

VIS 2024

The Language of Infographics: Toward Understanding Conceptual Metaphor Use in Scientific Storytelling

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Laura Garrison, University of Bergen

What are we doing?

1. Mapping linguistic Conceptual Metaphor Theory into visualisation
2. Database of infographics
3. Exploratory tool

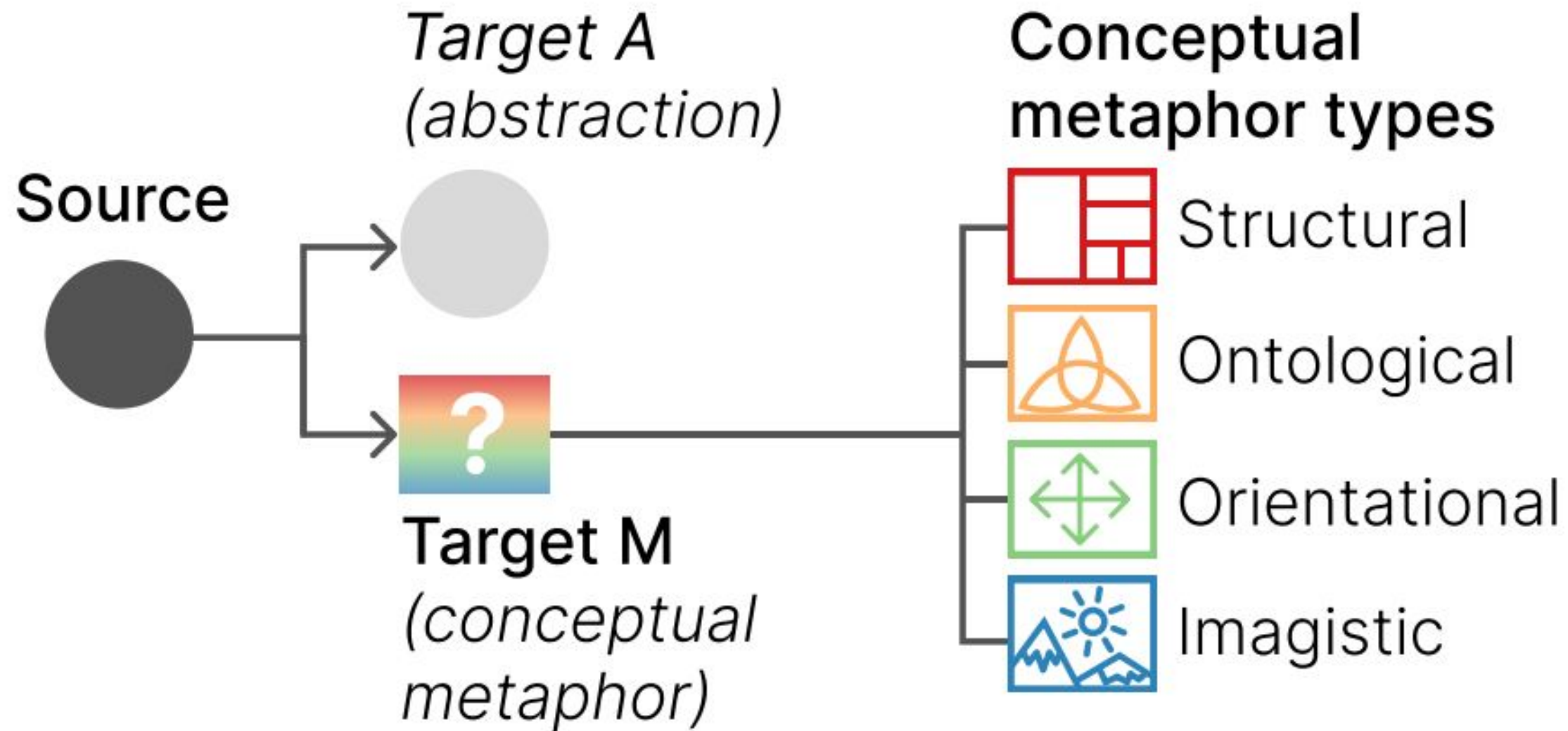
Why are we doing?

- Investigating visual metaphors in communication of unfamiliar topics
 - Application to scientific infographics

