Rules for Urban Space: Design Patterns Create the Human Scale

Nikos A. Salingaros

Departments of Mathematics and Architecture, The University of Texas at San Antonio, San Antonio, Texas 78249, USA.
Email: salingar@gmail.com

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Abstract

Urban geometry and details can help people enjoy healthier lives, and to live them more fully. The failure of postwar Industrial Modernism was made obvious by psychological illness experienced during the COVID-19 lockdown. A new toolkit for adaptive design combines the patterns of Christopher Alexander with recent results from perception science. Understanding people's interaction with urban space selects from among two opposing design options. A science-based approach uses updated traditional design tools to humanize our cities. Societies that adopt these rules focus on boosting human health and emotional well-being as their priority. Older pre-industrial techniques — long condemned and suppressed for stylistic reasons — prove to be far superior for human psychology and long-term health. The opposite approach of image-based design, however, suppresses human feelings. Extractive global construction creates spaces that nobody wishes to use.

Keywords

Urban Space, Plazas, Design Patterns, Human Scale, Adaptability.

Introduction

This paper describes how to improve the design of urban spaces. It is a plea for human-scaled urban design as a reaction to the image-oriented city formed of iconic structures and stylish urban spaces. The city's "life" depends upon its pedestrian spaces in front of, around, and next to buildings. Planners are not normally taught why urban space is an essential ingredient of a living city. Nor is anyone else in the chain of the regulatory system that oversees urban interventions. Industrial Modernism destroys useful public space, by making its detailed geometry hostile and unfriendly, so that users get little emotional nourishment from their immediate surroundings. The radically different design toolbox presented here could launch a new era of welcoming public space in cities.

All traditional societies recognized the central role that public space plays in the happiness and health of urban dwellers. Timeless rules for designing urban space that optimizes human well-being, discovered independently and implemented throughout the world and across cultures, were abandoned, then forgotten in the push to prioritize the car city. With a growing realization of two disasters — the declining health of residents, and unsustainability — UN-Habitat has tried to resurrect those forgotten practices (Mehaffy, 2021). The newly-recognized value of public space in a city's cultural and economic development demands new (or re-discovered) urban design tools.

Social behavior and interactions are emotion-driven, facilitated by biological responses to environmental stimuli. A geometry that is comfortable to experience tells us we are in the right place. The feeling of well-being is due to information interacting with the geometry of the environment (Ortiz et al., 2017). This unconscious mechanism of a user's engagement depends upon dynamic behavioral interactions. People need to be reassured by seeing

organized complexity, otherwise the brain slips back into a default vigilant state. Whenever that happens, we don't feel safe in that place and are too anxious to engage socially — thus wasting the public space.

Christopher Alexander warned designers of the harmful effects of environmental geometries that stress the user (Alexander, 1979: p. 114): "The build-up of stress, however minor, stays within us. We live in a state of heightened alertness, higher stress, more adrenaline, all the time. This stress … becomes a huge strain on the system. Since the organism's capacity to enter the stressed state is already partly 'used up' because it is perpetually in this state, our capacity to react to real new problems, dangers, and conflicts goes down, because the organism is constantly exhausted by the perpetual state of stress." This constant stressor comes from the wrong mathematical qualities of the post-war built environment.

Concepts mostly new to urban planning such as biophilia (Kellert et al., 2008; Salingaros, 2015), complexity (Jacobs, 1961; Salat, 2011; Salingaros, 2018), eye-tracking and visual attention simulation scans (Lavdas et al., 2021; Salingaros and Sussman, 2020), fractals (Batty and Longley, 1994; Crompton and Brown, 2008; Salingaros, 2013; Taylor, 2021), networks (Alexander, 1965; Mehaffy and Salingaros, 2015; Salingaros, 2005), neuroscience (Ruggles, 2017; Sussman and Hollander, 2021), and deep symmetry (Mehaffy and Salingaros, 2021; Salingaros, 2020a) offer us a healthier way of designing a city. The applied basis for these principles is derived from scientific inquiry and experiment.

The existing design framework known as "Pattern Language" relates intimately to these innovative developments. The pioneering handbook by Alexander and coworkers (Alexander et al., 1977) codified and summarized practical design relations extracted from built urban fabric, stated as socio-geometric "patterns". Michael Mehaffy and coworkers recently followed up with a new collection (Mehaffy et al., 2020). Design patterns evolved over centuries or millennia, but needed to be discovered as embedded in complex configurations, then documented (Leitner, 2015; Salingaros, 2017). Whereas mainstream architectural and urban design ignores design patterns, computer scientists enthusiastically adopted the concept as a useful means of organizing complexity (Cunningham and Mehaffy, 2014).

A city that aims to accommodate pedestrian life has an overriding need for socially-attractive public spaces (Efroymson et al., 2009; Jalaladdini and Oktay, 2012). This rule is summarized in a new design pattern (Mehaffy et al., 2020).

- New Pattern 2.3: PUBLIC SPACE SYSTEM. Lay out every city, and every increment of a city, as a system of inter-connected public spaces, large, medium and small, including streets, squares, parks, and the public areas of buildings. Make these spaces walkable and pedestrian-friendly, with attractive destinations at frequent intervals. Assure that every residence is within 200 meters of an active public space.

