

The Fundamental Behavioral Properties

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In this paper, we present 24 behavioral properties that capture “wholeness” in a lively human activity. In dynamic order like human activity, there is a wholeness, which cannot be understood by separating as parts. Based on Christopher Alexander’s theory of wholeness and center, we explore how centers create the wholeness of human activity. The properties are: 1. BOOTSTRAP, 2. SOURCE, 3. SPREADING, 4. ATTRACTION, 5. INVOLVING, 6. TOGETHERNESS, 7. BUILDING UP, 8. ORGANIC GROWTH, 9. REFLECTING, 10. ACCOMPANY, 11. ENHANCEMENT, 12. EMPATHY, 13. SELECTION, 14. SIMPLIFICATION, 15. CONSISTENCY, 16. LOOSENESS, 17. FLEXIBILITY, 18. ABUNDANCE, 19. ENDEAVOR, 20. CONNECTING, 21. POSITIONING, 22. DIFFERENTIATING, 23. OVERLAPPING, and 24. CONTINUOUS RELATION. These properties were found through the investigation of pattern languages of human action, and can be put to use to create new pattern languages or designing human activities.

behavioral properties; wholeness and center; Christopher Alexander; The Nature of Order; pattern language

1. INTRODUCTION

Wholeness is present in an activity where people or organizations work in a lively way. It is difficult to understand wholeness if it is separated into parts. This is because partial activities interact with each other in dynamic order like human activity.

For example, German composer Ludwig van Beethoven was most creative while taking a walk; he brought blank scores and a pen to his walk, and wrote his ideas whenever he needed to. Beethoven is said to have settled on the melodic subject for the second movement, known as the “scene by the brook,” of his Pastoral Symphony while walking along the Shriver River. It is impossible to capture his creative activity as a whole when we consider his act of *composing* and *walking* as individual actions. That is because the liveliness of his creative activity comes from the interaction of his *composing* and *walking*.

It is impossible to understand the wholeness of lively human activity by dividing the whole into parts. This means that wholeness is not a sum of separable parts. So in what way can we capture and understand wholeness?

2. WHOLENESS AND CENTER

Christopher Alexander explains his theory of creating wholeness in his book, *The Nature of Order* (Alexander, 2002a). He defines a basic unit, called a “center,” as an element of a lively wholeness. Wholeness is a conception in which parts and wholes work in a holistic way. In order to explain his theory consistently, he called all single elements of the whole “centers.” In other words, wholeness, which is not decomposable, is a “system of larger and smaller centers, in their connection, and overlap” (Alexander, 2002a, p. 90). A lively wholeness has a structure where centers reinforce each other.

Since there is also wholeness in lively human activities, we must consider the whole, and the centers that intensify the whole to capture its wholeness. What this means is that there are centers that create wholeness and intensify wholeness by strengthening each other in a human activity, making the activity lively.

For example, a boy might become interested in space and astrophysics by coincidentally finding a book on the origin of our galaxy in a library. His curiosity then might grow as he learns more and more. The excitement of his deepening knowledge could push him to know more, and he may finally become a specialist on galaxy. In this example, the interest in the galaxy is a center. The whole activity becomes lively as the center becomes intensified by other centers, such as reading books, meeting people, and hearing their stories.

As above, wholeness in lively human activity is created by the interaction between the centers. In what follows, we will propose properties by which the centers intensify each other.

3. HUMAN ACTIVITY AND BEHAVIORAL PROPERTIES

In this section, we will overview of behavioral properties that create wholeness in lively human activities. Through analyzing pattern languages of lively human activity, we found 24 properties of how centers strengthen each other to create the wholeness (Figure 1, Table 1).

The 24 properties we found are as follows: 1. BOOTSTRAP, 2. SOURCE, 3. SPREADING, 4. ATTRACTION, 5. INVOLVING, 6. TOGETHERNESS, 7. BUILDING UP, 8. ORGANIC GROWTH, 9. REFLECTING, 10. ACCOMPANY, 11. ENHANCEMENT, 12. EMPATHY, 13. SELECTION, 14. SIMPLIFICATION, 15. CONSISTENCY, 16. LOOSENESS, 17. FLEXIBILITY, 18. ABUNDANCE, 19. ENDEAVOR, 20. CONNECTING, 21. POSITIONING, 22. DIFFERENTIATING, 23. OVERLAPPING, and 24. CONTINUOUS RELATION.

