

Understanding Christopher Alexander's Fifteen Properties via Visualization and Analysis

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Christopher Alexander defines the concepts of wholeness and centers in his book *The Nature of Order*, and emphasizes the idea that a whole makes its parts, rather than the idea that a whole consists of parts. To clarify the difference, he calls the parts made by a whole as “centers.” He says that there are some or many centers within a whole, and they intensify each other. In his book, he proposes fifteen fundamental properties to show how centers intensify each other. This paper presents an illustration summarizing the fifteen fundamental properties and explains the dependencies between them. To show the interaction of the fifteen properties, we use correspondence analysis, a statistical technique providing graphic representation. Then, we map the illustration of each property on a plot of the correspondence analysis. We anticipate that these illustrations and plots will help a broad audience to conceptualize the fifteen properties.

Fifteen Fundamental Properties, Center, Wholeness; The Nature of Order; Correspondence Analysis

1. Introduction

When Christopher Alexander proposed the idea of pattern language, he aimed to support people's realization of the "Quality Without A Name" and their participation in design in the field of architecture. He states in his book *The Timeless Way of Building*, "There is a central quality which is the root criterion of life and spirit in a man, a town, a building, or a wilderness. This quality is objective and precise, but it cannot be named" (Alexander, 1979, p. 19). He named the quality as the "Quality Without A Name" because he did not understand it deeply at that time.

After publishing *A Pattern Language* (Alexander et al., 1977) and *The Timeless Way of Building* (Alexander, 1979), Alexander explored the quality more deeply for about 30 years and published The Nature of Order, in which he emphasizes the concept of life. His notion of "life" does not mean creatures in a biological sense but rather in a broad sense. For example, waves and fire are alive; i.e., they have some degree of life. He writes, "What I mean is that the wave itself — the system which in present-day science we have considered as a purely mechanical hydrodynamical system of moving water — has some degree of life" (Alexander, 2002, p. 31).

Christopher Alexander defines the concepts of wholeness and centers in his book *The Nature of Order, Book One* (Alexander, 2002). As he describes, his concept of wholeness is quite different from the conventional one, in which a whole consists of parts. He emphasizes the idea that a whole makes its parts, rather than the idea that a whole consists of parts. To clarify the difference, he calls the parts made by a whole as "centers." Thus, a whole consists of the centers it makes. Unlike a part, the boundary of a center is fuzzy. Note that the concept of center does not mean a particular location in space, such as the center of a circle or the midpoint of a line. Instead, it means a source of the living power and the essence of phenomena.

Alexander says that there are some or many centers within a whole, and they intensify each other. As a result of this coherence, the whole becomes profound and lively. In *The Nature of Order, Book One* (Alexander, 2002), Alexander proposes fifteen fundamental properties to show how centers intensify each other: (1) LEVELS OF SCALE, (2) STRONG CENTERS, (3) BOUNDARIES, (4) ALTERNATING REPETITION, (5) POSITIVE SPACE, (6) GOOD SHAPE, (7) LOCAL SYMMETRIES, (8) DEEP INTERLOCK AND AMBIGUITY, (9) CONTRAST, (10) GRADIENTS, (11) ROUGHNESS, (12) ECHOES, (13) THE VOID, (14) SIMPLICITY AND INNER CALM, and (15) NOT-SEPARATENESS.

In this paper, we will show illustrations each representing the fifteen properties and analyze

interactions among the fifteen properties. To understand deeper the order, it is necessary to understand both of how the centers intensify each other and the how the properties interact each other. The deeper understanding will help us to apply fifteen properties to other domains.

2. Visualizing the Fifteen Properties

The summaries of the fifteen fundamental properties based on our interpretation of Alexander's concepts of wholeness and centers are as follows. Also, we attempt to visualize the fifteen properties described in *The Nature of Order*, beyond the expressions. Figure 1-15 show illustrations summarizing the fifteen properties, where these illustrations are based on our interpretations, derived from Alexander's explanation in Chapter 5 "Fifteen Fundamental Properties" and Chapter 6 "The Fifteen Properties in Nature" in *The Nature of Order*, Book One (Alexander, 2002). These illustrations show that centers intensify each other inside the whole, not just drawn as a symbol.

