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Article

Centers in the Event Domain: A Retake on the Wholeness of Urban Spaces

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Abstract
This article demonstrates that geometric analysis by itself is not enough to evaluate Alexander's wholeness in public spaces and that his theories of wholeness can—and should—be extended into the realm of events. The first section provides a summary of the theory of centers and the relevance of events with regard to the theory of wholeness. In the second section, a new way to classify centers is presented, along with insights from Alexander's works into an approach for incorporating event centers into the theory of wholeness. The final part puts these ideas to the test on a public square in Stuttgart, Germany, using a geometric analysis and an analysis of user activity to determine the performance of the square as a center. The research concludes that utilizing Alexander's theories from an event-first rather than a geometry-first perspective is an approach especially well-suited for public spaces.

Keywords
abstraction; event-centers; events; public square; space; theory of wholeness; urban space; user activity

Issue
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1. Introduction

Throughout his career, Christopher Alexander was concerned with three main themes: (a) human well-being, (b) how the built environment could support well-being, and (c) how the built environment evolved over time. However, in his later and more abstract work, *The Nature of Order* (TNO), he invested more heavily in questions of morphology at the expense of social and temporal activities (Alexander, 2002a). The results of this decision can be observed in the development of these theories since their publication. For example, several researchers have attempted to develop the mathematical approach to wholeness described in TNO and apply them to the scale of buildings and objects (Billig, 2018; Salingaros, 1997). However, public spaces in the urban environment such as town squares or plazas involve a greater number of complex elements such as human flows and interactions or temporary events, which make them difficult to evaluate geometrically. Nevertheless, some works in urban morphology have also explored how mathematical definitions found in the theory of wholeness can be applied to the urban domain: for example, to measure the liveliness of cities through a geometric analysis of street networks (de Rijke et al., 2020; Jiang & de Rijke, 2022). These studies focus on a single component within the definition of wholeness, such as connectivity between the streets at different scales.

By contrast, Alexander's earlier works are more directly concerned with events, especially on the larger scales. Mehaffy and Salingaros (2015, p. 149) identify that cities are composed of overlapping networks of events on physical and temporal scales, an idea that follows from the concept of functional overlap described in *A City Is Not a Tree* (Alexander, 1965). Mehaffy (2019) also identifies six different areas of Alexander's potential contributions to the science of cities including an increased focus on the evolution of the city as an emergent and complex phenomenon, and an emphasis on aesthetics as an indicator of life-supporting order in cities. There is a missing link between these theoretical ideas and the theory of wholeness and centers presented in TNO. The analysis of urban spaces according to the theory of wholeness has either remained form-based and leaned on mathematical analysis or included non-form elements while remaining more abstract.

This could be due to many factors. Firstly, Alexander does not focus as much on events as he does on geometry in TNO. With the primary concern being the process of form-making and formation, it makes sense to approach the problem with geometry in mind first and presume that the form will generate social life within the geometry. However, this also means that a way to study geometry in Alexandrian terms exists, while a way to study events as direct contributors to wholeness does not. Secondly, the visual observation of a geometric pattern, a building, or the map of a city only requires the object of study and the observer. The study of events requires a series of preliminary steps before being directly accessible, such as the collection of event data at specific times, or the abstraction of data into a visual format. Most likely this difficulty, added to the lack of exploration of the topic by Alexander himself, led to an underdevelopment of theories in this area.

This study proposes that it is more suitable to apply Alexander's theory of wholeness not only to the geometries of large spaces but also to the events that occur within them. This type of analysis makes it easier to identify the wholeness of larger spaces by examining more centers than a purely geometric analysis would allow. The following three subsections outline the necessary background: a summary of the theory of centers as it evolved throughout Alexander's career, the relevance of events in evaluating urban spaces, and how events can be viewed as centers. The theory regarding the characterization and evaluation of centers is developed in the following sections: namely the ideas of canvas, substance, and abstraction. These ideas are used to classify the different types of centers that either Alexander himself or other scholars identified in previous works. Finally, in Section 5, these ideas are applied to a public square in Germany.

1.1. Centers and the Theory of Wholeness

In TNO, Alexander takes a fundamental and geometric approach to answer the question of how spaces can improve human well-being. His core tenet is the proposition that geometries, objects, buildings, and spaces possess a property called wholeness. Objects with more wholeness are full of life and promote a greater sense of well-being. The wholeness of a space or an object depends on its geometric composition; certain configurations result in more wholeness than others.

To explain these configurations, Alexander develops a theory of centers. Centers, which are typically geometric configurations in space, are points of focus that have a sense of geometric unity. The way the centers sit in relation to other centers increases or decreases the level of the wholeness of the global system. In other words, a system of centers is a field-like structure, the wholeness of which is defined at each point by the intensity of its local centers. Centers themselves are composed of other centers at a smaller scale, which serve the wholeness of the center at a larger scale. This recursiveness across scales is the first important property that is attributed to centers that create wholeness, named "Levels of Scale" by Alexander (2002a, p. 146). The hierarchical relationships between centers at different scales can be represented as a graph network. Recent explorations of such representations have led to the development of mathematical methods that quantify the number of scales in these graphs, finding that more distinct levels of scale lead to greater wholeness (Jiang, 2015).

In addition to Levels of Scale, Alexander noticed that there are more geometric relationships between centers that promote wholeness. There are 15 of these properties, for example, "Alternating Repetition," "Boundaries," "Void," and "Contrast." These properties are observable in nature and set guidelines for organizing centers in ways that will increase wholeness. A two-dimensional example that aids in understanding this definition and the 15 properties is shown in Figure 1. The pattern that resembles a flower, and the interlocking pattern beside it, are centers that have Alternating Repetition. The spaces that are between them are centers that display the Void property. This border which is composed of a repeating pattern of flowers, interlocking patterns,

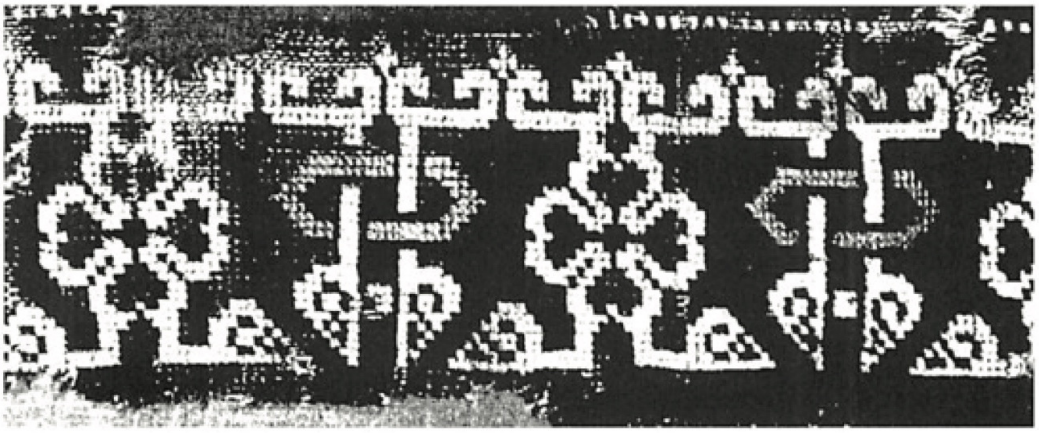

Figure 1. The border of an Anatolian carpet. Note: In TNO, this image is used to explain the concept of centers. Source: Alexander (2002a, p. 119).

and voids, is itself a center that displays the Boundary property at a larger scale. It is, of course, impossible to adequately summarize a four-volume study in two paragraphs, so the reader is referred to the original text or shorter summaries and commentaries (Gabriel & Quillien, 2019; Galle, 2020).

