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Evaluation And Selection of Areal Symbols
For Zoning Maps

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EVALUATION AND SELECTION OF AREAL SYMBOLS FOR ZONING MAPS

By

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ABSTRACT

EVALUATION AND SELECTION OF AREAL SYMBOLS
FOR ZONING MAPS

By

Shawn Farrell Chambers

Zoning maps are important tools used by planning agencies to delineate unique nominal data categories. Nominal mapping requires the use of areal patterns of similar visual significance. Studies indicate that of four variables affecting visual significance, value, texture, orientation and style, value and texture variations are the most influential. This study investigates these four variables and their combined effect on the visual impression generated by an areal pattern. Visual significance was measured by map-reader response to groups of pre-printed areal patterns and results were analyzed statistically by the Kolmogorov-Smirnov test for ranked data. The idea that patterns of similar value and texture generate similar visual significance was not consistently supported by test results and the influence of pattern style was greater than previously thought. Orientation was found to have little influence on pattern perception. A pattern guide for zoning maps was designed from the results.

ACKNOWLEDGMENTS

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CHAPTER 1: PATTERNS FOR ZONING MAPS

Planning agencies at every level of government are faced with the task of showing a wide variety of areal distributions including population, housing, and land use in graphic form on maps. Since these maps often influence the decisions made by agency policy-makers, it is important that the maps give not only an accurate representation of the data, but are also visually effective communication devices.

One type of map used frequently by planning agencies is a zoning map. A zoning map divides an area (region, county, township, or municipality) into districts or zones in which land is restricted to certain classified uses. Figure 1 is an example of a typical zoning map and consists of a number of categories with a legend containing the explanation of symbols. The map acts as a visual aid and at times is more readily understood than the zoning ordinance itself. Rody and Smith (1960, p.1.) state that the zoning map is an important part of a community's master plan and can be thought of as an intermediate control of existing and potential development. They further state that the map, along with the zoning ordinance (when based on a comprehensive master plan) control and direct municipal growth. These two statements clearly illustrate the importance of the zoning map

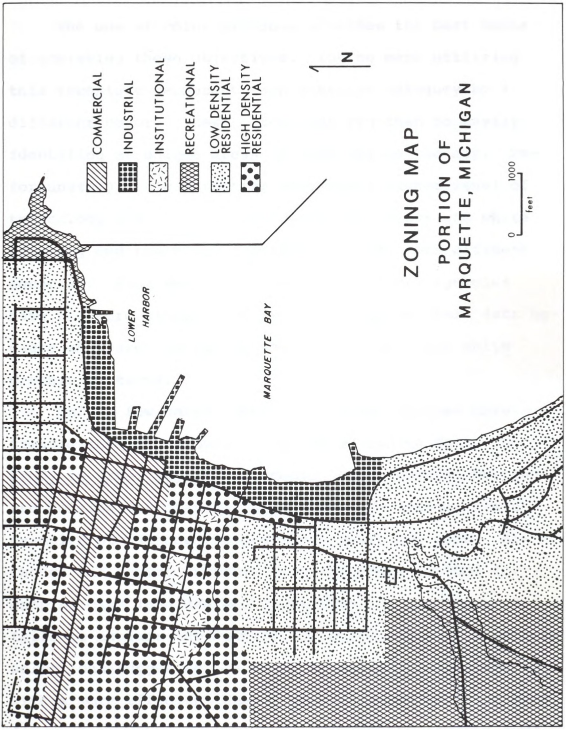


Figure 1: Typical Zoning Map

and indicate the need to map zoning data in a manner that is comprehensive and visually effective.

The use of color probably provides the best means of achieving these objectives. Zoning maps utilizing this technique represent each distinct category by a different color. These categories can then be easily identified as unique areas of land use on the map. Unfortunately, color printing requires a higher level of technology and is more expensive than black and white printing and therefore feasible only for more affluent agencies. Many regional, county, and local agencies have the more difficult task of portraying their data because they are limited to the use of black and white graphic patterns.

Only a few cartographic and zoning studies have treated the monochromatic mapping of zoning data. A Study in Urban Mapping, produced by the Central Mortgage and Housing Corporation, Ottawa, Canada (1944) offers examples of methods for preparing their own maps. Although the report presents a monochromatic method for mapping city land use and encourages its adoption, it fails to explain the reasons for recommending the pattern selections suggested. A study by Gibson (1972), deals with a more efficient style for urban area planning maps. Gibson tests the effectiveness of selected symbols used on planning maps but does not address zoning map symbolization specifically. Zoning data is areal in character and is best portrayed by areal patterns. Unfortunately literature dealing with areal patterns for zoning maps is unavailable and at present there are no uniform symbology or mapping guidelines utilizing areal patterns for these maps. The choice of possible patterns for zoning maps is wide and the appearance of such maps varies significantly within and between agencies. For this reason uniform standards and/or a list of mapping guidelines are most desirable from both a practical and professional viewpoint.

To map zoning categories in a comprehensive and visually effective manner, some knowledge of zoning data is necessary. Zoning data, a form of land use data, is nominal in character. Therefore all zoning categories are considered to be equal in importance. Rody and Smith (1960, p.20) support this by stating that zoning data should not be thought of in terms of "higher" or "lower" uses. In early applications though, zoning provided the device for protecting the homogeneous single family suburb from the city. Although zoning has undergone considerable changes in the past 50 years, Babcock (1966, p. 115) states that residential prioity is still prominent. Investigation of additional literature and zoning maps uncovers ordinal terms like "low, medium, and high density" to rank residential areas. Gallion and Eisner

(1980, p.304) state that most zoning ordinances provide for different densities of population in different districts. The above information indicates that zoning data is depicted and interpreted in both a nominal and ordinal manner.

Since nominal scaling places data in classes that are believed to relatively homogeneous, different cartographic techniques must be employed to map these two data types in a visually effective manner. Smith and Groop (1980) mention two important guidelines to consider when selecting patterns to map nominal data: (1) Areal symbols should be easily differentiable by the map-reader and (2) the patterns should not imply quantity or importance when viewed together. Patterns should also conform to accepted cartographic practice (some patterns produce noise) and they should be pleasing to a reader. An example of the above guidelines is shown in Figure 2.

Ordinal scaling ranks data and is characterized by "greater than" and "less than" relationships between classes. Darker and lighter tones are usually employed to connote ordinality with darker tones usually referring to "more" and lighter tones to "less" of ordinal or numerical data (Robinson, Morrison, and Sale, 1978, p.190). An example is given in Figure 3. These patterns must also conform to cartographic convention.

Areal patterns such as those in Figures 2 and 3 have

four visual characteristics that can be manipulated by cartographers: value, texture, orientation and style. Value refers to the relative lightness or darkness of a pattern and is usually measured as percent area inked (PAI) (Robinson et al., 1978, p. 317). It is the contrast between the pattern and its background that gives the impression of "more" or "less". Texture is the density of individual marks

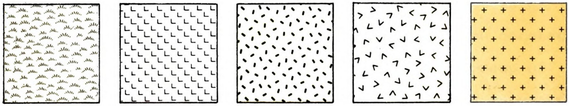


Figure 2: Nominal areal symbols that are easily differentiable and do not imply quantity from one pattern to the next.

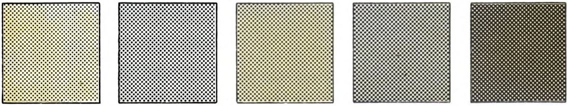


Figure 3: Ordinal or Numerical Symbols-lighter to darker.

in a pattern (measured as the number of lines of marks per inch) and is usually thought of in terms of coarseness or fineness. A large number of lines of marks per inch results in a fine texture. Orientation refers to the ordered arrangement of individual marks within a pattern usually oriented as vertical, horizontal or diagonal. Style, sometimes referred to as configuration, is the difference in appearance of individual marks used in areal patterns (i.e. dots, lines, squares, etc.).

Figure 4 is an example of these four pattern characteristics. Column A of Figure 4 illustrates the idea of value with a gray tone series. By holding texture constant (lines of dots per inch) and varying the PAI, a group of distinguishable patterns is created. Column B is an example of pattern texture. Here gray tone values are similar but texture varies. Orientation differences are clearly illustrated in Figure 4C. Value, style and texture are held constant while orientation varies. Figure 4D is an example of style differences. In the example, value, texture and orientation differences are minimized leaving style as the only differentiating element.

It is evident from previous research that variation in value and texture can greatly influence pattern significance. In all case results, value differences have visual levels that imply importance or quantity. These differences are useful in mapping quantitative (ordinal, interval and ratio) data but is unsuitable for mapping qualitative or nominal

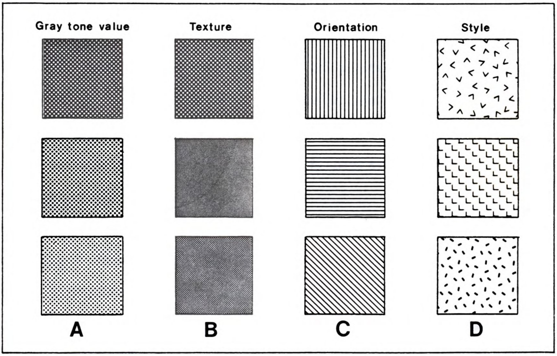


Figure 4: Examples of value, texture, orientation and style. After Smith and Groop, 1980, p. 93.

data (Smith and Groop, 1983, p. 91). Although Jenks and Knos (1961, p. 316) note that patterns of different textures having the same value create little contrast, a later study done by Robinson and Castner (1969) conclude that texture differences may affect the perception of value even though value is held constant. They state that value and texture are the primary pattern characteristics that influence the visual impression derived from a map. Subsequent research by Dent (1972, p. 92) supports the latter study. Working with value and texture variations of patterns, Dent concluded that texture variations can produce visual levels between patterns with equivalent pattern value. A study by Johnson (1978) indicates that patterns with coarse textures are seen as visually dominant.

Little research has been done with pattern orientation and style. Dent found orientation had little effect on visual significance but Robinson, Morrison and Sale (1978, p. 318) suggest that orientation is a poor differentiator between patterns and is likely to result in visual confusion. Pattern style has received only passing mention in the literature and no one has studied its effect on visual significance of patterns.

Thus in ordinal or numerical mapping, value appears to be the most appropriate characteristic to vary and in nominal mapping, variations in pattern style may produce the most effective symbols.

Zirbel (1976) incorporated the above ideas in a study of pattern selection for nominal mapping. She hypothesized that patterns with similar value and texture characteristics generate similar visual impressions and can therefore be used in the selection of more effective patterns for monochromatic mapping of nominal areal data. Zirbel's analysis of patterns consisted of two procedures: (1) an empirical testing of pattern value employing an image analyzer and (2) a perceptual testing of pattern textures my map readers. She then constructed a pattern selection guide based on the results of the value and texture analysis. The guide, illustrated in Figure 5, serves as a tool for choosing patterns of equal visual significance to be used in mapping nominal areal data. Zirbel provided an evaluation of sample maps utilizing patterns from the guide but there was no investigation of reader perception of these patterns in map context.

The mixed (nominal and ordinal) depiction and interpretation of zoning data and the varying number of classes on each map, make the development of a standard symbology for zoning maps impractical. However, by skillfully manipulating the four pattern variables of value, texture, orientation and style, better pattern choices can be made. It is the purpose of this study to investigate texture, value, style and orientation and their combined effect on the visual impression generated by a pattern. In this study, visual significance is measured by map-reader response, thus providing evidence gained in a real map viewing situation. Results from these

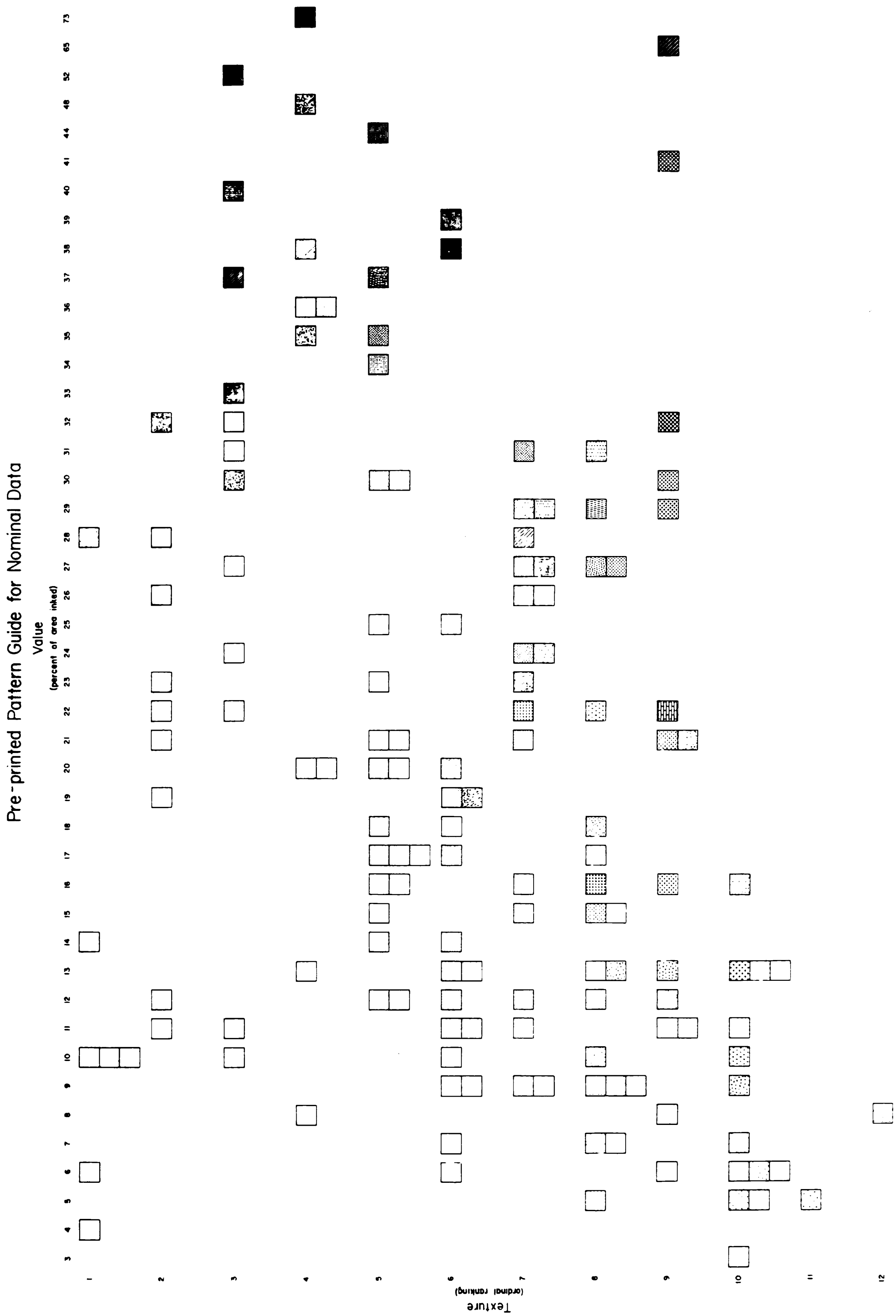


Figure 5: Taken from Zirbel, 1976.

procedures will allow creation of a pattern selection guide similar to Zirbel's but one which incorporates not only the effects of value and texture on pattern perception but includes also the effects of orientation and style.

