

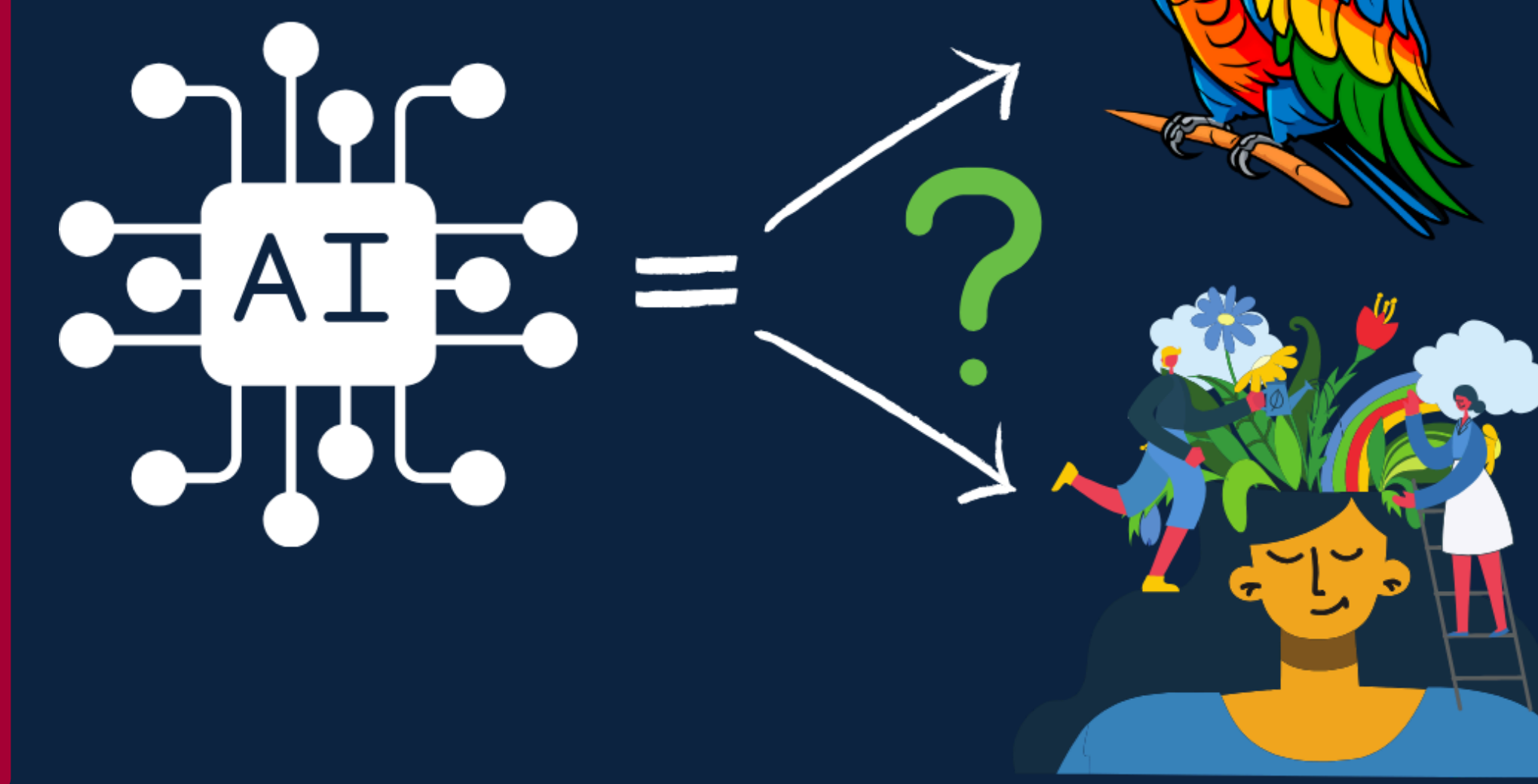
Contemporary Creativity

The many faces of AI art

A research project on the creative potential of Dream-OOD AI-generated images through the lens of Boden's Creativity Framework using an ELO based rating system

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1. Creativity vs Imitation

A contemporary look on the age-old questions:

- What is human creativity?
- Can programmes show 'human' creativity or do they just imitate it?
- If so, on what level and in what form?
- If not, what are the differences?
- And is the difference important?

