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SHORT AND SWEET

The small step toward asymmetry: Aesthetic judgment of broken symmetries

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Abstract. Symmetry and complexity both affect the aesthetic judgment of abstract patterns. However, although beauty tends to be associated with symmetry, there are indications that small asymmetries can also be beautiful. We investigated the influence of small deviations from symmetry on people's aesthetic liking for abstract patterns. Breaking symmetry not only decreased patterns' symmetry but also increased their complexity. While an increase of complexity normally results in a higher liking, we found that even a small decrease of symmetry has a strong effect, such that patterns with slightly broken symmetries were significantly less liked than fully symmetric ones.

Keywords: aesthetics, symmetry, broken symmetry, asymmetry, complexity, liking.

A number of factors, including symmetry and complexity, influence aesthetic evaluations (e.g. Berlyne, 1970; Leder, Belke, Oeberst, & Augustin, 2004). For abstract patterns, symmetry was considered the best predictor of aesthetic judgments, while complexity appeared to be the second-best (Jacobsen & Höfel, 2002; Tinio & Leder, 2009). However, there is a discussion, particularly regarding artworks, as to whether small asymmetries can also be experienced as beautiful (McManus, 2005; Silvia, 2006). Previous studies did not systematically explore such small deviations from symmetry, or could not avoid the confounding effects of the variation in complexity. We studied the effect of minor asymmetries on liking for abstract patterns. Liking comprises aesthetic judgments and aesthetic emotions (Leder et al., 2004; Leder, Augustin, & Belke, 2005) and allows for a broad range of responses (Silvia & Brown, 2007).

We created a new set of abstract black-and-white patterns using a simulated annealing stochastic optimization algorithm. The patterns are composed of 36 to 44 black triangular elements placed in an 8 × 8 rectangular grid on a white background. The number of objects (connected triangles) in each pattern varied from 1 to 10. Four types of symmetry were used: No symmetry (S00), one (S10, S01), two (S20, S02) and four symmetry axes (S22) (Figure 1). Furthermore, the patterns were randomly rotated by 0°, 90°, 180°, or 270°. Versions of each symmetric pattern with broken symmetry were created by perturbing the triangular elements within a randomly chosen 3 × 3 area of the 8 × 8 grid, while keeping the number of triangles and objects constant by applying the optimization algorithm to this area again without the symmetry constraint.

To select the stimulus set, in a pre-study, psychology students rated the visual complexity (five-point scale) of two different subsets of 288 patterns taken from a total set of 576 patterns (96 per symmetry type, containing full and broken symmetries). Each subset was rated by a different group of 48 (33 females, 15 males, median age: 23) and 64 (37 females, 27 males, median age: 25) participants. To control for the effects of complexity, mean complexity ratings were used to match patterns with slightly broken symmetries (BS) chosen from the full set of broken symmetric patterns and differing only in one moved triangle from full symmetry, with fully symmetric patterns (FS'). The fully symmetric (non-perturbed) patterns from which the stimuli of group BS derive were also included as stimulus group FS (Figure 2a). In order to conceal our interest in minor asymmetries, additionally

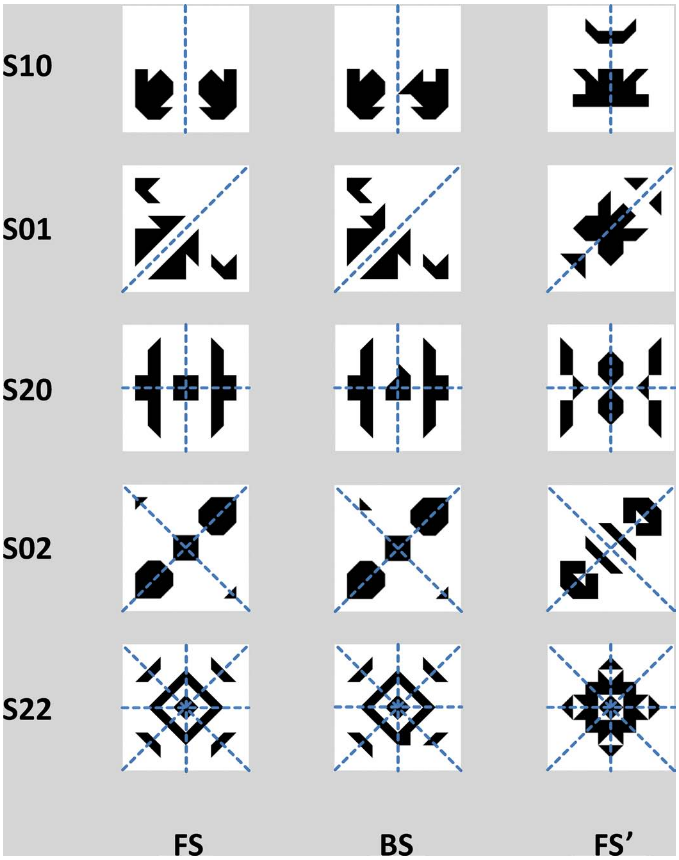

Figure 1. Example patterns by symmetry type (S10 to S22) vs. stimulus group (FS, BS, FS'). FS (Full Symmetry): fully symmetric patterns; BS (Broken Symmetry): patterns with broken symmetry generated from FS by moving one single triangular element; FS' (Full Symmetry'): fully symmetric patterns matched to BS by complexity.

