

## **Visual Scale is Governed by Horizontal Disparities: Linton Scale Illusion**

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We present a new illusion that challenges our understanding of visual scale. Since Helmholtz's 'telestereoscope' (1857), we've known that stereo vision governs visual scale, turning a real-world scene into a miniature scene despite all other depth cues being present. This effect is attributed to vergence and/or vertical disparities (Howard & Rogers, 2012). By contrast, Linton (2018) *BioRxiv*, attributes the effect to horizontal disparities. To adjudicate between these two accounts, we build a virtual reality 'telestereoscope' that can decouple changes in vergence and vertical disparity from changes in horizontal disparity. First, when horizontal disparity is ramped-up, but vergence and vertical disparity are normal, the scene looks miniature. This is an astounding effect, given all other distance cues indicate a normal scene. Second, when vergence and vertical disparity are ramped-up, but horizontal disparity is normal, the scene looks normal, challenging the role that vergence and vertical disparity play in visual scale. Third, ramping-up horizontal disparity also changes the slope of the ground-plane. Fourth, keeping vergence and vertical disparity fixed whilst ramping-up horizontal disparity creates a startling illusion. We judge the scene as a whole to reduce in scale, even though all that changes in our visual experience is a distortion of 3D shape (of the scene and its objects). The illusion changes our concept of 'visual scale' from being something that we directly perceive (vision having a range-finder, like vergence or vertical disparity) to something we merely cognitively infer on the basis of an association between accentuated 3D shape and closer distances.

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