

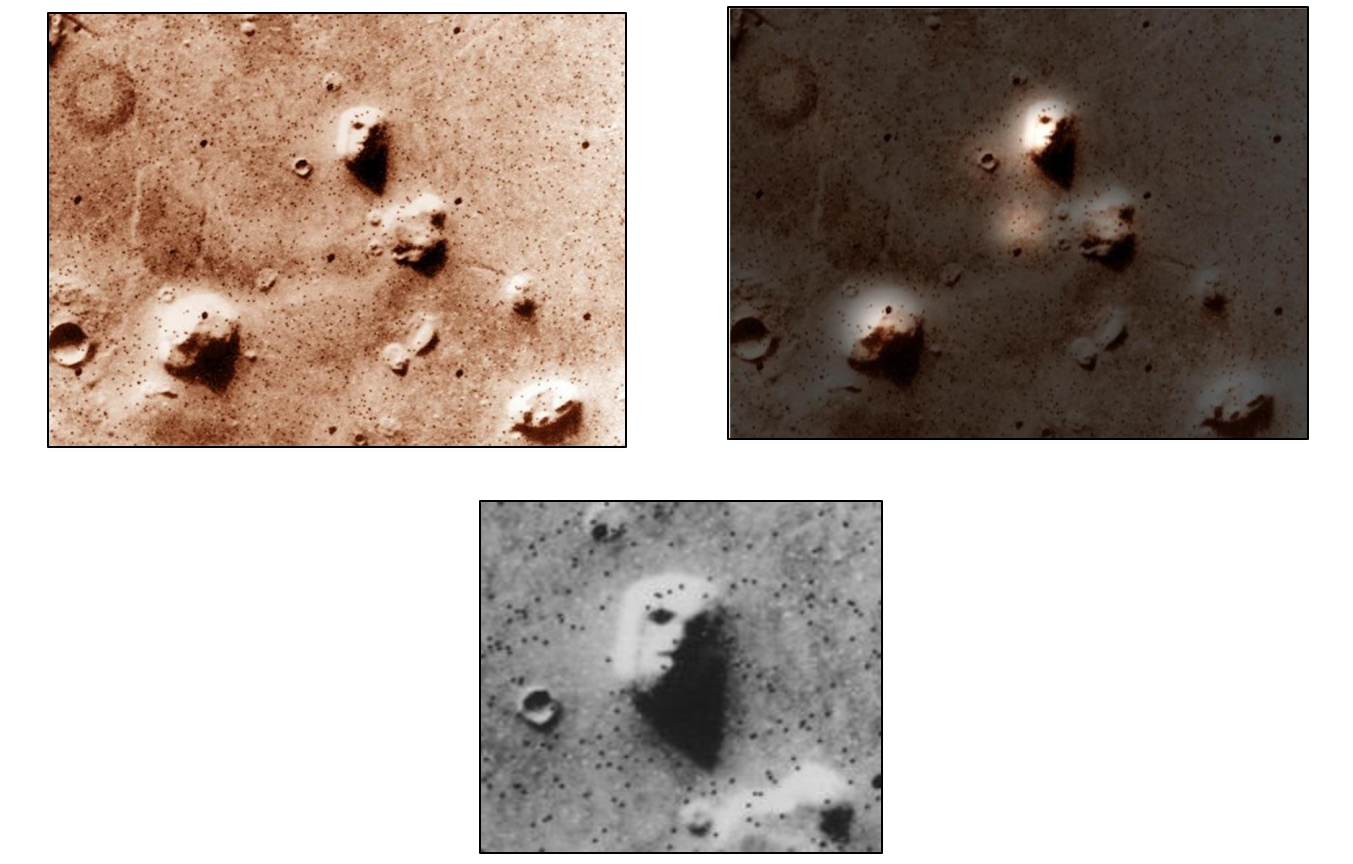
# Investigating face pareidolia using DeepGaze: Bridging human and artificial perception

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## Introduction

- Pareidolia, the tendency of humans to perceive familiar patterns, such as faces, in random stimuli, is a captivating aspect of visual perception.
- In this study, we investigate the phenomenon of face pareidolia using DeepGaze (Kummerer et al, 2017), a state-of-the-art computational model trained to predict human gaze behavior trained intensively on natural visual stimuli.
- Here, we ask to which extent DeepGaze can generalize and recognize face-like patterns by probing it with diverse visual stimuli exhibiting varying degrees of such patterns.