CHAPTER 2: TESTING POTENTIAL NOMINAL PATTERNS

The pattern variables of value, texture, orientation and style and their combined effect on pattern significance are the focus of this study. This chapter outlines a perceptual test that was administered to a group of students asked to view a series of patterns. The patterns of each series, having similar value and texture, allowed the investigation of style and orientation effect on pattern perception through the analysis of test results. These two variables, orientation and style, are of particular interest as they are crucial in the mapping of nominal data.

Test Design

Map-readers were asked to view a series of pattern chips to differentiate between the visual significance of individual patterns. The selection of patterns used in the testing procedure was subjective. Only patterns commonly utilized for the mapping of zoning data taken from literature and existing zoning maps and also available from Zirbel's list of researched patterns were used for the test. Cost considerations also limited the number of pre-printed patterns available for testing. A total of fifty-one patterns were selected for use in testing.

The fifty-one patterns were arranged in groups with similar value and texture in accordance with Zirbel's and others recommendations (Appendix A). Nine groups were formed with Group I having patterns with the lowest percent area inked and Group IX having patterns with the highest percent area inked. The pre-printed patterns were cut into squares, one inch by one inch, and adhered to pieces of white poster board measuring one by one and a half inches. Patterns with more than one possible orientation were adhered to the poster board with varying orientations. Each pattern chip was then labeled with a letter in the half inch margin. Lettering the pattern chips in this manner helped to assure proper orientation of the pattern chips during the testing and allowed for the positioning of patterns adjacent to one another, as they might appear on a map, while viewing. Labeling of the patterns within groups was not consecutive so that no order could be interpreted by the test participants. Figure 6 shows examples of the pattern chips and labeling.

Four different envelopes were made for each pattern group. All contained identical patterns (therefore the same styles) with only orientation of some patterns differing between envelopes. The envelopes were numbered with a two digit numeral, the first digit indicating the group number (1 through 9) and the second digit relating to the orientation of certain patterns in the envelope. The labeling procedure and envelope contents are illustrated in Figure 7.

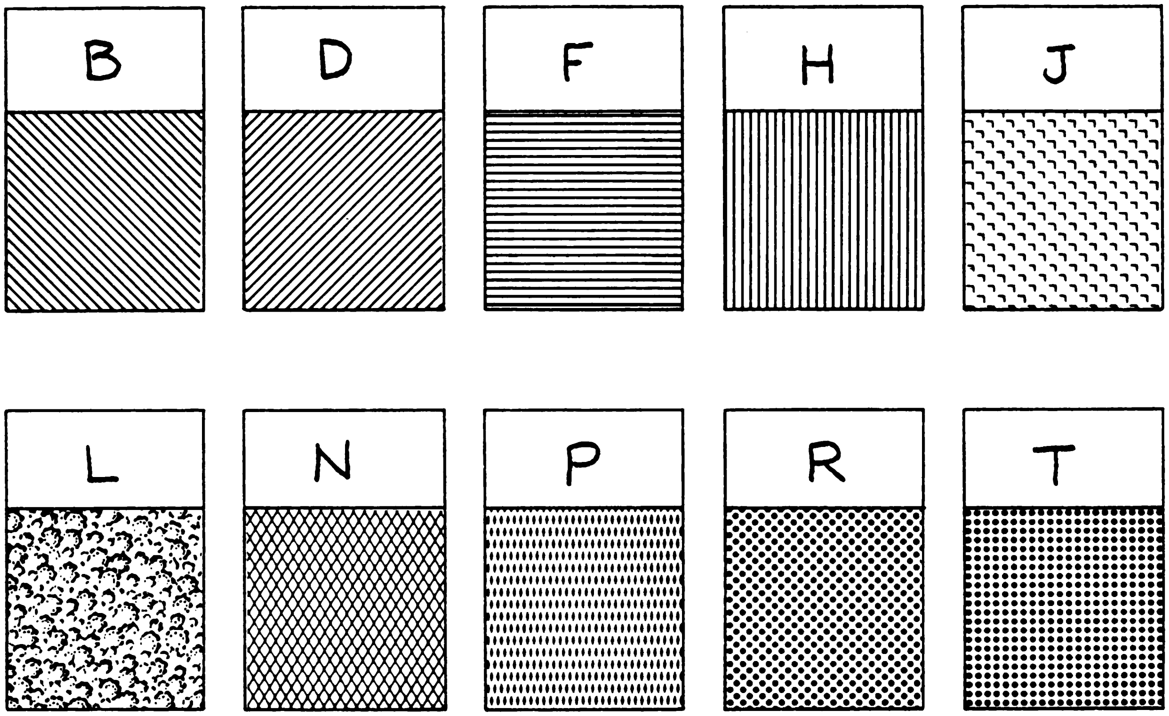


Figure 6: Examples of Pattern Chips Used in Testing

Each participant received four envelopes, each from a different pattern group. Care was taken so that no participant received all light pattern groups or dark pattern groups. Each test packet of four envelopes was accompanied by the test questionnaire and a blank white sheet of paper on which to view the pattern chips.

Testing

Test instructions called for each participant to carry out four separate tests. In each test the participant was asked to view and compare the patterns in one envelope and to select the pattern which was most noticeable or eye-catching.

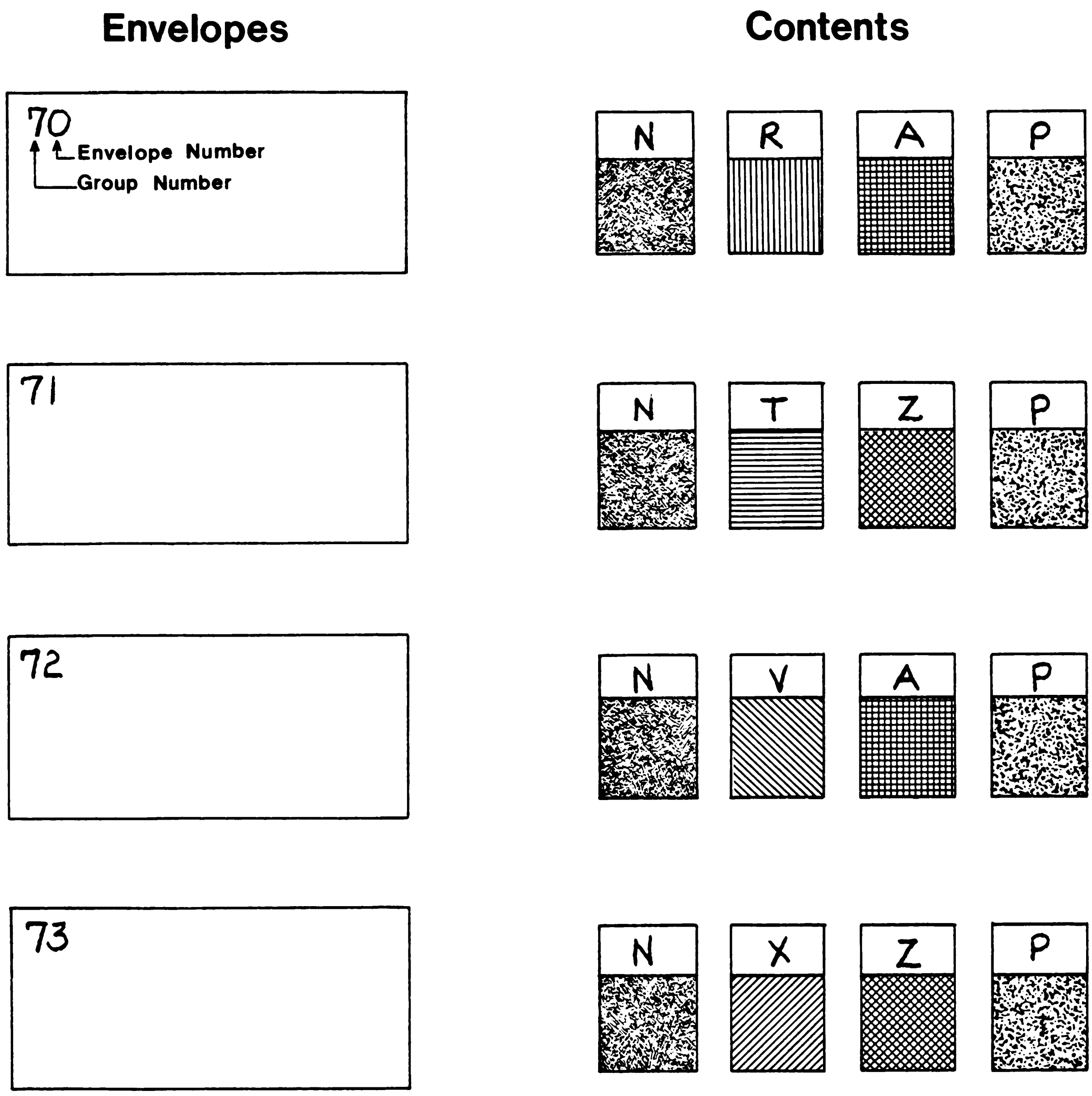


Figure 7: Envelope Labeling Procedure and Envelope Contents

This procedure was to be repeated until all the patterns from that one envelope were arranged in order from most noticeable to least noticeable. These ranked results were then registered on the test questionnaire (Appendix B). Participants were forced to discriminate between the visually similar patterns as no ties were permitted.

The test was administered to 82 college undergraduate students enrolled at Northern Michigan University who had no special map reading abilities. Test questionnaires were distributed and directions were read orally stressing the importance of removing all pattern chips from the envelopes. Students were instructed to proceed at their own rate but were encouraged not to spend too much time on any one envelope and participants' test times were all less than ten minutes. Each envelope was tested three times guaranteeing a minimum of 35 responses for each pattern. Test responses were tabulated and can be found in Appendix C.

During the testing procedure a few participants commented on the difficulty in discriminating between some of the patterns. Upon completion of the testing it was necessary to discard a few test questionnaires because of participant failure to remove all pattern chips from an envelope. Other than these minor problems, the participants seemed interested in the study and eager to answer the questionnaire.

CHAPTER 3: RESULTS AND ANALYSIS

The test questionnaire was designed to examine visual impressions map-readers obtain from specific groups of pre-printed patterns. Because the patterns of each group were of similar value and texture they should, according to Zirbel's findings, appear visually similar to the test participants. No one pattern should be visually dominant over another pattern in a group. If the patterns are indeed similar in visual significance (given similar value and texture) then confusion was expected on the part of the test participant in choosing visually dominant patterns. If, however, consistent responses of visual significance resulted, then it could be that style and/or orientation may influence pattern significance.

Responses for each pattern in a group were recorded by rank. For example, given a group of four pattern chips, there were four ranks, "most noticeable," "least noticeable," and two ranks in between. All responses for a pattern chip were recorded regardless of orientation since these results were used to determine the variation in the visual significance of pattern styles within groups. The responses of pattern chips with different orientations were also recorded in separate tables from which separate statistical tests were conducted and analyses made on orientation effects.

Statistical Procedure for Visual Significance by Group

The ordinal nature of the questionnaire results required the use of the Kolomogorov-Smirnov one sample statistical test for ranked data. The K-S test, a test of goodness of fit, is concerned with the degree of agreement between the distribution of sample values (observed) and some specified theoretical distribution (expected). The results of this statistical procedure determine whether the scores of the sample can reasonably be thought to have come from a population having the theoretical distribution. In this study, the theoretical or expected distribution is one that has an equal number of responses for each pattern of a particular group, indicating equal visual significance between the patterns. Statistical testing by the K-S procedure involves specifying the cumulative frequency distribution which would occur under this theoretical distribution and comparing it with the observed cumulative frequency distribution. From the two frequency distributions the greatest divergence is determined. Results indicate whether such observed values are likely on the basis of chance, that is whether or not the observed values and expected values came from the same population.

