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DOI
10.1080/23800127.2018.1505261

Publication date
2021

Document Version
Final published version

Published in
Applied Mobilities

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Link to publication

Citation for published version (APA):

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To cite this article: Marco te Brömmelstroet, Samuel Nello-Deakin, Jenny Quillien & Indranil Bhattacharya (2021) Towards a pattern language for cycling environments: merging variables and narratives, Applied Mobilities, 6:1, 35-53, DOI: 10.1080/23800127.2018.1505261

To link to this article: https://doi.org/10.1080/23800127.2018.1505261

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Published online: 17 Aug 2018.

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Towards a pattern language for cycling environments: merging variables and narratives

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ABSTRACT

To understand relationships between the urban environment and cycling practices we need new ways to face complexity and multidimensionality. Neither measurable environmental variables, nor thickly descriptive, particularistic, or overtly theoretical contributions provide satisfying recommendations for cycling policy and practice. We propose the development of a pattern language for urban cycling environments, together with a supporting methodology – named Embodied Making – for the development of novel patterns. We define an individual pattern as “a honed solution that successfully resolves conflicting forces in a recurring context”; a pattern language as a grouping of related patterns that work together within a given domain. Rather than attempting to identify existing solutions, Embodied Making seeks to develop new patterns from the bottom-up, i.e. from the analysis of forces themselves. The use of a pattern language naturally addresses the integrated quality of the physical, perceived, and lived dimensions of urban environments, and holds promise for a more holistic understanding of cycling environments, which could help bridge existing ontological and epistemological divisions within cycling research. We discuss how such a pattern language (1) Addresses integrated quality of physical, perceived, and lived environments; (2) Makes human experience part and parcel of the investigation; (3) Offers an approach to accommodating complexity; (4) Is adaptable, because it formulates patterns as mid-level abstractions instead of either absolutes or unique context-specifics; (5) Uses pragmatism as its philosophical underpinning; (6) Works with languages in which patterns take on significance and meaning according to connections with other patterns, and; (7) Facilitates community building.

“… in a real design problem, even our conviction that there is such a thing as ‘fit’ (of solution to problem) is curiously flimsy and insubstantial. We are searching for some kind of harmony between two intangibles: a form which we have not yet designed, and a context which we cannot properly describe”.

Christopher Alexander, Notes on a Synthesis of Form
you lean on your bike to try your first cigarette, to kiss your first girl, and carry your belongings when you first move away from home”.

Jildert Schat, Amsterdam biker

1. Introduction

How can we properly describe, analyse and predict a fitting context for urban cycling? How can we describe urban cycling itself, in a way that both capture its local particularities and its generic features? What relationships exist between environmental characteristics and cycling and (how) can we shape them? Such are the questions that spur this paper.

Although explorations into the relationship between urban characteristics and cycling have blossomed over the past decade, they have been overwhelmingly oriented towards quantitative methods, and, in particular, regression analysis (Buehler and Dill 2016; Heinen, van Wee, and Maat 2010; Muhs and Clifton 2016). Despite the undeniable value of such research, it restricts us to statistically measurable characteristics and, concomitantly, measures of bikeability that focus on physical infrastructure provision, network connectivity and destination accessibility (Lowry et al. 2012; Winters et al. 2013). The narrow focus on measurable environmental variables, which dominates in the transport geography and planning literature, helps us explain an important part of what makes a fitting cycling environment, but it does not provide us with a complete picture. In their review of the determinants of cycling, for instance, Heinen, van Wee, and Maat (2010) acknowledge that “predicting and influencing bicycle use needs to be grounded in other kinds of knowledge than those currently available for motorized forms of transport”, thus highlighting the importance of social environment variables, which are difficult to quantify in shaping cycling practices. Taking this point further, Vivanco (2013) writes that the statistical literature on cycling only provides a “partial and mostly culturally uninformed picture of the relationship between cities, people and bicycles” (p. 69). Experiencing and studying policy transfer around cycling first hand (Amsterdam annually hosts around 150 delegations from around the world) shows that giving the design manuals and statistical studies is not enough. Much of the learning takes place biking around, understanding cycling as a lived experience. Many of the environmental variables, in other words, seem “necessary, but not sufficient conditions” for cycling environments.