In an age of virtual design tools and computer games modeling urban growth, reversing antisocial planning practice is easy. Look at how a spontaneous city forms in the open spaces of post-war housing projects — either virtually, or where this has actually happened on the ground (Salingaros, 2021). The result is a distribution of open spaces all linked together. The state technocrats' vision of "efficient", isolated housing blocks sitting in vast concrete plazas or lawn is in reality a most inefficient typology. Geometry needs subdividing into a distribution of smaller scales to become "alive". Yet urban space also has to be protected from invasion, semi-surrounded by walls having sufficient architectural detail and visual interest to endow a sense of "life" to that space (Salingaros and Pagliardini, 2016).

Paths create the life of public space

We comprehend urban space by taking the paths that crisscross it. A public space is a receptacle of multiple pedestrian paths that coalesce. The open space should accommodate an infinite variety of possible cross-paths and not restrict pedestrians to a single narrow path. Where a person chooses to walk is strongly influenced by the surrounding information field — and depends upon the entire surroundings. Visually attractive goals unconsciously draw a pedestrian to move in a particular direction (Zacharias, 2001). Information embedded in the building façades, or other objects such as trees, helps to create a sense of psychological security that encourages the experience of walking in the open.

A Pattern Language (Alexander *et al.*, 1977) anticipates two notions later used by writers on biophilia: "refuge" is a psychologically safe space where we feel free from threat; whereas with "prospect" we see locations some distance away that attract us (Browning *et al.*, 2014; Kellert *et al.*, 2008; Ryan *et al.*, 2014). These two psychological states are fruits of human evolutionary development. Therefore, every portion of the spatial environment along a path must offer refuge so that a person feels safe while negotiating that journey. At the same time, a prospect offers us a range of goals for our journey, inviting us to leave our comfortable refuge and move toward them.

Three Alexandrian design patterns link emotionally-usable public space to paths, as presented here with my own summaries (Alexander *et al.*, 1977):

- Pattern APL 114: HIERARCHY OF OPEN SPACE. Satisfy the feeling of having one's back protected by a solid structure (refuge), while being able to see out to the world (prospect).
- Pattern APL 120: PATHS AND GOALS. Compose a path as a sequence of intermediate destinations. Flow is governed by the body's instinctive movements and psychological reactions.
- Pattern APL 121: PATH SHAPE. A successful path is also a welcoming space for people to linger in if they are not in a hurry.

Interactions with the built environment determine human behavior, often in surprising ways. People tend to avoid exposed open space and prefer to walk along its protected edges or perimeter boundaries (Salingaros, 2005: pages 32-33). Ann Sussman and Justin Hollander (2021) discuss this mechanism of *thigmotaxis*, defined as how animals move in response to edge conditions. Research finds that not just humans but organisms going back in evolutionary times avoid open spaces and stick to protected edges. The edges help us feel safe; they also efficiently orient and create a "mental map" of our surroundings.

The body's intuitive response — an unmistakable visceral feeling reacting to hormones and nerve signals — decides whether the environment is safe or not. The human perceptive system is exquisitely designed to detect variations in the quality of our surroundings. We adapt our behavior accordingly. A spatial configuration, translated subconsciously into an intuitive assessment of where we are, can be evaluated only in person, directly, using all of one's senses. Our perceptual system is the only qualified and dependable judge of whether being in a spot is good for us. Such judgments cannot be made from pictures, architectural drawings, intellectual arguments, or others' opinions.

Life couples us to the structures we inhabit, therefore the whole physical setting directly influences the actions of the individual user. Pedestrian movement is determined to a large part by the complex information field to which we are exposed at any moment (Lavdas, Salingaros and Sussman, 2021; Salingaros, 2005; Zacharias, 2001). We may, as ambulatory animals, have the freedom of choosing where to walk, but unconscious forces are far stronger than is usually realized. Adaptive design takes into account our changing visceral responses as a result of movement — the dynamic versus the static nature of information, which are entirely different.

Wayfinding depends on our perception of changing environmental information. Markers and signals help us navigate a space by continuously reinforcing how we are drawn to flow through it; or, conversely, signals hinder our movement with psychologically confusing cues (Lyons Stewart, 2015). People respond intuitively to the information patterns of floors (Salingaros, 2014: Chapter 7). Visual floor patterns engage us and strongly influence the direction in which we move forward, making it easier to stay on the path. Floor surfaces that are too plain visually lose any psychological utility and do not help to guide circulation and movement.

Ignoring neuroscience, conventional architectural practice imposes paths as abstractions on a plan, using blank paving, or with irrelevant visual patterns that violate the flow. Artistic intent trumps human nature. People get disoriented because the architect did not adapt the design to help direct the movement naturally (Lyons Stewart, 2015). Ambiguous or even contradictory signals come from the designed environment as we move. Deterministic paths by which we are forced to navigate spaces can be disturbing — often generating the sensation that we would rather walk elsewhere but are thwarted by obstacles blocking our passage.

Instead of designing public space as a container of spontaneously-generated pedestrian paths, an architect determines the plan of a plaza artistically in the studio. This naïve approach, indicative of how the profession has lost touch with reality, doesn't work. "Design" is limited to playing with the aerial view of an open space inserted between buildings. Then, as if by magic, pedestrians are supposed to walk exactly where the architect intends for them to do so (the "reverse-causation fallacy"). Of course, that will never happen in practice, which is why most post-war public spaces tend to feel dead and remain unoccupied.

