

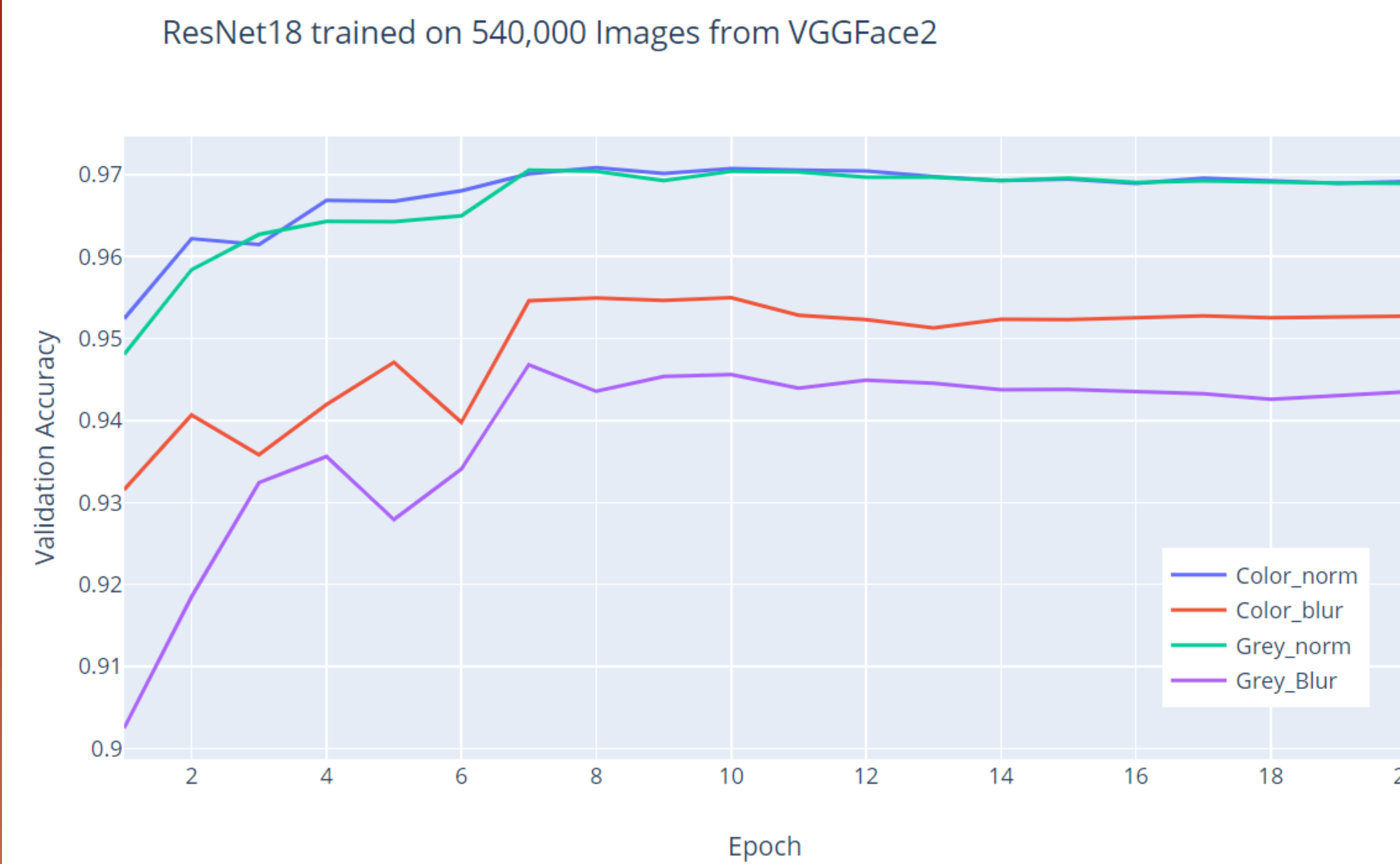
Background

- **What role does color play in face perception?** Studies have typically used small numbers of face images collected under controlled conditions; here we use large numbers of face images from the “wild”.
- **Issue 1** Competing goals of UV radiation protection and previtamin D3 production produce post-pubertal *sexual dimorphism* in skin coloration across races^[2].
- **Issue 2** Human performance data demonstrates an impairment to face sex classification accuracy when stimuli are presented in greyscale when shape information is degraded^[4]
- Deep Convolutional Neural Networks (DCNN) can predict neural responses to visual stimuli^[3]
- **Exp 1** Will a DCNN reveal an interaction between color sexual dimorphism and race for real-world face images?
- **Exp 2** Will a DCNN display similar impairment in a sex classification task when shape/color information is degraded?

