Supplemental information

Processing visual ambiguity in fractal patterns: Pareidolia as a sign of creativity

Antoine Bellemare-Pepin, Yann Harel, Jordan O'Byrne, Geneviève Mageau, Arne Dietrich, and Karim Jerbi
SUPPLEMENTAL FIGURES

Figure S1. Pareidolia for high- and low- creatives across fractal dimensions Related to Figure 5. To understand more precisely how creativity, fractal dimension and contrast interact in predicting pareidolia occurrences, we first divided subjects in low- and high-creatives using a median split, and then conducted regression analyses between FD and pareidolia for low-to-mid-contrast and high-contrast images. For images with high contrast, we show significant quadratic regression for low-creatives ($\Delta R^2=.32$, $p=.003$), while for high-creatives, only linear regression significantly predicts the occurrence of pareidolia ($\Delta R^2=.05$, $p=.16$) (Fig. s1). For images with low-to-mid-contrast, we report a significant quadratic regression only for the high-creative group ($\Delta R^2=.53$, $p<.001$). This figure illustrates the tendency of low-creative individuals to experience pareidolia more often at mid-FDs (around 1.3). (a) High-contrast images. (b) Low-mid-contrast images. $\Delta R^2$ corresponds to the change in the coefficient of determination when going from linear to quadratic regression model.
Figure S2. Image-based analysis of pareidolia occurrence (left column) and frequency of occurrence (right column) across subjects. Related to Figure 2. This image-based analysis of reported pareidolia was conducted to check whether there was some evidence for consistency across participants in their responses to identical stimuli. If the responses of the participants (i.e. pareidolia occurrence and number of percepts) were random and unrelated to pareidolia occurrence, we’d expect the mean pareidolia responses for the stimuli to be similar across stimuli. First, we computed the mean value of pareidolia responses for the stimuli to be similar across stimuli.
each single image. We then computed new means for the same variable but this time after randomly shuffling the provided responses across all stimuli (as a realization of a mean of random responses for each stimulus). We also computed the results using the mean of 10 such randomizations. If the participants' responses were driven by pareidolia, rather than random behavior, we'd expect that -across the group- some images will elicit more pareidolia than others.

**a, b.** Ranking of individual images (360 x 3 contrast levels) by their mean pareidolia scores across subjects. The original data contain more images associated with very rare and very frequent pareidolia than distribution obtained by randomized data across stimuli and subjects.  

**c, d.** The distribution plot for the original data also shows longer tails than the surrogate data.  

**e, f.** Differences between the distribution of the original pareidolia response data and 1000 randomized sets of responses using two-sample Kolmogorov-Smirnov tests. Both for pareidolia occurrence and for the number of objects variables, we found that the response distributions across subjects were significantly different from the distributions of random behavioral responses. These results indicate that the distribution of the original data significantly differs from that of randomly generated behavioral responses.
We introduced a measure for the concept of "spontaneous pareidolia" to capture the quick emergence of pareidolic percepts that "pop up" and distinguish them from later events that result from an active and deliberate search in the ambiguous stimulus. This required a temporal threshold to define what we consider to be a quick/spontaneous emergence. We tested spontaneous pareidolia at three different thresholds (1.5, 2 and 2.5 sec). (a) Spearman correlations between self-reported creativity (ECQ) and spontaneous pareidolia across thresholds. (b) Spearman correlations between divergent association task (DAT) and spontaneous pareidolia across thresholds. (c) Spearman correlations between fractal dimension of stimuli and spontaneous pareidolia across thresholds. From this investigation, 2 seconds seems to be a reliable threshold to adopt.
Figure S4. Distribution plots for the six variables in the correlation matrix with Shapiro-Wilk normality tests. Related to Figure 3.
**SUPPLEMENTAL TABLES**

| Fixed effects | Estimate | Std. Error | z value | p-value |
|---------------|----------|------------|---------|---------|
| (Intercept)   | 1.35     | 0.17       | 7.86    | < 0.001*** |
| FD            | 0.66     | 0.25       | 2.70    | 0.007**  |
| FD²           | -0.92    | 0.23       | -3.98   | < 0.001*** |
| Contrast      | -0.57    | 0.04       | -13.30  | < 0.001*** |
| DAT           | 0.57     | 0.16       | 3.68    | < 0.001*** |
| FD * DAT      | 0.32     | 0.25       | 1.28    | 0.20     |
| FD² * DAT     | -0.45    | 0.23       | -2.01   | 0.04*    |

Table S1. Moderation effect of FD on Divergent Thinking in predicting Pareidolia (Par). Related to Figure 4. (panel D). Number of participants = 42, number of trials = 360, total N = 15,120. *: p < .05; **: p < .01; ***: p < .001. GLMM built to predict pareidolia occurrences from Divergent Thinking (DAT), fractal dimension (FD) and contrast.