Towards ground truth in geometric textures

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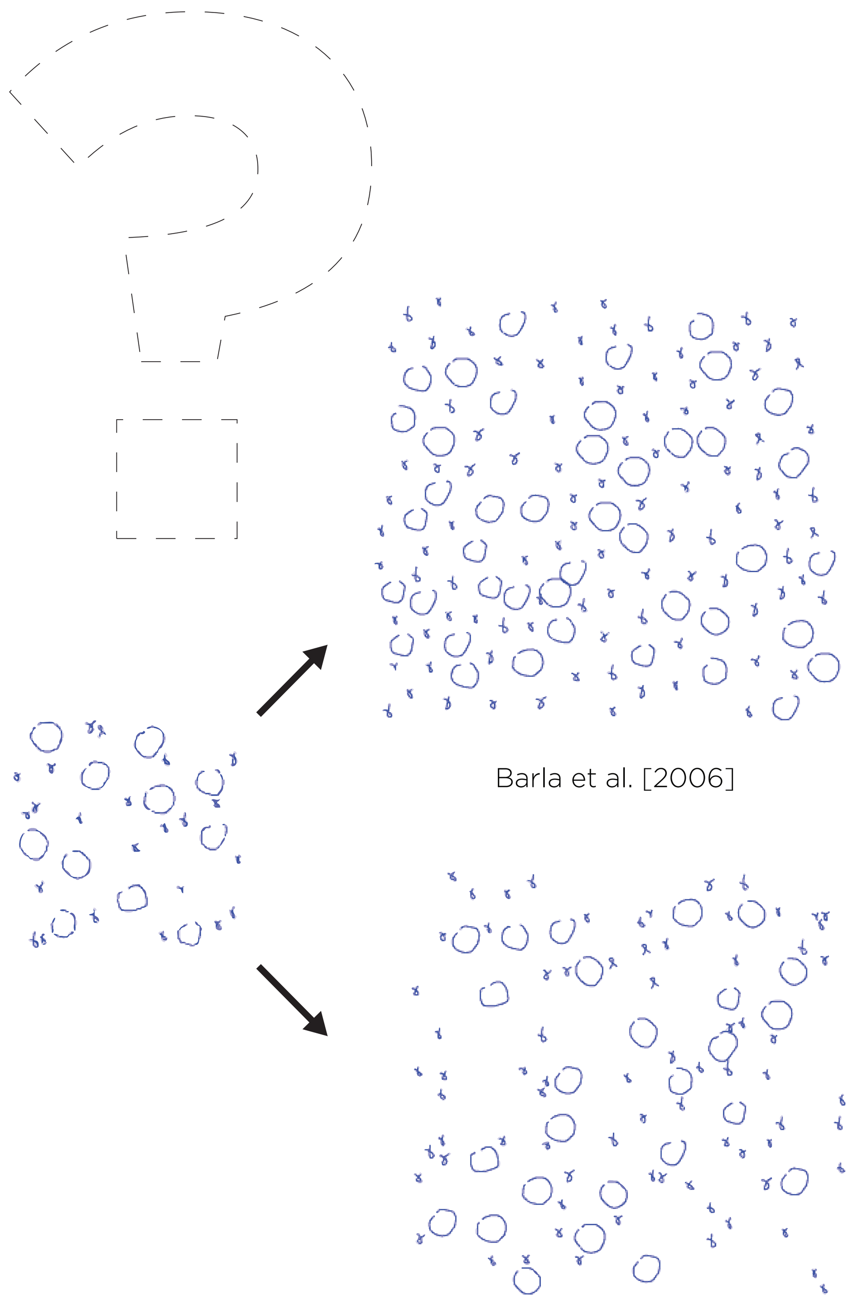

Barla et al. [2006]

Hurtut et al. [2009]

Our Goal

To emphasize the importance of visual preferences in the process of deciding geometric texture similarity. This work will further offer insight for future texture synthesis algorithms.

Our idea

The initial idea is to develop a viable evaluation that measures similarity between sample arrangements and synthesis results. Inspired by the work of Liu et al. [1]

Our approach

To identify important global and local visual aspects of arrangements, and then verifying that similar factors are used to compare synthesized and sample arrangements.