1.2. The Link Between Geometry and Events

The theory of wholeness as presented in TNO is mainly about the geometric configuration of centers. Due to this heightened focus on geometry, social and temporal concerns seen in some of his earlier works lose ground in TNO. One purpose of this article is to bring back these social elements to the forefront. In *The Social Logic of Space*, Hillier and Hanson (1984, p. 26) draw attention to the connection between the social and the spatial by stating: "Society must be described in terms of its intrinsic spatiality. Space must be described in terms of its intrinsic sociality." Alexander agrees with this view and adds, "it is not really possible to keep function and space separate," and that an integrated view is necessary (Alexander, 2002a, p. 417).

More recently, Kiss and Kretz (2021, p. 59) published an anthology in which they compiled essays from established authors who view the city with a "relational approach" where space is seen as an "amalgam of the social and the material." On this point, they identify a similar line of thinking between Aldo Rossi, Christopher Alexander, and Kevin Lynch. For Rossi, cities consist of "cultural types" which are happenings that are at once social and material (Rossi, 1984). Cultural types are similar to the patterns in *A Pattern Language* (APL) in the sense that both patterns and cultural types are a composite of spaces and the events that happen in them. Similarly, Lynch (1981) defines urban form as the spatial arrangement of people doing different things. In all these examples, form and actions constitute an inseparable composite, indicating that events and form are two sides of the same coin.

The concepts of "space," "place," and "event" are directly related to this relational approach. Prior to the last few decades, space was seen as absolute in the field of human geography, namely as a single container in which things happen (Amin, 2007; Murdoch, 2005). Harvey (2004) defines two additional views of space: relative and relational space. Relative space is defined by the relations between events, objects, and processes in time. The concept of relational space goes a step further, in asserting that processes define their own spatial frame and that space does not exist without processes that define it. (Harvey, 2004; Jones, 2009). In both definitions, the incorporation of events and processes means that it is not possible to disentangle space from time.

While there are many definitions of place, Cresswell (2008, p. 135) highlights that "place describes a way of relating to the world," and that the idea of "experience" is key to its definition. Therefore, place is about how humans relate to, and experience, their environment. Similarly, Seamon (2013, p. 150) defines place as "an environmental locus in and through which individual or group actions, experiences, intentions, and meanings are drawn together spatially and temporally." This spatial and temporal whole creates "place ballets," a routine of events recurring in a supportive physical environment (Seamon, 1984).

1.3. Events as Centers and Generators of Wholeness

Even though first elaborated in TNO, centers and wholeness are constant themes throughout Alexander's career and wrap the entirety of his works together. For example, the concept of center applies to many of the patterns in APL (Alexander et al., 1977). Each pattern presents a rule with which a strong center is created (Alexander, 2002b, p. 344), and consists of a design problem to solve, an explanation of how it solves this problem, a sequence of steps to apply this pattern successfully, and other patterns that are connected to it at the scales above and below. While most patterns are geometric solutions to problems that arise in architectural and urban design, there are also patterns that tackle problems of societal organization ("Old People Everywhere"), or those that are about a process rather than the resulting geometry ("Gradual Stiffening"). Seamon (2018) also identifies the different ways in which Alexander's patterns highlight the events and experiences of places in his works. For example, "Degrees of Publicness," "Promenade," and "Dancing in the Street" are all different examples of patterns that contain events as part of their description. Such patterns highlight the link between events and the built environment and provide clues as to they work together to create wholeness. Patterns or strong geometric centers enable processes or events to take place. These events then become part of the structure of that space and increase its wholeness (Alexander, 2002a). Figure 2 is a diagram that takes these ideas and presents a starting point for this research. The two types of centers shown in the figure, static centers of the built environment and dynamic event-centers, are defined in the following paragraphs.

Urban form is in a constant process of change (Moudon, 1997), and different urban systems such as streets or buildings change at different rates (Oliveira, 2016). Therefore, geometric centers in the built environment are not static at long timescales. A significant portion of Alexander's work is also devoted to the process of building, which includes this temporal component (Alexander, 2002b). For example, the complete lifecycle of a building can be considered an event, even though a building consists of static geometric centers for most of its life. However, Alexander does not usually consider this temporal component in analyses of the existing built environment. His analyses are usually done by identifying centers in photographs, diagrams, and plans. Therefore, this research will also regard centers in the

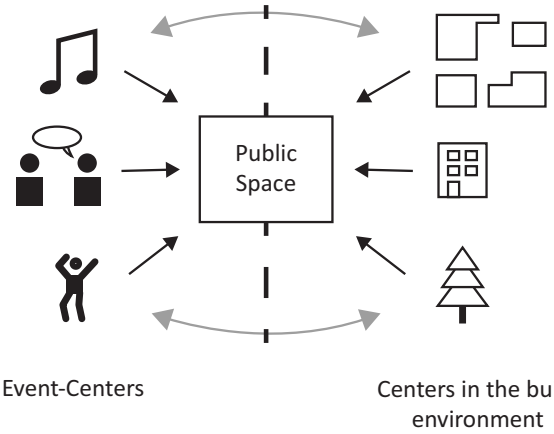

Figure 2. A thought diagram of centers contributing to the wholeness of an urban space. Note: Geometric centers of the built environment and dynamic event-centers happening and disappearing in time are both part of the wholeness of public spaces.

built environment as unchanging and examine them as such. This includes temporary installations such as shopping stands, as they are unchanging at the timescale of the observation of wholeness.

In contrast, event-centers are regarded as dynamic, with a rate of change that is detectable at the scale of observation of the research. Examples for such centers are people sitting and conversing on a park bench, or children playing behind it. Alexander (2002a, p. 391) describes these centers as follows: "…we now understand this wholeness to include centers which grow and fade as life goes on during the dynamic minute-to-minute actions and events which are occurring there." Such events that create life may be sustained by other centers, some of which are also events. Static centers in the built environment invite and shape events, while events can result in changes in static centers. For example, providing a place for people to dance can lead to people dancing in the street (Alexander et al., 1977). Conversely, social events such as protests can lead to political decisions which cause change in the built environment.

