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Virtual Urbanity:
A parametric tool for the generation of virtual cities

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Abstract

Which are the underlying rules that govern urban growth and the structure of the street network? Which are the distinctive characteristics that define highways and the differentiation of the various street patterns? How can we combine the above information and incorporate them in a computer aided urban simulation in order to successfully model a virtual city in which people will be able to successfully orientate and navigate?

This research aims to address and investigate the above issues and proposes the development of a parametrically adjustable computer program in order to conduct navigational and way-finding experiments. Virtual Urbanity is a simulation engine which is capable of procedurally generating a vast and diverse variety of virtual 3D urban configurations. It uses an operational grammar which consists of a local generative process which is based on a Lindenmayer system, and a prescriptive set of global parametric rules. This combination defines the topology, the geometry, the width, the length, the density and the spatial significance of the streets, ultimately setting an effective street hierarchy.

The program engages in the methodological exploration of existing and theoretical urban configurations and the analysis of the human perception about the structure of the built environment, and builds towards a working algorithm (rule-set) for the on the fly generation of city structures in the next generation video games. In accordance, a trial experiment regarding the mental correlations of the roads' width and their hierarchical significance and function within the street network was conducted and its findings were discussed.

Keywords: virtual city, urban growth, parametric, generative, procedural, simulation, L-systems, navigation, way-finding, cognition, legibility, hierarchy, patterns, road width

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To my beloved family

"Research should address the navigation of Virtual Environments per seas well as the transfer of spatial knowledge learned in Virtual Environments to the real world." (Ruddle, P. Et al. 1998)

1 Introduction

For many years the problem of understanding the multi-dimensional nature of the built form troubled theorists, architects and urban planners. Architectural design, ranging from crafting individual buildings to planning whole cities, requires good knowledge of the properties and the interrelationships between the different possible configurations of the built form in order to be successful. The same difficulties are encountered when designing virtual equivalents of the real world, particularly in the game industry, when the task involves the crafting of a large scale virtual environment. Whether it is a realistic urban setting or an abstract imaginary environment, released from constrains of the physical world[1], the same type of questions arise (Darken et al., 1999; Dalton, 2005).

When we design a space, whether physical or virtual, we literately augment the space by commissioning a function. In order to be functional, space first needs to be informative of its intended function. Its assigned characteristics and configuration need to provide the necessary feedback that will make it easily comprehendible by its users as their misinterpretation may have dramatic effects in its efficiency. Kevin Lynch first described this critical spatial property with the term legibility. In his book "The Image of the City" Lynch defines legibility as "…the ease with which its parts may be recognized and can be organised into a coherent pattern" (Lynch, 1960). Since then, numerous studies have focused on researching on this spatial property and the way individual spatial elements affect the human perception of the built environment and direct different patterns of movement. Most of these studies so far performed experiments in the real world. However,

[1] Charitos, in (Charitos, 1997), stretches the fact that since Virtual Environments are not bound to the natural restrictions put by the physical world, they should be exploring new methods of composing form.

the idea that these experiments could be carried out in a virtual environment gains approval among the scientific community.

Indeed, there is evidence that navigational and way-finding[2] experiments which were hitherto done in the real world could take place in an immersive virtual environment given their correct setup. Ruddle, in (Ruddle et al., 1997 and 1998), suggests that the development of virtual environments could contribute to a better understanding of real environments. Conroy, in (Conroy, 2001), echoes the above statement, by implying that navigational behavior in virtual environments could be considered analogous to navigational behavior in real environments, as it presents similar patterns of movement. Additional evidence on that matter could be extracted from the work of Haq (Haq, 2005). Not only it is easier to isolate the spatial attribute under investigation by accordingly setting up the layout of the test environment, but furthermore, this method allows easier and faster automated feedback by accurately collecting data regarding individual micro-scale decisions and analysing them directly using computational data analysis routines (Conroy, 2001). The above findings indicate the need of a specialised and highly controllable multipurpose piece of software which will assist in the execution of different experiments. This thesis draws on this need and tries to address the following related issues:

- Which should be the adopted strategy for crafting a program capable of producing virtual environments that can be parametrically customized to fit the demands of certain navigational experiments?

- In what ways is it possible to implement certain spatial characteristics in creating virtual yet realistic simulations of urban environments in this program? Which are the basic prerequisites that need to be included and how much abstraction is it possible to have?

[2] The term is coined to Lynch. (Lynch, 1960).

- Which would be the most effective method for addressing and testing the rules which govern these characteristics in respect to their role in creating identifiable patterns of urban schemes?

- Which are the emerging correlations between different urban elements and their certain spatial attributes, and semantically how strong are they? In result, how drastic is the distortion of these correlations, and how do people respond to it?

The thesis is structured in seven sections. The first section addresses the initial aims and objectives set for the development of the program and then outlines the strategic concept that was employed in achieving them. The second section briefly reviews related previous work on virtual simulations of city structures and exhibits the differences in their approach, function and usage. The third section reports on the theoretical framework which defined the thesis approach. Specifically, it illustrates different theories on urban growth and how these are evaluated in order to establish the basic guidelines for the construction of the program. Section four refers to the resulting program. In particular, it displays the structure of the code, highlighting its internal key elements. Following, is a description of a complete loop and the presentation of the programs limitations. In section five the experiment that was carried out in order to test the program is portrayed, while section six analyses the gathered data and discusses the findings. Lastly, section seven comments on the conclusions extracted during the realisation of this project, and projects ideas for its future development.

2 Aims and Objectives

This thesis builds on the challenging direction of the study of the built environment, and specifically proposes the development of a corresponding program for the analysis of the properties of cities, in respect to the emergent patterns of movement they stimulate. The program should enable the setup and execution of different navigational and configurational experiments, by its ability to generate a vast and diverse variety of virtual 3D urban configurations in which the user would be able to navigate freely. The project's specifications are both functional/practical, in respect to the program's key features, and theoretical, in respect to the constructional logic of the generated environment. These requirements, along with the strategies that were adapted in order to meet them, are discussed during the analysis of the code's structure below.

The key characteristic that guarantees both the program's functionality and efficiency is the real time generation of urban configurations simply by changing the parameters of the initial setup according to individual goals. Thus, the productive logic of the program is based on setting constructional rules instead of conventionally outlining every detail of the hitherto sought environment. The generative rules contain only a limited amount of information (compared to the amount of data needed to specifically describe every detail of the final product), which makes them easily adjustable, ensuring that different experiments could be easily carried out. Furthermore, the adoption of such advantageous strategy sets a genotype-phenotype relationship between the realisation methods and the final product. Each set of the generative rules functions as a generic constructional guideline and leads to a resulting environment which could be regarded as a single version of all possible configurations that share the same topological characteristics and differ nonetheless in their particular geometrical form. From a phenotypical point of view, this attribute renders a dynamic design process which eventually provides a great variety of similar yet different environments. On a genotypical level, the productive diversity expands even more and the design adaptability becomes even greater, since a minor change the synthetic rules results in the emergence of a radically different output.

3 Related Work

There are a great number of interrelated research projects in the extended field of computer aided urban simulations. These either focus on simulating 2D urban growth on a land planning level, or concentrate in modeling 3D virtual cities. Most of the latter projects aim at the construction of virtual equivalents of existing real environments. It is obvious that the manual design of these large scale environments would require a huge amount of time and effort, making the whole venture practically impossible. Hence, these projects use automated or semi-automated procedural methods that depend on the utilisation of digital databases.

Specifically, the most common procedures include the use of 2D or 3D GIS data (Coelho et al., 2005), elevation and building footprint data extracted from 2D plans (Laycock and Day, 2003), and photogrammetric or laser-scanner (LIDAR) methods on aerial photographs (Brenner, Haala and Fritsch, 2000; Zhang et al., 2003, Deng et al., 2005). However, these projects are not considered purely generative since they don't generate new spatial relations, but rather reproduce existing ones, by rendering 2D data into 3D forms.

There are projects that advance towards a more generative approach and produce completely fictitious environments from scratch. Greuter, in (Greuter et al., 2003), proposes a system that bases its function on the combination of preset floor plans and real time interactive generation. This system is using the user's behavior to inform an "on demand" bottom-up generative process, and does not focus on the creation of an environment infused with actual urban properties, but rather reproduces a simple pattern.

Lastly there are hybrid projects which are able to reconstruct the patterns of existing cities, or alternatively generate completely new ones (Parish and Muller, 2001; Sun et al., 2002; Gonzaga da Silveira and Musse, 2006). These projects have a better global understanding of urban dynamics and employ global rules in order to simulate them to a higher or lower degree. The first two concentrate on the creation of a hierarchical street network, while Parish and Muller's City Engine further deepens incorporating advanced methods for dividing blocks into lots, assembling volumes for the creation of the buildings, and

classifying by assigning the type, the maximum height and the architectural style of them. The last project has a more dynamic approach and proposes a generic framework for the initial generation of urban structures and the continuous update of their status by relating the generative process with the influential semantic forces of the activities of interactive virtual avatars.

From the urban growth point of view, most studies that research city development, utilise Cellular Automata generative methods (Yeh and Li, 2002), multi-agent systems (Lechner et al., 2006) or the combination of both (Torrens and Benenson, 2005). These studies engage in an in depth analysis of pre-manufactured models of cities (usually in 2D) and report on their potential development by examining local and global statistical data, planning regulations and geomorphic particularities.

4 Theoretical framework

During the construction the program, a thorough study was performed so as to discover the most important factors that affect city growth and are responsible for the different identifiable spatial patterns that they display. The theoretical framework which is presented in this chapter provided the basic guidelines for the determination of the elements that should be included in crafting the virtual environment and established the rules according to which the virtual environment was to be built.

4.1 Urban elements

Cities are considered to be among the most complicated artificial structures because their form and function reflects several stages in their development. They are continuously reshaped by several interrelated forces, among which economic, cultural and social, and they present great diversity in every aspect and every scale. The study of the inner workings of this multilayered network of overlapping forces sets a challenging research area which requires methodological study. Unsurprisingly, there is an extended literature concerning urban growth and the formation of cities and in an attempt to find a substantial and specialised vocabulary to describe common urban elements and patterns, the origins of their formation, and their evolution through time, one may find different and many times contradicting doctrines.

Christopher Alexander in his work "A Pattern Language" lists 253 patterns which constitute a "language for building and planning" (Alexander, 1977, p.ix). This approach is echoed in the movement of the New Urbanism, in its declaration of its principles for interpreting and designing cities[3]. Yet, the socio-spatial expression of the humans' fundamental need for symbiosis is, throughout history (regardless its status, from the primitive settlement, to the early village, to the

[3] For more information visit: www.newurbanism.org

medieval town and finally to the contemporary city or even the metropolis[4]), so complex in nature and context that there are "obvious objections to the idea that urban forms evolve according to general laws" (Hillier, 1996, p.262). Moreover, Hanson particularises by saying that "descriptive typologies are generally speaking too simple to be useful [...] or to detailed as to be idiosyncratic" (Hanson, 1989, p.81).

However, "determinants" which influence the development of the early rural and later urban shelters do exist, and may be identified in the special topographical and climatological features of the land, the resources on construction materials and the hitherto technological advances in constructional methods, the need for mobility, and economic, political, religious and defensive factors, to name a few among many others (A.E.J. Morris, 1972). Although the analytical method of Morris provides a great variety of urban form determinants, and besides the fact that in a lower level of analysis, it is the complex, yet fundamental, socio-spatial nature of our existence and our environment which also determines and shapes our cities (Hillier and Hanson, 1984), in an urban simulation one may naturally expect the reduction of the encoded elements that will be included, both in the procedure of the realisation of the model and the end product itself. The reproduction of reality in its whole is both unfeasible and impractical. Therefore, in the simulation of a city there is a certain degree of abstraction in the way elements are represented and associated. Lynch identified five distinctive elements that compose the city: paths (linear movement channels such as streets, trails, and sidewalks), edges (linear elements such as walls and shores), districts (identifiable city sectors with common features), nodes (strategic points of concentration) and landmarks (physical objects used for reference) (Lynch, 1960). Thus, in the Virtual Urbanity program, the city's is reduced to encompass the structure of an elementary street network and the general characteristics of its buildings. The differentiation of the generated results is to be found on these basic subsystems of cities, and their classification is done according to these.

[4] Metropolitan areas are, according to Jane Jacobs, "central cities, together with their suburbs and dependent towns" (Jacobs, 1961, p.218)

4.2 Basic guidelines

The basic guideline that the program affiliates for the generation of the urban environment lay on a bottom-up junction-based construction of the street network. The program presumes neither that building volumes are primarily built with the streets forming from the leftover free space between the buildings' blocks (a free-form attribute found in old parts of contemporary cities and early, underdeveloped settlements (Hillier, 1984, p. 59)), nor that main circulation axes are put down prior to building according to an urban design plan (more common in more developed cities (Hiorns, 1956, p. 207)) in an authoritarian manner. The hybrid generative concept in use rather lies on a combinational tactic, since both the building volumes and the part of the road in front of their entrance constitute the elementary structural unit.

There are certain rules that govern the emergent order of the environment as the junctions are placed down on the white canvas. Despite the fact that the rule pool is broad and deep, the ruleset (RG) which was used as a reference roughly recreates the urban patterns that emerged from the naturally developed European cities. Berry, in (Berry, 1973, p.116), underlines that "the physical skeleton of the European city was seldom the expression of economic forces played out on a rectangular grid, as it had been in most of North America". Indeed, the patterns which were inherited by the medieval origins of most modern European cities are by Morris' standards "organic", since they "evolved without preconceived planned intervention" (Morris, 1972, p.10). These are complex, irregular, dense and many times chaotic urban clusters consisting of streets that usually don't have a constant width and in some cases don't necessarily lead somewhere, demonstrating a tree structure (i.e. are dead-ends). Thus, the active ruleset initially generates an organic center of a given predefined radius, which approximates the medieval past of the city in progress (figure 1).

Wider roads in the form of avenues were introduced much later in the Baroque era (Mumford, 1961, p.367). This was directed by a technological upgrade on the wheeled carts and wagons which became widely used, requiring more space for movement. The avenues start to have increased economic value once the rich upper class moves towards the wide avenues (Mumford, 1961, p.370). These patterns are echoed in the program by the construction of a network of wide roads. The wide roads following the high value concept allow high-rise buildings

to be erected within a certain range from the city's old centre, reflecting the preserving policy for the old city centres in the last decades. Furthermore, it was taken as granted that towards the distant edges of the cities, site values naturally drop, therefore high-rise buildings were restricted. The emerging wide road

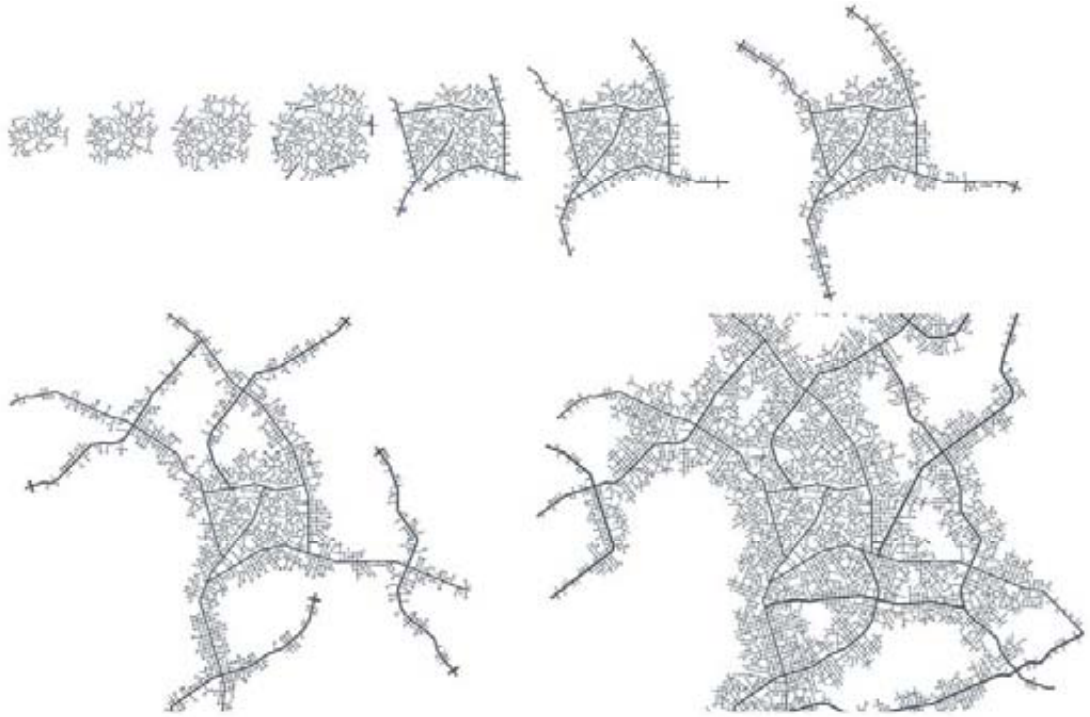

Figure 1: Urban growth using the RG ruleset, top view. An organic centre is first generated. The network of the wide roads grows rapidly to form a complete network, while the narrower streets have slower development.

shapes and sizes, which resemble different urban sectors or neighbourhoods. The wide roads, which are limited to a certain maximum number, function as highways[5]. Each branch of them roughly retains its starting direction by allowing a maximum of 90 or -90 degree overall angularity, mainly prohibiting a U-turn. Therewithal, certain types of junctions were excluded from use in wide roads as these would force rapid changes in the direction of the road (ex. 90° turns).

Some of the wide roads lead directly to the outer edges of the city, hypothetically extending old medieval gateways (Berry, 1973, p.116). It is natural for transportation axes, which serve as trade interconnections between cities, to generate constructional activity on the surrounding areas. This is evident regardless the nature of the axis. Railways many times act as a baseline on which

[5] The term Highway derived from the geometrical features of the Roman roads which were both direct (straight lines) and constructed on embankments for water drainage and supervision of the surrounding area (Flaherty, C.A.O'., 1967, p.4)

a structure of perpendiculars and parallels produce a regular grid is erected (Appleton, 1968, p.113). This is also featured in the program by the dominant presence of the wide roads, which expand much faster than the narrower streets and sometimes even penetrate in the pre-existent network. The arteriality of the wide road network, that is the contiguous connection of all 'top tier' elements (Marshall, 2005, p.61), is ensured by the wide roads that are not radial, which complete the network by linking with the formers, while shaping what Hillier depicted as a natural urban element, and described it using the term "deformed wheel" (Hillier, 1996, p.285). The network of the narrower streets, which expands due time, follows its own generative rules, embraces more diversity in the junction types it contains and is denser on the whole (Hall, 1970, p.131). The patterns it produces either follow a strict logic, forming gridiron structures or acquire a more relaxed development, forming more organic structures and adding to the overall complexity of the system.

In general, the density of the buildings starts to decrease gradually, as one moves out of the city, with sparser building units and much more empty lots, until the point at which the environment is considered to be rural (figures 12-14).

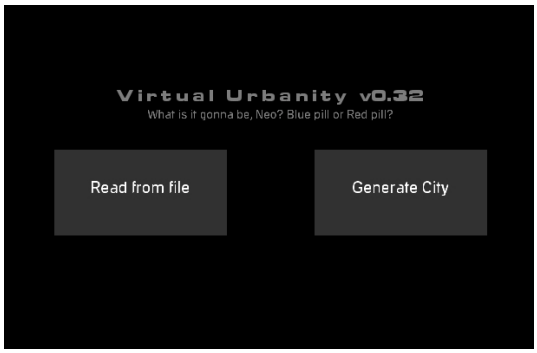

Figure 2: Starting screen.

Figure 3: 3D view of a cross junction in the city centre.

Figure 4: 3D view of the organic city centre.

Figure 5: Dead-end.

Figure 6: A wide straight road.

Figure 7: High-rise buildings.

Figure 8: A paved alley between a building and a wall, which isn't part of the street network.

Figure 9: An empty lot found on a wide road. Figures of people randomly placed help in the estimation of the scale.

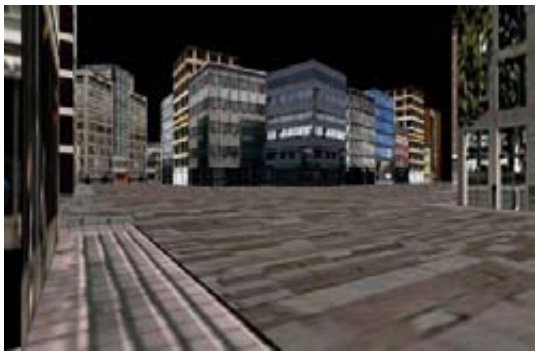

Figure 10: Two wide roads meet.

Figure 11: A "fork" junction.

Figure 12: Low density.

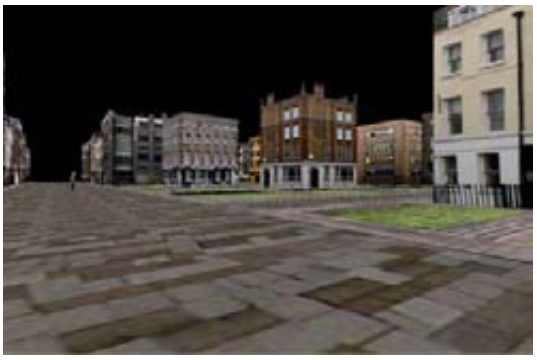

Figure 13: Lower density.

Figure 14: Rural environment.

Figure 15: Close up top view with two main roads of different width meeting.

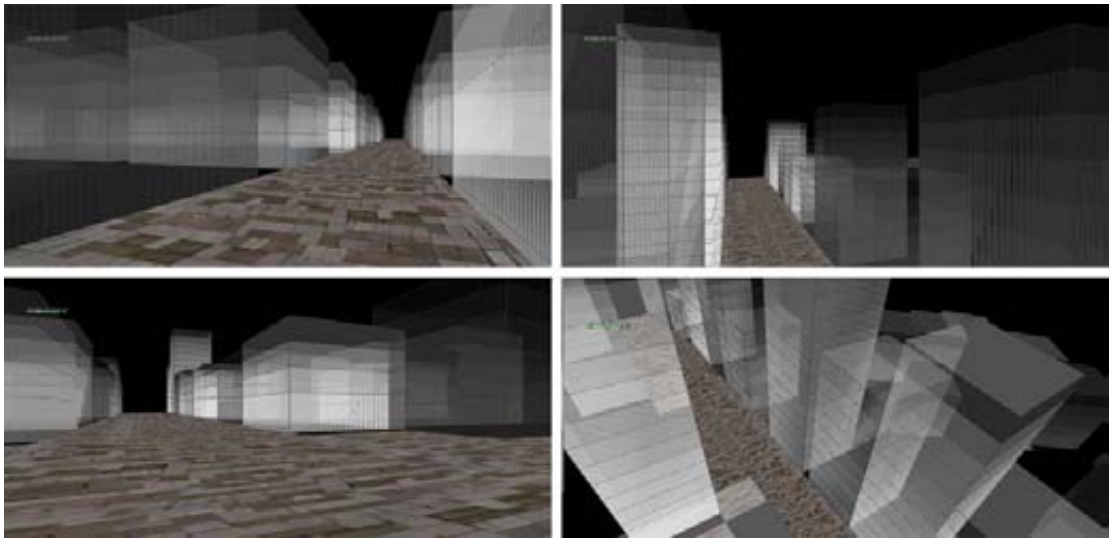

Figure 16: Alternately the textured buildings may be replaced by neutral volumes of the same height with the indication of the floors.

5 The program

In this chapter the code of the final program, Virtual Urbanity, is presented. Its development required the encoding of the aforementioned constructional norms into computational routines. The thorough demonstration of its operation includes the demonstration of the code's structure, its essential elements, and its limitations, highlighting the most influential formulas that were employed.

5.1 Structure of the code

The program has two operational modes (figure 2), the generative mode, where a new city is created according to preset parameters defined by the designer, and the read mode, in which the program reads from a file in order to reconstruct an already saved environment. In the generative mode, the code is organised in two independent and sequential computational cycles, the generative one and the executional one. The introduction of two separate cycles was directed by the enormous amount of processing power needed for the generation of the environments. The former cycle is where all the generation of the environment takes place and it is further divided into smaller computational routines which, apart from the generation, are in charge of different tasks, such as several checks concerning the adjustment and the fine-tuning of the overall result. The latter cycle renders the resulting environment of the first cycle, enables and records user navigation, and at the same time collects statistical data regarding his/her movement. Finally it saves all the gathered information of the session, including data for the reconstruction of the generated map in a 3 log files, so they are usable in the read mode of the program. This cycle is also available in the read mode with some alternations regarding the alternative loading and rendering of an already saved path from a previous session, instead of recording a new one. All navigational features are available in the read mode, along with different viewport presets which allow the close inspection and the visual analysis of the generated map and the corresponding saved route (figure 17).

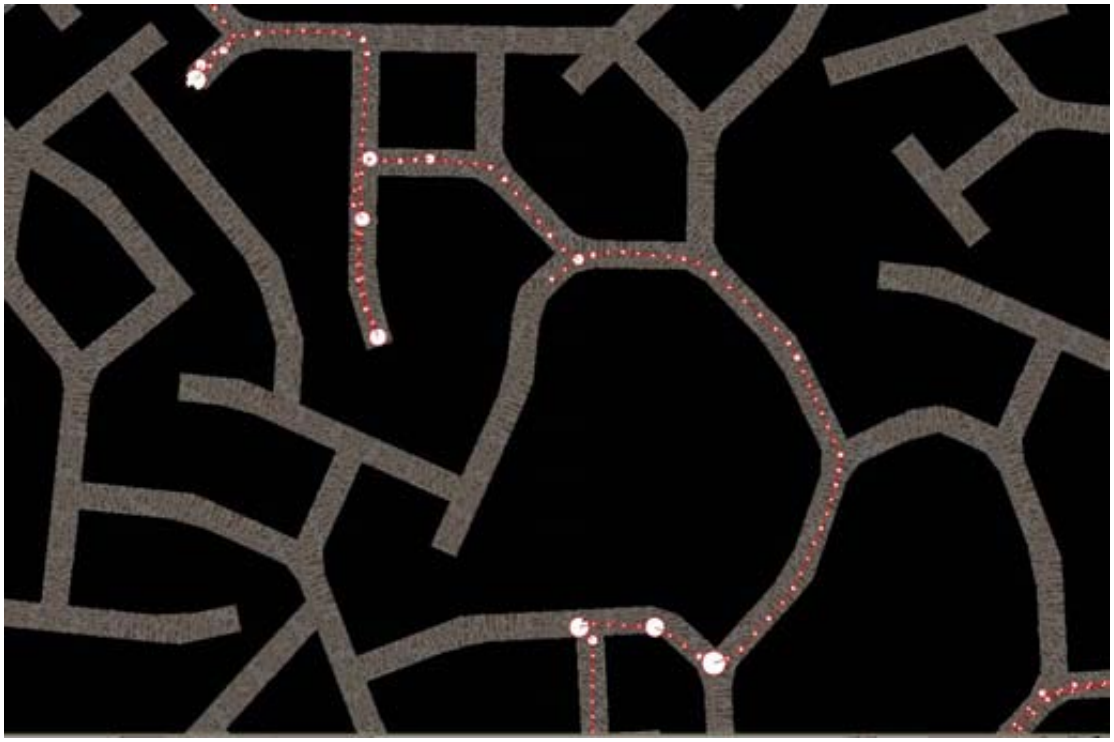

Figure 17: Close up top view without the interference of buildings for the uninterrupted view of the recorded route. The longer the user stays still, the bigger the radius of the circle at his/her position. From that feature, the number of pauses and their duration may be retrieved. The particular close up is from a part of the organic centre, hence the increased complexity.

5.2 Key elements

The code is structured around five key elements: the use of a vector class as a supportive unit; a set of interdependent constructional classes amongst which is the Junction class, which is conceived as the basic syntactical unit of the urban environment; the use of a local generative routine, substantiated by an extended L-system based Scene graph; the use of an adjustable set of parametric global rules which monitor and prescribe the overall process, and, lastly, the use of two Java based dynamic Arraylists as an organisational log feature which keeps a record of the results of the whole generation and further informs the generative process. Each element has its own discrete significance for the realisation of the project, as they were adapted in order to serve as the solution to specific organisational and functional matters, and together they constitute the operational core of the program.

5.2.1 The vector class

Vectors ("*vec*") are created at the lower level of the code's structure and, as described above, are widely used either as an end-product (in the case of the walker), or as underlying discrete entities that support and determine the behavior of higher level elements ⫤ in this case junctions, polygons and buildings. Each class's visual layout is in fact the phenotypic geometry of a carefully positioned static vector, whose metric relations to parent classes are pre-calculated and determined according to assigned dependencies.

5.2.2 Constructional classes

Three major classes are created, which ground their operation on the vector class and their status on interdependencies between them. The cornerstone of the program is the *Junction class*, which comprises all the basic constructional elements for the materialisation of the urban environment. The *Poly class* and the *Building class* are subclasses which contribute in the visualisation of the resulting environment by shaping the junctions and determining the type and the position of the buildings or empty lots on them respectively. A fourth class, euphemistically named "*Johnny class*", is also based on a set of moving vectors, and is used to create and drive the user-controlled walker.

5.2.3 The Junction class

As mentioned above, the *Junction class* is the implementation of the basic conceptual guideline for the construction of the urban environment, which is the generation of the street network. Within the junction class a number of characteristics are parametrically defined for every instance of it. Specifically, its type, position, orientation, width, and for certain types its rotation angle and the width of its vertical extensions. In order to build any of the junctions, a junction matrix needs to be established. The matrix, which is centered on point (*JposX*, *JposY*)[6], is a wireframe model that functions as the generic plan for the realisation

[6] JposX and JposY are the integers that indicate the position of the junction

of every possible junction type that needs to be constructed. It consists of 32 co-planar "*vec*" points, packed into 4 groups of 8, concentrically stacked into 3 stacks. These *vec* points are in fact guides for the correct positioning of the junction's images in 3D space (figure 18).

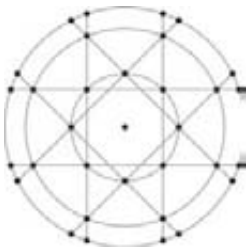

Figure 18:
The Junction matrix.

