Design Cognition and Behavior: Usability in the Built Environment

Proceedings of the workshop held at Spatial Cognition 2014

Beatrix Emo, Kinda Al Sayed, Tasos Varoudis (Eds.)

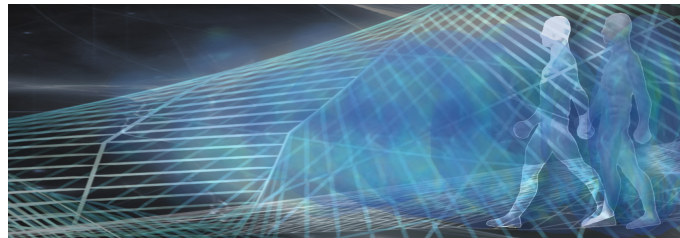**SFB/TR 8**
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University College London

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Preface

The workshop examines individual spatial cognition of the built environment from the perspective of the user and the designer. It aims to bring together researchers interested in how people behave in the built environment, using both psycho-physical and agent-based approaches.

Currently, various techniques and tools are being used for analysing and simulating how individuals interact with their environment, either through linking the structure of the environment with user behaviour (space syntax methods), or by simulating different levels of human cognition using automated sensorimotor systems (agent-based methods). The analysis of how individuals and groups use the built environment feeds directly into evidence-based design. Both virtual and real world experiments can be used, as well as hybrid environments, which combine elements of both. The ability to run virtual agents through models of the environment allows for an in-depth analysis of how people might move around such a space in the real world. The level and nature of the cognitive input that such agents might have is a matter for debate, which the workshop will address.

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Cognitively Biased Agent-Based Models

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Abstract. This speculative research proposal offers a user-centred perspective on Agent-Based Models for architectural/urban usability studies. As arbitrary decisions are typically made to model some variables over others, Agent-Based Models often miss the patterns and biases of human spatial behaviour long known in Spatial Cognition literature. When meaningful variables are included in the model, they are often assumed to be normally, or unimodally distributed. As a plethora of empirical studies have shown, human behaviour is neither logical, nor random, and very rarely optimal. This proposal presents the problem in detail and offers some avenues for further development, including the ideas for validation of the potential cognitively biased agent-based models.

Keywords: agent-based models, spatial cognition

The traditional approach to the majority of design disciplines has been (and still is) based on the designer's arbitrary decisions on the importance of particular factors for the outcome of the design process. Despite the fact this has been challenged by some design disciplines where user-centric approach has become commonplace (e.g. in Human-Computer Interaction), in urban design this tenet remains largely unquestioned. Agent-Based Models (ABM)—a tool often used to support urban planning—in their basic principle remain the illustration of this flaw.

Agent-Based Models often are the tool of choice for urban simulations, when the emphasis is put on the behaviour of city dwellers. Typically, the user is simulated at a very general level. Additionally, the choice of variables affecting agents' behaviour is usually top-down, i.e. arbitrary decisions are made on the significance of particular factors. Subsequently, the model is tested, and adjusted based on its fitness to the real world data. This approach has been identified as problematic, as it does not consider the bottom-up emergence of the city complexity phenomena from the human cognition [1]. Even though enriching ABM with simulated vision has proven to be beneficial, the major focus has been either on very generic, or too basic psychological characteristics (such as emotions) [2]. In each case, the process of emergence of those characteristics into the phenomena of spatial behaviour observed in empirical studies is mostly unknown.

Typically in ABM, logical movement choices (e.g. optimal shortest distance), and normal or unimodal distributions of the behaviour are assumed. In reality, although psychological characteristics tend to be normally distributed across populations, the behaviour resulting from those characteristics is rarely so. Human spatial behaviour is biased and therefore the distribution representing spatial choices in a specified situation is likely to be skewed. Intergroup, and intercultural differences have been shown to moderate those biases.

The aim of this project proposal is to inverse the process of designing Agent-Based Models by involving variables, importance of which has been empirically proven in the studies of Spatial Cognition. Examples of these include human preference for known path, or imprecise travel time

estimations for paths with more turns. Instead of making arbitrary decisions on the importance of specific variables, this importance can be assessed based on the existing knowledge base of Spatial Cognition.

Real-world case studies which put emphasis on spontaneous navigational behaviour will be selected for model validation. This might include road closure situations, sightseeing groups of tourists, or commuters traveling to rarely visited parts of the city. If similar datasets are available across cities, cross-cultural differences in real-life city navigational strategies can be investigated. The resulting ABM should also be tested against Space Syntax prediction (see [3] for considerable theoretical limitations of Space Syntax which can be tackled by ABM).

A study on traffic congestions using London taxi trips has already followed a similar framework [4], although it can be questioned to what extent their navigational strategies match those of less skilled commuters. In order to expand the use of the framework and foster the applicability of empirical findings from Spatial Cognition studies, more work is required on mapping the already known components of spatial behaviour [5] to its dynamic, socially-mediated, goal-driven manifestations in real-world environments.

The potential contribution of this work is a better understanding of not only how humans navigate the city on the everyday basis, but most importantly, what happens when a dynamic change occurs, requiring spontaneous navigational decisions from multiple commuters. The applications can include simulations of road closure/opening situations, emergency events, or the effect of dynamic road pricing system on driving behaviour. Substantial knowledge base in human Spatial Cognition allows for the development of user-centred agent-based models that represent empirically-informed behavioural patterns. The availability of rich city data makes it only now possible to test the laboratory-generated findings on a city-scale, in the real world.

References

1. Portugali, J.: How Complexity, Network and Big Data May Facilitate our Understanding of Contemporary Cities? In Kim, Y.O., Park, H.T., Seo, K.W., eds.: Proceedings of Ninth International Space Syntax Symposium, Seoul, Sejong University Press (2013) OOF:1–3
2. Kennedy, W.G.: Modelling human behaviour in agent-based models. In Heppenstall, A.J., Crooks, A.T., See, L.M., Batty, M., eds.: Agent-based models of geographical systems. Springer (2012) 167–179
3. Montello, D.R.: The contribution of space syntax to a comprehensive theory of environmental psychology. In: Proceedings of the 6th International Space Syntax Symposium. (2007) iv:01–12
4. Manley, E., Cheng, T., Emmonds, A.: Understanding Route Choice using Agent-based Simulation. Proceedings of the 11th international conference on GeoComputation (2011) 54–58
5. Wiener, J.M., Büchner, S.J., Hölscher, C.: Taxonomy of human wayfinding tasks: A knowledge-based approach. Spatial Cognition & Computation **9**(2) (2009) 152–165

Visual Search in Urban Environment Simulated by Random Walks

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Abstract. Human spatial behaviour, navigation and activity in cities are affected by visibility in the urban environment. In this paper we report on preliminary results for an ongoing research modelling pedestrians' search for urban activity as a possible realization of the random walk stochastic process. We represent the urban environment by means of a mathematical graph, which conceptualizes the relationship between urban activities and movement channels. The graph is based on visibility of possible navigational targets incorporated in the city street network. Random walkers, wandering on the graph, imitate aggregated visual search for the urban activities in the case study, the historical district of Tel Aviv-Yafo, Israel. The paper presents preliminary analysis of the agent-based simulation expositing a strong positive relation between the local and the global visibility properties of the built environment. Thereby, visual accessibility of the given urban layout is characterized and quantified.

Keywords: visibility, spatial cognition, activity location, random walks, sustainable urban environment

1 Introduction: Urban Activities, Pedestrian Movement and Vision

At the most fundamental level, a city represents a set of structured relationships between space, activities and pedestrian flows. In this paper we suggest a cognitive science approach to set out a link between human pedestrian behaviour, distribution of urban activities in cities and visibility of urban layout. Several past studies have shown that vision is the main source of information used by pedestrians to control their motion [6], [7], [9], [4] and [10]. We assume that human spatial behaviour in cities is guided by visibility properties of the environment and visual information regarding urban functional locations within pedestrian line of sight.

Any pedestrian journey in the city comprises multiple selections of origin and destination locations. In this study we address a question of pedestrian visual search for these urban locations. As possible navigation targets we examine one particular urban function - cafés, coffee shops, restaurants and other food and drink public

facilities. We implement random walk simulation imitating aggregated navigational search for these urban activity locations in the case study. The objective of the proposed simulation is to quantify visual accessibility of the urban setting linking city's functional structure to human cognitive behaviour.

2   Methods: Modeling Urban Visual Search by Random Walks

We represent urban environment as a mathematical graph that incorporates structural, functional and behavioral aspects of the city [8]. The graph has two types of nodes: the street intersection points, the decision points where a person makes a navigational choice, and the points of interest - locations of urban activities, i.e. possible navigation targets. The nodes are connected if they are visible from each other (Fig.1). Thus, a path in the graph is a hypothetical trajectory of a visual search for a specific place, function or location in the city.