The way in which these properties were found, the detailed explanation of each property, and its usage are written in sections 4, 5, and 6.

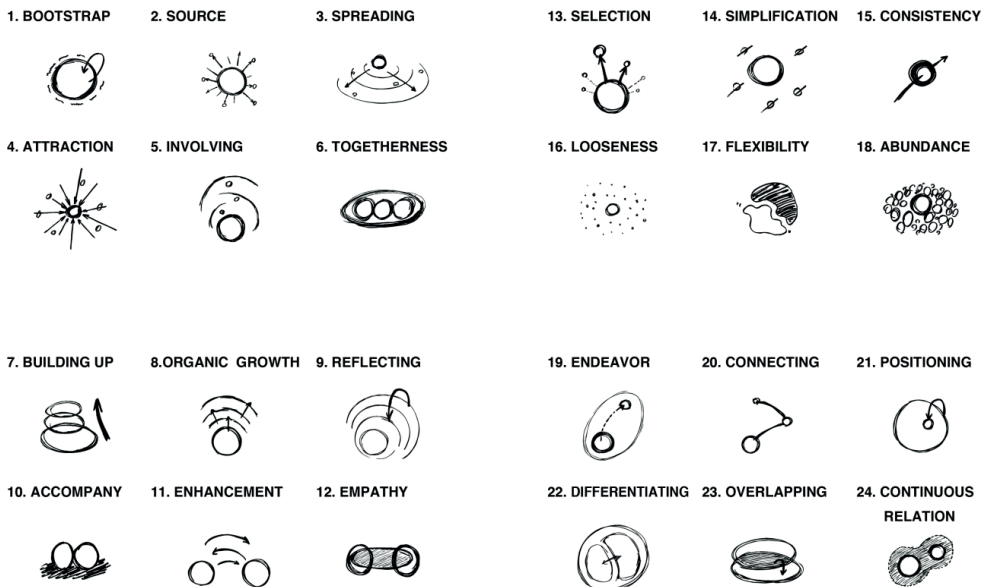


Figure 1: The Overall Picture of 24 Behavioral Properties

No.	Name	Summary
1	BOOTSTRAP	Centers that radiate their own energy recursively strengthen themselves through their own energy, rather than using other centers to strengthen.
2	SOURCE	An overwhelmingly strong center becomes a spring of energy and strengthens the surrounding centers, making the whole lively.
3	SPREADING	Power extends as a center strengthens the surrounding centers, and as those surrounding centers also strengthen their surrounding centers, creating a larger center.
4	ATTRACTION	A center with attractive power extracts the power of surrounding centers, ending up strengthening the attractive center itself.
5	INVOLVING	A center, which functions as a core, makes the whole lively by involving centers that are necessary for strengthening itself.
6	TOGETHERNESS	When small centers strengthen each other, they create a larger center that enfolds them, and as they reinforce each other, it makes the whole lively.
7	BUILDING UP	A whole becomes livelier as centers build up with consistency, repeatedly creating larger centers containing them.
8	ORGANIC GROWTH	By gradually growing while keeping its structure, a center can grow without losing its power, making the whole livelier.
9	REFLECTING	As a center reflects on the trajectory of its change, each trajectory becomes a new center and strengthens other centers, making the whole lively.
10	ACCOMPANY	The center by itself may be powerless, but it becomes affected by the power of the second center, being strengthened as a result.
11	ENHANCEMENT	The chain reaction of mutual enhancement between centers will result in an intensification of the liveliness of the whole.
12	EMPATHY	A center sometimes becomes strengthened when another center shows empathy towards it, and when the center shows empathy back, resonance is created.
13	SELECTION	Selecting centers to strengthen makes a center able to concentrate on specific centers, creating a relationship of strengthening between them.
14	SIMPLIFICATION	The center can effectively strengthen the surrounding centers by cutting off the relationship with incongruent centers.
15	CONSISTENCY	The whole becomes lively when centers with same direction align, creating an inclusive center.
16	LOOSENESS	The whole can be livelier when the relationship of centers is loose.
17	FLEXIBILITY	A center with flexibility adapts to the differences between centers in a relationship, creating numbers of relationships, making the whole lively.
18	ABUNDANCE	The core center of a whole can get strengthened when there are an abundance of centers, strengthening abundance of centers back.