1. **LEVELS OF SCALE.** Centers intensify each other when they are different in size. The gap between different scales must not be very large, and practically, one center would be half or twice the size of another. If there is a well-ordered range of sizes, a field effect is formed, and then, a whole is made by tying the centers together. Our illustration of this property is shown in Figure 1.



Figure 1: LEVELS OF SCALE

2. **STRONG CENTERS.** A living whole contains strong centers within it. The concept of a strong center is applied recursively; every strong center is made up from multiple smaller strong centers. Nevertheless, there is often a principal strong center in a whole. The strong center has a field effect generated by nesting. Our illustration of this property is shown in Figure 2.



Figure 2: STRONG CENTERS

3. BOUNDARIES. The ring-like center, made up from smaller centers, forms a field-like effect that intensifies the center that is bounded. It also unites the center that is bounded with the world beyond the boundary. Note that the order of the magnitude of the boundary and the center that is bounded needs to be same. Our illustration of this property is shown in Figure 3.



Figure 3: BOUNDARIES

4. ALTERNATING REPETITION. Centers are intensified when they repeat with subtle variation. Alternating repetition is not just simple repetition because what are repeated are modified according to their positions in a whole. When this rule is applied recursively to all entities, spaces between the entities, and the process of repetition, beautiful harmony is created. The pattern of repeating centers forms the field effect, and as a result, wholeness emerges. Our illustration of this property is shown in Figure 4.

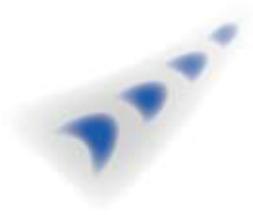


Figure 4: ALTERNATING REPETITION

5. **POSITIVE SPACE.** A living whole only has strong centers, where every part of space has the positive shape as a center. There is never any leftover from an adjacent shape. Our illustration of this property is shown in Figure 5.

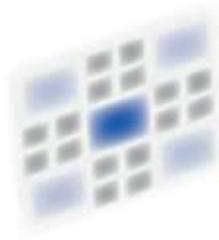


Figure 5: POSITIVE SPACE

6. **GOOD SHAPE.** A living whole has a good shape as a whole that is made up from multiple coherent centers. The good shape is the attribute of the whole, but the whole must be made up from intense centers that themselves are wholes. In that sense, the elements of a good shape are also good shapes themselves. Note that the result of a good shape is not only to make things beautiful but also to make them more profound and effective. Our illustration of this property is shown in Figure 6.



Figure 6: GOOD SHAPE

7. LOCAL SYMMETRIES. A living whole contains various symmetrical segments that interlock and overlap with each other. This feature of symmetry is called local symmetry to distinguish from overall symmetry. Each local symmetrical segment consists of smaller centers and creates a coherence of the centers. Local symmetries are not distinct but overlap with each other. This continuous overlapping of local symmetries works as a glue that establishes a whole. Our illustration of this property is shown in Figure 7.

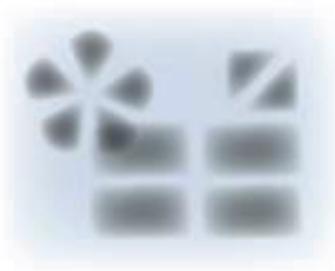


Figure 7: LOCAL SYMMETRIES

8. DEEP INTERLOCK AND AMBIGUITY. A living whole has some forms that interlock centers with its surroundings. The centers and their surroundings interpenetrate through a third set of centers that ambiguously belong to both. Our illustration of this property is shown in Figure 8.

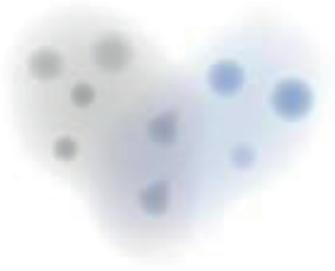


Figure 8: DEEP INTERLOCK AND AMBIGUITY

9. CONTRAST. A center is intensified by the sharp distinction between the character of the center and surrounding centers. For example, the forms of contrast are black/white, dark/light, empty/full, solid/void, and busy/silent. The difference between opposites not only separates things but also brings them together. Our illustration of this property is shown in Figure 9.

