

# One-color Frieze Patterns in Friendship Bracelets: A Cross-Cultural Comparison

Lorelei Koss

Department of Mathematics and Computer Science, Dickinson College; koss@dickinson.edu

## Abstract

In this paper, we investigate symmetry preferences in an emerging craft of a global online community, that of the *friendship bracelet*. We compare the frequencies of the seven frieze patterns from a sample of friendship bracelet patterns found in the online global database *Braceletbook* with previous studies of frieze pattern frequencies from eleven studies of decorative arts created by artists of different cultures.

Many cultures have incorporated *frieze patterns*, designs that repeat in one dimension, into decorative arts. Washburn and Crowe [17] give an extensive history of studies that demonstrate that cultural groups exhibit a strong preference for specific frieze patterns. Many studies of this type simply indicate which symmetry type is most prevalent in a collection without giving complete data; for example, Shepard classified 61% of the bands on Mesa Verde Black-on-White pottery as  $p112$  [16], and Lekka and Dascalopoulos found 65% of a sample of frieze patterns of Greek woven textiles belonged to the  $pmm2$  class [14]. Readers interested in learning the details of this history as well as viewing examples from a wide variety of cultures can read more in Washburn and Crowe's book; we use the naming conventions described in the book for the seven one-color frieze symmetries discussed here.



**Figure 1:** Friendship bracelets classified by one-color frieze symmetry patterns. From top to bottom,  $pma2$ ,  $p1a1$ ,  $pm11$ ,  $p112$ ,  $pmm2$ ,  $p1m1$ ,  $p111$

In this paper, we investigate symmetry preferences in an emerging craft of a global online community, that of the *friendship bracelet*. Friendship bracelets are a type of macrame typically knotted out of embroidery

floss; bracelets of each of the seven one-color frieze symmetry patterns appear in Figure 1. The history of friendship bracelets is unclear. Although there does not seem to be peer reviewed research available, many popular press articles speculate that friendship bracelets originated in Guatemala in the 1960s and then spread worldwide. While the designs and coloring of friendship bracelets from the early period have patterns similar to those seen in indigenous Mayan cultures, the method of constructing a friendship bracelet does not seem to be related to any traditional crafts [8]. Online databases of friendship bracelets first appeared in 2009.

In an online website and database called *Braceletbook*, started in 2010 [13], users design friendship bracelet patterns and submit them for consideration to be part of the collection. Although the thumbnail images on the website often show only a portion of the pattern, design requirements in the application require every friendship bracelet in this collection to be a frieze pattern. The full collection consists of over 7500 designs. Artists participating in this venture form a global community, with people from all 6 inhabited continents submitting designs and over 140,000 registered users. An analysis of all two-color normal friendship bracelets constructed from 9, 10, 11, 12, or 13 strings in the *Braceletbook* database appears in [2]. Here, we focus on uncolored patterns from the data collected to compare the specific percentage breakdown of frieze symmetries found in friendship bracelets to previous studies on other cultural artifacts. We restrict our attention to other investigations that examine a significant number of samples and which give details about all data collected. The selection of comparison studies used is not exhaustive, but it is extensive, representing a broad collection of cultures across a breadth of historical time periods using a variety of artistic mediums.

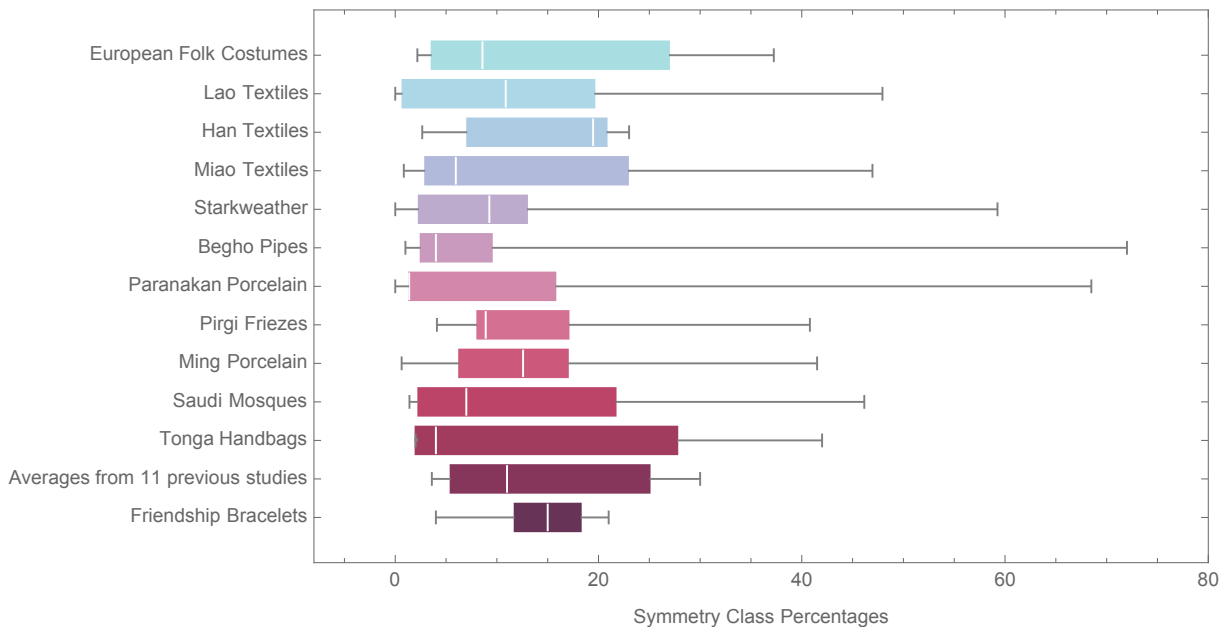
We compared data collected from 481 friendship bracelet designs on *Braceletbook* to eleven studies.