Network or graph-based representations of urban environment, where nodes and edges are embedded in space is an attractive approach for modelling urban dynamic phenomena. In recent decades Complex Network Theory has provided significant contribution to the quantitative characterization of city's spatial structure and dynamical processes occurring on the graphs [1], [21], [3] and [5].
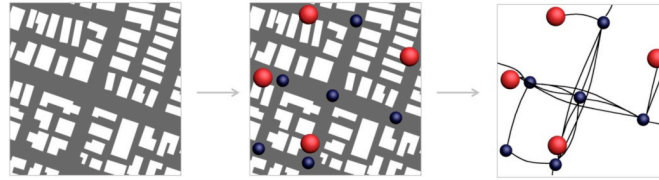
Fig. 1. Visibility graph. Blue nodes are intersections and red nodes are functional locations, namely locations of urban activities. They are connected if visible from each other.

In this study we propose an innovative use of random walk agent-based simulation to describe the aggregated navigational search and to estimate the distribution of visual search trajectories. Random walks represent natural stochastic process of diffusion on graphs [5]. It provides efficient solutions of many practical problems requiring non-deterministic algorithms, which contain probabilistically branched outputs. In our simulation random walk is a memoryless Markov chain, i.e. the next step of an agent does not depend on its previous step. At each step the agent chooses the next node from the neighbours of the current node with equal probability.

We simulate meandering random walkers on the visibility graph of the case study, the historical district of Tel Aviv-Yafo, Israel, called Lev Hair (City Heart) (Fig.2). Cafés, coffee shops, restaurants and other food and drink public facilities are among the most probable navigational targets for pedestrians who happen to be in the area. Moderate Mediterranean climate and street oriented historical facades of the buildings in the area make the district an ideal location for all kinds of outside public activities, especially for cafés and restaurants
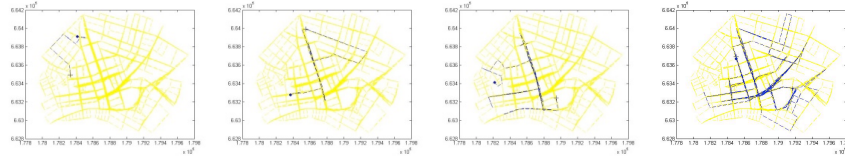
Fig. 1. Simulated trajectories captured at various random runs.

3 Preliminary Findings: Visual Intelligibility of Urban Environment

We suggest using outcomes of the random walk simulation to examine local and global visibility properties of the environment. Global-local relationship of the spatial networks is known by the term *Intelligibility* in Space Syntax Theory [7]. Intelligibility has proved to be a key determinant in human navigational and wayfinding abilities. This positive relation between the local and the global properties of nodes is a profound feature of complex networks and entails the underlying process of network self-organization [5].

In our study the global property of the node is characterized by the first passage time (FPT). FPT is defined as the expected number of steps required for a random walker to reach the node for the first time starting from a location randomly chosen among all locations of the graph. We estimate the FPT by Monte Carlo simulation of a random walk on the case study visibility graph. The examined local property of the node is its recurrence time (RT). RT indicates how long a random walker is expected to wander before revisiting - the node [5]. The preliminary results of the analysis expose a strong positive relation between local visibility properties of the urban place and its global properties (Fig.3a).

(a)   (b)
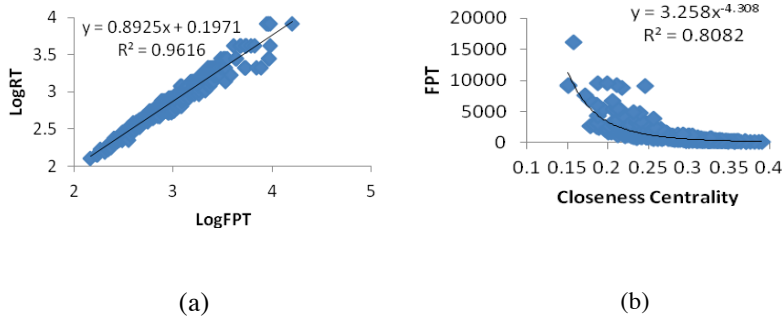
Fig. 2. (a) The time of recurrence to urban locations in the case study scales linearly with the first passage times. (b) Comparison between the first passage time and Closeness Centrality graph theoretical measure that holds power law relationship.

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We also compare FPT with deterministic local property of a node, namely, its closeness centrality graph-theoretical measure (Fig.3b). Comparison between the global properties, which are outcomes of the stochastic process, with the local deterministic properties can illuminate a part-whole relationship of city visual perception.

The proposed random walk simulation provides us with a method for quantifying and interpreting of visual distinction between different locations in urban environment. Our model treats a pedestrian's search of visual environment in an integrated way and thus partially provides explanation of factors which determine city morphology and pedestrian dynamics at the urban scale.

References

1. Andersson, C., Frenken, K., Hellervik, A.: A complex network approach to urban growth, Environment and Planning A, 38(10), 1941-1964 (2006)
2. Barthelemy, M.: Spatial Networks. Physics Reports, 499: 1–101(2011)
3. Batty, M.: Cities and Complexity: Understanding Cities. Through Cellular Automata, Agent-Based Models, and Fractals. MIT Press, Cambridge, MA (2005)
4. Batty, M.: Predicting where we walk. Nature 388:19–20 (1997)
5. Blanchard, P., Volchenkov, D.: Intelligibility and first passage times in complex urban networks. Proceedings of the Royal Society A: Mathematical, Physical and Engineering Sciences, 464(2096), 2153–2167 (2008)
6. Gibson, J.J.: Visually controlled locomotion and visual orientation in animals. Br JPsychol 49:182–194 (1958)
7. Hillier, B.: Space is the machine: a configurational theory of architecture. Cambridge, UK: Cambridge University Press (1999)
8. Natapov, A., Czamanski, D., Fisher-Gewirtzman, D.: Can visibility predict location? Visibility graph of food and drink facilities in the city. Survey Review 45(333), 462-471., (2013)
9. Turner, A., Penn, A.: Encoding natural movement as an agent-based system: An investigation into human pedestrian behaviour in the built environment. EnvironPlann B Plann Des 29:473–490 (2002)
10. Weisman, J.: Evaluating architectural legibility: Way-finding in the built environment. Environment and Behavior, 13(2), 189–204 (1981)

Pedestrian route choice by elementary school students: the role of street network configuration and pedestrian quality attributes in walking to school

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Abstract. This study examines the extent to which street network configuration is associated with path selection by pedestrians. The aim is to better understand how spatial layout of street network affects pedestrian route choice behavior, controlling for pedestrian quality attributes. Randomly selected 6th, 7th, and 8th grade students (ages 12-14) from 7 elementary schools (30 students per school) in Istanbul, Turkey were asked to draw their routes walking between home and school. Preliminary findings suggest that when all areas are merged into a single set, metric reach, which measures the street length that is accessible within a walking range, has significant impact on route selection jointly with the number of pedestrian crossings and traffic signals, as well as sidewalk width. However, directional reach, which measures the extent to which streets are sinuous or aligned, appears to be a strong correlate of route selection in the analysis of individual areas.

Keywords: route choice behavior, street network layout, pedestrian quality, walking to school, Istanbul

1 Introduction

This study examines the extent to which street network configuration is associated with path selection during target-directed walking. The aim is to better understand how spatial layout of street network affects pedestrian route choice behavior, controlling for pedestrian quality attributes at the street level.

There is a considerable body of literature on walking behavior and strategies pedestrians perform when navigating through the built environment. Yet route choice still remains one of the most interesting and challenging theoretical and practical problems in describing pedestrian travel. Studies investigating the environmental correlates of walking often rely on local and perceptual descriptions of the environment, such as street crossings, attractive landscaping, tree covers, and signalization [1-2], as well as aesthetic or safety features of the environment, such as cleanliness, interesting sights, and architecture [3-4]. However; it is very difficult to build these factors back into recommendations for designs of pedestrian-oriented environments. Even more crucially, environmental factors are actually associated with

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the character or atmosphere of an entire area—a neighborhood, a district, or a city. Hence, walking behaviors cannot be fully explained based on the local qualities of the individual space isolated from its global surroundings.

Any type of walking (exploratory or directed) requires pedestrians to exploit available connections that have been cognitively registered. The claim that the ordering of connectivity, measured by direction changes, plays an important role in pedestrian travel is consistent with research findings in spatial cognition which suggest that direction changes, as an aspect of configuration, are related with the cognitive effort required to navigate through an area [5-6]. Since walking occurs according to the fine grain of environment as well as according to its larger scale structure, appropriately discriminating measures of street connectivity are essential to better design for walkability.