Several different sketches of the junction matrix where tested before settling on the prevailing one. The approved matrix is the optimal one that allows the greatest number of constructible junction types by combining different image positions, without being itself too complicated. In the latest version of the program, the eight most common junction types where constructed. Taking into account the project's time restrictions, it was judged that their random combination was enough to produce an acceptable simulation of a close to real life built environment, even though it is clear that there are numerous additional constructible junction types, whose import would enhance the whole experience. Each junction has one entrance and one to three exits according to its type.

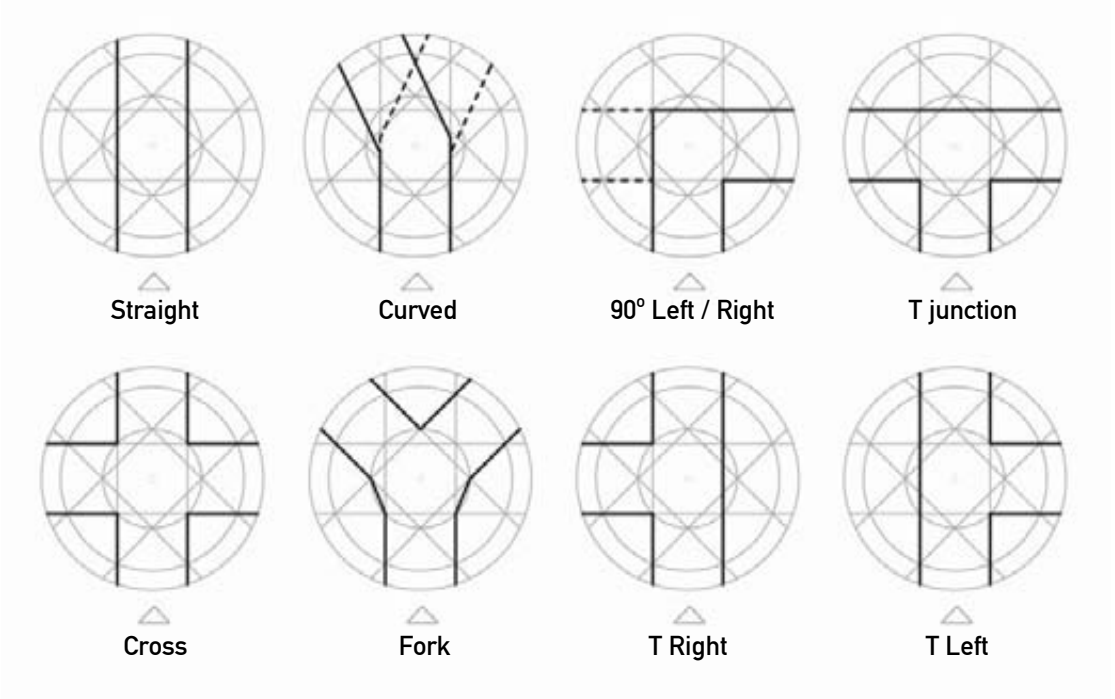

Figure 19: The eight Junction types.

5.2.4 Local and Global Rules

The generative routine, according to which the city is assembled, consists of both local and global rules. The local rules, being responsible for the generation of the junctions at the lowest level of the routine and part of the junction class, are applied first. They propose a set of parameters for the new junctions, which are later evaluated by the global rules. The latter come in two types: They are either applied in a restrictive manner during the generation process, forcing each time a modification on the local result, so that it best serves the global goals; or they have a promotional authority over the whole generative process, controlling the sequence of events in the general routine and specifying each time which roads are favored over others.

In the process of allocating a way according to which junctions would be generated and related to each other in a local scale, the solution of an L-System[7] based Scene graph was chosen. Quoting from (Parish and Muller, 2001) an L-System is "a parallel string rewriting mechanism based on a set of production rules. Each string consists of a number of different modules which are interpreted as commands. The parameters for these commands are stored within the modules". In this case,

This mechanism was introduced in the "*Breed()*" function of the Junction class and is called each time new geometry needs to be drawn. When called, the function creates and calculates a set of new junctions, which are cited as "children", and are placed at the exits of the parent junction. In order to simplify each computational step, the L-system was appointed a depth of one, which means that each parent junction breeds only one generation of children junctions. Moreover, the Breed() function of each instance may be called only once, restricting each parent junction from creating more than one set of children junctions. The use of a Scene graph extends the functionality of the L-System and allows the introduction of variety in the class instances. Each junction is of a certain type, which is indicated by the integer "*num*", and determines the number of its potential children. Their position and orientation is calculated by taking into account the position and orientation of the parent junction. Thus, the floating number "*Rot*" indicates the orientation of the junction on the Y axis, while the

[7] The concept of L-systems was introduced in 1968 by the Hungarian theoretical biologist Aristid Lindenmayer, in a successful attempt to model plant growth. However, their application could be extended to model several other processes of development.

"*JposX*" and "*JposY*" integers specify the position points on the X and Z axis respectively, where the actual geometry is drawn. Other parameters that are calculated by the local ruleset is the floating number "*degree*", which specifies the degrees of rotation angle of the exit of the road (in the case of the curved junction), while the "*Rwidth*" and the "*VRWidth*", define respectively the width of the road and the width of the vertical exits of it, if they exist.

The global rules exist in a form of several metric and time checks and functions over, within and after the generative process. First, there is a principal global rule which handles the breeding function, by increasing the breeding rate of the wide roads, and limiting it for the narrow ones, so that the formers are dominant in the generation of the whole environment. Secondly, there is a set of global rules which parametrically set certain attributes of the city. There is a rule instructing the construction of the organic centre which resembles the old part of the city. Another rule forces the emergence of a maximum amount of wide roads, which then take the lead in the generative arena. At certain checkpoints during this procedure, more wide roads are forced in, and Hillier's "Deformed Wheels" start to emerge. Other global rules, which supervise the street network, monitor certain attributes of individual roads, such as their type, their width, and their overall angularity according to the designer's predefined standards.

Other rules are concerned with the building supply on the sides of each road. Buildings have their own class, and are capable of being accredited with several characteristics such as usage, type, age, style, size, height, etc. Even though the program is capable of easily adapting numerous classification features, due to time restrains, at the point of its submission it only categorised the buildings according to their height. A global rule, which is based on probabilities defined by distance measurements, weights the probability of building or leaving an empty lot. The more distant the road from the centre, the more probability it has to have empty lots. That way the further one moves from the centre the more empty lots he encounters, until a point that the setting resembles a more rural area than urban. Another rule determines the erection of a high-rise building against a low-rise one, according to the type of the road and its position on the city map. This rule draws from the mentioned in a previous chapter economically sensitive approach, and allows the erection of tall buildings only in certain parts of the commercially prosperous wide roads.

There are numerous other global rules which determine other aspects of the city, such as its size (measured in junction population), its spread (by specifying a maximum radius for each type of street network), and the starting and final population of wide roads as well as their density. The Road Collision check takes place immediately after every loop of the generative routine, to discover the junctions that collide with each other and eliminate the most recent one, preserving that way the up to that point configuration of the environment. Finally, the Building Demolition function is a global routine that refines the overall generative result before it is executed.

An essential part of the code is the linking routine. This routine scans through 3D space and finds junctions that are close enough to be linked together in order to ensure urban continuity in the street network. Parish and Muller note that "in traffic systems the dead end road is the exception" as "most roads end when crossing other roads or circling back to themselves" (Parish and Muller, 2001, p.305). Every time a junction is about to breed a child junction, it first scans the surrounding area for neighboring junctions with free exits. It tracks the position and orientation of them, and adjusts the child-junctions so that they link to them. This mechanism is highly complicated, and naturally involves a great degree of precision.

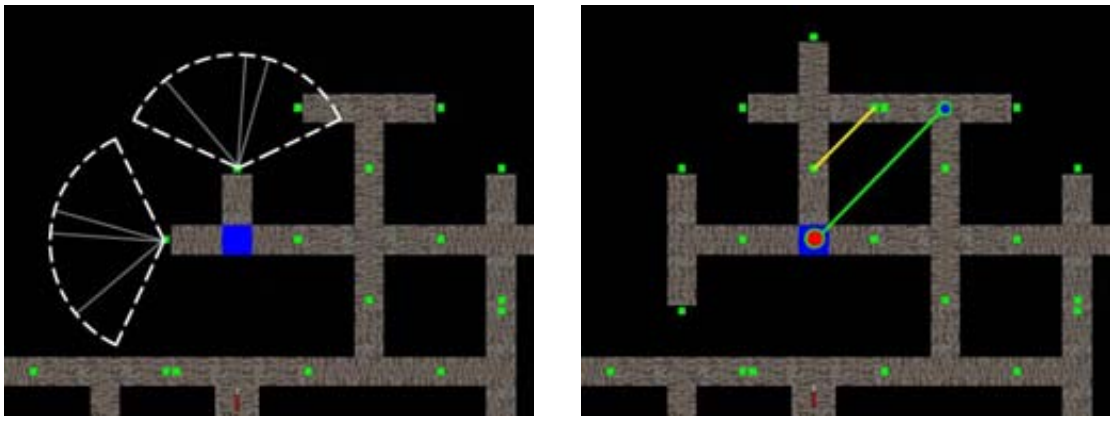

Figure 20: The linking routine. The junction indicated with blue scans the surrounding area for free exits (indicated with green). As soon as it tracks one, it places down an appropriate successor.

5.2.5 The dynamic Arraylists

The use of Java's Arraylists serves as a log for storing information about all the junctions that need to be drawn. Because of the complex sequence and the modifying manner of the routines, which add and remove junction instances according to a distance factor, this lists had to be easily accessed, automatically resized and sorted. Quoting from Sun's website, the Arraylist is a "resizable-array implementation of the List interface", which "permits all elements, including null" and is "roughly equivalent to Vector, except that it is unsynchronized". This means that it can be concurrently accessed and structurally modified without the need of further calculations for its maintenance. This dynamic nature of the Arraylist compared to the Vector's synchronisation problems, qualifies it as a convenient solution for keeping track of the calculation routines' results.

5.3 A complete loop

A better understanding of the above operational concepts, along with their function could be derived from the illustrated simplified descriptive diagram of the program's main routines in figure 21.

Sententiously, the Walker, the Junction, the Building and the Poly classes are firstly constructed along with the starting junction, which is then added to the Arraylist. A complete loop begins by reading all the stored elements in the Arraylist. A collision check between all junctions runs, and if two junctions collide, the newest one (naturally indexed after the oldest in the Arraylist) is removed. The population of all junctions is calculated and if it hasn't reached or surpassed the threshold, every childless junction breeds children utilising the rules of the L-System. The breeding routine produces a certain number of children junctions according to the type of the parent junction and calculates each one's orientation and position by taking into account the type, the orientation and the position of their parent. Most of the characteristics of the next segment are anticipated in a suggestive way. Of course, some of them, such as the width of the road for example, are directed by the type of the parent junction and cannot be modified at any circumstance, since it is rather rare to have dramatic changes in road widths while inside the city. Other characteristics however are assigned in a more

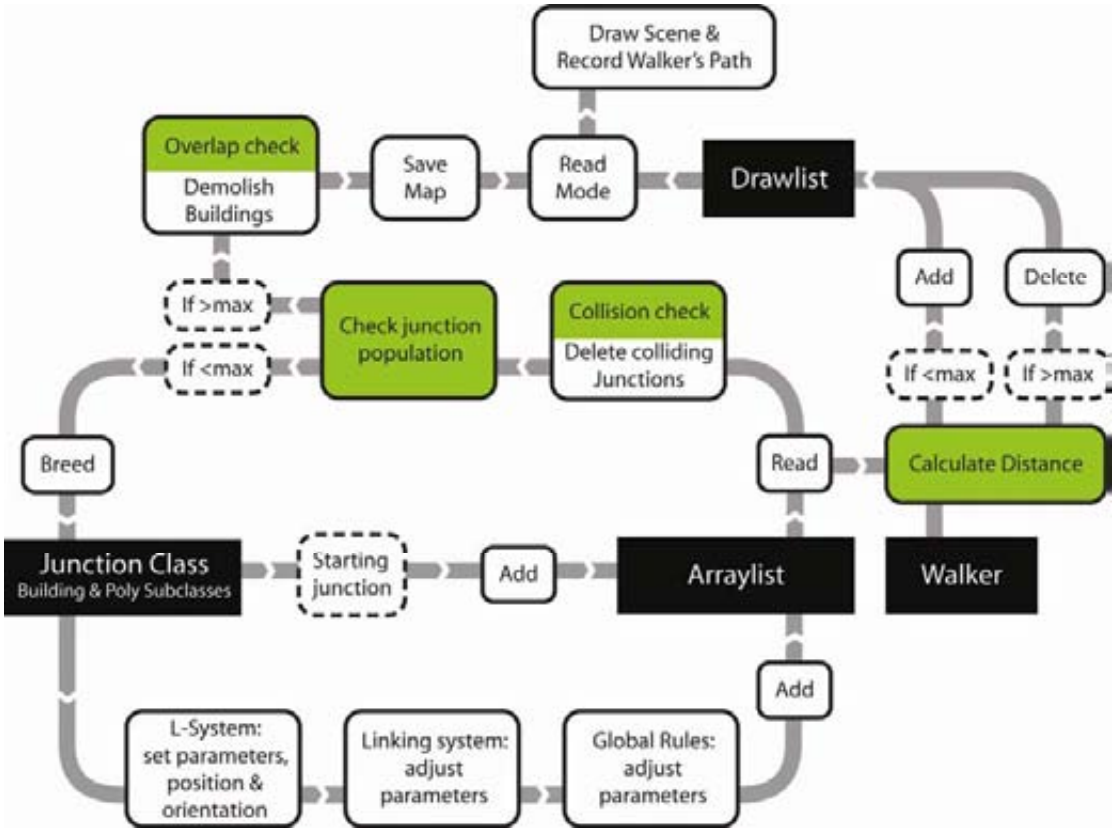

Figure 21: Simplified diagram of a complete loop.

random way, such as the angularity of the segment, and their selected values can be overridden in later stages. After the suggested characteristics of the child are set, the linking routine runs. If an available match is found, the child junction is adjusted to fulfill the requirements in order to ensure their smooth connection (to the degree which this is possible). The application of the global rules ensures that the proposed junction is not in clash with the global objectives, and makes necessary modifications where applicable. Lastly, the approved and tailored to fit junction is added to the Arraylist, and the next generative loop begins.

When the size of the Arraylist (i.e. the number of the active junctions) exceeds the maximum limit, the breeding mode ceases. An overlap test regarding the constructed buildings executes and ensuring the unimpeded rendering of the roads from buildings which may accidentally fall inside their free space. The produced map is saved and the program switches to read mode. In every loop of this mode, the stored junctions in the Arraylist are being read and their distance from the position of the walker is calculated. Every junction, whose distance is shorter than a predefined preset value, is copied as an entry to the Drawlist. This

way, the number of the objects that are eventually drawn to the scene decreases significantly so as to allow the smooth execution of the program. Additionally the difference in the position of the walker between two subsequent loops is calculated and stored in a path.txt file, while the time spent on every position is similarly calculated and recorded in a pathtime.txt file.

5.4 Program limitations

Due to the project's file size and development time restrictions 150 buildings' images were used in the program. While the number is big enough to create an acceptable degree of diversity (in view of the experiment's specifications), it inevitably leads to the frequent repetition of some buildings. All participants were specifically told not to rely on building facades to orientate but rather try to use other building characteristics, and they all acknowledged and agreed on that. Ideally, a procedural method of instantly generating building volumes and facades should be used in order to add gain to the realistic output of the environment, and avoid any kind of confusion to the participants.

A second issue that needs to be remarked is the static nature of the junction matrix, which results in the fixed size of the junctions' drawn geometry. This prohibited the smooth execution of the linking feature of the program, making the visual layout flicker when buildings were drawn over one another and the overall environment fragmented when streets weren't perfectly connected. This was dictated by the unsuitability of the Processing language for programming functions such as "extend" or "trim". Advanced operations as the above are considerable difficult to program with the Processing language, although they are comparatively easy to execute in commercial CAD programs.

6 The experiment

In order to test the functionality and the practicability of the developed application, a trial experiment was conducted. The experiment was set to estimate the extent to which the working ruleset was practically recognisable by the users, which were not shown the maps. It particularly focused on identifying the projected semantic significance and function of the street networks. The experiment was divided into six individual sessions at which an environment was tested and a questionnaire was then filled by the participant. Additionally, statistical data were automatically retrieved and were evaluated along with the recorded maps and routes.

6.1 Setup

The experiment was originally set to be conducted on a 2,5x3m projection screen at a resolution of 1024x768 with the participants positioned 3.5m away from the screen. The majority of the participants complained about dizziness and due to the relatively long duration of the experiment (roughly 1 to 1.5 hours) the setup changed. Therefore, the experiment was conducted on a laptop with a 15.4" screen at a resolution of 1280x800. The 3D scene was rendered using the OPENGL renderer. The participants were 8 females (F1-F8) and 8 males (M9-M16) of various backgrounds and occupations, aged between 24-32 (mean age 27, st. deviation 1,99), the vast majority of them familiar with both immersive environments and video games.

The navigation of the participants was controlled by using the arrow keys of the computer's keyboard. Specifically the Up and Down arrows controlled the movement, forward and backward respectively, while the Left and Right arrows controlled the rotation. In order to reduce simulator sickness, navigation speed was persistent, simulating fast walking speed, while rotation speed was restricted to 30° per second.

6.2 Rulesets

There were two rulesets, according to which six environments in sum were generated and assigned to each participant. Both rulesets construct an organic centre of 5000 pixel radius, and from that point on the generation of the first wide roads takes place. The first ruleset (RG) is supposed to be the regular one and is the ruleset that was thoroughly described in 4.2. The rules which this set encompasses derive from the simplification of the geometrical, topological and density attributes of the emerging street network patterns that are evident in most medium and small sized European cities. In order to examine the rationality and the validity of the granted fundamental decisions regarding the construction of this program, in respect to the readability of the produced environment and the clues it provides to the participants in order to understand it, the second ruleset contains a distortion of the generative rules. Because of the participants' presumed projection of a real city attributes on its virtual representation, it is assumed that in their endeavour to comprehend it, they would try to attain a global cognitive map[8] out of it, i.e. create a mental representation of the environment, by evaluating the visual information that they obtain during their navigation and further rationalising this information from past real world experiences[9]. In case the participants expect certain general urban attributes to be present in the simulation, their distortion would expectedly have a dramatic effect on their understanding of the environment. Their response and adaptability would be then measured through their ability to discover, decode and utilise the inherent constitutive characteristics of the environment they are put in. This will be possible by analysing their comments on the environment and ultimately their performance in it. Comparing these results, a general idea of the dominant characteristics of each environment may be attained and additional statistics can help in an understanding of the pre-established patterns that are existent in peoples' minds regarding the nature and the function of different elements of our built environment and the city as a whole.

Consequently, the second ruleset (RV) is a version of a reversal of the regular model, in terms of road angularity (figure 22). Several other rulesets could be regarded as reverse, each one reversing a different parameter. Road length,

[8] The term was originally used by phychologist Edward Chace Tolman in a 1948 paper (Tolman, 1948).
[9] According to the one of the many proposed definitions, a cognitive map "is a process composed of a series of psychological transformations by which an individual acquires, codes, stores, recalls and decodes information about the relative locations and attributes of phenomena in his/her everyday spatial environment" (Downs and Stea, 1973, p.9).

ratio of wide and narrow roads, placement of these roads, ordered centre and organic suburbs are just a few examples of different depictions of a reverse model. Nevertheless, the reversion of the angularity parameter was considered to be the best to serve the thesis research question. This distortion is associated with the assigned function of the wide road network. It is hypothesised in this thesis that in peoples' minds the width of the roads progressively correlates with their linearity, their length, their integration, their significance, and ultimately their function in the street network. In the RV environment, wide roads are forced to rapidly change their direction, in a consistent rate and at the constant degree of 45°. Moreover, the narrow streets, which could be regarded as radial due to their verticality to the wide circular ones, are forced to be extremely linear by forcing in straight segments. The preference of straight segments instead of cross-junctions, which would also ensure the continuance of the radial roads, results in a much sparser network of streets, since topologically the road has fewer connections with neighbouring roads, which intensifies the suburban feeling of the area of their application. Hence, the most promising medium which is capable of driving the user to the outer edges of the city are the narrow roads.

It is hypothesised that this is a radical setup that challenges the effectiveness of any pre-established assumption on the association of street properties, and makes the identification of any familiar global structure on the assembled cognitive model more difficult.

Figure 22:
A sample of a RV ruleset environment, top view.

6.3 Testing environments

All six of the produced environments contain the same number of junctions (on average 6500 junctions), i.e. have the same size. The first two (introRG and introRV, introduced in this order), were exactly the same for all participants and were used for introductory reasons. These were pre-generated environments which were generated by the two rulesets respectively. The participants were given 5 minutes in each environment to navigate freely in order to learn the controls, but most importantly to familiarise with the environments' degree of abstraction, by discovering which urban elements were included and which were excluded from the simulation.

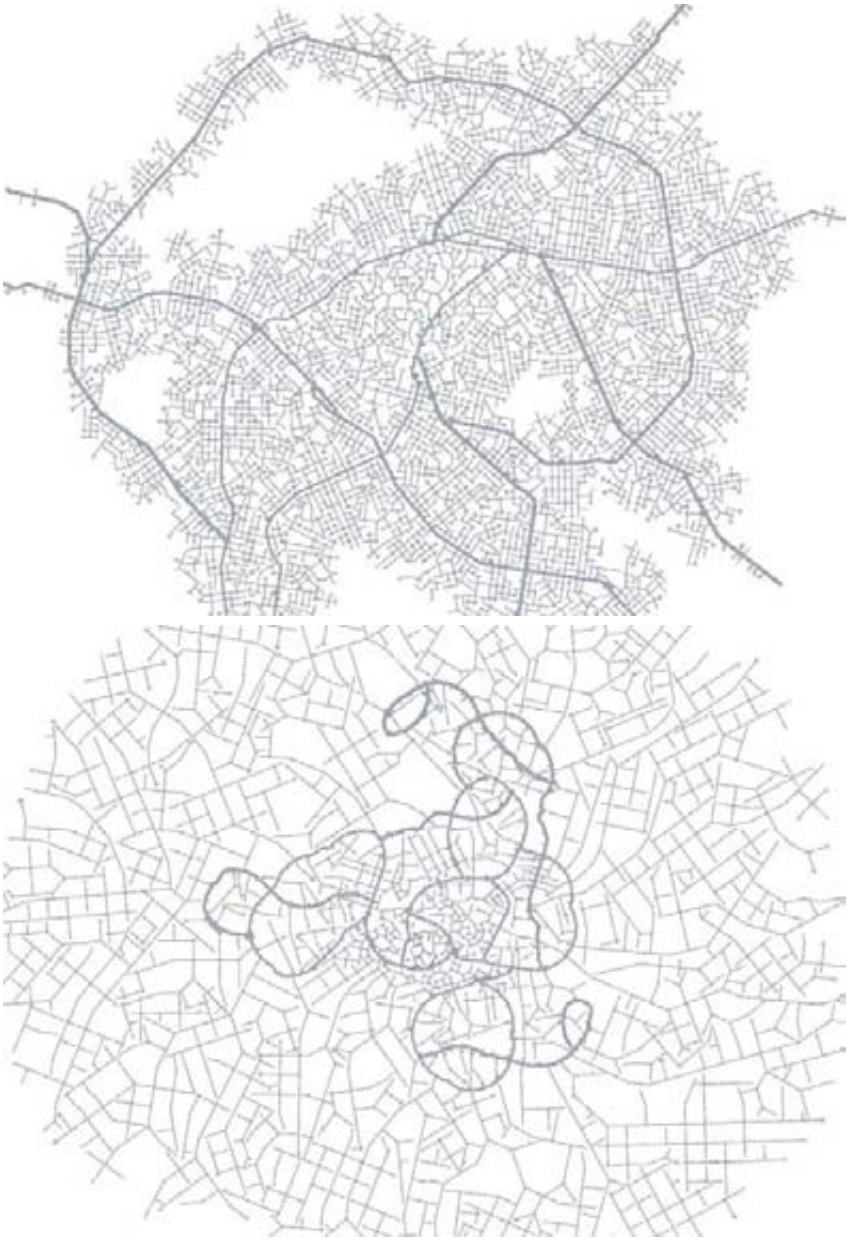

Figure 23:
The introRG and introRV environments respectively.

The next four environments, (RG, RGF, RV, RVF) were different for each participant, as they were generated on the fly. This strategy ensured the examination of the efficiency of the generative rules instead of the inspection of the effectiveness of the particular environment. In order to eliminate or at least minimise the error which originates from the fact that within time the participant becomes better in navigation and his route choices are affected from his past experience inside the previous environments, the order according to which these environments were introduced to each participant was randomised. The RG and RGF environments derive both from the regular ruleset. They both share the same general characteristics, except that the former allows the uninterrupted view of the horizon (insuperable rendering restrictions apply), whereas the second one restricts vision by the application of an added night effect. The same differentiation applies respectively between the RV and the RVF model which derive from the reverse ruleset (figure 24).

Figure 24: The -F environments apply a "night" effect which restricts long vision.

Figure 25: An alternative to the night effect, the application of fog, which was not used in the experiment.

Each of the participants is informed that he is initially placed at the geometrical centre of the generated environment, and their given task is to build up a strategy in order to reach the limits of the city. City limits are indicated by the existence of big red revolving spheres at the centre of the roads (figure 26). This hint was given in order to ensure that one would not be mislead by the possible occurrence of fairly large most of the times inner-city void areas, which may represent parks, hills, lakes or other urban regions which were not rendered in the simulation and where the road network ceases development and building is

restricted. Once the edges where found the participant would press a pre-assigned key in order to save his path and map. If the participant wasn't able to reach his goal during the given time, the program automatically saved his path and the generated map, and shut down within five seconds, while informing the participant about its status.

As a final note, it should be mentioned that some embedded features of the program weren't used in this particular experiment. In particular, these features are: the calculation of the duration of the participants' pauses, the indication of the elapsed time, the utilisation of a virtual compass, which reports to the participant his present orientation and the utilisation of a distance indicator, which informs the participant about his current distance from certain target points. The use of these add-ons would surely have composed an entirely different overall picture of the results, as they would compose a different set of experiments (figure 27).

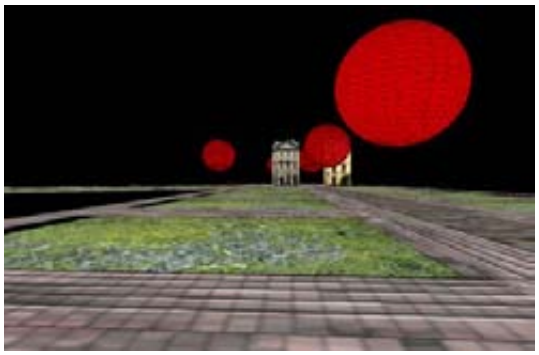

Figure 26: Red revolving spheres indicate the edges of the city.

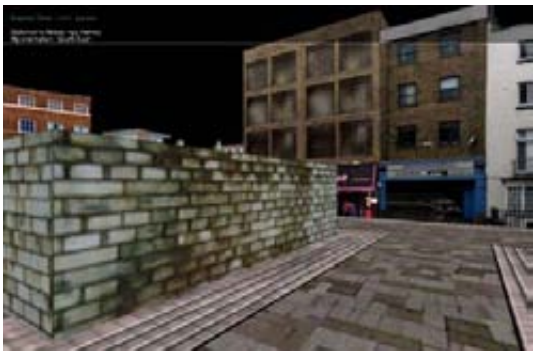

Figure 27: The optional top bar with information about the elapsed time, orientation and distance measurements was not used at the experiment.

7 Findings and Discussion

Participants' responses from the questionnaire (a sample questionnaire from the experiment is illustrated in Appendix C) were investigated with particular interest in their commentary answers regarding the strategy they used in order to complete the tasks they were given in the last four environments, as well as their views on the special structural elements or characteristics of each environment that they believed to have either assisted them or hindered them in their quest. Moreover, their ranking on each environment gave insight to their perception of each environment's global characteristics and defined to what extent the structure of it was perceived as complex, regular, repetitive, ordered, familiar, interesting, predictable, etc.

7.1 Route strategies

Regarding the two introductory environments, the area that was covered by the participants was as expected smaller than the area that was covered when a destination task was involved (figure 28). From the visual investigation of the recorded routes it is observable that participants explored a limited area, as no participant exceeded one third of the total radius of the map (see appendix E). In the introRG environment most of the participants didn't have a chance to visit the wide road network due to its geometrical output, which happened to be preventing access to it. However in the introRV environment, in which most people were able to visit both networks, visits between them were divided equally (46.5% vs. 56.5%) (figure 29).

In the next four environments, the routes expanded, doubling or even tripling the overall map coverage, which ranged from 1.14% to 1.50% compared to 0.37% and 0.54% of the first two environments. The examination of the statistical data, which were gathered by analysing each participant's routes, shows that the most noticeable difference between the four environments is on the field of the success of each participant in completing his/her task regardless the degree at

which he/she has consciously a complete global understanding of the environment's structure. There is a clear difference in the participants' scores, which separates the environments that derived from the regular ruleset from the ones that derived from the reverse ruleset, with the formers scoring much higher. Furthermore, there is a distinctive clustering of the environments that were generated from the same ruleset. Specifically, RV and RVF scored both exactly 0.20, which means that only one out of five participants was able to find the edges of their cities, while the RG and RGF scored much higher, 0.67 and 0.73 respectively (figure 30).

Considering the additionally queried descriptions of the strategies which were employed by the participants (see appendix F), a prevailing one is identified. 14 out of 16 participants, 87%, state that their strategy was to "find a wide enough road and stay on it", as participant M15 states, assuming that it would lead them out of the city. 30% of the participants explain their movement pattern as an attempt to keep their route as straight as possible, keeping a "consistent direction", as participant F2 mentions, while 37% of the people affirmed that their strategy was based on the differentiation of the buildings. They equally evaluated and associated the overall city density regarding building presence as well as the buildings' characteristics in terms of height and type. They depicted "high rise" buildings, "offices", "restaurants", "shops" and "residential buildings".

