Five Illusions Challenge Our Understanding of Visual Experience

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Abstract

Do inferential models of vision provide us with models of visual experience? I argue they do not. Five new visual illusions suggest that real-world visual experience is much simpler than we previously thought. These new illusions suggest that real-world visual experience is not an inferential process. Instead, the visual inferences modelled by inferential models of vision reflect purely cognitive inferences about our visual experience and/or the world. These five illusions provide us with new ways to tease visual experience and purely cognitive inferences apart.

Keywords: visual experience; visual inference

1. Visual Inference

The Hollow-Face illusion provided (Gregory, 1970) with the best evidence that vision is the visual system's "best guess" (or inference) about the outside world. The illusion is convincing in a 2D movie. But what we want is a theory of real-world visual experience, not a theory of picture or movie perception. So, does the Hollow-Face illusion invert perceived 3D depth in real-world visual experience?

I argue it does not. The crucial test is what happens when we place 3D objects in the hollow of the Hollow Face? Space that physically exists, but which is "impossible" so far as the illusion is concerned.

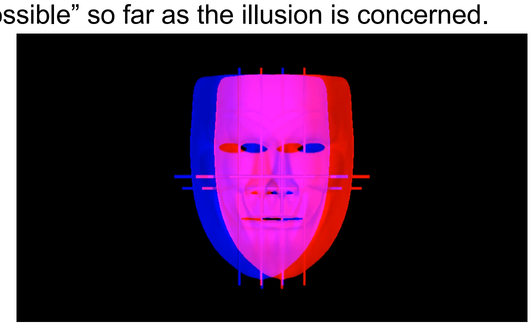

Figure 1. **Linton Un-Hollow Face Illusion**. Link to demo: https://youtu.be/33Ha-pxWNkA (needs red-blue glasses)

What we find is that the illusion doesn't invert real-world 3D depth: we perceive the veridical (un-inverted) depth between the poles and the face, even though the illusion persists (as evidenced by the illusory motion of the face). This suggests that the influence of priors and depth cue combination only appears to affect our *cognition* (or understanding) of perceived 3D depth in the illusion.

2. Visual Shape

Our real-world 3D visual experience appears, therefore, to reflect stereo vision. But stereo vision itself is typically thought to involve a conversion from retinal coordinates ('retinal disparities') to world coordinates, in a process known as 'depth constancy' (Guan & Banks, 2016). Does 'depth constancy' really affect our visual experience?

I argue it does not. The crucial test is what happens when we take two circles that are separated in stereo depth, and we move them forwards and backwards in depth together. When do the circles appear to move rigidly together in depth (with no change in their perceived stereo separation)? When (a) the *physical distance* between the circles is kept constant (left), or (b) the *retinal disparities* between the circles are kept constant? (right).

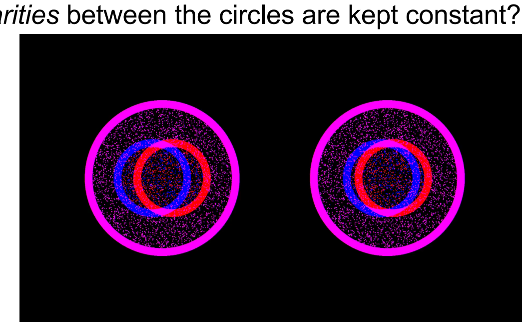

Figure 2. **Linton Stereo Illusion**. Link to demo: https://youtu.be/18ONHln7mkI (needs red-blue glasses)

As we see from the demo, the answer is constant retinal disparities (right). So 'depth constancy' only appears to affect our *cognition* (or understanding) of perceived depth.

WEBSITE: http://FiveIllusions.github.io
TOOLBOX: https://github.com/FiveIllusions

3. Visual Scale

(Helmholtz, 1857)'s 'telestereoscope' demonstrates that increasing the separation between the eyes reduces the apparent scale (size and distance) of objects in a scene. This is a startling effect, given all other size and distance cues are (roughly) intact, suggesting that whatever governs this effect also governs our impression of visual scale in everyday viewing conditions. But does this effect really change the perceived distance of objects?