2 Study Design/Method

2.1 Measures

Street network configuration of the entire region was evaluated by using two recent segment-based measures of connectivity [7]. *Metric reach* captures the density of streets and street connections accessible from each individual road segment. This is measured by the total street length accessible from each road segment moving in all possible directions up to a parametrically specified metric distance threshold. *Directional reach* measures the extent to which the entire street network is accessible with few direction changes. This is measured by the street length which is accessible from each road segment without changing more than a parametrically specified number of directions. Metric reach was computed for 1, 0.5 and 0.25 mile walking distance thresholds. Directional reach was computed for two direction changes subject to a 20° angle threshold. The 20° angle threshold was selected to set the threshold low enough to make the analysis sensitive to street sinuosity. Computing directional reach for two direction changes provides an estimate of how well a street segment is embedded in its surroundings from the point of view of directional distance.

Pedestrian quality attributes that are shown to affect navigation in urban environments through their impacts on pedestrians' perceptions are also included in the analysis. These include sidewalk continuity (distance from the curb); sidewalk width (average width on both sides); enclosure along sidewalks (average building setback from the sidewalk); safety (number of pedestrian crossings and traffic-signal on each street); and street-front land-uses (number and type of land-uses opening directly on each individual street segment). Sidewalk maintenance was not factored in since almost all sidewalks surveyed offered a moderate to good quality. Comprehensive data on these variables were collected through detailed field surveys. Due to resource limitations, only 40 street segments along the selected routes were sampled from each school area.

2.2 Case Context

Randomly selected 6th, 7th, and 8th grade students (ages 12-14) from 7 elementary schools (30 students per school) in Istanbul, Turkey were asked to draw their routes walking between home and school on a map. Figure 1 shows routes walked by students at two schools, coded according to their frequencies of selection, and the street networks of these areas coded according to the connectivity measures, 2-directional reach (20°) and metric reach (0.5 mile) respectively. The schools are drawn from diverse neighborhoods that vary substantially in street connectivity patterns across the region.
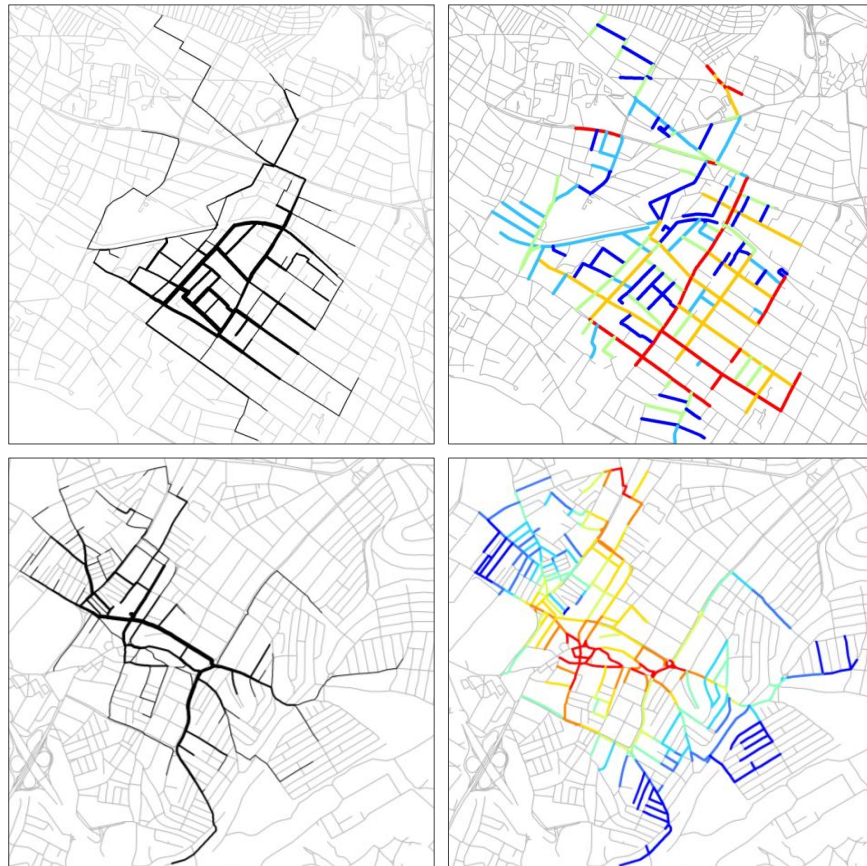
Fig. 1. Routes followed by children walking between home and school at two schools compared with the syntactic description of selected street lines. The thickness of selected routes is coded according to the frequencies of selection. The thickness of street lines is coded according to 2-directional reach (20°) (top image) and metric reach (0.5 mile) (bottom image).

4 Results

Our work is still in progress and conclusions are, at this stage, tentative. The preliminary results of this study emphasize the importance of including measures of street connectivity in studies of pedestrian travel. First set of regression analyses (when all data is merged into one set) indicate that metric reach (0.5 mile) is a reasonably significant predictor of the frequency of selected routes along with the number of street-front non-residential land-uses and pedestrian crossings. In the second set of regression analyses (analysis of individual areas) directional reach also appears to be a significant correlate of route choice for three areas. In addition, several additional variables become significant, including the number of traffic-signal (positive), and enclosure along sidewalks (positive). Importantly, linear models demonstrate that the coefficient of determination is considerably higher for 0.5 mile range. Thus, based on these results it can be argued that 0.5 mile should be promoted as the distance to design pedestrian context around schools to support walking.

Based on the preliminary evidence presented here, the further elaboration of this study may supplement existing literature on the environmental correlates of pedestrian travel. This study will be strengthened through more extensive assessments including but not limited to the expansion of the sample size; the expansion of the database on street-level pedestrian quality attributes; and the incorporation of population and land-use densities within school-environments. As the database and analyses expand, it might be possible to throw more light on the interplay between street network design and path selection for purposeful kind of movement, directed towards distinct destinations.

References

1. Agrawal, A.W., Schlossberg, M., Irvin, K..: How Far, by Which Route and Why? A Spatial Analysis of Pedestrian Preference. Journal of Urban Design. 13, 81-98 (2008)
2. CAO, X., MOKHTARIAN, P. & HANDY, S. 2007. Do changes in neighborhood characteristics lead to changes in travel behavior? A structural equations modeling approach. Transportation, 34, 535-556.
3. GEHL, J. 1986. Life Between Buildings, Using Public Space, New York, Van Nostrand Reinhold.
4. APPLEYARD, D. 1981. Livable Streets, Berkeley, University of California Press.
5. HILLIER, B. & IIDA, S. 2005. Network effects and psychological effects: a theory of urban movement. In: A.V. NESS (ed.) 5th International Symposium on Space Syntax. Delft: Teche Press.
6. JANSEN-OSMANN, P. & WIEDENBAUER, G. 2004. The influence of turns on distance cognition: New experimental approaches to clarify the route-angularity effect. Environment and Behavior, 36, 790.
7. PEPONIS, J., BAFNA, S. & ZHANG, Z. Y. 2008. The connectivity of streets: reach and directional distance. Environment and Planning B-Planning & Design, 35, 881-901.

Behavioural Space and Urban Pattern

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Abstract. This paper presents an ongoing research of the relationship between geographic space of a settlement and the behavior of selected group of inhabitants. We use Radotin, a quarter of Prague, as the settlement and women with children as respondents, for whom we construct the behavioural space. By comparing behavioural and geographic spaces we identify cases when people use remoter service even though similar service closer to their home exists. We offer some explanations for their decisions but also suggest further research that incorporates space syntax approach to analyse how different routes to a service can influence its usage.

Keywords: geographical space, behavioural space, usage index, space syntax, neighbourhood, settlement.

1 Introduction

The way people move in the urban area does not necessarily follow the metric distances between the origin and destination of their route. The movement can be better predicted by the topological or angular characteristics of the urban grid [1]. People also decide to choose certain service according to the quality of the service and its distance [2]. This research investigates which services people use considering the position of the service to their home. The research is carried out in Radotin, a town, which in 1974 become a quarter of Prague. Since Prague commercial and cultural centres were too far for everyday use, Radotin developed its own services such as shops, schools, kindergartens, church, gyms, etc. Even though it is strongly linked to the city of Prague it maintains its independent character and therefore can be used as a well-defined settlement for our case study. We investigate the relationship between metric properties of geographical space of 9 neighbourhoods in the settlement and behavior of a selected group of inhabitants.

2 Geographic space

Geographic space is a space that includes all objects around us. It can be objectively measured and described using geometry, mathematics and physics, independently on

the researcher. We will investigate geographic space of a settlement and its components - neighbourhoods.