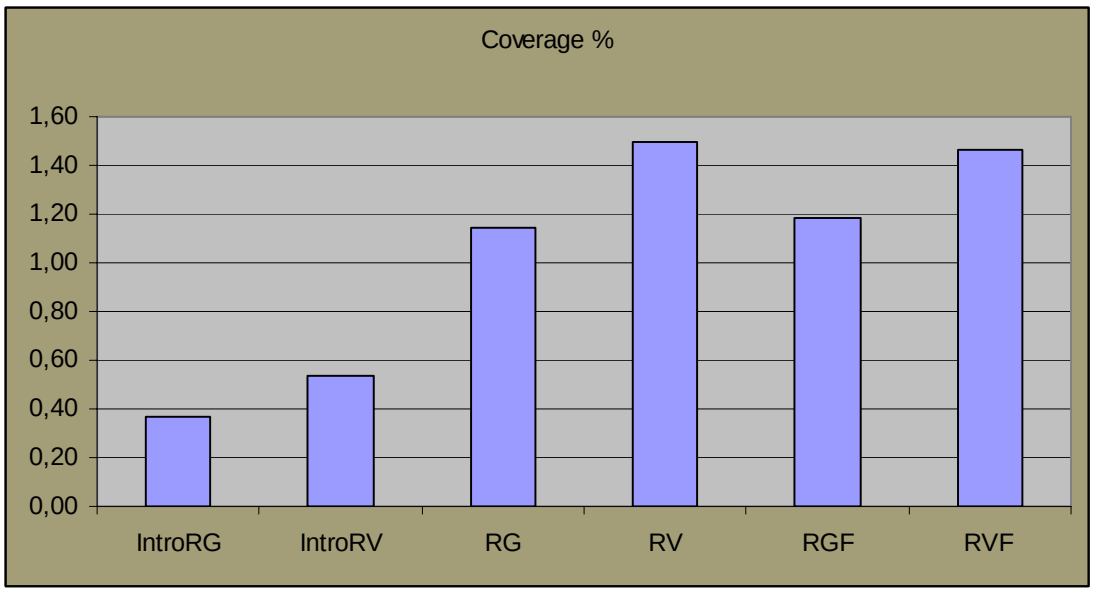

Figure 28: The average route coverage for all environments.

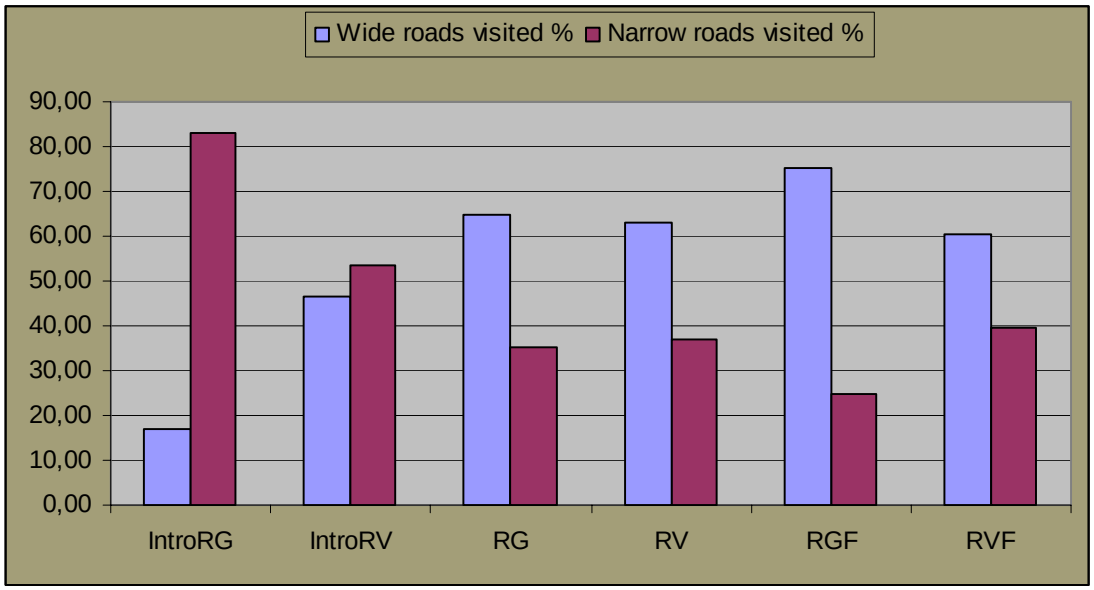

Figure 29: Average preferences in the wide and narrow networks for all environments.

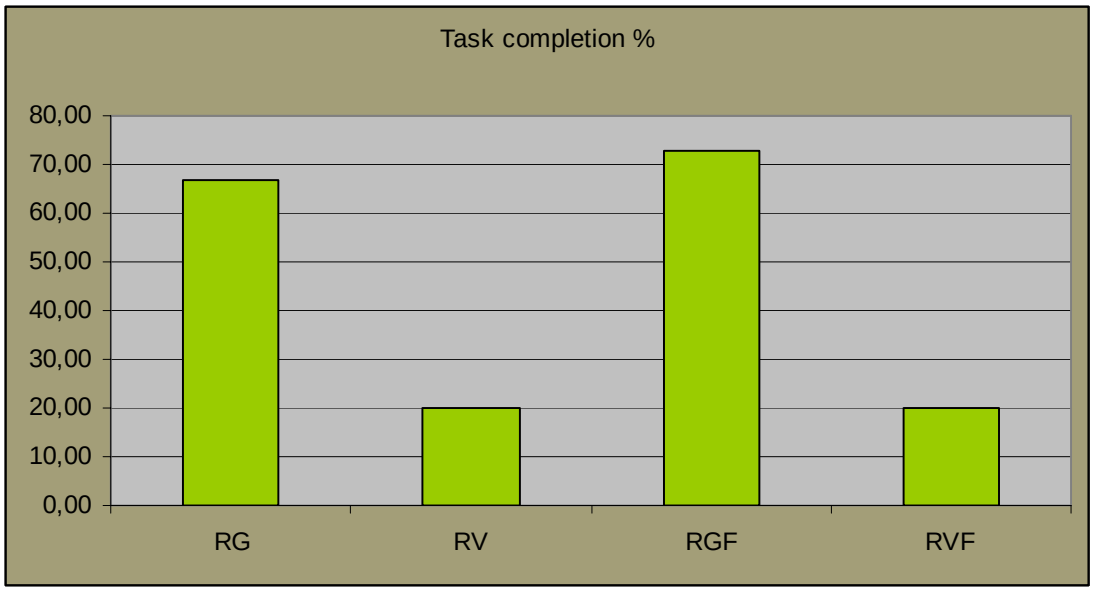

Figure 30: Task completion for all environments.

Indeed, the visual information extracted from the maps showing each participant's route, indicate that the majority of the people showed extensive faith in the wide roads (see appendix E). In addition, data concerning the preferences of the users in terms of road width showed that in all four environments there was a 60-65% usage of wide roads, to a 35-40% usage of narrow streets. At an extreme, a maximum of 75% preference to wide roads against a minimum of 25% for narrow road selection was recorded in the RGF environment. Although the standard deviation of the measurements ever drops below 20% (see appendix D), the general distribution for each environment between the percentage of wide and narrow road selection is more indicative for the general tendency:

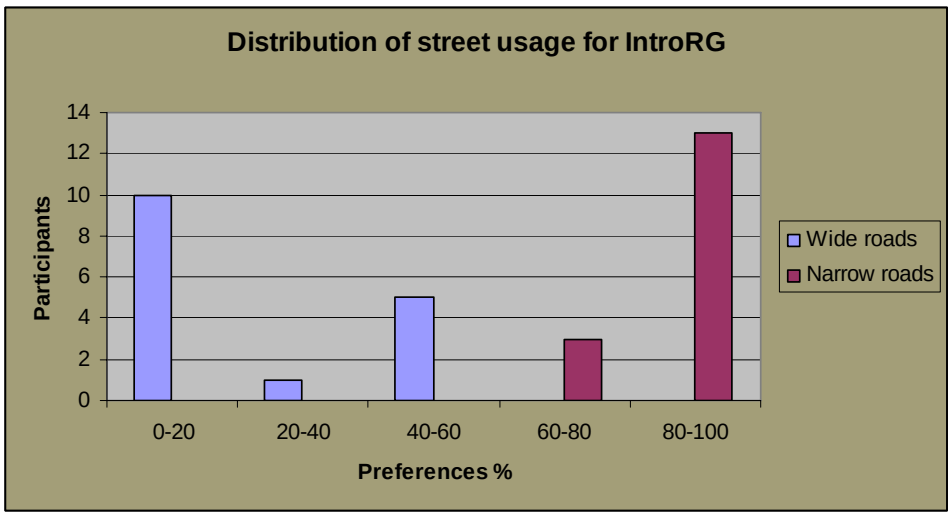

Figure 31: IntroRG - Distribution of street usage.

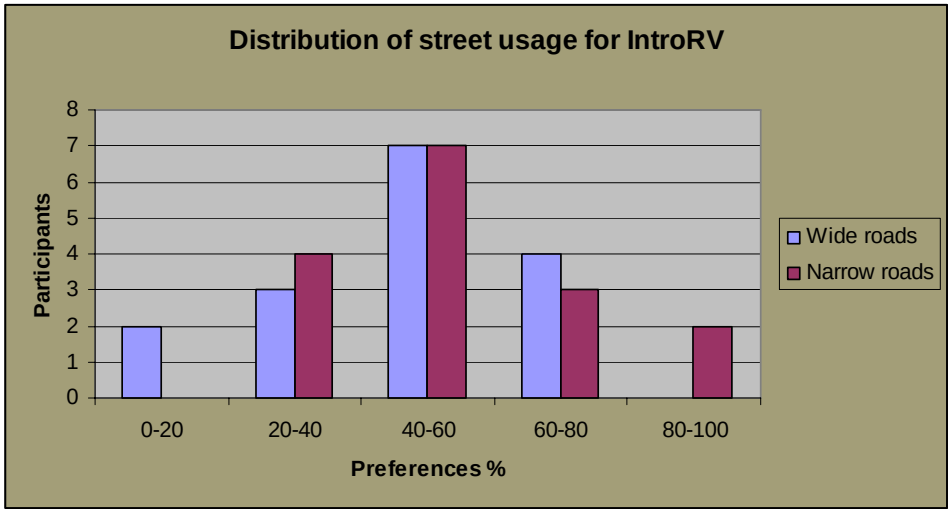

Figure 32: IntroRV - Distribution of street usage.

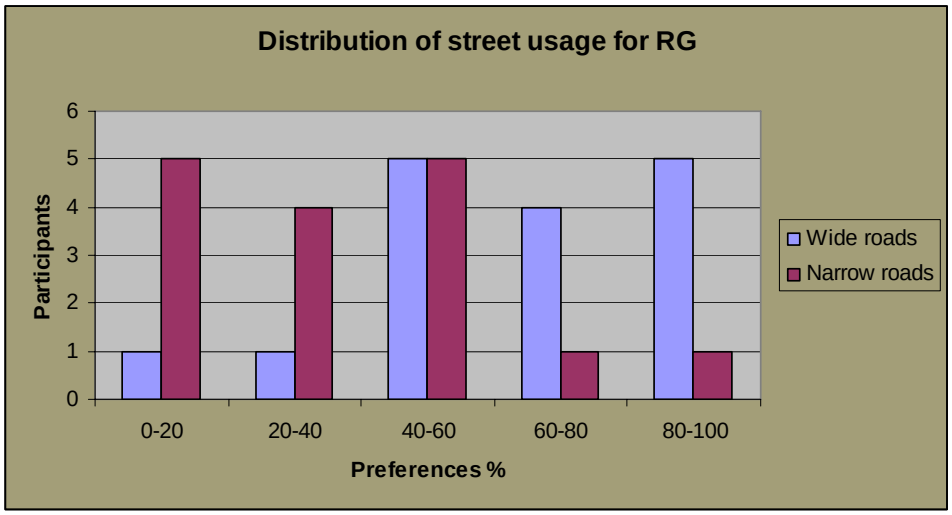

Figure 33: RG - Distribution of street usage.

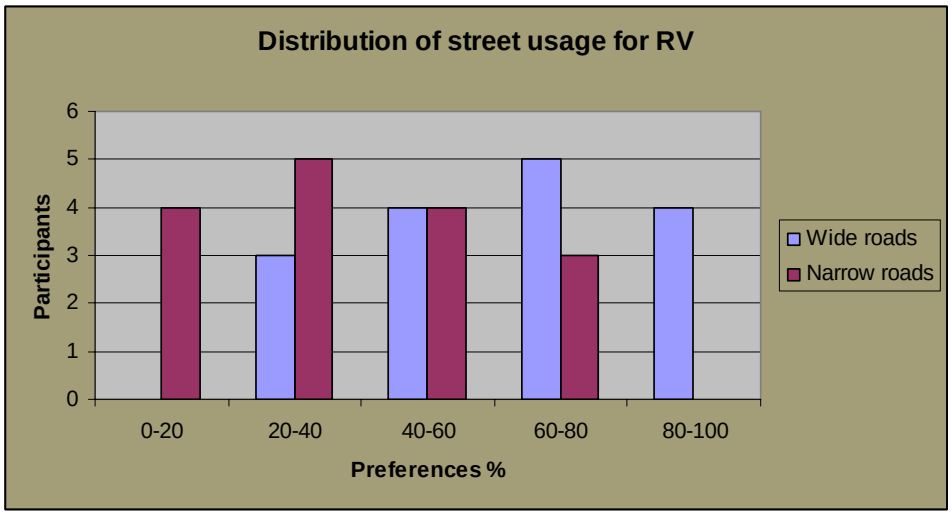

Figure 34: RV - Distribution of street usage.

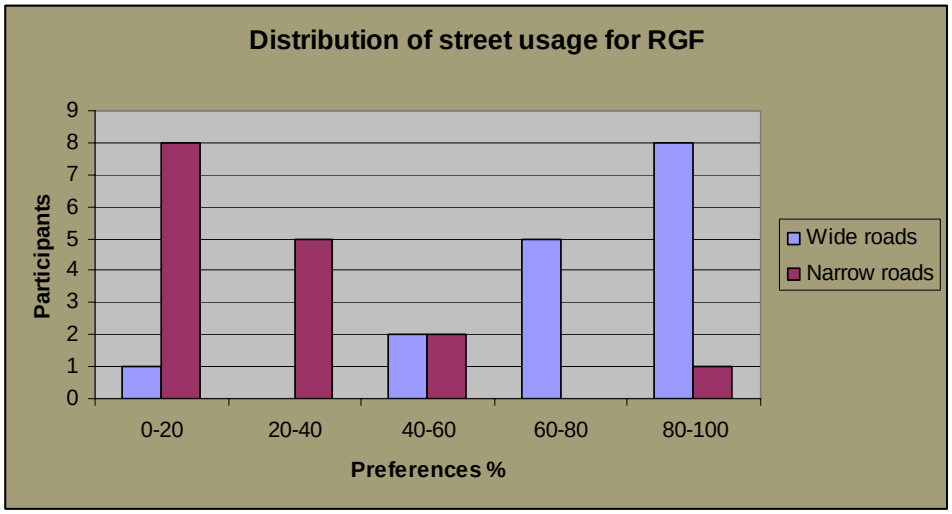

Figure 35: RGF - Distribution of street usage.

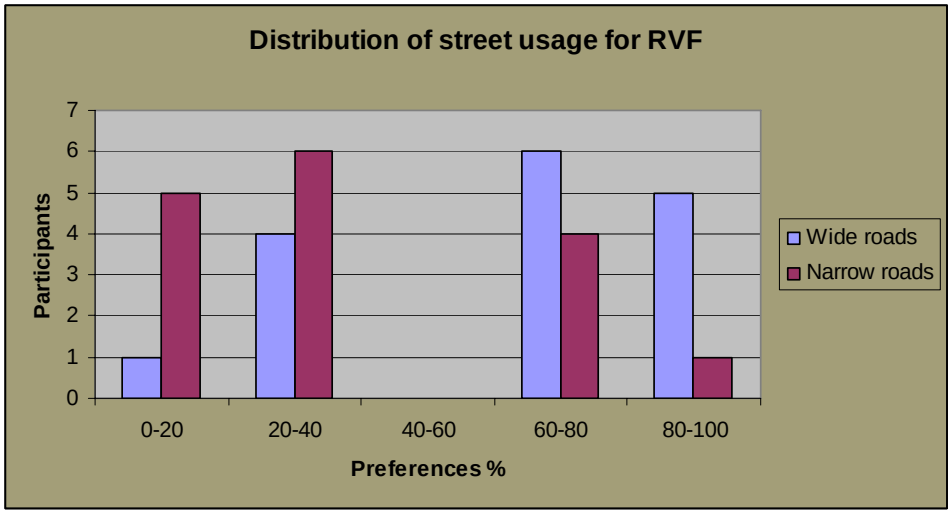

Figure 36: RVF - Distribution of street usage.

R. Conroy Dalton in her research on route path selection and angularity suggests that "subjects would always take a less complex route, only on condition that it is approximately in the direction of their destination" (Dalton, 2001, p.12). Keeping in mind that the participants were specifically told that their starting point was at the geometrical centre of the city, it is safe to presume that any initial direction may be equally convenient for them until a more promising route is found. Their preference in wide roads makes sense only under the schematic approach which decodes the environments' structural norms by relating different geometrical characteristics of its elements. Their assumption that the wide roads would eventually lead them to the outer edges of the city runs in parallel with the acknowledgement that the wide roads in general don't change their overall direction, i.e. they have low angularity. Hence, they make a better choice as a route as they would provide a less complex path with fewer turns and a much faster way out of the centre of the city. The alternative selection of narrower streets, which by default are considered to be part of a network system that allows more complexity, would theoretically complicate or even prohibit the solution of the task.

A second layer of decoding the high significance of the road's width could be based on a hierarchic associative concept. According to this local characteristics of the roads are highly associated with global topological ones, thus operational and hierarchical as well. It could be presumed by the participants that wide roads function as highways connecting isolated parts of the city together or linking the whole city with the surrounding rural areas of the hinterland.

Interestingly, wide roads are sometimes addressed by some of the participants as "broadways" (participant M11) "central streets" (participant F2) or "main roads" (participants F1, M12). This suggests a clear attempt to assign additional characteristics that don't originate from the knowledge of the global map of the city, but are educed by the local characteristics of the road such as width and/or the buildings that can be found on it.

56% of the participants seem to never have got aware of the circularity of their route in the RV models as they don't state it nor change their routes to follow straighter lines. From this portion, 44% reported that they noticed some kind of "repetitiveness" without indicating though where they located it, while the rest stated that they could not perceive any recognizable structure of the city: "It seemed I was missing some major element of the city's structure" (participant M11). The remaining 44% of the participants did notice the circularity of the wide roads, and 4 of them explained it as a "ring road" (participants M9, M13, M15 and M16). In (Brettel, 2006, p.47), it is concluded that "the more turns approximate an angle of 90 degrees, the more they are mentally categorised as turns". The low angularity of the wide roads could therefore the reason that a big sample of the participants failed to recognise that the wide roads were constantly changing their direction forcing them to run into endless circles. It is notable that one of the participants (F2) even commented on the RVF and RGF environments that the streets were "longer and straighter", apparently referring to the fact that no matter how much time was spent on them, the expected differentiation on the surroundings was never encountered.

It is rather noteworthy that the majority of the participants maintained their faith on the wide roads even if they realised that in the reverse model they probably forced them to run in circles. This realisation is evident in many of the written (see participants F5, F6, M11 commentary in appendix F) and verbal comments which were made during the experiment. Most of the realisations are not accompanied by a conscious observation of a specific attribute of the environment the participant inhabits and stay in an abstract state of an uncertified feeling. Participant M11 characteristically commented that the city "… looked huge, with wide streets that didn't seem to lead anywhere. I felt I was going in circles". The fact that he mentions that the wide streets didn't seem to lead anywhere, could signal his expectation of a change in the urban setting (i.e. city

district) that never occurred. Taking into consideration that all participants were aware of the imperfections of the simulation regarding the limited building textures because of the finite number of images available, it is fairly reasoned to assume that the indicators of the circularity of their route, wasn't the repetition of the buildings, but more likely the continuous angularity of the wide streets and the recurrences of the same urban configurations. The reason for their determination on the suitability of the wide roads could be explained in two possible ways. For example some of the participants, under the hypothesis of the imposition of the same rational hierarchy on the street network, noted that the circular wide roads may be some kind of "ring roads" and waited for a convenient vertical equally wide road in order to change their direction (M9, M15). Others testified that although they were not able to depict any structural rationality in the apparent continuous circularity of the wide roads, and in the fear of the complexity of the narrow street network, they believed they shouldn't try any alternative but stay instead on the wide roads (F1, M11). For these participants, this misplaced faith on the wide roads arises from a despondent need of choosing a route of reduced complexity, at any cost. Only a minority of 3 out of the 16 participants (M13, M15 and M16) consciously tried to redirect their route as soon as they noticed the circularity of the road they follow, by changing their attitude, staying loyal to their initial statement that their strategy is to keep moving along a straight line even if that meant they had to turn into a narrow street. This change in attitude requires the complete rejection of the hierarchic model strategy.

7.2 Reported obstacles

Many participants mentioned "dead-ends" as an obstructing factor in completing their task. Each time a dead-end is encountered, the walker is obligated to make a U-turn. Apart from the obvious inconvenience of having to re-devise his/her route, an additional, emerging side-effect could be identified by a finding in the psychological field. Miller, in (Miller, 1956), states that people are able to keep in their short term memory a maximum of seven items. A potential great number of u-turns along with the admittedly high complexity of the narrow street network, which occurs due to the fact that narrow roads may rapidly change

their direction, eventually makes it difficult to keep track of all sequential changes and results in a fast disorientation.

Another repeatedly reported hindering factor is the reoccurring of individual building textures hindered them from completing their task. The intensity with which this is mentioned certifies the importance of individual buildings in a way-finding task, and at the same time commissions them with a landmark function. Following Montello's classification model in (Montello, 2001), it is obvious that since the participants have no previous knowledge of the environment in which they navigate, they would firstly gain landmark knowledge of it. According to Cohen and Schuepfer's generic definition, "landmarks are unique visual configurations, which are used as course-maintaining aids", (Cohen and Schuepfer, 1980). Moreover, there may be a distinction between local and global landmarks according to the distance from where they can be firstly identified (Steck and Mallot, 2000, p.69). Illatively, it would be expected that the participants would try to make use of local (local spatial configurations and/or near by distinctive buildings) since global landmarks (distant buildings or landscape elements) where not included in the simulation.

Indeed, from their verbal commentary during the experience, it was confirmed that to a certain degree local landmarks provided guidance in achieving intermediate goals, for example when trying to break out of the maze-like organic centre which contained a high percentage of cul-de-sacs and required many 180° changes in direction. However, due to the reoccurrence of the same buildings, this practice was disorientating in many occasions, causing great confusion to the participants.

7.3 Statistical evaluation

In a more detailed exploration of the gathered statistical data and the rankings of the users, three data types (users, qualitative fields and environments) were extensively analysed for potential clustering properties, correlations and analogies between them.

Environments did not show any respectable differentiation apart from that in the field of their guests' success in completing their task, as mentioned in the above analysis. However, the RV environments are slightly graded as more

complex and irrational, scoring always 0.5 to 1 point higher than the RG ones on a scale of 1 to 9. Solution times for the RV environments were also longer than the RG ones. Also, environments that restricted vision were considered slightly larger than their counterparts, scoring 0.5 points higher in this field. In all other fields all six environments have the same quality footprint averaging around 5. However, in most fields there is a standard deviation of around 2, ranging from 1.24 to 2.48. The modal values in each field for all environments are very far from the respective mean values. These two facts offer an altered overall figure of the rankings, as it is obvious that different people evaluate very differently the environments, distributing the gamut of their rankings all over the spectrum.

	IntroRG			IntroRV		
TOTAL	SCORE	Deviation	Mode	SCORE	Deviation	Mode
simple / complex	5,06	1,98	7,00	5,63	1,93	8,00
regular / irregular	5,00	1,67	4,00	5,63	1,82	3,00
large / small	4,63	2,47	7,00	4,06	1,98	3,00
repetitive / alternating	4,56	2,00	2,00	6,25	1,24	6,00
rhythmic / arrhythmic	5,00	2,42	7,00	5,38	1,86	6,00
ordered / chaotic	4,75	2,21	3,00	4,69	2,24	3,00
predictable / unpredictable	5,94	2,05	7,00	5,50	1,93	3,00
familiar / unfamiliar	3,50	1,26	4,00	4,69	1,78	3,00
rational / irrational	4,50	2,07	2,00	4,38	1,78	3,00
interesting / monotonous	3,81	1,72	4,00	4,25	1,57	3,00
clearly structured / confusing	5,50	1,97	7,00	4,94	2,35	6,00

	RV			RG		
TOTAL	SCORE	Deviation	Mode	SCORE	Deviation	Mode
simple / complex	6,40	1,92	8,00	5,88	1,71	7,00
regular / irregular	5,13	2,13	7,00	4,63	1,59	5,00
large / small	3,07	2,02	3,00	2,75	1,73	2,00
repetitive / alternating	4,80	2,14	6,00	4,81	1,76	4,00
rhythmic / arrhythmic	5,00	2,07	7,00	4,88	1,78	6,00
ordered / chaotic	4,80	1,82	7,00	4,63	1,82	3,00
predictable / unpredictable	5,80	1,70	6,00	6,00	1,71	7,00
familiar / unfamiliar	5,20	2,04	3,00	4,50	1,97	3,00
rational / irrational	5,53	2,07	5,00	4,50	1,90	4,00
interesting / monotonous	3,80	2,54	1,00	3,88	2,13	5,00
clearly structured / confusing	4,80	2,48	5,00	5,44	2,25	7,00

	RGF			RVF		
TOTAL	SCORE	Deviation	Mode	SCORE	Deviation	Mode
simple / complex	5,31	2,02	3,00	6,31	1,78	7,00
regular / irregular	5,00	1,93	3,00	4,94	1,84	3,00
large / small	3,56	1,63	3,00	3,44	2,03	3,00
repetitive / alternating	4,69	1,82	5,00	4,25	2,27	2,00
rhythmic / arrhythmic	4,38	2,03	2,00	4,50	2,03	7,00
ordered / chaotic	4,00	1,83	4,00	4,63	1,89	3,00
predictable / unpredictable	4,69	2,33	4,00	5,69	1,66	7,00
familiar / unfamiliar	5,06	2,11	7,00	5,00	1,90	4,00
rational / irrational	4,44	2,03	3,00	5,44	1,79	4,00
interesting / monotonous	4,25	2,11	3,00	3,94	2,08	2,00
clearly structured / confusing	4,81	2,01	3,00	6,06	2,02	8,00

Regarding the examination of potential clustering between users provided no hard evidence of such an aspect, although the sample of 16 people is too small to reach to absolute conclusions. Grouping people according to their gender showed that males were more successful than females in their task (tables 2 and 3). Their rankings did not differ much, except on the apprehension of rhythm of the introRG environment. Females found introRG very arrhythmic rating it 3.25, while men rated it as high as 6.75. Minor differences on the order of roughly 2-2.5 are found in the rating regarding the perceived repetitiveness in the configuration of the environments, but nevertheless do not comprise an observable pattern. Other ways of grouping the participants: (according to their success in finding the edges, according to their evaluation ranking in each environment, and according to the number of changes between street networks), or correlating user statistics with rankings didn't demonstrate any noticeable patterns (see Appendix D).

	IntroRG		IntroRV		RG	
MALE - FEMALE comparison	Males	Females	Males	Females	Males	Females
simple / complex	5,75	4,38	6,38	4,88	5,88	5,88
regular / irregular	5,13	4,88	6,00	5,25	4,25	5,00
large / small	3,88	5,38	4,25	3,88	3,25	2,25
repetitive / alternating	5,75	3,38	6,50	6,00	5,88	3,75
rhythmic / arrhythmic	6,75	3,25	5,88	4,88	4,88	4,88
ordered / chaotic	5,38	4,13	4,75	4,63	4,50	4,75
predictable / unpredictable	6,50	5,38	5,75	5,25	5,25	6,75
familiar / unfamiliar	3,00	4,00	4,50	4,88	4,00	5,00
rational / irrational	3,88	5,13	4,00	4,75	4,00	5,00
interesting / monotonous	3,88	3,75	4,00	4,50	3,63	4,13
clearly structured / confusing	6,00	5,00	5,75	4,13	4,75	6,13
Time in environment (in minutes)	05:00	05:00	05:00	05:00	07:07	08:45
Environment size (in junctions)	6784	6784	6501	6501	6763	6725
Roads visited	26,75	23,25	32,38	37,63	74,13	79,88
Wide roads visited	6,38	3,50	17,13	17,88	53,38	45,25
Narrow roads visited	20,38	19,75	15,25	19,75	20,75	34,63
Wide roads visited %	23,26	10,48	48,04	44,95	73,57	55,81
Narrow roads visited %	76,74	89,52	51,96	55,05	26,43	44,19
Coverage %	0,39	0,34	0,50	0,58	1,10	1,19
Stops	9,50	7,63	8,13	9,25	9,50	13,75
Stops in Wide roads	1,00	0,13	2,25	1,63	2,75	2,25
Stops in Narrow roads	8,50	7,50	5,88	7,63	6,75	11,50
Stops in Wide roads %	8,44	4,17	33,17	17,84	36,53	25,08
Stops in Narrow roads %	91,56	95,83	66,83	82,16	63,47	74,92
Changes to Wide roads	1,75	0,75	2,38	1,75	2,25	3,13
Changes to Narrow roads	1,63	0,63	1,63	1,50	1,38	2,63
Changes	3,38	1,38	4,00	3,25	3,63	5,75
Task completed					1,00	0,38

Table 2: Male ≁ Female comparison in introRG, introRV and RG environments.