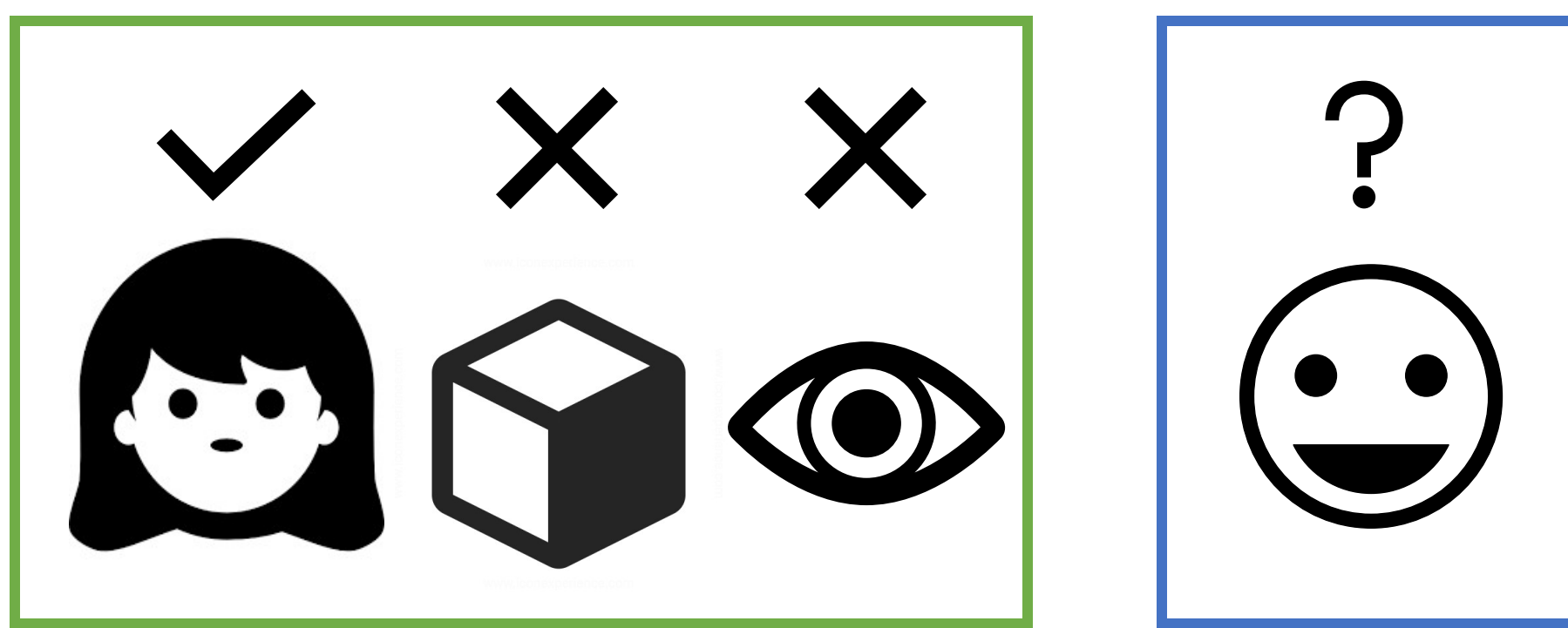
Face or not? Cydonia (Mars)