19	ENDEAVOR	Working diligently towards a shining center can strengthen a center, and as the shining center becomes synergistically strengthened, these centers create a larger center and become lively as a whole.
20	CONNECTING	A new connection between centers strengthens each other, creating a larger center with greater power than the individual centers.
21	POSITIONING	Clearly positioned in a whole, centers can release their energy at its best to the surrounding centers, making the whole lively.
22	DIFFERENTIATING	When a center is differentiated into several centers, each center's individual power gets strengthened as those centers strengthen each other, creating a living whole.
23	OVERLAPPING	The whole becomes lively as the overlapped part of overlapping centers becomes a new center and forms a strengthening relationship with the original centers.
24	CONTINUOUS RELATION	Centers having a continuous relationship get strengthened as the relationship becomes extended, and their strength becomes greater as a whole.

Table 1: Thumbnails of 24 Behavioral Properties

4. How Behavioral Properties were found

In order to determine the properties, we analyzed patterns of human action that we had previously created (Figure 2). In *The Nature of Order*, Book 2, Alexander says that a pattern language is an essential way of defining generic centers (Alexander, 2002b, p. 344). This means that it is possible to capture centers by investigating pattern languages. Based on this, we could capture the centers in human activities from the patterns and find the properties with their commonalities.

The basic strategies are as given: investigate pattern languages of human action in order to find out the mechanism that is creating the liveliness behind each pattern; verify the universality necessary for the properties of the mechanism by checking if they can describe other patterns' liveliness; express how the discovered properties generate the mechanism for liveliness by illustration and description while thinking about the relationship between the properties.

4.1. Finding the Mechanism Behind the Patterns

We examined human action pattern languages previously described, which helped us find these behavioral properties. We analyzed three human action pattern languages: *Learning Patterns* (Iba & Iba Lab, 2014a), *Collaboration Patterns* (Iba & Iba Lab, 2014b), and *Presentation Patterns* (Iba & Iba Lab, 2014c), which were created by Iba laboratory. Iba laboratory has

been creating pattern languages in order to seek liveliness in human activity. We hypothesized that through an investigation of these human action pattern languages, we could find the core properties shared within lively human activity. Similarly, Alexander investigated buildings and carpets with “life” to find and note the geometrical properties of “liveliness.”

We began by reading patterns in order to understand liveliness within the patterns and the kinds of mechanism that create that liveliness. The action of centers behind the patterns is what we call the behavioral properties. For example, a pattern talks about the importance of an environment that creates togetherness when working in a group. In this case, the members of the group can be regarded as interacting centers, and togetherness can be regarded as a larger center. We can then understand that when interacting centers create a larger center encompassing them, togetherness, which is a form of lively human activity, is created. We then grouped the patterns that share similar action in their centers, which led us to find a basis for behavioral properties.

4.2. Refining and Revising Properties

In order to validate our findings, we then used the properties we found to examine the liveliness of other human action pattern languages. By doing so, we were able to verify their universality, also finding some missing properties. Additionally, through this refining process, some properties that had been considered core properties were removed.

We continued to apply this process to other pattern languages in order to check whether the analysis of liveliness of human activity is possible and whether it is useful to use these behavioral properties. Some of the patterns we used for this process are “Generative Beauty Patterns” (Arao et al., 2013), “Creative CoCooking Patterns” (Isaku & Iba, 2015), and *Words for a Journey: The Art of Being with Dementia* (Iba et al., 2015), which were also created by Iba Laboratory. The other pattern languages for human actions such as *Fearless Change* patterns (Manns and Rising, 2005, 2015), Pedagogical Patterns (Pedagogical Patterns Editorial Board, 2012), and Creative Thinking patterns (Kohls, 2012, 2015) were not used as sources when mining the properties. We will examine the properties with these pattern languages in near future.

