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Eyes on Emotions: What Makes Faces So Captivating?

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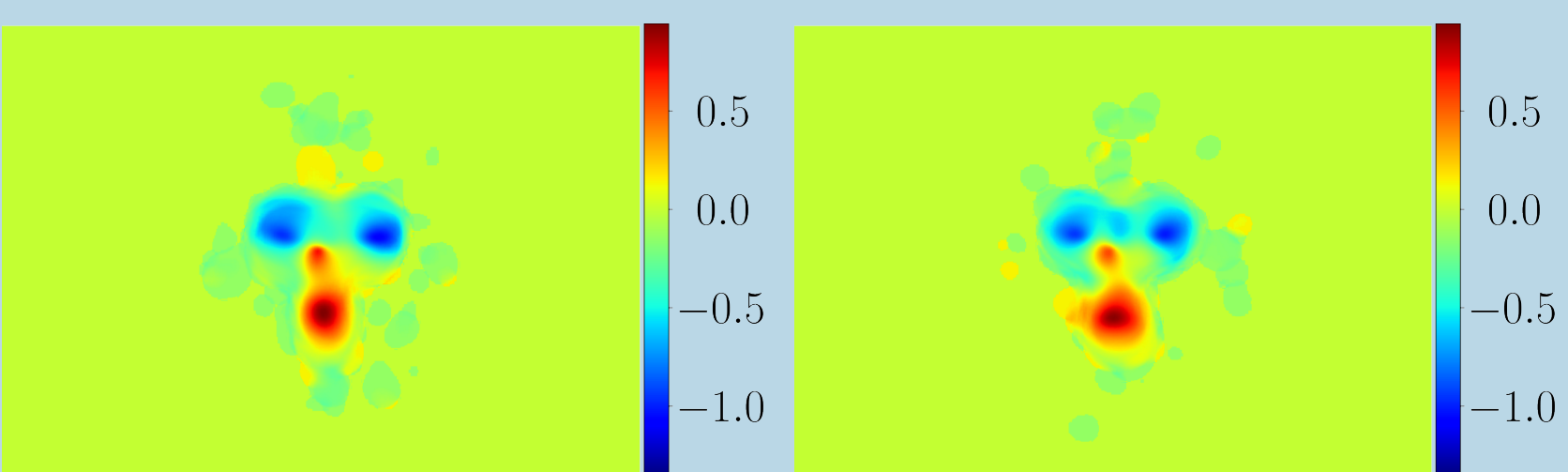
Introduction

Attention maps can be used to predict the regions most likely to attract the eye, thus highlighting the so-called “salient regions”. These regions depend both on the statistical properties of the scenes and the task of the observers. Several bottom-up models have been proposed to predict salient regions and more recently, **DeepGaze IIE**, a deep neural network model, has been trained directly onto human eye-tracking data to generalize them to unseen images but ignores task effects on eye fixations. Other methods, such as LayerCAM [4] provide maps that enhance the regions used by CNNs for a specific task.

In this context, we are interested in studying the salient regions of emotional faces. Emotional faces are specific stimuli that strongly attract gaze [1], especially on the eye and mouth. But it is unclear whether humans focus on these regions due to the performed task of expression recognition or due to the fact that these are “salient”. In a previous work [2], we demonstrated that CNNs maps highlight these and predict eye behaviour. Here, we:

- develop saliency maps that incorporates both bottom-up and top-down information.
- compare visual ROIs between eye-tracking and models’ data for emotional faces.
- evaluate CNN maps for predicting visual fixations during two tasks.

Cohen’s maps Emotion – Gender for Angry and Happy faces



Hypotheses

- **Eye fixations** focus on emotion- or gender-diagnostic information based on the categorization task.
- **Incorporating** task-specific information into saliency models improves prediction of eye fixation.
- **CNNs**, with task information, outperforms state-of-the-art saliency models.

