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SUMMARY: Random fluctuations arise at every stage of visual processing, but does this noise restrict what we see? Adapting a technique developed by radio and television engineers in the 1940s, we measure the effect of added visual noise on grating and letter identification, and estimate the amount of added noise that is equivalent to the observer’s intrinsic noise. We map out the equivalent noise as a function of the signal size, duration, and luminance, and compare our measurements to the predicted equivalent noise of several intrinsic noises arising at various levels in the visual system. The results show that visual sensitivity is limited by the sum of photon and cortical noises, each dominating a distinct stimulus domain. The visibility of small brief dim signals is limited by photon noise, while the visibility of large prolonged bright signals is limited by cortical noise. The boundary separating photon and cortical noise domains is a critical amount of light within the stimulus: the product of luminance, area, and duration. In the photon-noise domain, the measured equivalent noise tells us that vision uses 2% of the light entering the eye. The cortical equivalent noise is self-similar, and scales with luminance, size, and duration, affirming suggestions that cortical processing is scale-invariant. In brighter light, we can see smaller, briefer, and fainter objects, but, even in the brightest light, we will never see an edge whose width is less than 1% in luminance, the faintest that the cortical neurons can detect in their own noise. These two noises, photon and cortical, are of concern in their own right, but also represent an important quantitative limitation for any method sensitive to luminance."