We structure our inquiry around two user studies.

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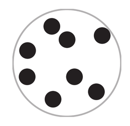
Study #1

The goal is to acquire and analyze human-generated 2D geometric arrangements. Study inquiries include:

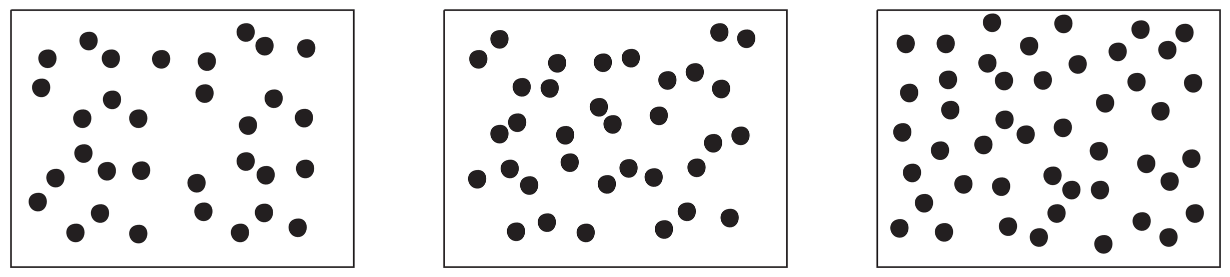
- How do participants synthesize larger arrangements from a given small sample?
- How do participants to evaluate their success at generating the larger arrangement?

Observations

Stimulus

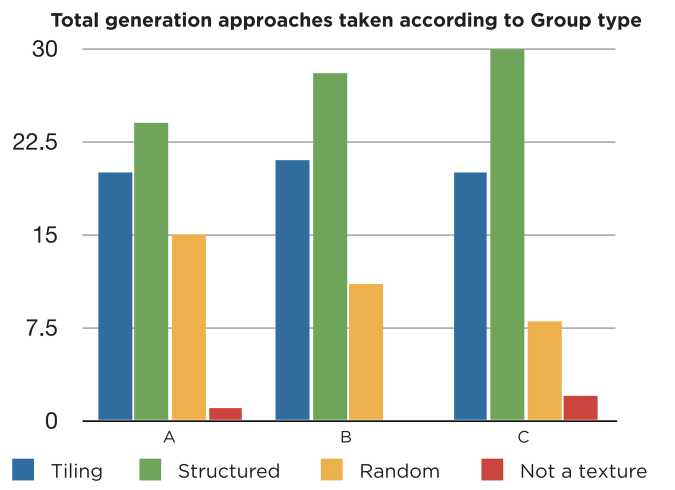


Approach	# Participants
Tiling only	3
Structured only	2
Random only	0
Tiling and random	1
Tiling and structured	2
Structured and random	5
Tiling, structured and random	7
	20

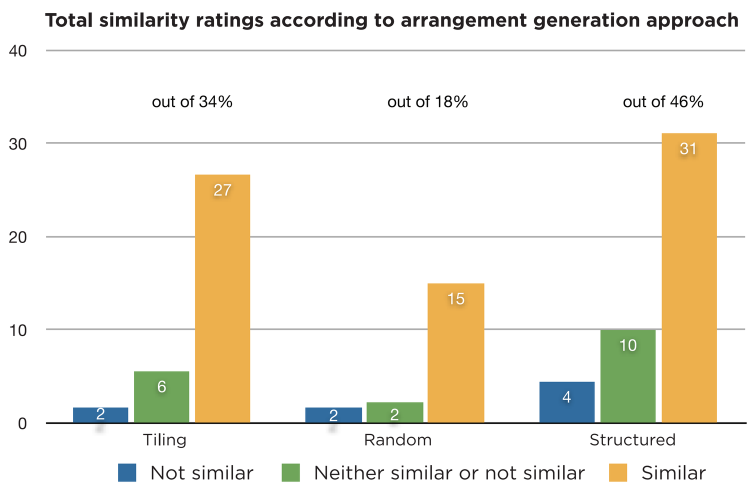


Tiling approach (P5) Structured approach (P14) Random approach (P15)

- Three generative strategies (Tiling, Structured, and Random)



Participants' strategies for generating arrangements depend on the complexity of the images.

