Implicit knowledge of the colours of natural scenes matches real colours

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Purpose

To test the hypothesis that observers have implicit knowledge about the colours of natural scenes.

1. Introduction

Observers can remember the colours of familiar objects and the colours of natural elements like grass, sky and foliage. But can observers estimate the colours of unknown complex natural scenes? Here we tested this hypotheses with an experiment where naïve observers adjust the colour gamut of unknown natural scenes to produce natural realistic images.

2. Methods

Stimuli

• Manipulated images of three natural scenes simulated illuminated by D65 (Figure 1) displayed on a calibrated monitor.

• Spectral data from natural scenes obtained by hyperspectral imaging.

• The colour gamut of the images could be expanded or contracted by the observers in CIELAB ($a*$, $b*$) by a factor between 0.5 and 1.5 (see Figure 2).

• Viewing distance: 110 cm.

• Visual angles: flower 10°×7°, fern 12°×9°, trees 12°×9°.

Observers

18 observers with normal colour vision.

Apparatus

24" CRT monitor (GDM-F900 Trinitron Color Graphic Display, Sony Corp., Japan) controlled by a video board in 24-bits-per-pixel true-color mode (ViSaGe MKII Visual Stimulus Generator; Cambridge Research Systems).

Design and procedure

In each trial one image was presented to the observer with its gamut contracted or expended by a random factor between 0.50 and 1.5 (see Figure 2). The observers used a joy-pad to adjust the gamut factor with a step 0.02 in such a way that the image appeared the most natural possible. Each observer tested three images and three times each image, all in a 10 minute session.
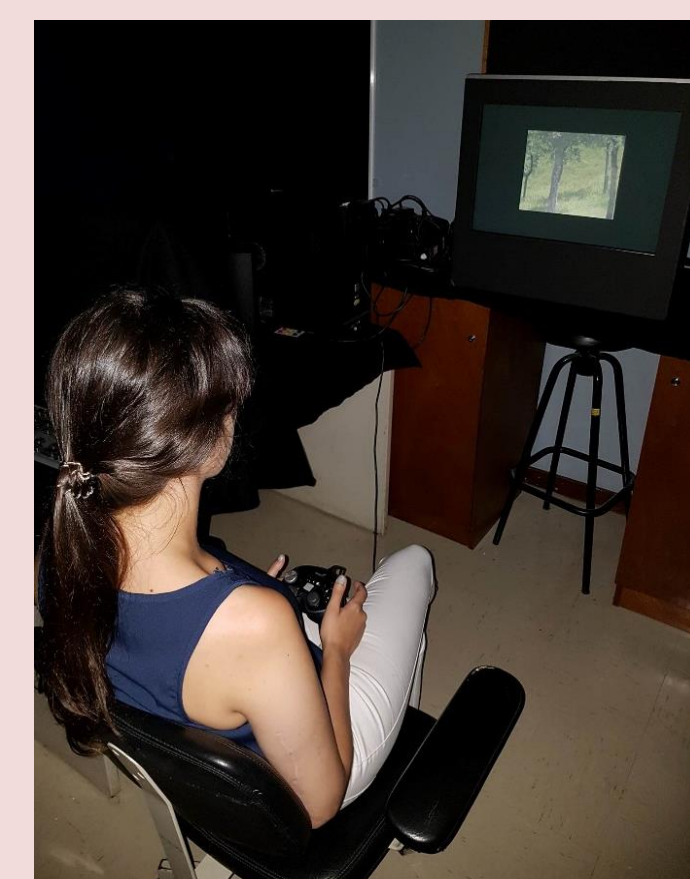
Figure 3 – The observers adjusted the joy-pad until the image appeared the most natural possible. The adjustment consisted in multiplying the colour gamut by a factor between 0.5 (contraction) and 1.5 (expansion) in steps of 0.02.