	RV		RGF		RVF	
MALE - FEMALE comparison	Males	Females	Males	Females	Males	Females
simple / complex	7,25	5,43	5,00	5,63	6,25	6,38
regular / irregular	5,25	5,00	4,88	5,13	5,00	4,88
large / small	3,13	3,00	3,38	3,75	3,50	3,38
repetitive / alternating	5,00	4,57	5,13	4,25	4,75	3,75
rhythmic / arrhythmic	5,25	4,71	4,25	4,50	5,00	4,00
ordered / chaotic	4,75	4,86	4,00	4,00	4,75	4,50
predictable / unpredictable	5,50	6,14	4,13	5,25	6,00	5,38
familiar / unfamiliar	5,75	4,57	4,75	5,38	5,63	4,38
rational / irrational	5,88	5,14	4,13	4,75	5,88	5,00
interesting / monotonous	4,13	3,43	3,88	4,63	4,38	3,50
clearly structured / confusing	4,50	5,14	4,50	5,13	6,63	5,50
Time in environment (in minutes)	09:27	09:36	06:59	07:07	09:46	10:00
Environment size (in junctions)	6535	6523	6757	6738	6545	6543
Roads visited	91,88	103,75	79,88	80,13	88,88	102,38
Wide roads visited	58,63	69,13	66,13	54,50	59,13	58,88
Narrow roads visited	33,25	34,63	13,75	25,63	29,75	43,50
Wide roads visited %	60,44	65,43	83,04	67,28	66,66	53,99
Narrow roads visited %	39,56	34,57	16,96	32,72	33,34	46,01
Coverage %	1,41	1,59	1,18	1,19	1,36	1,56
Stops	12,88	8,38	8,13	6,13	8,63	9,25
Stops in Wide roads	5,50	3,50	4,50	0,25	5,00	1,88
Stops in Narrow roads	7,38	4,88	3,63	5,88	3,63	7,38
Stops in Wide roads %	50,54	38,23	69,82	18,75	51,20	25,12
Stops in Narrow roads %	49,46	61,77	30,18	81,25	48,80	74,88
Changes to Wide roads	3,00	3,63	3,38	2,88	2,63	2,88
Changes to Narrow roads	2,38	3,38	2,50	2,13	2,13	2,25
Changes	5,38	7,00	5,88	5,00	4,75	5,13
Task completed	0,29	0,13	0,86	0,63	0,43	0,00

Table 3: Male ⋉ Female comparison in RV, RGF and RVF environments.

Finally, a fit Y to X analysis on the ranked qualitative fields was employed to search for analogies between them. Although their values are broadly spread all over the spectrum, their collapse to fit a first degree function 2D line shows traces of interesting correlations between several of them. Positive correlated pairs include order/chaotic and rational/irrational, order/chaotic and clearly structured/confusing, rational/irrational and clearly structured/confusing, regular/irregular and familiar/unfamiliar, and familiar/unfamiliar and rational/irrational, to name a few, while the most profound negatively correlated one is (remarkably enough) the repetitive/alternating and interesting/monotonous couple (figures 37-42). However, unjustified paradoxes arise when comparing the proportional pairs altogether as noticeable inconsistencies between them exist. This could have two possible explanations. It could be the result of the existence of a highly complex mental mechanism which produces ranking patterns which cannot be depicted by a simple fit Y to X function[10], especially on such a small yet high dimensional sample data space. Alternatively it could be claimed that the inconsistencies derive from the fact that when evaluating environmental attributes a stable pattern does not really exist, as this conscious activity could fall in the category of the much debated contrast between the stated and the revealed preferences.

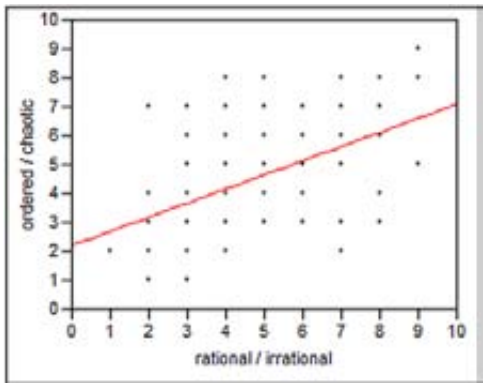

Figure 37: Bivariate Fit of ordered / chaotic by rational / irrational, taking into account all rankings.

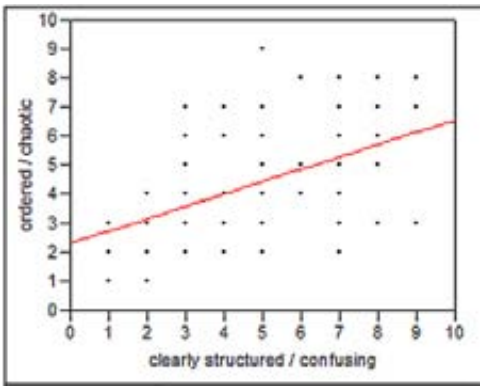

Figure 38: Bivariate Fit of ordered / chaotic by clearly structured / confusing, taking into account all rankings.

[10] Additional tactics of analysing the data made use of principle components in an attempt to collapse all data more efficiently. However this method did not as well provide clear correlations.

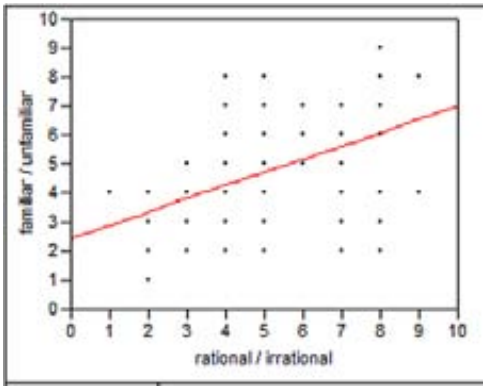

Figure 39: Bivariate Fit of familiar / unfamiliar by rational / irrational, taking into account all rankings.

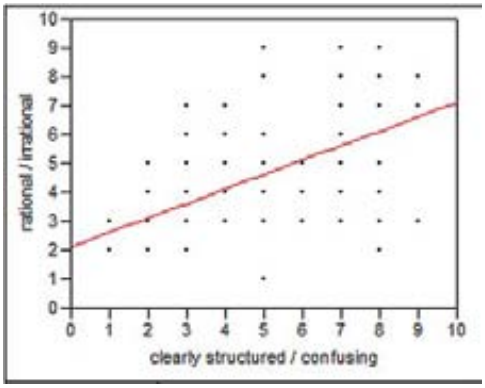

Figure 40: Bivariate Fit of rational / irrational by clearly structured / confusing, taking into account all rankings.

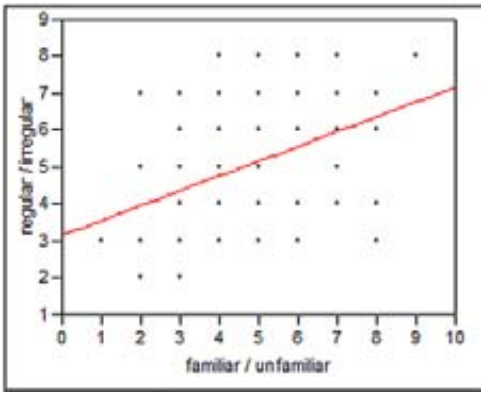

Figure 41: Bivariate Fit of regular / irregular by familiar / unfamiliar, taking into account all rankings.

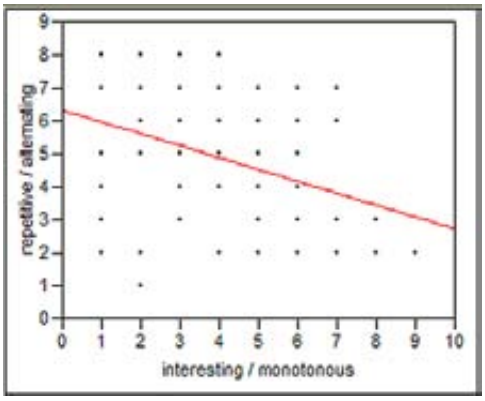

Figure 42: Bivariate Fit of repetitive / alternating by interesting / monotonous, taking into account all rankings.

On a higher level though, the great diversity in rankings follows the fact that the produced environments are indeed highly complex as they incorporate not few variables, reflecting to a certain degree the diversity of real cities. A possible explanation for the witnessed diversity is offered by Brettel which demonstrated that "one and the same city area can be perceived very differently depending on the journey through it" (Brettel, 2006, p.47). If this is true for one area, it is reasonable to claim that the general characteristics of otherwise similar environments are indeed perceived differently and always depend on the particular journey through them. .

8 Conclusions and Future Development

The thesis was set to explore the potential of creating a practical multipurpose application for the real time rule-based generation of urban structures and to address the fundamental principles in doing so. The developed system is able to generate on the fly a vast variety of different urban structures, which embody several measurable features such as junctions' density, street network patterns, building density and zoning by land value, calibrated by a set of parametrically configured local and global rules.

The generative tactic used for the realisation of the built environment required the breakdown of whole process into several conceptual steps. Assumptions about the structure of the built environment and practical simplifications were be made in order to produce a functional application. This approach, when compared to the actual crafting of a built environment, is exceptionally rewarding because it allows the effortless creation of several adjustable outcomes, directed by the designer's aims. The final program was enhanced with a set of additional recording and statistical routines for the analysis of the user's behaviour inside the produced environments, making it a practical assistant in built environment related experiments.

As illustrated, the design process of the Virtual Urbanity raised a number of issues both around urban growth and city structure. Set aside the logical simulation limitations, the program proved to be successful in providing clues regarding peoples' mental correlations between the fundamental characteristics and the function of basic urban elements. However, the greatest achievement of the developed application is its extendibility. The system is configured to make the addition and the modification of the generative rules easy, aiming both at the creation of even more detailed urban structures, or towards the direction of implementing more diversity in the existing simulations. The core mechanism of the application could be further developed by encoding more features of the urban environment. In terms of region identity, further registering of the buildings

according to their usage, age, architectural style and size would enable the more accurate representation of the different districts of the city, as well as the possibility of carrying out area identification experiments. Moreover, this clustering could be combined with a zone development function by assigning fitness values in each area according to their profile. This would lead to a more dynamic urban simulation with demolition routines apart from generative ones. Finally, a traffic driven evaluative routine based on the combination of geometrical measures and Space Syntax's analytical methods could be also introduced, in order to simulate a more realistic street network in respect to its integrity in general, and each road's traffic flow capacity in particular.

Summing up, this thesis demonstrated how a parametric tool can be developed in order to assist in the analysis of the complex nature of the built environment, expectedly contributing in architectural research and at the same time unveiling the current limitations and the full potential of this research technique.

Figure 43: Panoramic view of a virtual city.

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Additional resources:

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Factor 5 Inc., Available address: www.factor5.com (last visited on 27.08.2007)

Gamespot UK, Available address: uk.gamespot.com (last visited on 27.08.2007)

IGN Entertainment, Inc. Available address: uk.ign.com (last visited on 27.08.2007)

Insomniac Games Inc., Available address: www.insomniacgames.com (last visited on 27.08.2007)

Kikizo Ltd., Available address: www.kikizo.com (last visited on 27.08.2007)

New Urbanism, Available address: www.newurbanism.org (last visited on 27.08.2007)

Rockstar Games. Grand Theft Auto ⊢ San Andreas. Available address: www.rockstargames.com/sanandreas (last visited on 27.08.2007)

Appendix A: Next generation video games

Commercial interest in projects such as these presented in chapter 3 is prominent, as their methodologies and findings have several practical uses. The most obvious is on widely used public-access digital maps such as Google Earth and Google Maps, Microsoft Virtual Earth, and Nasa World Wind, helps in their enrichment with more detailed and informative 3D representations.

However there is another sector which may capitalise on the findings of urban (growth) studies and procedural modeling projects. The employment of the procedural techniques used in these studies is also the backbone of the design of the next generation of the 3D video games. Hi-tech video games that create virtual urban worlds, such as Team's Soho "Getaway" and Rockstar's "Grand Theft Auto", are characterized by their demanding nature in terms of processing power and memory capacity, mainly because of the heavy textured rendered graphics of their numerous on-screen objects. Their smooth performance yet relies on prerequisite state of the art hardware, hence there are already steps taken in this direction with the adoption of procedural graphics which are able to provide the same or even higher quality results with considerably less amount of data[11]. This could indicate a general move towards the more efficient procedural engines which promote a brand new concept in game design. By providing the generative rules instead of their output on every computational level, it is possible to end up with real time generation of the whole game world. Game developers such as Julian Eggebrecht of Factor 5 clearly talk about the simulation of worlds in real time, while Ted Price from Insomniac games takes it further by announcing the employment of sophisticated artificial intelligence systems to control different elements in games[12]. However, regarding solely the game environment, the shift from a heavily tested pre-designed layout to a procedural one holds a high probability of the production of a disastrous, user unfriendly environment in

[11]The first attempt towards this direction is Allegorithmic's ProFX graphic's toolkit for the professional authoring and on-the-fly generation of procedural textures in video games, which according to the company's claims, requires up to 99% less space. Available address: http://www.profxengine.com/resources/specifications/allegorithmic_profx_gamefest_2006.zip (last visited on 27.08.2007)

[12] Cited from the Sony Computer Entertainment Inc. 2005 PS3 Developer Interviews, which include comments from Game Development Executives: Ted Price of Insomniac Games, Kou Shibusawa of Keoi, Julian Eggebrecht of Factor 5, Hideo Kojima of Konami, and Sam Houser of Rockstar Games. Available address: http://www.kikizo.com/viewer/vidview_games.asp?games/e32005/kikizo_ps3_developer_interviews.wmv (last visited on 27.08.2007)

respect to its navigability. Dalton, in (Dalton, 2005) stretches the need for supporting environmental design in video gaming with space syntax analytic techniques, i.e. using real environment techniques to analyse virtual ones.

Appendix B: Additional Rulesets

Figure 44: Organic centre, free form wide roads, dense gridiron narrow street network.

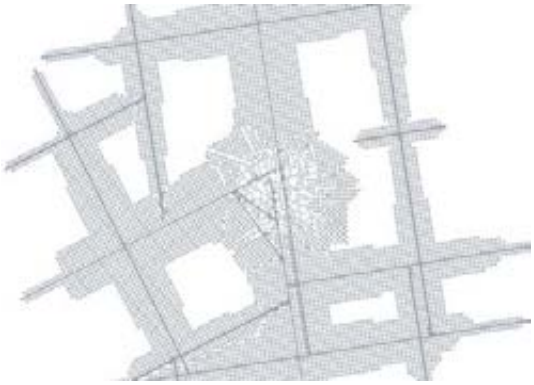


Figure 45: Organic centre, straight wide roads, dense gridiron narrow street network.

Figure 46: Organic centre, free form wide roads, tree form narrow street network.

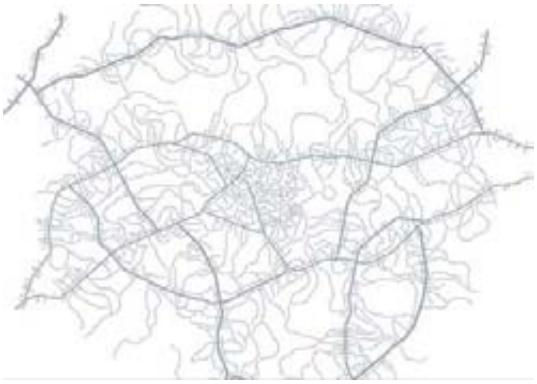


Figure 47: Organic centre, straight wide roads, free form narrow street network.

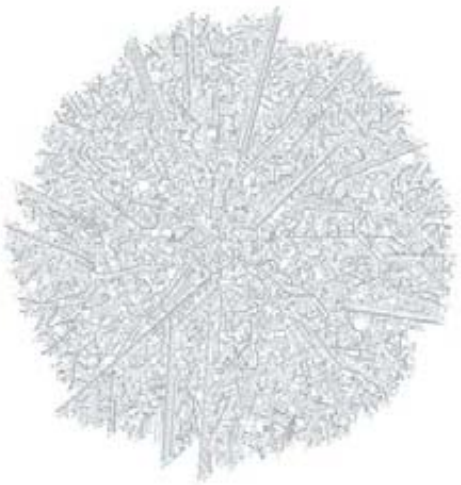


Figure 48: Unrestricted growth only with the linking routine as a global rule. Straight structures emerge and disappear in this dense and chaotic massive city.

Appendix C: Sample Survey Questionnaire

The Bartlett School of Graduate Studies
MSc AAC (Adaptive Architecture & Computation)
Virtual Urbanity Thesis Experiment

Personal information

Your personal details will be treated confidentially as the data will be used only for analysis and evaluation.

Name: Age: Gender: Occupation:

Are you familiar with immersive environments?

Are you familiar with video games?

Environment 1

Code: RG

In a climax of 1-9, rank **the structure** of the environment according to your experience.

simple	1	2	3	4	5	6	7	8	9	complex
regular	1	2	3	4	5	6	7	8	9	irregular
large	1	2	3	4	5	6	7	8	9	small
repetitive	1	2	3	4	5	6	7	8	9	alternating
rhythmic	1	2	3	4	5	6	7	8	9	arrhythmic
ordered	1	2	3	4	5	6	7	8	9	chaotic
predictable	1	2	3	4	5	6	7	8	9	unpredictable
familiar	1	2	3	4	5	6	7	8	9	unfamiliar
rational	1	2	3	4	5	6	7	8	9	irrational
interesting	1	2	3	4	5	6	7	8	9	monotonous
clearly structured	1	2	3	4	5	6	7	8	9	confusing

Environment 2

Code: RV

In a climax of 1-9, rank **the structure** of the environment according to your experience.

simple	1	2	3	4	5	6	7	8	9	complex
regular	1	2	3	4	5	6	7	8	9	irregular
large	1	2	3	4	5	6	7	8	9	small
repetitive	1	2	3	4	5	6	7	8	9	alternating
rhythmic	1	2	3	4	5	6	7	8	9	arrhythmic
ordered	1	2	3	4	5	6	7	8	9	chaotic
predictable	1	2	3	4	5	6	7	8	9	unpredictable
familiar	1	2	3	4	5	6	7	8	9	unfamiliar
rational	1	2	3	4	5	6	7	8	9	irrational
interesting	1	2	3	4	5	6	7	8	9	monotonous
clearly structured	1	2	3	4	5	6	7	8	9	confusing

(The pages of environments 3-6 are the same)

Environment 3 Code:

In a climax of 1-9, rank **the structure** of the environment according to your experience.

simple	1	2	3	4	5	6	7	8	9	complex
regular	1	2	3	4	5	6	7	8	9	irregular
large	1	2	3	4	5	6	7	8	9	small
repetitive	1	2	3	4	5	6	7	8	9	alternating
rhythmic	1	2	3	4	5	6	7	8	9	arrhythmic
ordered	1	2	3	4	5	6	7	8	9	chaotic
predictable	1	2	3	4	5	6	7	8	9	unpredictable
familiar	1	2	3	4	5	6	7	8	9	unfamiliar
rational	1	2	3	4	5	6	7	8	9	irrational
interesting	1	2	3	4	5	6	7	8	9	monotonous
clearly structured	1	2	3	4	5	6	7	8	9	confusing

Additional comments about the environment:

Explain your strategy in completing the task in a few words

Which elements / characteristics of the environment helped you in completing your task and in what way?

Which elements / characteristics of the environment hindered you from completing your task and in what way?

Appendix D: Tables of Data

introRG	F1	F2	F3	F4	F5	F6	F7	F8	M9	M10	M11	M12	M13	M14	M15	M16	SCORE	Deviation	Mode
simple / complex	3	8	5	2	5	4	2	6	7	7	7	7	7	3	4	4	5,06	1,98	7,00
regular / irregular	4	7	4	5	8	4	3	4	3	5	6	6	6	2	6	7	5,00	1,67	4,00
large / small	7	1	7	8	1	5	8	6	1	5	5	2	4	7	3	4	4,63	2,47	7,00
repetitive / alternating	2	7	2	5	3	2	2	4	5	7	8	6	4	6	6	4	4,56	2,00	2,00
rhythmic / arrhythmic	1	3	3	7	2	3	2	5	7	6	9	7	4	7	7	7	5,00	2,42	7,00
ordered / chaotic	1	3	3	6	9	2	3	6	7	5	7	6	7	4	4	3	4,75	2,21	3,00
predictable / unpredictable	5	8	4	7	9	2	2	6	7	7	6	7	4	8	7	6	5,94	2,05	7,00
familiar / unfamiliar	4	4	5	2	4	6	2	5	3	2	3	4	4	2	4	2	3,50	1,26	4,00
rational / irrational	2	4	6	4	9	7	3	6	3	4	2	5	7	5	3	2	4,50	2,07	2,00
interesting / monotonous	4	2	7	1	1	5	6	4	3	6	3	3	4	3	4	5	3,81	1,72	4,00
clearly structured / confusing	2	3	7	5	5	7	4	7	9	6	8	5	7	4	6	3	5,50	1,97	7,00
Time in environment (in minutes)	05:00	05:00	05:00	05:00	05:00	05:00	05:00	05:00	05:00	05:00	05:00	05:00	05:00	05:00	05:00	05:00	05:00	0,00	0,50
Environment size (in junctions)	6784	6784	6784	6784	6784	6784	6784	6784	6784	6784	6784	6784	6784	6784	6784	6784	6784	0,00	6784,00
Roads visited	23	33	34	11	16	9	21	39	35	28	22	23	18	27	30	31	25,00	8,68	23,00
Wide roads visited	0	17	11	0	0	0	0	0	0	12	0	10	0	13	0	16	4,94	6,78	0,00
Narrow roads visited	23	16	23	11	16	9	21	39	35	16	22	13	18	14	30	15	20,06	8,46	16,00
Wide roads visited %	0,00	51,52	32,35	0,00	0,00	0,00	0,00	0,00	0,00	42,86	0,00	43,48	0,00	48,15	0,00	51,61	16,87	22,88	0,00
Narrow roads visited %	100,00	48,48	67,65	100,00	100,00	100,00	100,00	100,00	100,00	57,14	100,00	56,52	100,00	51,85	100,00	48,39	83,13	22,88	100,00
Coverage %	0,34	0,49	0,50	0,16	0,24	0,13	0,31	0,57	0,52	0,41	0,32	0,34	0,27	0,40	0,44	0,46	0,37	0,13	0,34
Stops	10	3	6	6	11	16	6	3	5	12	14	13	11	4	8	9	8,56	4,05	6,00
Stops in Wide roads	0	1	0	0	0	0	0	0	0	4	0	3	0	0	0	1	0,56	1,21	0,00
Stops in Narrow roads	10	2	6	6	11	16	6	3	5	8	14	10	11	4	8	8	8,00	3,86	6,00
Stops in Wide roads %	0,00	33,33	0,00	0,00	0,00	0,00	0,00	0,00	0,00	33,33	0,00	23,08	0,00	0,00	0,00	11,11	6,30	12,23	0,00
Stops in Narrow roads %	100,00	66,67	100,00	100,00	100,00	100,00	100,00	100,00	100,00	66,67	100,00	76,92	100,00	100,00	100,00	88,89	93,70	12,23	100,00
Changes to Wide roads	0	3	3	0	0	0	0	0	0	3	0	2	0	4	0	5	1,25	1,77	0,00
Changes to Narrow roads	0	2	3	0	0	0	0	0	0	3	0	1	0	4	0	5	1,13	1,71	0,00
Changes	0	5	6	0	0	0	0	0	0	6	0	3	0	8	0	10	2,38	3,48	0,00
Task completed	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes			1,00

introRV	F1	F2	F3	F4	F5	F6	F7	F8	M9	M10	M11	M12	M13	M14	M15	M16	SCORE	Deviation	Mode
simple / complex	4	8	7	2	5	7	2	4	7	5	5	8	8	6	6	6	5,63	1,93	8,00
regular / irregular	3	8	6	4	7	7	3	4	3	6	5	8	8	5	6	7	5,63	1,82	3,00
large / small	5	1	7	5	3	5	2	3	3	7	4	2	6	2	7	3	4,06	1,98	3,00
repetitive / alternating	6	8	7	6	5	5	5	6	5	7	7	8	4	8	7	6	6,25	1,24	6,00
rhythmic / arrhythmic	7	2	6	5	3	8	5	3	5	6	8	8	4	6	6	4	5,38	1,86	6,00
ordered / chaotic	1	3	8	6	2	8	6	3	3	5	5	8	6	4	5	2	4,69	2,24	3,00
predictable / unpredictable	3	8	8	4	3	6	6	4	5	7	6	7	3	8	7	3	5,50	1,93	3,00
familiar / unfamiliar	3	5	5	6	3	8	5	4	3	3	3	6	7	7	5	2	4,69	1,78	3,00
rational / irrational	3	3	7	5	4	9	4	3	3	4	3	4	7	4	4	3	4,38	1,78	3,00
interesting / monotonous	7	2	4	3	5	5	5	5	3	7	3	4	6	2	3	4	4,25	1,57	3,00
clearly structured / confusing	1	2	9	4	2	8	4	3	5	6	6	6	8	6	6	3	4,94	2,35	6,00
Time in environment (in minutes)	05:00	05:00	05:00	05:00	05:00	05:00	05:00	05:00	05:00	05:00	05:00	05:00	05:00	05:00	05:00	05:00	05:00	0,00	0,50
Environment size (in junctions)	6501	6501	6501	6501	6501	6501	6501	6501	6501	6501	6501	6501	6501	6501	6501	6501	6501	0,00	6501,00
Roads visited	36	37	24	43	44	28	32	57	51	35	16	40	17	38	25	37	35,00	11,23	37,00
Wide roads visited	5	27	7	23	18	16	7	40	40	12	7	26	3	21	11	17	17,50	11,52	7,00
Narrow roads visited	31	10	17	20	26	12	25	17	11	23	9	14	14	17	14	20	17,50	6,28	17,00
Wide roads visited %	13,89	72,97	29,17	53,49	40,91	57,14	21,88	70,18	78,43	34,29	43,75	65,00	17,65	55,26	44,00	45,95	46,50	19,76	#N/A
Narrow roads visited %	86,11	27,03	70,83	46,51	59,09	42,86	78,13	29,82	21,57	65,71	56,25	35,00	82,35	44,74	56,00	54,05	53,50	19,76	#N/A
Coverage %	0,55	0,57	0,37	0,66	0,68	0,43	0,49	0,88	0,78	0,54	0,25	0,62	0,26	0,58	0,38	0,57	0,54	0,17	0,57
Stops	13	6	8	6	10	21	6	4	12	6	4	6	17	5	13	2	8,69	5,22	6,00
Stops in Wide roads	0	3	1	1	1	6	0	1	8	2	2	3	0	0	2	1	1,94	2,24	1,00
Stops in Narrow roads	13	3	7	5	9	15	6	3	4	4	2	3	17	5	11	1	6,75	4,86	3,00
Stops in Wide roads %	0,00	50,00	12,50	16,67	10,00	28,57	0,00	25,00	66,67	33,33	50,00	50,00	0,00	0,00	15,38	50,00	25,51	22,15	0,00
Stops in Narrow roads %	100,00	50,00	87,50	83,33	90,00	71,43	100,00	75,00	33,33	66,67	50,00	50,00	100,00	100,00	84,62	50,00	74,49	22,15	100,00
Changes to Wide roads	1	3	1	2	2	1	1	3	2	3	3	3	1	3	1	3	2,06	0,93	3,00
Changes to Narrow roads	1	2	1	2	2	1	1	2	1	3	2	2	0	2	0	3	1,56	0,89	2,00
Changes	2	5	2	4	4	2	2	5	3	6	5	5	1	5	1	6	3,63	1,82	5,00
Task completed	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes			1,00

RG	F1	F2	F3	F4	F5	F6	F7	F8	M9	M10	M11	M12	M13	M14	M15	M16	SCORE	Deviation	Mode
simple / complex	7	8	5	6	3	4	7	7	7	4	5	7	8	8	4	4	5,88	1,71	7,00
regular / irregular	4	7	5	5	2	4	7	6	5	5	3	6	2	6	4	3	4,63	1,59	5,00
large / small	2	2	1	2	2	5	2	2	1	6	3	1	6	2	2	5	2,75	1,73	2,00
repetitive / alternating	2	6	4	4	3	2	5	4	5	7	7	4	4	8	6	6	4,81	1,76	4,00
rhythmic / arrhythmic	2	3	6	7	3	7	5	6	3	6	7	5	4	6	6	2	4,88	1,78	6,00
ordered / chaotic	2	3	6	6	5	6	7	3	7	7	4	6	3	3	4	2	4,63	1,82	3,00
predictable / unpredictable	8	7	8	6	7	6	7	5	7	3	6	4	8	7	4	3	6,00	1,71	7,00
familiar / unfamiliar	3	4	2	7	3	7	6	8	5	5	3	6	3	4	5	1	4,50	1,97	3,00
rational / irrational	3	5	3	4	7	8	6	4	5	3	2	4	8	4	4	2	4,50	1,90	4,00
interesting / monotonous	5	2	3	1	7	8	1	6	3	5	3	5	5	1	4	3	3,88	2,13	5,00
clearly structured / confusing	7	4	8	3	8	8	4	7	7	5	3	5	9	3	4	2	5,44	2,25	7,00
Time in environment (in minutes)	10:00	08:16	10:00	06:32	05:14	10:00	10:00	10:00	09:12	05:21	05:25	07:34	10:00	07:58	05:07	06:20	07:56	0,00	0,01
Environment size (in junctions)	6639	6803	6623	6683	6569	6686	6893	6906	6949	6562	6716	6568	6751	6876	6993	6685	6744	142,63	#N/A
Roads visited	47	104	96	71	73	66	84	98	97	70	69	77	53	93	57	77	77,00	17,12	77,00
Wide roads visited	18	62	48	57	64	11	58	44	54	63	50	66	39	54	48	53	49,31	15,54	48,00
Narrow roads visited	29	42	48	14	9	55	26	54	43	7	19	11	14	39	9	24	27,69	16,91	14,00
Wide roads visited %	38,30	59,62	50,00	80,28	87,67	16,67	69,05	44,90	55,67	90,00	72,46	85,71	73,58	58,06	84,21	68,83	64,69	20,28	#N/A
Narrow roads visited %	61,70	40,38	50,00	19,72	12,33	83,33	30,95	55,10	44,33	10,00	27,54	14,29	26,42	41,94	15,79	31,17	35,31	20,28	#N/A
Coverage %	0,71	1,53	1,45	1,06	1,11	0,99	1,22	1,42	1,40	1,07	1,03	1,17	0,79	1,35	0,82	1,15	1,14	0,25	#N/A
Stops	26	6	18	15	3	28	2	12	17	6	4	6	20	4	9	10	11,63	8,22	6,00
Stops in Wide roads	3	1	4	7	0	1	2	0	0	4	1	3	5	2	5	2	2,50	2,07	1,00
Stops in Narrow roads	23	5	14	8	3	27	0	12	17	2	3	3	15	2	4	8	9,13	8,10	3,00
Stops in Wide roads %	11,54	16,67	22,22	46,67	0,00	3,57	100,00	0,00	0,00	66,67	25,00	50,00	25,00	50,00	55,56	20,00	30,81	28,39	0,00
Stops in Narrow roads %	88,46	83,33	77,78	53,33	100,00	96,43	0,00	100,00	100,00	33,33	75,00	50,00	75,00	50,00	44,44	80,00	69,19	28,39	100,00
Changes to Wide roads	2	4	6	2	3	2	4	2	1	2	3	2	1	5	2	2	2,69	1,40	2,00
Changes to Narrow roads	2	4	6	1	2	1	3	2	0	1	2	1	0	4	1	2	2,00	1,59	2,00
Changes	4	8	12	3	5	3	7	4	1	3	5	3	1	9	3	4	4,69	2,99	3,00
Task completed	No	Yes	No	Yes	Yes	No	No	No	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	0,67		1,00