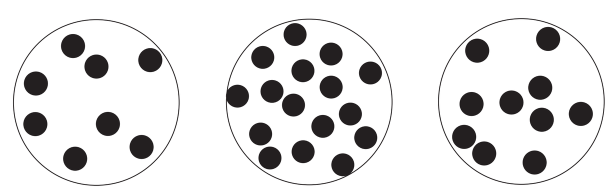


Regardless of the generation approach we find that the majority of arrangements resulted in high similarity ranks.

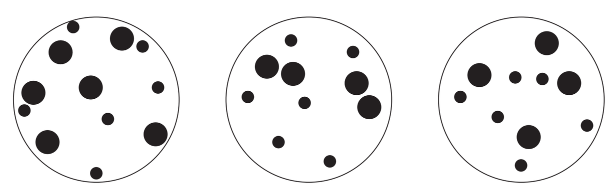
- Dominant visual properties for geometric arrangements

Irregular 2D geometric arrangements

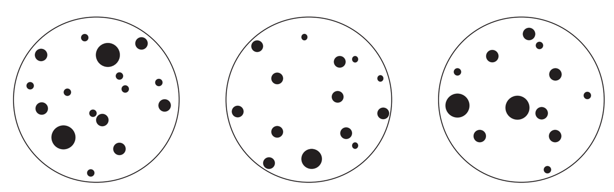
Group A



Group B



Group C



These images were all pseudo-randomly generated.

Visual factors used by participants when generating and comparing similarity of 2D arrangements

density	low high
clustering	pairs groups
frequency / sizes	number of elements number of different sized elements ratio of element sizes
overall pattern	discernible or not periodicity space filling
copied samples	number of copied stimuli accuracy of copied samples
distances	exact/approximate to stimulus not like sample
white space	amount
distribution type	regular / tiled irregular / random homogeneous
shape(s)	detectable/undetectable
sampling	impose circular boundary on image
symmetry	noticeable or not

Study #2

The goal is to examine how participants evaluate the similarity of human- and computer-generated geometric arrangements to given samples.

Quantitative analysis of collected similarity ranks

Measure of similarity in order of strength:

1) Spatial structures formed through multiple instances of stimulus patches
2) Identification of themes
3) Overall comparison using Mathematical attributes.

Conclusion

Our research provides a firm perceptual foundation from which future researchers can develop and subsequently assess the success of new algorithms. In this work we identify:

- important visual cues used by people when generating and/or comparing similarity of geometric arrangements.
- a set of strategies adopted by participants when generating arrangements.

Future work

- Develop benchmark samples for evaluating the effectiveness of new synthesis algorithms.
- Evaluating the effectiveness of existing Geometric texture synthesis algorithms (i.e., Barla et al. [2], Ijiri et al. [3], and Hurtut et al. [4]).
- Look for commonalties that exist between different texture styles (regular to irregular).

[1] LIN, W.-C., HAYS, J., WU, C., LIU, Y., AND KWATRA, V. 2006.Quantitative evaluation of near regular texture synthesis algorithms. Computer Vision and Pattern Recognition, IEEE Computer Society Conference on 1, 427–434.

[2] BARLA, P., BRESLAV, S., THOLLOT, J., SILLION, F. X., AND MARKOSIAN, L. 2006. Stroke Pattern Analysis

[3] IJIRI, T., MĚCH, R., IGARASHI, T., AND MILLER, G. 2008.An example-based procedural system for element arrangement. Comput. Graph. Forum 27, 2, 429–436.

[4] HURTUT, T., LANDES, P.-E., THOLLOT, J., GOUSSEAU, Y., DROUILLHET, R., AND COEURJOLLY, J. F. 2009. Appearance-guided synthesis of element arrangements by example. In NPAR'09: Proceedings of the 7th International Symposium on Non-Photorealistic Animation and Rendering, ACM, New York, NY, USA, 51–60.