1. James D., James A., and Root analyzed design elements on 9,101 European folk costumes from 73 cultures dating from 1870–1910. [11, 12]
2. Chidtavong studied frieze symmetries on 874 traditional and contemporary textiles from Laos. [4]
3. Hann investigated 113 patterns on traditional Han textiles in China. [7]
4. Hann analyzed traditional patterns that appeared on 1,544 Miao textiles in China. [7]
5. Campbell examined 54 pieces of prehistoric pueblo pottery from Starkweather in New Mexico, USA. [3]
6. Crowe studied patterns carved on 230 tobacco pipes excavated in Begho, Ghana. [5]
7. Aslaksen and Poh investigated 73 enameled Peranakan porcelains from the 19th and 20th century in Malaysia, Indonesia and Singapore. [1]
8. James D., James A., and Kalisperis studied 417 ornamental plasterwork friezes on facades in Pirgí, Greece. [9, 10]
9. Aslaksen and Poh analyzed 159 frieze patterns on Chinese Yuan and Ming blue and white porcelain dating from the 14th to the 17th century. [1]
10. Salman analyzed 143 frieze patterns in iron, stone, mosaic, marble, and color painting decorations in the Al Madina Mosque in Saudi Arabia. [15]
11. Gerdes studied plaited patterns on 57 Tonga handbags in Mozambique. [6]

Table 1 shows the percentage breakdown between each symmetry class for friendship bracelets and the 11 comparison studies. The second to last row in the table gives the averages of the percentages of the 11 previous studies for each symmetry class, and the last row shows the percentages of symmetry patterns in friendship bracelets. Figure 2 gives box-and-whisker plots of all of the relevant studies where just the seven percentage values shown in each row in Table 1 are used as data. Analyzing these percentage values removes information about the specific frieze classifications and focuses instead on how preferences spread across the seven symmetry types. We have chosen to extend the whiskers to the maximum and minimum values instead

**Table 1:** Percentages of artifacts found in each frieze symmetry class

Artifacts	$pmm2$	$pm11$	$pma2$	$p112$	$p1m1$	$p111$	$p1a1$
European Folk Costumes	37	32	12	5	3	9	2
Lao Textiles	48	20	0	2	19	11	0
Han Textiles	21	23	19	7	3	19	7
Miao Textiles	47	13	26	6	1	4	2
Starkweather Pueblo Pottery	4	13	9	59	2	13	0
Begho Pipes	72	10	4	8	4	2	1
Paranakan Porcelain	1	68	1	10	0	18	1
Pirgí Friezes	41	19	8	11	9	4	9
Ming Porcelain	6	42	8	13	1	18	13
Saudi Arabia Mosques	23	46	1	2	7	17	3
Tonga Handbags	21	42	4	2	2	30	2
Averages from 11 previous studies	29	30	8	11	5	13	4
Friendship Bracelets	21	16	11	14	15	19	4


**Figure 2:** Distributions of the percentage of occurrence of the seven frieze symmetries in artifacts from different cultures

of labelling outliers. These boxplots are, on one hand, a crude tool given that there are only 7 symmetry classes, but they do help visualize differences in the distributions of the strength of symmetry preferences in the studies under investigation. In particular, Figure 2 shows that friendship bracelets have the smallest spread and the smallest interquartile range. Friendship bracelets also have the smallest maximum at 21%.