Settlement. The largest conceptual unit in our analysis is a settlement. By settlement we understand heterogeneous spatial unit containing a number of services, transport, industrial, areas, recreation and infrastructure. It is described in terms of its spatial, functional and architectural characteristics. In our case we take Radotin as a single settlement. In our analysis the description of functional characteristics focuses on the distribution of services. The service locations were put down into a map and the services were classified into 12 categories. Examples of the categories are food shops, hairdressers, financial services, kindergartens, sweet shops, public transport stops, outdoors playgrounds, gyms, etc. The settlement was further divided into neighbourhoods, see Fig.1.

Fig. 1. Radotin: Settlement and neighbourhoods.

Neighbourhoods. By a neighbourhood we understand spatially distinctive and internally homogenous part of geographical space. In this research we consider only residential neighbourhoods. Within the settlement of Radotin we identified 9 neighbourhoods with distinctive urban and architectural characteristics. They were semidetached/detached/terrace type of houses, number of floors, presence of front gardens, density of construction, etc. Each neighbourhood was assigned an approximate centroid in the map that served as a reference point for distance calculations. The spatial

analysis of Radotin describes the position of each neighbourhood within the settlement. It was calculated as the shortest Manhattan distance from the centroid of each neighbourhood to all services in Radotin.

3 Behavioural space

Behavioral space (behavior setting system, action space) of a person is constructed as a subset of the geographic space. It consists of spaces that the individual uses on regular bases [3]. Behavioural spaces of inhabitants of each neighbourhood were constructed using questionnaires. The selected respondents were 40 women, age between 22 and 40 with at least one child younger than 15 years living with the respondent. Each woman was given a list of all services and important places in the settlement and she was asked to tick places that she uses on regular bases. Services were grouped into 12 categories, e.g. hairdressers, food shops, restaurants, gyms etc.

4 Measures in geographic and behavioural spaces

Using the data from the questionnaires and distances in the geographic space we constructed 4 measures for each neighbourhood and service category: geographic distance (G), behavioural distance (B), index of shortening B/G and the usage index I. Geographic distance G between the service category and the neighbourhood is the average metric distance between all services in the category and the centroid of the neighbourhood. The usage index of an individual service is defined as the ratio of the number of respondents who use this service to the number of all respondents in the neighbourhood. Behavioural distance of the individual service is the product of the geographic distance from the service to the neighbourhood and the usage index of the service. Behavioural distance B of the service category is the average behavioural distance of all services in the category. Usage index I of the category is the average value of all usage indices of all services in the category. Both I and B/G may have values between 0 and 1. If all respondents use all services in the category then B=G, otherwise B<G. The ratio B/G is called the index of shortening. Value B can be smaller than G either because respondents use mainly services that are close to their neighbourhood or because the respondents use only few services in the category. Comparison of the usage and shortening indices provides refined view on the question. It is possible to show that if I > B/G then respondents prefer using distant services over the nearer ones. If B/G < I, respondents prefer services closer to their neighbourhood. An example of these measures for one service category (food stores) and 3 neighbourhoods is shown in Fig.2.
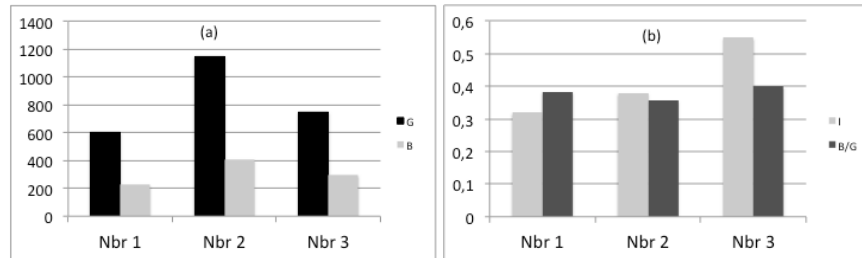
Fig. 2. (a) Geographic and Behavioural distance; (b) usage index I and index of shortening B/G.

Fig. 2 (a) shows the average geographical distance G (left bar) and average behavioural distance B (right bar) for 3 neighbourhoods. In all 3 cases B is smaller than G - respondents of all 3 neighbourhoods do not use all available services. In part (b) we compare the usage index I (left bar) and shortening ratio B/G (right bar). In the case of Nbr 1, the usage index I has lower value than the shortening index B/G. Respondents in this neighbourhood prefer services more distant from their homes over the closer ones. This "anomaly" deserves further investigation.

5   Discussion

There are several possible explanations why people prefer more distant service, for example the exceptional quality of the service or closeness of the selected service to various attractors (bank, post office, food shop). On the other hand there are repellents on a way to closer services (noisy places, places with frequent antisocial behaviour) that discourage people from using them. When we discard all these exceptional reasons we can still observe preferences for some distant services depending on the position of the neighbourhood within the settlement.

Our current research is focused on analyzing the settlement and individual neighbourhoods using space syntax techniques. We have calculated the segment metric integration data for the whole settlement and depths maps with the origin in the centroid of each neighbourhood. We expect that the correlations of data from the space syntax maps and the preferences of respondents will help to explain the shape of their behavioural spaces.

References

1. Hillier B.: Space is the Machine. A Configurational Theory of Architecture. (2007)
2. Ness P.: Accessibility, Activity Participation and Location of Activities: Exploring the Links between Residential Location and Travel Behaviour. *Urban Studies*. Vol. 43, No. 3, 627-652, March (2006)
3. Rapoport A.: Human Aspects of Urban Form. Pergamon Press. (1977)

Tools, Stages and Perspective-Taking during the Architectural Design Process: Preliminary Results from a University-building Case-study in Australia

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Abstract. This case-study investigated which tools and techniques building planners use during the architectural design process in order to anticipate future building-user experience. Preliminary qualitative analysis of seven semi-structured interviews with key stakeholders involved in the planning of a university building revealed that architects and designers mainly rely on past experience and tacit knowledge, rather than using systematic pre-occupancy-evaluation methods. Based on insights from interdisciplinary research, this article seeks to encourage further discussion of need-analysis for assistive tools in architectural design.

Keywords: Architectural Design, Design Research, Perspective Taking, User Experience, Wayfinding

1 Introduction

Architects and designers' understanding of architectural form and function evolves from a fundamentally different mind-set than that of building users [1]. Architectural experts may use different evaluative aspects for environmental appraisal [2]. They have to consider multiple aspects in unison (e.g. costs, energy efficiency, accessibility and building capacity), and may not *solely* focus on user experience [3]. Furthermore, building planners need to take into account expectations and needs of various stakeholders (e.g. the client and specialized consultants, such as landscape architects and wayfinding advisors), which requires perspective-taking and clear communication between all involved parties.

This study aimed to understand which tools and techniques architects and designers use during the multiple stages of the architectural design process and how research could potentially further inform and support this process. Furthermore, it

investigated how architects and building planners anticipate future usage of a yet-to-be-constructed building; specifically, to what extent they anticipate and imagine future building users' experience in terms of their behavior, cognition and emotion.

2 Methods

The case at hand was a new university-building for the faculty of Architecture, Building and Planning of the University of Melbourne in Australia [3]. In order to investigate the use of techniques and tools during architectural design, seven individual, semi-structured interviews were conducted with the major stakeholders of this project (one architect, four wayfinding consultants, two future building users). Interviews were video- and audio-recorded and transcribed to text for analysis.

Stakeholders were also asked to imagine and immerse themselves in the role of a particular future user (a first-time visitor, a regular building user, and a design critic), each of whom had a certain goal in mind (meeting a friend, picking up a lunch box at the office, and experiencing the building). While studying the floor plans, stakeholders were motivated to "think aloud" about how these fictional user groups would find their way from one location to another, and what they would experience on the (anticipated) way.