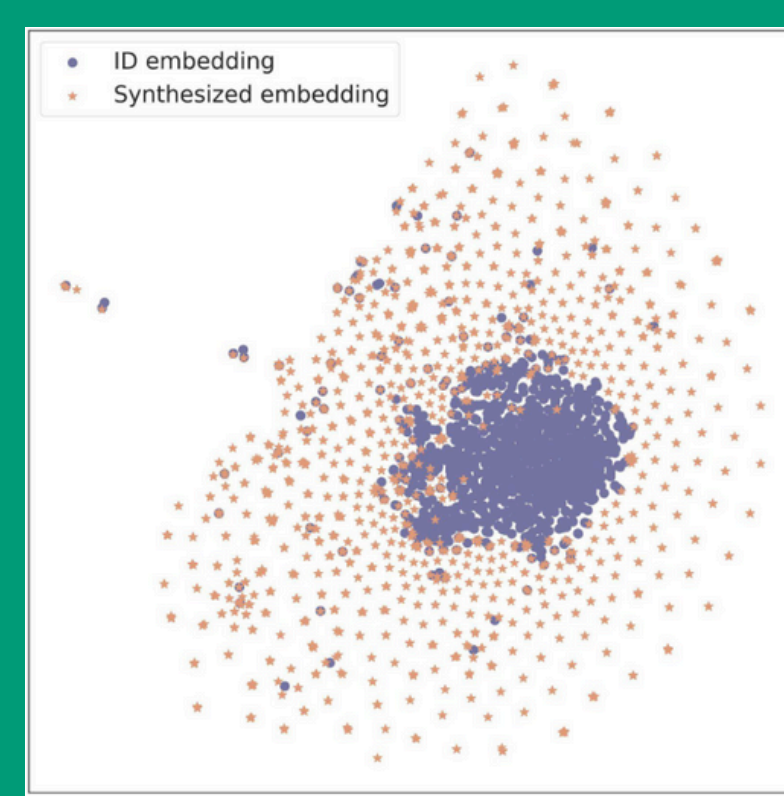
2. Background

M. Boden's definition [2] of creativity (NSV):

- Novel
- Surprising
- Valuable



She also named three types of creativity: **combinations** of familiar ideas, **exploration** of a structured conceptual space, and **transformation** of a structured conceptual space, all creating NSV ideas. The last one being the most difficult to replicate [1].



Synthesized OOD embeddings



Synthesized ID embeddings

Dream-OOD [3] is a stable diffusion model that generates **Out-Of-Distribution (OOD)** images by moving away from a classifier by adding Gaussian noise. These images could potentially show creative features. The model also generates **In-Distribution (ID)** images. The **IMAGENET-100** database was used as realworld training data.

3. Research Question

Can Boden's framework of creativity be used to determine whether Dream-OOD is creative?