The "fifteen-minute city" is permeable to pedestrian flow

Families locked down in their apartment or house as a result of the COVID-19 emergency have suffered severe psychological stress, and the children have suffered the most. It became evident that modernist planning disconnects interior from exterior spaces. The cementification of contemporary cities, with the elimination of easily-accessible local green spaces and parks has had catastrophic effects. But intimate contact with nature turns out to be essential for human health (Aresta and Salingaros, 2020).

People will use a plaza situated at a point in the pedestrian network where multiple flows cross. The geometry channels flows on many different scales. A functioning urban space is a complex node

concentrating pedestrian paths from the surroundings. If a plaza is the only open space within a large urban region, people might actually come to it, but a geometrically "hard" design and hostile urban furniture will compel people to detour around it. Dreary, unused contemporary plazas, observed the world over, ignore the logic of pedestrian flows. Three new design patterns help to ensure the emotional quality of the pedestrian experience (Mehaffy *et al.*, 2020).

- New Pattern 2.1: WALKABLE MULTI-MOBILITY. Make walkability a pervasive characteristic of the city, with special emphasis on the 400M through street network, and the mixed residential areas within this network. Coordinate the walkable network with other modes of travel, including well-distributed multi-modal hubs for public transit.
- New Pattern 4.2: PEDESTRIAN SANCTUARY. Lay out the streets within the principal through streets as slower, narrower and more irregular lanes. Do not attempt to optimize for flow, but deliberately give the priority to pedestrians through design.
- New Pattern 4.3: NEIGHBORHOOD SQUARE. Create neighborhood squares adjacent to neighborhood through streets, and at nodes where commercial activities are present or likely. Place them where climatic and other physical conditions make sitting there attractive.

Successful urban space defines a pedestrian catchment region (Pafka and Dovey, 2016). Use depends critically upon three independent factors: (*i*) having a pool of pedestrian activity in several surrounding blocks to draw from; (*ii*) informational interest that attracts people to the space; and (*iii*) street and sidewalk design that permits easy pedestrian access to the plaza through its permeable perimeter. Surrounding paths bring pedestrians to cross the plaza, and street furniture accommodates users who are channeled to walk towards and cross into the public space. Anything inside the plaza that is likely to attract users visually is of secondary importance to the paths: even a statue of General José Olivaro — Glorious Hero of the Revolution! — is not enough.

Adaptive design accommodates all human spatio-temporal scales. Through its physical design and placement in the wider network, an urban space should invite people in a hurry to cross it (2 min) instead of taking a parallel external path. This process corresponds to "catchment" of local pedestrian flow, diverting it to feed the plaza through emotional attraction, not by an imposition of the architect's will. While traversing the space, people's attention should be drawn momentarily yet repeatedly to architectural details in the surrounding façades (2 sec), and to possible greenery in the square. Other users must be attracted to stroll at a more leisurely pace (10 min), and some to sit down and relax (15–30 min). Families with young children should feel welcome to stay (30–60 min or longer).

To guarantee the "feeding" of the urban space, mixed-use buildings three blocks deep surrounding the plaza have to supply potential users: this span correlates with a 5 minute walk. Some of those pedestrians will naturally walk alongside the plaza, and people will choose to cross the urban space, but only if the environment and path structure are welcoming. A percentage of those users might decide to linger. There is a distribution of time periods for different users, or even for the same user on different occasions: to stay for anywhere from 1 minute to 1 hour (Pagliardini, Porta and Salingaros, 2010).

Envisioning the plaza or park as the nucleus of a roughly circular pedestrian catchment region, a 5-minute walk on both sides together with the time it takes to cross the urban space (2 minutes) brings us close to the 15-minute city (Duany and Steuteville, 2021; Krier, 1977; 2009; Moreno, 2020; Moreno *et al.*, 2021; Scruton, 2008). This "new urbanist" concept for restructuring cities devastated by industrial-modernist fancies is now enjoying a welcome comeback, especially after the world experienced the shock of the Covid-19 lockdown. The defining feature is a mixed use, walkable urban fabric. But single-use zoning in the surrounding blocks severely restricts the number of users and their frequency throughout the day.

Urban space needs to be protected from encroachment by parked cars and vehicular traffic. Utilize wide and raised sidewalks, arcades, bollards, etc. to protect the pedestrian, direct the traffic, and keep cars outside the pedestrian realm. We could provide tangential vehicular flow to "feed" the plaza, but at the same time make it impossible for cars to enter and take it over. Restrict vehicular flow to one or two sides maximum, otherwise an urban space entirely surrounded by roads is effectively cut off. The essential concept here is to plan for easy access and transit for pedestrians, but access with very restricted transit for vehicular traffic (Salingaros, 2005; Salingaros and Pagliardini, 2016).

Alexandrian patterns define attractive urban space

"Living" space envelops and nourishes us. This primal, biological sense of space goes far beyond strict utility. Urban spaces are the "neural nodes" of the city, connecting the flows that bring it to life. Evidence-based properties of living spaces exist on a much

deeper level than we normally design for. Many designers paradoxically reject this toolbox because of ideological prejudice. Modernist-trained architects study traditional urban fabric but fail to implement the informational structure of older buildings when designing something new.