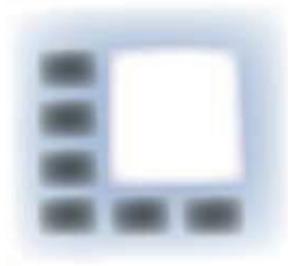


Figure 9: CONTRAST

- 10. GRADIENTS.** Qualities vary gradually, not suddenly, across space in a living whole. A graded series of different-sized centers forms new centers that have a field effect as a whole. These gradients are caused by responding to the natural variation of the circumstance. Our illustration of this property is shown in Figure 10.



Figure 10: GRADIENTS

- 11. ROUGHNESS.** Living wholes have some local irregularities within them. The irregularities are caused by adapting to irregularities in the environment and responding to the demands and constraints from other nearby centers, not by arbitrary decisions in the design. In that sense, roughness is a form of perfection. Our illustration of this property is shown in Figure 11.

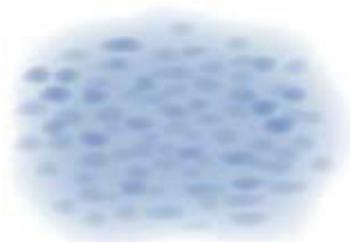


Figure 11: ROUGHNESS

- 12. ECHOES.** A living whole contains deep underlying similarities within it. These similarities do not exist merely at a superficial level, but they exist in a deeper level of the structure, derived from similarities in the process of creating them. The similarities of elements attach them together to form a unity. Our illustration of this property is shown in Figure 12.



Figure 12: ECHOES

- 13. THE VOID.** Centers are intensified by the existence of an empty center. This emptiness needs to exist in the field to preserve the balance between calmness and emptiness. Our illustration of this property is shown in Figure 13.

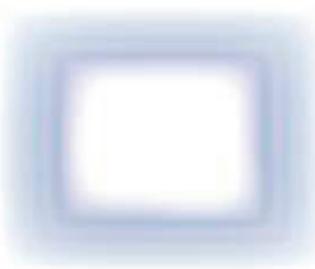


Figure 13: THE VOID

- 14. SIMPLICITY AND INNER CALM.** A living whole has certain slowness, majesty, and quietness, i.e., a state of inner calm. This quality derives from inner simplicity, where everything that is unnecessary is removed. It does not refer to simplicity in the superficial sense but refers to the true simplicity of the heart. Our illustration of this property is shown in Figure 14.



Figure 14: SIMPLICITY AND INNER CALM

- 15. NOT-SEPARATENESS.** In a living whole, any centers deeply connect and melt into their surroundings, not separate from them. They are merged inseparably, but they still have their character and personality. To achieve this connectedness, the boundary between the centers and their surroundings are fragmented or gradient. As a result of this deep coherence, things feel completely at peace. Our illustration of this property is shown in Figure 15.



Figure 15: NOT-SEPARATENESS

3. Analyzing Interactions among the Fifteen Properties

The interactions of the fifteen properties are shown in a table in the section “Fifteen fundamental properties” in *The Nature of Order, Book One* (p. 238) (Alexander, 2002). In the table, “if property A depends on property B or we need property B for a complete understanding of property A then an asterisk appears in cell AB.” Figure 16 shows the table, and Figure 17 depicts the dependencies among the properties based on the table

THE INTERACTIONS OF THE FIFTEEN PROPERTIES	
If property A depends on property B or we need property B for a complete understanding of property A then an asterisk appears in cell AB	
	PROPERTY B
PROPERTY A	
	Levels of Scale
	Strong Centers
	Boundaries
	Alternating Repetition
	Positive Space
	Good Shape
	Local Symmetries
	Deep Interlock and Ambiguity
	Contrast
	Gradients
	Roughness
	Echoes
	The Void
	Simplicity and Inner Calm
	Not-Separateness
Levels of Scale	* *
Strong Centers	* * * *
Boundaries	* * * * *
Alternating Repetition	* * * * *
Positive Space	* * * * * *
Good Shape	* * * * * *
Local Symmetries	* * * * *
Deep Interlock and Ambiguity	* * * * * *
Contrast	* * * * *
Gradients	* * * * * *
Roughness	* * * * * *
Echoes	* * * * * *
The Void	* * * * * *
Simplicity and Inner Calm	* * * * * *
Not-Separateness	* * * * * *