## Methods

### Dual Shot Face Detector (DSFD) algorithm

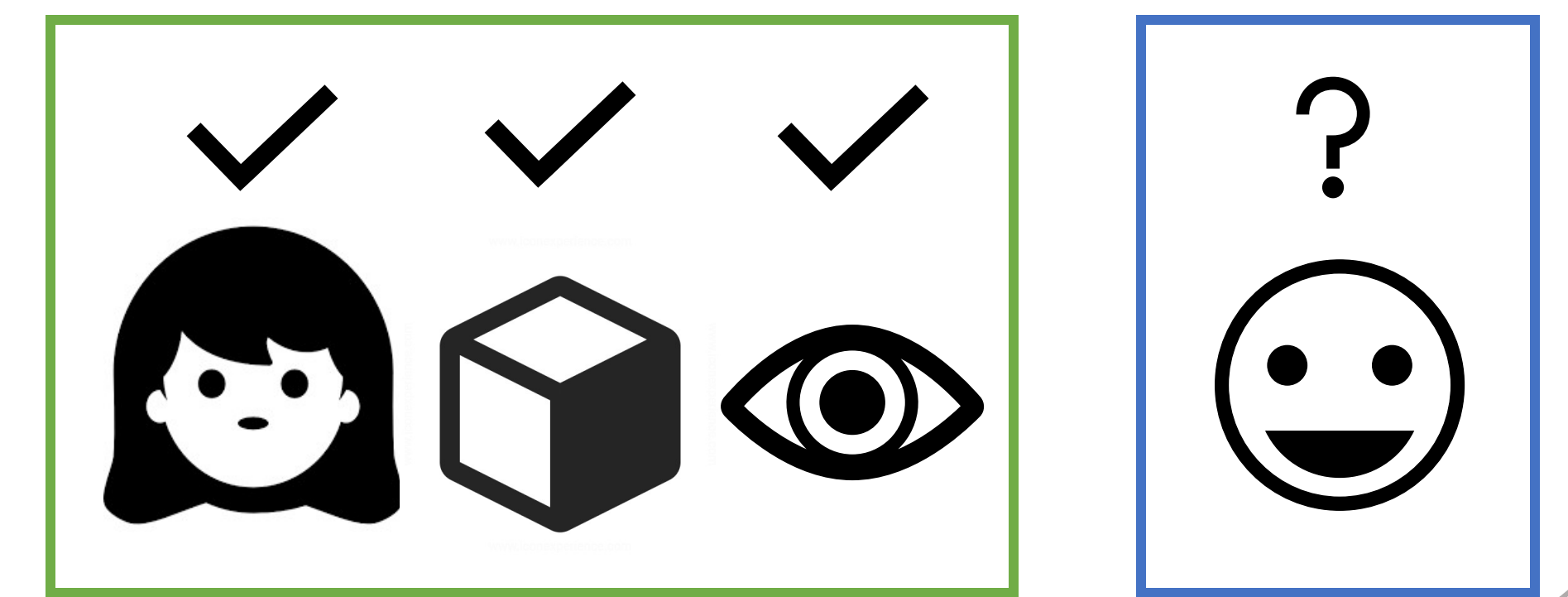
We used a state of the art human face detection algorithm (Li et al, 2019) to predict "face-like" behavior in context of face pareidolia.



### DeepGaze visual saliency algorithm

We directly compare the gaze-based heatmaps generated by DeepGaze with human gaze heatmaps (n = 38). The dataset includes a wide range of ecologically valid visual stimuli categorized into scenes with a single human face (100), regular scenes with objects (86) and face pareidolia (101).

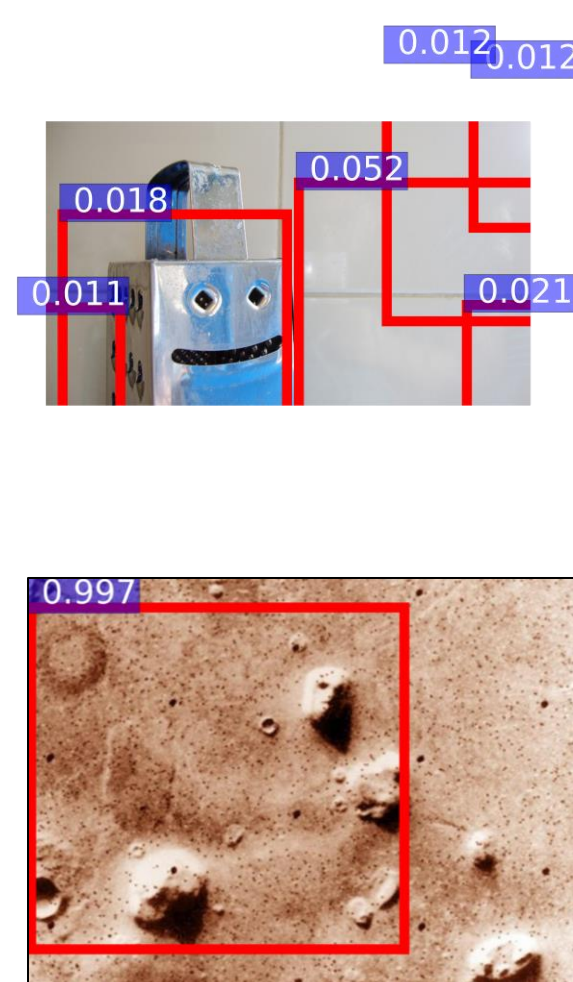
*DeepGaze has not been explicitly trained for face pareidolia!*