NATURAL SCENES

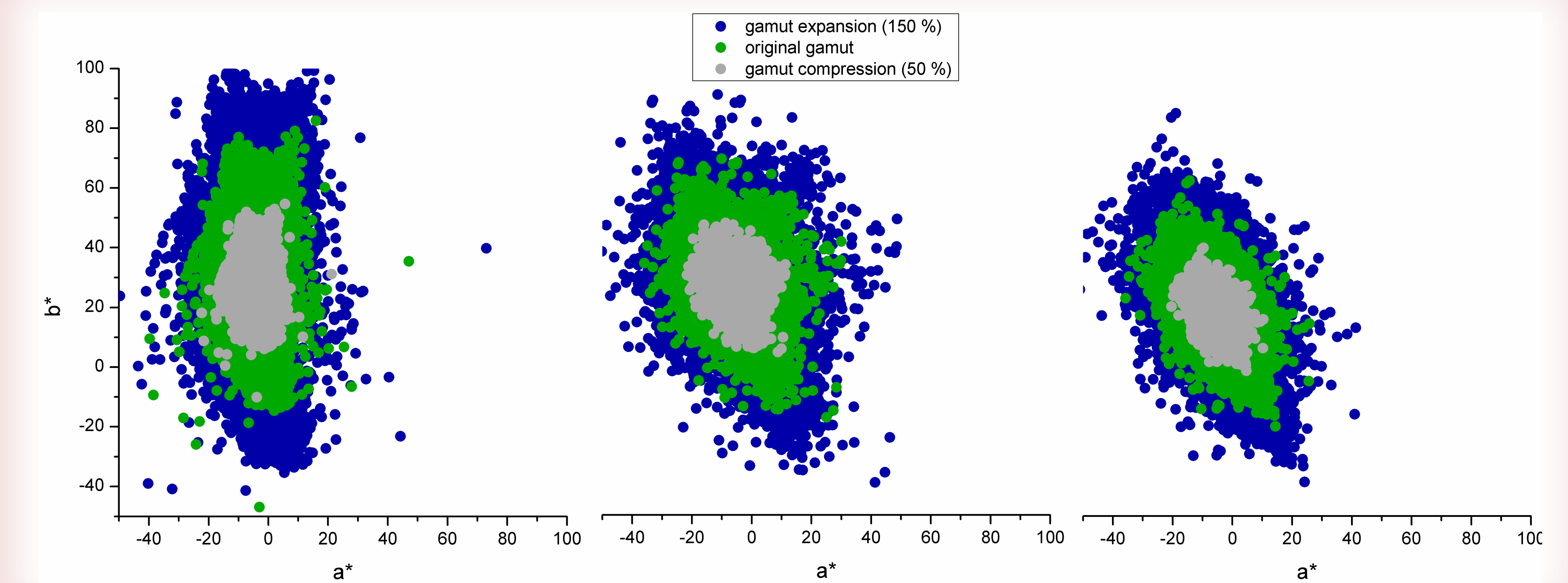Figure 1 – Images of the three natural scenes tested in the experiment.

Figure 2 – Colour gamuts when affected by a compression, an expansion or in their original form.