References

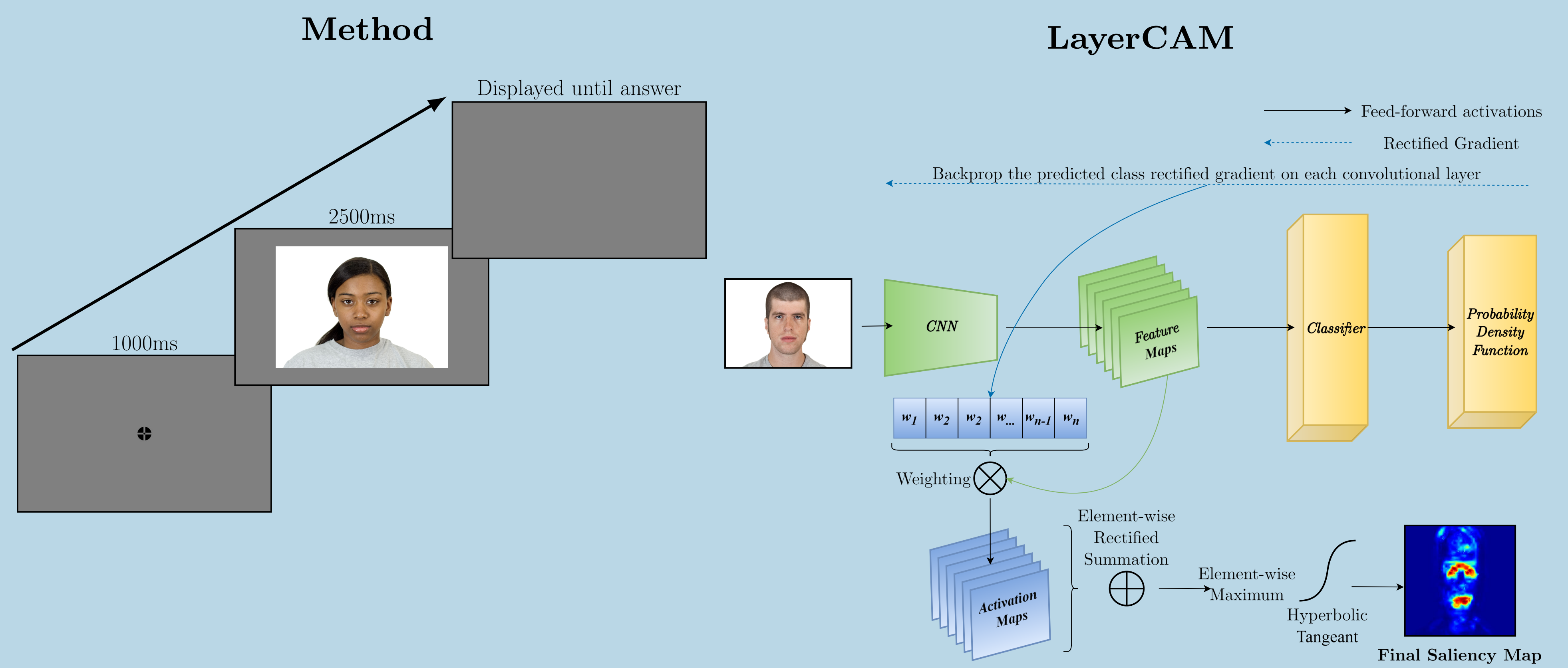
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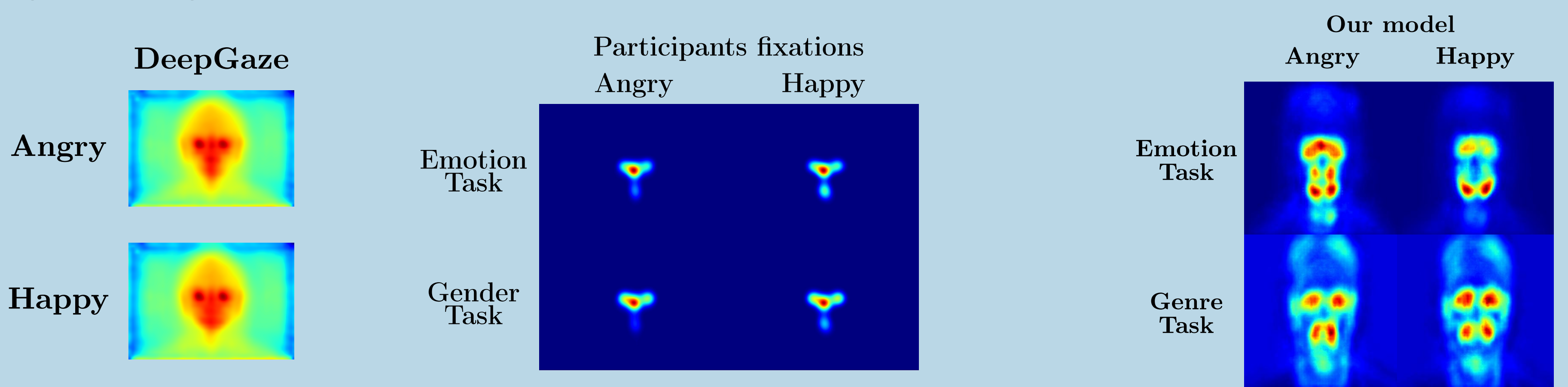
Method