Figure 16: Interactions of the fifteen properties
(from *The Nature of Order*, Book One, p. 238)

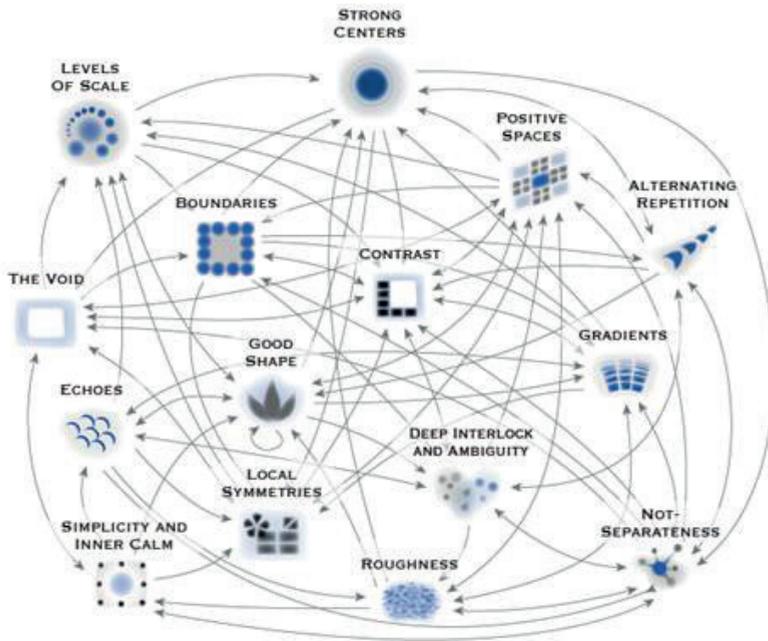


Figure 17: Network among the fifteen properties

To understand deeper the interactions among properties, we used the correspondence analysis, a statistical technique providing graphic representation. The multidimensional relations among the categories of the variables were calculated according to the χ^2 distances between them and projected on a map. Symmetric normalization was utilized to examine the relations between lines and columns of the contingency table. The contingency table was prepared using the table titled "The interactions of the fifteen properties" in the section "Fifteen fundamental properties" in *The Nature of Order, Book One* (Alexander, 2002, p. 238). If property A of each line category needed property B of column, we filled in "1"; otherwise, we filled in "0." The line score was projected on the map. The categories located near each other on the map are closely associated. Figure 18 shows the results of the correspondence analysis using the SPSS (Statistical Package for the Social Sciences) software package (version 21.0).