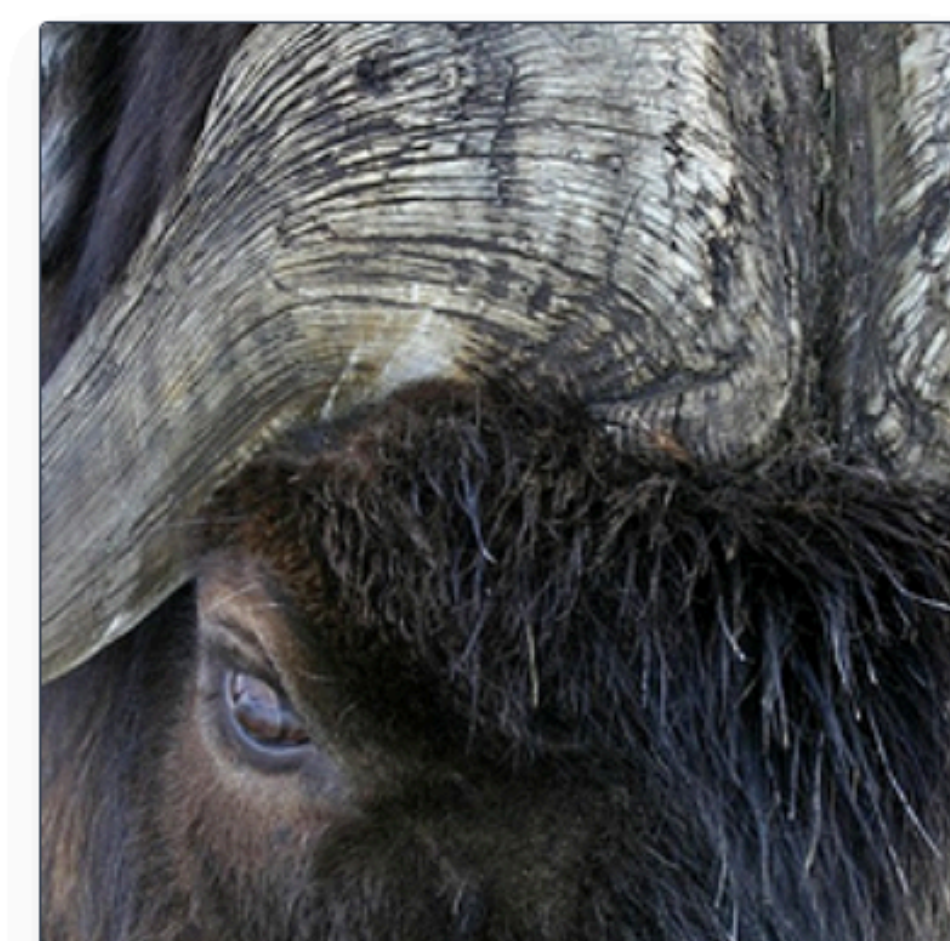
1. What **type** of creativity could that be?
2. Can the creativity of images be **ranked**?
3. Does Dream-OOD **appear** to be creative?
4. What **features** make it appear creative?
5. **Is** Dream-OOD creative vs appearing?

4. Methodology

1. Examining the mathematical synthesis of OOD and ID Images.
2. ELO based ranking system combined with Boden's creativity framework.
3. Design a user study to evaluate research question 2, 3 and 4.
4. Philosophical discussion on the difference between appearing and being creative.

5. User Study: voting on randomised pairs of pictures

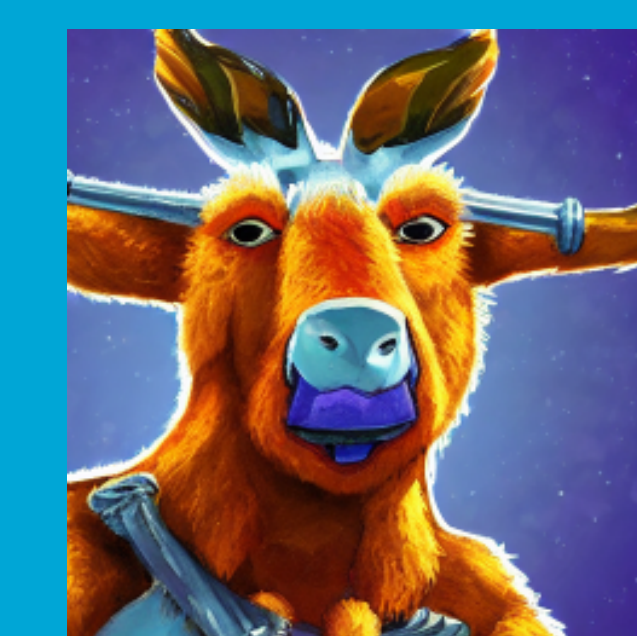
Participants choose the most novel, surprising, or valuable image from each pair.