Table 6: RG environment Ranking scores and movement statistics, all environments

RV	F1	F2	F3	F4	F5	F6	F7	F8	M9	M10	M11	M12	M13	M14	M15	M16	SCORE	Deviation	Mode
simple / complex		8	4	4	5	3	8	6	7	8	8	4	8	9	7	7	6,40	1,92	8,00
regular / irregular		7	2	5	2	5	7	7	3	7	3	4	8	3	7	7	5,13	2,13	7,00
large / small		2	1	3	2	3	7	3	3	7	1	1	6	2	3	2	3,07	2,02	3,00
repetitive / alternating		6	3	2	3	6	6	6	5	2	2	3	5	8	7	8	4,80	2,14	6,00
rhythmic / arrhythmic		3	2	3	8	7	6	4	7	7	7	3	6	4	6	2	5,00	2,07	7,00
ordered / chaotic		5	2	4	7	3	6	7	3	7	5	4	7	4	6	2	4,80	1,82	7,00
predictable / unpredictable		8	6	5	7	6	6	5	3	7	7	6	3	8	7	3	5,80	1,70	6,00
familiar / unfamiliar		5	3	4	3	3	6	8	3	8	8	8	6	5	5	3	5,20	2,04	3,00
rational / irrational		5	3	5	7	5	7	4	3	8	9	8	7	5	5	2	5,53	2,07	5,00
interesting / monotonous		2	1	4	8	3	2	4	1	8	7	5	6	1	4	1	3,80	2,54	1,00
clearly structured / confusing		5	3	5	9	5	4	5	1	8	7	7	3	2	7	1	4,80	2,48	5,00
Time in environment (in minutes)	10:00	10:00	10:00	06:48	10:00	10:00	10:00	10:00	05:36	10:00	10:00	10:00	10:00	10:00	10:00	10:00	09:32	0,00	0,01
Environment size (in junctions)	6554	6503	6522	6511	6526	6523	6508	6533	6533	6523	6539	6511	6519	6573	6502	6580	6529	23,12	6511,00
Roads visited	99	141	98	76	114	97	118	87	71	97	98	66	90	118	104	91	97,81	19,00	98,00
Wide roads visited	88	102	48	41	94	70	72	38	20	93	73	21	65	108	61	28	63,88	28,79	#N/A
Narrow roads visited	11	39	50	35	20	27	46	49	51	4	25	45	25	10	43	63	33,94	17,12	25,00
Wide roads visited %	88,89	72,34	48,98	53,95	82,46	72,16	61,02	43,68	28,17	95,88	74,49	31,82	72,22	91,53	58,65	30,77	62,94	21,96	#N/A
Narrow roads visited %	11,11	27,66	51,02	46,05	17,54	27,84	38,98	56,32	71,83	4,12	25,51	68,18	27,78	8,47	41,35	69,23	37,06	21,96	#N/A
Coverage %	1,51	2,17	1,50	1,17	1,75	1,49	1,81	1,33	1,09	1,49	1,50	1,01	1,38	1,80	1,60	1,38	1,50	0,29	1,49
Stops	6	2	7	11	4	19	5	13	12	5	14	12	15	9	15	21	10,63	5,51	5,00
Stops in Wide roads	4	0	2	10	1	6	2	3	7	5	6	3	9	6	7	1	4,50	2,97	6,00
Stops in Narrow roads	2	2	5	1	3	13	3	10	5	0	8	9	6	3	8	20	6,13	5,16	3,00
Stops in Wide roads %	66,67	0,00	28,57	90,91	25,00	31,58	40,00	23,08	58,33	100,00	42,86	25,00	60,00	66,67	46,67	4,76	44,38	28,14	66,67
Stops in Narrow roads %	33,33	100,00	71,43	9,09	75,00	68,42	60,00	76,92	41,67	0,00	57,14	75,00	40,00	33,33	53,33	95,24	55,62	28,14	33,33
Changes to Wide roads	3	4	5	2	4	3	3	5	1	3	2	4	4	3	4	3	3,31	1,08	3,00
Changes to Narrow roads	3	3	4	2	4	3	3	5	1	2	1	4	3	2	3	3	2,88	1,09	3,00
Changes	6	7	9	4	8	6	6	10	2	5	3	8	7	5	7	6	6,19	2,17	6,00
Task completed	No	No	No	Yes	No	No	No	No	Yes	No	No	Yes	No	No	No	No	0,20		0,00

Table 7: RV environment Ranking scores and movement statistics, all environments

RGF	F1	F2	F3	F4	F5	F6	F7	F8	M9	M10	M11	M12	M13	M14	M15	M16	SCORE	Deviation	Mode
simple / complex	3	5	4	4	9	7	6	7	5	6	4	3	8	8	3	3	5,31	2,02	3,00
regular / irregular	3	4	2	6	7	7	6	6	3	7	3	4	8	7	4	3	5,00	1,93	3,00
large / small	3	3	2	3	4	5	8	2	3	3	3	3	5	1	5	4	3,56	1,63	3,00
repetitive / alternating	2	5	4	5	7	2	5	4	5	7	7	2	4	7	6	3	4,69	1,82	5,00
rhythmic / arrhythmic	1	2	5	5	5	7	5	6	7	4	2	2	6	7	4	2	4,38	2,03	2,00
ordered / chaotic	3	2	3	4	4	8	5	3	3	4	4	2	8	5	4	2	4,00	1,83	4,00
predictable / unpredictable	1	4	3	7	8	7	7	5	5	4	4	2	3	9	4	2	4,69	2,33	4,00
familiar / unfamiliar	1	5	2	7	7	8	5	8	3	7	4	4	4	7	5	4	5,06	2,11	7,00
rational / irrational	2	3	8	5	6	5	5	4	3	6	3	3	8	6	3	1	4,44	2,03	3,00
interesting / monotonous	9	3	3	4	2	7	3	6	3	6	2	4	5	1	4	6	4,25	2,11	3,00
clearly structured / confusing	2	4	8	3	7	7	3	7	5	5	3	3	8	3	4	5	4,81	2,01	3,00
Time in environment (in minutes)	07:59	04:11	10:00	10:00	05:48	10:00	04:12	04:47	05:00	10:00	04:08	04:13	10:00	08:38	05:16	08:36	07:03	0,00	0,01
Environment size (in junctions)	6696	6675	6934	6821	6737	6622	6789	6630	6732	6992	6513	6503	6748	6966	6761	6838	6747	143,85	#N/A
Roads visited	113	56	84	123	78	58	67	62	67	123	59	65	64	104	69	88	80,00	23,40	123,00
Wide roads visited	88	49	48	75	64	0	66	46	59	115	58	58	34	71	69	65	60,31	24,57	58,00
Narrow roads visited	25	7	36	48	14	58	1	16	8	8	1	7	30	33	0	23	19,69	17,48	7,00
Wide roads visited %	77,88	87,50	57,14	60,98	82,05	0,00	98,51	74,19	88,06	93,50	98,31	89,23	53,13	68,27	100,00	73,86	75,16	24,92	#N/A
Narrow roads visited %	22,12	12,50	42,86	39,02	17,95	100,00	1,49	25,81	11,94	6,50	1,69	10,77	46,88	31,73	0,00	26,14	24,84	24,92	#N/A
Coverage %	1,69	0,84	1,21	1,80	1,16	0,88	0,99	0,94	1,00	1,76	0,91	1,00	0,95	1,49	1,02	1,29	1,18	0,33	#N/A
Stops	4	4	7	5	2	24	1	2	6	9	4	1	22	8	6	9	7,13	6,72	4,00
Stops in Wide roads	0	0	0	0	0	0	1	1	6	8	4	1	8	0	6	3	2,38	3,03	0,00
Stops in Narrow roads	4	4	7	5	2	24	0	1	0	1	0	0	14	8	0	6	4,75	6,44	0,00
Stops in Wide roads %	0,00	0,00	0,00	0,00	0,00	0,00	100,00	50,00	100,00	88,89	100,00	100,00	36,36	0,00	100,00	33,33	44,29	45,79	0,00
Stops in Narrow roads %	100,00	100,00	100,00	100,00	100,00	100,00	0,00	50,00	0,00	11,11	0,00	0,00	63,64	100,00	0,00	66,67	55,71	45,79	100,00
Changes to Wide roads	4	2	6	5	2	0	2	2	3	7	2	2	3	5	1	4	3,13	1,89	2,00
Changes to Narrow roads	3	1	5	4	1	0	1	2	2	6	1	2	2	4	0	3	2,31	1,74	1,00
Changes	7	3	11	9	3	0	3	4	5	13	3	4	5	9	1	7	5,44	3,63	3,00
Task completed	Yes	Yes	No	No	Yes	No	Yes	Yes	Yes	No	Yes	Yes	No	Yes	Yes	Yes	0,73		1,00

Table 8: RGF environment Ranking scores and movement statistics, all environments

RVF	F1	F2	F3	F4	F5	F6	F7	F8	M9	M10	M11	M12	M13	M14	M15	M16	SCORE	Deviation	Mode
simple / complex	5	5	7	8	8	3	8	7	7	4	7	6	8	8	7	3	6,31	1,78	7,00
regular / irregular	5	5	7	6	2	3	8	3	3	4	6	7	3	7	6	4	4,94	1,84	3,00
large / small	1	2	3	3	2	5	8	3	1	3	7	3	6	2	3	3	3,44	2,03	3,00
repetitive / alternating	1	3	2	5	2	2	8	7	5	6	2	6	4	7	6	2	4,25	2,27	2,00
rhythmic / arrhythmic	1	3	2	7	4	5	7	3	5	7	2	6	4	3	6	7	4,50	2,03	7,00
ordered / chaotic	3	4	6	2	7	4	7	3	3	3	3	6	8	3	6	6	4,63	1,89	3,00
predictable / unpredictable	7	6	3	5	5	5	8	4	7	4	5	7	3	8	7	7	5,69	1,66	7,00
familiar / unfamiliar	4	5	3	5	2	3	9	4	3	5	7	7	6	4	6	7	5,00	1,90	4,00
rational / irrational	4	5	3	4	7	5	8	4	7	4	7	8	8	3	5	5	5,44	1,79	4,00
interesting / monotonous	2	3	1	2	6	5	2	7	5	7	5	6	4	1	5	2	3,94	2,08	2,00
clearly structured / confusing	8	6	4	3	8	5	5	5	7	5	9	7	8	2	7	8	6,06	2,02	8,00
Time in environment (in minutes)	10:00	10:00	10:00	10:00	10:00	10:00	10:00	10:00	10:00	10:00	10:00	10:00	10:00	08:11	10:00	10:00	09:53	0,00	0,01
Environment size (in junctions)	6540	6574	6527	6501	6565	6525	6546	6564	6594	6557	6548	6564	6501	6568	6517	6509	6544	27,96	6501,00
Roads visited	84	143	111	111	107	64	109	90	58	118	69	82	66	102	119	97	95,63	23,76	111,00
Wide roads visited	60	129	67	80	40	2	31	62	51	99	60	19	46	23	112	63	59,00	34,02	60,00
Narrow roads visited	24	14	44	31	67	62	78	28	7	19	9	63	20	79	7	34	36,63	25,45	7,00
Wide roads visited %	71,43	90,21	60,36	72,07	37,38	3,13	28,44	68,89	87,93	83,90	86,96	23,17	69,70	22,55	94,12	64,95	60,32	28,43	#N/A
Narrow roads visited %	28,57	9,79	39,64	27,93	62,62	96,88	71,56	31,11	12,07	16,10	13,04	76,83	30,30	77,45	5,88	35,05	39,68	28,43	#N/A
Coverage %	1,28	2,18	1,70	1,71	1,63	0,98	1,67	1,37	0,88	1,80	1,05	1,25	1,02	1,55	1,83	1,49	1,46	0,36	#N/A
Stops	7	4	9	7	5	24	1	17	6	9	9	4	20	5	2	14	8,94	6,57	9,00
Stops in Wide roads	1	4	2	1	1	3	0	3	1	7	4	0	13	1	2	12	3,44	3,97	1,00
Stops in Narrow roads	6	0	7	6	4	21	1	14	5	2	5	4	7	4	0	2	5,50	5,35	4,00
Stops in Wide roads %	14,29	100,00	22,22	14,29	20,00	12,50	0,00	17,65	16,67	77,78	44,44	0,00	65,00	20,00	100,00	85,71	38,16	35,35	14,29
Stops in Narrow roads %	85,71	0,00	77,78	85,71	80,00	87,50	100,00	82,35	83,33	22,22	55,56	100,00	35,00	80,00	0,00	14,29	61,84	35,35	85,71
Changes to Wide roads	4	5	3	3	2	2	2	2	2	6	3	2	2	1	3	2	2,75	1,29	2,00
Changes to Narrow roads	4	4	2	2	2	1	1	2	1	5	3	2	1	1	2	2	2,19	1,22	2,00
Changes	8	9	5	5	4	3	3	4	3	11	6	4	3	2	5	4	4,94	2,51	4,00
Task completed	No	No	No	No	No	No	No	No	No	No	No	Yes	No	Yes	No	Yes	0,20		

Table 9: RVF environment Ranking scores and movement statistics, all environments

	IntroRG		IntroRV		RG		RV		RGF		RVF	
TOTAL	SCORE	Deviation	SCORE	Deviation	SCORE	Deviation	SCORE	Deviation	SCORE	Deviation	SCORE	Deviation
simple / complex	5,06	1,98	5,63	1,93	5,88	1,71	6,40	1,92	5,31	2,02	6,31	1,78
regular / irregular	5,00	1,67	5,63	1,82	4,63	1,59	5,13	2,13	5,00	1,93	4,94	1,84
large / small	4,63	2,47	4,06	1,98	2,75	1,73	3,07	2,02	3,56	1,63	3,44	2,03
repetitive / alternating	4,56	2,00	6,25	1,24	4,81	1,76	4,80	2,14	4,69	1,82	4,25	2,27
rhythmic / arrhythmic	5,00	2,42	5,38	1,86	4,88	1,78	5,00	2,07	4,38	2,03	4,50	2,03
ordered / chaotic	4,75	2,21	4,69	2,24	4,63	1,82	4,80	1,82	4,00	1,83	4,63	1,89
predictable / unpredictable	5,94	2,05	5,50	1,93	6,00	1,71	5,80	1,70	4,69	2,33	5,69	1,66
familiar / unfamiliar	3,50	1,26	4,69	1,78	4,50	1,97	5,20	2,04	5,06	2,11	5,00	1,90
rational / irrational	4,50	2,07	4,38	1,78	4,50	1,90	5,53	2,07	4,44	2,03	5,44	1,79
interesting / monotonous	3,81	1,72	4,25	1,57	3,88	2,13	3,80	2,54	4,25	2,11	3,94	2,08
clearly structured / confusing	5,50	1,97	4,94	2,35	5,44	2,25	4,80	2,48	4,81	2,01	6,06	2,02
Time in environment (in minutes)	05:00	00:00	05:00	00:00	07:56	02:00	09:32	01:19	07:03	02:32	09:53	00:27
Environment size (in junctions)	6784	0,00	6501	0,00	6744	142,63	6529	23,12	6747	143,85	6544	27,96
Roads visited	25,00	8,68	35,00	11,23	77,00	17,12	97,81	19,00	80,00	23,40	95,63	23,76
Wide roads visited	4,94	6,78	17,50	11,52	49,31	15,54	63,88	28,79	60,31	24,57	59,00	34,02
Narrow roads visited	20,06	8,46	17,50	6,28	27,69	16,91	33,94	17,12	19,69	17,48	36,63	25,45
Wide roads visited %	16,87	22,88	46,50	19,76	64,69	20,28	62,94	21,96	75,16	24,92	60,32	28,43
Narrow roads visited %	83,13	22,88	53,50	19,76	35,31	20,28	37,06	21,96	24,84	24,92	39,68	28,43
Coverage %	0,37	0,13	0,54	0,17	1,14	0,25	1,50	0,29	1,18	0,33	1,46	0,36
Stops	8,56	4,05	8,69	5,22	11,63	8,22	10,63	5,51	7,13	6,72	8,94	6,57
Stops in Wide roads	0,56	1,21	1,94	2,24	2,50	2,07	4,50	2,97	2,38	3,03	3,44	3,97
Stops in Narrow roads	8,00	3,86	6,75	4,86	9,13	8,10	6,13	5,16	4,75	6,44	5,50	5,35
Stops in Wide roads %	6,30	12,23	25,51	22,15	30,81	28,39	44,38	28,14	44,29	45,79	38,16	35,35
Stops in Narrow roads %	93,70	12,23	74,49	22,15	69,19	28,39	55,62	28,14	55,71	45,79	61,84	35,35
Changes to Wide roads	1,25	1,77	2,06	0,93	2,69	1,40	3,31	1,08	3,13	1,89	2,75	1,29
Changes to Narrow roads	1,13	1,71	1,56	0,89	2,00	1,59	2,88	1,09	2,31	1,74	2,19	1,22
Changes	2,38	3,48	3,63	1,82	4,69	2,99	6,19	2,17	5,44	3,63	4,94	2,51
Task completed		1,00		1,00	0,67		0,20		0,73		0,20	

Table 10: Total Ranking scores and movement statistics, all environments

	Intro RG		Intro RV		RG		RV		RGF		RVF	
Comparison according to number of changes	0 changes	>0 changes	<6 changes	>6 changes	<6 changes	>6 changes	<6 changes	>6 changes	<6 changes	>6 changes	<6 changes	>6 changes
simple / complex	4,70	5,20	5,64	5,50	5,36	6,67	7,20	5,78	5,78	5,00	6,67	5,50
regular / irregular	4,90	4,80	5,50	6,50	4,09	6,00	4,20	5,44	5,33	5,00	4,92	5,00
large / small	4,80	5,00	3,93	5,00	3,18	1,67	3,20	3,11	4,22	2,60	3,50	5,00
repetitive / alternating	4,10	5,00	6,21	6,50	4,73	5,67	3,80	5,22	4,67	5,20	4,67	4,00
rhythmic / arrhythmic	4,70	6,00	5,43	5,00	5,09	5,67	5,60	4,89	4,89	4,60	4,92	4,50
ordered / chaotic	5,20	4,20	4,86	3,50	4,82	5,33	4,60	4,89	4,56	3,60	5,08	3,00
predictable / unpredictable	5,50	6,40	5,57	5,00	5,36	7,33	6,00	5,44	5,00	5,00	5,75	4,50
familiar / unfamiliar	3,70	3,00	5,00	2,50	4,82	4,00	5,60	5,00	5,33	5,40	4,92	6,00
rational / irrational	4,60	4,40	4,50	3,50	4,64	4,33	6,00	5,33	4,44	5,20	5,58	5,50
interesting / monotonous	3,50	4,80	4,07	5,50	4,55	1,67	4,20	3,78	4,00	4,00	3,83	6,00
clearly structured / confusing	6,00	5,00	5,00	4,50	5,55	5,00	4,60	4,89	5,22	4,80	5,75	7,00

Table 11: Clustering according to number of changes between the wide and narrow network

Variable	by Variable	Correlation	Count	Signif Prob
clearly structured / confusing	rational / irrational	0,5574	95	0,0000
rational / irrational	ordered / chaotic	0,4925	95	0,0000
regular / irregular	simple / complex	0,4873	95	0,0000
clearly structured / confusing	ordered / chaotic	0,4745	95	0,0000
rational / irrational	familiar / unfamiliar	0,4649	95	0,0000
ordered / chaotic	rhythmic / arrhythmic	0,4293	95	0,0000
familiar / unfamiliar	regular / irregular	0,4223	95	0,0000
clearly structured / confusing	interesting / monotonous	0,3607	95	0,0003
familiar / unfamiliar	ordered / chaotic	0,3430	95	0,0007
predictable / unpredictable	simple / complex	0,3317	95	0,0010
ordered / chaotic	regular / irregular	0,3295	95	0,0011
familiar / unfamiliar	simple / complex	0,3172	95	0,0017
rhythmic / arrhythmic	repetitive / alternating	0,3147	95	0,0019
repetitive / alternating	regular / irregular	0,3080	95	0,0024
rational / irrational	simple / complex	0,3066	95	0,0025
predictable / unpredictable	rhythmic / arrhythmic	0,3042	95	0,0027
predictable / unpredictable	ordered / chaotic	0,3001	95	0,0031
repetitive / alternating	simple / complex	0,2930	95	0,0040
ordered / chaotic	simple / complex	0,2737	95	0,0073
predictable / unpredictable	repetitive / alternating	0,2530	95	0,0134
clearly structured / confusing	predictable / unpredictable	0,2478	95	0,0155
clearly structured / confusing	familiar / unfamiliar	0,2463	95	0,0161
rational / irrational	predictable / unpredictable	0,2420	95	0,0181
clearly structured / confusing	rhythmic / arrhythmic	0,2395	95	0,0194
interesting / monotonous	large / small	0,2314	95	0,0241
predictable / unpredictable	regular / irregular	0,2237	95	0,0293
interesting / monotonous	rational / irrational	0,2151	95	0,0363
familiar / unfamiliar	rhythmic / arrhythmic	0,2059	95	0,0453
familiar / unfamiliar	predictable / unpredictable	0,1923	95	0,0619
clearly structured / confusing	simple / complex	0,1721	95	0,0953
rational / irrational	rhythmic / arrhythmic	0,1625	95	0,1157
rhythmic / arrhythmic	simple / complex	0,1457	95	0,1589
rational / irrational	large / small	0,1438	95	0,1644
rational / irrational	regular / irregular	0,1356	95	0,1903
rhythmic / arrhythmic	large / small	0,1352	95	0,1914
ordered / chaotic	large / small	0,1330	95	0,1987
rhythmic / arrhythmic	regular / irregular	0,1186	95	0,2522
clearly structured / confusing	large / small	0,0894	95	0,3890
interesting / monotonous	familiar / unfamiliar	0,0859	95	0,4078
interesting / monotonous	rhythmic / arrhythmic	0,0657	95	0,5272
large / small	regular / irregular	0,0491	95	0,6367
ordered / chaotic	repetitive / alternating	0,0414	95	0,6902
familiar / unfamiliar	large / small	0,0397	95	0,7027
interesting / monotonous	ordered / chaotic	0,0290	95	0,7804
familiar / unfamiliar	repetitive / alternating	0,0072	95	0,9445
repetitive / alternating	large / small	-0,0350	95	0,7365
clearly structured / confusing	regular / irregular	-0,0548	95	0,5976
large / small	simple / complex	-0,1381	95	0,1821
interesting / monotonous	simple / complex	-0,1767	95	0,0866
predictable / unpredictable	large / small	-0,1841	95	0,0741
interesting / monotonous	regular / irregular	-0,1997	95	0,0524
rational / irrational	repetitive / alternating	-0,2291	95	0,0255
interesting / monotonous	predictable / unpredictable	-0,3126	95	0,0020
clearly structured / confusing	repetitive / alternating	-0,3189	95	0,0016
interesting / monotonous	repetitive / alternating	-0,3683	95	0,0002

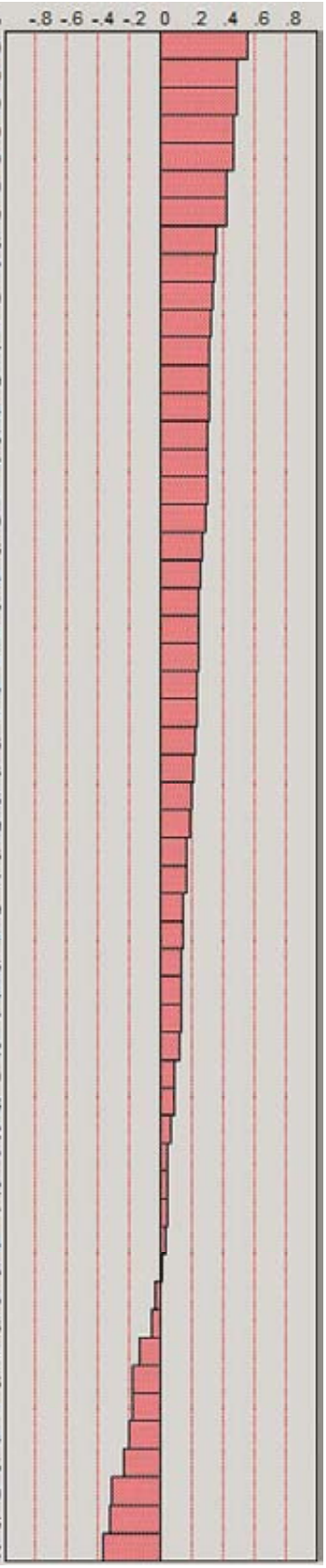


Figure 49: Correlations between qualitative fields.

	IntroRG		IntroRV		RG		RV		RGF		RVF	
TOTAL Males	SCORE	Deviation	SCORE	Deviation	SCORE	Deviation	SCORE	Deviation	SCORE	Deviation	SCORE	Deviation
simple / complex	5,75	1,75	6,38	1,19	5,88	1,81	7,25	1,49	5,00	2,14	6,25	1,83
regular / irregular	5,13	1,73	6,00	1,69	4,25	1,49	5,25	2,19	4,88	2,10	5,00	1,69
large / small	3,88	1,89	4,25	2,12	3,25	2,12	3,13	2,23	3,38	1,30	3,50	2,00
repetitive / alternating	5,75	1,39	6,50	1,41	5,88	1,46	5,00	2,51	5,13	1,96	4,75	1,91
rhythmic / arrhythmic	6,75	1,39	5,88	1,55	4,88	1,73	5,25	1,98	4,25	2,19	5,00	1,85
ordered / chaotic	5,38	1,60	4,75	1,83	4,50	1,93	4,75	1,83	4,00	1,93	4,75	1,98
predictable / unpredictable	6,50	1,20	5,75	1,91	5,25	1,98	5,50	2,14	4,13	2,23	6,00	1,77
familiar / unfamiliar	3,00	0,93	4,50	2,00	4,00	1,60	5,75	2,12	4,75	1,49	5,63	1,51
rational / irrational	3,88	1,73	4,00	1,31	4,00	1,93	5,88	2,53	4,13	2,30	5,88	1,89
interesting / monotonous	3,88	1,13	4,00	1,69	3,63	1,41	4,13	2,85	3,88	1,81	4,38	2,00
clearly structured / confusing	6,00	2,00	5,75	1,39	4,75	2,31	4,50	3,02	4,50	1,69	6,63	2,20
Time in environment (in minutes)	05:00	0,00	05:00	00:00	0,00	0,00	0,01	0,00	0,00	0,00	0,01	0,00
Environment size (in junctions)	6784	0,00	6501	0,00	6763	163,50	6535	28,17	6757	181,36	6545	32,64
Roads visited	26,75	5,50	32,38	12,09	74,13	15,49	91,88	16,92	79,88	22,99	88,88	23,64
Wide roads visited	6,38	7,01	17,13	11,85	53,38	8,45	58,63	33,20	66,13	22,79	59,13	32,85
Narrow roads visited	20,38	8,09	15,25	4,59	20,75	13,68	33,25	20,58	13,75	13,00	29,75	27,32
Wide roads visited %	23,26	25,01	48,04	18,58	73,57	12,62	60,44	27,52	83,04	16,44	66,66	28,70
Narrow roads visited %	76,74	25,01	51,96	18,58	26,43	12,62	39,56	27,52	16,96	16,44	33,34	28,70
Coverage %	0,39	0,08	0,50	0,19	1,10	0,22	1,41	0,26	1,18	0,31	1,36	0,36
Stops	9,50	3,66	8,13	5,22	9,50	6,00	12,88	4,70	8,13	6,22	8,63	5,90
Stops in Wide roads	1,00	1,60	2,25	2,55	2,75	1,83	5,50	2,51	4,50	3,02	5,00	5,13
Stops in Narrow roads	8,50	3,21	5,88	5,41	6,75	6,04	7,38	5,90	3,63	5,24	3,63	2,20
Stops in Wide roads %	8,44	13,08	33,17	25,32	36,53	22,38	50,54	28,48	69,82	40,24	51,20	36,45
Stops in Narrow roads %	91,56	13,08	66,83	25,32	63,47	22,38	49,46	28,48	30,18	40,24	48,80	36,45
Changes to Wide roads	1,75	2,05	2,38	0,92	2,25	1,28	3,00	1,07	3,38	1,92	2,63	1,51
Changes to Narrow roads	1,63	2,07	1,63	1,19	1,38	1,30	2,38	1,06	2,50	1,85	2,13	1,36
Task completed					1,00	0,00	0,29	0,00	0,86	0,00	0,43	0,00