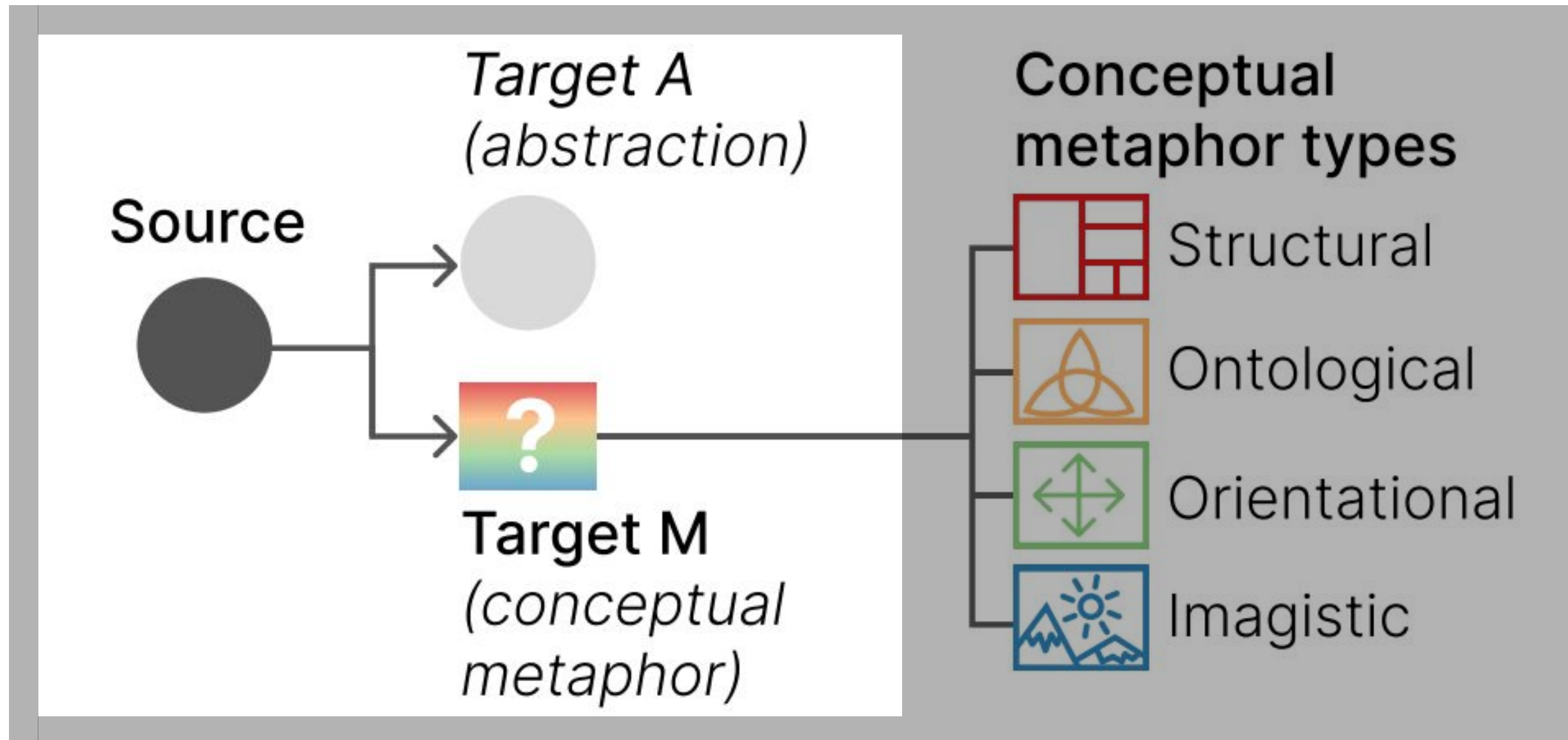
Conceptual metaphors

- Literary device
 - Understanding of the unknown through concepts of the known
 - Bridge domains
- Cultural differences
- Lakoff and Johnson (1980, *Metaphors We Live By*)
 - ‘...not just a matter of language but a matter of thought and reasoning’

Visual conceptual metaphors vs. visual abstractions

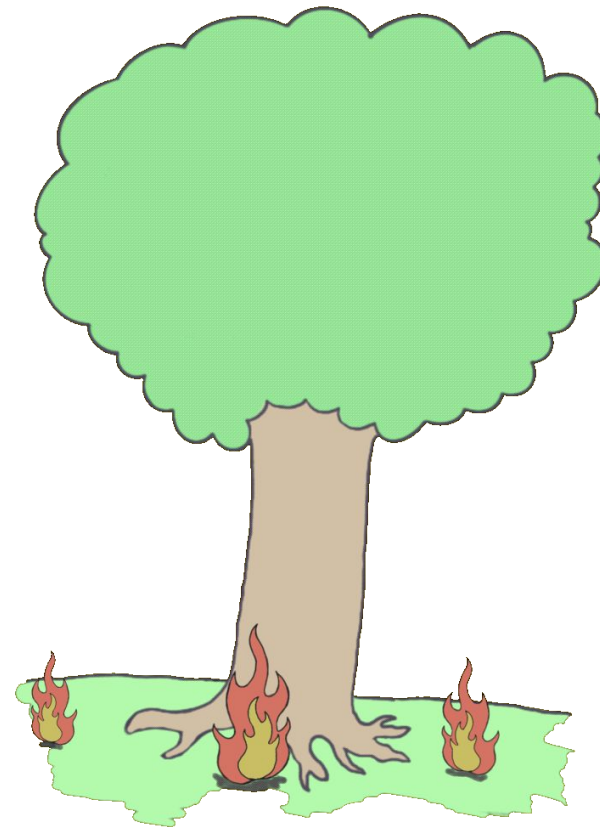
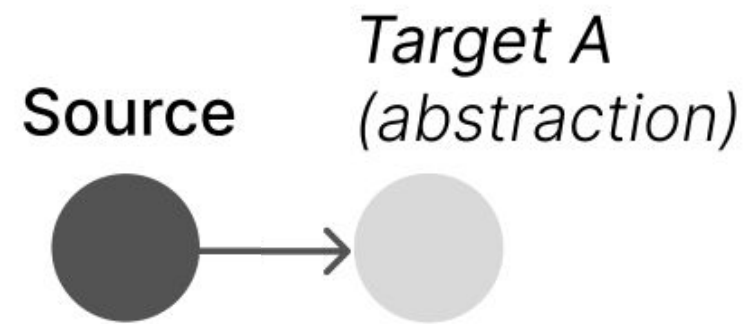


Visual conceptual metaphors vs. visual abstractions



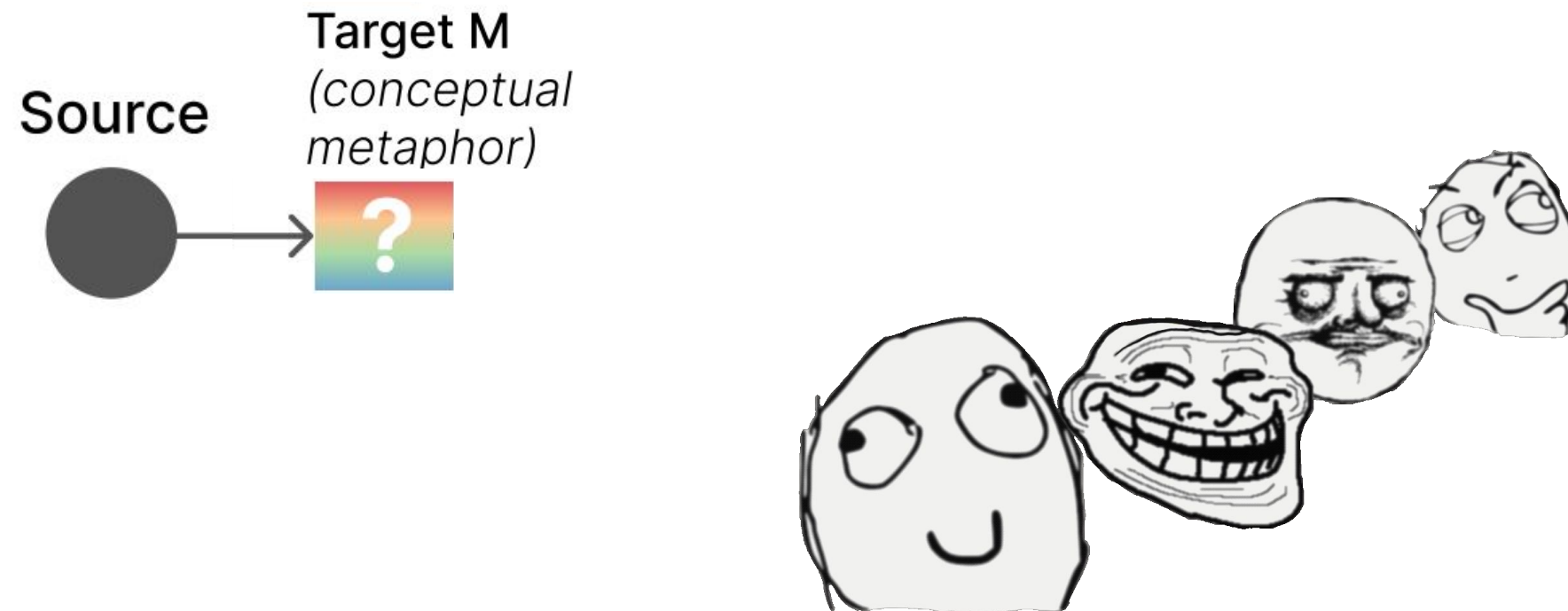
Visual abstraction

Fire around a tree represents forest fire.