3 Preliminary Results

3.1 Tools and Techniques during the Architectural Design Stages

Through qualitative analysis of the interview transcripts from this case-study, it appeared that the architects mainly used the initial brief from the university, as well as budget and site requirements, in order to design the floor plans. They regularly consulted the client and mainly relied on past experience and tacit knowledge. They did not work with quantitative tools for wayfinding analysis themselves, but brought in specialized wayfinding consultants after the floor plan design had largely been settled. These wayfinding consultants mainly used tools in the first (information gathering) stage, and less in other (design) stages (Figure 1). For example, in order to visualize their arguments during discussions with the other stakeholders, the wayfinding consultants relied on self-initiated pedestrian counts along with space syntax analyses and a survey for future building users. When asked what a 'utopian support tool' could look like, the wayfinding consultants suggested a 3D-representation of the building, which could interactively "*take in some of the factors of school modeling and syntaxin*g" and simulate pedestrian flow "*in order to identify bottlenecks or awkward corners.*" Such a utopian tool would primarily need to be time-efficient and immediately legible so that "*somebody could pick up their report and in two minutes understand what they're looking at, rather than trying to interpret a whole series of numbers.*"
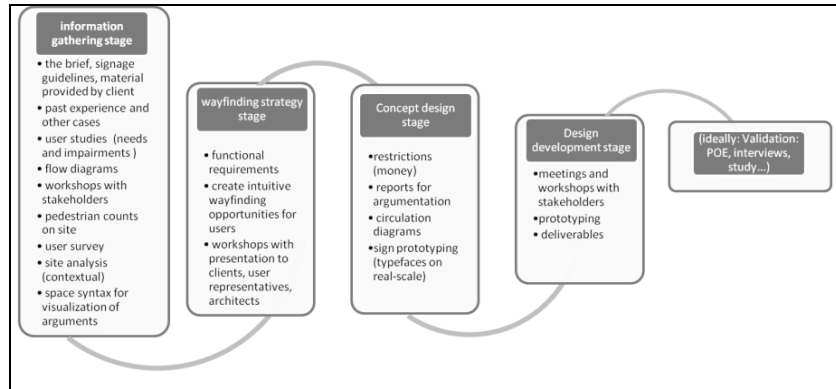
Fig. 1. Stages of wayfinding design from the perspective of the wayfinding consultants.

3.2 Anticipation of Future Users' Wayfinding Experience

From qualitative analysis of the imagined wayfinding task, it appeared that each stakeholder mainly anticipated user experience from their own perspective and expertise. Although the task description specifically mentioned different user groups with differing building familiarity and aims, the perspective and the manner in which stakeholders responded remained highly similar for each of the three tasks.

The architect mentioned landmarks outside of the building for orientation first and then continued by commenting on structural building features (such as the high ceiling), "interesting places" (such as an exhibition center), and materials used. When directly asked how a space felt during the imagined user journey, the architect mainly mentioned sculptural elements, expected lines of sight, light conditions, and places for anticipated social interaction between future building users. Often the architect pointed out *all* route opportunities from a given point, rather than *one* route from the perspective of a specific user group.

The wayfinding consultants also mentioned structural features (e.g. the complex façade, prominent staircases, and the large atrium), as well as where they had planned to install signage, and which materials they had used. Occasionally the wayfinding consultants commented on anticipated user strategies, which were mainly based on expected lines of sight from a particular point of view. When directly asked how space felt from the user-perspective, wayfinding consultants tended to describe spatial features (e.g. the high ceiling), light conditions and anticipated user experience in terms of perceived security and openness versus narrowness. They expected a rather sequential interaction with signage that lead *straight*, without distractions, from one location to another. From time to time, the wayfinding consultants took the perspective of a certain user group (e.g. "*[I] come out, decide to take the central stair, 'cause you know, [I am] watching out for my health*").

The two future users (architectural graduate students) frequently stated expectations of where signage and rooms could potentially be located, although the floor plans did not specifically include this information (e.g. "*I would expect from this central point here to be able to see some sort of interactive display, or else a list of rooms*", or: "*I would probably assume that something like a workshop is going to be on the ground floor because you've got to have deliveries and you've got to get rid of rubbish*"). They appeared to easily take the perspective of a certain user group (e.g. "*as an academic, this probably wouldn't be the preferred route*"), although one of the graduate students (who was a trained architect) sometimes switched to an allocentric perspective, especially when fascinated by a certain building feature. When directly asked how the space felt, both students mentioned structural features from the floor plan (e.g. "*this would probably be interesting, because assuming that this is all glass around here, it would probably be extremely well-lit*").

While the architect consistently used an allocentric, floor-plan-view perspective (e.g. "*you'll see the large, glazed wall there, so essentially, it's acting as a marker*"), the wayfinding consultants mostly reported anticipated user experience from an egocentric perspective (e.g. "*I know where I'm going which is on level one, which is above me 'cause I'm next to this terrace I see as I come in*"), and only used an allocentric perspective when explaining details to the interviewer (e.g. "*as you come into this space, you get a sight line through the glazing wall*"). The two future users stayed in the egocentric perspective (e.g. "*If I come back to the foyer, I'd really be looking for some kind of signage, because otherwise, I'd have no idea where to go*").

4 Conclusions

Taking preliminary, qualitative analysis of the interviews and the imagination tasks together, it appears that the architect and wayfinding designers mainly used tacit knowledge and past experience to inform design. Taking the (anticipated) user-perspective was potentially easier for the wayfinding designers and future users, although their comments tended to include structural elements as well (most likely because the view in the imagination task was allocentric by nature). Based on the results from this case-study, we can conclude that analytic, quantitative evaluation tools were seldom consistently used during the design stages.

In order to motivate and improve pre-occupancy evaluation (before a building is constructed [4]) during the architectural design phase, interactive interfaces could be designed, which could allow uploading (concepts of) building floor plans, along with pedestrian count or simulated multi-agent data. Building planners could then use such a system to systematically vary building features, and present this information to the other stakeholders on-the-fly, using it as a communication device and support for perspective-taking.

With this article we hope to encourage further discussion about how and to what extent insights from interdisciplinary research could inform the architectural design process, and how future research could deepen further need-analysis for assistive tools.

References

1. Tenbrink T., Hölscher C., Tsigaridi D. & Dalton R. (in press). Cognition and Communication in Architectural Design, in Montello DR, Grossner K., and Janelle D.G. (Eds.). Space in mind: Concepts for spatial learning and education. Cambridge, MA: MIT Press.
2. Benz, I. & Rambow, R. (2011). Sichtbeton in der Architektur; Perspektivenunterschiede zwischen ArchitektInnen und Laien [Exposed Concrete in Architecture: Perspective Differences Between Architects and Laypeople]. Umweltpsychologie, 15:1, pp. 112--129.
3. Hölscher, C., Dalton, R.C., Kuliga, S., Tomko, M. (2014). Towards Computer-Assisted Wayfinding Design Support: Interview-based needs analysis across stakeholders, Poster Abstracts of Design Computing and Cognition'14, London, United Kingdom.
4. Guski, R. & Schuemer, R. (2008). Umweltevaluation. In E.D. Lantermann & V. Linneweber (Hrsg.), Umweltpsychologie Band 1: Grundlagen, Paradigmen und Methoden der Umweltpsychologie, Göttingen: Hogrefe, pp. 785--810.

Space Synthesizer - An experimental setup for investigating the relationships between urban form and emotional responses

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1   Background

One of the key steps in the planning of cities is the definition of urban form in which decisions about shape, dimensions and allocation of buildings are made. These decisions have a relatively long lasting impact on the future developments of a city, because once streets and buildings are built they are hard to change. Therefore it is important for planners to assess the implications of their decisions as early and as comprehensively as possible. A better understanding of the impact of urban form on the behavior of people can improve the design of cities (Hillier, 1996; Gehl, 2010). To be able to assess the impact of design decisions in the design phase, methods are needed for predicting the most likely behavioral responses to a specific design proposal. The fact that the context for each design problem, and consequently also the design proposal, is unique makes it hard to apply best practice solutions or patterns to produce good design (Alexander et al., 1977; Parolek et al., 2008) Such approaches typically fail to capture the multiple interdependencies that an urban context and the design proposal involve (Hillier, 1996). Using computational methods, the urban geometry can be analyzed in detail according to multiple aspects such as visibility (Bittermann & Ciftcioglu, 2008; Benedikt, 1979; Turner, 2001), accessibility (Hillier & Hanson, 1984; Sevtsuk, 2010) or daylight (Ratti et al., 2003; Compagnon, 2004). The advantage of these methods is that features of the urban form are derived directly from the specific design proposal, and therefore no a prioi categorizations are necessary. A key question in this context is how to determine if there are significant correlations between the measures derived from the computational analysis and identifiable human behavioral responses to urban form. If such correlations can be shown, these measures could then be utilized to evaluate and improve design proposals. Since digital models are required, a design process using this approach can be described as a "computationally aided evidence informed design" (CED). The components necessary for establishing such a process are shown in Figure 1. The prerequisite for a CED, however, remains the thorough study of man-environment relationships.
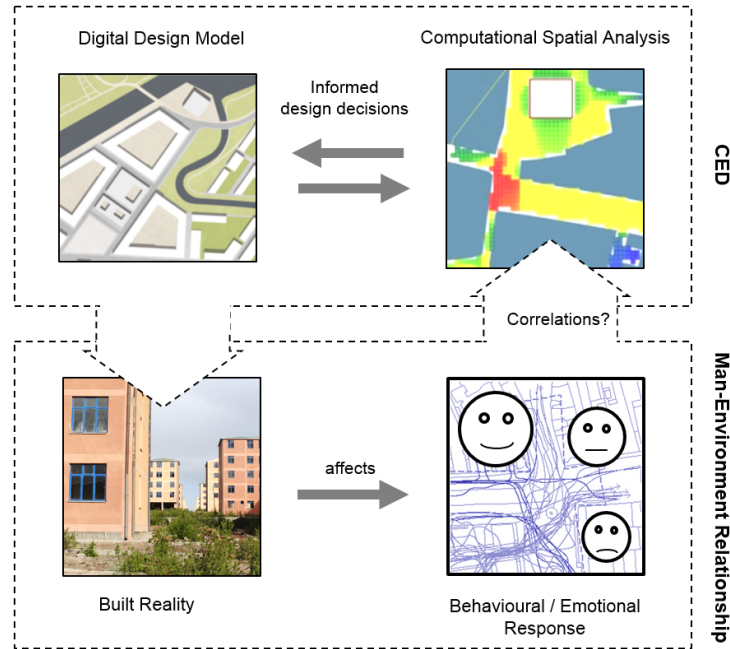
Fig. 1. Framework for the development of a Computationally Aided Evidence Informed Design (CED) Process