Some studies, seeking to widen or change the focus, have also examined the role of perceived environmental characteristics in shaping cycling practices (Ma and Dill 2017; Willis, Manaugh, and El-Geneidy 2015). However, limiting people’s perceptions to a few quantifiable variables inevitably produces an overly simplistic picture. In addition, the causal relationship between perceptions and cycling remains unclear: perceptions may influence cycling practices, but it appears that cycling also influences perceptions (Kroesen, Handy, and Chorus 2017). Some authors point out that intangible aspects of the environment also play a role in cycling practices. Forsyth and Krizek (2011), for instance, highlight the importance of the “view from the bicycle” in mediating the relationship between cyclists and the environment, and argue that cyclists’ experiences should be taken more seriously by planners. In a similar vein, Stefansdottir (2014) outlines a theoretical perspective on cyclists’ aesthetic experience of the environment.
Others have explored cycling from a mobilities perspective, rendering the embodied experience of cycling itself salient. In the words of Spinney (2009), these studies “explore the content of the line between A and B in order to highlight the often fleeting and ephemeral meanings that can contribute significantly to what movement means”. This strand of research includes topics such as sensescapes (Van Duppen and Spierings 2013), affective atmospheres (Simpson 2017), cyclists’ acoustic engagement with the environment (Jungnickel and Aldred 2014), and the experience of night cycling (Cook and Edensor 2017). Jon Day’s memoir of his three years as cycling courier in London focuses on the kinaesthetic understanding of a city provided by cycling (Day 2016), while Vivanco popularized the “lived experience” of cycling mentioned above in Reconsidering the Bicycle (Vivanco 2013). Although studies approaching cycling from a mobilities perspective provide us with valuable insights into embodied experiences of the cycling environment, their thickly descriptive, particularistic and often overtly theoretical perspective makes it difficult to see how they can be translated into concrete recommendations for cycling policy and practice (Shaw and Hesse 2010). Based on experience, we often know if a certain city does (not) offer conditions for a successful cycling environment, but it is difficult to pinpoint this in an explicit way.

The challenge we face, then, is to achieve a perspective of urban cycling environments which acknowledges and integrates their physical, perceived and lived dimensions, and which communicates back and forth with practical insights for policy-makers, planners and urban designers. To engage the challenge of bringing together the measurable and immeasurable qualities of urban cycling environments, we propose a pattern language approach (Alexander et al. 1977), supported by the Embodied Making Method (Quillien 2017) for devising novel patterns. These twinned methodological approaches naturally address the integrated quality of the physical, perceived, and lived dimensions of urban environments and holds promise for a more holistic perspective. In doing so, they could help us bridge the existing ontological and epistemological divide between different strands of cycling research.

2. What is a pattern language?

The origin of the pattern language approach goes back to the mid-1970s when a branch of the American government, the National Institutes of Health, put out a Request For Proposal on the following research question: What, if any, is the relationship between the built environment and human well-being? This tender was answered by a team of architects and urban planners from the University of California, Berkeley, who were willing to give it their best, but admitted that they did not have a methodology: they would have to experiment (C. Alexander, personal communication).

The upshot was a “walkabout” where they noticed, recorded and catalogued configurations (i.e. patterns) in the physical built environment across a range of scales which seemed to support human comfort. For example, they noticed a configuration which they eventually named as the pattern SIX FOOT BALCONIES. When a balcony was at least six feet deep it tended to be used: children played there, people took time with their coffee or had lunch on a small table, basked in the sunshine, and enjoyed their connection to the street, watching the world go by. On the other hand, a balcony under six feet in depth would not be used, collected junk, and mostly became little more
than a place where laundry was hung to dry. The perceived quality of the deeper balconies was that of a connective tissue linking life inside the building to life outside, a quality entirely lacking from the shallow “glued planks” of narrow balconies. The ledge of the narrow balconies was too uninviting, creating a precarious lived environment which only reinforced the sensation of tenement dreariness.

To give another example, the Berkeley team noticed that generous overhanging roofs provided a strong sense of comfort: they gave shade, a place to sit next to the house, read, chat, or keep an eye on children at play. A physical ease, a sort of animal sense of security prevailed and distinguished these buildings from the ones with more perfunctory caps on their heads. This SHELTERING ROOF, as this pattern came to be called, could be found in building traditions from California to Borneo, the variations among them reflecting the texture of local materials, tools and social fabric. The following description of a traditional Black Forest roof from Heidegger’s “Building Dwelling Thinking” (Heidegger 1971, 157–158) notes how the forces at play (technology, geography, culture) intersected, found resolution in the roof construction, and gave a coherent frame for human living (Figure 1).

“...It placed the farm on the wind-sheltered mountain slope looking south, among the meadows close to the spring. It gave it the wide overhanging shingle roof whose proper slope bears up under the burden of snow, and which, reaching deep down, shields the chambers against the storms of the long winter nights. It did not forget the altar corner behind the community table; it made room in its chamber for the hallowed places of childbirth and the ‘tree of the dead’ – for that is what they call a coffin there: the Totenbaum – and, in this way, it designed for the different generations under one roof the character of their journey through time”.

Figure 1. Vogtsbauernhof Open air Museum.
The original request for research from The National Institutes of Health called for a direct grappling with the ineffable: human well-being. In the responding pattern language approach, physical forms were considered successful when they were culturally appropriate and supportive of human activities. It was assumed that we like our daily activities to be choreographed in a reliable and phenomenologically comforting sort of “place ballet”, to use the well-known expression from urban critic Jane Jacobs (1961).