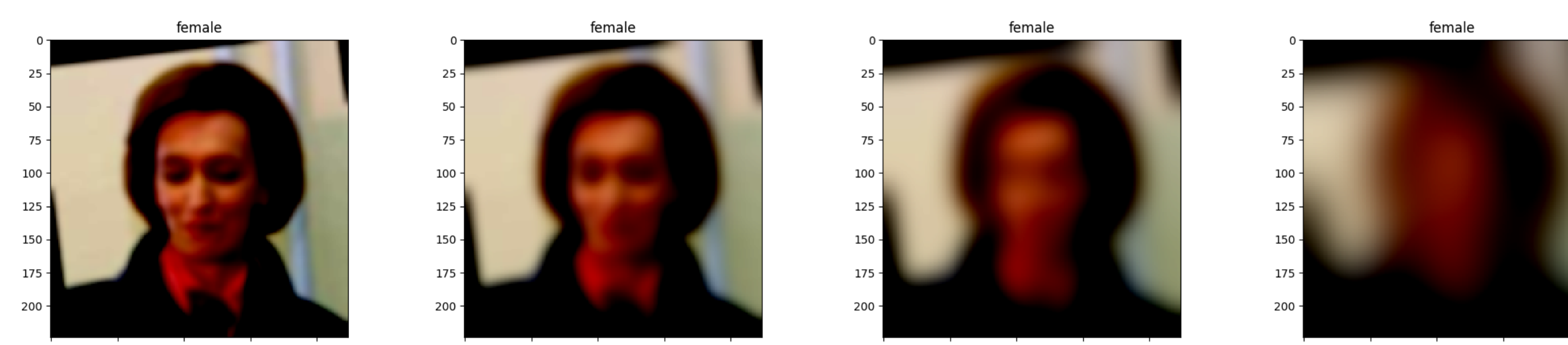
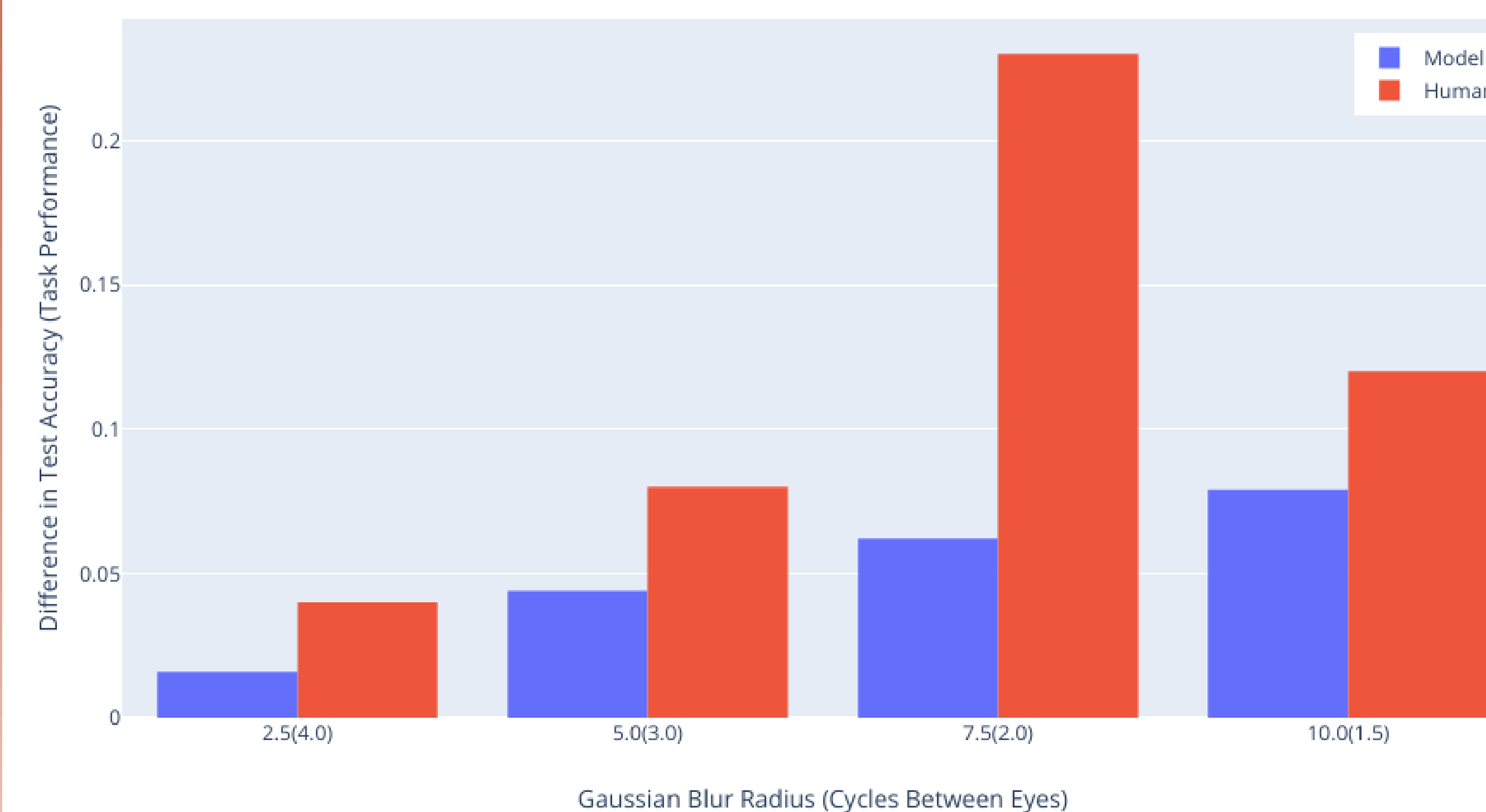
Methods