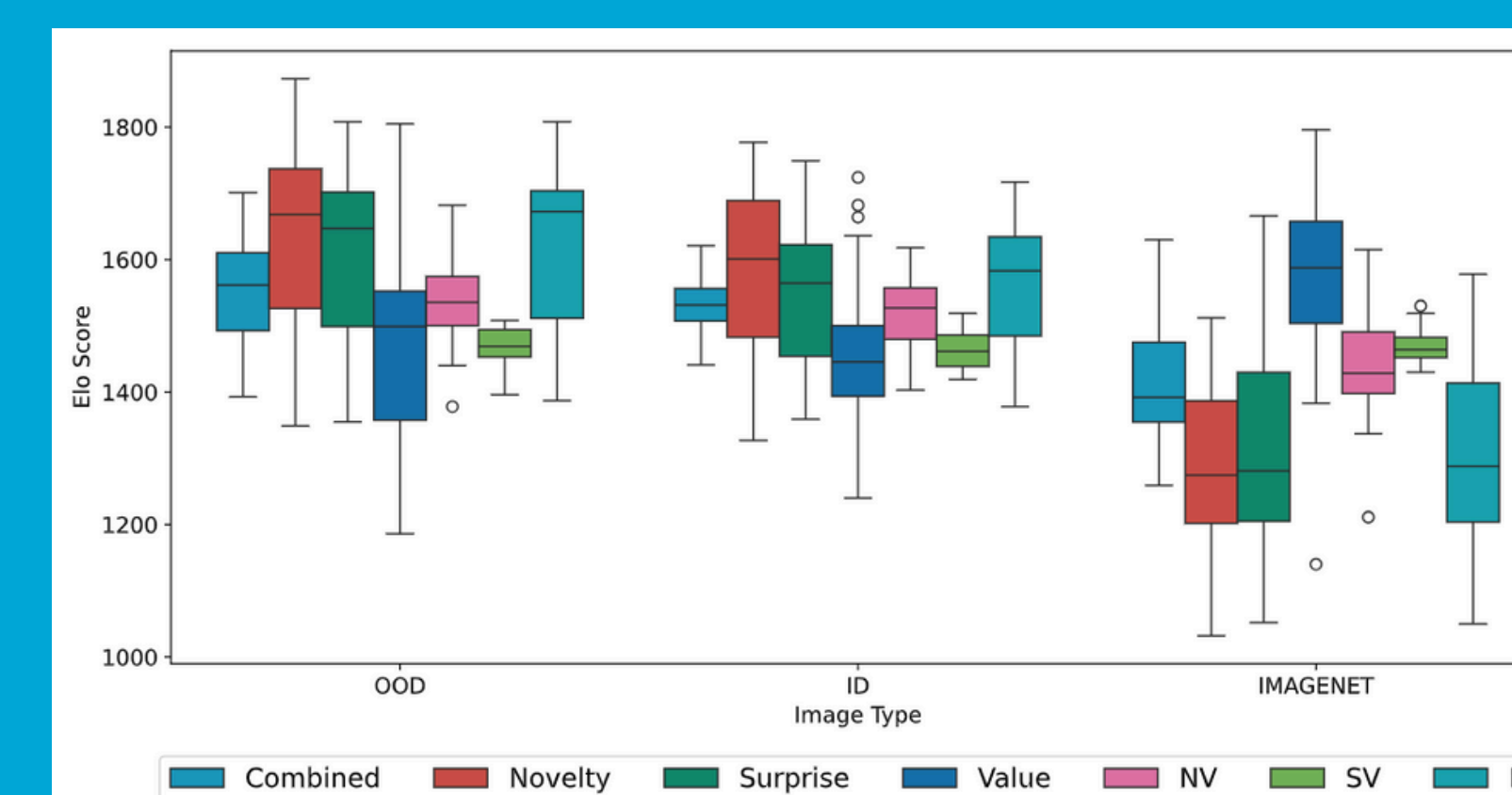
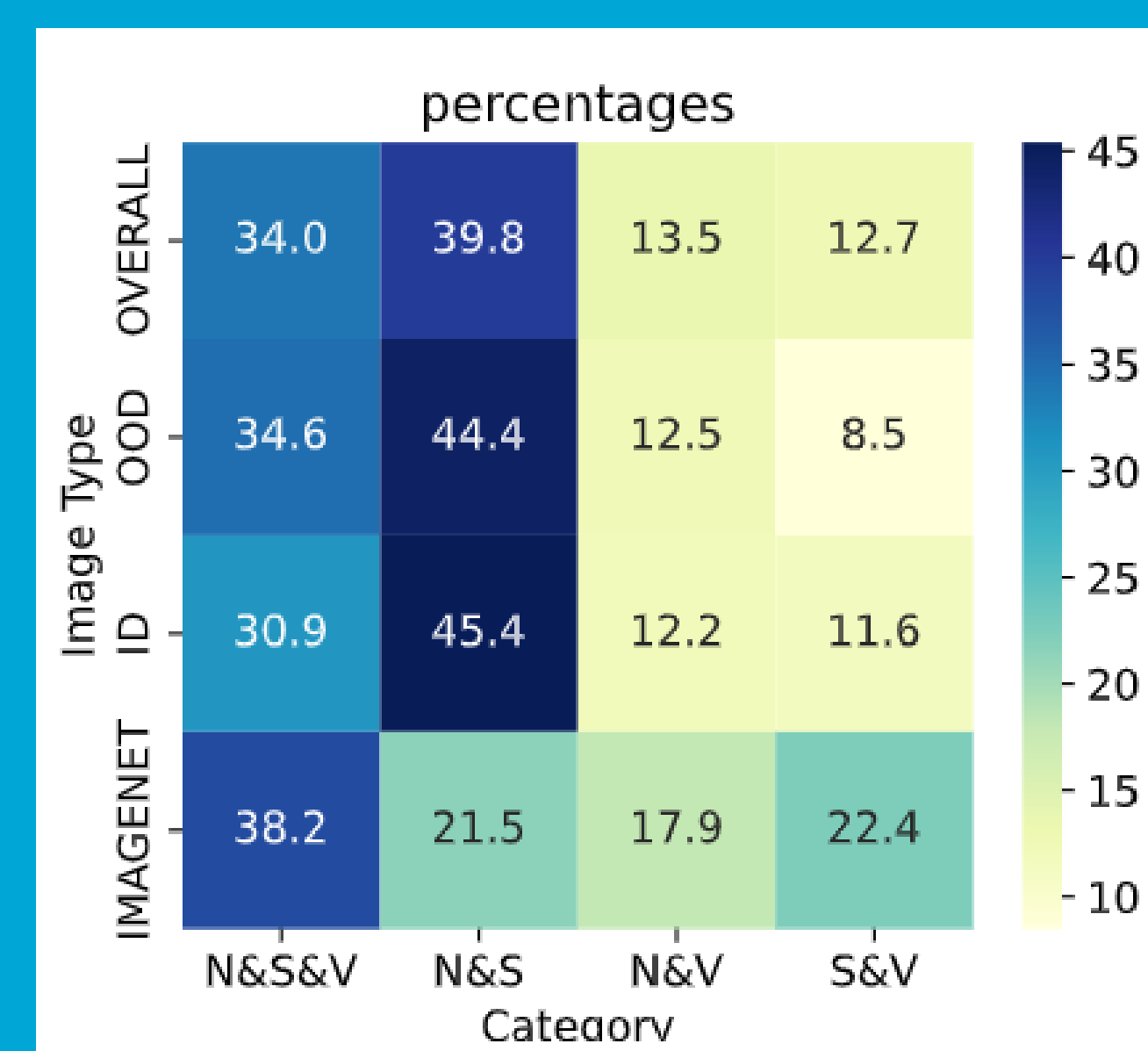
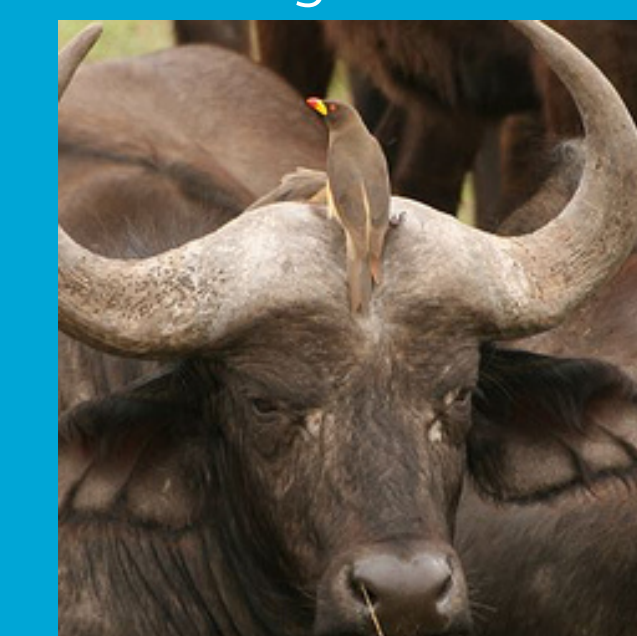
- OOD, ID, IMAGENET images
- 20 images per type = 60
- 30 votes per participant
- 1 IMAGENET class = 'Ox'
- ELO starting value = 1500
- ELO K-factor = 32
- Scores updated every vote
- Different score for novelty, surprisingness, value and combined.