Group I will be used to illustrate the statistical testing procedure. Seven different patterns were investigated in Group I and the results of the questionnaire are shown in Table 1. For example, two participants chose pattern 7186 as "most noticeable," five participants chose pattern 239 as "most noticeable" and so forth. Because there

were seven rank divisions (from most to least noticeable) for Group I, a separate statistical K-S test was done for the pattern results for each rank. The steps for the statistical procedure are as follows:

1) The null hypothesis is formulated (H_o) -- There is no difference between patterns in terms of noticeability.
2) The significance level of $\alpha = .05$ was chosen.
3) Statistic D was computed (Table 2).
   a) First the observed and expected cumulative frequency distributions were determined.
   b) Differences were calculated between observed and expected for each pattern.
   c) D was found by inspection and defined as the largest difference between observed and expected cumulative frequencies.
4) The probability distribution of D in which critical values of D are given for different sample sizes and probability levels was used to determine whether or not to reject the null hypothesis.
5) The statistics of interest for this example involved the confidence level of $\alpha = .05$ for the sample size of 35 (Table 2).
6) The computed value of D = .14 did not exceed the critical value of D; therefore, the null hypothesis could not be rejected.
7) The results indicate that the patterns are not different in visual significance.
8) At the rank of "most noticeable" (7th rank) it could not be concluded that the patterns of Group I are visually different.

The above procedure only took into consideration the frequencies for the rank of "most noticeable" (7th rank) with Group I pattern chips arranged in one specific order. The above statistical procedure was repeated for each remaining rank of Group I (6 through 1). Pattern chip order was then randomly rearranged into five other order arrangements to assure adequate test results. Since there was no set order for the patterns of Group I in terms of noticeability, the

TABLE 1
Frequencies of Questionnaire Responses
for Group I Patterns

NOTICEABILITY RANKING	PATTERN							
	7186	239	7127	288	219	612	228	N
MOST 7	2	5	6	9	2	5	6	35
6	1	1	7	9	4	5	8	35
5	3	4	2	4	11	1	10	35
4	7	7	1	8	5	3	4	35
3	11	9	4	0	7	3	1	35
2	7	6	9	3	4	4	2	35
LEAST 1	4	3	6	2	1	15	4	35

TABLE 2
K-S Test Results and Critical Value
for Group I Patterns

	PATTERN							
	7186	239	7127	288	219	612	228	N
Observed	.26	.43	.49	.66	.80	.86	1.0	35
Expected	.14	.29	.43	.57	.71	.86	1.0	35
Difference	.12	.14	.06	.09	.09	0.0	0.0	

Critical Value-- .23 $\alpha = .05$

statistical procedure was performed on each of the six random pattern chip orders. In the case of Group I, seven ranks were statistically tested six times for a total of 42 Kolmogorov-Smirnov results. Each of the other eight groups of pattern chips were statistically tested in this manner.

Statistical Procedure for Orientation

The Kolmogorov-Smirnov two sample test was used to determine the effect of pattern orientation on the visual significance of the pattern chip. Observed values of one sample set (one orientation) were compared with the observed values of another sample set (another orientation). Since the K-S test required paired comparisons between a pattern having two different orientations, the samples having more than two orientations had to be altered to conform to this requirement. In such a case, a series of paired comparisons were conducted.

Statistical analysis involved the comparison of two observed cumulative frequency distributions. As before, the greatest divergence between cumulative frequencies was determined and compared with the K-S two sample table of critical values. Table 3 is a sample calculation for Group I, pattern 7186 and illustrates the procedure used for patterns with different orientations. All other patterns with more than one orientation were statistically analyzed in this manner.

Analysis of Results

The analysis of results will be discussed group by group. After each group has been covered, an overview of all group results will be included to provide some insight into pattern perception. These comments will address the following questions:

1) Do patterns with similar texture and value appear similar in visual significance?

2) Do certain pattern styles appear visually dominant or which pattern styles, if any, appear consistently "more or less" noticeable?

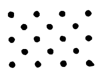
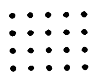
3) Does orientation affect the perceived visual significance of a pattern?

4) Is there a certain texture at which patterns are perceived as lighter or darker?

Group I

The results of the K-S procedure on Group I indicate that participants had difficulty in selecting any pattern from the group that was visually dominant over any of the other patterns (Table 4). Of the forty-two tests conducted on Group I, only 11 cases rejected the null hypothesis. Four of the rejected cases were found in the first rank of "least noticeable" which indicates that differentiation of pattern chips that have less visual significance was less difficult for the participants. It appears that these seven patterns are not visually different to the map reader (Figure 8). Therefore they could be used together on a nominal map without any of the patterns "standing out" visually.

TABLE 3
Questionnaire and K-S Two Sample Test Results
for Group I, Pattern 7186

Pattern 7186		NOTICEABILITY						
		7	6	5	4	3	2	1
ORIENTATION		0	0	3	3	4	5	3
		2	1	0	4	7	2	1
Observed$_1$		.0	.0	.17	.34	.56	.84	1.0
Observed$_2$		.12	.17	.18	.42	.83	.95	1.0
$O_1 - O_2$		.12	.17	.01	.08	.27	.11	0

Critical Value-- .3429 $\alpha = .05$

Results of the orientation test on three patterns of Group I (patterns 7186, 239, and 228, Appendix A) indicate that there were no differences between the pattern orientation in terms of noticeability (Table 3 and Appendix D). It was concluded that patterns in this group are fairly equal in visual significance regardless of orientation.

Pattern styles of this group varied from regular dot and geometrically shaped patterns to irregular geometric and pictographic vegetation patterns. From the results it would appear that style had little effect on pattern perception except possibly in the case of pattern 612 which had a heavier response rate as "least noticeable."

TABLE 4
Matrix of K-S Test Results
for Group I

	PATTERN ORDER					
	1	2	3	4	5	6
7	-	-	-	-	-	-
6	R	-	-	-	-	R
5	R	-	-	R	-	R
4	-	-	-	-	-	-
3	R	-	-	-	-	R
2	-	-	-	-	-	-
1	R	R	R	-	-	R

α=.05
R = Reject H_o
- = Fail to reject H_o

<u>Pattern Orders</u>
1) Z288, Z228, Z219, F7127, Z239, F7186, Z612
2) F7186, Z228, F7127, Z612, Z219, Z288, Z239
3) Z288, Z219, Z239, Z612, Z228, F7127, F7186
4) Z612, Z239, F7127, Z228, F7186, Z288, Z219
5) Z228, F7186, Z612, Z219, Z288, F7127, Z239
6) Z612, F7186, Z239, F7127, Z219, Z228, Z288

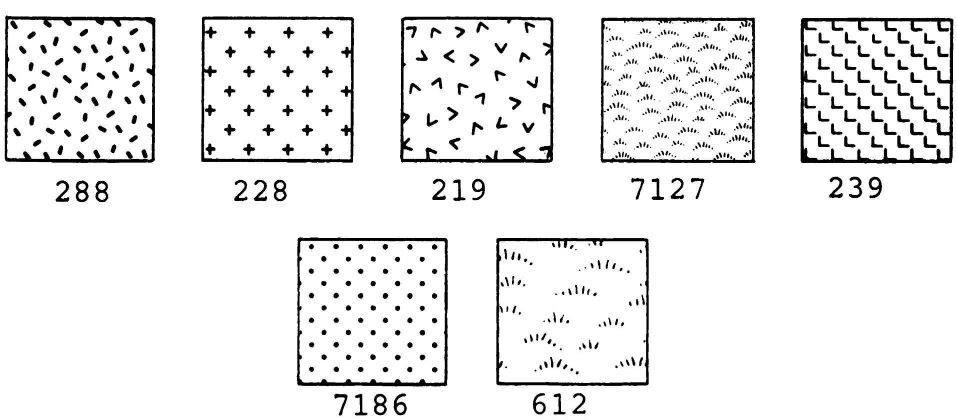


Figure 8: Group I Patterns

Group II

Test results indicate that the participants had difficulty in differentiating patterns in the middle ranks but were able to distinguish patterns that were more or less noticeable (Table 5). Of the thirty tests conducted, thirteen of the cases rejected the null hypothesis. Eleven of these rejected cases were found in the fifth ("most noticeable") rank and the first ("least noticeable") rank. These results indicate that the patterns of Group II (Figure 9) would be inappropriate for use together in mapping nominal zoning data, as map-readers can easily distinguish between the visual significance of the patterns.

Orientation tests were performed on two patterns of Group II, line pattern 7102 and pattern 7106. Paired comparisons were conducted in which each orientation of an individual pattern was tested against all other orientations. Results of the test failed to reject the null hypothesis indicating that the visual significance of these patterns was not affected by orientation differences (Appendix D).

Group III

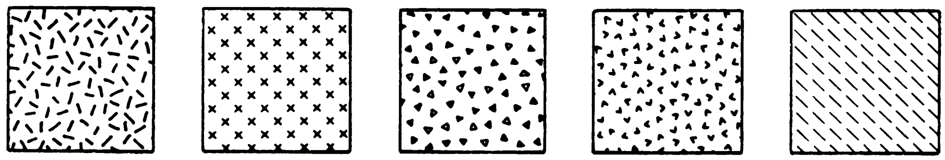
Results of the K-S test on Group III indicate that participants had little difficulty differentiating one dominant pattern, 7184, but could not discriminate between the remaining pattern chips (Figure 10). Of the forty-two tests conducted, only eight cases rejected the null hypothesis (Table 6). Four of these were found in the seventh

TABLE 5
Matrix of K-S Test Results
for Group II

	PATTERN ORDER					
	1	2	3	4	5	6
5	R	R	R	R	R	R
4	-	-	-	-	R	R
3	-	-	-	-	-	-
2	-	-	-	-	-	-
1	R	R	R	-	R	R

α =.05
R = Reject H_o
\- = Fail to reject H_o

Pattern Orders
1) F7219, F7106, Z77, Z217, F7102
2) F7219, Z77, F7102, F7106, Z217
3) F7102, Z217, Z77, F7106, F7219
4) Z77, Z217, F7106, F7102, F7219
5) Z217, F7102, F7129, F7106, Z77
6) F7106, Z77, F7102, F7219, Z217



7219 7106 77 217 7102

Figure 9: Group II Patterns

TABLE 6
Matrix of K-S Test Results
for Group III

	PATTERN ORDER					
	1	2	3	4	5	6
7	R	R	R	-	R	-
6	-	-	-	-	-	-
5	-	-	-	-	-	-
4	-	-	-	-	-	-
3	R	-	-	-	-	-
2	R	R	-	-	-	-
1	R	-	-	-	-	-

$\alpha = .05$
R = Reject H_o
\- = Fail to Reject H_o

<u>Pattern Orders</u>
1) F7184, Z279, F7155, F7094, Z75, Z362, Z238
2) Z238, Z362, Z75, F7094, F7155, Z279, F7184
3) Z75, F7155, Z362, Z238, F7184, Z279, F7094
4) F7094, Z279, Z75, F7155, Z362, F7184, Z238
5) F7184, Z362, F7094, Z238, Z75, F7155, Z279
6) Z362, F7155, F7184, Z238, Z75, Z279, F7094

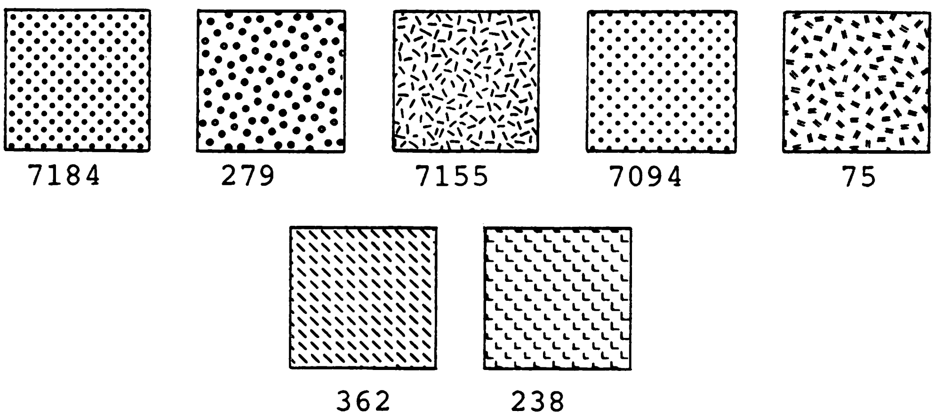


Figure 10: Group III Patterns

("most noticeable") rank. It would appear from the results that six of the patterns of Group III would work together well in mapping nominal data effectively but that one pattern, 7184, would not.

The test on pattern orientation was conducted on four of the patterns of Group III. Three patterns with two orientations and one pattern with four orientations were tested. Results failed to reject the null hypothesis in any of the cases (Appendix D).

Group IV

Group IV results are mixed. While participants had little difficulty differentiating a pattern of less visual significance, they had trouble differentiating between other patterns of Group IV (Table 7). Difficulty was evident in the middle ranks with somewhat less difficulty discriminating patterns that were more noticeable. Of the thirty-six tests conducted, eighteen cases rejected the null hypothesis. Ten of these were found in the lower ranks along with four in the fifth rank and four in the sixth rank. The results suggest that the patterns of Group IV (Figure 11) should not be used together in mapping nominal data since test participants were able to differentiate between the visual significance of most of the patterns.