As the research evolved, patternists developed a set literary form when writing up a pattern. First, each pattern has a short name which aims to capture its essence (we use small caps to signal such a pattern name), accompanied by an image. Then there is a description of the context where the pattern occurs, possibly referring to a larger pattern that this pattern helps complete. This is followed by a statement of the problem that the pattern is trying to solve. Next is a discussion of the various forces that are present and must be addressed. “Forces” – an admittedly fuzzy term – are broadly defined as those facts, motivations, constraints that make a situation what it is. We then find instructions (in a ‘therefore’ statement) to generate a solution. Finally, a pattern and its solution can be related to other patterns or refer to additional background material.

This early research was essentially looking at vernacular architecture and “cherry picking” interesting existing configurations which people had slowly perfected over centuries. The first catalogue of patterns by the original Berkeley team collects 253 such configurations, such as SIX FOOT BALCONY, COURTYARDS THAT LIVE, SHELTERING ROOF, LIGHT ON TWO SIDES OF EVERY ROOM, etc. (Alexander et al. 1977).

As a short operational definition, we summarise an individual pattern as a honed solution or configuration which successfully resolves the conflicting forces in a recurring context. A pattern is a stable solution. In the original work a pattern was a physical form. Later, other disciplines extended patterns to practices. A pattern language is a grouping of related patterns that work together. For example, a BICYCLE HIGHWAY to be fully functional would need to connect seamlessly with BICYCLE PARKING, RENTAL BICYCLES, perhaps BICYCLE/TRAIN TRANSFER. REPAIR SHOPS AND TREE COPSES might be incorporated into the BICYCLE HIGHWAY itself.

### 3. A pattern language for cycling?

We suggest that the bicycle itself, bicycle paths, bicycle share options, etc., can also be viewed as successful when they are culturally appropriate and supportive of human activities. Rather than dismiss the question of human well-being as unamenable to quantification, the authors wish to cautiously embrace the query. Why is it that the classic Dutch fiets has us sitting up straight? Poor for racing aerodynamics, but excellent for scanning and negotiating movements in the environment as things happen. How does this co-evolve with Dutch cycling infrastructure and the larger Dutch social and spatial environment? But also, what elements of this are more generic and transferable to other cultural contexts? It is questions like these that a pattern language helps us to engage with.

We are aware that the original formulation of an architectural pattern language by Alexander et al. (1977) has received a number of academic criticisms, as summarised by Dawes and Ostwald (2017). They state that there are two criticisms that pertain to pattern languages (within wider criticism of Alexander’s work). In response to these,
we accept that a single pattern might express itself in different ways based on geographical context and over time. To address the critique that Alexander did not establish a clear methodology to find and test patterns we built on the Embodied Making methodology. Below, we explain how and why this offers a useful way of developing patterns, and testing them empirically. Above all, the spirit of the present article is intended to be hypothetical, rather than definitive: we are not seeking to provide a “finished” theory, but merely a tentative exploration of how pattern languages might offer a useful way of thinking about cycling environments in a way that complements existing quantitative and qualitative approaches.

4. Advantages of a pattern language approach

Besides the first advantage of addressing the integrated quality of physical, perceived, and lived environments, pattern languages, as they were conceived and formalized by the Berkeley team, present the advantage of being deliberately Second-Order Science. First-Order Science, which readers will remember from their school days, stringently excludes the experimenter from the experiment; in other words, the world is an “object” distinct from the “subject", the human observer. In current science, however, more and more attention is given to the role that experimenters play in the outcome of their own experiments. By clearly making human experience part and parcel of the investigation and evaluation process, the pattern language approach prioritises the experience and satisfaction of cyclists themselves.

As a third advantage, patterns are a subtle and powerful approach for accommodating complexity. As an illustration, we consider the pattern ENTRANCE TRANSITION and request that the reader think about a context that repeats itself: going home. At its most elementary, the reader, i.e. you, wants to get out of the rain – we can consider this a force. You also want to seal off the cold wet wind so that it does not enter the house – another force. Additionally, you will want to return back outside to get to the office the next morning (yet another force). These forces can be resolved by a pattern, albeit one so simple as to not be retained in the literature as worthy of notation: a panel with hinges, i.e. a door. However, a door is insufficient for complete well-being. The reader is asked to reflect a bit more on the experience of coming home. Psychologically, after a long day at work, you want to shed your outer public persona and enter your domestic space as a more genuine and relaxed self. This is also a force that needs to be taken into account. In other words, as we explore the forces at play we are exploring and coming to terms with the different dimensions of the problem space. Here, we realize that the more interesting problem to be solved is this: our experience of a building is influenced by how we enter it. If the transition is too abrupt (as with a simple door), we will have no feeling of arrival and no sense of inner sanctum. This is true for private homes but for many other types of buildings as well: consider a church or town library, for instance. The ‘therefore’ statement reads:

*Make a transition space between the street and the front door. Bring the path which connects street and entrance through this transition space, and mark it with a change of light, a change of sound, a change of direction, a change of surface, a change of level, perhaps by gateways which make a change of enclosure, and above all with a change of view.*

(pattern #112 from Alexander et al. 1977, 548)
A fourth advantage is adaptability. Patterns are formulated as mid-level abstractions, which give general guidance about constraints but do not specify a design. To continue with the ENTRANCE TRANSITION example, you can have many possible instantiations of the pattern depending on the specific realities of topography, vegetation, budget and culture. Imagine that you, like the authors of this paper, are in Amsterdam where property taxes have traditionally been levied according to the width of a building. You do not want to pay taxes (a force) so you build a narrow house. More forces now come into play making your ENTRANCE TRANSITION more difficult since every square centimetre must be used to the hilt. Unless, of course, you wish to display your wealth (yet another force).

The formatting of patterns as mid-level abstractions makes space for cultural adaptations. Far away from Amsterdam, across the seas in Algiers, citizens are not concerned with taxes on building width but they are concerned with their own cultural pressures for privacy. They will have to figure out protected entrance transitions where front doors are shielded from view. Both Amsterdammers and Algerians can use a well formulated pattern, such as ENTRANCE TRANSITION, that will capture the essence of motivations, physical constraints, and their resolution, and yet leave them free to find a fine-grained idiosyncratic answer to their own particular circumstances.

Besides allowing for adaptation to geography, building materials and cultures, pattern languages adapt with time. A pattern language is a living system. Today a Dutch BAKFIETS (Figure 2) is a symbol of gentrification and illustrates gender roles within households (Boterman 2018), but the original BAKFIETS was mostly a working-class device in the early 1900s, and in between became a strong cultural signifier for the 1970’s squatter movement. Clearly, current efforts to cultivate bicycle use will call for a serious and ongoing (i.e. living) ontological review of bikeness. What is (not) a bicycle? What should be allowed on bicycle paths? These become non-trivial question in light of new electrical cargo bikes for delivery businesses, high speed electrical assist, scooters and various encapsulated bikes.

A fifth advantage concerns pragmatism as the philosophical underpinning of this approach. There is no search for an ultimate truth or obedience to a particular school of thought. Each pattern can be loosely thought of as an if-then proposition. If these forces are at play then this general configuration resolves them. This is not meant in a coercive

![Figure 2. Cargobike: (left) from working class (milkman) to (middle) counter culture in the 1970s to (right) gentrification symbol ("Bakfietsmoeder").]
mathematical if-then sort of way, but rather as a heuristic, a felt way which has grounding in one’s lived phenomenological experience (Van Aken 2004). Flyvbjerg (2001) has called this way of knowing “phronesis”; Schön (1983) studied it in several domains while Sennett (2008) found it to be the key of how craftsmen learn and transfer skills. Straatemeier et al. (2010) have documented how this approach can inform research in urban and transport planning.

Building on pragmatist thinkers (e.g. Dewey 1938; Peirce 1877; Rorty et al. 1991), a pattern can be considered a “warranted assertion” found through collaborative inquiry and open to being amended through testing and evaluation. In the words of Christopher Alexander,

“The key to the improvement of patterns is in the fact that it can be piecemeal… We can define, discuss, criticize and improve one pattern at a time: so that we never have to throw away all the other patterns in a language just because one of them is faulty… No language is ever finished”. (Alexander 1979, 345–346).

A pattern is a hypothesis. In the critical reviews (again referring to the summary by Dawes et al. 2017), Alexander is seen as unscientifc, however, it behoves us to read the original work more carefully. In the original work, there is a deep concern for validation and the difficulty of validation. There was no intent to reify and codify a group of patterns in book form. The original idea was to maintain a stance of work-in-progress through loose leaf binders where pages would be replaced as experience grew. A star rating was used to indicate the level of confidence in the “warranted assertion”. The classic “error signal” would be the recognition that a force had gone unrecognised. With today’s technology, a curated wiki would be the most appropriate way to proceed. This “living” pattern language could thus actively engage with both the domains of more quantified testing of environmental variables (i.e. through providing hypotheses, solidifying tested variables) and with more qualitative narratives that map experienced forms of the cycling environment (i.e. through linking recurring narratives, enriching the language).

A sixth advantage is that this approach does not work with individual patterns as isolated one-offs but with languages. Patterns, like words in a sentence, take on significance and meaning according to connections with other patterns. A GARDEN WALL is, after all, just a pile of bricks and only acquires its full significance from connecting patterns: its relationships to the surrounding plants, overhanging trellis, path, and benches. The GARDEN WALL of a modest backyard with lowly flower bed manifests the pattern differently from, say, a GARDEN WALL of Versailles with imposing terraces. A language for cycling might include COMMUNAL BIKES that can have NEIGHBOURHOOD REPAIRS for a VARIETY OF BIKES that are distributed by usage and parked within CONTOURED FENCES made available through NESTED IDENTITIES (this last pattern so named after a successful experiment at the University of Padua where student access to bikes was made convenient by tying it to the general student card granting other privileges).