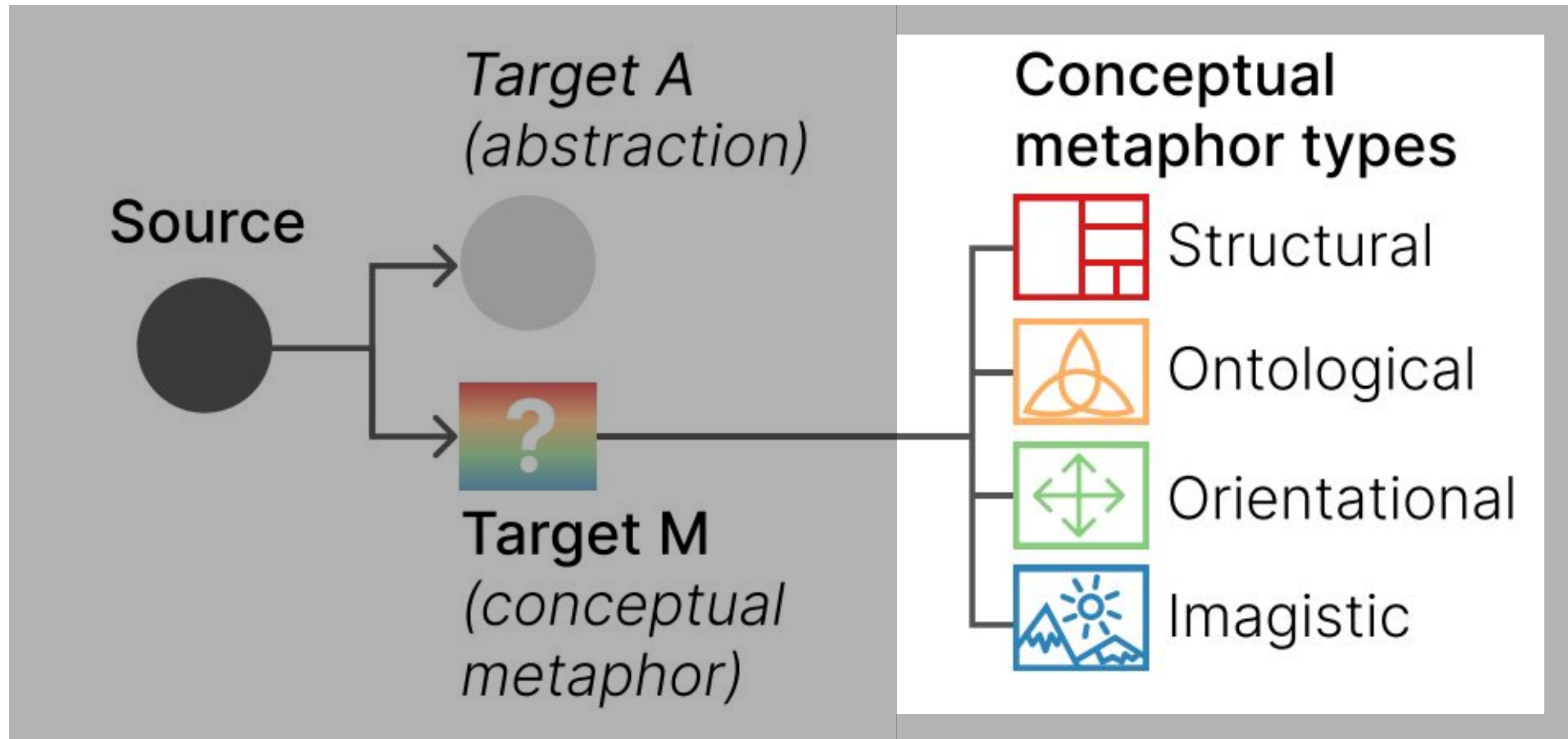


Visual conceptual metaphor

Wildfire represents the **spread of memes.**



Types of visual conceptual metaphors



Types of visual conceptual metaphors

Distinguished based on complexity:



Imagistic: correlates one concept with another based on graphical similarity



Orientational: concept based on spatial orientation

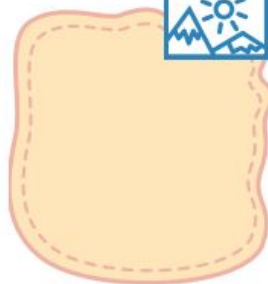


Ontological: projects concrete entities onto abstract concept



Structural: unfamiliar conceptual network to familiar conceptual network through entailment relationship

Structural



Imagistic

Ontological



Ontological

Ontological



Metaphor and novelty in science education visuals

Mol Mir¹, Steph Nowotarski^{1,2}, Alejandro Sánchez Alvarado^{1,2}
 1- Stowers Institute for Medical Research, Kansas City, MO, USA
 2- Howard Hughes Medical Institute, Chevy Chase, MD 20815, USA

Metaphor

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The golgi apparatus is a different type of workstation, where the finishing touches are added to meals as they are sorted for delivery. Some of the meals will be transported to other parts of the cell, while other orders are to-go. They get packaged up and sent to the cell membrane, where they will leave the cell and go on their way.

Mitochondria are the coffeehouse of the cell! They are responsible for keeping everything running by providing the energy source, ATP, like a steady supply of hot coffee.

Novelty

This new representation of the cell cycle is broken up by visual differences in the stages. It features a twist, manipulating the cycle into an infinity sign, to imply how this process can continue forever. Thinking of new ways to represent classic biological concepts with learning, which comes more easily when the same topic has been described in multiple ways and from different perspectives.

Let's add to the world's collection of educational visuals by coming up with new ways to convey information.

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Prophase: During prophase, paired chromosomes become even more conveniently packaged, transforming from stringy to chunky and thus, more easily visible with microscopy. The nuclear envelope begins to break down, components disappearing from view into the cytoplasm. Microtubules begin to organize.