Group V

Table 8 illustrates the results of Group V testing. As indicated, participants had difficulty in discriminating

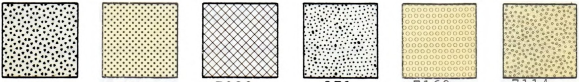
TABLE 7

Matrix of K-S Test Results
for Group IV

	PATTERN ORDER					
	1	2	3	4	5	6
6	R	R	-	R	R	-
5	R	R	-	R	R	-
4	-	-	-	-	-	-
3	-	-	-	-	-	-
2	R	R	R	R	-	R
1	R	R	R	-	R	R

$\alpha = .05$
R = Reject H_o
\- = Fail to Reject H_o

<u>Pattern Order</u>
1) Z78, F7181, F7080, Z371, F7169, F7114
2) F7114, F7169, Z371, F7080, F7181, Z78
3) F7169, F7080, Z371, Z78, F7181, F7114
4) F7181, F7080, F7169, Z78, F7114, Z371
5) F7080, F7169, F7114, Z371, F7181, Z78
6) Z371, Z78, F7181, F7169, F7114, F7080



78 7181 7080 371 7169 7114

Figure 11: Group IV Patterns

between patterns of higher visual significance (shown by a higher frequency of failures to reject the null hypothesis). It was also noted that patterns of less visual significance were easier to differentiate (shown by the lower frequency of failures to reject the null hypothesis). Of the thirty-six tests conducted, twelve cases rejected the null hypothesis and most of these rejections occurred in ranks one and two. For the most part, the arrangement of the rejections warrants caution in the use of the six patterns of Group V for mapping nominal zoning data (Figure 12).

Results of the orientation test on four patterns, 222, 7166, 73, and 259, of Group I indicates that pattern orientation had little effect on the visual significance of these patterns (Appendix D).

Group VI

Results of Group VI testing indicate that participants had little difficulty ranking the six patterns from least to most noticeable (Table 9). Of the thirty-six tests conducted on Group VI, twenty-nine cases rejected the null hypothesis. Therefore, these patterns could not be used together on nominal zoning maps (Figure 13).

Orientation analysis involved four patterns from this group. Three of the patterns were tested for two orientations and the fourth pattern was tested by paired comparisons for four orientations (Appendix D). In each case, the null

TABLE 8
Matrix of K-S Test Results
For Group V

	PATTERN ORDER					
	1	2	3	4	5	6
6	R	-	-	-	R	-
5	R	-	-	-	R	-
4	-	-	-	-	-	-
3	-	-	-	-	-	-
2	R	-	R	-	R	R
1	R	-	R	R	R	-

$\alpha = .05$
R = Reject H_o
- = Fail to Reject H_o

<u>Pattern Order</u>
1) Z259, Z73, F7092, Z222, F7215, F7266
2) Z222, Z259, F7266, F7092, F7215, Z73
3) F7215, Z73, Z222, Z259, F7266, F7092
4) F7092, F7215, Z259, F7266, Z222, Z73
5) F7266, F7215, Z222, F7092, Z73, Z259
6) Z73, Z222, F7215, F7092, Z259, F7266

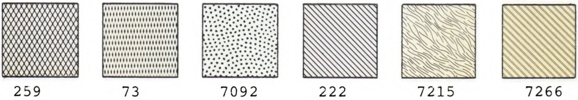


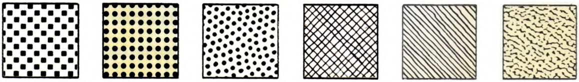
Figure 12: Group V Patterns

TABLE 9
Matrix of K-S Test Results
for Group VI

	PATTERN ORDER					
	1	2	3	4	5	6
6	R	R	R	R	-	R
5	R	R	-	R	R	R
4	R	R	R	R	R	R
3	R	R	R	R	R	-
2	R	R	R	R	-	R
1	R	-	-	R	R	-

$\alpha = .05$
R = Reject H_o
\- = Fail to Reject H_o

Pattern Orders
1) F7229, F7188, F7147, Z432, F7138, F7087
2) F7188, F7147, F7138, F7087, F7229, Z432
3) Z432, F7138, F7229, F7087, F7147, F7188
4) F7087, Z432, F7188, F7147, F7229, F7138
5) Z432, F7087, F7147, F7188, F7138, F7229
6) F7188, F7087, Z432, F7138, F7229, F7147



7229 7188 7147 432 7138 7087

Figure 13: Group VI Patterns

hypothesis was not rejected and it was concluded that orientation did not affect the perception of these patterns.

Group VII

Results in Table 10 indicate that participants had difficulty discriminating any difference in pattern prominance. Of the twenty-four tests performed, only four rejected the null hypothesis. It appears that these four patterns, illustrated in Figure 14, could be used to avoid differences in visual importance.

The K-S two sample test for orientation investigated two of the patterns of Group VII, patterns 208 and 223. In both cases the null hypothesis was rejected and as in the other groups, it was concluded that orientation had little effect in the perception of patterns (Appendix D).

Fine textures characterized the patterns of Group VII. It is possible that these finer textures help minimize visual difference between patterns.

Group VIII

The patterns of Group VIII are unsuitable for use in nominal data mapping as indicated by the results of the K-S test. These patterns are shown in Figure 15. Participants easily discriminated between most of the patterns. The results of twenty-one rejected cases out of the thirty-six tested is illustrated in Table 11.

TABLE 10
Matrix of K-S Test Results
for Group VII

	PATTERN ORDER					
	1	2	3	4	5	6
4	R	-	-	-	-	-
3	-	-	-	-	-	-
2	-	-	-	-	-	-
1	R	-	-	-	R	R

$\alpha = .05$
R = Reject H_o
- = Fail to Reject H_o

Pattern Orders
1) F7208, F7086, F7242, Z223
2) F7086, Z223, F7208, F7242
3) F7242, F7086, Z223, F7208
4) F7208, Z223, F7086, F7242
5) Z223, F7208, F7242, F7086
6) F7086, F7242, F7208, Z223

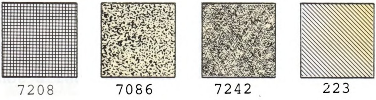


Figure 14: Group VII Patterns

Orientation tests using the two sample procedure indicate that of the five patterns tested (one with four orientations and four with two orientations), none showed differences in visual significance (Appendix D).

The patterns of Group VIII ranged in value from 34 to 38 and in texture from 4 to 5 (taken from Zirbel's guide). The small change in texture, may be responsible for the incompatibility of these patterns in nominal zoning data mapping but because the texture change is small it may be possible that pattern style had more influence on pattern significance.

Group IX

K-S test results for this group indicate confusion in choosing patterns that differ in visual significance: the participants were unable to discriminate between the four patterns of Group IX in terms of noticeability (Table 12). Of the 24 tests conducted, there were only four cases in which the null hypothesis was rejected. It is evident that these four patterns, illustrated in Figure 16, could be used with confidence in mapping nominal data.

Orientation test results indicate that pattern orientation did not affect pattern perception. Three patterns were investigated regarding their orientations and in no case could the null hypothesis be rejected (Appendix D).

The results of this group proved interesting. Texture variation ranged from 3 to 5 and value from <u>44</u> to <u>73</u>, yet

TABLE 11
Matrix of K-S Test Results
for Group VIII

	PATTERN ORDER					
	1	2	3	4	5	6
6	R	R	R	R	R	R
5	R	R	R	R	R	R
4	-	-	-	-	-	-
3	R	R	-	-	R	-
2	-	-	-	-	-	-
1	R	R	R	R	R	R

α=.05
R = Reject H_o
- = Fail to Reject H_o

<u>Pattern Orders</u>
1) F7185, F7182, F7089, Z262, Z260, Z83
2) F7182, Z262, Z83, F7185, F7089, Z260
3) Z260, Z262, F7182, Z83, F7185, F7089
4) F7089, Z262, Z83, F7182, F7185, Z260
5) Z83, Z262, F7185, F7182, F7089, Z260
6) Z262, F7185, Z83, Z260, F7089, F7182

7185 7182 7089 262 260 83

Figure 15: Group VIII Patterns

TABLE 12
Matrix of K-S Test Results
for Group IX

	PATTERN ORDER					
	1	2	3	4	5	6
4	R	-	-	-	-	-
3	-	-	-	-	-	-
2	-	-	-	-	-	-
1	R	-	-	-	R	R

$\alpha = .05$
R = Reject H_o
- = Fail to Reject H_o

Pattern Orders
1) Z253, Z331, F7139, F7149
2) Z331, F7149, Z253, F7139
3) F7139, Z331, F7149, Z253
4) Z253, F7149, F7139, Z331
5) F7149, Z253, Z331, F7139
6) F7139, Z331, Z253, F7149

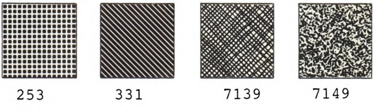


Figure 16: Group IX Patterns

participants were unable to differentiate visual significance between the patterns. These results might indicate that pattern perception is not influenced greatly by texture at higher percent area inked levels.

Overview of Group Results

An overview of group results provides some interesting observations and answers to the questions put forth earlier in this chapter.

> Do patterns with similar texture and value appear similar in visual significance?

Although patterns with similar value and texture are thought to have equal visual significance, the results of the present study suggest this may not always be true. The patterns of Groups II, IV and VIII, similar in measured value and texture, were not perceived by participants as being similar in visual significance, possibly because of differing orientations or styles. Since orientation effects on pattern perception appear insignificant then some styles may cause the visual difference between certain pre-printed patterns.

> Do certain pattern styles appear visually dominant; or which pattern styles, if any, appear consistently as "more" or "less" noticeable?

The cases where texture and value did not influence the visual significance of some patterns, style of pattern may be the cause. Line patterns were consistently rated as less noticeable in the groups in which they appeared; only one line pattern was rated highly. Crosshatch patterns also appeared to dominate in ranking, with most crosshatch patterns scoring heaviest in the middle ranks. Dot patterns were placed in the top two ranks of their respective groups in every case except one. It is interesting to note that patterns of Group VIII are basically dot, line and crosshatch patterns and that participants had little difficulty differentiating the visual significance of Group VIII patterns. The scores for geometric patterns varied considerably and no conclusion could be made as to the affect of this style on pattern perception. Investigation of irregular geometric patterns indicated that they were seen as visually more significant than irregular areal and pictographic patterns.

Does orientation affect the perceived visual significance of a pattern?

It can be reasonably concluded from the Kolmogorov-Smirnov two sample test results that orientation has little influence on the map-reader's impression of visual significance. Even though orientation does not appear to effect pattern perception, care must be taken in mapping not to create visually complex combinations of patterns that can cause map noise at areal unit boundaries.

Are there certain textures at which patterns are perceived as lighter or darker?

Two generalizations can be made: (1) within groups of higher value (PAI greater than 27), coarse textures were seen as visually more significant with the exception of line patterns, and (2) patterns with higher values and finer textures are difficult to differentiate according to their visual significance. The results suggest that texture differences can affect the way a pattern is perceived. Results suggest that patterns with coarse texture should be avoided in mapping nominal data.

Results of the analysis led to the selection and deletion of patterns for consideration in forming a pattern guide for zoning maps. In general, only pattern groups containing pre-printed patterns of similar visual significance (determined through testing) were chosen. Ideally, any group with coarse textured patterns should not be included in the guide. For the most part this rule was adhered to but because of the limited number of patterns available, some pattern groups with coarser textures were included in the guide. The resulting pattern guide is discussed in the following chapter.

CHAPTER 4: THE PATTERN GUIDE

The mapping of zoning data in a comprehensive effective manner involves the use of accepted cartographic techniques. Zoning data has both nominal and ordinal characteristics and is a complex mapping task. Ordinal scaling ranks data and is characterized by "greater than" and "less than" relationships between classes while nominal scaling requires patterns with little visual difference. Thus pattern selection for zoning maps requires care. "More than" and "less than" are easily controlled by the map maker by varying pattern value but patterns with equal visual prominence for nominal categories are more difficult to determine and must vary in style. This study has provided five groups of patterns with varying style, but having similar visual significance. These groups form the basis of the pattern selection guide.

Organization and Use of the Guide

The pattern selection guide is based on value/texture changes as well as changes in pattern style. A copy of the guide can be found in the map pocket. Value/texture and style form the two dimensions of the guide with changes in pattern <u>style</u> along the vertical axis and changes in <u>texture</u> and <u>value</u> occurring along the horizontal axis. The resulting matrix has patterns of similar texture and style arranged in horizontal rows in which only style varies providing patterns

of equal visual significance. Patterns of the same style are arranged in columns where value increases to provide patterns of varying visual significance.

In selecting patterns for use on a zoning map, the map maker can select across a row for patterns to represent nominal data categories and select from a column to represent ordinal data categories. Using the map in Figure 1 as an example, the following zoning categories are present:

1) Recreational
2) Institutional
3) Commercial
4) Industrial
5) Residential-low density
6) Residential-high density

These include five nominal classes, with two residential categories in high and low ordinal classes. In mapping the nominal categories, five patterns might be selected from row two (Group III patterns) of the guide. To show the ordinal nature of the two residential categories a sixth pattern can be chosen. If, for example, a dot pattern was selected for the residential category then a high and low value dot pattern from the same column could be chosen. The resulting map (Figure 17) illustrates five nominal categories of equal visual significance and at the same time illustrates the ordinal relationship between two subdivisions of one category.

