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Relation between Perceptual Entropy and Symbolic Numeral Representation

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Abstract

Perceptual features, either magnitude (size, area) or non-magnitude dimensions (color, shape), affect number representation by changing signal-to-noise ratio. Clarity of signal about numerical value may explain why comparing Arabic numerals is faster than comparing dots. The present study manipulated signal-to-noise ratio to investigate the effect of perceptual noise on symbolic numeral representation. Noise was quantified based on perceptual entropy of Arabic numerals, which were presented either in a single (low entropy) or three colors (high entropy). Thirty-eight adults were asked to compare two Arabic numerals, presented in single-single, single-three, and three-three colors. RT decreased as numerical ratio ($b = -0.20$) and entropy ratio ($b = -0.11$) increased, indicating symbolic representation was affected by entropy. RT increased as sum of numerical values ($b = 0.08$) and sum of entropy values ($b = 0.06$) increased. The results suggest perceptual noise impaired numerical judgment even though adults are highly familiar with Arabic numerals.