A Pattern Language (Alexander *et al.*, 1977) defines urban spaces that invite users (Leitner, 2015; Salingaros, 2005; 2017). I list some of these urban space patterns here: for copyright reasons, the following summaries are my own. The reader is urged to consult the original statement for each numbered pattern, which includes research material giving detailed supporting arguments and/or scientific validation.

- Pattern APL 60: ACCESSIBLE GREEN. People will only use green spaces when those are very close to where they live and work, accessible by a pedestrian path.
- Pattern APL 61: SMALL PUBLIC SQUARES. Give public squares a maximum width of approximately 60 feet (20 m). Their length can vary. The walls enclosing the space, whether partially or wholly surrounding it, should make people feel as if they are in a large open public room.
- Pattern APL 106: POSITIVE OUTDOOR SPACE. The built structures partially surrounding an outdoor space, be it rectangular or circular, must define a concave perimeter boundary, making the space itself convex overall.
- Pattern APL 119: ARCADES. Use an arcade on one edge of urban space to link all building entrances along that side of the block. The space under the arcade is a crucial transition region between indoors and outdoors.
- Pattern APL 122: BUILDING FRONTS. Avoid building setbacks and instead build up to the urban space or sidewalk. This requires re-writing modernist zoning codes that impose setbacks.
- Pattern APL 124: ACTIVITY POCKETS. The success of urban space depends on what can occur along its boundaries. A space will be lively only if there are pockets of activity all around its edges.
- Pattern APL 171: TREE PLACES. Trees shape social places, so shape buildings around existing trees, and plant new trees to generate a usable, inviting urban space.

An enveloping and reassuring space will be readily used. A pedestrian should feel comfortably "embraced" by public space (Alexander, 2005; Salingaros, 2005). Our body signals with either a fight or flight reaction (in unwelcoming urban spaces) or, under the appropriate circumstances, it could tell us that staying and experiencing this particular environment is healing (Ruggles, 2018; Sussman and Hollander, 2021). Biology contradicts the popular architectural images linking contemporary design to fashion, ideology, innovation, politics, progress, style, etc. Our body reacts the way it has evolved to do so, and it's time for design professionals to learn this basic fact.

No architect or planner talks about the "life of the site" nowadays, since that concept contradicts Industrial Modernism. The long-neglected adaptive approach shapes geometry to enhance emotional "life", and relies upon perceiving, then liberating the essential configurations inherent in the site (Neis, 2017; Salingaros, 2020b). People only care for what they love: the basis for a profound sense of urban community. We love something we have created and shaped, hence active user participation leads to a deeper sense of ownership than simply buying a place (Alexander, 1979; 2005).

The living city needs a connected "necklace" of public spaces in a range of sizes according to an inverse-power (fractal) distribution: one or two large open spaces, several of intermediate size, and very many local public spaces of quite small size. Open space in spontaneous cities evolves into a complex morphology, an organic process that reveals concentrated left-over space around buildings to be a mistake (Salingaros, 2021). The distributed morphology of urban space flies against industrial simplification, where a large open space surrounds isolated large-footprint buildings. Post-war planning creates deficient urban space — too much of it, but never used because it has the wrong geometry.

Industrial Modernism makes large-scale open space too exposed to feel comfortable in (so as to look nice on a photo), and eliminates intermediate spaces such as arcades (porticoes). Even where arcades are built, the industrial aesthetic sets inhumanly large dimensions — the pedestrian feels exposed and vulnerable rather than safely protected by the structure. Humane urbanism opens up to and welcomes the user, whereas Industrial Modernism is invariably hostile to the pedestrian. These antagonistic goals oblige dominant architectural culture to reject documented design patterns for urban space from its design toolkit, which is image-based (Salingaros, 2005).

After the Second World War, modernist-trained urbanists obsessed with industrial production quietly took control of the planning profession. They changed the urban codes to guarantee that all cities evolved towards strict industrial-modernist typologies. This was a tremendous victory for those who desired the formalist city for ideological reasons (and perhaps from

misguided good intentions). New codes were written by lawyers, and now those laws tie the hands of adaptive architects and urbanists, so that it is illegal to build humanly-adaptive environments. This type of zoning is not reformable. It will have to be ignored — which is illegal — or be totally rewritten.

The network creates engaging urban space

A successful, usable urban space defines a giant outdoor room open to the sky (Alexander, 2005; Salingaros and Pagliardini, 2016). It is necessary to surround the open space with psychologically attractive façades, perforations and folding of the built fabric, plus a host of fixed activities. A welcoming urban space envelops its users and provides a feeling of psychological reassurance. People are drawn to the texture, tectonic balance, composition, color, and ornamentation of building façades bounding an urban space (Lavdas, Salingaros and Sussman, 2021; Salingaros, 2005; Salingaros and Sussman, 2020).