Seventh, the use of a pattern language facilitates community building. Patterns are elegant vessels of knowledge, allowing for compression of knowledge (mid-level abstraction, format and name) which can then be unpacked to regain full complexity with each new rendition. With this form, memorable pattern names act like vocabulary to assist citizens in discussing what kind of cycling environment they want. The
language itself helps connect individuals within a biking community and becomes germane to the evolution of the common habits of a cycling culture. As recognized by Dawes and Ostwald (2017), the published compilation of 253 patterns, *A Pattern Language*, gives short shrift to practical instructions on how users should proceed. Other publications, such as Alexander’s *Timeless Way* (1979) and other authors, notably Nikos Salingaros (2000), have fleshed out the concept of a pattern grammar (containment, generalization, completion, levels of scale, complementarity, either-or, etc.) and practical approaches to involve end-users with manageable numbers of patterns, typically around a dozen.

5. Cherry picking existing patterns versus forces first

Early pattern efforts were about cataloguing proven existing solutions. Importantly, the starting point of the investigation was “noticing” successful configurations. In building a pattern language for cycling there will be some of these. Indeed, the world cycling community sends waves of observers to Dutch towns (VisionZeroCA 2017), who are ignorant of pattern languages but are intuitively picking up on patternesque material: e.g. SIDE STREET CYCLE PATH, UNINTERRUPTED URBAN FLOW, OPTIMIZED BIKE SHARE, BIKE & TRAIN. There is a rich blog culture, for instance, which tries to tease out the subtle differences between equally successful cycling environments, such as Copenhagen and Amsterdam. To illustrate the noticing of an existing configuration, here are two partially developed patterns we might call TWO ASIDE JAUNT (figure 3) and DELTA JUNCTIONS (figure 4).

TWO ASIDE JAUNT

A cycle cruise with another person provides moments for shared observations, contemplations, and conversations. The riders are not in a rush to get somewhere. Cycling gives them a deep connection with their environment and moving through that environment together helps them develop shared understanding and purpose. Bicycle paths are often wide enough for several bikes. The bicycles are designed for comfort and stability with thick tires, large wheels, broad seats, and high handlebars for sitting upright. Cyclists can steer with a single hand. Riding side by side, friends can catch up, couples can share moments, parent and child can learn together, and colleagues can work out difficult decisions.

*Therefore*: Plan cycle paths wide enough to cycle side by side.

Other pattern material will be more “latent” requiring more teasing out. To illustrate this, consider how bikers informally collect themselves at junctions and how to fully work out the pattern, other forces, such as traffic, road type, pedestrians, would need to be studied and included.

DELTA JUNCTIONS

Cyclists waiting at a junction ride a variety of bikes, powered in different ways, with different kinds of loads. They embody different levels of skill and fitness, and varying levels of urgency to get somewhere. Cycle junctions that are the same width as cycle paths treat bicycle traffic like car traffic. Cyclists, however – unlike car drivers
are in closer physical proximity with each other and are better able to resolve spatio-temporal dynamics in the moment. Perhaps a bit by accident, city junctions occasionally lend themselves to self-organization by cyclists. Their close proximity allows them assess each other with greater nuance, and they can assess when to follow or break social norms.

'Therefore': By deliberately making cycling junctions broad, up to 10 bicycles can wait at a junction, ready to cross and form a narrow file on the other side as the path narrows. Like river deltas, bicycle paths are narrow when cyclists move and broad when they wait.

In the field of architecture, some of more recent pattern spin-off efforts, notably The New Urbanist Movement, continue to take existing configurations as the starting point and, perforce, remain conservative. However, there is another “camp”, so to speak, where spin-off work abandons the search for existing solutions (because there are none) and starts with the identification of forces. In the field of architecture, for instance, the Wisconsin firm of Kubala and Washatko is exemplary in working with end-users to design novel and contemporary civic buildings. In computer sciences, patterns inspired object-oriented programming. Developing patterns as processes as well as “products” is gaining ground. For example, the Public Policy Faculty at Keio University in Tokyo conducts extensive pattern work on topics, such as citizen involvement in earthquake management (Iba et al. 2017).