Table 12: Total male ranking scores and movement statistics, all environments

	IntroRG		IntroRV		RG		RV		RGF		RVF	
TOTAL Females	SCORE	Deviation	SCORE	Deviation	SCORE	Deviation	SCORE	Deviation	SCORE	Deviation	SCORE	Deviation
simple / complex	4,38	2,07	4,88	2,30	5,88	1,73	5,43	1,99	5,63	2,00	6,38	1,85
regular / irregular	4,88	1,73	5,25	1,98	5,00	1,69	5,00	2,24	5,13	1,89	4,88	2,10
large / small	5,38	2,88	3,88	1,96	2,25	1,16	3,00	1,91	3,75	1,98	3,38	2,20
repetitive / alternating	3,38	1,85	6,00	1,07	3,75	1,39	4,57	1,81	4,25	1,67	3,75	2,60
rhythmic / arrhythmic	3,25	1,91	4,88	2,10	4,88	1,96	4,71	2,29	4,50	2,00	4,00	2,20
ordered / chaotic	4,13	2,64	4,63	2,72	4,75	1,83	4,86	1,95	4,00	1,85	4,50	1,93
predictable / unpredictable	5,38	2,62	5,25	2,05	6,75	1,04	6,14	1,07	5,25	2,43	5,38	1,60
familiar / unfamiliar	4,00	1,41	4,88	1,64	5,00	2,27	4,57	1,90	5,38	2,67	4,38	2,13
rational / irrational	5,13	2,30	4,75	2,19	5,00	1,85	5,14	1,46	4,75	1,83	5,00	1,69
interesting / monotonous	3,75	2,25	4,50	1,51	4,13	2,75	3,43	2,30	4,63	2,45	3,50	2,20
clearly structured / confusing	5,00	1,93	4,13	2,90	6,13	2,10	5,14	1,86	5,13	2,36	5,50	1,77
Time in environment (in minutes)	05:00	00:00	05:00	00:00	08:45	01:54	09:36	01:08	07:07	02:40	10:00	00:00
Environment size (in junctions)	6784	0,00	6501	0,00	6725	126,77	6523	16,20	6738	106,07	6543	24,63
Roads visited	23,25	11,15	37,63	10,41	79,88	19,22	103,75	20,17	80,13	25,39	102,38	23,38
Wide roads visited	3,50	6,68	17,88	11,98	45,25	20,20	69,13	24,70	54,50	26,40	58,88	37,43
Narrow roads visited	19,75	9,36	19,75	7,21	34,63	17,78	34,63	14,25	25,63	20,13	43,50	23,09
Wide roads visited %	10,48	20,08	44,95	22,06	55,81	23,29	65,43	16,16	67,28	30,31	53,99	28,59
Narrow roads visited %	89,52	20,08	55,05	22,06	44,19	23,29	34,57	16,16	32,72	30,31	46,01	28,59
Coverage %	0,34	0,16	0,58	0,16	1,19	0,28	1,59	0,31	1,19	0,37	1,56	0,36
Stops	7,63	4,44	9,25	5,52	13,75	9,92	8,38	5,60	6,13	7,47	9,25	7,57
Stops in Wide roads	0,13	0,35	1,63	2,00	2,25	2,38	3,50	3,21	0,25	0,46	1,88	1,36
Stops in Narrow roads	7,50	4,60	7,63	4,44	11,50	9,55	4,88	4,32	5,88	7,66	7,38	6,97
Stops in Wide roads %	4,17	11,79	17,84	16,60	25,08	33,94	38,23	28,26	18,75	37,20	25,12	30,99
Stops in Narrow roads %	95,83	11,79	82,16	16,60	74,92	33,94	61,77	28,26	81,25	37,20	74,88	30,99
Changes to Wide roads	0,75	1,39	1,75	0,89	3,13	1,46	3,63	1,06	2,88	1,96	2,88	1,13
Changes to Narrow roads	0,63	1,19	1,50	0,53	2,63	1,69	3,38	0,92	2,13	1,73	2,25	1,16
Task completed					0,38		0,13		0,63	0,00	0,00	0,00

Table 13: Total female ranking scores and movement statistics, all environments

Comparison according to completion	RG		RV		RGF		RVF	
	Successful	Unsuccessful	Successful	Unsuccessful	Successful	Unsuccessful	Successful	Unsuccessful
simple / complex	5,60	6,33	5,00	6,75	5,09	5,80	5,67	6,46
regular / irregular	4,60	4,67	4,00	5,42	4,55	6,00	6,00	4,69
large / small	2,60	3,00	2,33	3,25	3,55	3,60	2,67	3,62
repetitive / alternating	5,60	3,50	3,33	5,17	4,82	4,40	5,00	4,08
rhythmic / arrhythmic	4,80	5,00	4,33	5,17	3,91	5,40	5,33	4,31
ordered / chaotic	4,70	4,50	3,67	5,08	3,36	5,40	5,00	4,54
predictable / unpredictable	5,40	7,00	4,67	6,08	4,64	4,80	7,33	5,31
familiar / unfamiliar	4,30	4,83	5,00	5,25	4,82	5,60	6,00	4,77
rational / irrational	4,00	5,33	5,33	5,58	3,55	6,40	5,33	5,46
interesting / monotonous	3,40	4,67	3,33	3,92	3,91	5,00	3,00	4,15
clearly structured / confusing	4,40	7,17	4,33	4,92	4,18	6,20	5,67	6,15

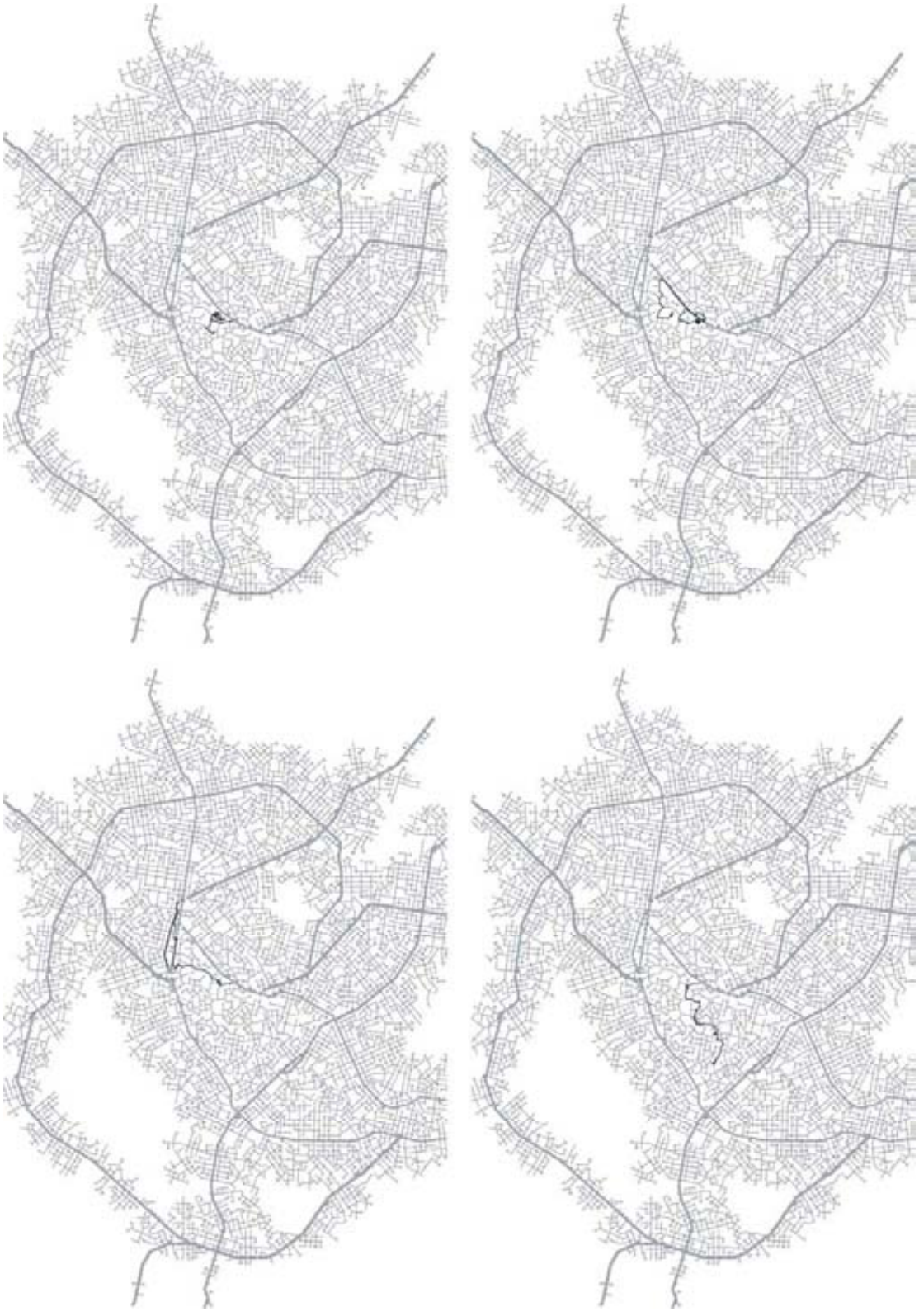
Table 14: Clustering according to success of completion

Figure 50: Fit Y by X method between all qualitative fields

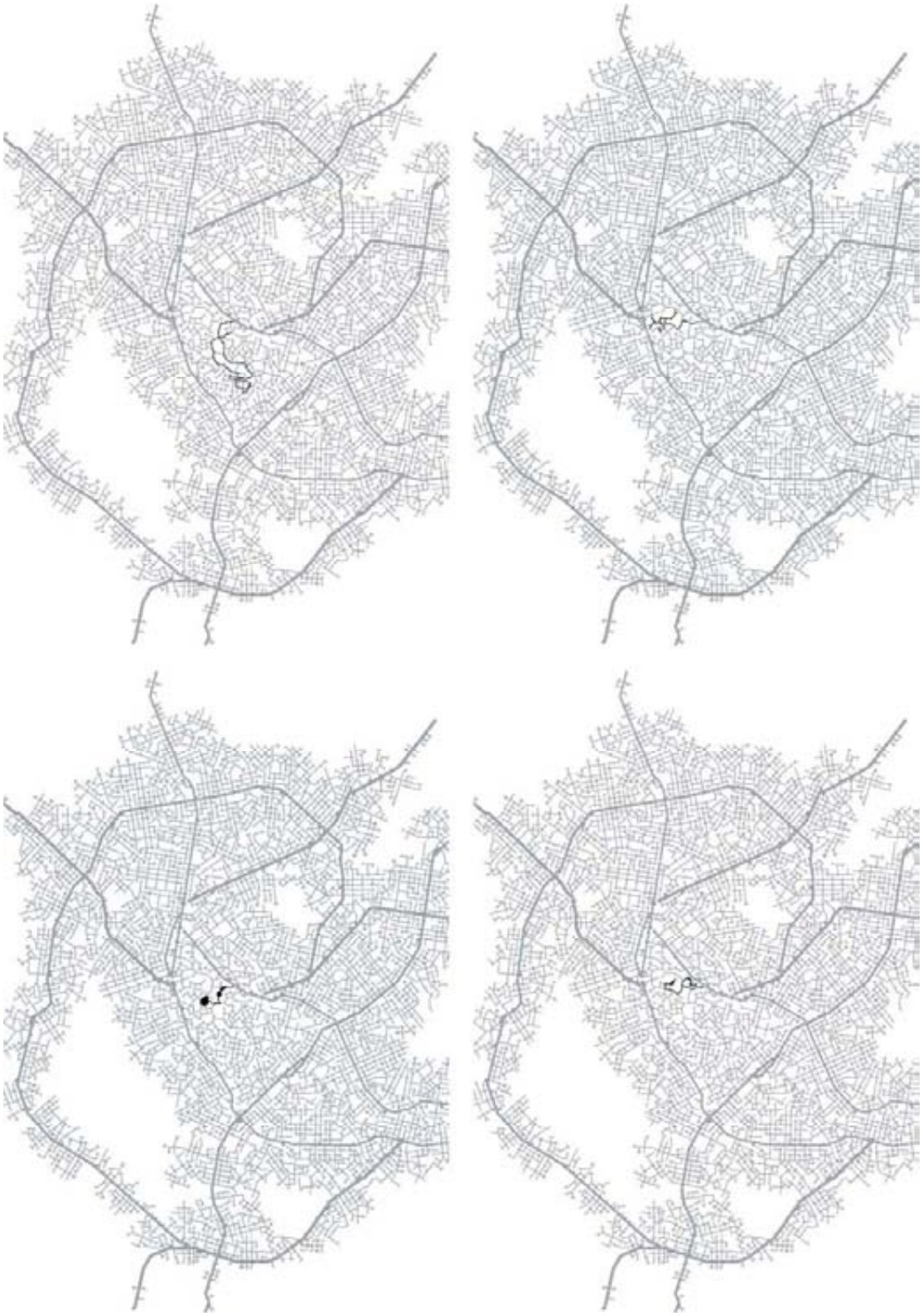
Ranking correlations	Participant A	Participant B	Correlation
IntroRG	F6	F3	0,81
	M14	F4	0,77
	M12	F2	0,72
	M11	M9	0,72
	F7	F3	0,71
	M12	M9	0,71
	M12	F3	-0,72
	M12	F7	-0,85
IntroRV	M16	F5	0,87
	M10	F6	-0,78
RG	M14	F2	0,84
	F7	F4	0,83
	F7	F2	0,72
	M9	F7	0,72
	M14	M11	0,71
	M16	F6	-0,79
RV	M15	F2	0,81
	F3	F2	0,81
	M14	F3	0,78
	M12	M11	0,77
	M14	F2	0,76
RGF	M14	F5	0,77
	F5	F2	0,74
	M14	F4	0,73
RVF	F2	F1	0,95
	M12	F2	0,77
	M15	F2	0,73

Table 15: Correlation between participants according to their ranking

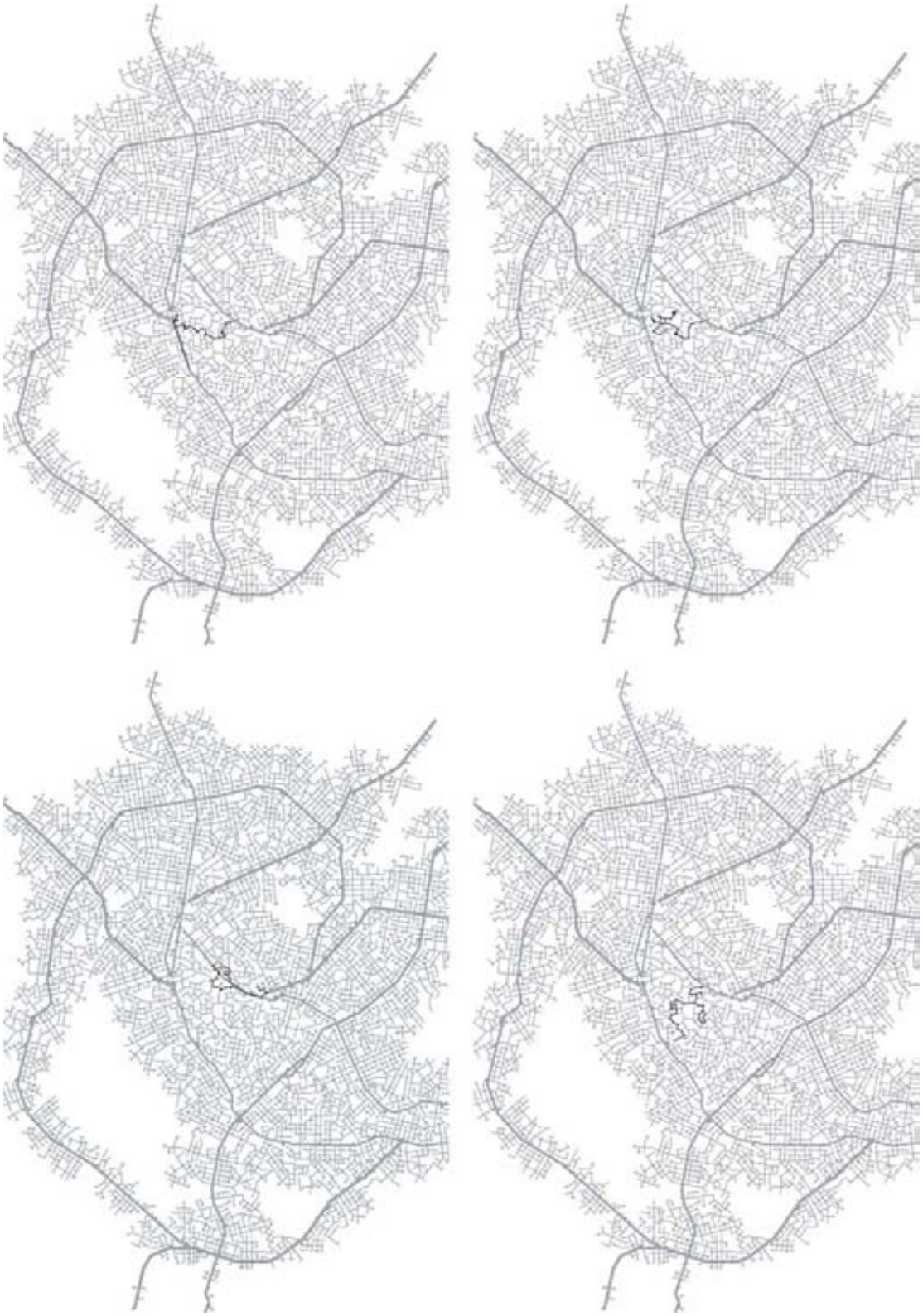
Appendix E: Participants' maps and routes



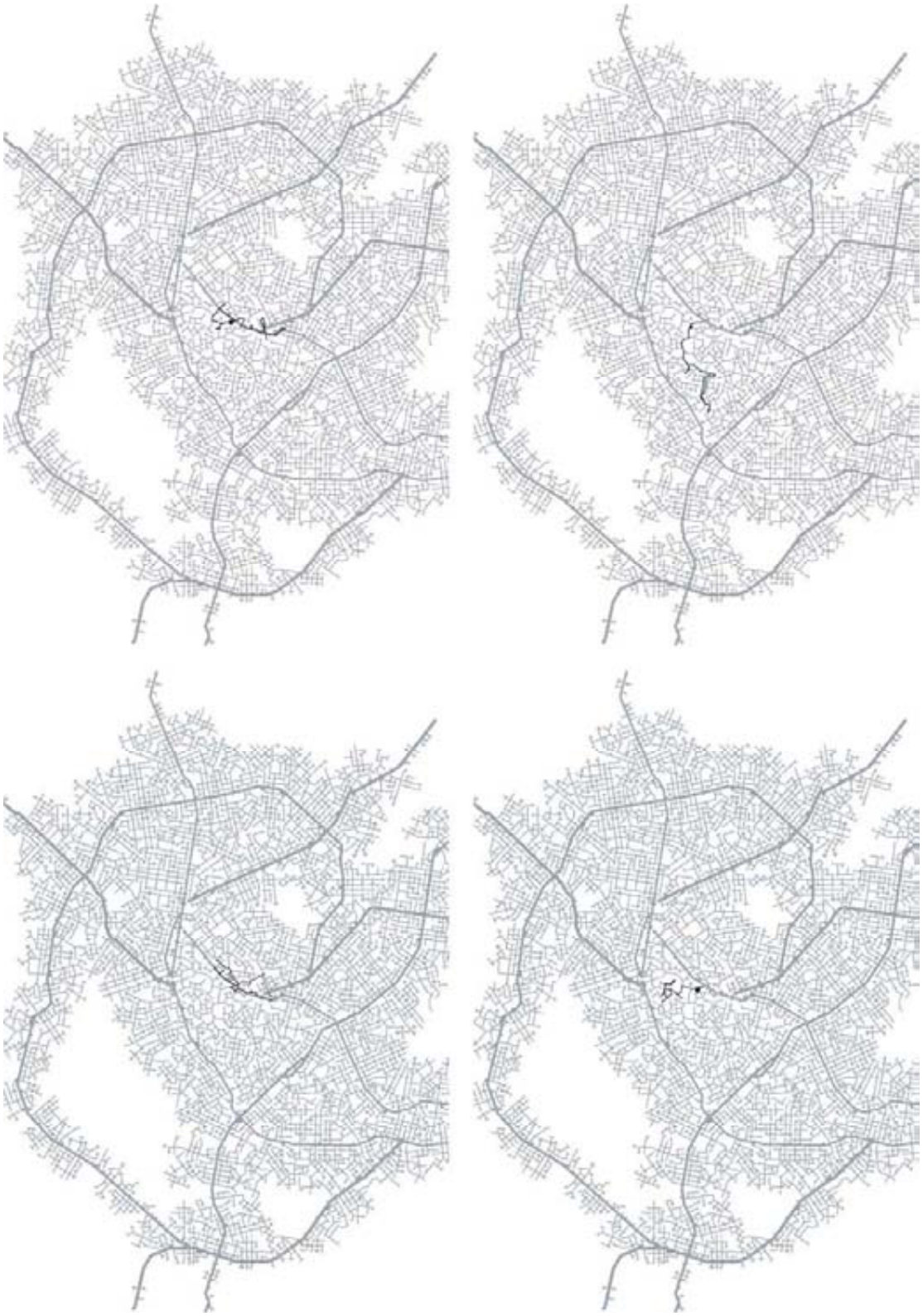
Environment IntroRG
(Participants F1-F4 maps and routes)



Environment IntroRG
(Participants F5-F8 maps and routes)



Environment IntroRG
(Participants M9-M12 maps and routes)

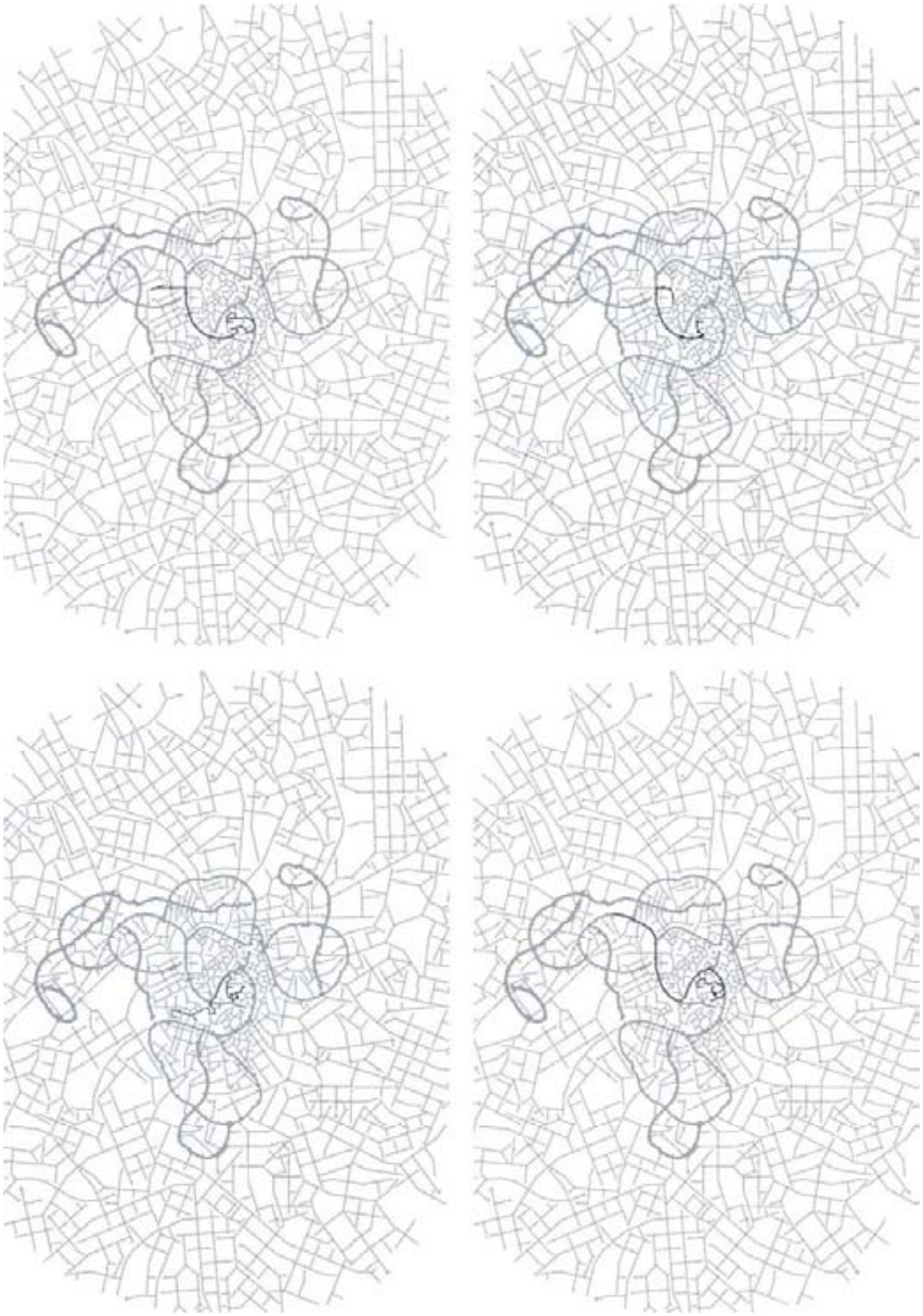


M16 M15

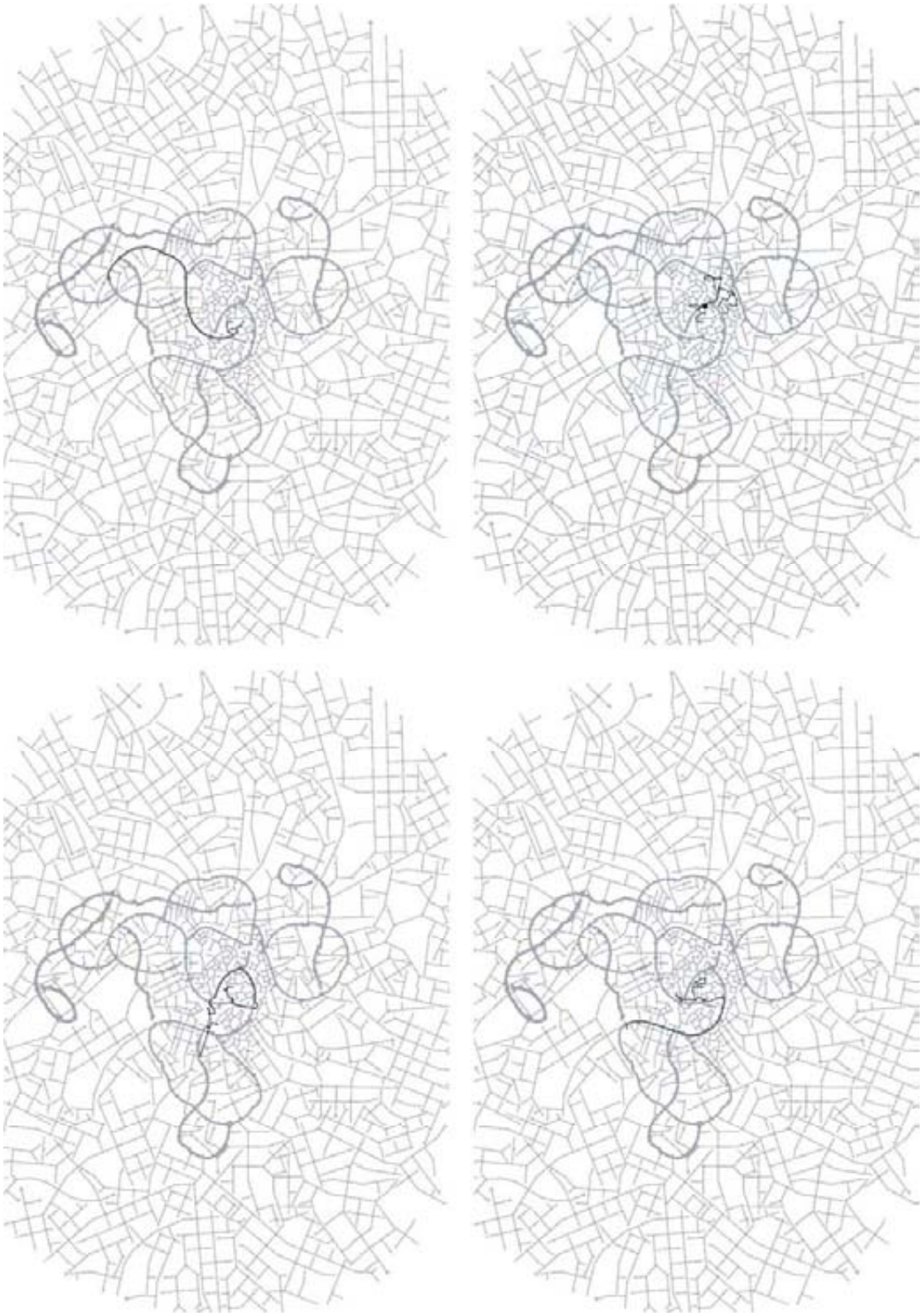
M14 M13

Environment IntroRG
(Participants M13-M16 maps and routes)

Environment IntroRV
(Participants F1-F4 maps and routes)

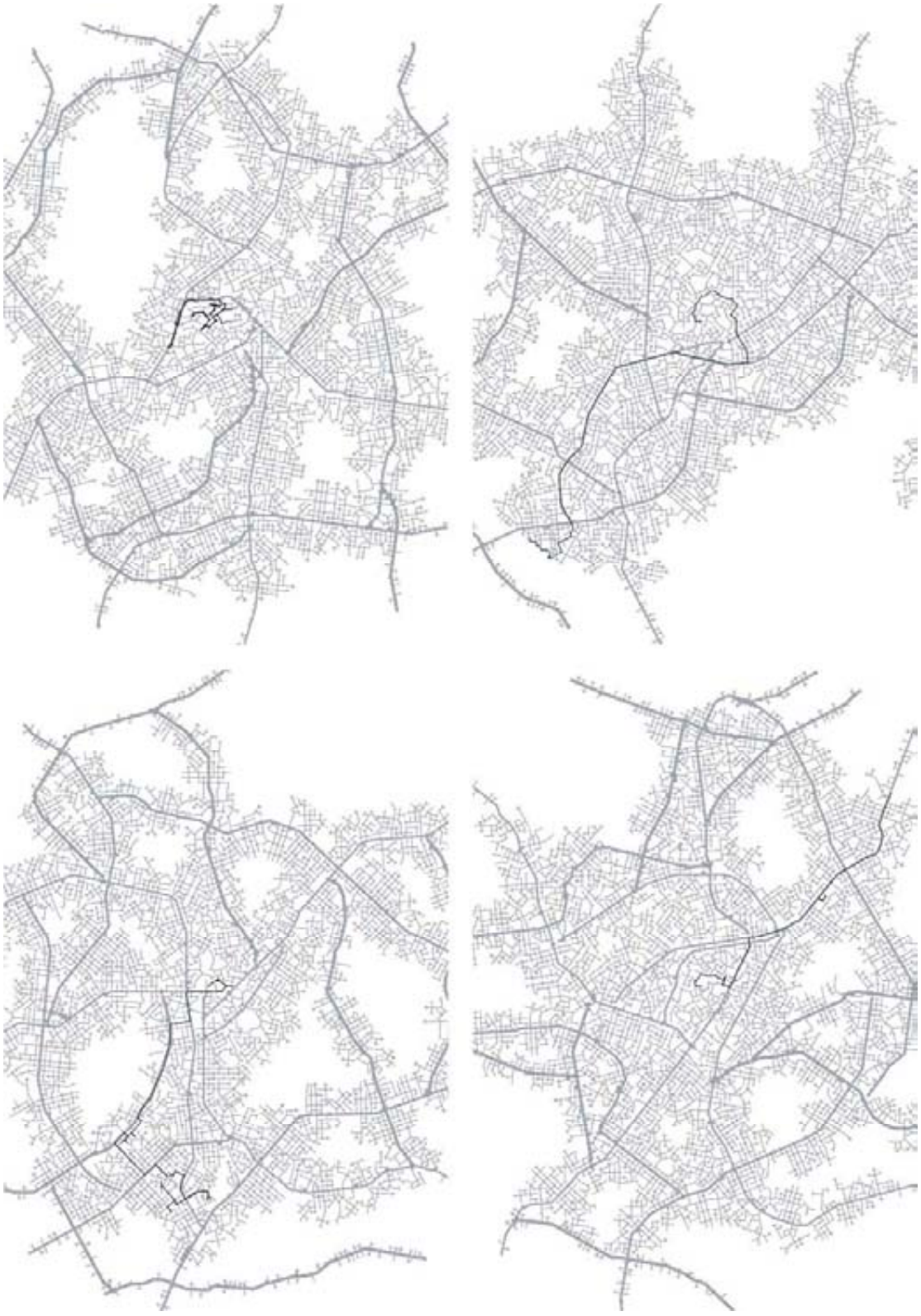


Environment IntroRV
(Participants F5-F8 maps and routes)



