# Patterns at the Edge: Strategies of Looking at Nonrepresentational Art

Dorothy K. Washburn (103201.2114@compuserve.com)
Liberal Arts Division, The Maryland Institute, College of Art 1300 Mount Royal Ave.
Baltimore, Maryland 21217 USA

### Abstract

Practicing artists, art students, and non artists were asked to respond to six different two-dimensional infinite patterns which they viewed via a new methodology that presents the stimuli as iterating dots on a computer screen. As evidenced in the drawings they made, most viewers searched for shapes with clearly defined edges in the "negative" background space, rather than for shapes as defined by clusters of dots. The process of shape definition using the figure/ground distinction and the issue that past experience influences our perceptions are discussed.

## Introduction

Research has shown that the process of perceiving shape at the preattentive level focuses on such basic features as line, angle, curvature, and brightness contrast. At the cognitive level, the focus is on object identity through comparison of the specific arrangement of these features to knowledge stored in memory (Triesman, 1986). Conventional wisdom imputes that the cognitive translation from what is seen to what one thinks one has seen is interlaced with influences from "cultural" factors (cf. Hochberg, 1978). Nodine, Locher & Krupinsky (1993) have, for example, shown that knowledge and expertise influence how individuals look at images. From examination of eye movement scans of viewers looking at representational art images, they concluded that artists examine compositional features while nonartists focus on specific items of content. But, although such eye scan studies capture what individuals look at, we need to know more about the process of seeing.

This paper reports a new method which explores how viewers with a range of art training respond to patterns presented 1) in-the-process-of becoming-a-pattern, rather than a fully formed pattern, thereby facilitating recovery of the amount and kind of information which viewers use to determine that they have seen a pattern, and 2) asking the viewers to make a sketch of the pattern they see.

It is arguable whether the best presentation of geometric pattern should be as continuous line or in a dotted format as used in this research. Uttal (1987) has noted that, while conclusions about form detection of dot stimuli perhaps should be limited to forms in that format, the use of dot stimuli is justified if the research is concerned with preattentive visual processing because it facilitates focus on whole forms/shapes rather than local features.

The hypothesis was that if experience and particular knowledge affect recognition, then viewers with particular visual training, such as artists who have had extensive training in the perception and manipulation of form and color, would, in comparison to those with no art training 1) more often correctly identify the patterns being generated and 2), use a distinctive recognition strategy honed by years of practice and experience in making and viewing art.

### Participants

Forty nine participants from the Maryland Institute, College of Art, Baltimore, Maryland: 12 faculty artists (10M, 2F; age range 32-62 yrs.); 13 staff with no art training (8 F, 5M; age range 24-63 yrs.); and 24 junior, senior, and graduate art students (11F, 13M; age range 18-39 yrs.).

### Stimuli

Six different two-dimensional infinite patterns (*cm, pgg, pmg, p3, p4g,* and *p4m*) (Figure 1) (see Washburn & Crowe, 1988 for description of plane patterns and their crystallographic nomenclatures) were generated on a computer screen using a program written by Field and Golubitsky (1992). The patterns developed as clusters of white dots on a black screen (although for clarity, the images were printed for this paper as black dots on a white background).

### Procedure

Individual respondents, seated in front of a computer monitor, viewed sequentially the six patterns as they iterated from an array of random dots to a fully formed pattern. With each iteration, the dot density increased. Respondents were instructed to hit the pause key during the iterating sequence when they discerned a pattern (that is, a regularly repeating array) and then to sketch what they saw. A screen dump printout of each paused image was made for reference.

## Results

There was a statistically significant difference in correct pattern identification ($\chi^2 = 51.3$ with 5 df); pattern *p4g* was the most difficult to discern while *pmg* and *p4m* were the easiest to detect.