It's the open space that's most important, hence the role of buildings is to define and enhance public space, not the other way around. And yet, stand-alone buildings have gained the center stage for the media and the public. Abstract "signature" projects reject traditional path-based patterns of human use, leaving the morphology of the adjoining/surrounding space to chance. That approach misunderstands how living cities function through users interacting in and with the open spaces. Professionals jettisoned the traditional spatial vocabulary that worked successfully for so long, and accepted amorphous urban geometries as a new design paradigm (Buras, 2020; Millais, 2009). Standard industrial-modernist typologies that degrade the urban experience should henceforth be abandoned.

Observations of use over time reveal urban space success (Council of Europe, 2012; Efroymson *et al.*, 2009; Jalaladdini and Oktay, 2012). Relevant design patterns should be applied to plan new pedestrian environments, and to diagnose and repair urban spaces that are seen to repel rather than attract users (Neis, 2017; Salingaros, 2020b). Contemporary industrial-minimalist building fronts fail to provide this welcoming attraction for users to linger in a space's interior. Above all, a network of linked urban spaces is a necessary condition for a city to be alive — in the sense of encouraging positive and varied human activity and interaction (Mehaffy *et al.*, 2020).

- New Pattern 6.1: PLACE NETWORK. When planning a building, a street or other parts of an environmental structure, conceive of them as part of a tapestry of places — a place network. Work to articulate these places as part of a continuous network with many connections, and many points of modulation of connection: doors, windows, gates, hedges, fences and other structures.

A new plaza inserted into an older living city, if done correctly, can be fed by existing networks. Inserted into a new city, it's often dead space. Why? Because pedestrian networks make urban space work (Salingaros, 2005; Salingaros and Pagliardini, 2016). Historical plazas provided a pedestrian "catchment" as the principal reason for their success. Living urban spaces define the collector nodes of the pedestrian network, and other transportation networks should add to (but do not destroy) circulation channels. Any new construction that is conceived in isolation — as a stand-alone design — has not evolved in context, and consequently cannot effectively plug into existing pedestrian flows. Or the urban setting around a new plaza contains hardly any pedestrians.

Organic growth results in a recognizably complex urban footprint (Salingaros, 2005; 2021). This organized geometrical complexity is a consequence of how the self-organizing city functions as a dynamic complex system that actually metabolizes (Peponi and Morgado, 2021). A living city's street network is interspersed with public spaces of many different shapes and sizes. A spontaneous settlement grows according to local economic and social forces, evolving its "in-between" spaces (Salingaros, 2021). Free from top-down controls, informal urban forms develop through a process of self-organization.

Mainstream urban practice is insufficiently developed to realize this; yet a diagnostic tool for finding the wrong geometry is to immediately suspect any simplistically-ordered urban plan. If building footprints and connective networks obviously lack fractality (a distribution of elements of different interlocking sizes), then that region lacks essential adaptivity, which represents a planning problem. Informal, spontaneous settlements provide a laboratory for studying the adaptive evolution of urban form. Where formally-trained planners see only disorder in self-building, sensitive urbanists recognize instead a marvelous adaptation to multiple flows and forces.

The vital importance of informationally-rich façades

Built structures surrounding the urban space — in their architecture and situation — are a major factor determining its use. This characteristic is totally independent of the plan. Perceiving the urban plaza as a harmonious whole depends very strongly on specific informational properties of the surrounding building façades (among other criteria). Ordered complexity shown on a building's front is created by mimicking

the structural rules of life forms, and is thus expressive of life itself (Alexander, 2001-2005; Lavdas, Salingaros and Sussman, 2021; Mehaffy and Salingaros, 2021; Salingaros, 2005; 2015; 2018; 2019; 2020a; Salingaros and Sussman, 2020). The opposite guarantees a deadening environment.

Three new design patterns are relevant here (Mehaffy *et al.*, 2020).

- New Pattern 11.4: FRAMING. Do not try to clear out and simplify a design when there is a natural frame around it — whether that is vegetation, a portion of another building, columns or other interruptions. Instead, work with these elements as frames, and use them to make the experience more powerful.
- New Pattern 15.2: HUMAN-SCALE DETAIL. Create a generous number of elements that are human-scale, i.e. 1 meter by 2 meters or less. Make sure that many of these elements are structures that people are physically familiar with, e.g. roughly human-proportioned windows, hand-crafted patterns, etc.
- New Pattern 15.4: COMPLEX MATERIALS. Avoid large expanses of perfectly flat, smooth panels of metal and glass. Use complex materials that have subtle structural characteristics that can be perceived at human scales.

This is the key message of the present paper — the geometry of the environment couples with the user's neural system via unconscious emotions to influence behavior and decisions in public spaces. Alexander already summarized this vital process early on: "*The fact is, a person is so far formed by his surroundings, that his state of harmony depends entirely on his harmony with his surroundings.*" (Alexander, 1979: p. 106) There are specific design elements for buildings fronting urban space: architectural style plays a central role. To get close to achieving positive emotional engagement with the user, surrounding façades should exhibit the following geometrical features:

1. Employ scaling symmetry, where the different scales of ordered structure relate to each other through magnification (a characteristic of fractals). Use visual patterns nested within other patterns, including fractals generated by recursion and Cellular Automata (Taylor, 2021).

2. Build up organized complexity into "deep symmetry", in which many different patterns on smaller scales coordinate through symmetries to produce a coherent whole. Superimpose traditional geometrical patterns such as reflectional, translational, and rotational symmetries in a coherent manner (Mehaffy and Salingaros, 2021).