Environment IntroRV
(Participants M9-M12 maps and routes)

Environment IntroRV
(Participants M13-M16 maps and routes)

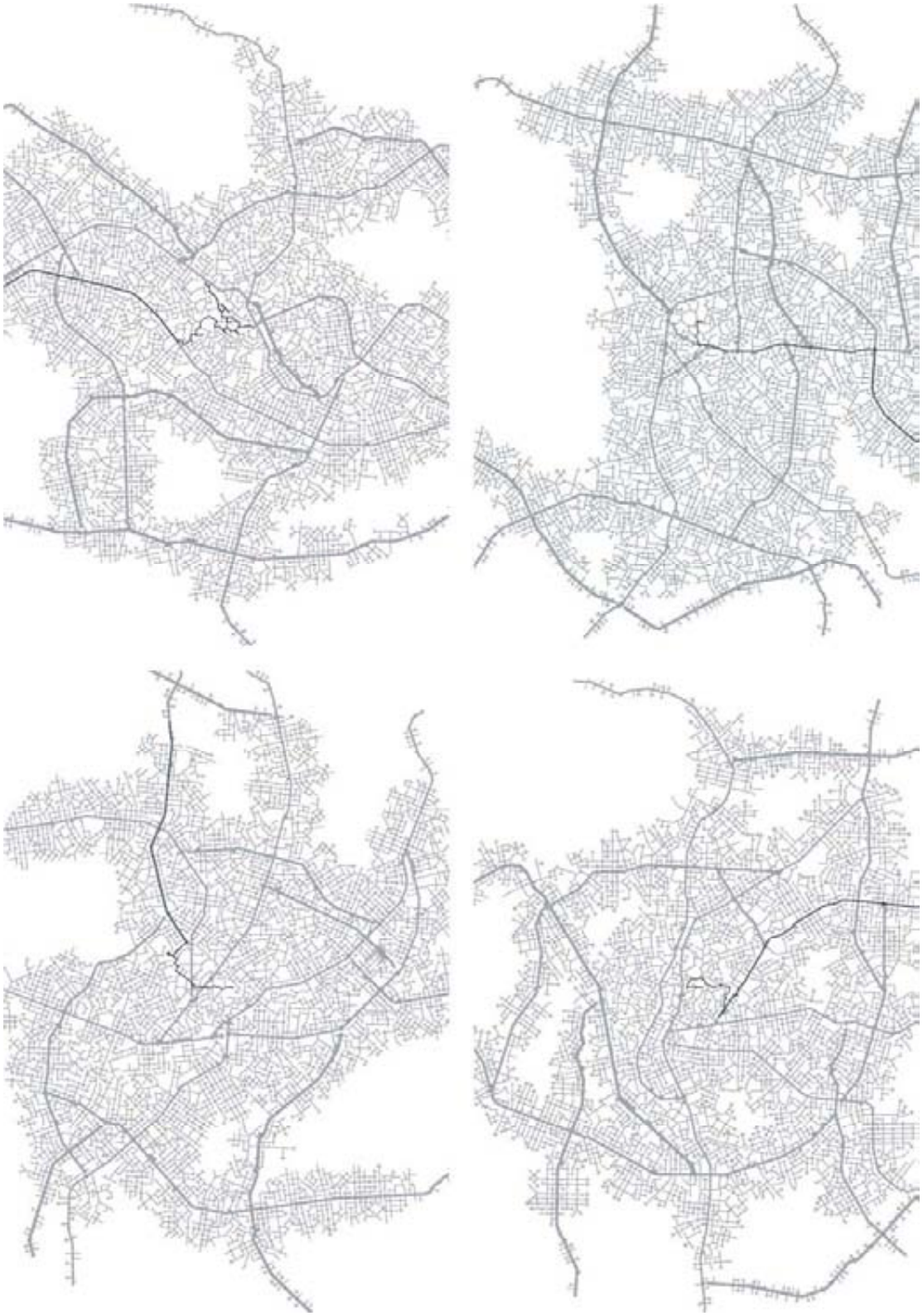


F4 F3

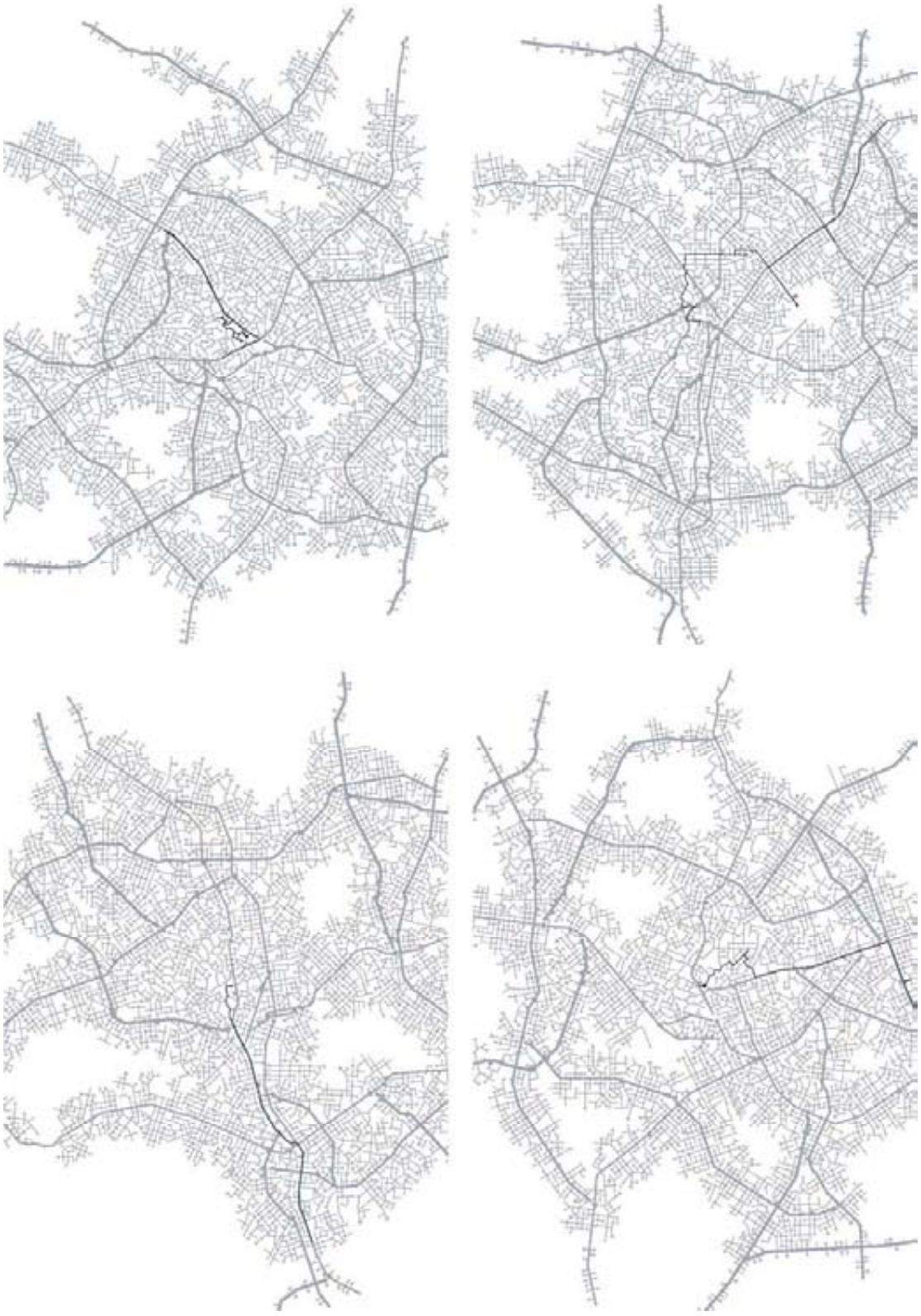
F2 F1

Environments RG
(Participants F1-F4 maps and routes)

Environments RG
(Participants F5-F8 maps and routes)



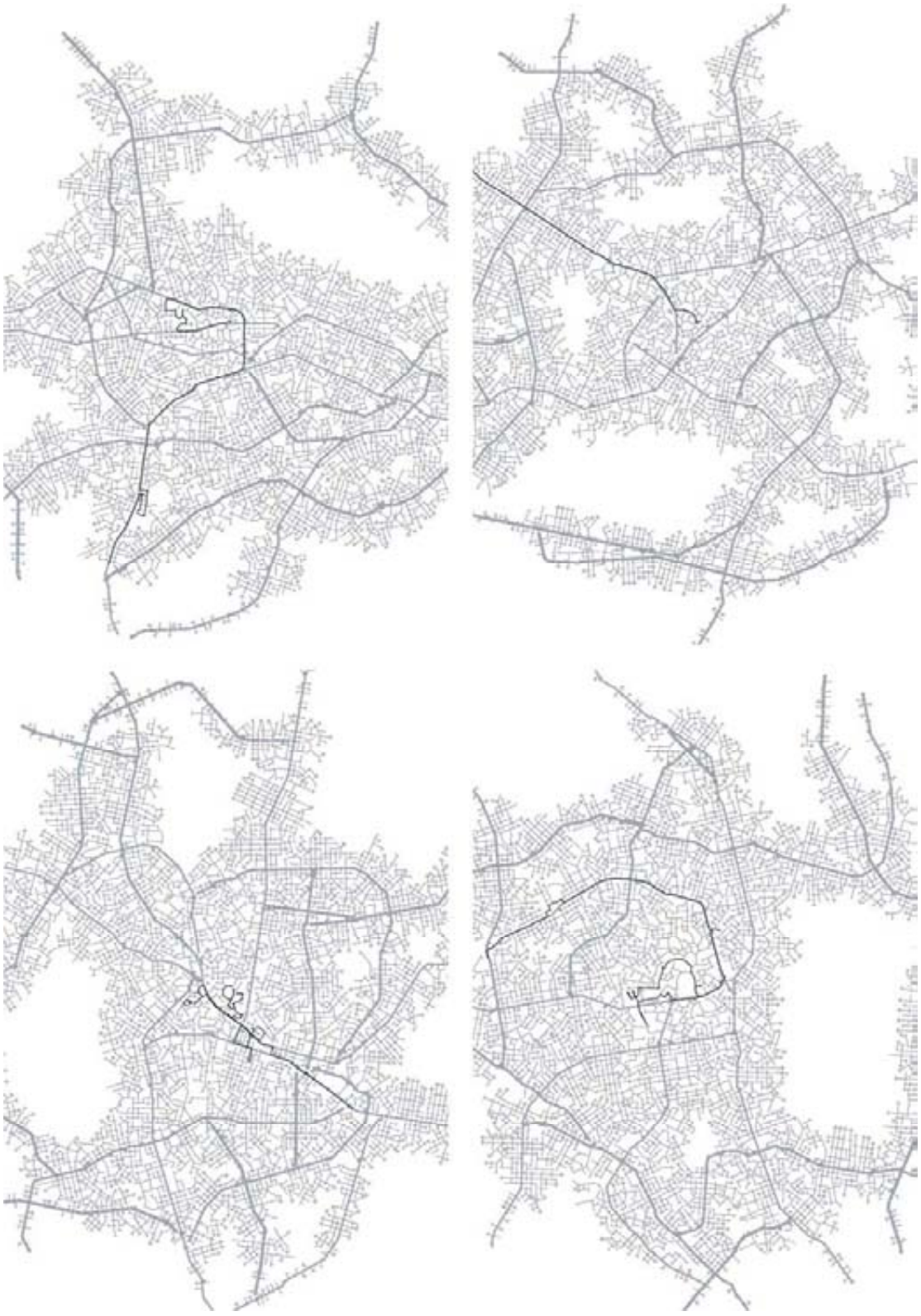
Environments RG
(Participants M9-M12 maps and routes)



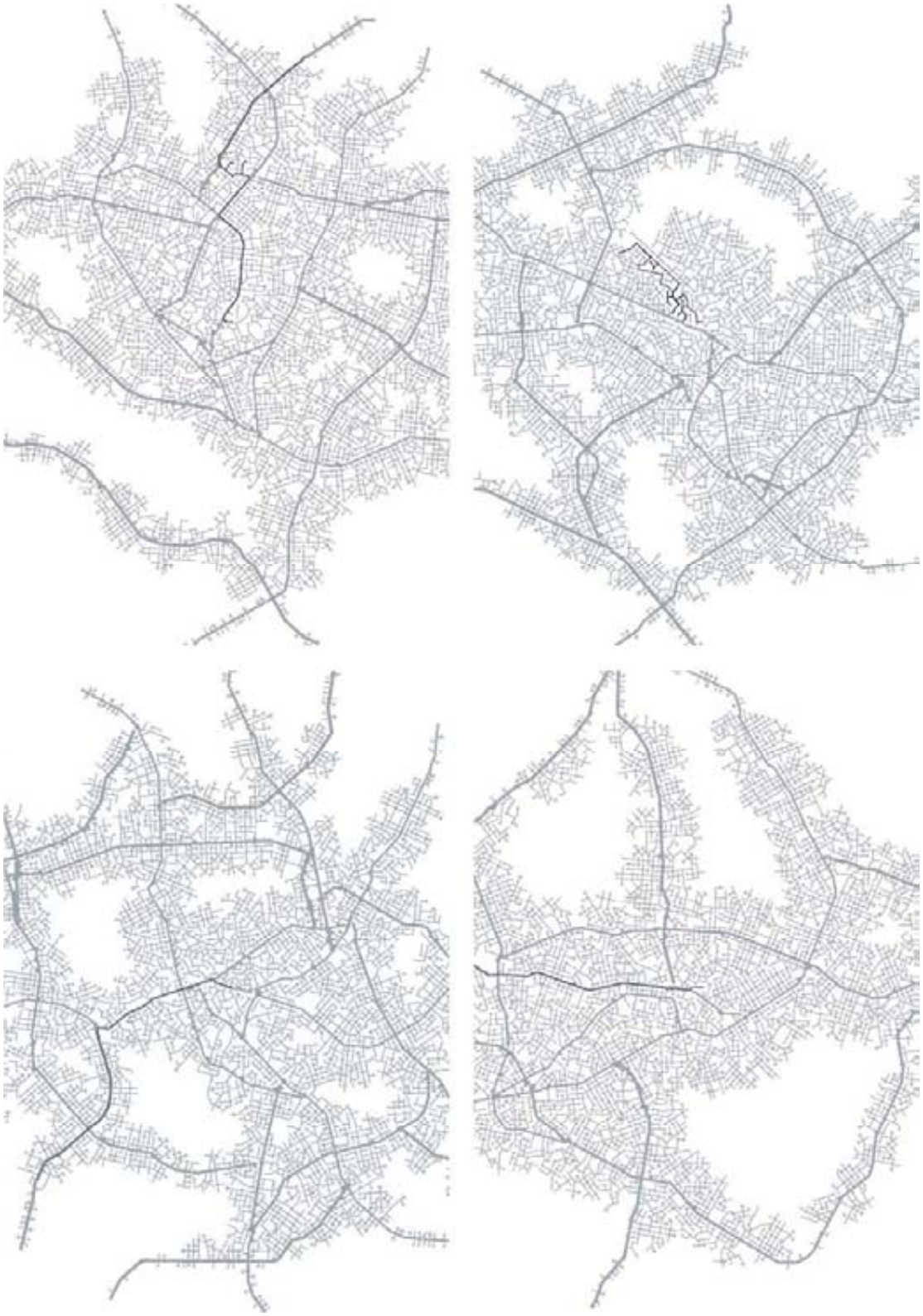
M16 M15

M14 M13

Environments RG
(Participants M13-M16 maps and routes)



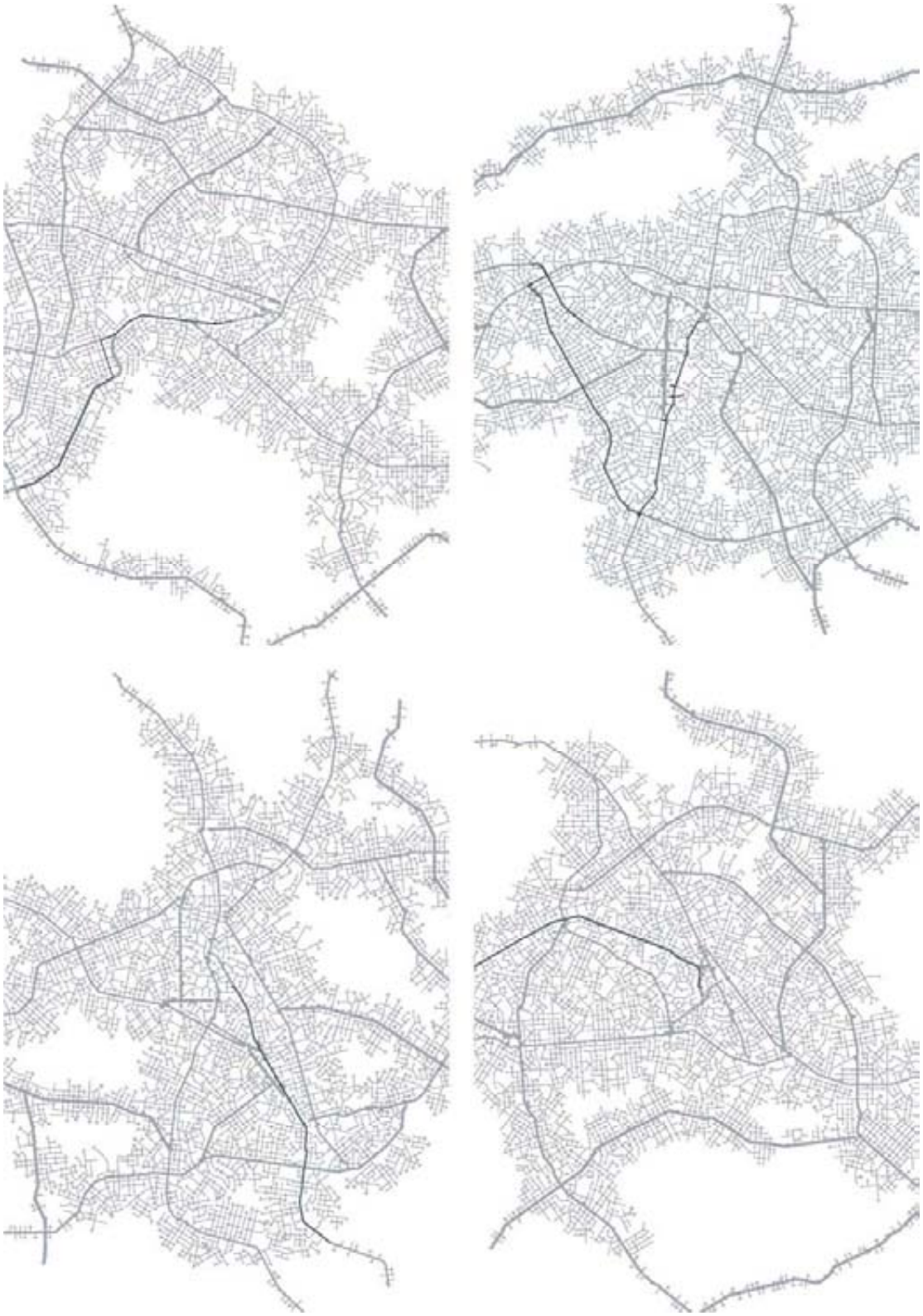
Environments RGF
(Participants F1-F4 maps and routes)



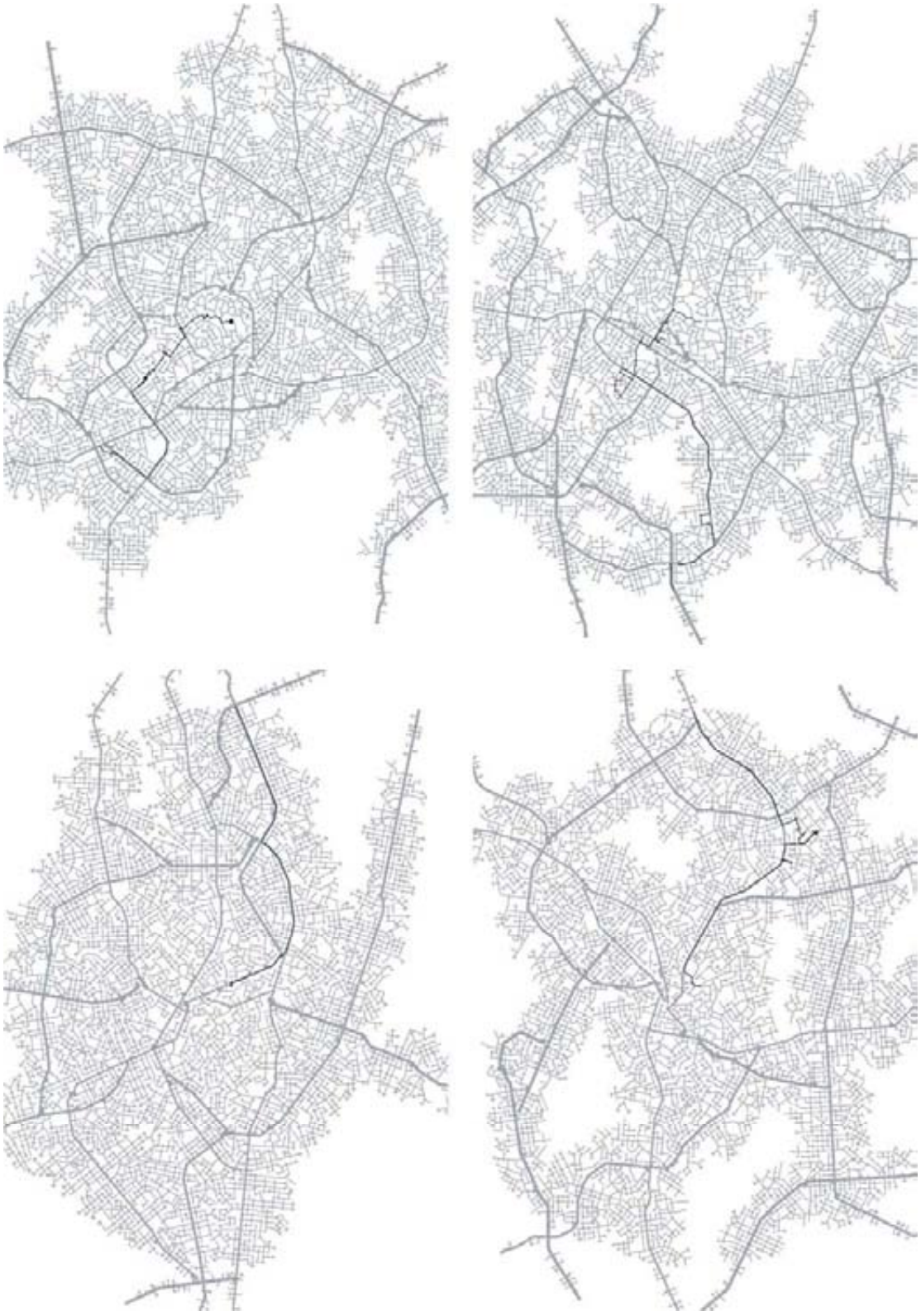
F8 F7

F6 F5

Environments RGF
(Participants F5-F8 maps and routes)



Environments RGF
(Participants M9-M12 maps and routes)



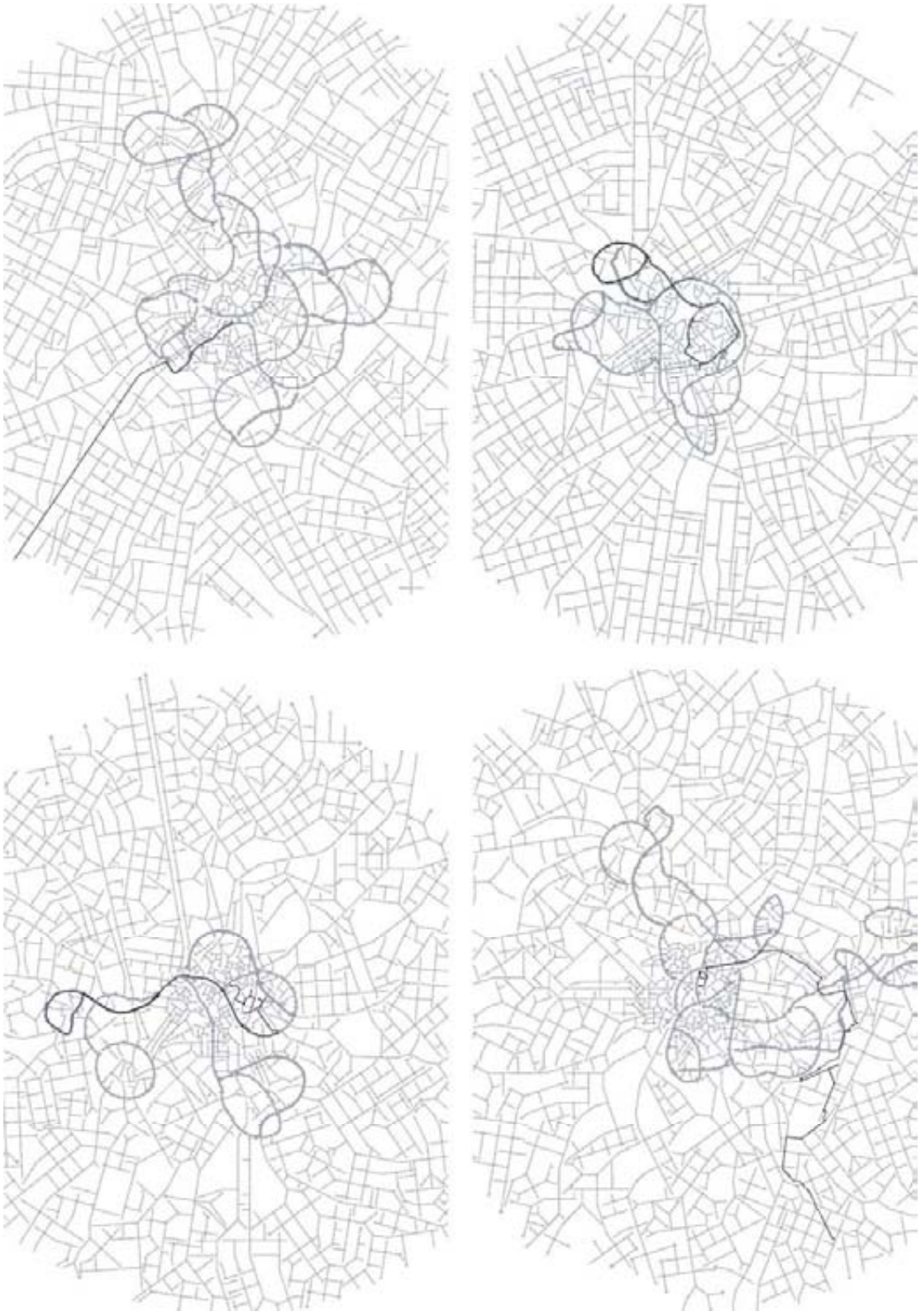
M16 M15

M14 M13

Environments RGF
(Participants M13-M16 maps and routes)

Environments RV
(Participants F1-F4 maps and routes)

Environments RV
(Participants F5-F8 maps and routes)