In the following we present an experimental setup that can be used for the study of emotional responses to several environmental features. The setup is easy to use, adaptable to different research questions and allows to continuously vary different control variables during a test.

2 Experimental Setup "Space Synthesizer"

To study the relationships between environmental features and emotional responses several methods for representing the environment can been used, such as Images/Photographs (e.g. used by Weber et al., 2008; Gjerde, 2010), Virtual Reality Systems, such as HMDs or CAVEs (e.g. used by Franz & Wiener, 2008; Stamps, 2010) or the real world. The use of VR-Systems has several advantages. In contrast to real world experiments most parameters can be controlled very precisely. Compared to 2-dimensional images, the use of VR-Systems provide a feeling of being immersed in a scene (e.g. by seeing stereoscopic images and freely moving in a scene).

To figure out the influence of certain parameters on certain emotions typically variants are presented to the test persons. Thereby continuous variables, such as height of buildings or width of street are discretized. This process is often driven by the desire

to proof a certain hypothesis, what can significantly influence the findings since the a priori excluded states of examined variables might be of importance. Thus variants are not generated fully objectively and one is in advance excluding other possible configurations. Further this limited amount of variants makes it hard to precisely identify thresholds for configurations of parameter causing certain emotional responses. Thus, a method is needed to generate a sufficient set of variants.

To assess the emotional response of a test person to a configuration of parameters we use an approach developed by Gustav Fechner, called the method of production (McManus, 2014). Thereby participants have to produce objects that cause a certain emotional reaction to them (such as pleasing or uncomfortable). Since usually subjects do not have sufficient skills to model an environment a tool needs to be at hand which eases the creation of variants.

By the experimental setup, we developed, we tried to satisfy the requirements mentioned aforehand (immersive, continuous variation of variables and ease of use). The so called "Space Synthesizer" mainly consists of three components: a VR Headset (Oculus Rift), a game engine (Unity) and a physical interface (based on Arduino components). In Unity a parametric model is defined which can be controlled by the test person with the physical interface (see Figure 2). The scenario used to test the setup are streetscapes. We used five parameters for the generation of variants:

- Width of the Street (5m – 20m)
- Height of Buildings (3m – 100m)
- Width of Buildings (8m – 30m)
- Distance between Buildings (0m – 20m)
- Number of Buildings (4 – 20)

Fig. 2. Experimental Setup using Oculus Rift, Unity and a self-developed User Interface (based on Arduino Components)

By turning the rotary controls of the physical interface the test persons can easily create different variants of a streetscape. To get configurations provoking certain emotional reactions the test persons have to fulfil several tasks. For example they can be asked (by displaying the question on the screen) to create a streetscape that looks pleasing to them or to find the configuration of parameters that the streetscape is no longer appearing uncomfortable. After the test person has adjusted the parameters he/she has to press a button to continue with the next task. The results of each test are automatically sent to a database for further evaluation.

3   Outlook

Currently we are running a preliminary test study in order to examine if the developed setup offers a valuable addition to existing setups. By analyzing the different configurations generated by the test persons we hope to find similarities between adjustable parameters and emotional responses.

Acknowledgement

References

Alexander C (1977) A Pattern Language: Towns, Buildings, Construction. Oxford University Press, New York

Benedikt ML (1979) To take hold of space: isovists and isovist fields. Environ Plan B 6:47 – 65 .

Bittermann MS, Ciftcioglu O (2008) Visual Perception Model for Architectural Design. J Des Res 35–60.

Compagnon R (2004) Solar and daylight availability in the urban fabric. Energy Build 36:321–328

Franz G, Wiener JM (2008) From space syntax to space semantics: a behaviorally and perceptually oriented methodology for the efficient description of the geometry and topology of environments. Environ Plan B Plan Des 35:574–592.

Gehl J (2010) Cities for People. Island Press, Washington - Covelo - London

Gjerde, M. (2010) "Visual aesthetic perception and judgement of urban streetscapes". In Barrett, P., Amaratunga, D., Haigh, R., Keraminiyage, K. & Pathirage, C. (Eds.) Proceedings W101 – Special Track 18th CIB World Building Congress. Salford.

Hillier B (1996) Space is the machine: a configurational theory of architecture. Cambridge University Press

McManus C and Gesiak P (2014) Experimenting with Mondrian: Comparing the Method of Production with the Method of Choice, Poster, Design Computing and Cognition (DCC14), London, England.

Parolek DG, Parolek K, Crawford PC (2008) Form Based Codes: A Guide for Planners, Urban Designers, Municipalities, and Developers. 352.

Ratti C, Raydan D, Steemers K (2003) Building form and environmental performance: archetypes, analysis and an arid climate. Energy Build 35:49–59.

Sevtsuk A (2010) Path and place : a study of urban geometry and retail activity in Cambridge and Somerville, MA. Massachusetts Institute of Technology

Stamps, A (2010) Effects of Area, Height, Elongation, and Color on Perceived Spaciousness. Environment and Behavior 2011 43: 252

Turner A, Doxa M, O'Sullivan D, Penn A (2001) From isovists to visibility graphs: a methodology for the analysis of architectural space. Environ Plan B Plan Des 28:103–121.

Weber R, Schnier J, Jacobsen T (2008), Aesthetics of streetscapes: influence of fundamental properties on aesthetic judgments of urban space. In: Perceptual and Motor Skills (Impact Factor: 0.49). 03/2008; 106(1):128-46.

Landscape Stories. Using narrative methods for collaborative design-research processes

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Abstract. The paper describes the developement of design methods that involve narrative practices to analyze, describe and design within the field of large scale urban landscapes. Within the field, the question of how to include people and their perspective in large-scale planning processes has become a crucial point. Within two design research projects this question has been tackeled by developing a research design that investigates perspectives, spatial practice and cognition of teenagers on a larger scale in „co-production" with teenagers. Methods and approaches will be presented and discussed in the paper against the theoretical background of urban landscapes, design research and storytelling.

Keywords: urban landscapes; narrative design research strategies; research through design; planning processes; user perspectives; storytelling; creating knowledge

1   What has storytelling to do with urban landscapes?

Urban Landscapes are the result of complex processes of land use, ways of living, ideas, interests, attitudes that take place on a regional scale and are subject to constant change (Seggern et al. 2008; Seggern / Sieverts 2006). Contemporary landscapes are "characterised by mankind's urban way of life" (Seggern and Werner 2008). Understanding urban landscapes as dynamic processes and lived practice asks for new approaches, tools and representations to engage with complexity, unpredictability and constantly changing dynamics. This means to engage simultaneously with socio-economic and cultural issues, longer timeframes and different types of stakeholders such as local people, experts (engineers, sociologists, other architects and planners).

1.1   Creating knowledge through design

The potential of design approaches to deal with the challenges of complex transformation processes has been scholarly explored and discussed during the last decade and within different disciplines (u.a. Mareis 2011; Prominski 2004; Seggern et al. 2008; Jonas 2001). With its contextual, transdisciplinary and application-oriented focus, design research relates to a Modus 2 knowledge production (Prominski 2004). While the traditional modus-1 science is characterised by developing universally

valid statements, Modus 2 is is characterised by creating a contextualized working knowledge (Nowotny et al. 2001; Nowotny et al. 2004) that emerges among stakeholders from different knowledge backgrounds by collaborating in mutual learning processes. It combines analytical with intuitive aspects and shifts the view from final products to the processes of creating knowledge in a relational practice (Buchert 2011).