A few suggestions are in order for using the pattern selection guide. From investigation of existing zoning maps it was apparent that certain patterns are commonly used for

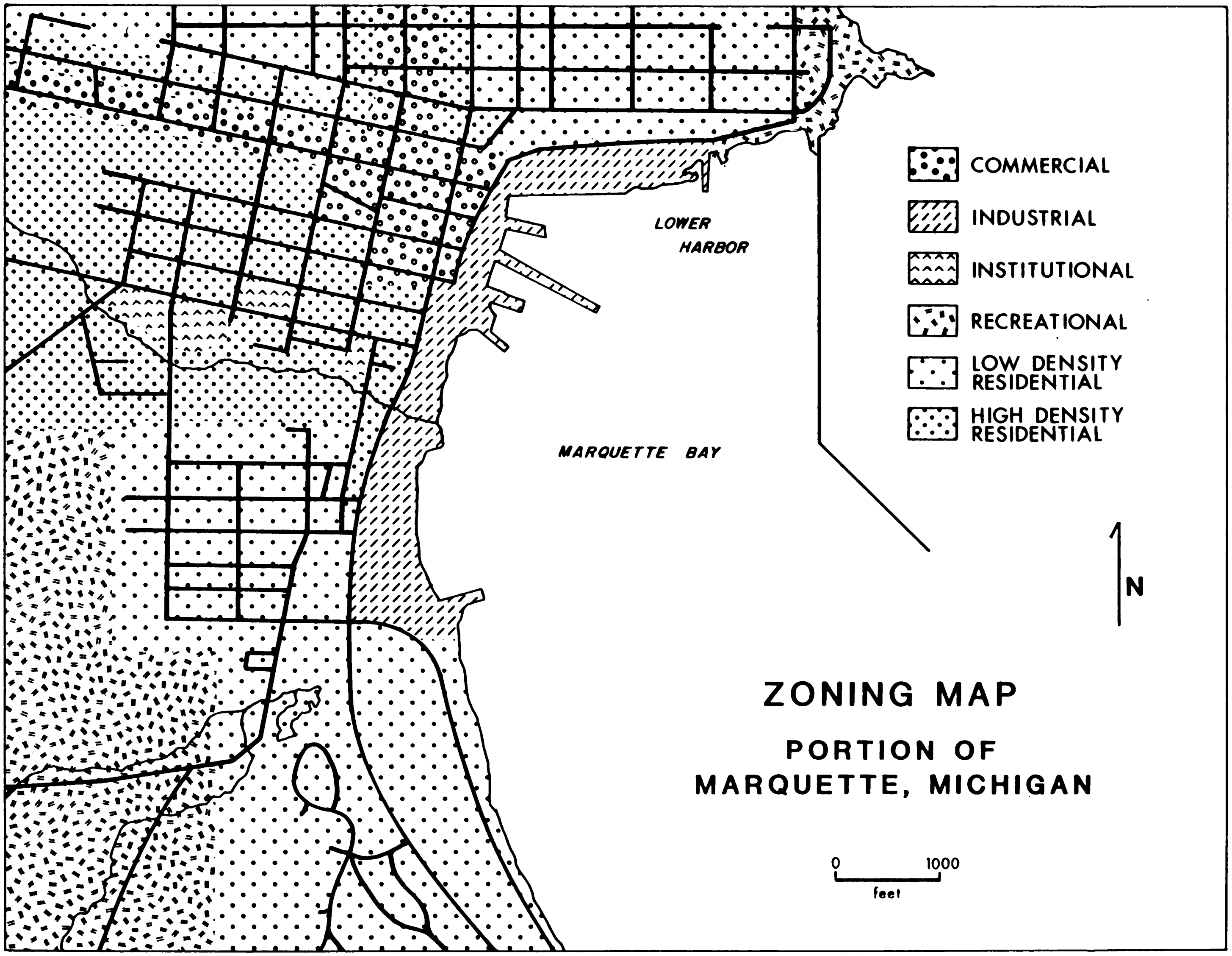


Figure 17: Zoning Map Utilizing Patterns From Guide

certain zoning categories. For example, dot patterns are most commonly used to represent residential categories on many zoning maps and pictographic vegetation patterns are often used to represent recreational areas. Symbol association may be an important aspect in zoning maps and when possible, associative patterns should be used to illustrate their corresponding zoning categories.

At times a zoning map is constructed and used to emphasize a certain category to the public or policy-makers. If a map is to be constructed with this use in mind, patterns of higher visual significance can emphasize the importance of certain categories over others. For example, industrial categories are at times represented by patterns of greater visual significance which connote an environmental impression (smoke, pollution) which people perceive. Care must be taken in emphasizing areas of nominal data as perceptual bias will be introduced.

The guide is limited in effectiveness because of the number of patterns from which to choose. Investigation of other patterns may help in the area of ordinal and nominal data mapping and at the same time improve and expand the content of the guide. While pattern orientation was found to have little effect on pattern perception, using different orientations of a pattern on a map is not recommended as it might imply a relationship between nominal categories. In addition, visual confusion is likely to result as the number or orientations increases. Orientation, in relation to line patterns poses a problem for the map-maker. A map-reader will tend to move his or her eyes in the direction of a line and the use of numerous orientations on a map forces the reader's eye to change direction frequently. This can result in difficulty in extracting information from the map. When it is necessary to use varying orientations of the same pattern on a map, it is advisable to avoid line patterns and to use other pattern styles with care.

Summary

The pattern selection guide provides the map-maker with a tool for mapping zoning data in a visually effective manner. The guide is based on groups of patterns with varying styles. Pattern groups were tested and only groups with patterns that were equal in visual significance were used in the guide while groups with patterns that differed in visual significance were rejected. Even with a limited number of patterns, the guide can help the cartographer or planner map zoning data in a more effective manner.

CHAPTER 5: FURTHER CONSIDERATIONS

The need for a pattern selection guide for mapping zoning data, as evidenced by the ineffectiveness of existing methods, prompted the present study. The objective of obtaining pattern groups of similar visual significance to represent nominal categories of zoning data was attempted through the investigation of patterns considered to be equal in visual significance. The analysis led to the development of the pattern selection guide based on pattern value and texture and on pattern style.

The zoning map pattern guide was based on Zirbel's more general guide and inherited some limitations from that study. The use of Zirbel's value and texture ratings eliminated the need for testing these characteristics, but at the same time, limited the number of patterns available for use. Further pattern elimination resulted in a guide involving only twenty-five of the original fifty-one patterns from Zirbel's study. Although this is a sufficient number for most zoning maps, more available patterns would be preferable. In selecting patterns from the guide, the map maker must also be conscious of the aesthetic quality of individual patterns, a consideration confronting the construction of all maps. "The map maker can only attempt to select a set of patterns which are pleasant to view and are individually and collectively appealing" (Zirbel, p. 41). The present study does not address this problem and, unfortunately, the guide provided no information concerning this critical mapping decision.

Results of this study provided additional insight into visual characteristics influencing pattern perception. The idea that patterns of similar value and texture generate similar visual prominence is not supported by the results of this study. Pattern orientation appears to have little effect on the visual importance of a pattern, but style may play a larger role than is thought in pattern prominence. Pattern adjacency may also influence pattern significance. Line patterns placed next to one another on a map are known to create noisy boundaries. A map reader experiences difficulty in focusing on the map and in extracting information. The aesthetic quality of a map can be greatly affected by the placement of adjacent patterns.

This study raises unanswered questions relating to the study of pattern perception and pattern use in the mapping of zoning data. There may be many additional patterns that could be included in the pattern selection guide and further research is needed to identify these. As Zirbel suggests, photographic reduction of patterns may give very different visual impressions to map readers. Another consideration might include the investigation of overlapping patterns. Both of these ideas would increase the number of available patterns for mapping nominal zoning data and provide planners and policy-makers with more effective maps.

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BIBLIOGRAPHY

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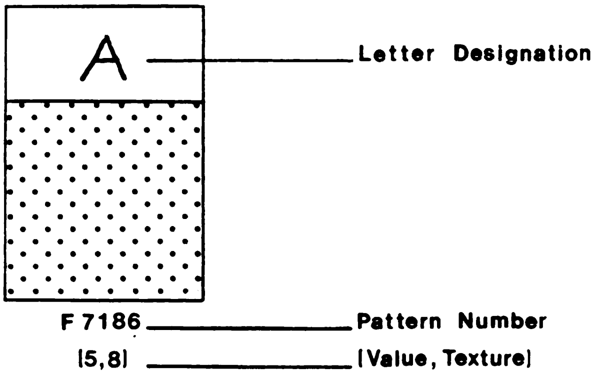
APPENDICES

APPENDIX A: GROUPS OF PATTERNS AND THEIR LETTER DESIGNATIONS



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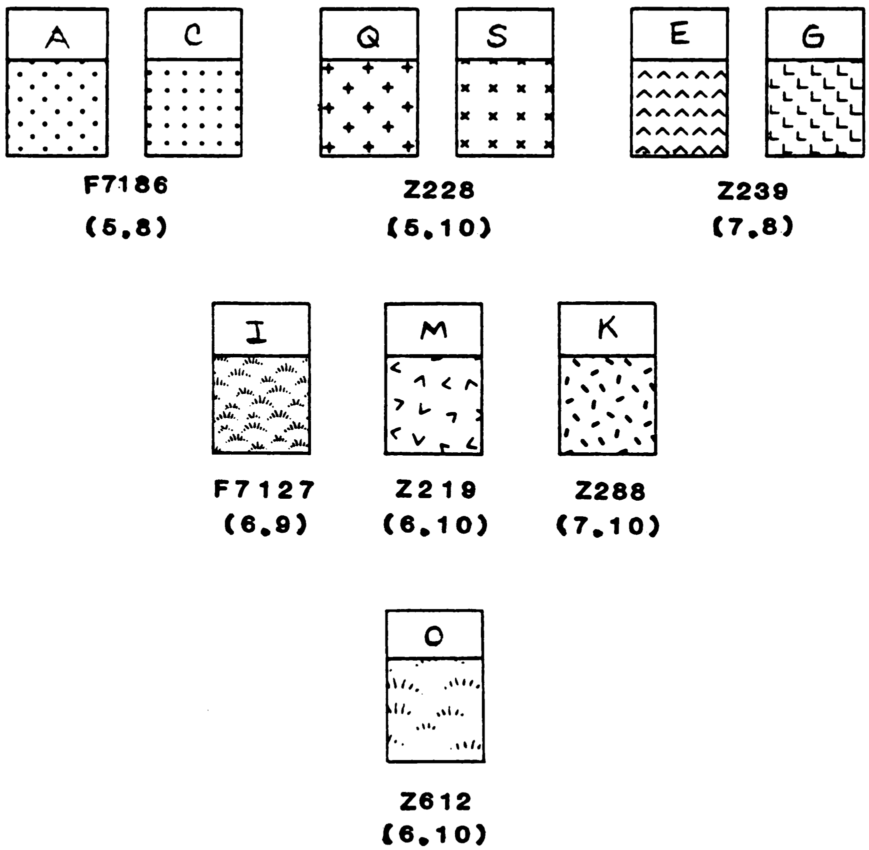

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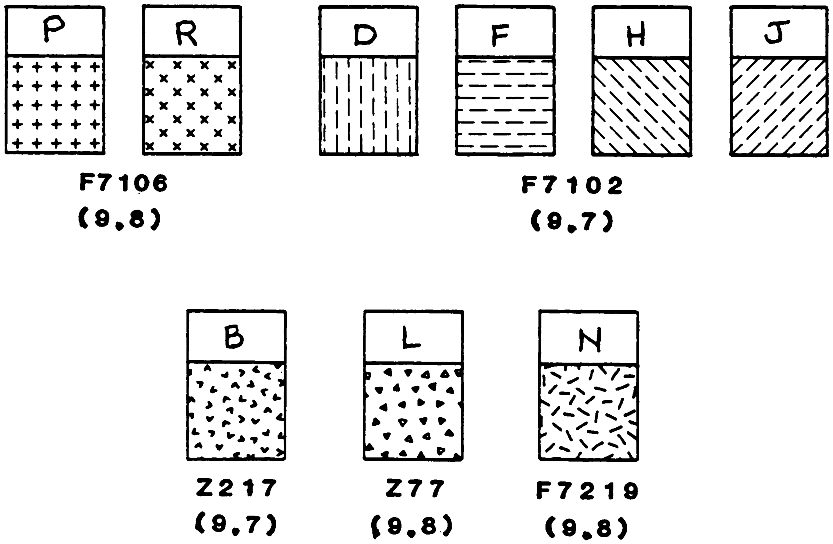