I argue it does not. By decoupling changes that affect 3D shape ('horizontal disparities') from changes that simulate optical distance ('vergence' and 'vertical disparities'), we show that this effect is due to changes in 'horizontal disparities' altering the perceived 3D shape of the objects, whilst their distance remains unchanged.

Figure 3. **Linton Scale Illusion**. Link to VR demo: https://github.com/FiveIllusions (Five Illusions Toolbox)

This suggests that visual scale relies on a purely *cognitive* understanding of the relationship between perceived 3D shape and closer distances (due to no 'depth constancy').

4. Size Constancy

What about distortions of 2D space, such as 'size constancy', where perspective cues are thought to distort the perceived angular size (x and y-axis extent) of objects in an image (Murray et al., 2006). Does 'size constancy' really distort the perceived angular size of objects?

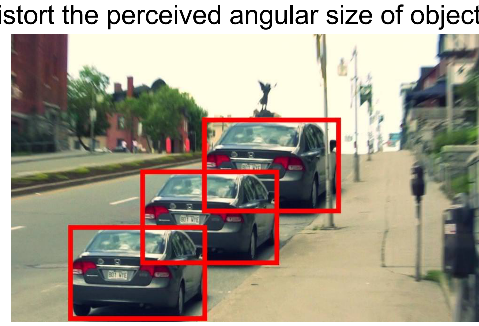

Figure 4. **Linton Size Constancy Illusion**, based on illusion by **Alex Blouin** (https://imgur.com/WBAzkuI)

I argue it does not. If 'size constancy' really distorts regions of an image – expanding some regions of the image, and shrinking others – then we would expect any object placed in the same region of the 2D image to be equally distorted. But this is not what we see in Figure 4. Instead, the cars appear distorted whilst the rectangles appear undistorted. This suggests that 'size constancy' appears to only affect our *cognition* (or understanding) of the perceived angular size of objects in an image.

5. Color Constancy

The same analysis can be applied to color and lightness constancies. Does 'color constancy' really affect the perceived shade of a patch in an image?

I argue it does not. If it did, then when we change the interpretation of a patch by changing its surround, we would expect this supposedly 'perceptual' change to also become apparent. But consider the following demo.

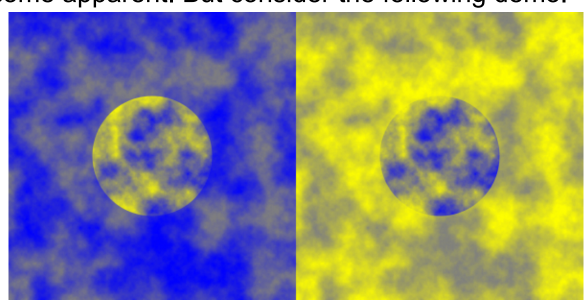

Figure 5. **Akiyoshi Kitaoka's version of (Anderson & Winawer, 2005)**. Used in **Linton Color Constancy Illusion**. Link to demo: https://youtu.be/Ai4rBdBdeUM

As we change the surround, our interpretation of the patch changes, but the perceptual appearance of the patch itself does not appear to change. This suggests that color and lightness constancies only affect our *cognition* (or understanding) of the perceived shade (color or lightness) of a patch, but not its perceptual appearance.

Conclusion

These five illusions provide significant support for the 'minimal' (non-inferential) theory of visual experience developed by (Linton, 2023)(Linton, 2021)(Linton, 2017), according to which both retinal color and 3D shape from stereo are *perceived* at the level of our visual experience, whilst prior knowledge, cue integration, visual scale, and (depth, size, and color) constancies merely affect our *cognition* (or understanding) of our visual experience.

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Five Illusions of Visual Experience
VSS Abstract: (Linton, 2024a)
VSS Poster: https://osf.io/4g3fq

Linton Un-Hollow Face Illusion
Preprint: (Linton, 2024d)
AVA Abstract: (Linton, 2024e)

Linton Stereo Illusion
Preprint: (Linton, 2024c)
AVA Abstract: (Linton & Kriegeskorte, 2024)

Linton Scale Illusion
Preprint: (Linton, 2024b)
AVA Abstract: (Linton, 2024f)

Linton Size Constancy Illusion
AVA Abstract: (Linton, 2025b)

Linton Color Constancy Illusion
AVA Abstract: (Linton, 2025a)

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