Conceptual Developments in the Analysis of Patterns
Part Two: The Application of the Principles of Symmetry

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Abstract
This paper reviews the more important literature concerned with pattern analysis, and appraises the application of the systematic classification system outlined in part one. It is apparent from the literature that when a representative selection of patterns from a given cultural setting is classified in terms of symmetry characteristics, a non-random distribution of symmetry preferences results, indicating that symmetry is a culturally sensitive parameter.

1. Introduction
Part one of this paper presented a summary of the more important geometrical concepts deemed to be of importance in the classification of motifs, border patterns and all-over patterns. The basic symmetry operations of translation, rotation, reflection and glide reflection were seen to combine to provide seven classes of border patterns and seventeen classes of all-over patterns. Flow diagrams to aid identification of a pattern’s symmetry class were provided. The objective of the second part of the paper is to present an appraisal of symmetry classification as an analytical tool in the analysis of patterns from different cultural settings and historical periods.

Although it has long been recognised that geometry plays an important role in the underlying structure of pattern, this recognition has generally manifested itself in practice rather than theory. On a few occasions where an identification of the geometrical principles governing patterns was evident in the design literature of the late 1800s and early 1900s, this was often from the perspective of pattern synthesis (i.e. the construction of patterns) rather than from the perspective of pattern analysis (i.e. the determination of the source, function, symbolism or other cultural parameters as well as structure). The majority of design publications were thus aimed at the design practitioner and not the design analyst. Meyer, for example, in the introduction to his handbook, stated his intentions when he declared that his handbook was:
“... based on a system which is synthetic rather than analytic and intended more to construct and develop...than to dissect and deduce” (Meyer, 1894).

It is none the less interesting to note that Meyer grouped designs according to their spatial characteristics into ribbon-like bands, enclosed spaces or unlimited flat patterns corresponding to border patterns, motifs and all-over patterns respectively (Meyer, 1894, p3). In addition, Meyer recognised that the foundation of every form of all-over pattern was a “...certain division, a subsidiary construction or a network” (Meyer, 1894, p3). He thus anticipated the use of the term nets (used for example by Woods, part 1, 1935) to refer to the skeletal grids (or lattices) underlying the structure of all-over patterns, a phenomenon explained elsewhere (see for example Hann and Thomson).

Although not adopting the terminology and theoretical perspectives being developed by crystallographers at the time, certain late nineteenth and early twentieth century observers none the less exhibited an astute awareness of the underlying geometrical principles fundamental to the construction of all-over patterns. Other non-mathematical sources acknowledged the importance of grid structures in the construction of patterns. Stephenson and Suddards (1897, chps. 2-5), for example, in their appraisal of the geometry of Jacquard woven patterns, illustrated patterns with constructions based on rectangular, rhombic, hexagonal and square lattices. Similarly, Day (1903, chps 2-6) placed much emphasis on the geometrical basis of all two-dimensional design and illustrated the construction of all-over patterns on square, parallelogram, rhombic and hexagonal type lattices. In 1910, Christie (1969 ed., chp.9) rationalised all-over patterns, including many textile patterns, into two main types: those which were comprised of isolated units (spot-like effects, where the background totally surrounds each individual motif) and those which were comprised of continuous units (where motifs are repeated to form a continuous mass). Through further sub-division, Christie (1969 ed, p59) gave numerous examples of how all-over patterns could be developed by the practitioner. Christie’s work is of importance for it represents a first stage in the categorisation of patterns for the purpose of both analysis and synthesis, by reference to their geometrical structures. As indicated in the Introduction to part one of this paper, another perspective of pattern analysis and classification evolved: the consideration of patterns by reference to their symmetry characteristics, a perspective which has its origin in the scientific investigation of crystals.

3. The Development of Symmetry as an Analytical Tool

In order that the study of surface decoration can be conducted systematically, the use of explicitly defined units would appear to be a necessary pre-requisite. Precise tools of classification enable hypothesis formation and theory testing. Symmetry classification, as outlined in part one of this paper, is such a tool.

Brainerd (1942) was seemingly the first archaeological investigator to use symmetry classification as an analytical tool and, in so doing, provided a penetrating insight into its potential value in cross-cultural analysis and comparisons of decorated objects. Using prehistoric pottery as a data source of motifs and patterns, Brainerd conducted an analysis of the symmetry characteristics exhibited by fragments from two distinct archaeological sites. Two principal observations resulted from his study. First, Brainerd found that different types of symmetry predominated in each of the two groups of pottery, and that symmetry exhibited by one group of designs was more diverse than that exhibited by the other group of designs. In retrospect, these findings may not seem to be startling, but the method of obtaining data (i.e. through recording the symmetry characteristics of a given group of designs) demonstrated that an objective comparison could be made between designs originating from different cultural settings. Second, Brainerd implied that within a given cultural setting there will be a preferred symmetry or symmetries used to decorate objects and while such symmetry arrangements may not necessarily be named or even recognised consciously by the people using them, they will none the less be followed exactly.