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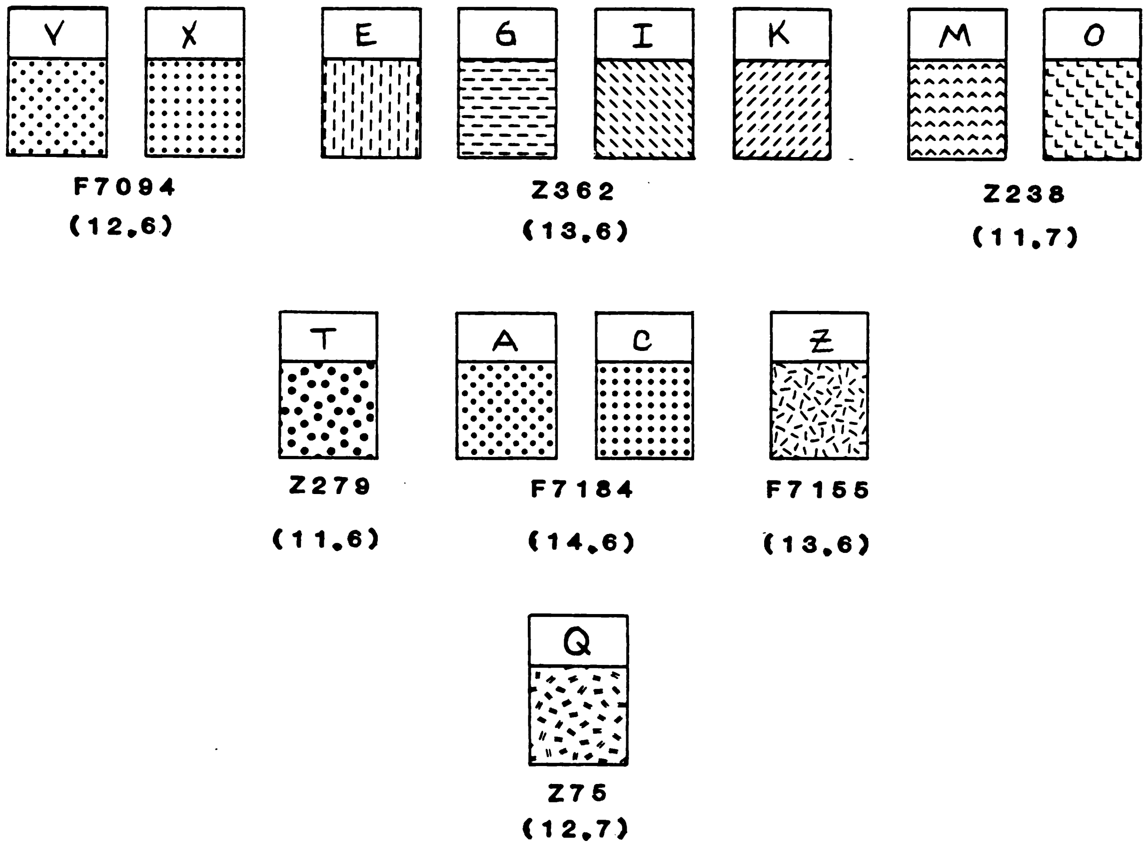

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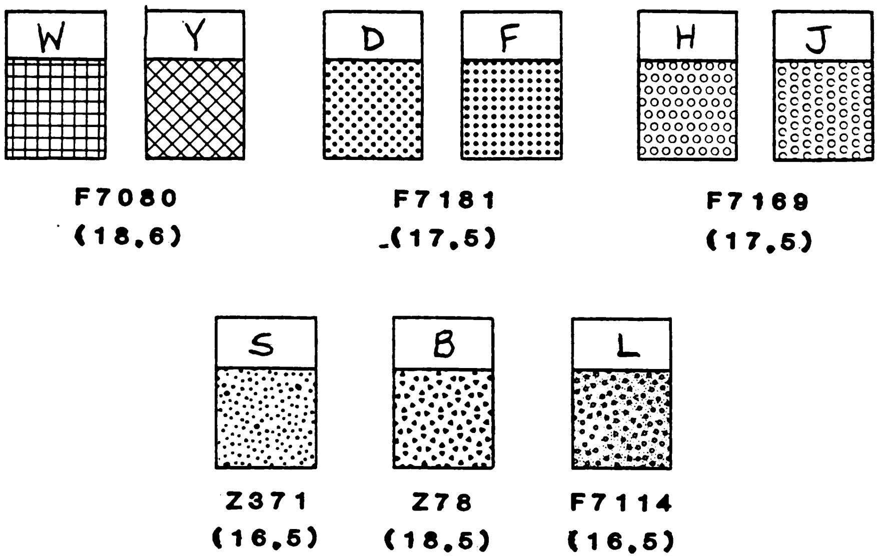

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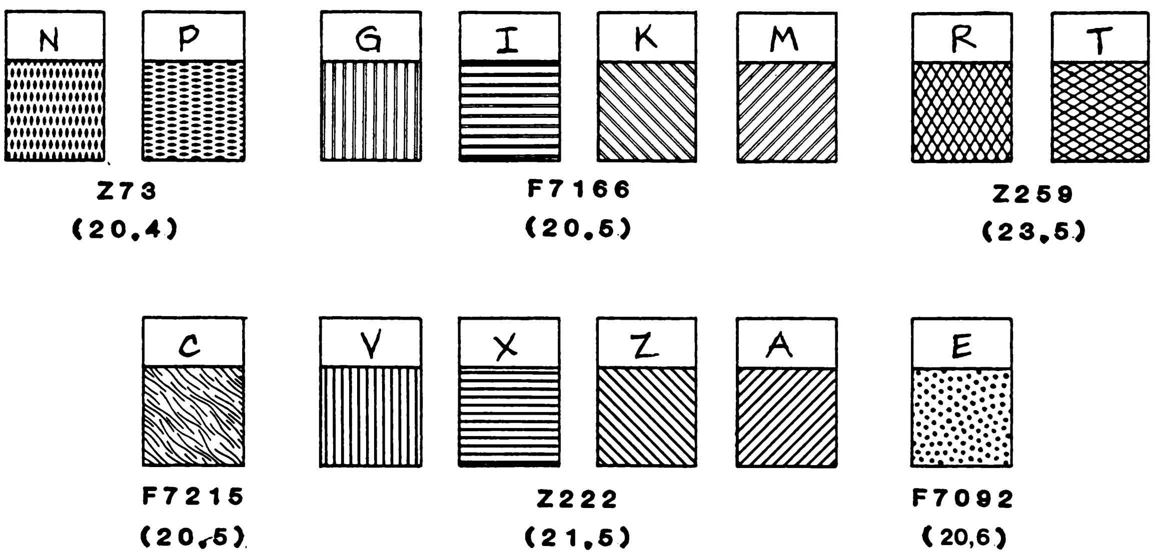

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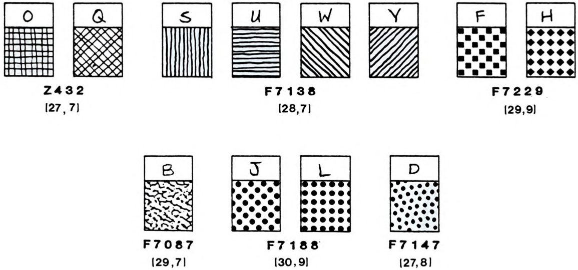
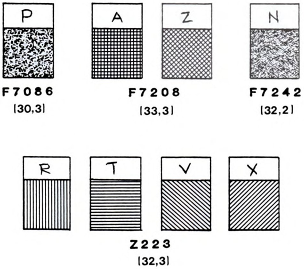


GROUP VII



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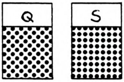
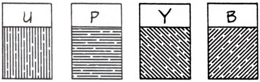
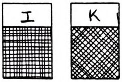


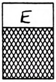


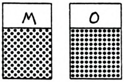


F7185
(35,5)

Z83
(37,5)

F7089
(38,4)



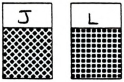


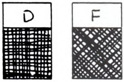
Z260
(36,4)

F7182
(34,5)

Z262
(35,4)

GROUP IX

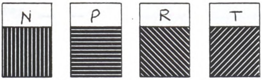




Z253
(44,5)

F7149
(48,4)

F7139
(52,3)



Z331
(73,4)

Appendix B. Test Questionnaire

QUESTIONNAIRE

In this questionnaire you will be asked to make a series of evaluations concerning the visual qualities of various map patterns. You will be given a number of patterns and will be asked to pick out the pattern that is most noticeable (the pattern that stands out or is eyecatching). You must then repeat this procedure with the remaining patterns. The result will be an arrangement of patterns from most noticeable to least noticeable.

PLEASE FOLLOW DIRECTIONS CAREFULLY!

For each envelope:

1. INDICATE ENVELOPE NUMBER IN BLANK.
2. Open envelope and view patterns on blank sheet of paper provided.
3. Arrange the patterns from most noticeable to least noticeable.
4. Write the letter designation of the patterns in the appropriate place along the line.
5. RETURN PATTERNS TO PROPER ENVELOPE.

EXAMPLE.

B C A E D

Most — Least

NOTICEABLE

Envelope Number ______

Most — Least

NOTICEABLE

Envelope Number ______

Most — Least

NOTICEABLE

Envelope Number ______

Most — Least

NOTICEABLE

Envelope Number ______

Most — Least

NOTICEABLE

APPENDIX C: QUESTIONNAIRE TEST RESULTS BY GROUP

TABLE 13
Frequency Responses for Group I Patterns

NOTICEABILITY RANKING	PATTERN							
	7186	239	7127	288	219	612	228	N
MOST 7	2	5	6	9	2	5	6	35
6	1	1	7	9	4	5	8	35
5	3	4	2	4	11	1	10	35
4	7	7	1	8	5	3	4	35
3	11	9	4	0	7	3	1	35
2	7	6	9	3	4	4	2	35
LEAST 1	4	3	6	2	1	15	4	35

TABLE 14
Frequency Responses for Group II Patterns

NOTICEABILITY RANKING	PATTERN					
	217	7102	277	7219	7106	N
MOST 5	2	4	2	22	6	36
4	5	3	13	4	11	36
3	7	3	12	7	7	36
2	8	7	7	3	11	36
LEAST 1	14	19	2	0	1	36

TABLE 15
Frequency Responses for Group III Patterns

NOTICEABILITY RANKING	PATTERN							
	279	7094	7155	7184	362	238	275	N
MOST 7	13	1	4	15	0	1	2	36
6	6	6	7	8	5	2	2	36
5	5	5	6	4	5	3	8	36
4	5	7	9	2	4	2	7	36
3	4	6	4	1	9	9	3	36
2	2	5	2	3	8	9	7	36
LEAST 1	1	6	4	3	5	10	7	36

TABLE 16

Frequency Responses for Group IV Patterns

NOTICEABILITY RANKING	PATTERN						
	371	7080	78	7181	7169	7114	N
MOST 6	2	10	8	13	2	1	36
5	0	8	16	9	2	1	36
4	11	6	8	7	2	2	36
3	10	5	2	3	10	6	36
2	6	2	2	4	3	19	36
LEAST 1	7	5	0	0	17	7	36

TABLE 17
Frequency Responses for Group V Patterns

NOTICEABILITY RANKING	PATTERN 73	259	222	7215	7092	7266	N
MOST 6	8	14	1	6	5	2	36
5	11	7	5	2	10	1	36
4	9	9	8	5	2	3	36
3	5	3	11	4	9	4	36
2	2	3	6	3	5	17	36
LEAST 1	1	0	5	16	5	9	36

TABLE 18
Frequency Responses for Group VI Patterns

NOTICEABILITY RANKING	PATTERN 432	7138	7087	7147	7229	7188	N
MOST 6	0	0	2	2	17	15	36
5	2	3	1	3	12	15	36
4	2	1	2	25	4	2	36
3	16	6	9	2	2	1	36
2	9	19	5	1	0	2	36
LEAST 1	7	7	17	3	1	1	36

TABLE 19
Frequency Responses for Group VII Patterns

NOTICEABILITY RANKING	PATTERN 7242	7086	223	7208	N
MOST 4	15	3	16	2	36
3	9	13	8	6	36
2	11	7	10	8	36
LEAST 1	1	13	2	20	36

TABLE 20
Frequency Responses for Group VIII Patterns

NOTICEABILITY RANKING	PATTERN 262	260	7089	7182	7185	83	N
MOST 6	2	0	3	0	29	2	36
5	4	3	5	23	1	0	36
4	7	7	11	4	4	3	36
3	7	12	10	2	1	4	36
2	9	10	7	7	0	3	36
LEAST 1	7	4	0	0	1	24	36

TABLE 21
Frequency Responses for Group IX Patterns

NOTICEABILITY RANKING	PATTERN 7139	7149	253	331	N
MOST 4	3	6	12	15	36
3	12	4	12	8	36
2	14	8	8	6	36
LEAST 1	7	18	4	7	36

APPENDIX D: RESULTS OF ORIENTATION TEST FOR GROUPS I THROUGH IX

FREQUENCY RESPONSES AND K-S TEST RESULTS
CRITICAL VALUE = .3429 α = .05

TABLE 22
Frequency Responses for Group I, Pattern 239

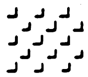
PATTERN	NOTICEABILITY						
239	7	6	5	4	3	2	1
	3	1	2	1	3	4	3
	2	0	2	6	6	2	0
Observed$_1$	.18	.24	.36	.42	.60	.83	1.0
Observed$_2$	.11	.11	.22	.55	.88	.99	1.0
Diff $\lvert O_1 - O_2 \rvert$	.07	.13	.14	.13	.28	.16	0

TABLE 23
Frequency Responses for Group I, Pattern 228

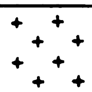
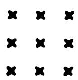
PATTERN	NOTICEABILITY						
228	7	6	5	4	3	2	1
	3	5	5	3	1	1	0
	3	3	5	1	0	1	4
Observed$_1$	.17	.45	.73	.89	.95	1.0	1.0
Observed$_2$	.18	.35	.65	.71	.71	.77	1.0
Diff $\lvert O_1 - O_2 \rvert$	.01	.10	.08	.18	.24	.23	0

TABLE 24a
Frequency Responses for Pattern 7102, Group II

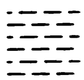
PATTERN	NOTICEABILITY				
7102	5	4	3	2	1
	1	0	1	1	6
	0	1	1	3	4
Observed d_1	.11	.11	.22	.33	1.0
Observed d_2	0	.11	.22	.55	1.0
Diff $\|O_1-O_2\|$	.11	0	0	.22	0

TABLE 24b

PATTERN	NOTICEABILITY				
7102	5	4	3	2	1
	1	0	1	1	6
	1	1	1	1	5
Observed d_1	.11	.11	.22	.33	1.0
Observed d_2	.11	.22	.33	.44	1.0
Diff $\|O_1-O_2\|$	0	.11	.11	.11	0