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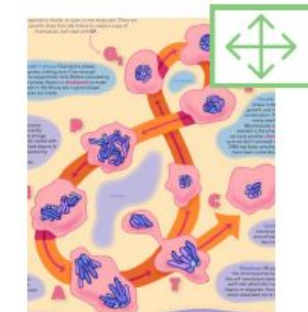
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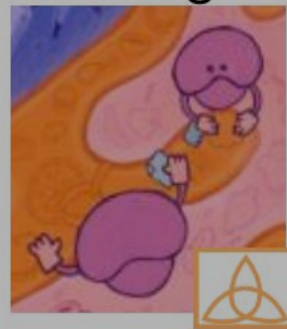
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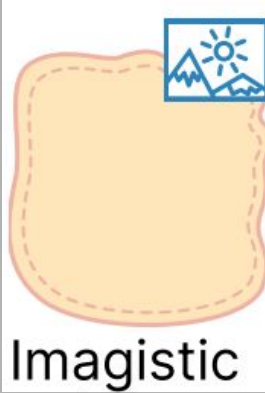
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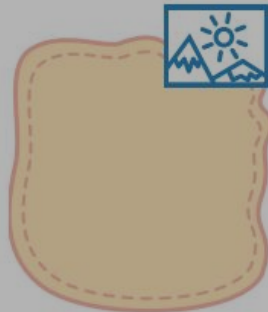


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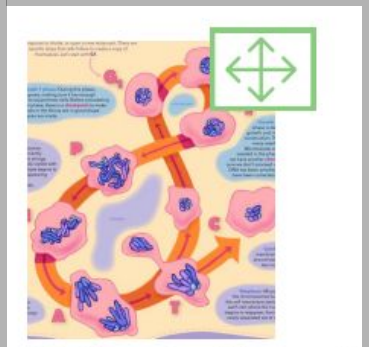
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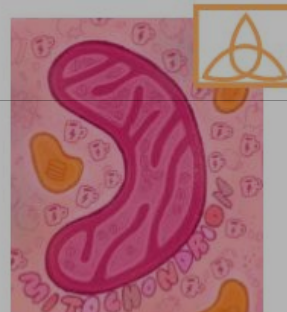
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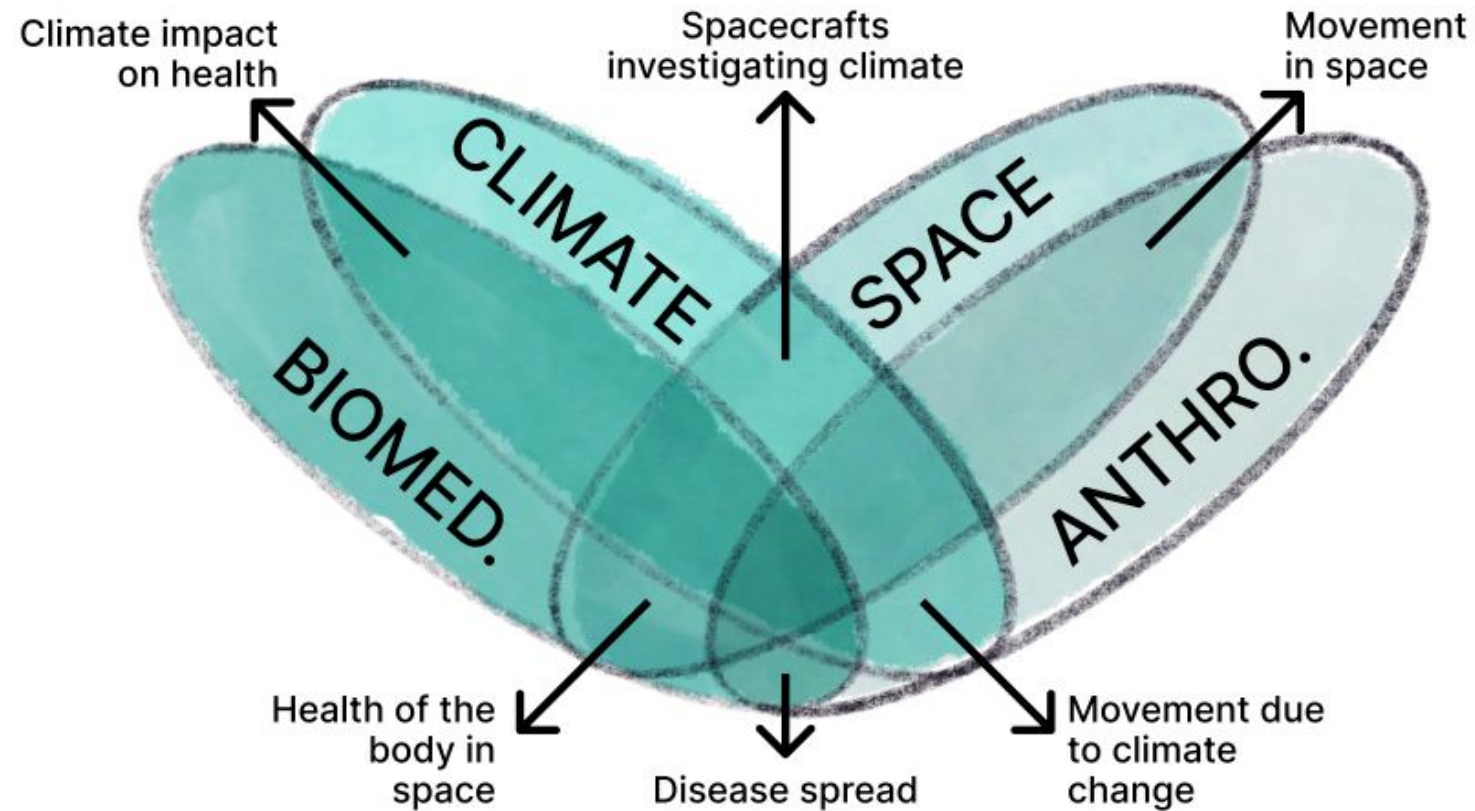
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Our process

1. Defining (shown previously)
2. Selecting corpus
3. Deconstruction and classification
4. Synthesis
5. Summary

Selecting corpus



2D infographics (10-15 per domain)

Synthesis

1. Database
2. Exploratory tool



Database



Online exploratory tool

Exploratory tool



Visual Conceptual Metaphor Explorer Biomedicine Climate Space Anthropology

How to use this tool: To begin, choose a domain from the navigation menu above. Then, explore the spatio-temporal of collected infographics in this domain in the below scatterplot.
Hover on any point to view infographic details, including the types of metaphors employed in the visual design.