3. Emphasize the vertical symmetry axis, because our body evolved in gravity and connects to the vertical. Avoid extensive horizontal or diagonal elements on buildings, since those give rise to feelings of anxiety. Arches are fine, because they are reflectionally symmetric across a vertical axis.

4. Use color abundantly, interesting in itself in every occurrence, and also creating large-scale color harmony. But colors reminiscent of death (grey concrete, black or dark brown surfaces) and colorless surfaces upon which the eye cannot focus (transparent or translucent glass curtain walls, reflective metal) are negative, whereas welcoming colors reminiscent of our natural environment, flowers, and fruit (rich and pastel colors that humans find psychologically nourishing) are positive.

5.Welcoming façades require interesting (neither minimalist, nor random) materials, attractive details, and ordered articulations to draw the pedestrian's attention. Industrial Modernism undid all of these biophilic design factors — essential for human engagement — that are inherent in traditional materials.

A minimalist design approach removes cognitively necessary signals from the built environment. When people are forced into such environments they eventually become emotionally numbed, which is terrible for their body. Compulsory cultural acceptance and social pressure from the media to love alien, disturbing spaces, and to fear color suppresses but cannot erase people's innate feelings of unease. The insipid global uniformization joined to a ruthless profit motive exploits design ideology that dismisses human health. Living in an inhumane city, citizens lose their instinctive power to react to their surroundings (Buras, 2020; Millais, 2009).

Specific architectural qualities attract human beings to approach and enjoy experiencing the environment from every distance. For example, our sensory system has evolved to cope with gravity, and is set up to subconsciously recognize faces and forms with bilateral vertical symmetry; hence skewed forms generate alarm and physiological distress. Without a vertical axis of reflectional symmetry, a person could experience nausea caused by the inner ear's mechanism for vertical orientation. Our biological warning reaction at unbalanced diagonal forms cannot be changed or unlearned. Any symmetry axis is fine on a

floor pavement, but an explicit or implicit vertical axis on a façade or entrance is essential for sensing stability.

Ideological motivations for designing "hard" plazas

Design rules for creating usable, welcoming urban spaces are found in historical examples that still attract users (Buras, 2020; Salingaros, 2017). Attractive parks and plazas from around the world fill with people during many hours of the day. Alexander (Alexander *et al.*, 1977), Jan Gehl (Gehl, 1987), and William Whyte (White, 1980) performed pioneering work to determine which urban squares are actually used, and why. Jane Jacobs described the spatial complexity of the living city (Jacobs, 1961). Adaptive urban fabric reveals itself from observed human movement and reactions, not its abstract design. When a park or plaza is surrounded by minimalist façades lacking the appropriate geometrical complexity, there is no emotional attraction (Lavdas, Salingaros and Sussman, 2021; Ruggles, 2018; Sussman and Hollander, 2021).

Adaptive design through patterns tries to predict the socio-geometric forces that a structure will generate if built in a specific location. Hopefully, those are going to be harmonious and not anxiety-inducing. Let's begin by stressing the importance of color, curves, detail, fractals, plants, sunlight, symmetries, etc., known together as "biophilic" qualities, and documented in this design pattern (Mehaffy *et al.*, 2020).

- New Pattern 2.4: BIOPHILIC URBANISM. Incorporate biophilic properties and their components into urban structures at all scales, down to the details, including buildings and ornaments.

Biophilia, connective networks, and fractal qualities characterize a "soft" urban plaza, such as the older *La Rambla* strip in Barcelona. Bushes, trees, old-fashioned benches, lamps with detail, human-scale street furniture, umbrellas and canopies, and ornamented 19th Century kiosks make the ensemble fractal and highly biophilic (Salingaros, 2015; Taylor, 2021). The pavement's designs are varied, and the biophilic effect is multiplied several-fold by the flowers and fruits presented for sale. This is not merely a romantic idea or pretty tourist picture; it is an essential enhancement of the living quality of place through biophilia and the fractal hierarchy of scales.

The opposite design rules were consistently implemented in post-war planning (Efroymson *et al.*, 2009; Jalaladdini and Oktay, 2012). All of the essential biophilic elements listed above were removed with a vengeance in the crusade to "modernize" urban spaces. Ideological design is careless of human well-being, and when backed by the myth of modernization, it is a prescription for keeping people away. Yet people became passive consumers of alien urban typologies spread by those in power. New urban plazas awarded with architectural prizes remain empty, except for stray dogs and vagrants.

A plain slab pavement with strict rectangular geometry, no trees, no kiosks, and no embedded visual patterns could be either starkly desolate, or contain a menacing abstract sculpture, severe and uncomfortable "design" benches, and lamps boasting an industrial-minimalist look. This hostile style of urban furniture further reduces the biophilic qualities of the experienced space. New plazas conceived as giant sculptural abstractions also tend to be situated in the wrong places in the network of pedestrian flows, so that the surrounding path structure does not feed users into and across the space.