50 broken symmetric patterns differing in more than one triangle from full symmetry (BS+) and 40 totally asymmetric patterns (AS) were included as distractors. The three stimulus groups FS, BS, and FS' consist of 10 patterns for each of the symmetry types S10, S01, S20, S02, and S22.

In the main experiment (after a short inspection phase showing all patterns), all 240 patterns were rated by 21 participants (students of psychology, 13 females, 8 males, median age: 24) on a seven-point scale (keyboard) for liking. The patterns were presented on a gray background in random order without time limit by the software E-Prime 2.0.8.90. The mean liking ratings of the different symmetry types and stimulus groups are shown in Figure 2b. All experiments were conducted in accordance with the Declaration of Helsinki and local guidelines.

We analyzed the liking ratings with a linear mixed effects model using R version 2.15.1 and the R package lme4. The categorical predictors stimulus group and symmetry type were treatment coded using FS and S10 as baseline categories and were included as fixed effects (as well as the interaction). One pattern had to be excluded from the analysis due to a misclassification. The random effects structure consisted of by-subject random intercepts and slopes for stimulus group and symmetry type, and by-stimulus random intercepts. The plot of residuals against fitted values was visually inspected to check for normality and homogeneity. All presented p-values were calculated using likelihood-ratio tests.

The effect of stimulus group BS ($Estimate = -0.67$, $SE = 0.28$, $t = -2.41$, $p = 0.004$) and the interaction of stimulus group FS' with symmetry type S22 ($Estimate = 1.06$, $SE = 0.35$, $t = 3.03$, $p = 0.001$) were significant. Specifically, the liking ratings for BS were significantly lower than for the baseline group FS. Except for symmetry type S10, these effects were large (Cohens $d > 0.8$). Since there were no significant interactions with symmetry type, this can be assumed for all symmetry types. And while there was no significant difference between the liking ratings for stimulus groups FS' vs. FS for baseline symmetry type S10, due to the significant interaction with S22, this changed for higher symmetries, where the liking was higher for stimulus group FS' than for FS.