Although Brainerd’s work was published in 1942, in one of the most popular North American archaeological journals,
A more widespread acceptance of symmetry classification was not forthcoming for several decades. Exceptions include Muller's study of symmetry in the tiling patterns of the Alhambra Palace, in Granada, Spain (Muller, 1944). Shepard (1948) explored the potential of symmetry as an analytical tool to the archaeologist and illustrated different classes of motifs and border patterns with examples from the American Southwest. She outlined the nature of a variety of problems (e.g. faulty draughtsmanship or the combination of different symmetries in complex designs) which may be encountered by the analyst and highlighted the tendency for certain symmetries to predominate within a given cultural context. In addition she remarked on how cultural change (brought about particularly by the adoption of cultural traits from another culture) may be pinpointed by symmetry analysis, subject to the availability of a representative time series of data. Subsequent to these pioneering studies, a number of investigators set out to classify and compare patterns on decorated objects from specific cultural settings. The work of Crowe (1971, 1975, and 1982), Zaslow and Dittert (1977), the Aschers (1981), Van Esterik (1979), Kent (1983), Washburn (1977, 1983, and 1986), Campbell (1989) and Hann (1992) are of importance in advancing the subject.

An important result from much of the empirical literature listed above is that when a representative sample of patterns from a defined cultural context or historical period is classified by reference to symmetry characteristics, a non-random distribution of symmetry classes results. This non-randomness is of fundamental significance to anthropologists, archaeologists and design historians for it demonstrates that design structure, assessed in terms of symmetry characteristics, is in some way cultural sensitive and as such may prove of use as an indicator of cultural adherence, continuity and change.

4. An Appraisal of the Potential of Symmetry Classification

For many years anthropologists have focused upon understanding culture as a series of inter-related subsystems bound together by a series of organisational rules (e.g. laws, values, attitudes and habits) developed by participants in order that their society can be maintained and perpetuated. Typical examples of subsystems include the economy, religious practices, language, music and the decorative arts. Observers have maintained that the conception, execution and function of the decorative arts of any culture can be considered to be as integral to the growth and maintenance of that culture as any other subsystem (Washburn, 1977, p5). Following from this, it appears that much of the relevant anthropological literature assumes firstly that the same organisational rules permeate through the many subsystems of a given culture; second, that these organisational rules are some how manifested in the structural characteristics of the culture's decorative arts; third, that continuities and/or changes in any one subsystem are reflected in all other subsystems (including the decorative arts) due to changes in the organisational rules applicable to the culture in general. Based on these assumptions, a number of investigators have attempted to relate the structural characteristics (but not the full spectrum of symmetry characteristics) of the decorative arts with other aspects of culture. A selection of these is identified below.

Adams (1973) attempted to relate the organisational principles of Sumba textile design to certain other activities such as marriage exchange, ritualistic practices, and structure of ceremonial language. A study by El-Said and Parman (1976) attempted to relate the geometry of Islamic tilings to aspects of Islamic cosmology. Kaeppler (1978) found structural relationships between Tongan music and bark cloth design and maintained that these were manifestations of wider societal characteristics. Arnold (1983), in a study conducted among the residents of Quinua (Peru), found a relationship between decoration on textiles and the principles governing the spatial organisation expressed in ritual and religion. While these studies may well be worthwhile in their own right, in that they have contributed to advances in the understanding of specific cultures, it should be stressed, however, that clearly defined rules of universally applicable methodology have failed to emerge. In addition, the relationship between the decorative arts and other subsystems never seems to be specified in a
way which can lend itself to general application in cultures other than that which was the focus of attention in the relevant study.

The apparent importance of the decorative arts as an integral component of all cultures should not, however, be underestimated. This was recognised by Alland for example, when he stated that the art of any society is, “...an emotionally charged and culturally centred storage device for complex sets of conscious and unconscious information” (Alland, 1977, p41). In order to gain access to the information contained therein, Washburn argued convincingly that it was necessary to identify a universal parameter, fundamental to all decorative art forms in all societies, (Washburn, 1977, p.3). Symmetry classification is a systematic and reproducible analytical procedure which relies on the use of standardised units of measurement of a parameter which is fundamental to all decorative art forms. As such, it would appear to offer the facility for advancing the understanding of the decorative arts, either in general or else with specific reference to a given culture, medium or time period. The work of Washburn and Crowe is of significance in this regard. Symmetries of Culture should be recognised as an essential preparatory text to researchers intent on exploring further the universality of symmetry in a cultural context.

5. In Conclusion
This paper has debated the potential of symmetry classification as an analytical tool to aid the understanding of pattern and its cultural significance. The fact that different cultural settings appear to show different symmetry preferences is of importance. Also, non-random distributions of symmetry classes, from culture to culture, indicate that symmetry classification is capable of isolating and pinpointing an attribute which is culturally sensitive. The consideration of symmetry preferences may thus offer the key to discovering the precise relationship between the decorative arts and other subsystems as well as the nature of cultural change itself.
References


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