To examine the wholeness of a public space, both static centers and event-centers must be investigated. Dynamic centers such as people sitting down or having a conversation interact with the centers in the environment, changing the physical nature of the space, and therefore its wholeness (Alexander, 2002b, p. 348). Thus, an analysis of wholeness without events is incomplete.

2. Characterizing and Visualizing Centers

Examples of centers in Alexander's work are varied. To understand events as centers, one must first take the step to recognize the different types of centers within his works. To do this, an analogy from painting is borrowed. Like a painting, each center or pattern exists on a canvas and is made of a type of paint, from here on referred to as a substance. The canvas describes the dimension in which centers occur, while the substance describes the matter, object, or concept with which the center is composed. Figure 3 categorizes patterns and centers with this analogy. There are four canvases: 1-D space, 2-D space, 3-D space, and 4-D Space-Time (three dimensions of space plus one dimension of time). Each row in Figure 3 adds a new dimension to the canvas, while each column is a different substance.

Alexander evaluates the wholeness of spaces through the configuration of centers in space. This can be the configuration of colors and patterns on a carpet (as demonstrated in Figure 1), or it can be the configuration of "subcultures" in a city as demonstrated in the pattern "Subculture Boundary" (Alexander et al., 1977). The concept of substance highlights the difference between these examples. In the latter case, the boundary is made up of space in which there is a lack of said subculture, or a mix of said subculture with another subculture. This boundary is not visually observable as in the first case; nevertheless, it contributes to the wholeness of the system by interacting in space with other similar centers through the 15 properties. Figure 3 separates event-centers into their own classification by grouping them onto the canvas of Space-Time.

3. Seeing the Whole Through Abstraction: Wholeness Fluctuating in Space

The idea that centers can exist in different dimensionalities, composed of completely different objects or substances, and still generate wholeness, in the same way, is key for incorporating events into the theory of centers. However, observing centers in substances such as culture or function is not as straightforward as observing colors on a carpet. Alexander addresses this using abstraction, which solves two issues: (1) by abstracting invisible "substances" such as function or culture into colors, the centers can be visualized, designed, or evaluated; and (2) abstraction allows the designer to have an overview of the entire system at once.

Abstraction

Substance / Canvas	Color and Texture	Objects	Culture	Sounds	Actions
1D Space	*A pattern on a black and white strip	*A wooden beam with brass caps at the ends.			
2D Space	*Figures on a carpet	*A collonade	*The pattern IDENTIFIABLE NEIGHBORHOOD		
3D Space	*A garden	*A building	*The pattern MOSAIC OF SUBCULTURES		
Space-Time ("The realm of events")	*Light beams from windows lighting an interior space	A ball rolling on a road.	An interaction of people from different subcultures on a street	*A song, or *birds chirping (the change in sounds over time)	*Children playing in a park, or *people conversing

Figure 3. Examples of different "substances" painted on different "canvases" existing in different dimensions. Note: Examples from either APL or TNO were chosen whenever possible and are marked with an asterisk.

Other fields such as sociology also deal with abstractions to and from physical space. For example, Bourdieu (2018) proposes that social agents have a location in "social space" revealing their social and political status. The structure of social space manifests itself in physical space, for example in the location of suburbs or slums in a city, and those who can afford them. Through this relation, Bourdieu (2018) claims that social space is more complete than physical space and that physical space is a projection of social space that can only be understood through an abstraction (physical geography). Similarly, Latane and Liu (1996, p. 27) define social space as a "structure that determines people's relationships to each other," defined and shared by multiple minds. However, they acknowledge physical space as an important driver for shaping social structures and view it less as a projection and more as fundamental. This approach is similar to that of Alexander, who builds his entire theory of wholeness on the structure of physical space, to which the social space contributes.

Latane and Liu (1996) also acknowledge the difficulty of representing social space due to the number of different features to consider, such as human movement or information flow through different media. Therefore, they suggest capturing each feature in separate models representing different aspects of social space. This is similar to the process of abstraction that Alexander takes in the third volume of TNO, in which he gives the example of designing a neighborhood starting with the spatial distribution of different functions (Alexander, 2005). In this exercise, a neighborhood has four main types of space: pedestrian space, gardens, buildings, and space for cars. The spatial configuration of these four types of space determines the wholeness of a neighborhood. To visualize the entirety of the system of centers, each function is given a color and abstracted onto a 2-D map, after which the designer can experiment with the configuration of colors in a manner similar to a board game (Alexander, 2005, p. 304). Since "function" is not a visible center, it is necessary to perform this abstraction that allows the designer to observe differences in function as colors and to understand the complexity that they entail. The original caption of Figure 4 draws attention to the complex relationship among the colors, and the complex structure to which it gives rise.

In addition to allowing the designer to visualize and use invisible centers, abstraction also serves the purpose of giving an overview of the whole. In one of his more recent works, *Harmony-Seeking Computations*, Alexander (2009) hypothesizes that natural processes that might, at first, seem to be generating order in an emergent manner also display the property of preserving the whole. This is an important realization because it rejects the proposition that a purely bottom-up design approach can lead to wholeness. By extension, this means that an act of designing that preserves wholeness always requires access to an overview of the whole. This topic is also relevant in observing wholeness. In many cases, wholeness can only be partially observed but is nevertheless a property of the whole. For example, an observer standing in a sparse part of town might conclude that the wholeness of that area is weak, even though this area might be serving a greater purpose at a larger scale. Therefore, the wholeness of the neighborhood must be viewed as a property that fluctuates depending on where the observation is made. This understanding fits within Alexander's description of centers as "field-like" phenomena (Alexander, 2002a).

