

Four Illusions Challenge Our Understanding of Visual Experience

How does the brain convert the 2D images on our retinas into the 3D world that we see? In this talk I will highlight four visual illusions that I have developed as a NOMIS Fellow at the Italian Academy that force us to re-evaluate the fundamental mechanisms of 3D vision. First, prior knowledge about the world is thought to play a crucial role in 3D perception. However, I will show that the role that top-down information plays in classic 3D illusions (such as the ‘hollow-face illusion’) has been widely misunderstood, and top-down information plays a much more limited role. Second, stereo vision (depth perception from the two eyes) is thought to rely on converting the retinal projections in the two eyes into real world distances. However, I will show that perceived stereo depth simply (and directly) reflects the projections on the retina rather than distances in the world. Third, visual scale (the size and distance of objects) is thought to be provided by various ‘range-finders’ (distance cues) that the visual system relies on to estimate distance. However, I will show that vision doesn’t appear to have any ‘range-finders’, and instead relies on a rather surprising (and indirect) source of distance information: learning how the 3D stereo shape of objects distorts with distance. Fourth, ‘size constancy’ (seeing objects as roughly the same size despite changes in their viewing distance) is thought to be a perceptual effect that relies on feedback from higher visual areas. However, I show that this feedback does not appear to affect our visual experience, opening up the possibility that 3D visual experience is processed much earlier than previously thought.