Regardless of experience, respondents followed two strategies when discerning patterns from the dot arrays:

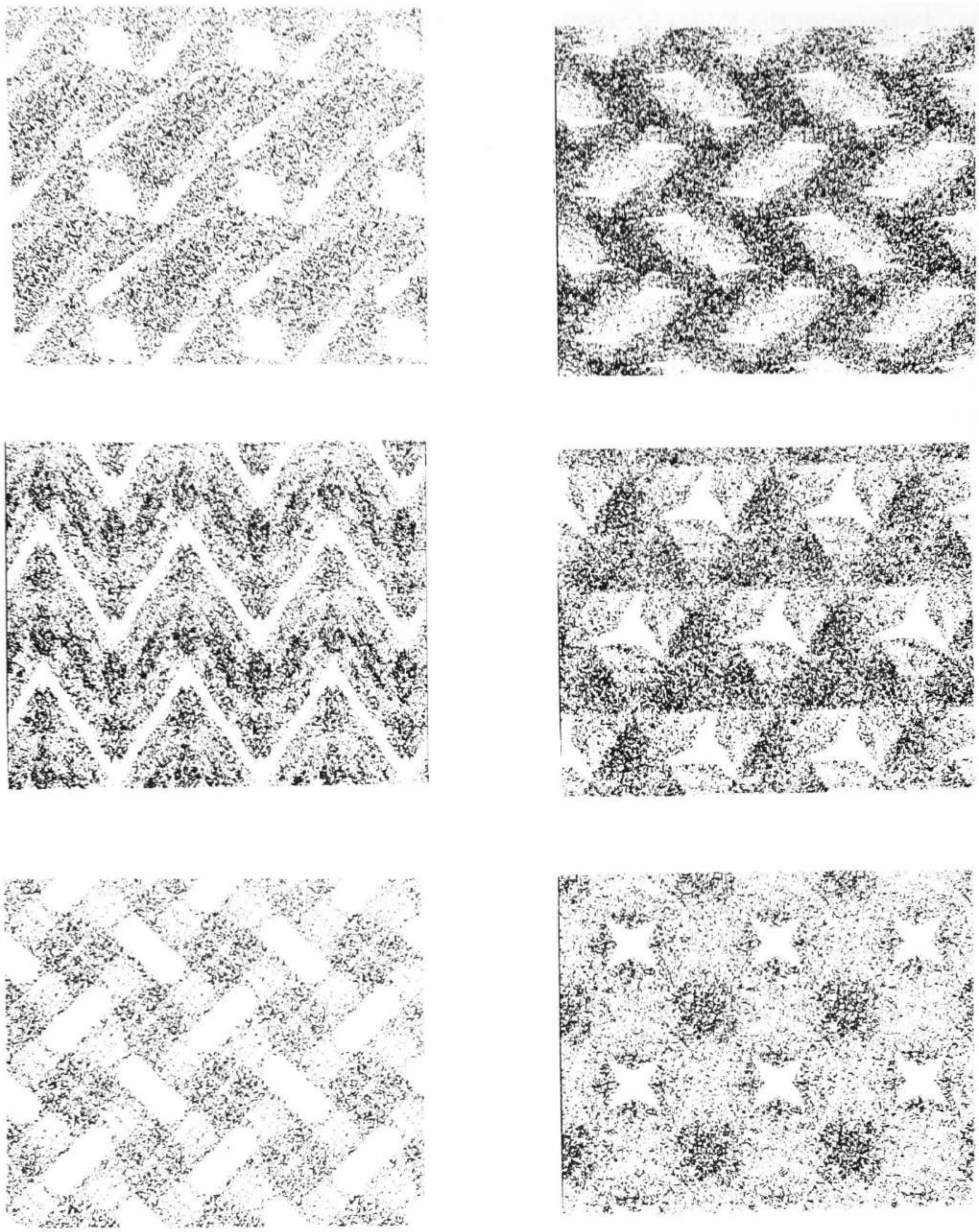

Figure 1: (top to bottom) *cm, pmg, p4g* (top to bottom) *pgg, p3, p4m*

patterns were defined in the negative space or they were seen as formed by dot groupings. Surprisingly, only 30% of the responses indicated that the viewers saw pattern in the positive, that is, in clusters of regularly repeated dots. Rather, 70% of the responses showed that the viewers focused on the negative space between the dot clusters. Most individuals think of this space as space that performs a secondary, supportive role, and, indeed, use linguistic terms which imply this function, such as "negative" and "background." Nevertheless, viewers used the sharp and clear edges between the dots and the empty background as the line boundary for a shape. This viewing strategy, which will be called the negative strategy in this paper, was clearly indicated in the sketches where viewers drew the negative space as the pattern (Figure 2).