4.3. Describing Behavioral Properties

Finally, while considering the relationship between these behavioral properties, we added illustrations and descriptions in order to make them shareable (Figure 1, Table 1). Thinking about the relationships of properties helped to validate and clarify them. With the addition of illustrations and words, the behavioral properties appeared to be more useful, particularly in dialogs and for mining more and better patterns for human activity.



Figure 1: The Overall Picture of 24 Behavioral Properties

5. TWENTY-FOUR FUNDAMENTAL BEHAVIORAL PROPERTIES

In this section, we will explain each behavioral property in detail. The 24 properties are divided into four groups, based on how centers strengthen each other in that property. Note that detailed examples and the description with patterns are shown in Iba et al. (2015), Harashima et al. (2015), and Akado et al. (2016).

First of all, 1. BOOTSTRAP, 2. SOURCE, 3. SPREADING, 4. ATTRACTION, 5. INVOLVING, and 6. TOGETHERNESS are in a group in which centers intensify themselves with their energy.

1. BOOTSTRAP: In a living whole, there are centers that radiate their own energy (Figure 3). Rather than using other centers to strengthen them, these centers are recursively strengthened by themselves. During this process, power spreads out to its surroundings, which eventually actualizes a living whole. These centers are a core element upon which the lively process is built.



Figure 3: BOOTSTRAP

2. SOURCE: The existence of one overwhelmingly strong center in a whole makes it lively (Figure 4). The overwhelmingly strong center becomes a spring of energy and strengthens the surrounding centers. As surrounding centers get strengthened, the strong center gets even stronger.

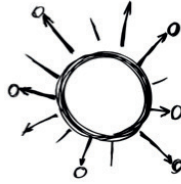


Figure 4: SOURCE

3. SPREADING: The power extends as a center strengthens the surrounding centers, and those surrounding centers also strengthen their surrounding centers (Figure 5). As power extends, it creates a larger center, which also strengthens the centers within it.



Figure 5: SPREADING

4. ATTRACTION: There is a center that has an attractive power in a living whole (Figure 6). It attracts other centers and pulls out the power of those centers, which end up strengthening the strong center itself. The whole becomes livelier as the attractive power gets stronger.

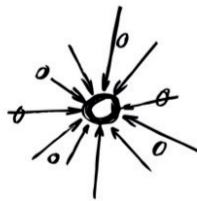


Figure 6: ATTRACTION

5. INVOLVING: A center that works as a core makes the whole lively by involving other necessary centers (Figure 7). The involved centers strengthen each other and, at the same time, they strengthen the core center as well. Thus, the more the centers get involved, the stronger the whole can be.



Figure 7: INVOLVING

6. TOGETHERNESS: At times when small centers strengthen each other, they create a larger center that enfolds them (Figure 8). The large center strengthens the small centers within itself, and small centers strengthen the enfolding center. Thus small centers and the larger center reinforce each other, making the whole lively.



Figure 8: TOGETHERNESS

Next, 7. BUILDING UP, 8. ORGANIC GROWTH, 9. REFLECTING, 10. ACCOMPANY, 11. ENHANCEMENT and 12. EMPATHY are grouped together, as these centers grow by the influence of other centers.

7. BUILDING UP: The whole can become livelier when centers continuously build up with consistency (Figure 9). As centers build up continuously, built-up centers strengthen each other, and create larger centers. As centers are built up into larger centers repeatedly, the whole become livelier.

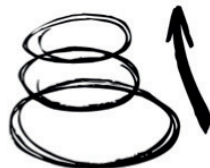


Figure 9: BUILDING UP

8. ORGANIC GROWTH: The whole may become more lively when a center grows gradually (Figure 10). A center can grow without losing its power if it keeps its own structure. As the center gradually grows, the whole becomes livelier.



Figure 10: ORGANIC GROWTH

9. REFLECTING: As a center reflects on the trajectory of its change, the whole can become livelier (Figure 11). By reflecting on the change in the center, each trajectory becomes a new center and they strengthen each other, creating a living whole.