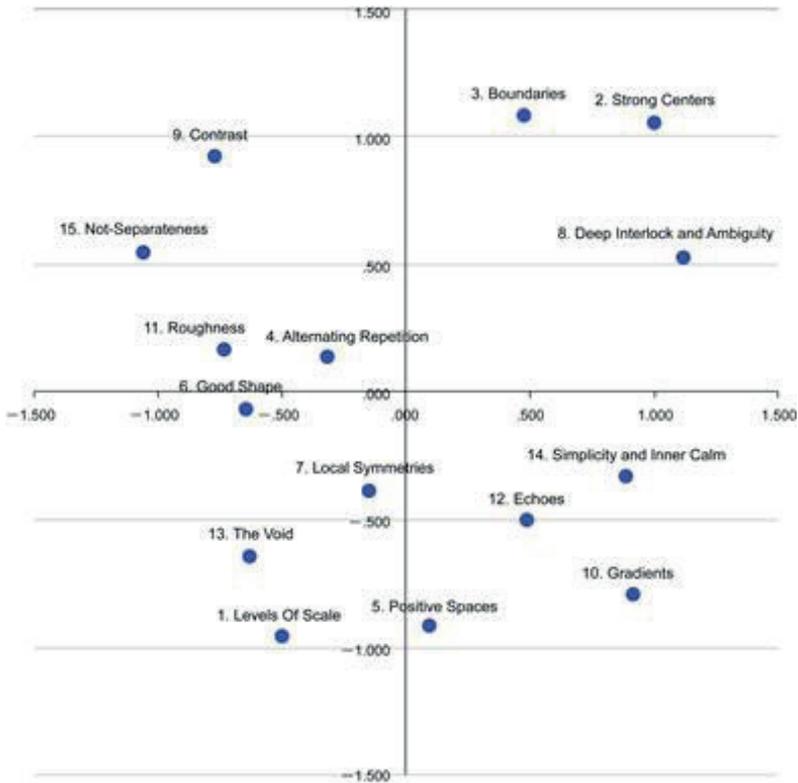


Figure 18: Plot of the results of correspondence analysis of the fifteen properties

Figure 19 is the illustration-mapping version of the plot of the correspondence analysis of the fifteen properties. Figures 20 and 21 are plots showing clusters that are grouped among close properties. Figure 19 has four clusters. The first cluster consists of (9) CONTRAST, (15) NOT-SEPARATENESS, (11) ROUGHNESS, (4) ALTERNATING REPETITION, and (6) GOOD SHAPE, among which GOOD SHAPE also appears in other groups. The second cluster consists of (7) LOCAL SYMMETRIES, (13) THE VOID, (1) LEVELS OF SCALE, (6) GOOD SHAPE, and (5) POSITIVE SPACE, among which GOOD SHAPE and POSITIVE SPACE also appear in other groups. The third cluster consists of (3) BOUNDARIES, (2) STRONG CENTERS, and (8) DEEP INTERLOCK AND AMBIGUITY. Finally, the fourth cluster consists of (14) SIMPLICITY AND INNER CALM, (12) ECHOES, (10) GRADIENTS, and (5) POSITIVE SPACE, among which POSITIVE SPACE appears also in other groups.

Figure 20 shows five clusters. The first cluster consists of (9) CONTRAST and (15) NOT-SEPARATENESS. The second cluster consists of (11) ROUGHNESS, (4) ALTERNATING REPETITION,

and (6) GOOD SHAPE. The third cluster consists of (7) LOCAL SYMMETRIES, (13) THE VOID, (1) LEVELS OF SCALE, and (5) POSITIVE SPACE. The fourth cluster consists of (3) BOUNDARIES, (2) STRONG CENTERS, and (8) DEEP INTERLOCK AND AMBIGUITY. The fifth cluster consists of (14) SIMPLICITY AND INNER CALM, (12) ECHOES, and (10) GRADIENTS.

Because the properties in each cluster appear to be similar or interrelated, we may understand the coherency among them from the plots and clusters. Further discussion is open.

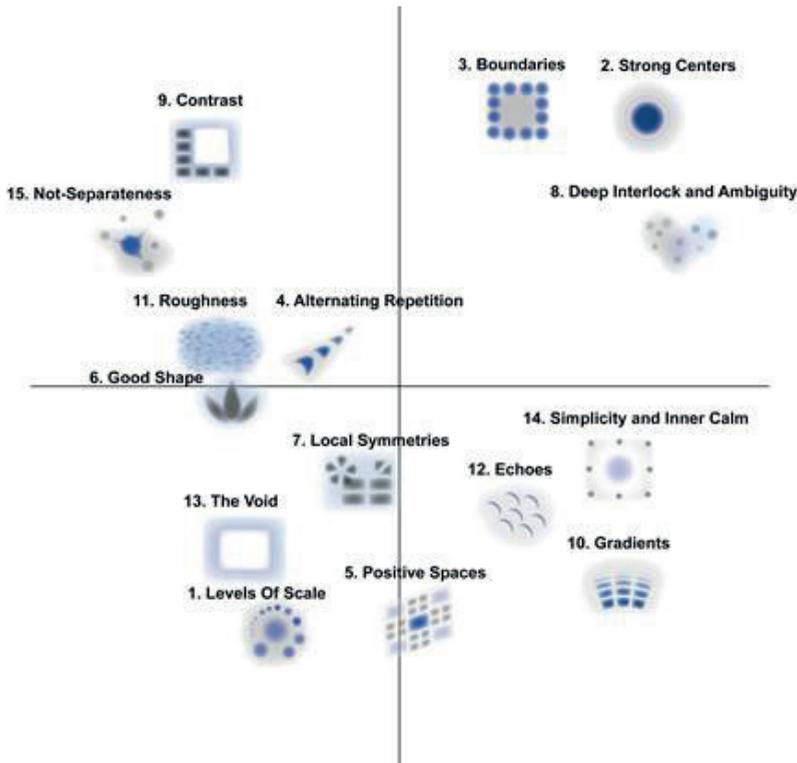


Figure 19: Mapping illustrations on the plot of correspondence analysis of the fifteen properties

