1,001 SYMMETRICAL PATTERNS

A Complete Resource of Pattern Designs Created by Evolving Symmetrical Shapes

Jay Friedenberg and Jacob Roesch
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Visual symmetry in a broad sense refers to self-similarity. A pattern is symmetric if, after some operation, the pattern remains unchanged. There are three primary symmetry operations. A *translation* takes a pattern and simply moves it to a new location. We see the effect of translation in architecture, where columns repeat across the front of a building. In *reflection* a pattern is mirror-imaged or made bilateral with an axis defining the two opposite halves. Reflectional symmetry can be found in faces or bodies where one side corresponds to the other. Finally, there is *rotation*, where a pattern is spun about a point. Flower petals and wheel spokes are examples of rotational symmetry, since both are rotated about their centers.

Symmetry patterns are classified according to their dimensionality. A point or *finite symmetry* is a coherent single shape or object that is dimensionless because it is defined by its center. *One-dimensional symmetries* extend in a single direction only. Examples of these are decorative friezes or bands. There are a total of seven one-dimensional symmetry types, each defined by the number and kind of symmetry operation applied. *Two-dimensional symmetries* extend outward in two directions and can
completely cover a planar surface. There are seventeen of these, again
determined by the application of the number and kind of operation. Rugs and
wallpaper are examples.

Symmetry is ubiquitous in the natural and artifactual world. Bilateral
symmetry is found in biological organisms including most plants and animals,
but we also see it in many human-constructed forms such as cars, airplanes,
and furniture.\(^3\) It appears in the art of all human cultures, including weaving,
baskets, pottery, tapestries, textiles, embroidery, tiles, and jewelry.\(^4\) Many of
the plane symmetries can also be found as decorative art from around the
world. All seventeen two-dimensional symmetry patterns have been found in
the Alhambra.\(^5\)

What is the enduring appeal of symmetry, and why does it seem to be
regarded as universally aesthetic? There may be a biological basis. In psy-
chology experiments, faces with greater reflectional symmetry are rated
as more attractive.\(^6\) Some researchers argue that bilateral facial symmetry
signals resistance to parasitic infection because infections during develop-
ment disrupt the body’s normal symmetrical growth processes, and because
sexual selection of an immunocompetent partner would thus help to ensure
fit offspring.\(^7\) However, this hypothesis cannot account for the allure of trans-
lational and rotational symmetries.

The patterns in this book are all finite-point symmetries forming single
objects. The basis for each pattern is a motif that is translated, reflected, and
rotated to create a new version of the motif that is then aligned with or super-
imposed upon itself. The motifs can be geometric, as in the case of squares,
circles, and hexagons, or they can be representative of a shape such as a
mushroom, ice cream cone, or kite. A number of the motifs we utilize here
are inspired by existing designs from the history of decorative art and include
Egyptian, Greek, Roman, Arabic, Indian, Japanese, Chinese, and Celtic as well
as more modern computer-generated shapes.\(^8\)

*For footnotes, see page 206.*
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About the Authors

Jay Friedenberg is professor of psychology and chair of the psychology department at Manhattan College. He founded and directs the Cognitive Science Program at the college, whose mission is to educate undergraduates in and prepare them for graduate study in the cognitive sciences and allied fields. He also currently serves as department chairperson.

Friedenberg's research interests are in vision and he has published numerous articles on symmetry detection, center of mass estimation, and art perception. In addition to focused publications in the above-mentioned areas, he has written a number of books on cross-disciplinary topics.

Jacob Roesch is an artist, designer, and educator whose work spans across many disciplines, from fine oil painting to children's book illustration. His work has appeared in numerous shows including ORG: Reaping the White Walls at the Macy Gallery, Ground Zero at the Detroit Museum of New Art, AGAST at the Gowanus Art Center, and Selected Works at the Carrie Haddad Gallery in Hudson, New York. Roesch currently teaches graphic design and digital drawing at Manhattan College and continues to hone his painting and design skills. He resides in Connecticut with wife, Diana, and his dog, Fergus.
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