## DeepGaze outperforms DSFD

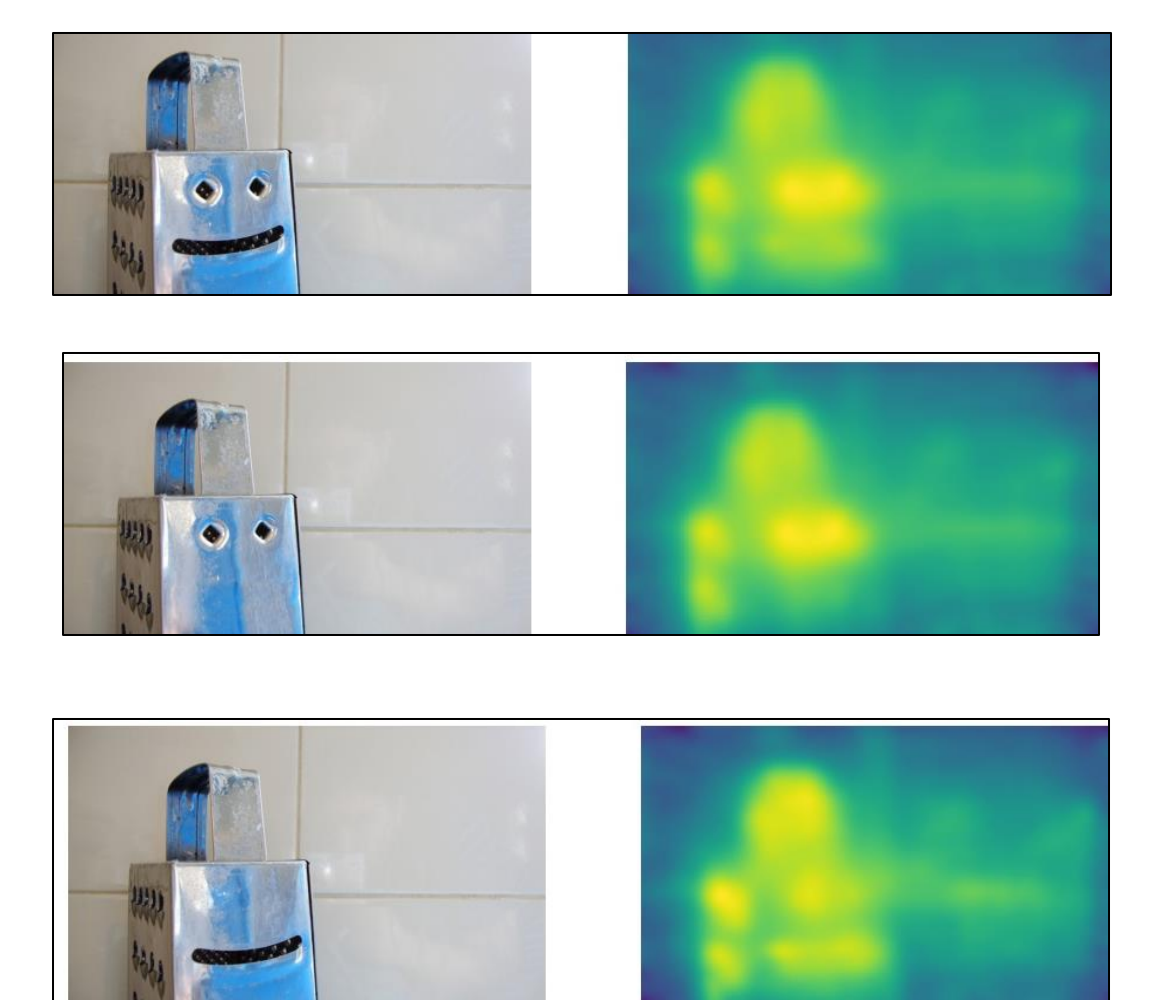
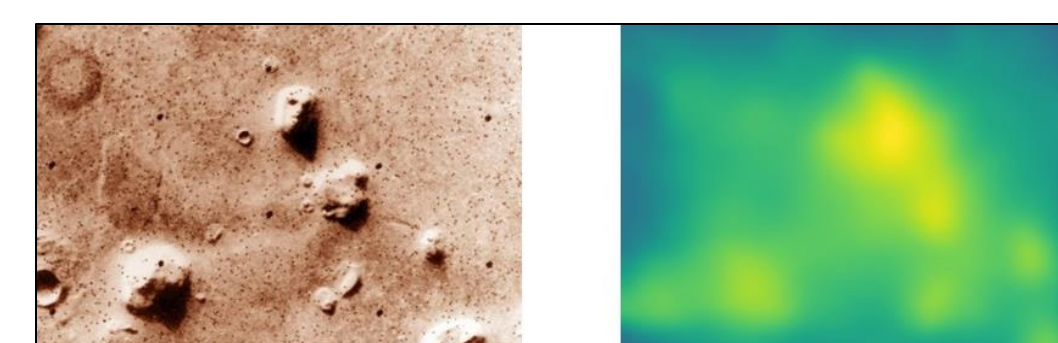
### DSFD overfits to human faces