1.2 Storytelling as a design research instrument

A key question in this context adresses the use of tools and representations to work in a different way in an unpredictable field. Conventional representations in landscape architecture such as plans, sections and perspectives are disciplinary and specialized methods developed to design and describe specific physical design projects. Regarding spatial developement as a „multidimensional performative process" (Werner / Seggern 2008, S.51) has to include more spatial dimensions such as dynamics, temporal, socio-economic or cultural issues. Using narratives as a strategic tool for collaborative design research processes to work with different stakeholders in the described processes are a promising approach that has been developed and experimented with in the two design research projects discussed in this paper.

Telling stories is a basic human cultural practice of sharing and organizing (complex) knowledge and experience. We use narratives to understand, to learn, to communicate, etc. (Herman 2011, Totzke 2005, Albes and Saupe 2010). Through storytelling implicit knowledge can be activated and understood, such as knowledge about space. As Hayden White puts it, "far from being one code among many that a culture may utilize for endowing experience with meaning, narrative is a meta-code, a human universal on the basis of which transcultural messages about the nature of a shared reality can be transmitted" (White 1987).

2 Two case studies

Within the two case studies, storytelling and narratives as a fundamental cultural practice were developed as an design research instrument to describe, design and convey urban landscapes on eye-level and in dialogue with (in these cases) teenagers. The narrative tools were developed to convey the implicit spatial perception and knowledge of the teenagers.

2.1 Citysurfer, Quartierfans&Co.

In Citysurfer, Quartierfans & Co. (STUDIO URBANEL LANDSCHAFTEN 2009) (Stadtsurfer, Quartierfans & Co.), an interdisciplinary team from the fields landscape architecture, architecture, urban development and sociology at STUDIO URBANE LANDSCHAFTEN /Leibniz Universität Hannover investigated on behalf of the Wüstenrot Stiftung current city constructions of young people. The team wanted to know about the city locations that are really relevant to young people and the qualities of these locations. Whether and according to which criteria young people connect these different locations and which layers or dimensions of the city are significant to them were also of interest. The project focused on the actual use as well as the mental and emotional perception of space including conscious and unconscious aspects.

The design-related research was carried out as seen "through the eyes of young people". Building models allowed young people from Year 7, Year 9 and students of a Year 12 geography class taking part in the research project to explore their places and spatial use. While doing so, they were orally telling stories to the researchers about their everyday lives that the models helped to reveal. The model worked as a narrative anchor. Furthermore, the result, the actual model was a narrative in itself, telling in the whole picture about a specific understanding of space. In the interpretation, 5 different types of city users could be identified. The models told a very different view of space that conventionally applied by the disciplines. It contained characters, place and timeline, all part of a story. The talks and anecdotes with the teenagers during the workshop were needed to be reveal and document the findings.

Fig. 1. One of the models of a 14 year old girl. The model (markers emphasise situations quoted by the student during the interview) shows situations that have been arranged as if on a stage without any distances or location relations. The school day model "Hannover City" shows the home right next to the school close to the city centre. The girl included passers-by on the way to school having a go at her.

2.2 Out and about in Educational Landscapes

In the ongoing research project „Out and about in Educational Landscapes" („Unterwegs in deutschen Bildungslandschaften) (STUDIO URBANEL LANDSCHAFTEN 2014) a team of landscape architects, architects, city planners and documentary filmmakers developed design research methods with a focus on filmmaking to investigate the lifestyles and everyday lfe of fourteen-year-olds in two contrary regions of Germany: a rural, declining area and growing metroplitan region to find out more about the role of the spatial dimensions in educational processes.

Therefore, four teenagers from the countryside community of Bodenfelde in Lower Saxony and four teenagers living in Hamburg stepped into the role of the researcher and teenagers tell about their daily lives in short documentary movies that are integrated in a dialogic process. Based on the idea of an exchange programme, the teenagers visited each other for four days and film the daily routines of the other teenager. As a result, 4x2 cinematic portraits tell the story about the life and challenges of teenagers nowadays.

The medium film enabled the teenagers to create complex narratives. Again, as in the project Citysurfer, the films were a narrative anchor to ask questions in interviews, and to understand more in mappings and to create ideas for the future landscape in a workshop.

3 Conclusions

Narrative strategies are a way to understand, describe aand design with the complexity of urban landscapes as a process that includes events, people, time and space. Developed as a design research tool narrative instruments can foster open, collaborative, and user-oriented design research processes. They proved to be useful methods in finding out about specifics of urban landscapes and working with people from various backgrounds. They can therefore support open and antihierachical forms of research.

The narrative instruments enabled the landscape users to express their specific perspective.The design of the research instrument according to the overall research aim is needs careful attention, since it sets a framework for the overall question, but still leaves the participants enough freedom to express themselves.

References

1. Albes, Claudia/Saupe, Anja (eds) 'Vom Sinn des Erzählens. Geschichte, Theorie und Didaktik', 2010
2. Nowotny, H, 'Designing as working Knowledge' in Hv Seggern, J Werner, & L Grosse-Bächle, Studio Urbane Landschaften (eds.), Creating knowledge: Innovationsstrategien im Entwerfen urbaner Landschaften, Jovis, Berlin, 2008, pp. 13 - 20.
3. Herman, D, Basic Elements of Narrative, Wiley, 2011.
4. Seggern, Hv, & J Werner, 'Designing as an integrative Process of Creating Knowledge' in Hv Seggern, J Werner, & L Grosse-Bächle, Studio Urbane Landschaften (eds.), *Creating knowledge : Innovationsstrategien im Entwerfen urbaner Landschaften*, Jovis, Berlin, 2008, pp. 35-68.
5. Mareis, C, Design als Wissenskultur: Interferenzen zwischen Design- und Wissensdiskursen seit 1960, 1., Aufl. edn., Transcript, Bielefeld, 2011.
6. Buchert, M, 'Formen der Relation. Entwerfen und Forschen in der Architektur' in U Frank (ed.), *EKLAT*, Berlin, 2011, pp. 76-86.
7. Nowotny, H, P Scott, & M Gibbons, Wissenschaft neu denken: Wissen und Öffentlichkeit in einem Zeitalter der Ungewißheit, Velbrück Wiss., 2004.
8. Nowotny, H, P Scott, & M Gibbons, Re-Thinking Science. Knowledge and the Public in an Age of Uncertainty, Polity Press, Cambridge, Oxford,Malden, 2001.
9. Prominski, M, Landschaft entwerfen: zur Theorie aktueller Landschaftsarchitektur, Reimer, Berlin, 2004.
10. Totzke, R, 'Erinnern - Erzählen - Wissen: Was haben (Erfahrungs-)Geschichten mit echtem Wissen zu tun?' in G Reinmann (ed.), *Erfahrungswissen erzählbar machen. Narrative Ansätze für Wirtschaft und Schule*, Pabst Science Publishers, 2005, pp. 19-35.
11. 'Creating knowledge : Innovationsstrategien im Entwerfen urbaner Landschaften / innovation strategies for designing urban landscapes', 2008
12. White, H, The Content of the Form: Narrative Discourse and Historical Representation, Johns Hopkins UP, Baltimore, 1987.
13. Jonas, W, 'Die Spezialisten des Dazwischen - Überlegungen zum Design als Interface-Disziplin', *Tagung Medium Design, Bauhaus-Universität Weimar* 2001,
14. Seggern, Hv, & T Sieverts, 'Gestaltung der Stadtregion als Landschaft' in DGGL (ed.), Regionale Gartenkultur. Über die Identität von Landschaften, 2006,
15. STUDIO URBANE LANDSCHAFTEN, 'Stadtsurfer, Quartierfans & Co. Stadtkonstruktionen Jugendlicher und das Netz urbaner öffentlicher Räume', 2009

Projects

1. Citysurfer, Neighbourhoodfan&Co. is a research project of the Wüstenrot foundation executed by STUDIO URBANE LANDSCHAFTEN, Team: Hille v. Seggern Anke Schmidt, Börries v. Detten, Claudia Heinzelmann, Henrik Schultz, Julia Werner, advisors: Ulfert Herlyn, Timm Ohrt (06/2005 – 12/2007)

2. Out and about in Educational Landscapes is a research project of the Wüstenrot foundation executed by STUDIO URBANE LANDSCHAFTEN; Team: Arge STUDIO URBANE LANDSCHAFTEN unterwegs Thomas Gräbel, Anke Schmidt, Sabine Rabe, Prof.-Dr. Hille v. Seggern together with doktales + Lilli Thalgott; (02/2013 – 11/2014)

An Intimate Experiential Learning:
The Osmotic Bubble as a *Transitional-Learning Space*

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"The significance of the learning environment cannot be underestimated. The brain learns faster in challenging, creative, accommodating, and healthy environments. To provide for the growing, learning brains of our children, we must not forget that the environments we design have a major influence in building smarter brains."
Chan and Petrie[1] (Chand and Petrie, 1988)

Abstract The Osmotic Bubble is a multi-sensorial learning environment (of both curricula and a physical built space) that aims to foster free play, creative insight, and self-discovery driven by inner processes of complex brain systems that have the potential to take us closer to becoming part of world ecologies. In shaping education for the 21st Century, both neuroscience and design[ing] need to become the core of educational systems—neuroscience as the basis to understand and harness human capabilities and design[ing] as the means by which to develop and enact such capacities. My research seeks to demonstrate that the Osmotic Bubble could potentially provide conditions that will enable the production, absorption, and retrieval of tacit—unspoken, implicit—knowledge through an organic, osmotic process. The desire outcome is a new pedagogy that propels cognitive flexibility and everyday creativity for resilience, through self-regulation, positive emotions, and intuition. The ultimate goal is to develop a pedagogical framework adaptable to various age groups regardless of specific disciplines.