Infographic Spatio-Temporal Distribution

Temporal Coverage	Spatial Coverage
nanosec	molecules
sec	viruses
min	cells
hour	organs
day	organ systems
week	organism
month	population
year	population

Image Details

Image name: Human Cell - A Molecular City
Image author: Peter Mindek
Domain distribution: Biomedicine,

Human Cell - A Molecular City: A cell is like a city, with its own railroad network, production factories, and power plants. Blueprints for all of this incredible molecular machinery are stored in DNA. But how do we get from DNA to a protein molecule - the basic building block of a cell?

Image link
<https://conferences.eg.org/vcbm2022/awards/>

Conceptual metaphor analysis

Metaphor Type	Count
Str	1
Ont	0
Ori	1
Img	0

Structural: 1) molecules in a cell functioning together: a dense cluster of units with different functions, processes that work together, and depend on each other to create proteins, just like a complex infrastructure in a dense city

Ontological: /

Oriental: 1) placement of steps in a circular clockwise fashion that represents a cyclical and repeating process

Imagistic: /

Supporting textual metaphor: yes

Type: structural

Exploratory tool



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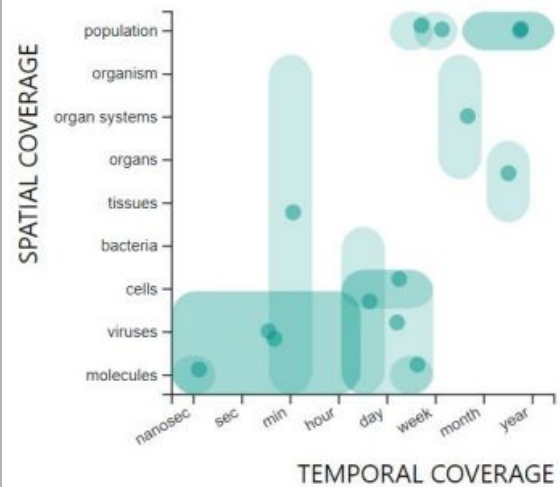
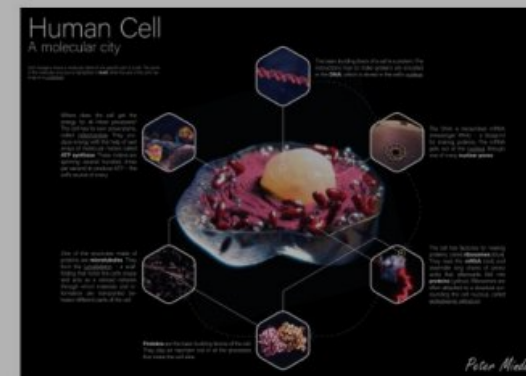


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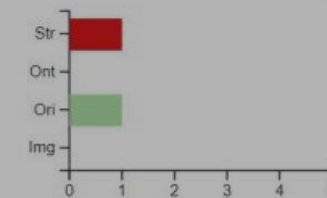
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SPATIAL COVERAGE

TEMPORAL COVERAGE

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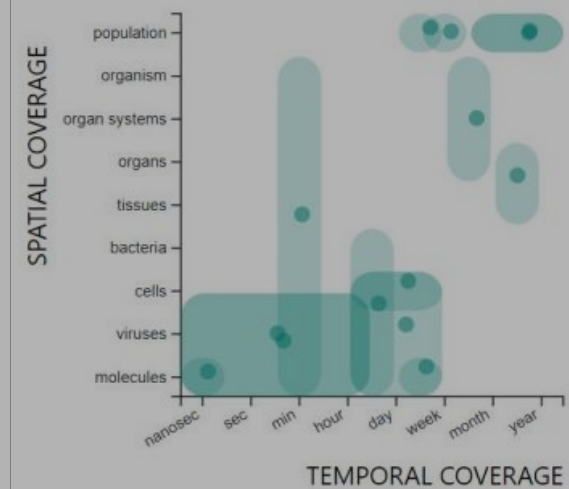
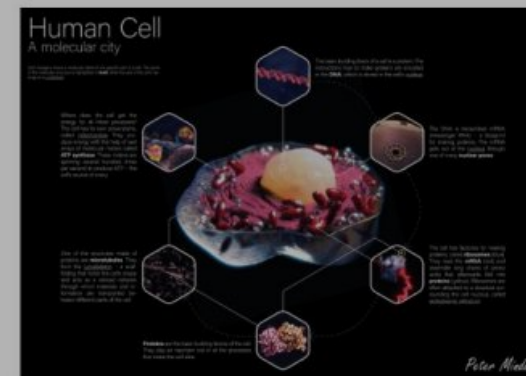


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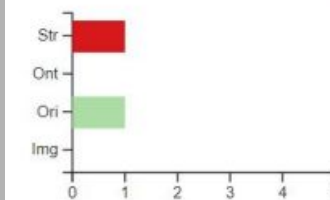
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Imagistic: /







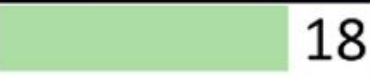




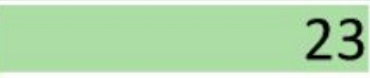
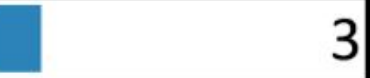