6. Results & Findings

- 4222 votes of 151 participants.
- OOD & ID images win most on Novelty and Surprise
- IMAGENET images win the most on Value.
- There is significant agreement between the Novelty & Surprise feature, even more so for the OOD & ID images.
- OOD & ID images have higher scores than IMAGENET images. Only the Value scores showed the opposite.

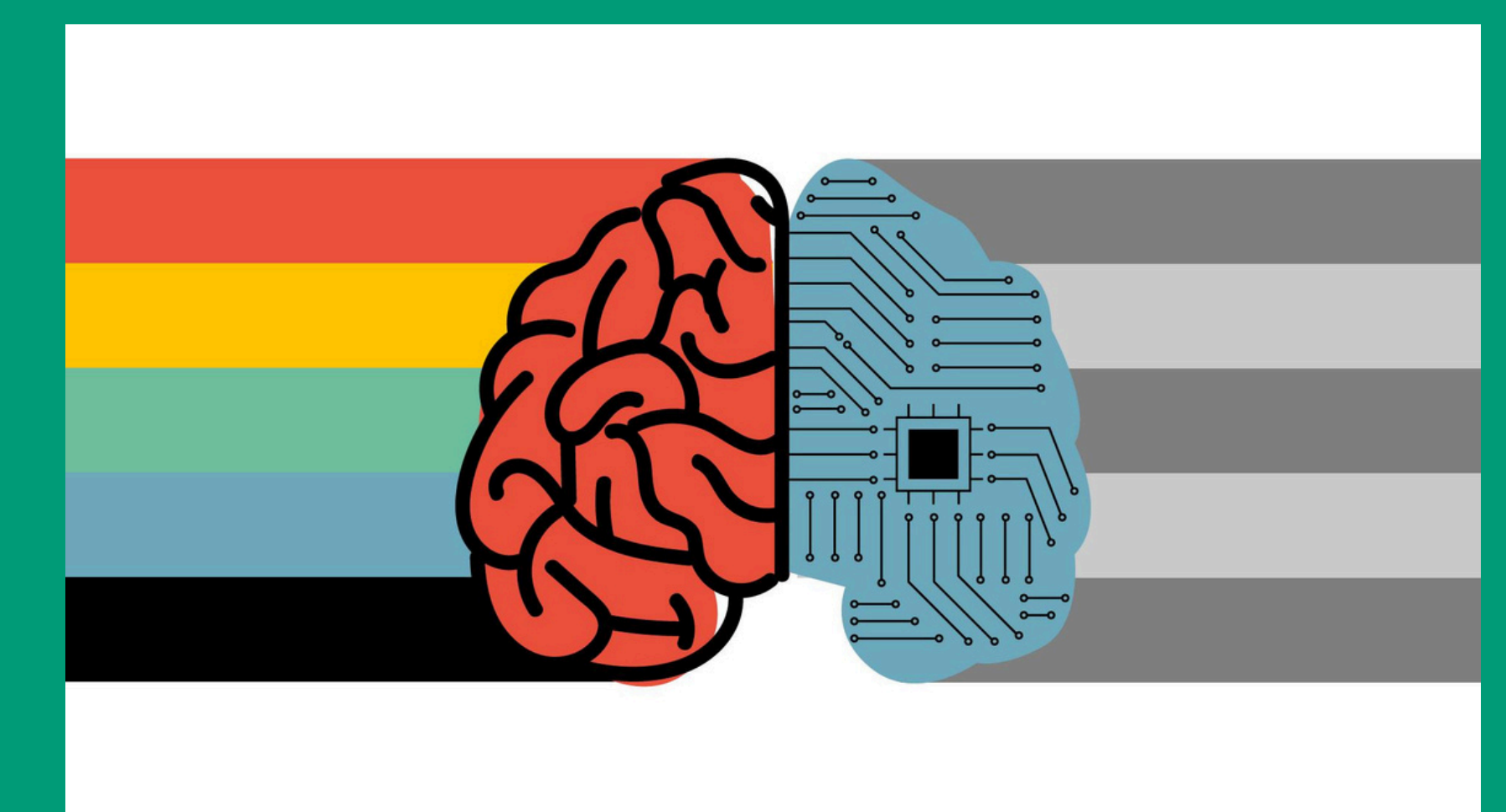


The four pictures with the highest ELO combined score



7. Discussion of the RQ's

1. The method used seems to **explore**, rather than transform the conceptual space.
2. ELO ranking shows **promise** for ranking creativity.
3. Based on the ranking we can conclude that the OOD& ID images **appear** more creative than IMAGENET photos.
4. A 'good' **balance** of NVS seems important.
5. Depends on your own definition of creativity. Even if it doesn't line-up, it might be a different kind of creativity. The distinction between appearing and being creative might be impossible to perceive once something appears very creative.



8. Future work

- Start with randomised pairing. Next, introduce ELO scores to pair similar scoring images.
- Optimise ELO start and update settings.
- Look out for possible overlap in understanding of novelty and surprise (agreement)
- Only one IMAGENET category has been used so far. Doing the same experiment on more classes would benefit the evaluation of creativity.
- Every category has around a 1000 images which can be evaluated on their creativity.
- Crowdsourcing platforms can be used to get a higher number of votes.

References

- [1] M. A. Boden, 'Creativity and artificial intelligence', Artificial Intelligence, vol. 103, no. 1–2, pp. 347–356, 1998, doi: 10.1016/s0004-3702(98)00055-1.
- [2] M. A. Boden, The creative mind: Myths and mechanisms: Second edition. 2003, p. 344. doi: 10.4324/9780203508527.
- [3] X. Du, Y. Sun, X. Zhu, and Y. Li, 'Dream the Impossible: Outlier Imagination with Diffusion Models', presented at the Advances in NeurIPS, 2023.
- [4] 'ImageNet'. Accessed: Jun. 24, 2024. [Online]. Available: <https://image-net.org/index.php>