The method of pattern development we wish to outline belongs in this second camp. The solutions require crafting from scratch, moving from the raw phenomenology of

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**Figure 3. TWO ASIDE JAUNT.**
(https://farm8.static.flickr.com/7453/27520025514_7915dbed6e_b.jpg)
lived experience to the identification of forces and then to configurations that resolve those forces and finally to honing those configurations which, when successful over time, become patterns. Resulting patterns are now the end product and Embodied Making, as it has been coined, is the methodology of “how-to-get-there”. This methodology is itself composed of process patterns.
6. Embodied making

Embodied Making does not aspire to a dualistic modality of thought. Action-reaction, observation-hypothesis, and problem-solution pairs are examples of interpreting phenomena in dualisms. Rather, Embodied Making requires a threefold mode of thought that needs to be continuously sustained through understanding experiences, complexity and resolutions. Experiences are understood through narratives, knowing that narratives cannot substitute actual experience but are an adequate surrogate substitute. Complexity is understood through individual forces contributing to clusters of complexity, knowing that at any time, only a finite number of forces may be uncovered. Resolutions are understood through propositions of forms (solutions with physical presence) and practices (solutions that occur), knowing that no solution ever resolves all forces and in turn creates complexity of its own (figure 5). Learning to live with this incompleteness and recursively growing understanding of experiences, complexity, and resolutions as nested threefold knowing that the recursions will never result in a perfect or stable understanding is the essence of Embodied Making.

Developed over the last decade, Embodied Making has been applied in structuring large-scale organizational change with as many as 250,000 employees, participatory software engineering, workspace design, and urbanization (Bhattacharya and Hartges 2012). What all of these efforts have in common is sustaining a simultaneous threefold practice of understanding experiences, complexity and resolutions.

6.1. The nature of embodiment

Riding a bicycle requires coordinating muscular efforts, balancing the weight of one’s body with the weight of the bike, sensing when the bike might tilt over, watching the

Figure 5. Extract of some process patterns for Proposition Development with relationships.
environment for oncoming cars or other bikers, surveying the road surface for dangers, such as tram grooves, steering, adjusting speeds and ringing the bell to alert pedestrians that you are moving toward them (and braking when they do not get out of the way). Vivanco (2013) refers to this as a perfect human-machine hybrid, while Day (2016) makes the point that cycling leads to an especially deep kinaesthetic understanding of the urban environment. A cyclist is constantly managing numerous forces that propel them either forward on their journey or toward a crash. Of course, there are varying levels of proficiency and hence variations in the number and complexity of forces that can be dealt with. The unskilled tourist clumsily biking through the centre of Amsterdam will annoy the locals whose level of embodiment of forces allows for breakneck speed, simultaneous cycling and texting, riding with gloveless hands in their pockets in winter, and balancing babies, baggage, cellos or umbrellas in the rain.

As most cyclists remember, there comes a point in the initial learning curve when skills merge into a whole, an “embodied” sense of how to handle oneself, the bike, and the environment. This is not learned from a textbook, but can only be reached through “embodied making”. Indeed, the common denominator of Dutchness, as one cyclist suggested, was the shared childhood experience of the glorious moment when they realized that Mom or Dad had let go and they were biking successfully on their own embodied instincts of what to do. Auto-ethnographic research suggests that for relatively skilled newcomers to Amsterdam, adapting to the unique Amsterdam cycling patterns takes about four to five days (Te Brömmelstroet and Glaser 2017; Chen 2017). In this period, attention goes through stages of anxiety and stress as a result of increasing challenges, until it settles again in a certain state of flow after a new skill-challenge ratio is reached (confirming observations in Flow Theory by Csikszentmihalyi 1990). Simultaneously, a deep and centred visual focus slowly widens into a more peripheral and less focused one. This, then, is the essence of embodiment, the taking on, not just intellectually, but kinaesthetically, of all the pushes and pulls in a situation.

Each of us has developed several such embodied skill sets. Embodiment is what happens when we take a pottery class and attempt to centre the clay on the wheel. We fail repeatedly at it until the various forces, pressure of our hands on the clay, specific inconsistencies in the clay, speed of the wheel, all fall into place in our muscular understanding of what to do. Carpenters, plasterers, plumbers, electricians, musicians and dancers all develop an embodied skill of action-in-circumstance; so do managers, planners, engineers, soccer team coaches or politicians learning to “feel” the complexity of forces at play which need to be managed in order to act competently.

More purely intellectual efforts are also embodied. Take the astronomer Kepler who knew that the planetary orbits were not circular but could not yet make sense of his measurements. He sat with them and sat some more and still sat perplexed. Through the sitting, the assimilating of the numbers into the core of his being, he suddenly realized, “it breathes”. From that holistic and “felt” insight, he then could work out the rhythmic slightly irregular elliptical movements. Or, consider the chemist Dimitri Mendeleev who covered his living room floor with notes written on bits of paper and for three days systematically shoved them around. At the end of the three days he had the periodic table. Incidentally, several Dutch authors, musicians and academics describe these sudden leaps in thinking to happen while cycling (anecdotal examples are Ben Feringa, Nobel prize laureate and Professor of molecular nanotechnology, Frans de
Waal, Professor of primatology, Jelle Brandt Corstius, writer, rappers collective De Jeugd van Tegenwoordig and Bénédicte Ficq, lawyer).