Further, not only did 70% of the responses utilize the negative space strategy, but of these responses, 60% of them discerned the correct pattern. In contrast, of the 30% of the responses which focused on the dots as shape, only 16% resulted in a correct pattern identification (Figure 3). That is, in 84% of the viewing episodes in which the viewers chose to look at the "positive" image—that is, the dot clusters—their identification of the pattern was incorrect. This suggests that, under conditions where stimuli presented in the positive has uncertain edges, it is more difficult to recognize the dotted areas as pattern. In the dot stimuli presented in this study, especially in the early stages of the iteration sequence, the dot groupings are thin and spread out and thus are difficult for most viewers to discern as definable shapes.

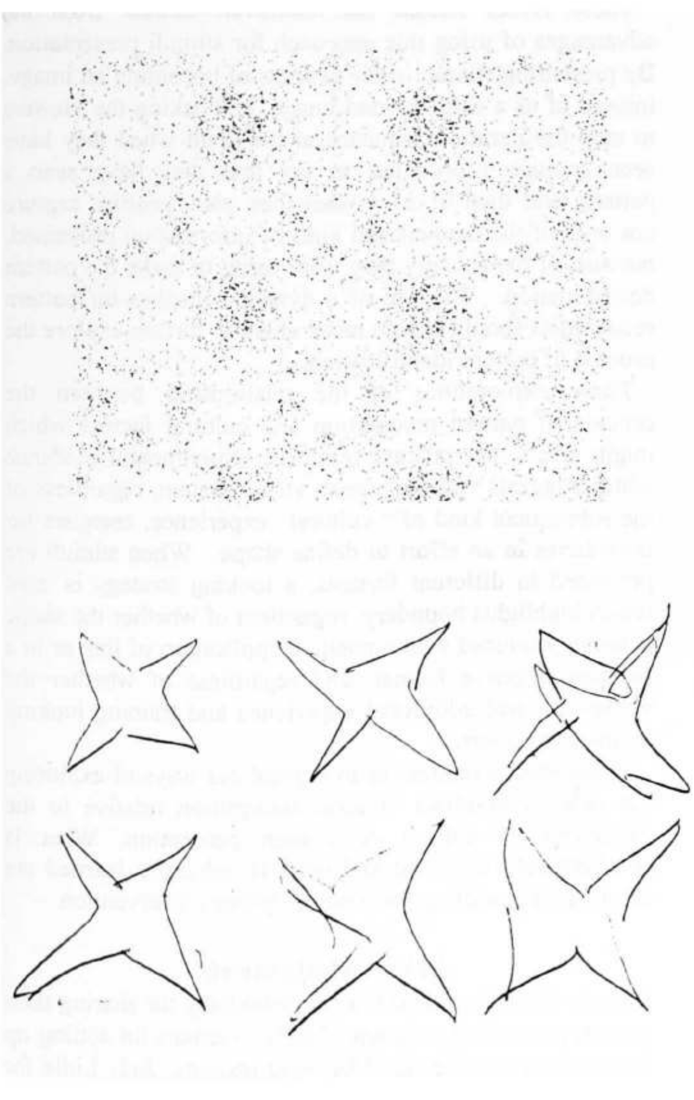

Figure 2: Iterated pattern and sketch of the background areas as the *p4m* pattern.