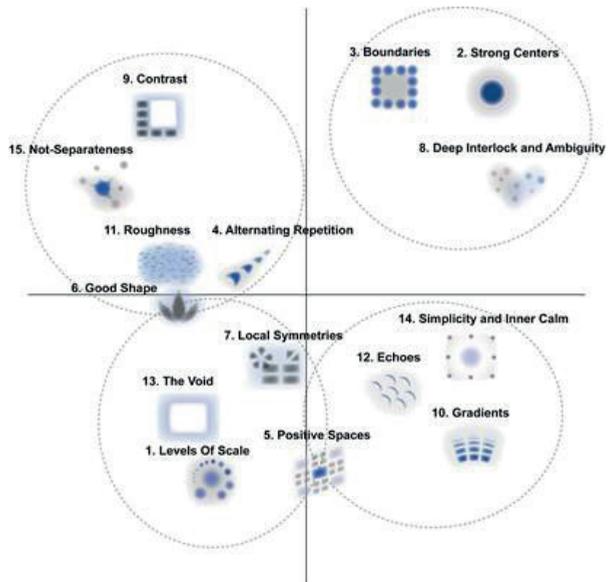


Figure 20: Rough grouping with 4 clusters on the plot of correspondence analysis of the fifteen properties

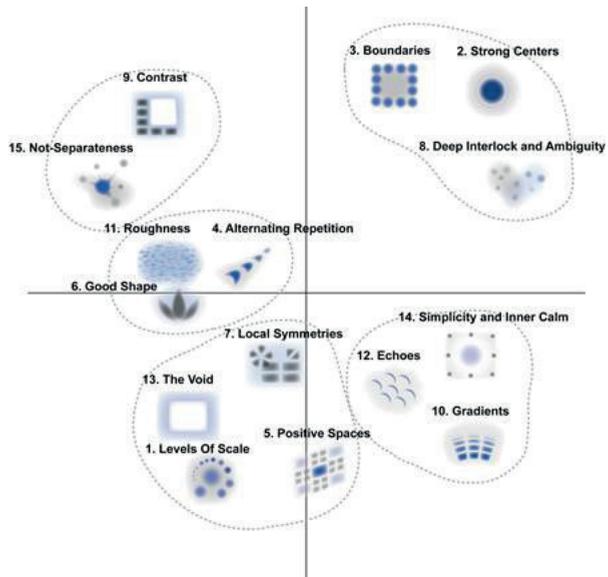


Figure 21: Detailed grouping with 5 clusters on the plot of correspondence analysis of the fifteen properties

4. Conclusion

In this paper, we present illustrations of the fifteen properties proposed by Christopher Alexander in *The Nature of Order, Book One* (Alexander, 2002): (1) LEVELS OF SCALE, (2) STRONG CENTERS, (3) BOUNDARIES, (4) ALTERNATING REPETITION, (5) POSITIVE SPACE, (6) GOOD SHAPE, (7) LOCAL SYMMETRIES, (8) DEEP INTERLOCK AND AMBIGUITY, (9) CONTRAST, (10) GRADIENTS, (11) ROUGHNESS, (12) ECHOES, (13) THE VOID, (14) SIMPLICITY AND INNER CALM, and (15) NOT-SEPARATENESS. Moreover, we show the plots of the correspondence analysis of the properties, then map the illustrations on the plots, and show the clusters of the properties. The results imply that combining visualization and analysis is useful to arrive at a deeper understanding of the fifteen properties. We anticipate that the results will open the door to a new way of discussing the fifteen properties.

5. References

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