The *Braceletbook* community, unlike the overwhelming majority of cultures studied, does not express a strong preference for a particular type of symmetry. Only one symmetry type,  $p1a1$ , is significantly less represented in the collection, and it is the only class representing less than 10% of the full collection. While  $p1a1$  is not the least represented symmetry type in every culture (see [1, 7, 9, 10], for example), the author was unable to find any cultures for which  $p1a1$  is the preferred symmetry type.

Our evidence indicates that there is not, at this time and for the specific craft of friendship bracelets, a global preference for a particular type of frieze symmetry. We hypothesize that users are creating designs based on symmetry preferences of their local culture, and thus the designs that appear on *Braceletbook* might

be viewed more as an average of local symmetry preferences. Our conclusion, of course, is based on a very early examination of these particular cultural artifacts, as the online database is only 11 years old. The concept of a global online culture is relatively new, and it would be interesting to perform a similar study of frieze patterns in friendship bracelets in the future to see if changes occur and preferences begin to coalesce around a certain symmetry type.

## References

- [1] H. Aslaksen and K. Poh. "Frieze Patterns on Ming Porcelains." *NUROP Congress Paper Symmetry Groups in Arts and Architecture*, Singapore, 2002, pp. 1–101.
- [2] K. Beck and L. Koss. "Symmetries of Online Culture: Two-color Frieze Patterns in Friendship Bracelets." *Symmetry: Culture and Science*, vol. 32, no. 1, 2021, pp. 91–102.
- [3] P. J. Campbell. "The Geometry of Decoration on Prehistoric Pueblo Pottery from Starkweather Ruin." *Computers Math. Applic.*, vol. 17, no. 4-6, 1989, pp. 731–749.
- [4] L. Chidtavong. "Analysis, Modeling and Generation of Traditional Lao Woven Textile (Doctoral dissertation)." 2016. <http://www.ub.uni-heidelberg.de/archiv/20605>
- [5] D. W. Crowe. "The Geometry of African Art III. The Smoking Pipes of Begho." In *The Geometric Vein*, Springer, New York, NY, 1981.
- [6] P. Gerdes. "Plaited Strip Patterns on Tonga Handbags in Inhambane (Mozambique)—An Update." *Visual Mathematics*, vol. 12, no. 17, 2003. <http://www.mi.sanu.ac.rs/vismath/gerdtonga/index.html>
- [7] M. A. Hann. "The Fundamentals of Pattern Structure: Part III: The Use of Symmetry Classification as an Analytical Tool." *Journal of the Textile Institute*, vol. 94, no. 1–2, 2003, pp. 81–88.
- [8] J. Hevrdejs. "Armed and Friendly." *Chicago Tribune*, Feb.7, 1990.
- [9] D. James, L. N. Kalisperis, and A. V. James. "The Mathematics of Color-Reversing Decorative Friezes: Facades of Pirgí, Greece." *Bridges Conference Proceedings*, Granada, Spain, July 23–25, 2003, pp. 135–142. <http://archive.bridgesmathart.org/2003/bridges2003-135.html>
- [10] A. V. James, D. A. James, and L. N. Kalisperis. "A Unique Art Form: The Friezes of Pirgí." *Leonardo*, vol. 37, no. 3, 2004, pp. 234–242.
- [11] D. A. James, A. V. James, and M. J. Root. "Symmetry in European Folk Costumes." Deep Blue, University of Michigan, 2017. <https://hdl.handle.net/2027.42/136161>. Excel spreadsheet and Access database: [www.dx.doi.org/10.7302/Z2HD7SKC](http://www.dx.doi.org/10.7302/Z2HD7SKC)
- [12] D. A. James and A. V. James. "Symmetry in European Regional Folk Dress: A Multidisciplinary Analysis." *Leonardo*, vol. 53, no. 2, 2020, pp. 157–166.
- [13] J. Kleň. *Braceletbook*. 2010. <https://www.braceletbook.com>
- [14] L. Lekka and S. Dascalopoulos. "Motifs and Symmetry Characteristics of the Ornamentation on Traditional Greek Woven Textiles from the Area of the Aegean." *Fibres and Textiles in Eastern Europe*, vol. 16, no. 3, 2008, pp. 74–78.
- [15] A. Salman. "Interaction Relationship between Symmetry and Arts in the Kingdom of Saudi Arabia." *International Journal of Computer Science Issues*, vol. 10, no. 6, 2013, pp. 32–41.
- [16] A. O. Shepard. *The Symmetry of Abstract Design with Special Reference to Ceramic Decoration*. Carnegie Institution of Washington, 1948.
- [17] D. K. Washburn and D. W. Crowe. *Symmetries of Culture: Theory and Practice of Plane Pattern Analysis*. University of Washington Press, 1988.