Most important to its success, Barcelona's *La* Rambla is "fed" by dense pedestrian urban fabric along both sides. A "hard" plaza could work as a transit space, i.e. just another very wide pedestrian street. This presupposes attractive pedestrian destinations all around the plaza's perimeter, so that paths conveniently cut across the plaza. Piazza San Marco in Venice is of this category. Because of its size, Piazza Navona in Rome is mostly a transit space, yet it also includes attractive destinations with its three fountains. But inserting obstacles in an effort to make the space "interesting" destroys transit plazas. Abstract sculptures, useless changes of level, or pools of water placed unintelligently block the most enticing pedestrian paths.

Why are Barcelona's new plazas uncompromisingly "hard"? Supposedly, those designs expressed pent-up sentiments that were freed by the ending of the Franco dictatorship. Socio-political forces included frustration, reaction to oppression, the urge to provide public platforms for expressing the new freedom, etc. But deeply-felt political resentment should not demand an unfriendly geometry! An image that deliberately opposes a much "softer" typology has been accepted emotionally, without any rational thinking. Even in today's totally changed socio-political dynamic, nobody dares to upgrade those unused plazas using traditional solutions to create a more humane environment: they are terrified of anything that reminds them of the hated past.

Stop prioritizing the auto-dependent city: it permanently perverts life

Beginning in the 1920s, the city was optimized for rapid vehicular movement. Along with the invasion of cars and trucks, auto-dependent urban components devoured the city: gasoline stations, open car parks,

garages, car dealerships, car washes, drive-through take-out restaurants and coffee shops, drive-through pharmacies, strip malls, giant surface parking lots surrounding big-box stores and commercial malls, etc. These urban typologies displace pedestrians by occupying a tremendous amount of ground. Surface transportation creates space that is no longer walkable and eliminates intimate human contact from the physical city (Efroymson *et al.*, 2009; Jalaladdini and Oktay, 2012; Salingaros, 2006).

Incredibly, modernist-trained planners do not reflect on how thoroughly vehicular transport substitutes for urban space. It is a monumental trade-off that altered life on earth, and our way of perceiving the environment. Speed blurs and dematerializes the world. Human-scale detail, ornament, and structural coherence are not experienced from a car, hence they become irrelevant. Commercial advertising jumped up in scale from modest lettering to huge signs, creating a visual cacophony that competes for our momentary attention. What make the greatest impact are large-scale forms and flashy, shiny structures to draw our attention from a distance as we drive by them.

By changing the way human beings interact with the built environment, cars drastically restructured people's existence. Highways and open parking lots define urban morphology all over the world today, replacing emotionally-nourishing urban spaces. The perspective of driving to a building ignores how that building meets the pedestrian at ground level (it usually doesn't!), and validates the illusion of monstrous structures such as skyscrapers. Judging buildings from a non-human distance distracts people, making them focus on the skyline and forget about the disappearance of usable public space.

Nevertheless, some commercial developers discovered lately that human beings still prefer a human-scale environment. Small-scale profit-driven development reversed decades of top-down urban destruction. The tremendous success of retrofitting urban pedestrian zones that compete with indoor malls has reversed a decades-long trend. Hopefully, cities in the developing world that are getting ready to bulldoze their nicest human-scale environments (copying dismal planning mistakes from 70 years ago) will learn from this experience and work instead to retain those places.

Design philosophy needs to be radically re-oriented before creating a newly humanized environment. Sustainability occurs naturally out of design by patterns (Mehaffy, 2021). Such a change requires great conviction and courage to implement, and to stand up to destructive, unsustainable practices by authorities. A quote from Theodore Dalrymple (2021) is apt:

"I once lived *in a city not famed for its beauty, to put it mildly, but which possessed one or two gracious areas and some buildings of magnificence. They, naturally, were the first to be destroyed by the reforming council, and if not outright demolished, were at least definitively spoilt by the erection of huge and horrible buildings next to them. An area of real elegance was spoiled in the name of social engineering."*

Two contrasting design paradigms rely upon completely opposite geometries for their buildings and urban space networks. A fascination with "design purity" removes everything but the largest scales, which are inadequate to define a complex humane environment. Bollards, colonnades, and arcades, which Industrial Modernism deemed to be "geometrically impure", introduce fractal structure at smaller scales. But that is precisely the point: urban elements coordinate on all scales, while privileging the human scale. Lacking traditional solutions for creating intermediate spaces and protective semi-permeable borders, a city becomes dangerous and deadening.

Experience warns us to mistrust the interventionist and megalomaniac projects of extractive globalism, given their proven record of upsetting natural balances (Salingaros, 2021). We can learn from the opposite of iconic and signature urban projects, which remove us totally from biological reality. Adaptive land use in urban settlements is to be found in the spontaneous building traditions of people around the world. Minimizing energy usage pushed societies to build and maintain a pedestrian city. Several authors support this idea — Stephen Mouzon describes how true sustainability arises from locality, modest scale, and re-use (Mouzon, 2010).

The fantasy of progress by means of early 20th-Century industrial-modernist images continues to seduce politicians, however. The exciting "look" of the superficially fashionable, new, and shiny wins instead of a far more adaptable, human, and sustainable design during competitive selection. What looks futuristic, industrial, and minimalist replaces older (yet perfectly functional) urban fabric that only requires regular repair to last for centuries. Healthy urban components — including working plazas — are condemned because they look "old-fashioned", whereas vast economic power implements typologies that create emotionally-cold, inhuman, and unsustainable places.

