in their own right. It is true that the current types of machine learning used, require less input from developers, but still the **architectures and methods are carefully chosen**, and if not, we don't expect much more than just mimicking, and picking up on statistical patterns

System owners

If I sold the GenerAltor to a company that wants to use it for finding new products in the food and beverage industry, how can I **prevent them from using it on another domain** and selling those ideas to another company..

Thanks for your attention!