4. Adding the Time Component: Wholeness Fluctuating in Time

Centers that are events add another level of complexity to the definition of what a center can be. Alexander

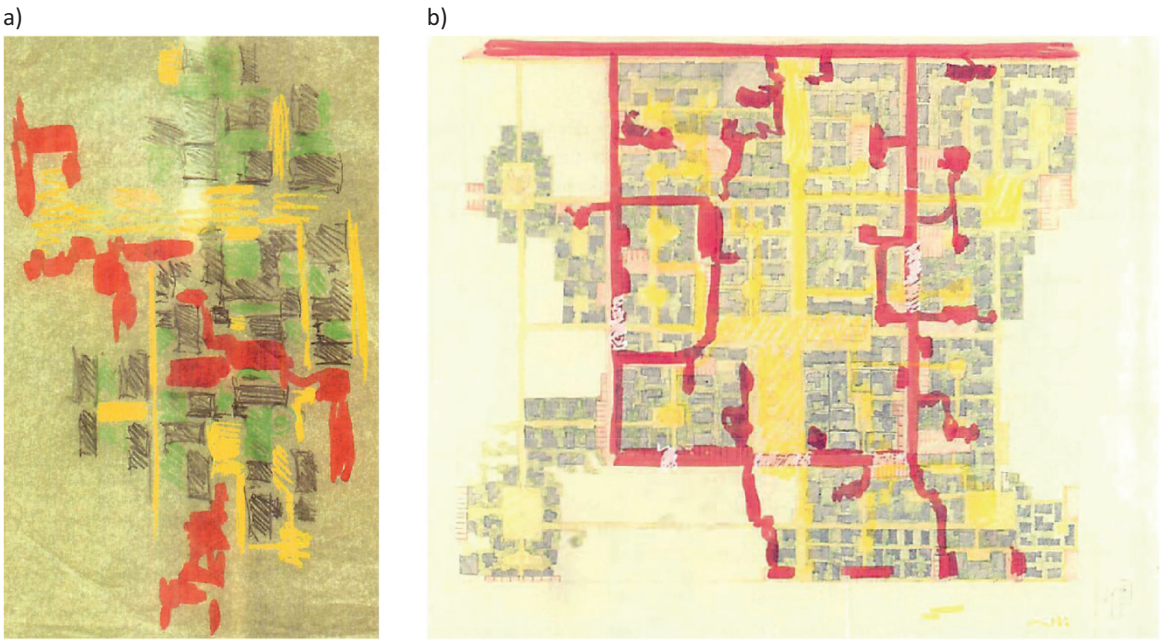

Figure 4. Two images from TNO: (a) the process of designing with four colors representing four functions and (b) the resulting 2-D map of a neighborhood. Source: Alexander (2005, p. 308).

includes the chirping of birds or playing children as examples of these kinds of centers and writes that they take place in "the realm of actions" (Alexander, 2002a, p. 391). Similar to geometric shapes in space, these events can be long or short in time and can form overlaps and interactions. It is not enough to observe the entirety of the space in question to gain a complete understanding of wholeness because the wholeness that is created by events fluctuates in time as well as in space; a park that is lively during the day might present a different picture at night. Therefore, a space must be observed for a long period of time in order to yield a more accurate impression of its wholeness.

To visualize these centers and the relationships between them, the process of abstraction developed in the previous section can be used. The closest example to this can be found in *A City Is Not a Tree* (Alexander, 1965). Here, Alexander highlights that cities that arise spontaneously over time contain overlaps between different functions, as opposed to those that are deliberately created by designers. For example, he criticizes the separation of university campuses from the city, which restricts the overlap between university life and city life that would otherwise happen through activities such as pub-crawling, coffee-drinking, the movies, etc. Without this separation, the static parts of the city which are university and residential buildings, and the dynamic parts of the system which are different actions of the citizens occur in the same space. This spatial overlap of actions creates life. To explain this concept, Alexander uses Figure 5. It is an abstraction, albeit less direct, helping the observer to understand geometrically what overlapping functions might look like. The overlap of triangles in different configurations creates a multiplicity of shapes and gives the painting its structure.

There are different ways in which the overlap of events can be observed directly in the time domain. One idea is given in Figure 6. Inspired by abstractions in Alexander's works, it focuses on visualizing events and their overlap as colors. This provides a way to gain an overview of the fluctuating wholeness of events specific to a place. Other substances such as age groups or

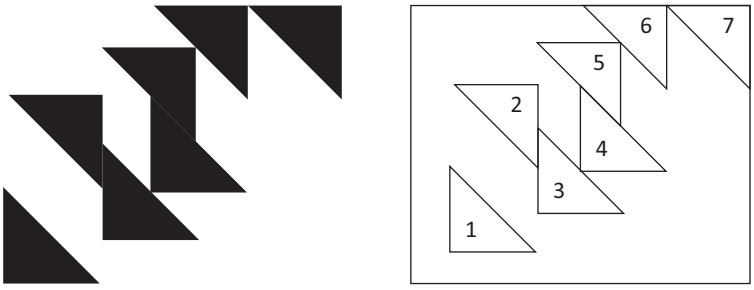

Figure 5. Simon Nicholson's painting. Note: In *A City Is Not a Tree*, this painting is analyzed to highlight the overlap between geometries, and how all the spaces are made up of overlaps. Source: Alexander (1965, p. 20).

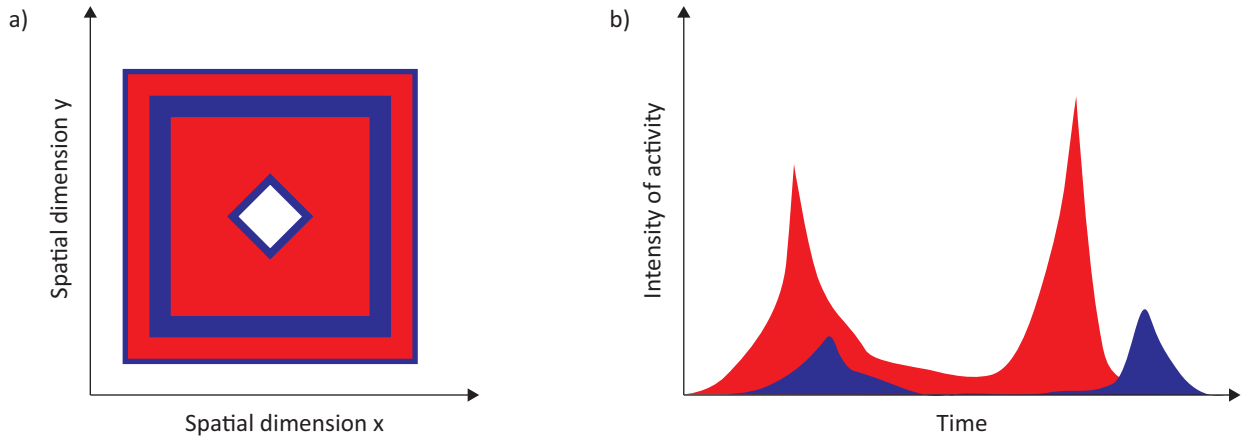

Figure 6. (a) Colors in spatial dimensions can be observed as centers and (b) the overlap of activities can be visually observed as centers through abstraction into colors.

activity lengths could also be abstracted and graphed instead of activity types. However, since types of activity are the closest substance to Alexander's abstractions shown in Figure 5, the type and intensity of activities were chosen as the axes.

This interpretation of Alexander's theory of wholeness results in the following conclusions: (a) temporal elements are an essential part of wholeness and must be analyzed to gain a correct understanding of public spaces, and (b) events must be observed in large sections of time to give a conclusive evaluation of the wholeness of a space.