TABLE 24c

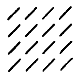
PATTERN	NOTICEABILITY				
7102	5	4	3	2	1
	1	0	1	1	6
	1	2	0	2	4
Observed d_1	.11	.11	.22	.33	1.0
Observed d_2	.11	.33	.33	.55	1.0
Diff $\|O_1 - O_2\|$	0	.22	.11	.22	0

TABLE 24d

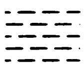
PATTERN	NOTICEABILITY				
7102	5	4	3	2	1
	0	1	1	3	4
	1	1	1	1	5
Observed d_1	0	.11	.22	.55	1.0
Observed d_2	.11	.22	.33	.44	1.0
Diff $\|O_1 - O_2\|$	.11	.11	.11	.11	0

TABLE 24e

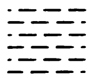
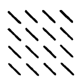
PATTERN	NOTICEABILITY				
7102	5	4	3	2	1
	0	1	1	3	4
	1	2	0	2	4
Observed d_1	0	.11	.22	.55	1.0
Observed d_2	.11	.33	.33	.55	1.0
Diff $\|O_1-O_2\|$	.11	.22	.11	0	0

TABLE 24f

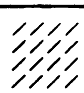
PATTERN	NOTICEABILITY				
7102	5	4	3	2	1
	1	1	1	1	5
	1	2	0	2	4
Observed d_1	.11	.22	.33	.44	1.0
Observed d_2	.11	.33	.33	.55	1.0
Diff $\|O_1-O_2\|$	0	.11	0	.11	0

TABLE 25
Frequency Respones for Pattern 7106, Group II

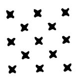
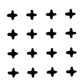
PATTERN	NOTICEABILITY				
7106	5	4	3	2	1
	1	6	3	8	0
	5	5	4	3	1
Observed_1	.06	.39	.56	1.0	1.0
Observed_2	.28	.56	.78	.94	1.0
Diff $\lvert O_1 - O_2 \rvert$	.22	.17	.22	.06	0

TABLE 26
Frequency Responses for Pattern 7094, Group III

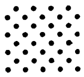
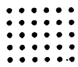
PATTERN 7094	NOTICEABILITY						
	7	6	5	4	3	2	1
	0	2	4	4	2	2	4
	1	4	1	3	4	3	2
$Observed_1$	0	.11	.33	.56	.67	.78	1.0
$Observed_2$	.06	.28	.33	.50	.72	.89	1.0
Diff $\|O_1-O_2\|$	.06	.17	0	.06	.05	.11	0

TABLE 27
Frequency Responses for Pattern 238, Group III

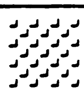
PATTERN 238	NOTICEABILITY						
	7	6	5	4	3	2	1
	1	2	2	0	5	4	4
	0	0	1	2	3	6	6
$Observed_1$	.06	.17	.28	.28	.56	.78	1.0
$Observed_2$	0	0	.11	.22	.39	.72	1.0
Diff $\|O_1-O_2\|$	.06	.17	.17	.06	.17	.06	0

TABLE 28a

Frequency Responses for Pattern 362, Group III

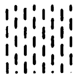
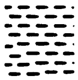
PATTERN	NOTICEABILITY						
362	7	6	5	4	3	2	1
	0	1	1	3	3	1	0
	0	0	1	2	2	2	2
Observed$_1$	0	.11	.22	.56	.89	1.0	1.0
Observed$_2$	0	.22	.33	.33	.56	.89	1.0
Diff $\lvert O_1-O_2 \rvert$	0	.11	.11	.23	.33	.11	0

TABLE 28b

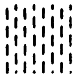
PATTERN	NOTICEABILITY						
362	7	6	5	4	3	2	1
	0	1	1	3	3	1	0
	0	2	1	1	3	1	1
Observed$_1$	0	.11	.22	.56	.89	1.0	1.0
Observed$_2$	0	.22	.33	.44	.78	.89	1.0
Diff $\lvert C_1-C_2 \rvert$	0	.11	.11	.12	.11	.11	0

TABLE 28c

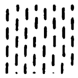
PATTERN 362	NOTICEABILITY						
	7	6	5	4	3	2	1
	0	1	1	3	3	1	0
	0	2	2	0	1	2	2
$Observed_1$	0	.11	.22	.56	.89	1.0	1.0
$Observed_2$	0	.22	.44	.44	.56	.78	1.0
Diff $\|O_1-O_2\|$	0	.11	.22	.12	.33	.22	0

TABLE 28d

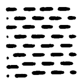
PATTERN 362	NOTICEABILITY						
	7	6	5	4	3	2	1
	0	0	1	2	2	2	2
	0	2	1	1	3	1	1
$Observed_1$	0	0	.11	.33	.56	.78	1.0
$Observed_2$	0	.22	.33	.44	.78	.89	1.0
Diff $\|C_1-C_2\|$	0	.22	.22	.11	.22	.11	0

TABLE 28e

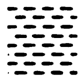
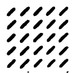
PATTERN 362	NOTICEABILITY						
	7	6	5	4	3	2	1
	0	0	1	2	2	2	2
	0	2	2	0	1	2	2
Observed_1	0	0	.11	.33	.56	.78	1.0
Observed_2	0	.22	.44	.44	.56	.78	1.0
Diff $\lvert O_1 - O_2 \rvert$	0	.22	.33	.11	0	0	0

TABLE 28f

PATTERN 362	NOTICEABILITY						
	7	6	5	4	3	2	1
	0	2	1	1	3	1	1
	0	2	2	0	1	2	2
Observed_1	0	.22	.33	.44	.78	.89	1.0
Observed_2	0	.22	.44	.44	.56	.78	1.0
Diff $\lvert C_1 - C_2 \rvert$	0	0	.11	0	.22	.11	0

TABLE 29
Frequency Responses for Pattern 7184, Group III

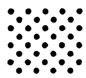
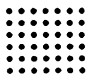
PATTERN 7184	NOTICEABILITY						
	7	6	5	4	3	2	1
	7	3	3	0	1	1	3
	8	5	1	2	0	2	0
$Observed_1$	.39	.56	.72	.72	.78	.83	1.0
$Observed_2$	.44	.72	.78	.89	.89	1.0	1.0
Diff $\|O_1 - O_2\|$	.05	.16	.06	.17	.11	.17	0

TABLE 30
Frequency Responses for Pattern 7080, Group IV

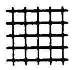
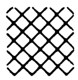
PATTERN 7080	NOTICEABILITY					
	6	5	4	3	2	1
	6	5	4	2	0	1
	4	3	2	3	2	4
Observed$_1$	.33	.61	.83	.94	.94	1.0
Observed$_2$	.22	.39	.50	.67	.78	1.0
Diff $\lvert O_1 - O_2 \rvert$	.11	.22	.33	.27	.16	0

TABLE 31
Frequency Responses for Pattern 7181, Group IV

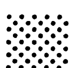
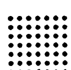
PATTERN 7181	NOTICEABILITY					
	6	5	4	3	2	1
	6	3	4	2	3	0
	8	5	3	1	1	0
Observed$_1$	.33	.50	.72	.83	1.0	1.0
Observed$_2$	.44	.72	.89	.94	1.0	1.0
Diff $\lvert O_1 - O_2 \rvert$	.11	.22	.17	.11	0	0

TABLE 32
Frequency Responses for Pattern 7169, Group IV

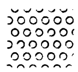
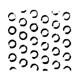
PATTERN 7169	NOTICEABILITY 6	5	4	3	2	1
	1	1	1	3	2	10
	1	1	1	7	1	7
$Observed_1$	.06	.11	.17	.33	.44	1.0
$Observed_2$	.06	.11	.17	.56	.61	1.0
Diff $\lvert O_1 - O_2 \rvert$	0	0	0	.23	.17	0

TABLE 33a
Frequency Responses for Pattern 7166, Group V

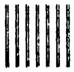
PATTERN 7166	NOTICEABILITY					
	6	5	4	3	2	1
	0	0	0	2	3	4
	0	1	1	2	4	1
Observed_1	0	0	0	.22	.56	1.0
Observed_2	0	.11	.22	.44	.89	1.0
Diff $\lvert O_1 - O_2 \rvert$	0	.11	.22	.22	.33	0

TABLE 33b

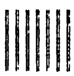
PATTERN 7166	NOTICEABILITY					
	6	5	4	3	2	1
	0	0	0	2	3	4
	0	1	1	0	5	2
Observed_1	0	0	0	.22	.56	1.0
Observed_2	0	.11	.22	.22	.78	1.0
Diff $\lvert O_1 - O_2 \rvert$	0	.11	.22	0	.22	0

TABLE 33c

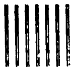
PATTERN 7166	NOTICEABILITY					
	6	5	4	3	2	1
	0	0	0	2	3	4
	0	0	2	2	3	2
Observed$_1$	0	0	0	.22	.56	1.0
Observed$_2$	0	0	.22	.44	.78	1.0
Diff $\lvert O_1 - O_2 \rvert$	0	0	.22	.22	.22	0

TABLE 33d

PATTERN 7166	NOTICEABILITY					
	6	5	4	3	2	1
	0	1	1	2	4	1
	0	1	1	0	5	2
Observed$_1$	0	.11	.22	.44	.89	1.0
Observed$_2$	0	.11	.22	.22	.78	1.0
Diff $\lvert O_1 - O_2 \rvert$	0	0	0	.22	.11	0

TABLE 33e

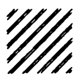
PATTERN 7166	NOTICEABILITY					
	6	5	4	3	2	1
	0	1	1	2	4	1
	0	0	2	2	3	2
Observed_1	0	.11	.22	.44	.89	1.0
Observed_2	0	0	.22	.44	.78	1.0
Diff $\lvert O_1 - O_2 \rvert$	0	.11	0	0	.11	0

TABLE 33f

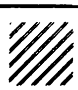
PATTERN 7166	NOTICEABILITY					
	6	5	4	3	2	1
	0	1	1	0	5	2
	0	0	2	2	3	2
Observed_1	0	.11	.22	.22	.78	1.0
Observed_2	0	0	.22	.44	.78	1.0
Diff $\lvert O_1 - O_2 \rvert$	0	.11	0	.22	0	0

TABLE 34
Frequency Responses for Pattern 73, Group V

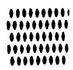
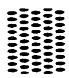
PATTERN	NOTICEABILITY					
73	6	5	4	3	2	1
	4	5	5	4	0	0
	4	6	4	1	2	1
Observed_1	.22	.50	.78	1.0	1.0	1.0
Observed_2	.22	.55	.78	.83	.94	1.0
Diff $\lvert O_1 - O_2 \rvert$	0	.05	0	.17	.06	0

TABLE 35
Frequency Responses for Pattern 259, Group V

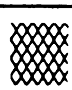
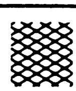
PATTERN	NOTICEABILITY					
259	6	5	4	3	2	1
	10	3	4	1	0	0
	4	3	6	2	3	0
Observed_1	.56	.67	.94	1.0	1.0	1.0
Observed_2	.22	.39	.72	.83	1.0	1.0
Diff $\lvert O_1 - O_2 \rvert$	.34	.28	.22	.17	0	0

TABLE 36a
Frequency Responses for Pattern 222, Group V

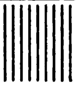
PATTERN 222	NOTICEABILITY 6	5	4	3	2	1
	0	0	1	3	4	1
	1	1	3	2	0	2
Observed$_1$	0	0	.11	.44	.89	1.0
Observed$_2$	.11	.11	.56	.78	.78	1.0
Diff $\lvert O_1 - O_2 \rvert$	.11	.22	.45	.34	.11	0

TABLE 36b

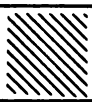
PATTERN 222	NOTICEABILITY 6	5	4	3	2	1
	0	0	1	3	4	1
	0	1	3	4	0	1
Observed$_1$	0	0	.11	.44	.89	1.0
Observed$_2$	0	.11	.44	.89	.89	1.0
Diff $\lvert O_1 - O_2 \rvert$	0	.11	.33	.45	0	0

TABLE 36c

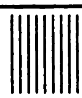
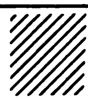
PATTERN 222	NOTICEABILITY 6	5	4	3	2	1
	0	0	1	3	4	1
	0	3	1	2	2	1
Observed_1	0	0	.11	.44	.89	1.0
Observed_2	0	.33	.44	.66	.89	1.0
Diff $\lvert O_1 - O_2 \rvert$	0	.33	.33	.22	0	0

TABLE 36d

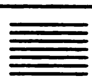
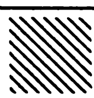
PATTERN 222	NOTICEABILITY 6	5	4	3	2	1
	1	1	3	2	0	2
	0	1	3	4	0	1
Observed_1	.11	.22	.56	.78	.78	1.0
Observed_2	0	.11	.44	.89	.89	1.0
Diff $\lvert O_1 - O_2 \rvert$	.11	.11	.12	.11	.11	0

TABLE 36e

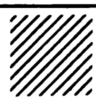
PATTERN	NOTICEABILITY					
222	6	5	4	3	2	1
	1	1	3	2	0	2
	0	3	1	2	2	1
Observed$_1$	.11	.22	.56	.76	.76	1.0
Observed$_2$	0	.33	.44	.67	.89	1.0
Diff $\|O_1-O_2\|$	.11	.11	.12	.11	.11	0

TABLE 36f

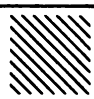
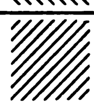
PATTERN	NOTICEABILITY					
222	6	5	4	3	2	1
	0	1	3	4	0	1
	0	3	1	2	2	1
Observed$_1$	0	.11	.44	.89	.89	1.0
Observed$_2$	0	.33	.44	.67	.89	1.0
Diff $\|O_1-O_2\|$	0	.22	0	.22	0	0