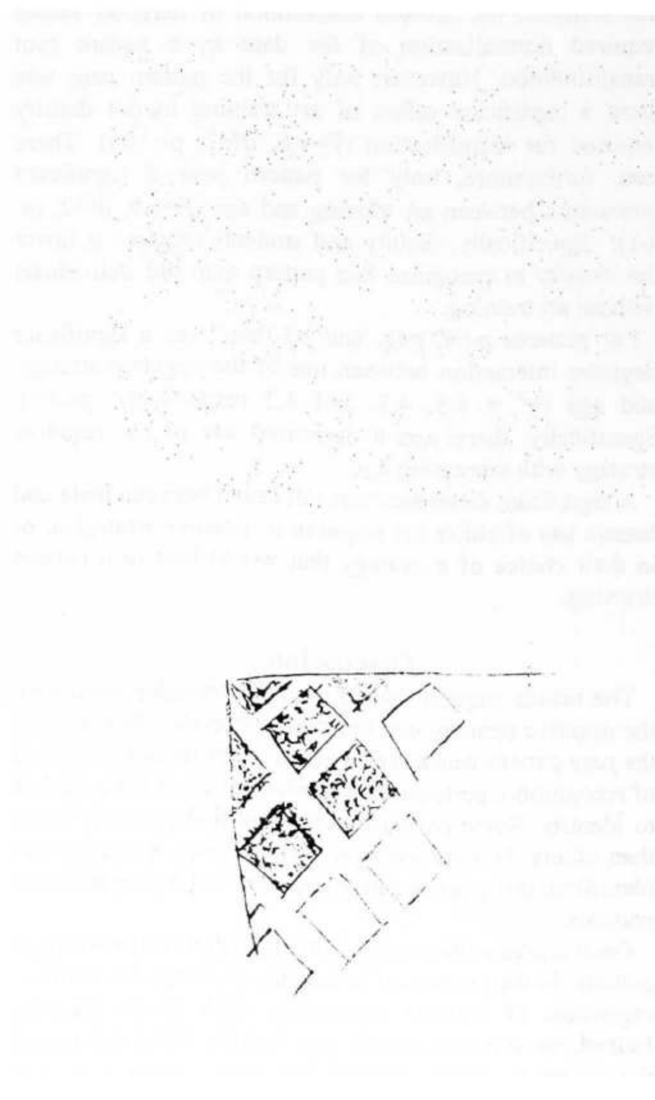

Figure 3: Iterated pattern and incorrect sketch of the positive areas as the *p4g* pattern.

For the *cm*, *pmg*, *pgg* patterns, there was a statistically significant difference in the use of the negative recognition strategy and correct identification of the patterns ($\chi^2$ =4.8, p<.05; $\chi^2$=7.6, p<.01; $\chi^2$ =9.8, p< .01 respectively).

Overall, training or experience had no significant effect on the selection of a strategy for pattern recognition. No statistically significant difference in the use of the two strategies by the faculty, students, or staff for recognition of the six patterns was observed, except for pattern *p4g*, where, among the three groups of viewers with different training, viewing strategies leading to a correct pattern identification were significantly different (p=.02).

The dot density required by each expertise group to correctly recognize each pattern was examined. Dot density was measured by number of iterations; the higher the number of iterations, the greater the dot density. For this analysis, the skewed distribution of iteration values required normalization of the data by a square root transformation. However, only for the pattern *pmg* was there a significant effect of art training in dot density required for identification (F=4.6, df=2, p< .05). There was, furthermore, only for pattern *pmg* a significant interaction between art training and age (F=5.9, df=2, p< .01). Specifically, faculty and students required a lower dot density to recognize this pattern than did individuals with no art training.

For patterns *p4m*, *p4g*, and *p3* there was a significant negative interaction between use of the negative strategy and age ($\chi^2$ = 4.5, 4.3, and 4.2 respectively; p<.05). Specifically, there was a decreased use of the negative strategy with increasing age.