5. Case Study

This evaluation of a public square in Germany is intended to show the importance of evaluating events in analyzing the wholeness of the square, and that evaluating purely geometry can lead to ambiguous results. Firstly, a geometric analysis of static centers in the square is performed following similar examples from Alexander's works. Then, event analyses at multiple times are performed and evaluated for their effects on the static centers. The previous sections provide the necessary theoretical background for the investigation.

The most important novel point being addressed here is the issue of visualizing event-centers. The closest Alexander comes to addressing this is abstractions like the one shown in Section 3. From all the examples of event centers given in the earlier sections, it could be summarized that *living beings doing things in proximity to geometric centers increases the wholeness of a region of space.* Therefore, this study aims to map the location of human users of the square to identify their contribution to the geometry of the plan.

5.1. Methods

Geometric analysis is performed in the plan, where centers and 15 properties in the square are identified. It is important to keep in mind that even though Alexander provides a somewhat reproducible method with which to analyze the wholeness of spaces, there are no concrete criteria for evaluation available when applying them. Centers are highly personal, and the feelings of the observer as they move through the space are key to identifying the wholeness of a place (Alexander, 2004). Nevertheless, there are examples of wholeness analyses in the plan: e.g., the analysis of the Cathedral of Chartres (Alexander, 2005, p. 194) or the plan of the Alhambra (Alexander, 2002a, p. 187). In these examples, Alexander examines the shapes of built structures and the spaces that they create as centers according to the 15 properties. Similarly, in this research, centers in and around the square are identified and their geometric relationships are examined.

For the mapping of events, this research leans on the observational methodologies described by Whyte (1980) and Gehl and Svarre (2013). In order to understand how a plaza is used, Whyte (1980, p. 23) observes the locations of sitting pedestrians on a "sighting map," a map of the plaza with hand-drawn symbols to identify additional information about age or gender. In their example, this mapping takes around five minutes to complete. Gehl and Svarre (2013, p. 26) describe this method as "mapping'' or "behavioral mapping," used to indicate "where people are standing and sitting." The result is a frozen picture of the area, revealing a snapshot of the locations and activities of the people within. Similar to Whyte's methodology, mapping is done by an observer walking through the area. Ng (2016) gives a comprehensive explanation of behavioral mapping and examples of previous research using this method.

In this research, behavioral mapping is used to identify the locations of groups and their activities. It was observed that the users of the square interact in groups. Just as a handshake event requires a group of two people (Alexander, 2002a, p. 304), a conversation event requires a group of multiple interacting individuals. Therefore, to conserve the nature of the event centers as they

occur in space, each group of interacting individuals was mapped as separate entities. A researcher moved through the public square in a pre-specified path, noting down the locations and activities of the users on a map. A single map took between five and ten minutes to create, depending on the number of users in the square. In cases where the number of users exceeded what is manageable through direct observation, photographs were taken to aid the researcher in creating the maps of highly occupied areas. More specifically, photographs were only used at 17:00 and 17:30 on the weekend to manage the large numbers of individuals in the square (Figure 9D). The data was collected in late March and early April, in sunny weather conditions. Unlike many behavioral mapping studies which report only the statistics of users and activities, the geometric nature of this work necessitates the reporting of the maps themselves, similar to the research done by Gümüş and Yılmaz (2022) and Askarizad and Safari (2020). As identified by Ng (2016), privacy is a concern when performing this kind of research. Care was taken to make sure all data is anonymous. No gender data was collected.

Activities are divided into six groups: talking, watching, eating, social drinking, playing, and other activities (begging, foraging, doing a survey, etc.). Talking was determined to be the default activity for groups while watching was the default activity for individuals. In cases where multiple activities are performed at the same time, such as eating and talking, activities that are different from default take priority (in this case, eating takes priority over talking). There is constant traffic of individuals and groups who are actively walking, running, or biking in the square due to it being a transport hub. Unless they engaged in a stationary activity such as getting caught up in a conversation with a stationary user, these were not included in the data. There are ambiguous cases where the identification of a stationary activity can be difficult. For example, a biker could be moving through the square to reach a destination or could be making circles and performing tricks in which case they are an active user of the square. Usually, a few seconds of observation was enough to clarify their inclusion in the data. This does not mean that traffic of moving pedestrians should not be considered centers. However, as most of the event examples in Alexander's works are of a stationary nature, this work only examines such events.

5.2. Marienplatz

Marienplatz in Stuttgart is a public square with an area of approximately 6,000 m^2. It is surrounded mostly by residential buildings and functions as a central location where people can gather and socialize (Figure 7a). The square is pentagonal in shape and is surrounded on four sides by roads. It also functions as a transport hub, with an underground metro station situated to the northwest of the square, and a cable car station that is near the center of the square. The square is divided into two areas by the cable car station. One side of the square is connected to the front of a building, where restaurants and tables are situated.

In 2003, after decaying into a spot with excessive illegal activity, a redesign of the square took place that was controversial due to the lack of differentiating elements in the new design, resulting in a large, empty space. This space that is marked with the number 1 in Figure 7c is the heart of the square and will be referred to as Area 1. It is a big open space where events such as festivals, concerts, protests, and flea markets take place. On the northwest side, it is bounded by steps that serve as seating.

5.3. Geometric Analysis of Centers

Seen in the larger urban fabric, Marienplatz benefits from constant traffic thanks to being a transportation hub. While there are smaller squares around it such as Erwin-Schöttle-Platz to its west, it is the biggest square of its kind in the neighborhood. As a center, the square displays the Void property. Its boundaries—the steps, the fountain, the cable car station, and surrounding trees—are all strong centers (Figure 7b and 7c). These boundaries are connected to other centers such as the restaurant or the basketball court, enhancing the strength of the boundary. These not only act as geometric centers but also as centers of activity. The boundary is full of Contrast, showing different kinds of centers that provide hubs for different activities, such as benches for sitting or drinking, ping pong tables for playing, etc. The shapes of the centers and voids display the "Positive Space" property as described by Alexander. However, the overall shape of the square does not display the natural coherence and symmetry that Alexander covets in the examples given in TNO.

Area 1 itself is large and lacking definition, as there is not a lot of geometric differentiation in the middle of the square. It is somewhat reminiscent of the example that Alexander (2002a, p. 224) uses to describe the Void property: an empty square in Tibet. The size of the square is much larger than what is advised for a public square in APL and TNO (See pattern "Small Public Places"). Gehl (1987, p. 153) also observes that desolate and empty spaces need supports such as benches, columns, plants, etc. to provide people with places to stop, which are severely lacking in Area 1. This results in a lot of the citizens moving through the square without spending much time in it or preferring to stay at the peripheries. From the perspective of this analysis, mainly because of the scale of the space and the lack of differentiating centers, the central area does not seem to promote wholeness geometrically. However, due to the richness of the boundaries and the activity they attract, the center may not feel totally desolate. An analysis of events at different times must be conducted to reach a conclusion on the center's wholeness.