The architectural press brands as "backward" those few cities and countries that attempt to assert their heritage and traditions privileging the human scale, bravely resisting the global building industry's destructive onslaught. Complicit architects justify entrenched ideological choices made in the 1920s

(Salingaros, 2017). Colluding architectural academics attribute an imagined redemptive value to futuristic designs, and teach this prejudice to impressionable students. They ignore scientific evidence that identifies those industrial-modernist typologies as causing anxiety, psychological stress, and as repelling people from urban space.

Understanding that life comes from the geometry

There exists a market for good design and human-scale urban spaces. Attractive urban space is indispensable on a campus (Neis, 2017; Salingaros, 2020b). Proposed alternatives to standard design methods involve little or no additional financial investment. Some developers already know that they can be more successful with good (adaptive) design than with bad (image-driven) design. It's simply a matter of understanding what is healthy versus what is "trendy". In the case of government projects, these alternative design methods guarantee a more humane result. Politicians who align themselves behind an innovative human-scale methodology better serve the interest of their constituents.

Implementing urban innovations based on design patterns holds the greatest hope for a humane future for the world's cities. The present image-based paradigm can be changed by adopting a superior method with practical outcome. People with the power to push for change became accustomed to building cities in a standardized but often inhuman way. Starting from a rigid ideology, the system attempted to mold human nature to suit a very narrow conception of the world. After decades of experts telling decision makers that building with post-war industrial typologies was the only way to make cities, it requires sustained effort to appeal to basic intuition and common sense.

Shared public space enhances human well-being as well as encouraging beneficial social outcomes. Attractive public space holds the key to urban vitality and healthy societal interactions (Council of Europe, 2012). Nevertheless, previous documentation of this tends to miss the geometrical basis for designing usable public space. It is essential, but not enough to recognize a working public space that creates the living heart of a neighborhood: without a scientific toolkit at hand, the reasons for its success remain elusive. Designing a new park or plaza is still a hit-or-miss undertaking. And subsequent remodeling could destroy living structure.

Implementing abstractions detached from human feedback is a planning approach that eliminates usable urban space, "designed" according to a psychologically alien model (Lavdas, Salingaros and Sussman, 2021; Mehaffy, 2021; Mehaffy and Salingaros, 2015; Salingaros, 2005; Salingaros and Sussman, 2020). A linked set of design practices based on industrial priorities, beneficial to the construction industry but hostile to users, has become institutionalized. This corpus of non-adaptive design tools defines the urban design curriculum. Planning codes adopted after World War II discourage or legally prevent the creation of human-scale public spaces in the city.

Both commercial and government forces act to suppress public space for different motives (Agbo, 2020; Goldstein, 2017; Mela, 2014; Zaprianov, 2012). Parks and open spaces are dismantled for private development; or the government does the same thing in order to control and rule out public gatherings. Special interests extract profit from privatizing public space so as to manipulate users into consumerism. Their tactic is to build private commercial spaces while erasing public space. Historic spaces are thereby wiped out, while new parts of a city — or even entire new cities — are deliberately planned to contain no public space at all.

Conclusion

Creating attractive public spaces in our cities implements rules already documented in two books of design patterns: *A Pattern Language* (Alexander *et al.*, 1977) and *A New Pattern Language for Growing Regions* (Mehaffy *et al.*, 2020). This paper discussed how to apply design patterns in combination, giving the necessary background to understand how and why they work. Even though architectural and planning culture dismisses such design tools as "old-fashioned", recent results from neuroscience validate them in their entirety (while repudiating established design and planning rules that have devastated public spaces).

Open spaces in a living city — not just some isolated public square — have to follow specific rules. We have the knowledge to build a wonderfully humane living environment, once the majority of players understand the advantages of doing so. Forces shaping urban form should generate the human scale, abandoning design prejudices that created inhumane cities. Society was deceived into judging a rendering only by its imageability, ignoring the real-world consequences for human life. Implementation of monstrous ideas occurs partly for the economic profit of a ruling elite, and partly out of paternalistic good intentions divorced from science.

Three goals lead to cities better adapted to human sensibilities and uses:

1. *Research*: Scientific reasons lie behind healthy city form and urban processes. Much of this information is readily available, even though the profession ignores it.

2. *Education*: Learn from evidence and facts, and protect design knowledge from ideology and special interests linked to corruption, greed, and inertia.

3. Application: Convince decision-makers to build human-scale cities and to resist fashion or the unthinking copying of outdated models.

Recent examples where this program was implemented successfully all use traditional design typologies. Those commercially-driven projects turned out to make large profits for their investors. Small-scale developers have built the best projects. Traditional architectural forms were employed together with form-based urban codes extracted from older, living urban fabric. After an initial reluctance of government permitting boards, those innovative projects went through. Resistance came primarily from architectural academia, which mounted a desperate effort to discredit neo-traditional developments.

Whenever large money and power interests fuel speculative construction, city shape conforms to abstract images. Recognizing those forces and re-directing them towards a more adaptive and healthier built environment is a matter of life and death for our cities. Mainstream urbanism follows a reductionistic and unscientific conception of land-use, driven by utopian schemes of shaping how other people should be forced to live. Such cities are unsustainable, and represent ticking time-bombs that will become unusable because they are too expensive to run.

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