Figure 11: REFLECTING

10. ACCOMPANY: A center is sometimes intensified when it is accompanied by another center placed right beside it (Figure 12). The center by itself may be powerless, but it may be made more powerful by the second center. As a result, the whole will be livelier.

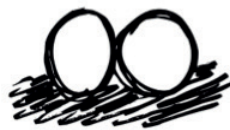


Figure 12: ACCOMPANY

11. ENHANCEMENT: When a center exists, a nearby center may be influenced by it, and intensified (Figure 13). This second center may then influence the first center to strengthen it. This chain reaction of mutual enhancement will result in the intensification of the whole, to make it livelier.

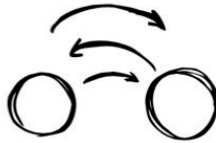


Figure 13: ENHANCEMENT

12. EMPATHY: A center sometimes becomes strengthened as another center shows empathy towards it (Figure 14). The center that received empathy returns empathy and creates a resonance between the centers. Resonance strengthens the centers even more, making the whole lively.

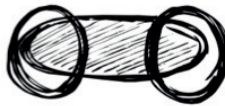


Figure 14: EMPATHY

Then, 13. SELECTION, 14. SIMPLIFICATION, 15. CONSISTENCY, 16. LOOSENESS, 17. FLEXIBILITY, and 18. ABUNDANCE are in the same group, as the properties become strengthened when centers are in a complex situation.

13. SELECTION: Centers can be strengthened by selecting centers that they want to be in a relationship with (Figure 15). The selection of centers makes it possible to concentrate on specific centers to strengthen. The selected centers can be more intensified by being intensively strengthened. The intensified center can then re-strengthen the original center, creating a strengthening relationship.



Figure 15: SELECTION

14. SIMPLIFICATION: A center can be strengthened as it simplifies relationships with other centers (Figure 16). Cutting off its relationship with incongruent centers prevents the dispersal of its power. In this way, the center can strengthen the surrounding centers effectively, and actualize a living whole.

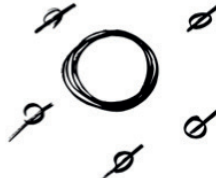


Figure 16: SIMPLIFICATION

15. CONSISTENCY: The whole becomes lively when centers with the same direction align (Figure 17). As these centers align, the centers strengthen each other to create an inclusive center. The inclusive center then strengthens inner centers recursively, making the whole more living.



Figure 17: CONSISTENCY

16. LOOSENESS: The whole can be livelier when the relationship between centers is loose (Figure 18). The centers can be in a strengthening relationship with various centers by making relationships free rather than fixed. The loose coupling between centers makes the whole lively.



Figure 18: LOOSENESS

17. FLEXIBILITY: There are centers with flexibility in a living whole (Figure 19). Those centers meet other centers, they easily become adapted to a new environment, and they can be in a stronger relationship. The existence of such centers makes it possible to create new relationships, making the whole lively.



Figure 19: FLEXIBILITY

18. ABUNDANCE: The core center of a whole can become strengthened when there is an abundance of centers (Figure 20). The existence of an abundance of centers strengthens the center of the core and the strengthened core center strengthens those centers back.



Figure 20: ABUNDANCE

Finally, 19.ENDEAVOR, 20.CONNECTING, 21.POSITIONING, 22.DIFFERENTIATING, 23.OVERLAP, and 24.CONTINUOUS RELATION are in the same group, where centers intensify with the differences or commonality that centers have.

19. ENDEAVOR: A center can get strengthened when it is working diligently towards a shining center (Figure 21). The shining center is also strengthened by the fact that it is endeavored by another center, and the endeavoring center is strengthened by the act of endeavoring. The relationship between these centers creates a larger center including them and become lively as a whole.



Figure 21: ENDEAVOR

20. CONNECTING: Centers can be strengthened when they are connected with other centers (Figure 22). When a new connection is born, connected centers create a larger center that enfolds them. The larger center can exert a power that could not be created by the included individual centers.



Figure 22: CONNECTING

21. POSITIONING: A center can be strengthened by positioning itself in the whole (Figure 23). As it is clearly positioned in a whole, the center can release its energy to the surrounding centers. As the surrounding centers are strengthened, the whole will become livelier.