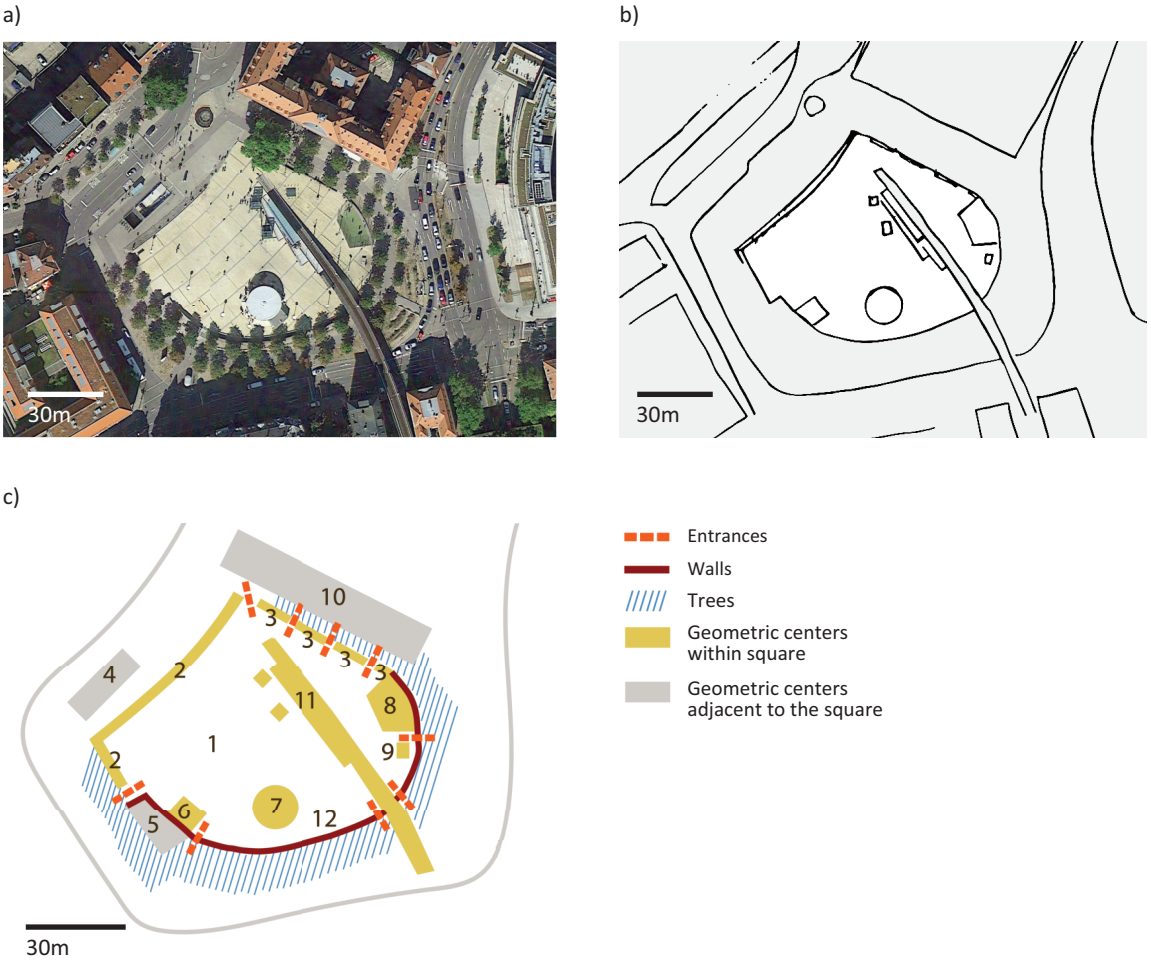

Figure 7. (a) Satellite image of Marienplatz in Stuttgart, Germany functions as a transport hub and a leisure space (Google Earth Pro); (b) a hand sketch of the area showing the study area in white, and the surroundings in gray; and (c) a center map where important geometric centers in the built environment are identified and numbered: 1. Empty space at the center of the square (referred to as Area 1), 2. steps serving as seating, 3. stone benches, 4. bus and metro station, 5. children's playground, 6. water fountain, 7. ice cream hut, 8. basketball court, 9. ping pong table, 10. restaurants on the periphery, 11. cable car station, and 12. wall enclosing the square.

5.4. Event Analysis

The events that occurred in Marienplatz were observed at different times to determine the location and variety of activities performed by persons in the square. As described in the methods section, the ages and activities of users in the square are recorded by a researcher on a behavior map. Users of the square were observed on four different occasions. The first three were on the same weekday: morning at 8:30, afternoon at 13:00, and evening at 19:30. In each case, one behavioral map was created. The final observation was done on a weekend from 17:00 until 20:00. In this final observation, a behavioral map was created every half an hour for a total of six maps. Figure 8 displays photographs and the percentages of activities in the square. Figure 9 displays the behavior maps.

The activity in the square changes drastically over the course of the weekday. Barely anyone uses the square in the morning (Figure 9a). At lunchtime, the most prominent activity is eating (Figures 8a and 9b). The activity is concentrated in the boundaries, suggesting that a rich boundary of multiple centers displaying many of the 15 properties attracts activity, strengthening the boundaries further. A farmer's market took place on the afternoon that the observation was made, which resulted in additional geometric centers attracting further activity to the middle of the square. Nevertheless, most of Area 1 is still empty and lacks any centers at lunchtime.

In the evening, the prominent activity is social drinking (Figures 8b and 9c). The square shows a very different structure of centers to before, with most of the empty area being used as a leisure space for groups to sit and drink. The spacing between the groups is similar throughout the square, indicating that there is a specific distance with which groups feel comfortable. This is not surprising, as similar phenomena were observed by Whyte (1980). The groups grow inward from the boundaries to occupy empty spots and do not disperse across the empty square. It is also worth noting the lack of