Practitioners of the Embodied Making methodology must be trained to be mindful of this process. They learn to enter a domain (call it a problem space or query space) with an open beginner’s mind, engage with the inhabitants of that domain, tease out the forces at play, cluster those forces, look for (feel or intuit) solutions that might resolve conflicting constraints, and hone those solutions into mid-level abstractions that lend themselves to easy adaptation in numerous circumstances.

### 6.2. A craft rather than a sequential series of steps

Embodied making does not offer a comfortable pre-defined sense of directionality. The directionality of the original pattern-language method was that of collection and curation: (1) notice a configuration, (2) analyse the forces that intersect and find resolution, (3) intuit an abstract form, (4) research for relevant background, (5) give the pattern a memorable name and standard format.

Since the Embodied Making method is not about cataloguing established patterns it proceeds with a multi-directional flow of inquiry and solutions, a network of actions that can be taken in any order rather than a step-by-step process. The practitioner might dig in from any point. Where, for example, would one logically begin to coherently digitalize cycling life in Amsterdam? By this, we mean not only using cell phones to locate nearby bicycles to rent but also coordinating various smart city apps, interceding on traffic lights to get the ambulance through in minimum time, protecting the citizen’s digital rights of privacy, etc.

### 6.3. Information at the edges

A practitioner of embodied-making looks less to models and theories than to the edges where ordinary folk are engaged in ordinary life, gathers (a bit like an ethnographer), stories (thick descriptions à la Geertz 1994) of their experiences. This is done in order to develop a grounded deep-felt textured grasp of the problem space. The practitioner derives forces from the stories to understand exactly why people have the experiences they do. For example, an urban planner certainly has valuable input, but it might be the cargo Mom, the teenager cycling to school, the policeman, or the small bike repairman who will have the better “lived” pulse on the actual cycling fabric.

### 6.4. Cohabitable solutions

Intuiting the latent “wholeness” from the dynamic interplay of these forces, the practitioner resolves them in elegant effective solutions. This is not an easy process and until all forces can find their “freedom” to move through a configuration, we do not have a pattern. For an illustration of a pattern “in the making” but not yet complete, consider the stories of cyclists, both locals and tourists, in Amsterdam that reveal the following forces: locals tend to know the city like the back of their hand; locals do not need a map or GPS; cyclists have many more route options than motorists; on a bike, just travelling roughly in the right direction will get you to your destination; tourists do not know their
way around; tourists constantly consult paper maps or phone GPS; consulting maps detracts from their ability to enjoy their surroundings; consulting maps requires visual attention; consulting maps takes their attention away from other cyclists and traffic; consulting maps makes them more accident prone; consulting maps makes them a danger for others. Now, the practitioner of the embodied making method attempts an embodied feel for the dynamic interplay of these forces. One solution, currently under consideration, which would resolve these forces is a simple haptic GPS that could convey signals about direction through the handlebars, seat, or possibly pedals, leaving the cyclists who are unfamiliar with the town free to scan and pay attention to the immediate environment and also steer in the right direction.

Attention on misfits, i.e. those spots where discomfort and accidents point to unresolved forces, can be productive in pattern making and pattern improvement. For example, cities, such as Hong Kong and Guangzhou, needing to move millions of people by the hour, paid attention to accidents, how, when, where, and why they happened. This slowly led to an urban transit pattern we might call, DIFFERENT MODES OF TRAFFIC NEVER INTERSECT. Jamie Lerner, as mayor of Curitiba, struggling with rural exodus and dire budget restrictions, successfully identified many of the forces at play in fast effective subway train, such as same level walk-ons, having people pay prior to boarding, and high frequency trains. He then retrofitted the bus system to be more like a metro system at a fraction of the cost of putting in underground subway lines. We could call the new bus system a pattern, perhaps giving it a name, such as SPEED BUS. In our own domain of interest, cycling accidents are rarely officially recorded, but story collection would not be a difficult task and might yield the necessary forces to start developing effective patterns.

Paying attention to variations on a theme will also contribute to a stronger pattern language. As illustrated earlier, the pattern ENTRANCE TRANSITION is expressed and lived differently in Amsterdam and Algiers, but both embody the mid-level abstraction of the pattern. Likewise, CARGO BIKE would be expressed differently in Amsterdam than in India: in the former, we might expect children or personal groceries to be wheeled around, while in the latter we might find a neighbourhood milkman on a delivery run or merchant of fruits and vegetables.

7. Embodied making uses process patterns

Practitioners of Embodied Making typically find themselves working in unfamiliar territory and must develop surrogate understanding. Imagine, for example, that a programmer who does not ride a bike finds him or herself on a software project to develop digital bikesharing solutions. To facilitate this process, the methodology of Embodied Making is formulated into procedural and decision patterns for proposition development. Practitioners use these process patterns in different combinations depending on the project and their orientation within the network of patterns.