We tested whether human face-specific features are enough with a highly accurate open-source human face-detection system. The output is a bounding box with a confidence score for the face (1.0=highest). DSFD is unable to identify pareidolia faces ( $p < 0.01$ , bootstrap-test).



### DeepGaze generalizes much better

We tested whether human face-generic features would provide a better foundation for identifying face pareidolia images using a state of the art visual saliency model. DeepGaze identifies face-like patterns as salient features within diverse visual stimuli.



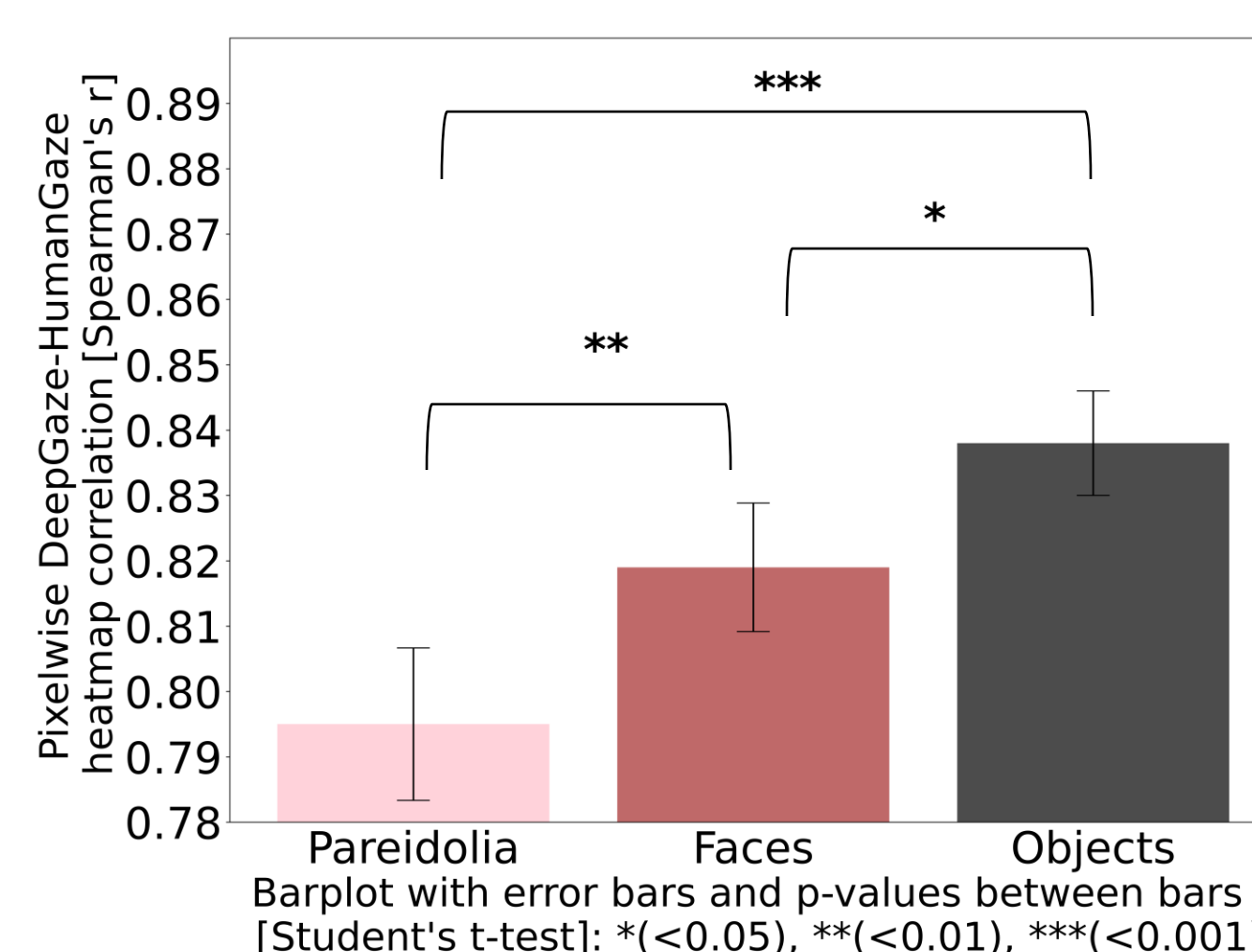
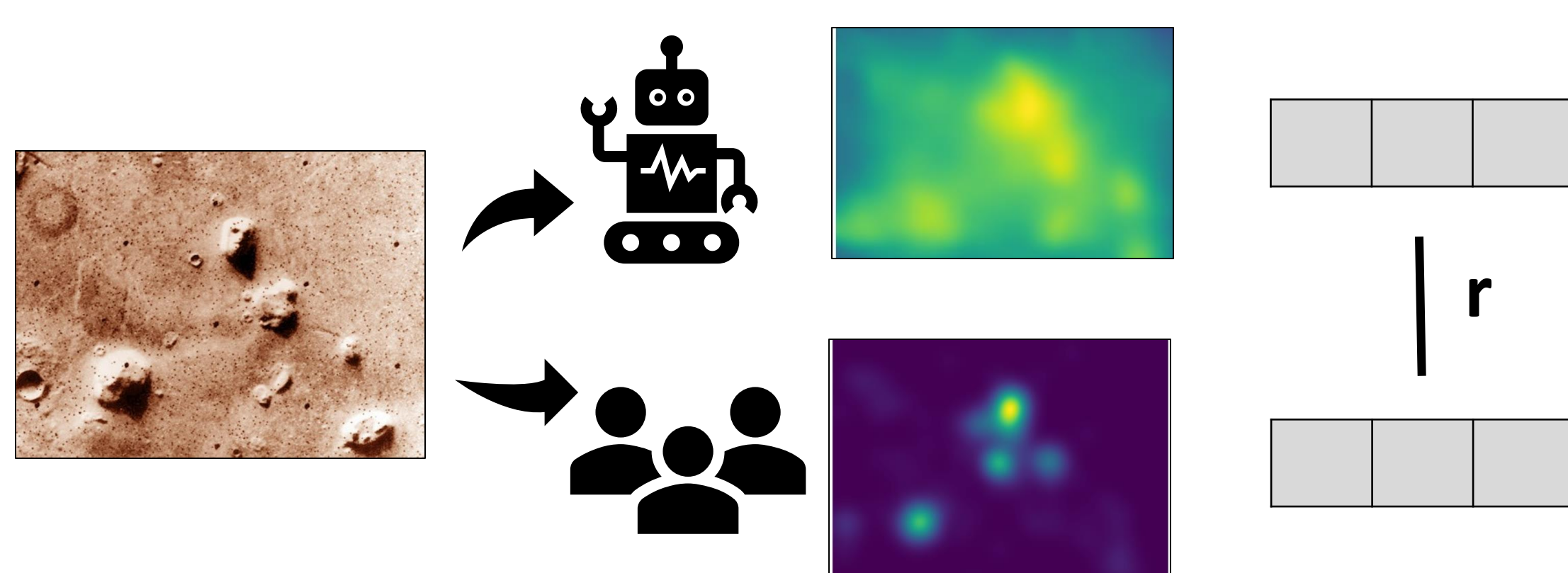
## DeepGaze shows high correlation with human gaze