TABLE 37
Frequency Responses for Pattern 432, Group VI

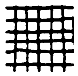
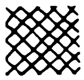
PATTERN	NOTICEABILITY					
432	6	5	4	3	2	1
	0	2	2	8	4	2
	0	0	0	8	5	5
Observed$_1$	0	.11	.22	.67	.89	1.0
Observed$_2$	0	0	0	.44	.72	1.0
Diff $\|O_1 - O_2\|$	0	.11	.22	.23	.17	0

TABLE 38
Frequency Responses for Pattern 7229, Group VI

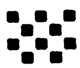
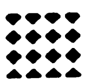
PATTERN	NOTICEABILITY					
7229	6	5	4	3	2	1
	8	7	1	1	0	1
	10	4	3	1	0	0
Observed$_1$	.44	.83	.89	.94	.94	1.0
Observed$_2$	.56	.78	.94	.99	1.0	1.0
Diff $\|O_1 - O_2\|$	.11	.05	.05	.05	.06	0

TABLE 39a
Frequency Response for Pattern 7138, Group VI

PATTERN	NOTICEABILITY					
7138	6	5	4	3	2	1
	0	2	0	1	5	1
	0	1	0	1	6	1
$Observed_1$	0	.22	.22	.33	.89	1.0
$Observed_2$	0	.11	.11	.22	.89	1.0
Diff $\lvert O_1 - O_2 \rvert$	1	.11	.11	.11	0	0

TABLE 39b

PATTERN	NOTICEABILITY					
7138	6	5	4	3	2	1
	0	0	0	2	5	2
	0	0	1	2	3	3
$Observed_1$	0	0	0	.22	.78	1.0
$Observed_2$	0	0	.11	.33	.67	1.0
Diff $\lvert O_1 - O_2 \rvert$	0	0	.11	.11	.11	0

TABLE 39c

PATTERN	NOTICEABILITY					
7138	6	5	4	3	2	1
	0	2	0	1	5	1
	0	0	0	2	5	2
Observed$_1$	0	.22	.22	.33	.89	1.0
Observed$_2$	0	0	0	.22	.78	1.0
Diff $\lvert O_1 - O_2 \rvert$	0	.22	.22	.11	.11	0

TABLE 39d

PATTERN	NOTICEABILITY					
7138	6	5	4	3	2	1
	0	2	0	1	5	1
	0	0	1	2	3	3
Observed$_1$	0	.22	.22	.22	.89	1.0
Observed$_2$	0	0	.11	.33	.67	1.0
Diff $\lvert O_1 - O_2 \rvert$	0	.22	.11	0	.22	0

TABLE 39e

PATTERN	NOTICEABILITY					
7138	6	5	4	3	2	1
	0	0	0	2	5	2
	0	1	0	1	6	1
$Observed_1$	0	0	0	.22	.78	1.0
$Observed_2$	0	.11	.11	.22	.89	1.0
Diff $\|O_1-O_2\|$	0	.11	.11	0	.11	0

TABLE 39f

PATTERN	NOTICEABILITY					
7138	6	5	4	3	2	1
	0	0	1	2	3	3
	0	1	0	1	6	1
$Observed_1$	0	0	.11	.33	.67	1.0
$Observed_2$	0	.11	.11	.22	.89	1.0
Diff $\|O_1-O_2\|$	0	.11	0	.11	.22	0

TABLE 40
Frequency Responses for Pattern 7188, Group VI

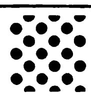
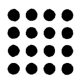
PATTERN	NOTICEABILITY					
7188	6	5	4	3	2	1
	9	7	1	0	1	0
	6	8	1	1	1	1
Observed$_1$	.50	.89	.94	.94	1.0	1.0
Observed$_2$	.33	.78	.83	.89	.94	1.0
Diff $\lvert O_1 - O_2 \rvert$	.28	.11	.11	.05	.06	0

TABLE 41a

Frequency Responses for Pattern 223, Group VII

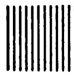
PATTERN 223	NOTICEABILITY 4	3	2	1
	2	1	4	2
	0	2	2	5
Observed$_1$	.22	.33	.78	1.0
Observed$_2$	0	.22	.44	1.0
Diff $\lvert O_1 - O_2 \rvert$	.22	.11	.33	0

TABLE 41b

PATTERN 223	NOTICEABILITY 4	3	2	1
	2	1	4	2
	0	3	0	6
Observed$_1$	.22	.33	.78	1.0
Observed$_2$	0	.33	.33	1.0
Diff $\lvert O_1 - O_2 \rvert$	.22	0	.45	0

TABLE 41c

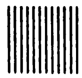
PATTERN 223	NOTICEABILITY 4	3	2	1
	2	1	4	2
	2	0	2	5
$Observed_1$	.22	.33	.78	1.0
$Observed_2$	.22	.22	.44	1.0
Diff $\lvert O_1 - O_2 \rvert$	0	.11	.33	0

TABLE 41d

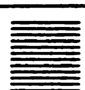
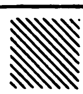
PATTERN 223	NOTICEABILITY 4	3	2	1
	0	2	2	5
	2	0	2	5
$Observed_1$	0	.22	.44	1.0
$Observed_2$	.22	.22	.44	1.0
Diff $\lvert O_1 - O_2 \rvert$	.22	0	0	0

TABLE 41e

PATTERN 223	NOTICEABILITY 4	3	2	1
	0	2	2	5
	0	3	0	6
Observed$_1$	0	.22	.44	1.0
Observed$_2$	0	.33	.33	1.0
Diff $\|O_1-O_2\|$	0	.11	.11	0

TABLE 41f

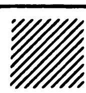
PATTERN 223	NOTICEABILITY 4	3	2	1
	0	3	0	6
	2	0	2	5
Observed$_1$	0	.33	.33	1.0
Observed$_2$	.22	.22	.44	1.0
Diff $\|O_1-O_2\|$	.22	.11	.11	0

TABLE 42
Frequency Responses for Pattern 7208, Group VII

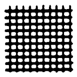
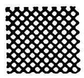
PATTERN	NOTICEABILITY			
7208	4	3	2	1
	5	6	5	2
	11	2	5	0
Observed d_1	.28	.61	.89	1.0
Observed d_2	.61	.72	1.0	1.0
Diff $\lvert O_1 - O_2 \rvert$	.33	.11	.11	0

TABLE 43a
Frequency Responses for Pattern 83, Group VIII

PATTERN	NOTICEABILITY					
83	6	5	4	3	2	1
	0	0	0	1	1	7
	2	0	0	2	1	4
Observed$_1$	0	0	0	.11	.22	1.0
Observed$_2$	.22	.22	.22	.44	.56	1.0
Diff $\|O_1-O_2\|$	.22	.22	.22	.33	.34	0

TABLE 43b

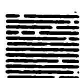
PATTERN	NOTICEABILITY					
83	6	5	4	3	2	1
	0	0	0	1	1	7
	0	0	1	0	1	7
Observed$_1$	0	0	0	.11	.22	1.0
Observed$_2$	0	0	.11	.11	.22	1.0
Diff $\|O_1-O_2\|$	0	0	.11	0	0	0

TABLE 43c

PATTERN 83	NOTICEABILITY 6	5	4	3	2	1
	2	0	0	2	1	4
	0	0	1	0	1	7
Observed$_1$	.22	.22	.22	.44	.55	1.0
Observed$_2$	0	0	.11	.11	.22	1.0
Diff $\|O_1-O_2\|$	.22	.22	.11	.33	.33	0

TABLE 43d

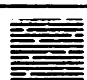
PATTERN 38	NOTICEABILITY 6	5	4	3	2	1
	0	0	2	1	1	5
	0	0	0	1	1	7
Observed$_1$	0	0	.22	.33	.44	1.0
Observed$_2$	0	0	0	.11	.22	1.0
Diff $\|O_1-O_2\|$	0	0	.22	.22	.22	0

TABLE 43e

PATTERN	NOTICEABILITY					
83	6	5	4	3	2	1
	0	0	2	1	1	5
	2	0	0	2	1	4
Observed$_1$	0	0	.22	.33	.44	1.0
Observed$_2$	.22	.22	.22	.44	.56	1.0
Diff $\|O_1-O_2\|$	.22	.22	0	.11	.12	0

TABLE 43f

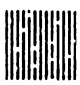
PATTERN	NOTICEABILITY					
83	6	5	4	3	2	1
	0	0	2	1	1	5
	0	0	1	0	1	7
Observed$_1$	0	0	.22	.33	.44	1.0
Observed$_2$	0	0	.11	.11	.22	1.0
Diff $\|O_1-O_2\|$	0	0	.11	.22	.22	0

TABLE 44
Frequency Responses for Pattern 7185, Group VIII

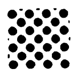
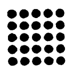
PATTERN 7185	NOTICEABILITY					
	6	5	4	3	2	1
	15	1	0	1	0	1
	14	0	4	0	0	0
Observed_1	.83	.89	.89	.94	.94	1.0
Observed_2	.78	.78	1.00	1.00	1.00	1.0
Diff $\lvert O_1 - O_2 \rvert$	.15	.11	.11	.06	.06	0

TABLE 45
Frequency Responses for Pattern 260, Group VIII

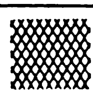
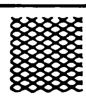
PATTERN 260	NOTICEABILITY					
	6	5	4	3	2	1
	0	1	3	7	3	4
	0	2	4	5	7	0
Observed_1	0	.06	.22	.61	.78	1.0
Observed_2	0	.11	.36	.61	1.00	1.0
Diff $\lvert O_1 - O_2 \rvert$	0	.05	.11	0	.22	0

TABLE 46
Frequency Responses for Pattern 7089, Group VIII

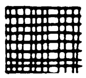
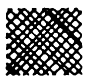
PATTERN	NOTICEABILITY					
7089	6	5	4	3	2	1
	1	2	6	5	4	0
	2	3	5	5	3	0
Observed_1	.06	.17	.50	.78	1.0	1.0
Observed_2	.11	.27	.56	.83	1.0	1.0
Diff $\lvert O_1 - O_2 \rvert$	.05	.10	.06	.05	0	0

TABLE 47
Frequency Responses for Pattern 7182, Group VIII

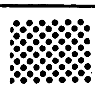
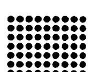
PATTERN	NOTICEABILITY					
7182	6	5	4	3	2	1
	0	10	2	2	4	0
	0	13	3	0	2	0
Observed_1	0	.56	.67	.78	1.0	1.0
Observed_2	0	172	189	189	1.0	1.0
Diff $\lvert O_1 - O_2 \rvert$	0	.16	.22	.11	0	0

TABLE 48a
Frequency Responses for Pattern 331, Group IX

PATTERN	NOTICEABILITY			
331	4	3	2	1
	4	3	1	1
	4	2	1	2
$Observed_1$	.44	.78	.89	1.0
$Observed_2$	.44	.67	.78	1.0
Diff $\|O_1 - O_2\|$	0	.11	.11	0

TABLE 48b

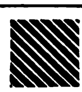
PATTERN	NOTICEABILITY			
331	4	3	2	1
	4	3	1	1
	2	5	1	1
$Observed_1$	.44	.78	.89	1.0
$Observed_2$	.22	.78	.89	1.0
Diff $\|O_1 - O_2\|$	.22	0	0	0

TABLE 48c

PATTERN	NOTICEABILITY			
331	4	3	2	1
	4	3	1	1
	3	2	1	3
$Observed_1$	.44	.78	.89	1.0
$Observed_2$	.33	.56	.67	1.0
Diff $\lvert O_1 - O_2 \rvert$	.11	.22	.23	0

TABLE 48d

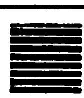
PATTERN	NOTICEABILITY			
331	4	3	2	1
	4	2	1	2
	2	5	1	1
$Observed_1$	.44	.67	.78	1.0
$Observed_2$	.22	.78	.89	1.0
Diff $\lvert O_1 - O_2 \rvert$	.22	.11	.11	0

TABLE 48e

PATTERN	NOTICEABILITY			
331	4	3	2	1
	4	2	1	2
	3	2	1	3
Observed$_1$	.44	.67	.78	1.0
Observed$_2$	.33	.56	.67	1.0
Diff $\|O_1-O_2\|$	.11	.11	.11	0

TABLE 48f

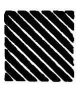
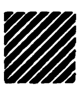
PATTERN	NOTICEABILITY			
331	4	3	2	1
	2	5	1	1
	3	2	1	3
Observed$_1$	.22	.78	.89	1.0
Observed$_2$	.33	.56	.67	1.0
Diff $\|O_1-O_2\|$	.11	.22	.22	0

TABLE 49
Frequency Responses for Pattern 7139, Group IX

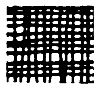
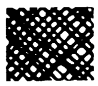
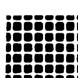
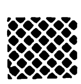
PATTERN	NOTICEABILITY			
7139	4	3	2	1
	2	7	7	2
	1	5	7	5
Observed$_1$	.11	.50	.89	1.0
Observed$_2$	.06	.33	.72	1.0
Diff $\|O_1-O_2\|$	.05	.17	.17	0

TABLE 50
Frequency Responses for Pattern 253, Group IX

PATTERN	NOTICEABILITY			
253	4	3	2	1
	6	7	5	0
	6	5	3	4
Observed$_1$	.33	.72	1.00	1.0
Observed$_2$	.33	.61	.78	1.0
Diff $\|O_1-O_2\|$	0	.11	.22	0