A significant difference was not found between male and female use of either the negative or positive strategies, or in their choice of a strategy that would lead to a correct drawing.

## Discussion

The results suggest that of the two strategies employed, the negative strategy was the most successful. But only for the *pmg* pattern was there an effect of art training on speed of recognition, perhaps because this pattern was the easiest to identify. Some patterns were identified correctly faster than others. Not surprisingly, pattern *pmg*, a zigzag, was identified, using the negative strategy, faster than the other patterns.

From a preattentive point of view, individuals looking at patterns in the process of becoming all search for contour, regardless of cultural experience, such as art training. Indeed, more than a decade ago Pinker (1984) questioned the extent to which general knowledge plays a role in recognizing shape. He argued then that it was unclear what kind of knowledge is used for shape recognition and how that knowledge is used in the search for features and wholes. This exercise, which requested viewers to produce drawings at the point when they discerned that a pattern had formed, suggests that the necessary information is related to the edge and boundary of the shape. The concept of figure/ground difference is an assessment about a fully formed image. It does not describe the *process* which viewers use to discern emerging shapes that have unclear edges. Indeed, these results suggest, with another methodology, that one important aspect of the process of shape definition occurs at the edge.

In future research the relationship of the specific nature of a given pattern, such as its complexity, should be studied relative to choice of recognition strategy. For example, the zigzag pattern *pmg* was much simpler than the over/under weaving *p4g* pattern. In addition, pattern stimuli should be chosen that develop with identical shapes in the negative and positive, as was the case for the *pmg* pattern.

These issues should not, however, detract from the advantages of using this approach for stimuli presentation. By presenting stimuli in the process of becoming an image, instead of as a fully formed image, and asking the viewers to stop the iteration sequence at the point when they have seen enough information to say that they have seen a pattern, and then to draw what they see, enables capture not only of the amount and kind of information processed, but also of the strategy they were using to make the pattern determination. The use of a dynamic display for pattern recognition should enable researchers to further explore the process of pattern identification.

These explorations of the relationship between the process of pattern recognition and cultural factors which might affect that process reinforce experimental evidence which suggests that the human visual system, regardless of the subsequent kind of " cultural" experience, searches for boundaries in an effort to define shape. When stimuli are presented in different formats, a looking strategy is used which highlights boundary, regardless of whether the shape is being produced with a positive application of line or in a residual negative format, and regardless of whether the viewer has had additional experience and training looking at line and pattern.

These results redirect us to expand our ways of exploring the process involved in form recognition relative to the influences of culture on human perception. What is preattentively universal and what is culturally learned are thorny issues waiting for interdisciplinary intervention.

## Acknowledgments

I thank, Mike Field and Martin Golubitsky for sharing their pattern generating program, Hadley Garbart for setting up the computer tests at the Maryland Institute, Judy Lidie for input on the design of the tests, Frank Shen for the statistical analyses, and Diane Humphrey for comments on a previous draft.

## References


Field, M., & Golubitsky, M. (1992). *Symmetry in Chaos*. Oxford, UK: Oxford University Press.

Hochberg, J. (1978). Art and Perception. In E. Carterette & M. Friedman (Eds.), *Handbook of Perception, X.* New York: Academic Press.

Nodine, C., Locher, P., & Krupinski, E. (1993). The role of formal art training on perception and aesthetic judgment of art compositions. *Leonardo*, *26*, 219-227.

Pinker, S. (1984). Visual Cognition: An Introduction. *Cognition*, 18, 1-63.

Triesman, A. (1986). Properties, Parts, and Objects. In K. Boff, L. Kaufman, & J. Thomas (Eds.), *Handbook of Perception and Human Performance, II.* New York: J. Wiley & Sons.

Uttal, W. (1987). *The Perception of Dotted Forms.* Hillsdale, NJ: Lawrence Erlbaum Associates.

Washburn, D., & Crowe, D. (1988). *Symmetries of Culture.* Seattle, WA: University of Washington Press.