Figure 23: POSITIONING

22. DIFFERENTIATING: The whole sometimes become more lively when centers are differentiated from each other (Figure 24). When a center is differentiated into several centers, each center will have a unique power that other centers do not have. This power becomes strengthened as each center strengthens the others, creating a living whole.



Figure 24: DIFFERENTIATING

23. OVERLAPPING: There are overlapping centers in a living whole (Figure 25). When centers overlap, the overlapped part becomes a new center. The overlapped centers strengthen the new center as the new center strengthens them. The strengthening relationship makes the whole livelier.

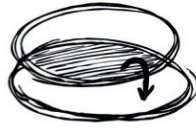


Figure 25: OVERLAPPING

24. CONTINUOUS RELATION: A whole with centers having a continuous relationship has liveliness (Figure 26). As the relationship endures, each center is strengthened, and their strength as a whole becomes greater. As the relationship between centers continues, the whole may become livelier.

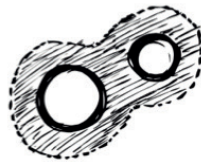


Figure 26: CONTINUOUS RELATION

6. USAGE OF BEHAVIORAL PROPERTIES

In this section, we will describe how the 24 behavioral properties can be used. This will mainly be for three purposes: pattern mining, pattern writing, and designing.

6.1. Pattern Mining with Properties

Properties can be used to indicate patterns from experience or episodes shared at pattern-mining interviews or workshops. As behavioral properties describe the properties of lively human activities, understanding them makes it possible to estimate how actions from the experiences or episodes make each activity full of life.

For example, a participant in a workshop may share a story about the importance of increasing the number of members in order to accomplish a goal. In this context, the interviewer can conjecture that INVOLVING causes liveliness in this story, and he may ask a confirmation question such as “Do you talk passionately about your vision or the benefit people will receive in order to get people involved?” Knowing the properties enables the creation of direct questions to approach the core of patterns. If empathy is created within the group or related episodes from other members are pulled out from the question, this shows that these stories, and experiences may become a pattern of lively human behavior.

As above, it becomes possible to grasp the essence of tips, and hints at interviews or workshops with the use of properties.

6.2. Pattern Writing with Properties

Properties are also useful for the accurate verbalization of how patterns contribute to make an activity lively. Behavioral properties are properties of how centers intensify each other to create liveliness in human activities. Therefore, it will assist the writer to capture the centers in the description of a pattern and understand how those centers intensify each other to create the liveliness of that activity. By capturing this, the writer will then be able to improve the description. Thus, properties work as a trigger for inspecting liveliness in specific human activities.

There are patterns that include several properties to make an activity lively. It is necessary to determine whether properties enhance each other or whether they only appear in one series of action. If they appear in one series of action only, there is a need to write them out as individual patterns to verbalize how each property affects an activity.

6.3. Design with Properties

Besides for patterns, properties can also be used for designing. Even though patterns on lively human behavior are small in number, there are various lively human behaviors that have not yet been converted into patterns. It is possible to recognize wholeness by identifying centers of its behavior and how those centers intensify each other.

Behavioral properties were used as inspirations of ideas at some workshops (Iba & Akado, 2015; Yoder & Iba, 2015; Iba, Yoder, & Wirfs-Brock, 2015). Using the properties as a common language assisted the participants to think about how this conference can be “strengthened” from the properties’ point of view. Rather than urging the participants to come up with specific ideas, sharing ideas based on the properties also created wholeness in the conference.

7. BEHAVIORAL PROPERTIES AND GEOMETRICAL PROPERTIES

Alexander discovered how centers intensify each other, proposing 15 geometrical properties (Alexander, 2002a). In this section, we describe the relationship between our 24 behavioral properties, and Alexander’s 15 geometrical properties.

The relationship between behavioral and geometrical properties can be compared from the viewpoint of a time series. Alexander's 15 geometrical properties capture the liveliness of the structure at one point in the time series. On the other hand, 24 behavioral properties capture the liveliness of movement through the flow of time.