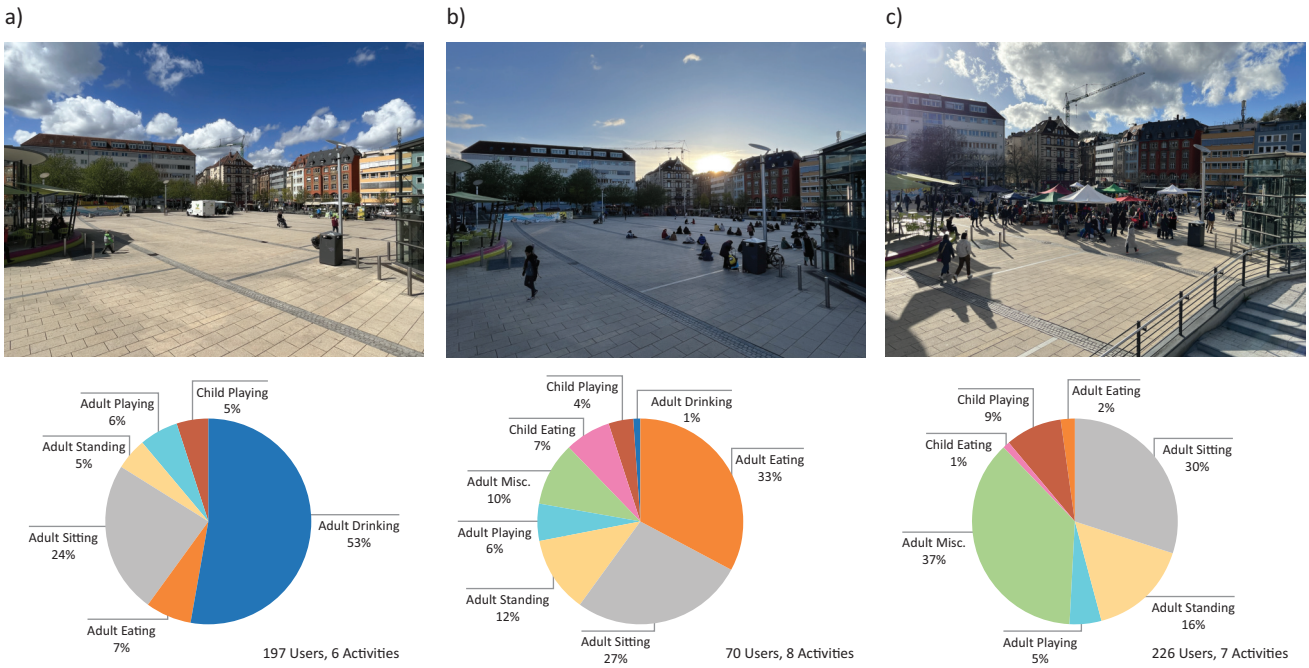

Figure 8. Photos and pie charts of the range of different activities in the square at (a) weekday 13:00; (b) weekday 19:30; and (c) weekend 17:00. Notes: These photos are to give a visual idea of what the square looks like. Only the photograph shown in Figure 8c was part of a set of photographs taken to aid in the creation of the behavior maps (see Sub-Section 5.1 for details).

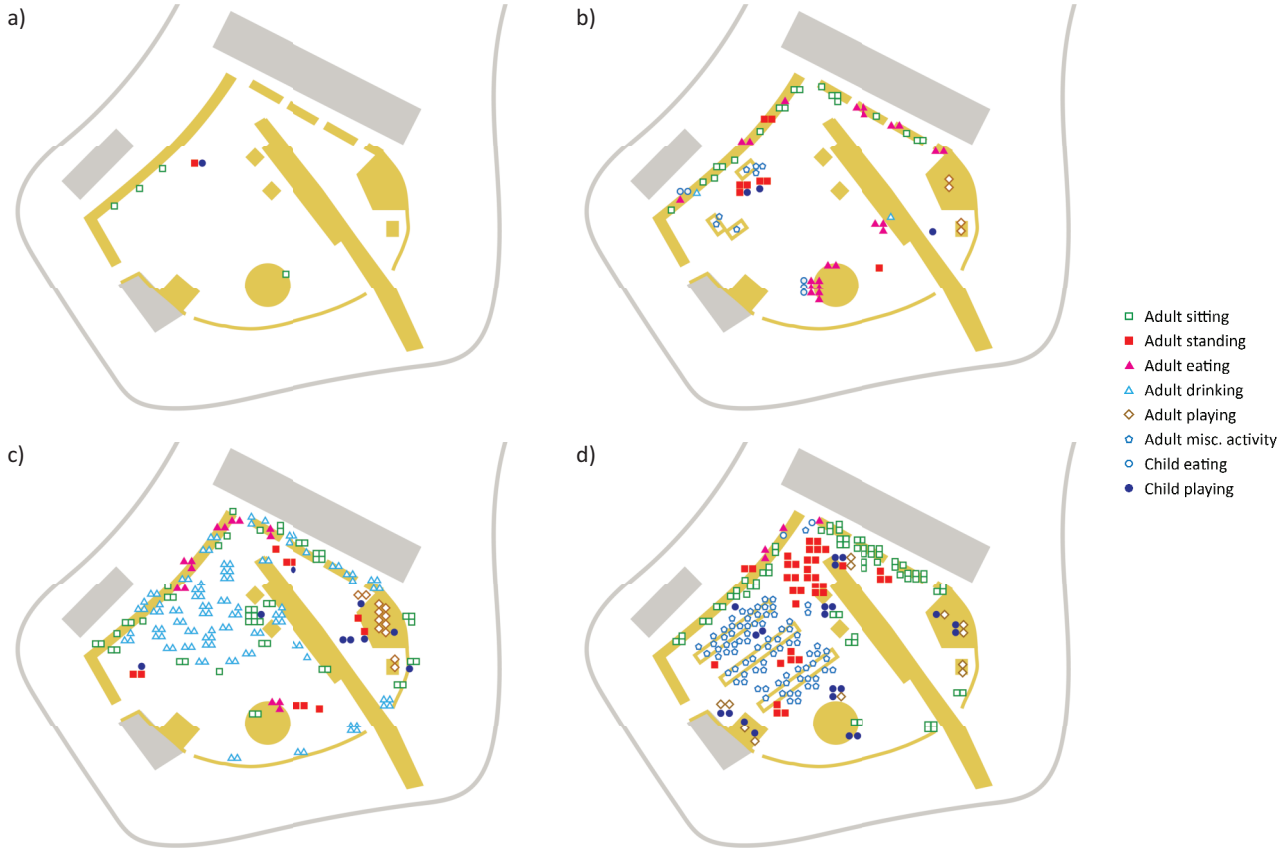

Figure 9. Behavior maps of Marienplatz generated at four different times: On a weekday at (a) 8:30; (b) 13:00; (c) 19:30, and on a Saturday at (d) 17:00. Notes: The flea market event on Saturday resulted in the users buying or selling goods being identified under adult miscellaneous activity. Multiple symbols which are spatially connected indicate groups of interacting individuals.

events directly on the northeast side of the cable car station, even though its scale is more appropriate for a public square. This could be due to environmental effects such as sunlight that remains longer on the west side compared to the east. There could also be a more social reason, where the larger area is designated as the appropriate place for drinking in the evenings after hosting other events such as festivals and markets. Finally, it could be that people simply enjoy the feeling of openness in the space when there are other groups to share this with, a more Alexandrian explanation of The Void as a center. In either case, the structure of the space has changed due to the activity of the square, affecting the saliency of the surrounding centers, and therefore their wholeness (Alexander, 2002b, p. 347).

