Understanding the relation of physical intensity and perceived magnitude: the case of contrast.

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The longstanding question of how physical magnitude relates to perceived magnitude remains unanswered. It could be explained by an internal representation modeled as a function mapping physical intensity to perceived intensity (transducer), along with some perceptual variability (noise). Studies employing discrimination tasks have helped shape this internal representation, but the challenge lies in the infinite combinations of transducers and noise that are compatible with a given discriminability pattern.

Zhou, Duong, and Simoncelli (2022) have suggested that magnitude estimation tasks fully define this internal model, where the transducer represents the average estimation response and the noise represents the variability (standard deviation). According to their proposal, δ, calculated as the slope of the transducer divided by the noise, should correspond to the observed discriminability pattern in discrimination tasks. To assess this framework, a group of five participants engaged in both discrimination and magnitude estimation tasks for contrast perception. The choice of contrast is deliberate as discrimination studies have revealed a nonlinearity at low intensities known as the pedestal effect, which should be reflected in δ obtained from magnitude estimation.

Our findings for the discrimination task confirmed the presence of the pedestal effect. In magnitude estimation, we observed a primarily linear or slightly compressive trend for the transducer and an expansive trend for the noise. The δ estimated from magnitude estimation also shows the pedestal effect, consistent with the results of the discrimination task. Altogether, the results indicate that magnitude estimation offers a reliable approach to understanding internal responses to contrast perception.