3. Results

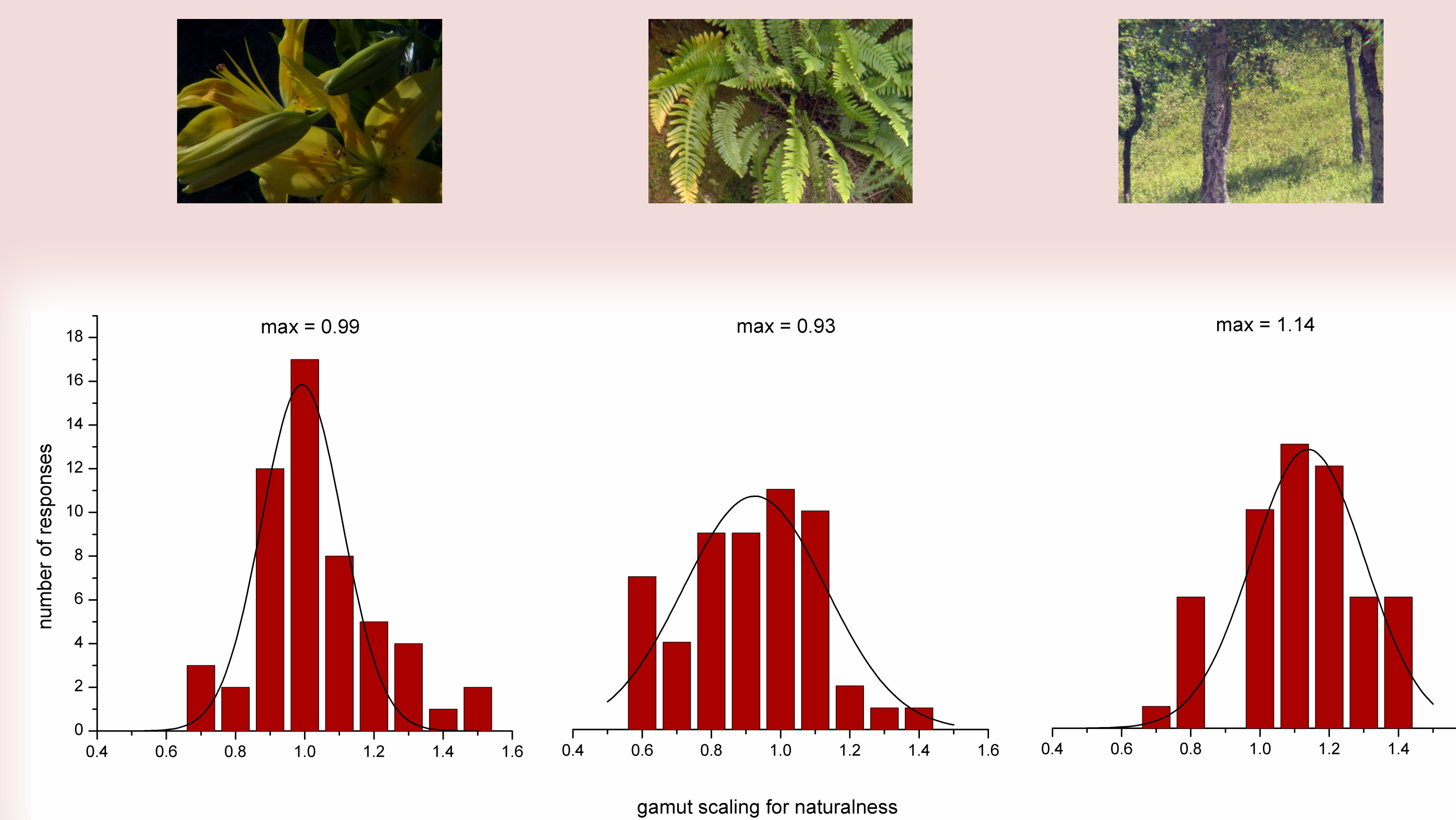### Individual images

All images

max = 1.03

Figure 4 – Distribution of the observers responses for each of the images tested. Data pooled across 18 observers with three trials per image. The lines through the data represent the best-fitting normal distributions.
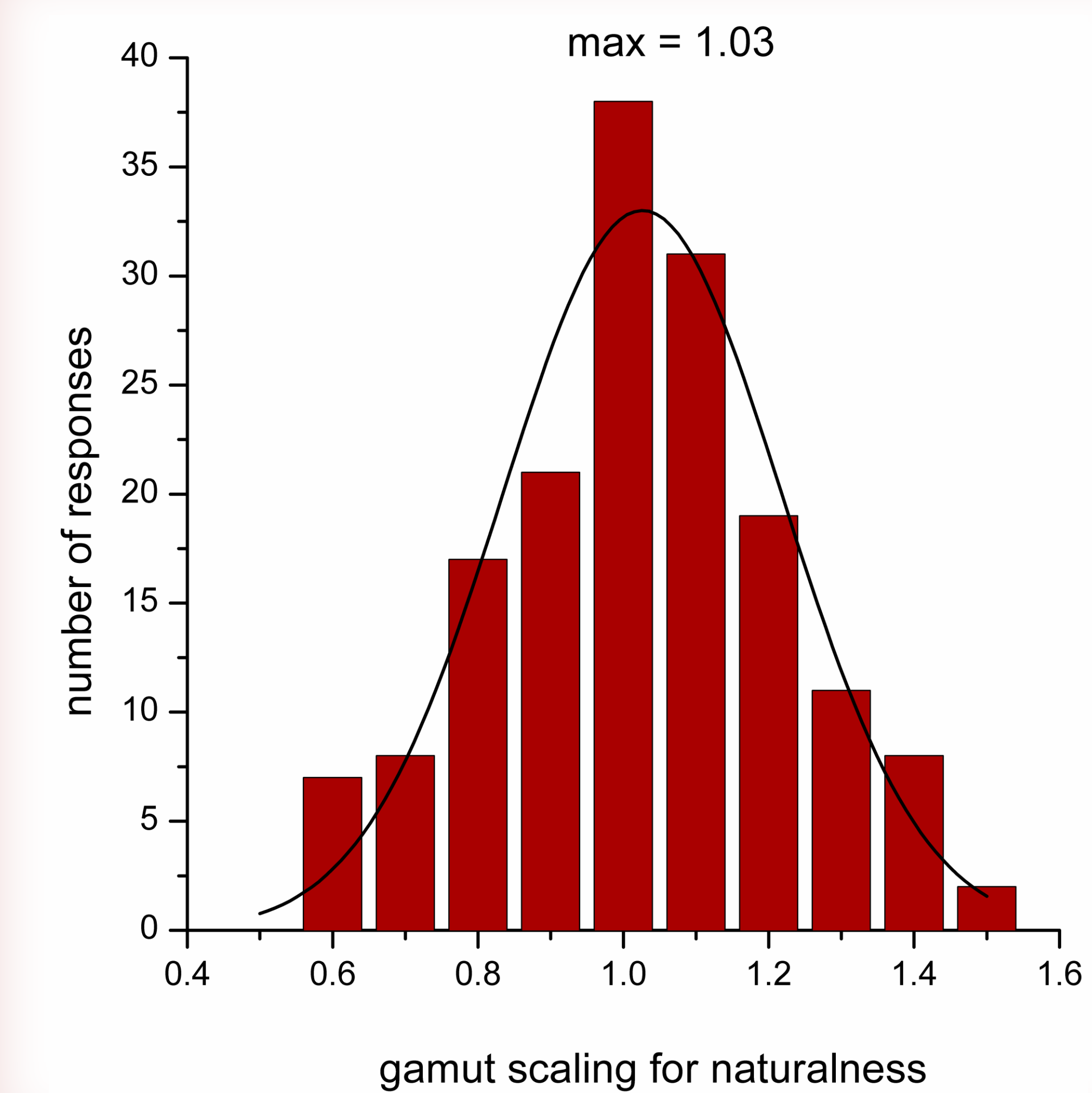
Figure 5 – Distribution of the observers responses. Data pooled across the three images tested and 18 observers. The line through the data represent the best-fitting normal distribution.

4. Conclusion

• The gamut selected by observers was, on average, within 3% of the original one.

• Observers seem to have very precise implicit unbiased knowledge of the colours of natural scenes.