The final observation was made on a weekend at a flea market event (Figures 8c and 9d). Similar to Figure 9c, the square is full of life. This time, temporary shopping stands act as centers in addition to the event-centers, giving form to the events. This shows that the interplay of event-centers and geometric centers arising from objects can bring an otherwise barren area to life. It also highlights the importance that empty spaces have in the urban context.

Due to this flea market being a temporary happening, multiple maps were created for three hours between 17:00 and 20:00 as elaborated in Sub-Section 5.4 to observe the changes in the life of the square as it ended. The number of users performing each event is displayed in Figure 10 for an abstracted view of events stripped from their geometry, making it possible to visualize the fluctuating nature of event-based wholeness in time. This kind of analysis gives an idea of the overlap between different events in the square as discussed in Figure 6. For example, at 19:30, most of the individuals in the square are either playing children or drinking adults. This is an overlap of different event centers in the temporal domain, similar to what is described in *A City Is Not a Tree* (Alexander, 1965).

For this research, interacting groups and individuals performing actions were each considered to be events. However, a flea market event is itself a large event-center both in spatial and temporal terms, containing many individual smaller events. From this perspective, Figure 10 could be seen as the temporal interplay of different small events such as children playing or adults drinking, or the overlap between the larger events "flea market" and "quiet evening at Marienplatz."

6. Conclusion and Discussion

This study opens up a new way to think about and utilize Alexander's theories on wholeness. The categorization of centers according to the canvas-substance analogy given in this study provides a method to classify the examples of centers in TNO while putting a needed emphasis on how they differ. The discussion on abstraction in Alexander's works provides examples of how other centers that are not directly visible can be visualized and evaluated. Specifically, the idea that the wholeness of spaces is not a constant value but a fluctuating, field-like property through space and time informs the incorporation of events as a part of the theory of wholeness.

Event analyses tap into the event side of Seamon's (1984) "place ballet" concept elaborated in Sub-Section 1.2, examining the wholeness generated by the space-event composite from a new perspective. Nevertheless, observing centers in the event domain

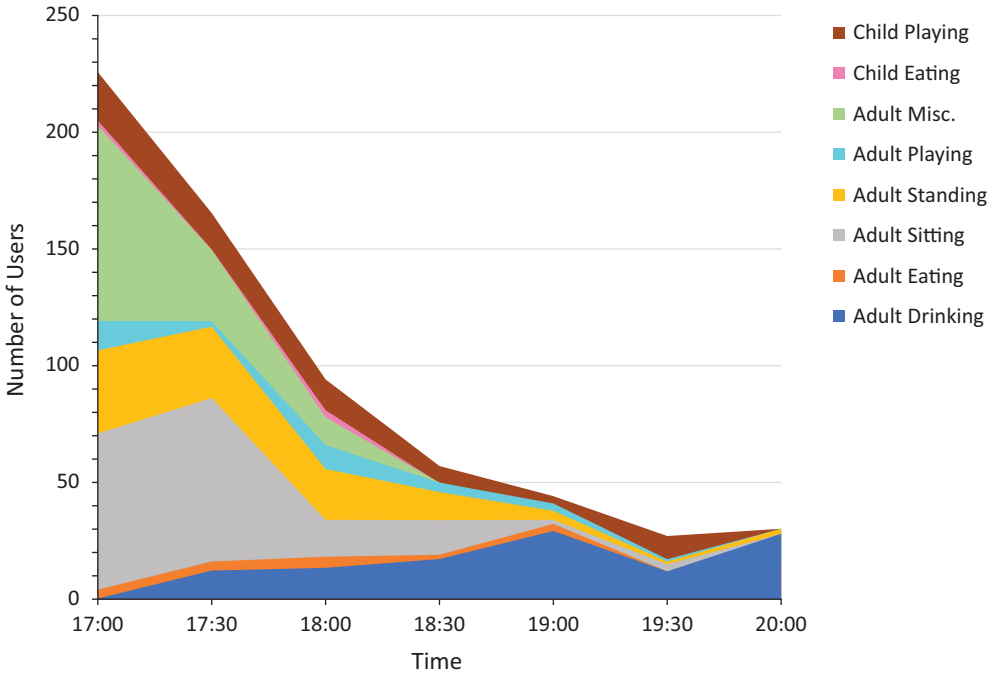

Figure 10. The evolution of events through time at Marienplatz on a weekend.

is intended to be used in combination with a geometric analysis of centers. The case study presented in this work shows the necessity of this approach. The event analysis in Section 3 makes it clear that Marienplatz functions as an important space within the urban fabric that hosts a large number of different event-centers at different times, even though it is far from wholeness enhancing in its form. There could be multiple reasons for the success of this space in terms of events, such as the lack of other large empty spaces in the neighborhood dedicated to hosting a variety of events, or the richness of the boundaries in terms of restaurants, cafes, and other points of interest. These multiple factors that affect the usage of the square, some of which are centers of geometry or function, are difficult to pin down in their entirety. Jacobs calls this a problem in "organized complexity," where the variables that affect the square are all interrelated in unpredictable ways (Jacobs, 1961, p. 433).

The approach presented in this article still suffers from an oversimplification of the complexity involved in designing and evaluating public spaces. Nevertheless, Alexander's concern with observing the whole throughout the process of design, and his use of abstractions for identifying centers of different "substrates" address some of this complexity. By drawing attention to these tools, this article demonstrates that the theory of wholeness includes elements other than geometry that have direct applicability in urban design.

Much work has been done in exploring the hierarchical nature of static spatial centers at different scales. Since dynamic centers such as events have not yet been explored to the same depth, there are questions as to how to approach them as hierarchical centers. A hierarchical approach, this time including the temporal dimension, can be a future line of research. Figure 10 provides a starting point for this direction. Furthermore, actions are not the only events related to the wholeness of spaces. Sounds and smells, for example, could also be mapped and explored in similar ways. Solving how the nature of such centers can be addressed remains a potential next step for this research.

Due to the limitations of the manual behavioral mapping method, the mapped area was restricted strictly to the boundaries and the square itself. However, urban areas are very closely linked to their surroundings in complex ways. A more complete picture could be attained by incorporating more surrounding centers, particularly the centers numbered 5 and 10 in Figure 7c, which are directly adjacent to the area investigated. Another addition to this research could be the incorporation of pedestrian flow. The constant stream of people contributes to the feeling of the space even when they do not stop in the square. Data collection is another critical point that can be optimized. Images and video provide access to data in larger slices of time, which could reveal more of the interactions between events. Another approach could be the collection of data using social media sources instead of observational methods.

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Conflict of Interests

The author declares no conflict of interests.

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