We submitted gender and emotion categorization tasks to thirty-three participants and collected their eye-tracking data. Half of them saw fearful and neutral faces, half of them saw angry and happy faces. Each group performed the two tasks on the same set of stimuli and the order was counterbalanced between participants. We optimized two convolutional neural networks for the realization of the same tasks as those performed by participants. After the training phase, we collected LayerCAM [4] class activation maps. Then, we compared the tasks’ effects on eye fixation distribution and the performance of models’ saliency maps.

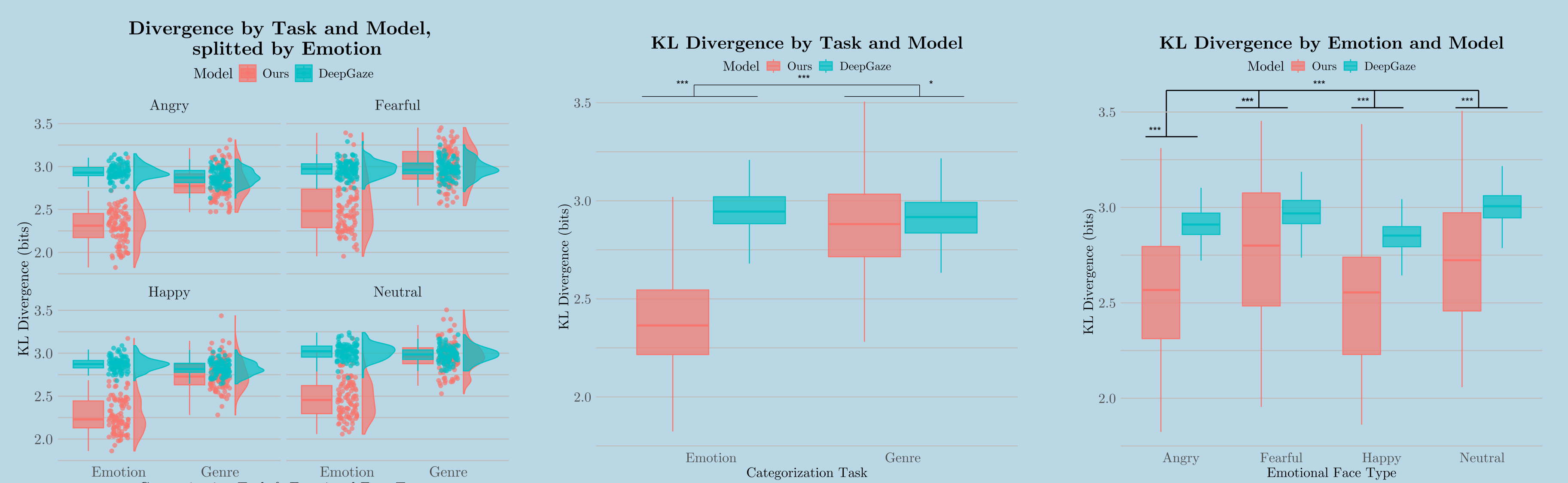


Results

There is an **effect of the task (Gender vs. Emotion categorization)** on the accuracies of participants such that they are, on average, more accurate when performing gender recognition than emotion recognition. This effect **interacts with the type of participant group**, as there is no significant effect of the task on the scores for the happy and angry faces group, but this effect is strong for the group that saw fearful and neutral faces.



The DeepGaze model, as compared to ours, does not take into account the task effects. Therefore, we tested whether it is a better model for the eye fixation densities for emotion categorization or gender categorization. Our results demonstrate that taking into account the task allows for better saliency map predictions. In particular, when analyzing Kullback-Leibler divergences (*lower is better*), we found both a **task by model** and an **emotion by model** interaction.



Conclusion

We demonstrate that:

- **Eye movements** are task-dependant, even in the very first few saccades.
- **Incorporating** top-down information into visual attention maps is needed to correctly predict eye movements.
- **CNNs** constitute good candidates to build such attention maps.