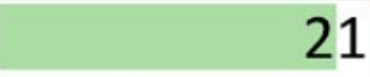








Supporting textual metaphor: yes

Type: structural

C





Summary

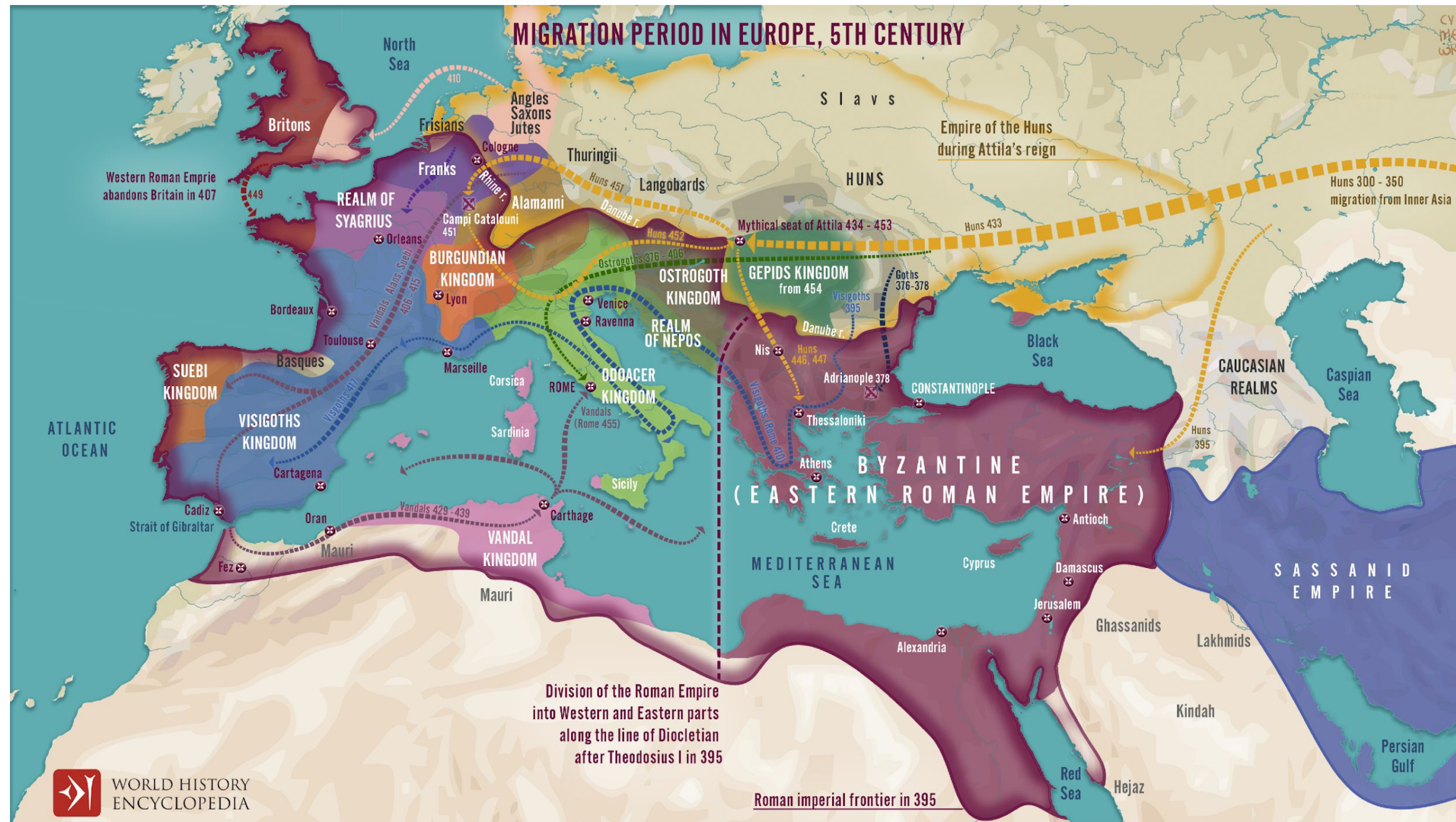
131 visual conceptual metaphors in 55 infographics (out of 109)

Domain	Type of visual conceptual metaphor				Other observations	
					Textual metaphors	Affective vis.
Biomed.	 2	 15	 18	 1	 5	 7
Climate	0	 23	 23	 3	 11	 11
Space	0	 9	 21	 2	 5	 2
Anthropo.	0	 4	 9	 1	 3	 5