- From VGGFace2^[1] Dataset: 600,000 images: 540,000 train, 60,000 test, balanced on sex, random across race
- ResNet18 CNN Architecture modified for binary classification for sex, images re-sized to (224x224) and normalized
- Greyscale filtering and Gaussian blur used to degrade color/shape information at test time
- R:G ratios calculated across each image in dataset, rated from highest (High R, Low G) to lowest (Low R, High G)
- Examine learned color biases with respect to sex in output FC layer using images with only red or green content intact

Degraded Shape Manipulation



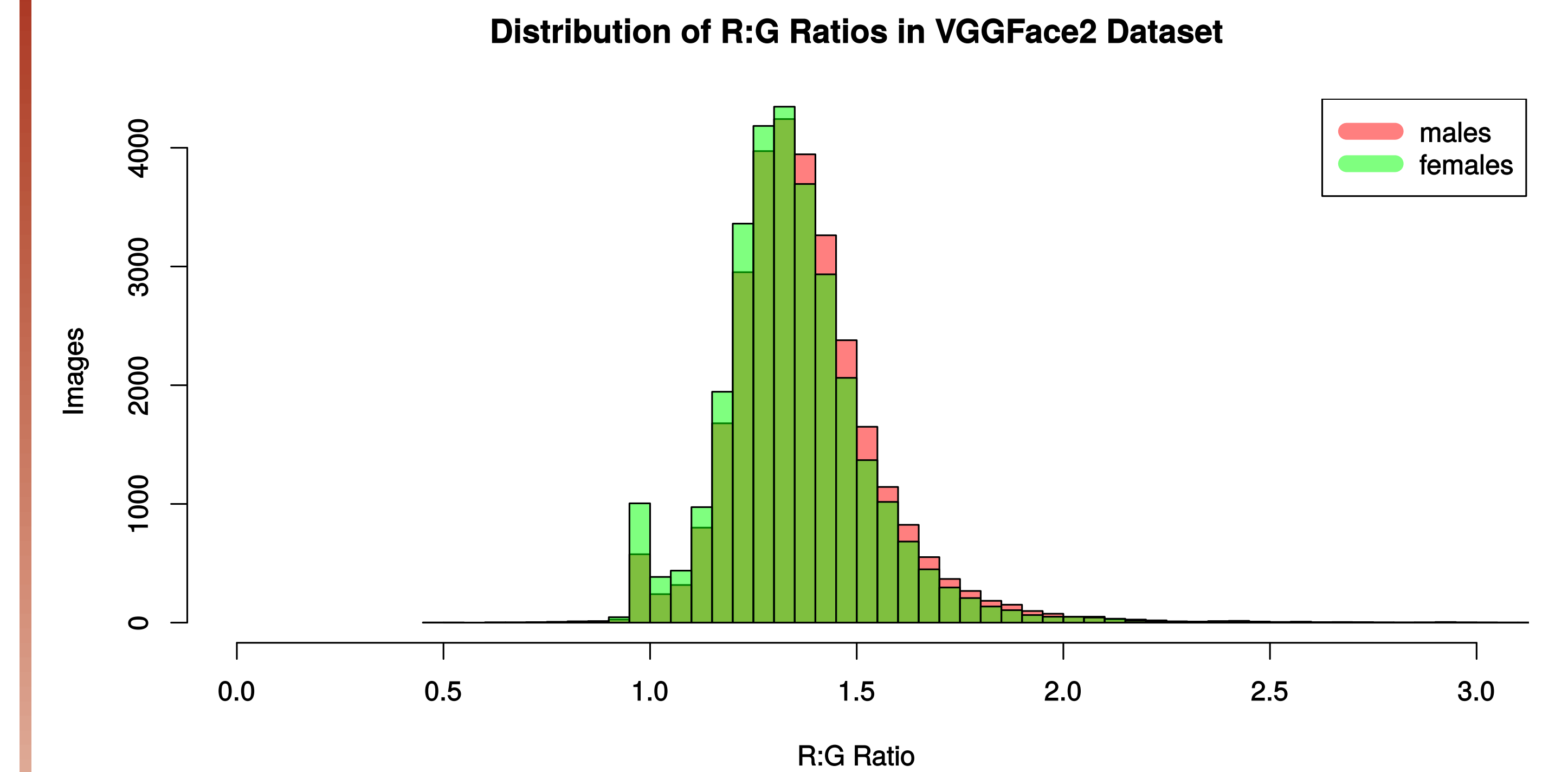
[Color-Greyscale] Accuracy Differences for Model (Human) Performance at Various Shape Degradation Levels



Progressive Levels of Gaussian Blur

Sexual Dimorphism

- Skin reflectance data suggests male faces are more red and female faces are more green



- R:G ratio calculated by summing all red and green pixel values for each image, with center crop of (100x100) used to focus in on face rather than background
- Mean R:G ratio for males: 1.374767, for females: 1.346971

Conclusions & Next Steps

- **Conclusion Issue 1** Distribution of “wild” faces are consistent with prior findings that males are redder than females
- **Conclusion Issue 1** The DCNN does not appear to learn this difference; possibly because of the diagnosticity of shape information and the high variability of color due to lighting
- **Conclusion Issue 2** Results (albeit low $N = 2$) suggest a disproportionate impairment in humans for sex classification in the absence of clear shape information
- Results across the DCNN and humans are similar in pattern, but not magnitude due to ceiling performance in the DCNN
- Thanks to the members of TarrLab for their invaluable support

References

- [1] Q. Cao et al. “VGGFace2: A dataset for recognising faces across pose and age”. In: *International Conference on Automatic Face and Gesture Recognition*. 2018.
- [2] N. G. Jablonski and G. Chaplin. “The Evolution of Human Skin Coloration”. In: *Journal of Human Evolution* 1.39 (2000), pp. 57–106.
- [3] I. Rafegas and M. Vanrell. “Color encoding in biologically-inspired convolutional neural networks”. In: *Vision Research* 151.1 (2018), pp. 7–17.
- [4] A. Yip and P. Sinha. “Contribution of Color to Face Recognition”. In: *Perception* 8.31 (2002), pp. 995–1003.