Keywords. play · creative insight · cognitive flexibility · everyday creativity · design studies

1   Introduction

In the midst of the 21st century, education is still concerned with the transmission of information rather than nurturing an expansive way of thinking, giving the most value to information retention. Creative capacities are lost when children, in the process of being educated both in the home and at school, are encouraged to memo-

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[1] Tak Cheung Chan and Garth F. Petrie, "The Brain Learns Better in Well-Designed School Environments 1998, vol2, no. 3.
   http://www.ascd.org/publications/classroom_leadership/nov1998/The_Brain_Learns_Better_in_Well-Designed_School_Environments.aspx

rize over thinking, to mimic and to follow directions over searching for their own answers. In adulthood, vocational education aims to re-teach students some of the capacities they once had, and lost. In my role as a design educator, I have been concerned with my students' complaints about losing their creative juices once in design school; when confronted with systematic design methodologies, students become handicapped, unable to embrace their creative capabilities because, even when asked to "think outside the box," there is a limit to the *outsideness* of that box, defined by cultural biases and social validation. This is a disservice to students' growth both as professionals and as individuals. In order to enhance brain capacities and flexible thinking for resilience, and ultimately nurture students' full potential through thinking and acting, we need to reframe education as the means by which to stimulate all types of intelligences—of cognitive styles; acknowledging intelligences as independent from "what it is known," and instead understand intelligence as interactive, ever-changing, and adaptive cognitive processes that involve sensory stimuli (information input), brain interactivity (learning), and bodily movements (behaviors/actions). In addition, education needs to embrace design[ing][2] (design ability) as an innate form of intelligence.[3] Imagination, creativity and independent thinking have to become the academic backbone that uses design[ing] as a way to stimulate brain circuits engaged in learning. Moreover, current models of education use classroom spaces as containers with no agency, as opposed to acknowledging the space of instruction as a mediator of the learning experience; spaces where the interactions of students with—instead of in—the space, becomes an igniting element to achieve one's full potential. I argue that in the same manner that our real-world environment reshapes our brain, the space of instruction informs, and reshapes, our learning experiences and that, even though the relationship between inner (classroom) and outer (real-life) environments is important, there is more to explore in the confinements of the classroom space as an active participant in the learning experience. In re-thinking education, schools need to become *transitional-learning spaces[4]* that stimulate the minds of children in becoming creators, pioneers, and innovators—the new designers of possible futures.

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[2] I use the term design[ing] through this text as "the act of creating something new."

[3] Howard Garner, Frames of Mind: The Theory Of Multiple Intelligences (NY: Basics, 1983); p. 041.

[4] Donald W. Winnicott, *Playing and Reality* (Psychology Press, 1971). English pediatrician and psychoanalyst Donald Woods Winnicot used the terms transitional phenomenon, potential space, transitional object, and good-enough holding environment, interchangeably to refer to a transitional space (1989).

1 A Transitional-Learning Environment

1.1 Curricula (content)

While mentally tackling everyday problems related to specific classes, such as math, intro to design, etc.—that involve conscious processes in order to engage with the more evolved, rational, Neocortex brain—students will decode already validated brain games transferred to the surfaces of the Osmotic Bubble. These brain games will stimulate the visual and tactile senses, which in combination with physical movements in space, will connect the Limbic brain, linked to instinctual, motor skills, working in an unconscious level. Students will be given an open-ended goal to achieve in a specific timeframe. Developing exercises that enable lateral, divergent thinking will stimulate right and left-brain equally, and awaken the unconscious mind to retrieve tacit knowledge. Along with multisensory stimuli, physical movement (kinetic learning) is an integral part of this new pedagogy because it is through movement that we perceive, experience, and act in the world; exercise also helps produce more oxygen in the body to be sent to the brain, enhancing synaptic connections.[5] My argument is that, in moving to explore the space while playing— activating the motor cortex—innovative thinking can become imprinted in the reptilian brain— the oldest and less evolved part of our brain that automatizes motor skills to transform them into unconscious reflexes. Once this new way of thinking is imprinted and automatized—like learning how to ride a bicycle—students will become innovators naturally, in an organic process of osmotic, ongoing, unconscious learning.

1.2 Form (space)

When exploring the space, visual projections will deliver academic content in the form of visuals, oral narrative and text, that will loop several times.; for instance, design theory, geometry, or biology, will be implicitly delivered and explained as projections of images (static and/or moving), text, and oral narrative. The teacher is responsible for putting together the delivered information while stepping out once the exercise starts. EEG technology, also known as Neurofeedback technology of real time, self-regulation systems, will be used to track electrical activity in students' brain as a way to both collect neural field potential data and provide feedback for self-regulating students' emotional states. Self-regulation is achieved by making brain electrical activity visible (e.g., LED light changes in color patterns). Students will be asked to doodle ideas as they come to mind wherever they feel like it, on the surfaces of the structure, using provided ma-

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[5] Palmer 1980; Brink, 1995. As cited by Tak Cheung Chan and Garth F. Petrie, 1998, vol2, no. 3

terials: markers, paint, paper, etc.—the brainstorming[6] and mind-mapping steps of the creative process. Using Exquisite Corpse pedagogy to render collective hand-drawn sketches, psycho-geographic maps, and pictorial mindmaps will allow students to share pre-verbal/verbal ideas. Afterwards, prototyping and testing will be a process of individual, introspective, exploration.
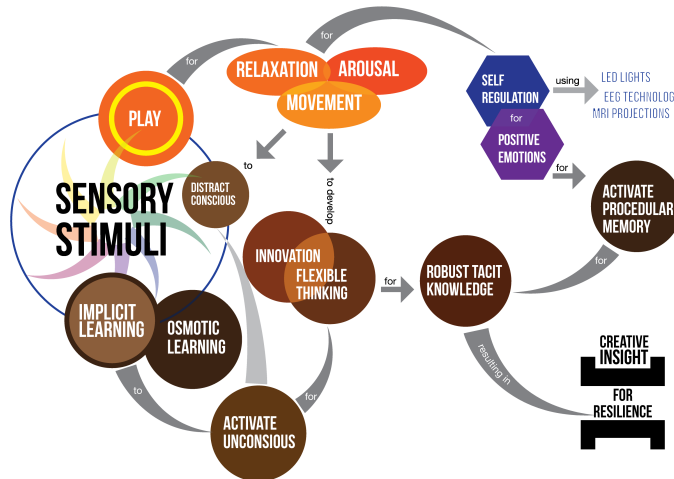

Fig. 1. Concept map; analysis of elements, technology, and brain circuits integrated in the Osmotic Bubble pedagogy (Source: Polo, 2014, "The Osmotic Bubble: Creative Insight by Dint of Synchronized atmospheres" p.56)

2   Conclusion

The goal of the Osmotic Bubble —an experimental project still in its early stages of development—is to enhance human innate capacities through a new pedagogy of flexible curricular instruction and within a built learning space that can be adapted regardless of disciplines. By means of integrating multi-sensory elements on a space (visual projections, oral narrative, textures, scents), different kinds of perceiving will develop ways of knowing—of learning—will help produced different types of knowledge[7] that speak to an array of cognitive styles and personalities. The aim of the space is to stimulate students' whole brain—left and right brain equally, in both conscious and unconscious levels—in order to enhance their brain's innate capacities of

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[6] Coined by the Alex Osborn, a partner in the advertising agency B.B.D.O., in the late nineteen-forties. After 1958, it has been used for many, both designers and non-designers, to get creative juices flowing.
[7] Daniel Tammet "Different Ways of Knowing." TED Talk, 2011; 10:53. Filmed March 2011.
http://www.ted.com/talks/daniel_tammet_different_ways_of_knowing