For example, an organization is in a good state when the goal of the team or individual members matches the trend, when each member has their own role, and when they help each other out. This phenomenon can be captured by the geometrical properties, ECHOES, and POSITIVE SPACE. ECHOES is a property where centers generate a larger center by similarity of orientation, and the property POSITIVE SPACE is where adjacent centers are partially strengthened in order to strengthen a specific center.

From a different point of view, the team is activated by having and heading towards a challenging attractive goal, and involving cases, information, or people related to the project. This phenomenon can be captured by the behavioral properties, ENDEAVOR and INVOLVING. ENDEAVOR occurs where centers working diligently towards a shining center, and INVOLVING is where a core center involves new centers that are necessary for strengthening itself, also strengthening the whole.

This example shows that there are different sets of properties visible from two different viewpoints, namely: geometrical properties that capture liveliness at a certain time, and behavioral properties, which express the liveliness of the process of the change in the flow of time. Geometrical properties are properties on a plane, showing the structure, and the being of things at one point in the series of time. Behavioral properties are properties of movement expressed by time axis, describing movement or how things become another in the transition of time.

Geometrical properties and behavioral properties are not only properties that appear in architecture, nature, or in human activity, but also viewpoints for capturing lively phenomena. Therefore, it is important to capture and generate wholeness from both the point of view of structure and motion.

8. CONCLUSION

In this paper, we proposed fundamental behavioral properties for capturing the wholeness of lively human behaviors, explaining its usage and its relationship with Alexander's geometrical properties. In addition to the behavioral properties of human activity, we presumed that the investigation of the existence of emotional properties could be done as a future study.

The 15 properties are commonly discussed, as they are basic theory when talking about the wholeness of buildings throughout *The Nature of Order*, but Alexander also reveals the existence of color properties in Book 4 of *The Nature of Order* (Alexander, 2004). He states that colors are also an essential part of wholeness and that there are properties of how they intensify life. Thus, he calls the ways that centers of color create, and intensify life in one another color properties.

Similarly, we consider that not only behaviors but also emotions are important in order to create a lively wholeness in human activity. That is because in order to capture the deep wholeness of human activity, it is necessary to understand the emotions behind the behaviors and actions. For example, "Passion for Exploration," from the *Learning Patterns*, advises you to choose a topic that you can be passionate about while choosing a subject to explore. Additionally, "Mission for the Future" from the *Collaboration Patterns* talks about the importance of having an image of how the future must be and starting work with a sense of a mission, which you must be the one to make this future a reality. These two patterns make the activity lively with passionate emotion from the sense of vocation. As the patterns show, additional properties with emotion may be required to capture the wholeness of human activity.

We hope that additional research will be done on the comprehensive theory of wholeness by systematizing geometrical, color, behavioral, and emotional properties, which have not been discovered yet (Figure 27), and searching for more properties.

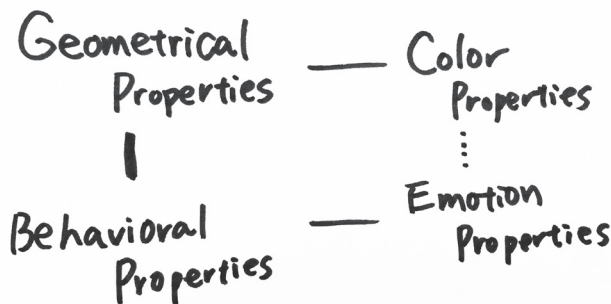


Figure 27: A Vision for the Theoretical Overview of Fundamental Properties

9. Acknowledgement

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PURSUIT OF PATTERN LANGUAGES FOR SOCIETAL CHANGE

Designing Lively Scenarios
in Various Fields

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This book focuses on the pattern approach established by the Austrian-born Christopher Alexander - architect, mathematician and philosopher, and collects selected papers on work presented at, or related to the *PURPLSOC* World Conference held at Danube University Krems, July 3 – 5, 2015. *PURPLSOC* is the acronym for "*In Pursuit of Pattern Languages for Societal Change*", a series of (roughly) biennial conferences on patterns in and with disparate fields such as architecture, design, media, arts, IT, management, pedagogy, social activism, social innovation and diverse grassroots movements.

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