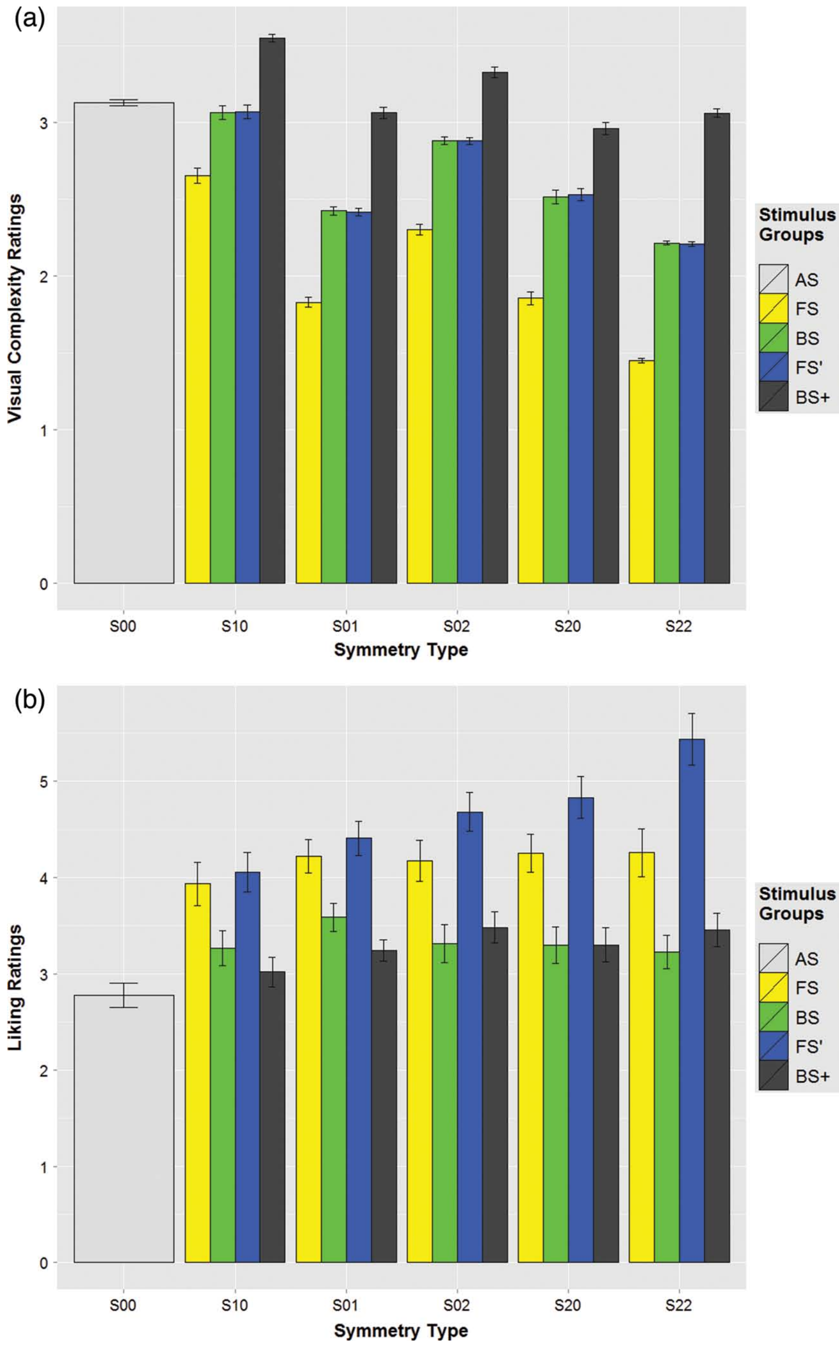

Figure 2. (a) Mean visual complexity ratings. Breaking the symmetry (FS→BS) increased the mean complexity. The matched stimulus groups BS and FS' show the same mean complexity. The whiskers show standard error of means after averaging over participants. (b) Mean liking ratings. Breaking the symmetry (FS→BS) decreased the mean liking. Keeping the symmetry constant while increasing the mean complexity (FS→FS') increased the mean liking. The whiskers show standard error of means after averaging over stimulus patterns. The distractor stimuli (AS and BS+) are also shown, but were not included in the analyses.

Breaking the symmetry of abstract patterns has two effects. First, it obviously reduces the symmetry. Second, it increases the perceived complexity (see Figure 2a). As a result, broken symmetry patterns were liked less (see Figure 2b). However, when the symmetry is kept constant (FS vs. FS'), then liking tends to increase—at least for higher symmetry types. In summary, increasing the complexity alone increases the liking. However, in combination with even a small decrease of symmetry, the symmetry effect dominates and the overall liking decreases. We can therefore confirm Jacobsen and Höfel's (2002) results showing that symmetry is indeed a stronger and more important factor of aesthetic appreciation than complexity. Moreover, even small deviations from symmetry can have drastic effects. Given that these results derive solely from abstract patterns without semantic content, it would also be interesting to investigate individual differences in preference for asymmetries, to use more "art-like" stimuli, and to test art experts for which even preferences for asymmetries might be assumed (e.g. Silvia, 2006).

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References

Berlyne, D. E. (1970). Novelty, complexity, and hedonic value. *Perception and Psychophysics, 8,* 279–286. doi:10.3758/BF03212593

Jacobsen, T., & Höfel, L. (2002). Aesthetic judgments of novel graphic patterns: Analyses of individual judgments. *Perceptual and Motor Skills, 95,* 755–766. doi:10.2466/PMS.95.7.755

Leder, H., Augustin, D., & Belke, B. (2005). Art and cognition! Consequences for experimental aesthetics. *Bulletin of Psychology and the Arts, 5*(2), 11–20.

Leder, H., Belke, B., Oeberst, A., & Augustin, D. (2004). A model of aesthetic appreciation and aesthetic judgments. *British Journal of Psychology, 95,* 489–508. doi:10.1348/0007126042369811

McManus, I. C. (2005). Symmetry and asymmetry in aesthetics and the arts. *European Review, 13*(Supp. No. 2), 157–180. doi:10.1017/S1062798705000736

Silvia, P. J. (2006). Artistic training and interest in visual art: Applying the appraisal model of aesthetic emotions. *Empirical Studies of the Arts, 24,* 139–161. doi:10.2190/DX8K-6WEA-6WPA-FM84

Silvia, P. J., & Brown, E. M. (2007). Anger, disgust, and the negative aesthetic emotions: Expanding an appraisal model of aesthetic experience. *Psychology of Aesthetics, Creativity, and the Arts, 1*, 100–106. doi:10.1037/1931-3896.1. 2.100

Tinio, P. P. L., & Leder, H. (2009). Just how stable are stable aesthetic features? Symmetry, complexity, and the jaws of massive familiarization. *Acta Psychologica, 130,* 241–250. doi:10.1016/j.actpsy.2009.01.001