Sometimes the starting point is a general malaise about a worsening situation still in a shake-down phase coupled with the desire to provide a solution. Imagine, for example, that we are exploring the need for a proposition for urban bike shares in a situation where massive quantities of bike shares are being dumped on the market by startups.
and how experienced Amsterdam cyclists feel about the proliferation of these bikes. From stories, we put together a sampling of illustrative short stories. Such stories allow us to formulate SALIENT EXPERIENCES and the SALIENT PURPOSE of a proposition. For example, NESTED IDENTITIES might emerge from story excerpts, such as “Some other students told me I could get a free bike for the semester but I did not really understand what to do and never bothered finding out” or “We’re working on the metro line in Rotterdam and have to close down 3 stations. We want the personal OV chip card to cover rental bikes between the closed stations” or “With my student ID I can take books from the library and get discounts on museums and, of course, enrol in a class”.

Sometimes the process demands that the practitioner re-iteratively return to a STORY OF REAL EXPERIENCE to substantiate a force, its occurrence, experienced quality, consistency and result. So sometimes a story leads to a force. Sometimes a force leads to a story. Storying has its own forces: it’s a selective memory of the past; different people experience the same event differently; stories are selectively shared; some stories are public, some private; stories can be vehicles for publicizing the storyteller, and so on.

In all cases, the practitioner has to locate KEYSTONES, people who know the domain intimately although their expertise tends to be tacit, i.e. more in their hands than in their vocabulary. However, KEYSTONES may sometimes be able to articulate the body of forces in an environment, and to some extent, the solutions. Consider Erik-Jan Dijkman who has run a bicycle shop in Amstelveen for a few decades, who succinctly sums up the problem of stray bikes by asking, “Are you going to spend 80 Euros to fix a bike that you bought for 80 Euros or are you going to abandon it to buy another 80 Euro bike?” Typically, the practitioner has to find KEYSTONES through CHANCE CONVERSATIONS with other more accessible but less skilled people in the domain.

Practitioners often collect as many as one thousand ELEMENTAL FORCES before they feel they are ready to “reduce” them to FORCE CLUSTERS and COHABITABLE SOLUTIONS. There is no simple way to know how much information is enough to cover a domain. It’s a gut feel but a rule of thumb is that we need a decent sampling of informants, i.e. a MOSAIC OF PARTICIPANTS, that yield about one thousand forces. Why so many forces? Because we want solutions capable of handling a rich variety of facts and situations.

8. Conclusion

At present, different research traditions on cycling environments, rooted in different ontological and epistemological approaches, result in a situation resembling the six blind men each touching a different part of the elephant (Bosson, Swann, and Pennebaker 2000). The development of a pattern language to describe cycling environments could be helpful as a potential bridge between existing research traditions, and help us develop a more holistic understanding of cycling environments. In addition, a cycling pattern language might constitute a useful tool to transfer understanding to places where an uptake of cycling is a policy goal.

We have argued that a pattern language approach:

(1) Addresses the integrated quality of physical, perceived, and lived environments
(2) Makes human experience part and parcel of the investigation
(3) Offers an approach to accommodating complexity
(4) Is adaptable, because it formulates patterns as mid-level abstractions instead of either absolutes or unique context-specifics
(5) Uses pragmatism as its philosophical underpinning
(6) Works with languages in which patterns take on significance and meaning according to connections with other patterns
(7) Facilitates community building

In addition, we have put forward the methodology of Embodied Making as an effective means of developing new patterns, i.e. new and always improvable “warranted assertions” for an urban cycling environment. While we might be able to inductively identify the basic patterns of existing cycling environments, Embodied Making helps us develop new patterns starting from forces and lived narratives themselves, rather than existing solutions. In this respect, Embodied Making allows us to develop patterns from the ground up in a context-specific manner, allowing us to “fit” or “tweak” a pattern to a specific local context. Patterns developed through Embodied Making can include not only individual solutions, but also the processes and relationships themselves which allow us to “transfer” the solution into a guide for action.

We have addressed the two specific criticisms of the pattern language approach: testing and ease of use (Dawes and Ostwald 2017). We also address a third concern noted by others: any urban fabric is composed of “fat nodes” where we are sedentary and “axial spaces” for movement. Alexandrian patterns focus on “fat nodes”, such as buildings, rooms, and parks, but leave “axial spaces” largely unexamined (Seamon 2004). By developing cycling patterns, we strengthen the pattern library.

Turning to the opening quote from Alexander, understanding cycling environments is very much like working on a form not yet designed. Pattern language and Embodied Making allows us to bring forth that form from the ground up so that it concretely and richly meets our needs. We are working within a context which we cannot yet properly describe but the methodology of embodied making, based on lived narratives and force analysis, promises an optimal grasp of the domain. We can maintain our conviction that there is such a thing as “fit”. The new configurations would allow us to both articulate forces and solutions as patterns, i.e. webs of relationships, and “transfer” the solution into a guide for action. Since patterns address human comfort, they are conducive to uptake by the wider community.

Note


Disclosure statement

No potential conflict of interest was reported by the authors.
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