Results and discussion

Anthropology uses least metaphors -> metaphor use domain-dependent





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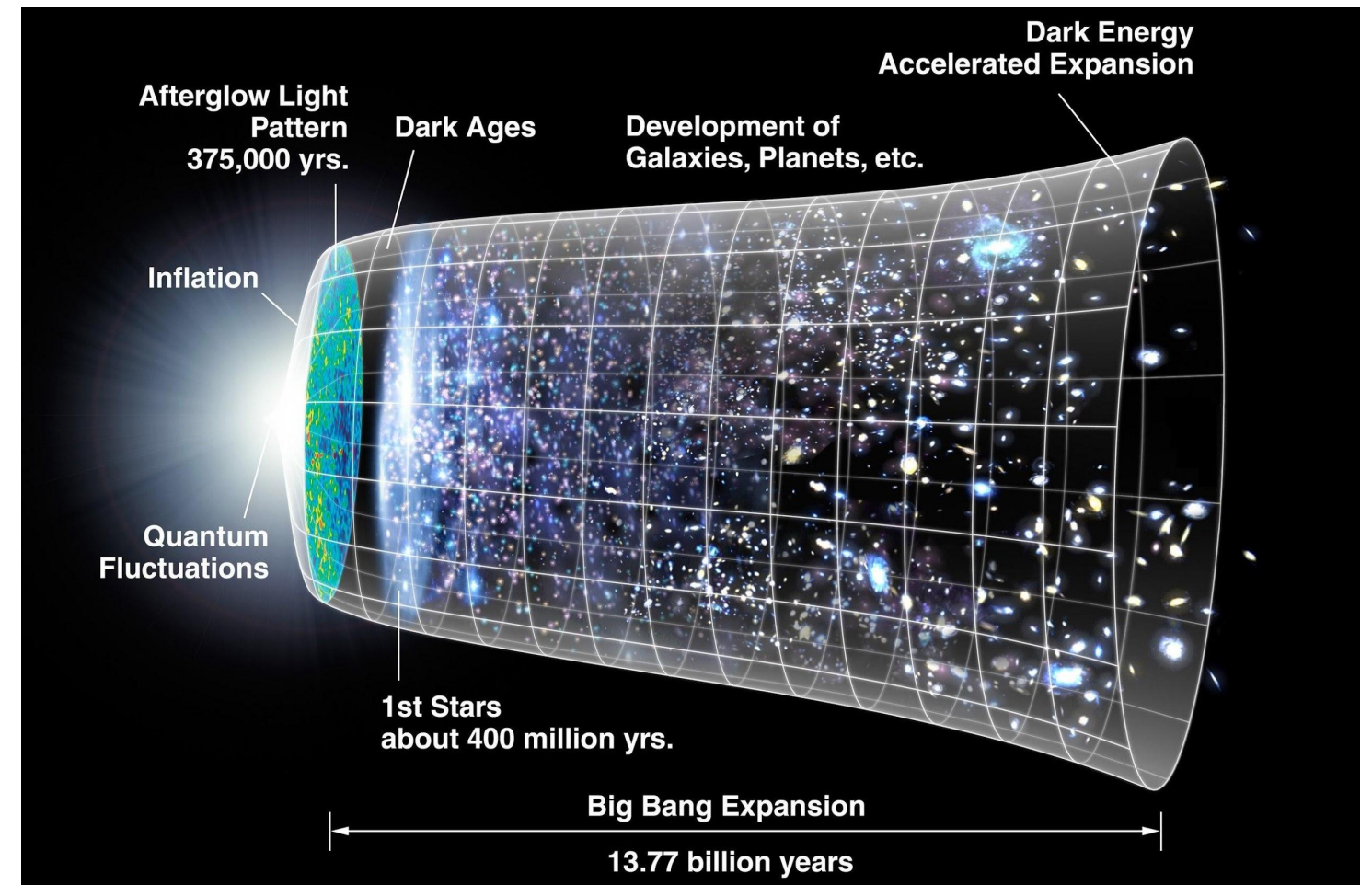
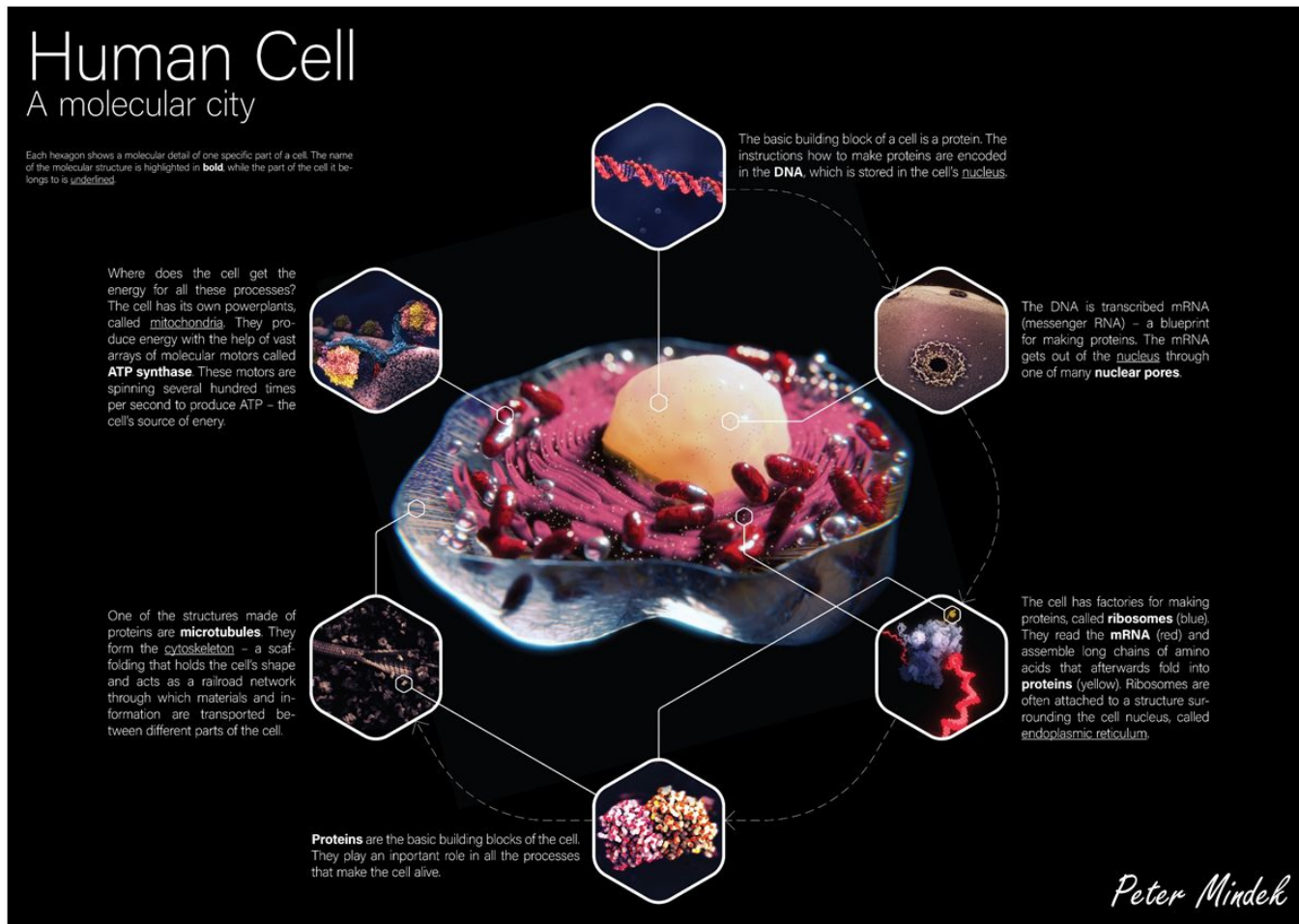


Migration Period in Europe, 5th Century by Simeon Netchev from World History Encyclopedia under the Creative Commons Attribution-NonCommercial-ShareAlike license

Results and discussion

Reliance on orientational and ontological metaphors -> perfect balance?

Domain	Type of visual conceptual metaphor				Other observations	
					Textual metaphors	Affective vis.
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People's Choice Award image from VCBM Workshop 2022 (September 22–23, 2022) by Peter Mindek, under CC-BY license obtained from the author by written agreement.

The Big Bang and Universe Expansion by NASA/WMAP Science Team – Original version: NASA; modified by Cherkash obtained from Wikipedia, which is in the public domain.

Results and discussion

Affective strategies with orientational and ontological vis-> visual metaphors may promote *affective* visualisation

Domain	Type of visual conceptual metaphor				Other observations ^v	
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SCIENCE CONNECTIONS WESTERN WILDFIRES & CLIMATE CHANGE

Wildfires are increasing and wildfire season is getting longer in the Western U.S.

Average number of large wildfires per year bigger than 1,000 acres

Period	Average number of large wildfires per year
1980-1989	~140
1990-1999	~160
2000-2012	~250

Average length of wildfire season

Early 1970s: 5 months

Today: 7+ months

Climate change is driving up temperatures and increasing wildfire risk.

TEMPERATURES ARE RISING
Average annual temperatures in the Western U.S. have increased 1.8°F since 1970.

SNOW MELTS SOONER
Winter snowpack melts up to 4 weeks earlier than in previous decades.

FORESTS ARE DRIER, LONGER
Conditions are primed for wildfires to ignite and spread.

Wildfires are projected to burn more land as temperatures continue to rise.

Projected increase in annual burn area with an additional 1.8°F rise in temperature

0% — 200% — 400% — 650%

By mid-century, temperatures in the Western U.S. are expected to increase even more (2.5°-6.5° F) due to heat-trapping emissions from human activity.