### DeepGaze performs better in scenes with objects and faces than in face pareidolia scenes

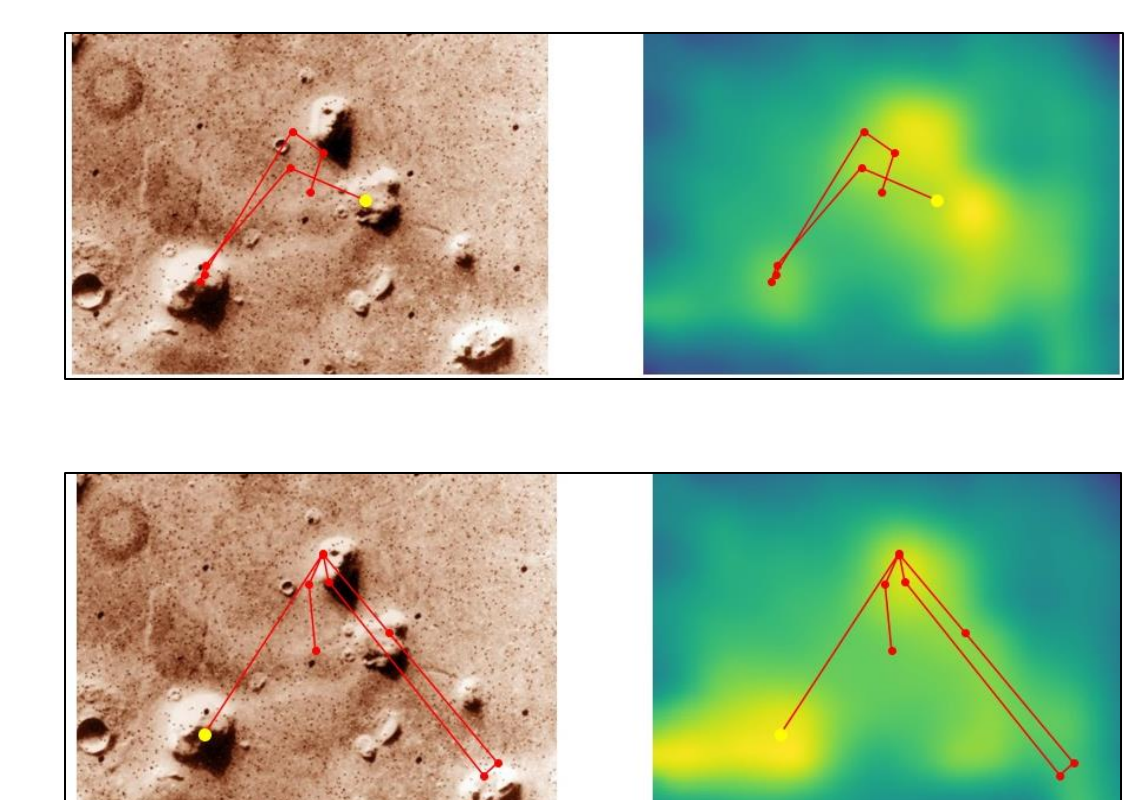
We tested whether there is a high similarity between the heatmaps generated by human gaze behavior and DeepGaze by performing pixelwise correlation (spearman).

Face-like stimuli pixelwise correlation is 0.80. However, DeepGaze is better in scenes with objects and faces than in face pareidolia scenes ( $p < 0.01$ , t-test).

The latest model of DeepGaze (III) allows the study of strong individual differences in eye saccades while free viewing the same stimuli.



### HumanGaze DeepGaze(III)



## Conclusion

Findings indicate that training on human eye gaze patterns across diverse stimuli provides DeepGaze with a more robust foundation for detecting and generalizing to face pareidolia, compared to systems optimized solely for human face features. However, certain nuances of human gaze behavior in face pareidolia remain uncaptured by DeepGaze.

→ Our results reveal DeepGaze as a promising tool for investigating complex perceptual phenomena like face pareidolia.