Percepts from noise patterns: The role of fractal dimension in object pareidolia

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The human visual system allows us to form percepts, mental states associated with having the experience of seeing a coherent form, even when there is no object present. Here we asked subjects to form percepts from silhouette images of fractal terrains that we generated with the random midpoint displacement method. We converted the terrains into binary images by applying a color scheme of black below and white above the median height, which resulted in silhouette fractals that range in fractal dimension from $1 < D < 2$. The fractal dimension quantifies the ratio of coarse to fine structure in the fractal terrain and therefore acts as a measure of its visual complexity. Participants were told that they would see a black and white image for one minute and were asked to press a button as they named aloud objects they saw. We recorded participants' response times and the number of objects named per image. At the end of the naming period for each image, participants were asked to draw an outline of each percept. Fifty-four participants each saw 16 images, four images from four levels of fractal dimension (1.1, 1.3, 1.5, and 1.9). Statistical analyses revealed significant linear and quadratic trends for both the response time and rate of naming data. Participants formed percepts fastest around dimension 1.3, and named the most objects at this level of complexity as well. At other levels of dimension, responses were slower and fewer objects were named. Processes that allow us to deal with occlusion and camouflage in natural environments may allow us to induce pareidolic states when viewing noise. Fractal image statistics may enhance the likelihood of such an occurrence in patterns with dimension near 1.3, as fractals with dimension nearer 2 exhibit greater fragmentation, whereas lower dimensions exhibit larger coherent regions.