The choices we make today will determine how much temperatures increase this century, how long and damaging wildfire seasons become, and how prepared communities are for the growing risks of wildfires.

© Union of Concerned Scientists 2013; www.ucsusa.org/westernwildfires



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Today: 7+ months

Western Wildfires and Climate Change made by the Union of Concerned Scientists for educational purposes.

Results and discussion

Visual and textual metaphors often cooperate

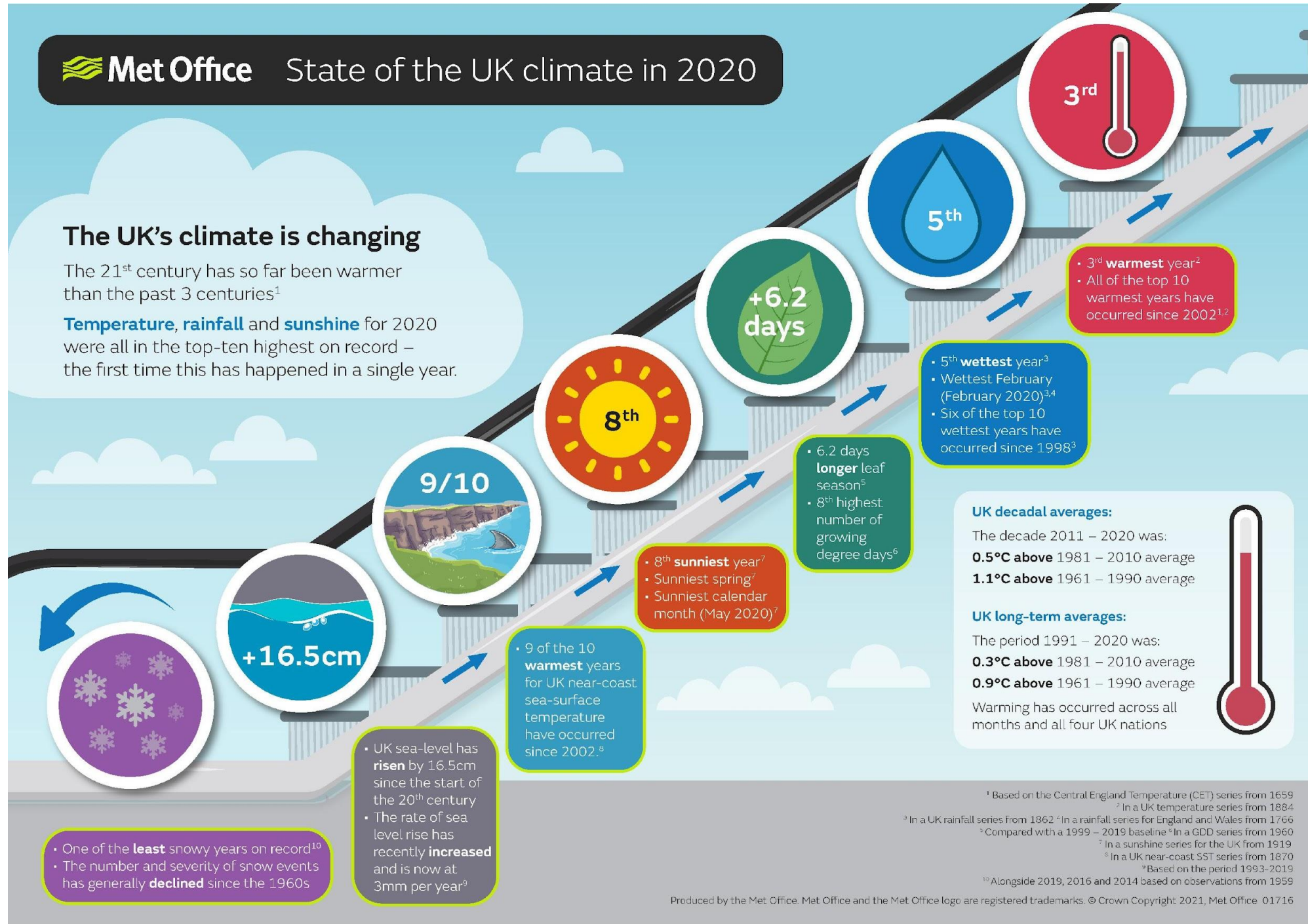
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v

The UK's climate is changing

The 21st century has so far been warmer than the past 3 centuries¹

Temperature, rainfall and sunshine for 2020 were all in the top-ten highest on record – the first time this has happened in a single year.



State of the UK Climate 2020 by the Royal Meteorological Society for educational purposes and with written permission.

Boundaries may be blurred for metaphor classification



Visualized: The 4 billion-year path of human evolution by Mark Belan from Visual Capitalist, used for individual research.

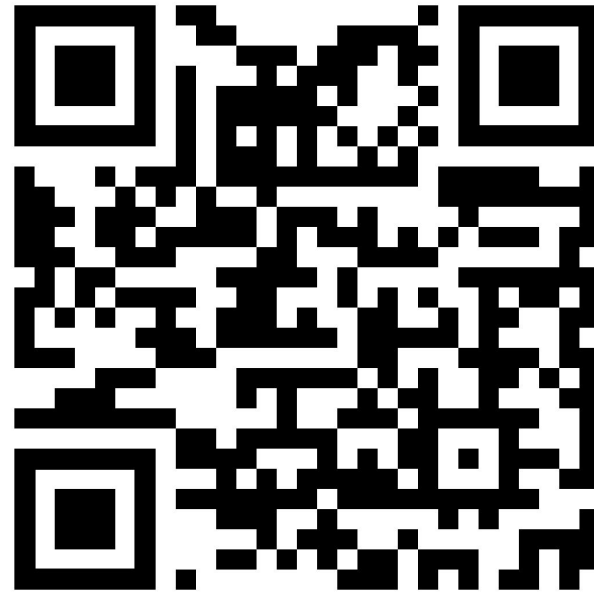
Future work

- Extending the proposed understanding of metaphors in SciCom
 - Classification technique may provide approach for producing specific metaphor elements of specific type with specific instructions
 - Understand how different metaphor types facilitate communication aims (e.g., ontological metaphor better for complex or only for simpler phenomena?)

Limitations

- Look beyond our scope
 - More abstract depictions of data
 - Beyond science

Thank you for your attention!



Paper

E-mail: **hpokojna@mail.muni.cz**



<https://osf.io/8xrjm/>



<https://github.com/lauragarrison87/metaphorTool>



<https://www.replicabilitystamp.org/index.html#https-github-com-lauragarrison87-metaphortool>