DIMENSIONAL HIERARCHY: A UNION OF FORM AND FUNCTION

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Introduction

Pattern is a relationship between entities [1]. *Form* is a relationship within an entity [1]. *Pattern formation* is thus an interdependent mix of an object and its context. Pattern formation must be based upon an underlying physical mechanism in order to account for the numerous examples of pattern formation found in nature [1]. A dimensional hierarchy is graphically represented in order to advance the understanding of pattern formation and its mechanism of action.

Experimental

Materials
A 3-dimensional Cartesian coordinate system
A graphic representation of cubic symmetry known as a geometric complementary code (GCC)

Apparatus and Procedures
A Cartesian coordinate system places an origin and 8 quadrants within a field of cubic symmetry. *Diametric opposites* can then be defined as a hybrid of Cartesian and symmetry definitions of opposites. Cartesian opposites have opposite positive and negative signs. Symmetry opposites are antipodal.

Results and Discussion

The GCC (Fig. 1) is a template for cubic symmetry. Cubes are color coded. Red and yellow cubes pair as complements as does blue and green. Complementary pairing implies the presence of non-complementary pairs. Blue and yellow is one such non-complementary pair as is the red and green pair.

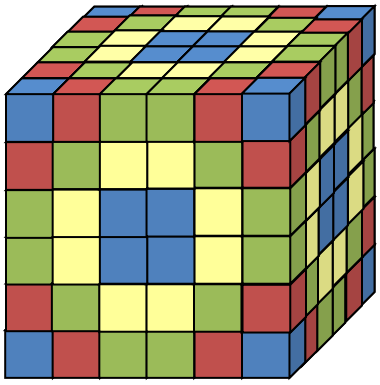

Fig. 1: A GCC template of cubic symmetry

Non-complementary pairing (NCP) generates a tangential gradient in 3-dimensions (Fig. 2) and courses parallel to the grid system in 3-dimensions. Complementary pairing (CP), however, is along a radial gradient coursing diagonally relative to the grid (Fig. 3). The tangential and radial gradients are orthogonal, independent and playing off each other in a two-way communication. Pattern formation's two-way communication mechanism has previously been theorized [2].

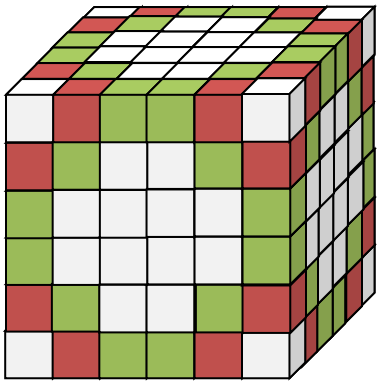

Fig. 2: Non-complementary pairing is tangential

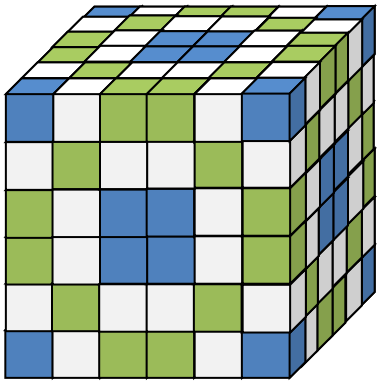

Fig. 3: Complementary pairing is radial

Cubic symmetry's dimensionality of tangential and radial is within a 3-dimensional Cartesian coordinate system. Axes X, Y, and Z intersect at the origin and generate 8 quadrants. Emerging from these relationships is a geometry of diametric opposites which is hierarchical. At the first level of the hierarchy, a pair of cubes is diametrically opposed when they are located in quadrants opposite in positive or negative signs for axes, X, Y, and Z *and* are equally distant from the origin (Fig.4).

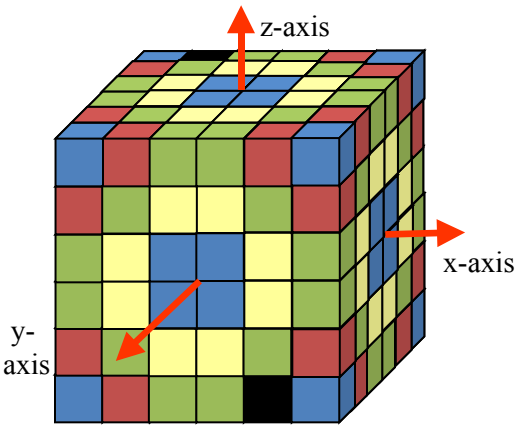

Fig. 4. The pair of black cubes is an example of diametric opposites

Extending the hierarchy, quadrants with opposite signs for axes X, Y, and Z are diametric opposites. Finally, NCP pairing of 4 quadrants defines one half of the GCC as a

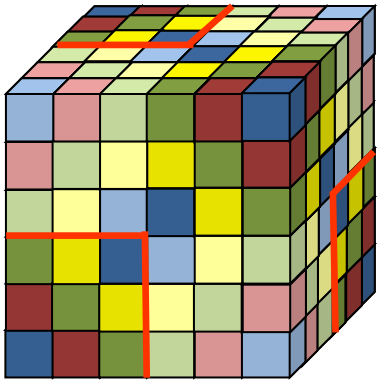

Fig. 5: Diametric opposites in aggregate are the relationship of one half of the GCC diametrically opposite to the other half.

diametric opposite to the other half, which is equal in composite but inverted (Fig.5).

Conclusion

Cubic symmetry's dimensionality of tangential and radial within Cartesian system is a hierarchy of diametric opposites. NCP takes the form of antipodes that are equal in makeup but inverted in relationship to each other. CP is the process of one inverted NCP form synchronized with the other across the field of cubic symmetry. For example, each half of the GCC is a tripod having rotational symmetry of order 3. However the pair of tripods is inverted in relationship and when synchronized as complementary pairs result in a hexagonal geometry with rotation symmetry of order 6. Diametric opposition is thus akin to vector algebra and may be aptly referred to as *vector geometry*. In vector geometry, antipodal opposites are synchronized along complementary diameters in order to generate a resultant whole. This whole is synchronized across scales for a symmetry that is internal as well as external.

References

1. Ball, P. In *The Self-Made Tapestry,* Oxford University Press, Oxford (1999) 1-15
2. Ben-Jacob, E.; Levine, H. *Nature,* **409** (2001) 985-986.