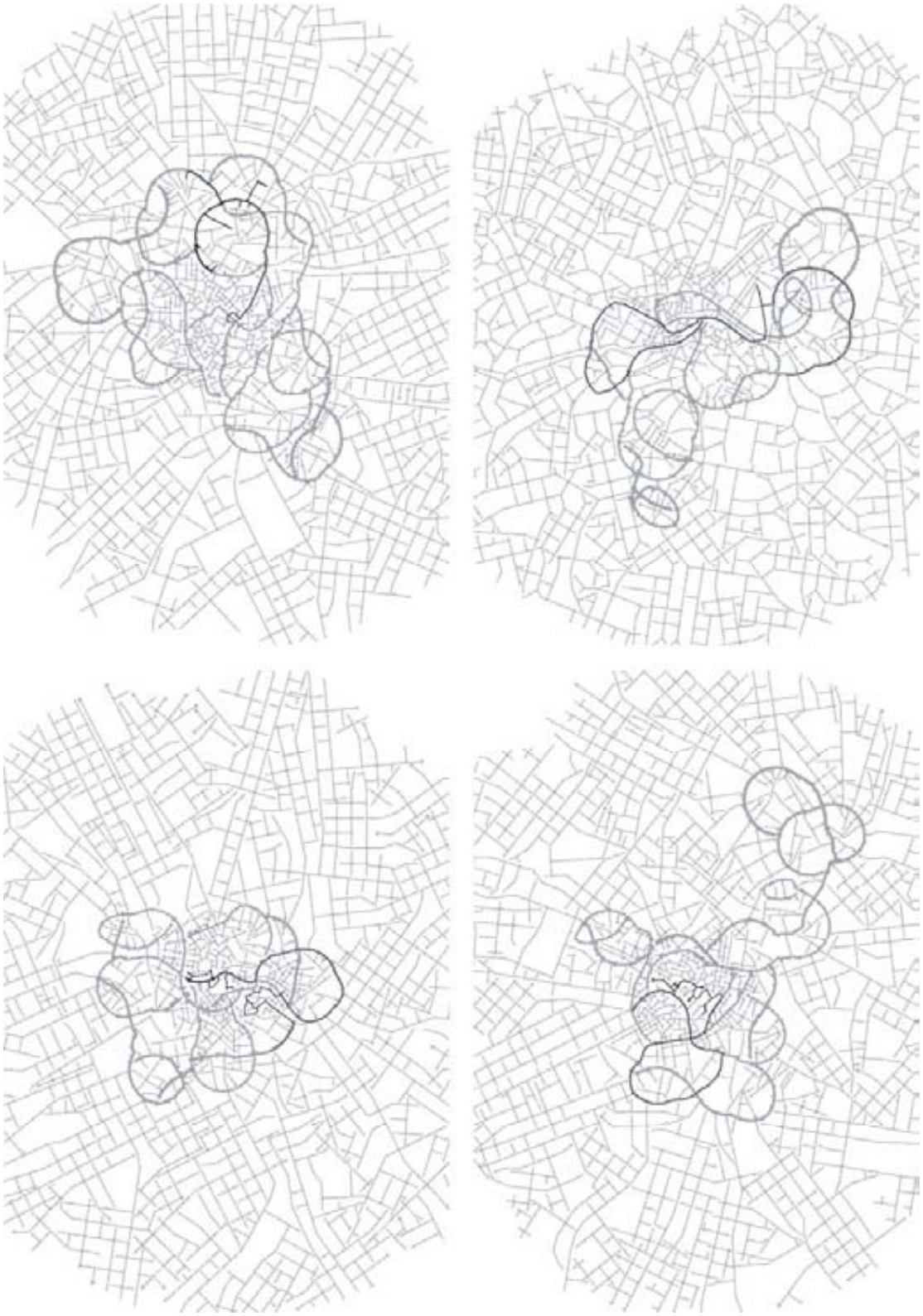


Environments RV
(Participants M9-M12 maps and routes)

M16 M15

M14 M13

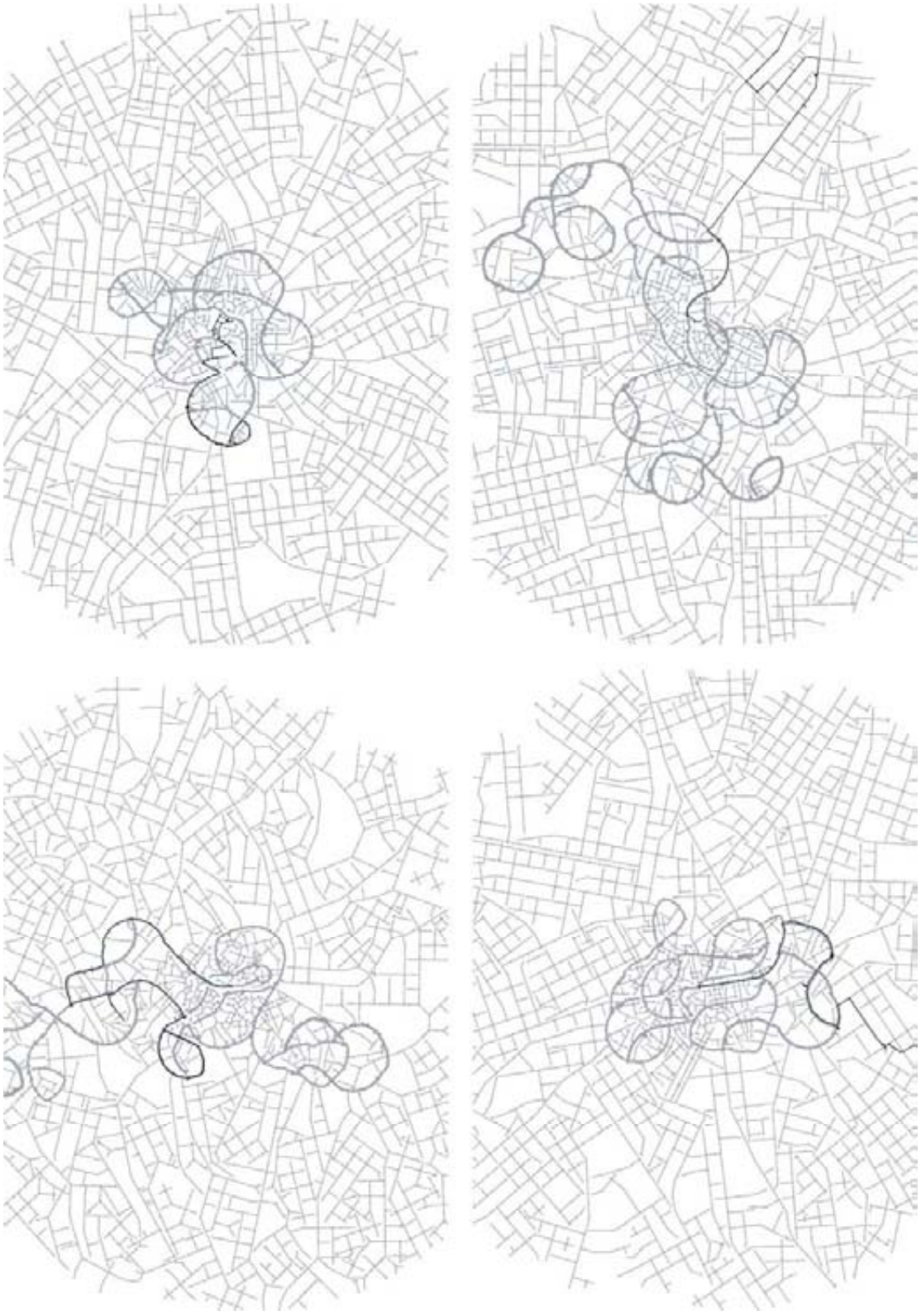
Environments RV
(Participants M13-M16 maps and routes)



Environments RVF
(Participants F1-F4 maps and routes)

Environments RVF
(Participants F5-F8 maps and routes)

Environments RVF
(Participants M9-M12 maps and routes)



Environments RVF
(Participants M13-M16 maps and routes)

Appendix F: Survey Questionnaires

The Bartlett School of Graduate Studies
MSc AAC (Adaptive Architecture & Computation)
Virtual Urbanity Thesis Experiment

Personal information

Your personal details will be treated confidentially as the data will be used only for analysis and evaluation.

Name: Participant F1 Age: 26 Gender: F Occupation: Architect

Are you familiar with immersive environments? Not so much

Are you familiar with video games? Quite Familiar.

Environment 1

Code: RG

In a climax of 1-9, rank **the structure** of the environment according to your experience.

simple	1	2	(3)	4	5	6	7	8	9	complex
regular	1	2	3	(4)	5	6	7	8	9	irregular
large	1	2	3	4	5	6	(7)	8	9	small
repetitive	1	(2)	3	4	5	6	7	8	9	alternating
rhythmic	(1)	2	3	4	5	6	7	8	9	arrhythmic
ordered	(1)	2	3	4	5	6	7	8	9	chaotic
predictable	1	2	3	4	(5)	6	7	8	9	unpredictable
familiar	1	2	3	(4)	5	6	7	8	9	unfamiliar
rational	1	(2)	3	4	5	6	7	8	9	irrational
interesting	1	2	3	(4)	5	6	7	8	9	monotonous
clearly structured	1	(2)	3	4	5	6	7	8	9	confusing

Environment 2

Code: RV

In a climax of 1-9, rank **the structure** of the environment according to your experience.

simple	1	2	3	(4)	5	6	7	8	9	complex
regular	1	2	(3)	4	5	6	7	8	9	irregular
large	1	2	3	4	(5)	6	7	8	9	small
repetitive	1	2	3	4	5	(6)	7	8	9	alternating
rhythmic	1	2	3	4	5	6	(7)	8	9	arrhythmic
ordered	(1)	2	3	4	5	6	7	8	9	chaotic
predictable	1	2	(3)	4	5	6	7	8	9	unpredictable
familiar	1	2	(3)	4	5	6	7	8	9	unfamiliar
rational	1	2	(3)	4	5	6	7	8	9	irrational
interesting	1	2	3	4	5	6	(7)	8	9	monotonous
clearly structured	(1)	2	3	4	5	6	7	8	9	confusing

Environment 3

Code: RG

In a climax of 1-9, rank **the structure** of the environment according to your experience.

simple	1	2	3	4	5	6	(7)	8	9	complex
regular	1	2	3	(4)	5	6	7	8	9	irregular
large	1	(2)	3	4	5	6	7	8	9	small
repetitive	1	(2)	3	4	5	6	7	8	9	alternating
rhythmic	1	(2)	3	4	5	6	7	8	9	arrhythmic
ordered	1	(2)	3	4	5	6	7	8	9	chaotic
predictable	1	2	3	4	5	6	7	(8)	9	unpredictable
familiar	1	2	(3)	4	5	6	7	8	9	unfamiliar
rational	1	2	(3)	4	5	6	7	8	9	irrational
interesting	1	2	3	4	(5)	6	7	8	9	monotonous
clearly structured	1	2	3	4	5	6	(7)	8	9	confusing

Additional comments about the environment:

Quite flat, there are less squares, junctions, it keeps the same physiognomy (same rise, only 2-3 types of roads width.) in buildings

Explain your strategy in completing the task in a few words

- follow the height of the buildings
- Avoid paths which have office buildings (means that are located in the centre of city)
- Search for the wider streets (main road ways indicating the way out)

Which elements / characteristics of the environment helped you in completing your task and in what way?

- The width of the paths
- low rise/high rise buildings

Which elements / characteristics of the environment hindered you from completing your task and in what way?

- In some extend it wasn't predictable.
& there wasn't any relationship between the deadends and the building's usage.

Environment 4

Code: ℓVF

In a climax of 1-9, rank **the structure** of the environment according to your experience.

simple	1	2	3	4	5	6	7	8	9	complex
regular (?)	1	2	3	4	5	6	7	8	9	irregular
large	1	2	3	4	5	6	7	8	9	small
repetitive	1	2	3	4	5	6	7	8	9	alternating
rhythmic	1	2	3	4	5	6	7	8	9	arrhythmic
ordered	1	2	3	4	5	6	7	8	9	chaotic
predictable	1	2	3	4	5	6	7	8	9	unpredictable
familiar	1	2	3	4	5	6	7	8	9	unfamiliar
rational	1	2	3	4	5	6	7	8	9	irrational
interesting	1	2	3	4	5	6	7	8	9	monotonous
clearly structured	1	2	3	4	5	6	7	8	9	confusing

Additional comments about the environment:

I still haven't figured out the importance of repetition of buildings. Is it ~~twice~~ as an indication of choosing the wrong path – in my attempt to find my way out – or an irrelevant element for setting a familiar environment?

Explain your strategy in completing the task in a few words

Not sure if I completed! ↔ repetitiveness ↔ residential

Just followed the main roads, cause everything else leaded either to deadends or smaller roads & residential areas (closed gardens) patios.

Which elements / characteristics of the environment helped you in completing your task and in what way?

– Due to the lack of light, I didn't have the overall view of the road, so, the only clue was the width of the ~~road~~.

Which elements / characteristics of the environment hindered you from completing your task and in what way?

The perpetual appearance of the same ~~images~~ buildings.

Environment 5

Code: RV

In a climax of 1-9, rank **the structure** of the environment according to your experience.

simple	1	2	3	4	5	6	7	8	9	complex
regular	1	2	3	4	5	6	7	8	9	irregular
large	1	2	3	4	5	6	7	8	9	small
repetitive	1	2	3	4	5	6	7	8	9	alternating
rhythmic	1	2	3	4	5	6	7	8	9	arrhythmic
ordered	1	2	3	4	5	6	7	8	9	chaotic
predictable	1	2	3	4	5	6	7	8	9	unpredictable
familiar	1	2	3	4	5	6	7	8	9	unfamiliar
rational	1	2	3	4	5	6	7	8	9	irrational
interesting	1	2	3	4	5	6	7	8	9	monotonous
clearly structured	1	2	3	4	5	6	7	8	9	confusing

Additional comments about the environment:

I haven't got a clue of whether I am at the right direction or not. I would have liked to see a differentiation in the height of build. ie. An indication that I am moving towards the centre of the city → office buildings high rised. the outskirts → → low-rise buildings, or factories with a great distance in between them showing in a way the industrial zone of the city.

Explain your strategy in completing the task in a few words

It seems like the city (network) wanted me to keep following the main road (the wider one). Each time that I choose a different one, it was a dead end. This was an indication (probably) that I was on the right way. It felt more safe to stay on the main roads

Which elements / characteristics of the environment helped you in completing your task and in what way?

This was what I found a helping clue. (like in a labyrinth, the deadend is always a bad sign)

Which elements / characteristics of the environment hindered you from completing your task and in what way?

It was a bit confusing the repetition of the buildings. If is not for indicating a wrong path or that you're at the same point, what is for?

++ It seems to me that I spend more time into that city, rather than the previous one. Maybe because of the long, full of the same boring buildings roads.

Environment 6

Code: PGF

In a climax of 1-9, rank **the structure** of the environment according to your experience.

simple	1	2	3	4	5	6	7	8	9	complex
regular	1	2	3	4	5	6	7	8	9	irregular
large	1	2	3	4	5	6	7	8	9	small
repetitive	1	2	3	4	5	6	7	8	9	alternating
rhythmic	1	2	3	4	5	6	7	8	9	arrhythmic
ordered	1	2	3	4	5	6	7	8	9	chaotic
predictable	1	2	3	4	5	6	7	8	9	unpredictable
familiar	1	2	3	4	5	6	7	8	9	unfamiliar
rational	1	2	3	4	5	6	7	8	9	irrational
interesting	1	2	3	4	5	6	7	8	9	monotonous
clearly structured	1	2	3	4	5	6	7	8	9	confusing

Additional comments about the environment:

Very familiar, less unpredictable space.

Explain your strategy in completing the task in a few words

Finally, I completed!
My theory about approaching the countryside when the buildings are in distance, was helpful/right.

Which elements / characteristics of the environment helped you in completing your task and in what way?

High-low rise of buildings and the distances in between them.

Which elements / characteristics of the environment hindered you from completing your task and in what way?

The repetition of the same buildings.

Thank you very much for your participation!

The Bartlett School of Graduate Studies
MSc AAC (Adaptive Architecture & Computation)
Virtual Urbanity Thesis Experiment

Personal information

Your personal details will be treated confidentially as the data will be used only for analysis and evaluation.

Age: 28 Gender: F Occupation: ARCHITECT Participant F2

Are you familiar with immersive environments? YES

Are you familiar with video games? YES

Environment 1 Code: RG

In a climax of 1-9, rank the environment according to your experience.

simple	1	2	3	4	5	6	7	**8**	9	complex
regular	1	2	3	4	5	6	**7**	8	9	irregular
large	**1**	2	3	4	5	6	7	8	9	small
repetitive	1	2	3	4	5	6	**7**	8	9	alternating
rhythmic	1	2	**3**	4	5	6	7	8	9	arrhythmic
ordered	1	2	**3**	4	5	6	7	8	9	chaotic
predictable	1	2	3	4	5	6	7	**8**	9	unpredictable
familiar	1	2	3	**4**	5	6	7	8	9	unfamiliar
rational	1	2	3	**4**	5	6	7	8	9	irrational
interesting	1	**2**	3	4	5	6	7	8	9	monotonous
clearly structured	1	2	**3**	4	5	6	7	8	9	confusing

Environment 2 Code: RV

In a climax of 1-9, rank the environment according to your experience.

simple	1	2	3	4	5	6	7	**8**	9	complex
regular	1	2	3	4	5	6	7	**8**	9	irregular
large	**1**	2	3	4	5	6	7	8	9	small
repetitive	1	2	3	4	5	6	7	**8**	9	alternating
rhythmic	1	**2**	3	4	5	6	7	8	9	arrhythmic
ordered	1	2	**3**	4	5	6	7	8	9	chaotic
predictable	1	2	3	4	5	6	7	**8**	9	unpredictable
familiar	1	2	3	4	**5**	6	7	8	9	unfamiliar
rational	1	2	**3**	4	5	6	7	8	9	irrational
interesting	1	**2**	3	4	5	6	7	8	9	monotonous
clearly structured	1	**2**	3	4	5	6	7	8	9	confusing

Environment 3

Code: RG

In a climax of 1-9, rank the environment according to your experience.

simple	1	2	3	4	5	6	7	(8)	9	complex
regular	1	2	3	4	5	6	(7)	8	9	irregular
large	1	(2)	3	4	5	6	7	8	9	small
repetitive	1	2	3	4	5	(6)	7	8	9	alternating
rhythmic	1	2	(3)	4	5	6	7	8	9	arrhythmic
ordered	1	2	(3)	4	5	6	7	8	9	chaotic
predictable	1	2	3	4	5	6	(7)	8	9	unpredictable
familiar	1	2	3	(4)	5	6	7	8	9	unfamiliar
rational	1	2	3	4	(5)	6	7	8	9	irrational
interesting	1	(2)	3	4	5	6	7	8	9	monotonous
clearly structured	1	2	3	(4)	5	6	7	8	9	confusing

Additional Comments about the environment:

Explain your strategy in completing the task in a few words

I tried to take a consistent direction and when I got to a street that seemed central I followed it without turning.

Which elements / characteristics of the environment helped you in completing your task?

width and continuity of streets (visibility). Height of buildings (I think)

Which elements / characteristics of the environment hindered you from completing your task?

The material of the streets that is always the same. The difficulty to remember if I had already passed from a place.

Environment 4 — Code: RV

In a climax of 1-9, rank the environment according to your experience.

simple	1	2	3	4	5	6	7	**8**	9	complex
regular	1	2	3	4	5	6	**7**	8	9	irregular
large	1	**2**	3	4	5	6	7	8	9	small
repetitive	1	2	3	4	5	**6**	7	8	9	alternating
rhythmic	1	2	**3**	4	5	6	7	8	9	arrhythmic
ordered	1	2	3	4	**5**	6	7	8	9	chaotic
predictable	1	2	3	4	5	6	7	**8**	9	unpredictable
familiar	1	2	3	4	**5**	6	7	8	9	unfamiliar
rational	1	2	3	4	**5**	6	7	8	9	irrational
interesting	1	**2**	3	4	5	6	7	8	9	monotonous
clearly structured	1	2	3	4	**5**	6	7	8	9	confusing

Additional Comments about the environment:

A street that seemed central ended suddenly on a façade.

Explain your strategy in completing the task in a few words

Same as before

Which elements / characteristics of the environment helped you in completing your task?

Same as before, morphology of building façades (central street → high-rise buildings, small streets → lesser housing)

Which elements / characteristics of the environment hindered you from completing your task?

Sudden transitions from central areas to local neighborhoods, unpredictable dead-ends

Environment 5

Code: RGF

In a climax of 1-9, rank the environment according to your experience.

simple	1	2	3	4	(5)	6	7	8	9	complex
regular	1	2	3	(4)	5	6	7	8	9	irregular
large	1	2	(3)	4	5	6	7	8	9	small
repetitive	1	2	3	4	(5)	6	7	8	9	alternating
rhythmic	1	(2)	3	4	5	6	7	8	9	arrhythmic
ordered	1	(2)	3	4	5	6	7	8	9	chaotic
predictable	1	2	3	(4)	5	6	7	8	9	unpredictable
familiar	1	2	3	4	(5)	6	7	8	9	unfamiliar
rational	1	2	(3)	4	5	6	7	8	9	irrational
interesting	1	2	(3)	4	5	6	7	8	9	monotonous
clearly structured	1	2	3	(4)	5	6	7	8	9	confusing

Additional Comments about the environment:

I can't really rank this environment because I couldn't see it!

Explain your strategy in completing the task in a few words

Tried not to change direction

Which elements / characteristics of the environment helped you in completing your task?

Pavements showing the edges of the streets

Which elements / characteristics of the environment hindered you from completing your task?

No hierarchy in lightning - maybe if central streets were more lit it could help orientation.

Environment 6

Code: P-VT

In a climax of 1-9, rank the environment according to your experience.

simple	1	2	3	4	(5)	6	7	8	9	complex
regular	1	2	3	4	(5)	6	7	8	9	irregular
large	1	(2)	3	4	5	6	7	8	9	small
repetitive	1	2	(3)	4	5	6	7	8	9	alternating
rhythmic	1	2	(3)	4	5	6	7	8	9	arrhythmic
ordered	1	2	3	(4)	5	6	7	8	9	chaotic
predictable	1	2	3	4	5	(6)	7	8	9	unpredictable
familiar	1	2	3	4	(5)	6	7	8	9	unfamiliar
rational	1	2	3	4	(5)	6	7	8	9	irrational
interesting	1	2	(3)	4	5	6	7	8	9	monotonous
clearly structured	1	2	3	4	5	(6)	7	8	9	confusing

Additional Comments about the environment:

As before. I had the impression that the streets were longer and straighter.

Explain your strategy in completing the task in a few words

Some

Which elements / characteristics of the environment helped you in completing your task?

The long straight lines of streets.
The experience from the previous navigations.

Which elements / characteristics of the environment hindered you from completing your task?

The environment seemed more homogeneous than in the previous navigations.

Thank you very much for your participation!

The Bartlett School of Graduate Studies
MSc AAC (Adaptive Architecture & Computation)
Virtual Urbanity Thesis Experiment

Personal information

Your personal details will be treated confidentially as the data will be used only for analysis and evaluation.

Name: Participant F3 Age: 27 Gender: F Occupation: ARCHITECT

Are you familiar with immersive environments? No

Are you familiar with video games? Yes

Environment 1

Code: RG

In a climax of 1-9, rank **the structure** of the environment according to your experience.

simple	1	2	3	4	**5**	6	7	8	9	complex
regular	1	2	3	**4**	5	6	7	8	9	irregular
large	1	2	3	4	5	6	**7**	8	9	small
repetitive	1	**2**	3	4	5	6	7	8	9	alternating
rhythmic	1	2	**3**	4	5	6	7	8	9	arrhythmic
ordered	1	2	**3**	4	5	6	7	8	9	chaotic
predictable	1	2	3	**4**	5	6	7	8	9	unpredictable
familiar	1	2	3	4	**5**	6	7	8	9	unfamiliar
rational	1	2	3	4	5	**6**	7	8	9	irrational
interesting	1	2	3	4	5	6	**7**	8	9	monotonous
clearly structured	1	2	3	4	5	6	**7**	8	9	confusing

Environment 2

Code: RV

In a climax of 1-9, rank **the structure** of the environment according to your experience.

simple	1	2	3	4	5	6	**7**	8	9	complex
regular	1	2	3	4	5	**6**	7	8	9	irregular
large	1	2	3	4	5	6	**7**	8	9	small
repetitive	1	2	3	4	5	6	**7**	8	9	alternating
rhythmic	1	2	3	4	5	**6**	7	8	9	arrhythmic
ordered	1	2	3	4	5	6	7	**8**	9	chaotic
predictable	1	2	3	4	5	6	7	**8**	9	unpredictable
familiar	1	2	3	4	**5**	6	7	8	9	unfamiliar
rational	1	2	3	4	5	6	**7**	8	9	irrational
interesting	1	2	3	**4**	5	6	7	8	9	monotonous
clearly structured	1	2	3	4	5	6	7	8	**9**	confusing

Environment 3

Code: PG

In a climax of 1-9, rank **the structure** of the environment according to your experience.

simple	1	2	3	4	5	6	7	8	9	complex
regular	1	2	3	4	5	6	7	8	9	irregular
large	1	2	3	4	5	6	7	8	9	small
repetitive	1	2	3	4	5	6	7	8	9	alternating
rhythmic	1	2	3	4	5	6	7	8	9	arrhythmic
ordered	1	2	3	4	5	6	7	8	9	chaotic
predictable	1	2	3	4	5	6	7	8	9	unpredictable
familiar	1	2	3	4	5	6	7	8	9	unfamiliar
rational	1	2	3	4	5	6	7	8	9	irrational
interesting	1	2	3	4	5	6	7	8	9	monotonous
clearly structured	1	2	3	4	5	6	7	8	9	confusing

Additional comments about the environment:

REMOVE THE SIGNS!!!

Explain your strategy in completing the task in a few words

MOVING ALONG A SPESIFIC DIRECTION AND TRY TO KEEP THE SAME ONE TILL THE END. PREFER TO MOVE IN PARALLEL WITH LARGE STREETS

Which elements / characteristics of the environment helped you in completing your task and in what way?

AVOID MOVING TOWARDS CROWDED BUILDINGS

Which elements / characteristics of the environment hindered you from completing your task and in what way?

NOT HAVING VISUAL IN STRAIGHT STREETS (CLIPPING PLANE)

Environment 4

Code: RGF

In a climax of 1-9, rank **the structure** of the environment according to your experience.

simple	1	2	3	4	5	6	7	8	9	complex
regular	1	2	3	4	5	6	7	8	9	irregular
large	1	2	3	4	5	6	7	8	9	small
repetitive	1	2	3	4	5	6	7	8	9	alternating
rhythmic	1	2	3	4	5	6	7	8	9	arrhythmic
ordered	1	2	3	4	5	6	7	8	9	chaotic
predictable	1	2	3	4	5	6	7	8	9	unpredictable
familiar	1	2	3	4	5	6	7	8	9	unfamiliar
rational	1	2	3	4	5	6	7	8	9	irrational
interesting	1	2	3	4	5	6	7	8	9	monotonous
clearly structured	1	2	3	4	5	6	7	8	9	confusing

Additional comments about the environment:

Explain your strategy in completing the task in a few words

LOOKING AT THE TYPES OF BUILDINGS TRY TO IDENTIFY COMMERCIAL OR INDUSTRIAL AREAS WITHIN THE CITY.

Which elements / characteristics of the environment helped you in completing your task and in what way?

TYPES OF BUILDINGS

Which elements / characteristics of the environment hindered you from completing your task and in what way?

FOG = DISORIENTATING

Environment 5

Code: RV

In a climax of 1-9, rank **the structure** of the environment according to your experience.

simple	1	2	3	4	5	6	7	8	9	complex
regular	1	2	3	4	5	6	7	8	9	irregular
large	1	2	3	4	5	6	7	8	9	small
repetitive	1	2	3	4	5	6	7	8	9	alternating
rhythmic	1	2	3	4	5	6	7	8	9	arrhythmic
ordered	1	2	3	4	5	6	7	8	9	chaotic
predictable	1	2	3	4	5	6	7	8	9	unpredictable
familiar	1	2	3	4	5	6	7	8	9	unfamiliar
rational	1	2	3	4	5	6	7	8	9	irrational
interesting	1	2	3	4	5	6	7	8	9	monotonous
clearly structured	1	2	3	4	5	6	7	8	9	confusing

Additional comments about the environment:

Explain your strategy in completing the task in a few words

MOVING AWAY FROM COMMERCIAL BUILDINGS OR HIGH OFFICE BUILDINGS MOVING TOWARDS RESIDENTIAL BUILDINGS OR MOVING ALONG STREETS EMPTY OF PEOPLE

Which elements / characteristics of the environment helped you in completing your task and in what way?

Which elements / characteristics of the environment hindered you from completing your task and in what way?

REPETITION OF THE SAME BUILDING IS NOT HELPFUL FOR ORIENTING YOURSELF IN THE CITY

Environment 6

Code: RNF

In a climax of 1-9, rank **the structure** of the environment according to your experience.

simple	1	2	3	4	5	6	7	8	9	complex
regular	1	2	3	4	5	6	7	8	9	irregular
large	1	2	3	4	5	6	7	8	9	small
repetitive	1	2	3	4	5	6	7	8	9	alternating
rhythmic	1	2	3	4	5	6	7	8	9	arrhythmic
ordered	1	2	3	4	5	6	7	8	9	chaotic
predictable	1	2	3	4	5	6	7	8	9	unpredictable
familiar	1	2	3	4	5	6	7	8	9	unfamiliar
rational	1	2	3	4	5	6	7	8	9	irrational
interesting	1	2	3	4	5	6	7	8	9	monotonous
clearly structured	1	2	3	4	5	6	7	8	9	confusing

Additional comments about the environment:

Explain your strategy in completing the task in a few words

1. TRY TO MOVE ALONG A LARGE STREET – FAILED
2. MOVE AROUND IN NON-COMMERCIAL AREA – FAILED

Which elements / characteristics of the environment helped you in completing your task and in what way?

TYPES OF BUILDINGS + WIDTH OF THE STREETS (move away from large streets)

Which elements / characteristics of the environment hindered you from completing your task and in what way?

VISIBILITY + REPETITION

Thank you very much for your participation!

The Bartlett School of Graduate Studies
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Virtual Urbanity Thesis Experiment

Personal information

Your personal details will be treated confidentially as the data will be used only for analysis and evaluation.

Name: Participant F4 Age: 27 Gender: F Occupation: STUDENT

Are you familiar with immersive environments? YES

Are you familiar with video games? YES

Environment 1 Code: RG

In a climax of 1-9, rank **the structure** of the environment according to your experience.

simple	1	(2)	3	4	5	6	7	8	9	complex
regular	1	2	3	4	(5)	6	7	8	9	irregular
large	1	2	3	4	5	6	7	(8)	9	small
repetitive	1	2	3	4	(5)	6	7	8	9	alternating
rhythmic	1	2	3	4	5	6	(7)	8	9	arrhythmic
ordered	1	2	3	4	5	(6)	7	8	9	chaotic
predictable	1	2	3	4	5	6	(7)	8	9	unpredictable
familiar	1	(2)	3	4	5	6	7	8	9	unfamiliar
rational	1	2	3	(4)	5	6	7	8	9	irrational
interesting	(1)	2	3	4	5	6	7	8	9	monotonous
clearly structured	1	2	3	4	(5)	6	7	8	9	confusing

Environment 2 Code: RV

In a climax of 1-9, rank **the structure** of the environment according to your experience.

simple	1	(2)	3	4	5	6	7	8	9	complex
regular	1	2	3	(4)	5	6	7	8	9	irregular
large	1	2	3	4	(5)	6	7	8	9	small
repetitive	1	2	3	4	5	(6)	7	8	9	alternating
rhythmic	1	2	3	4	(5)	6	7	8	9	arrhythmic
ordered	1	2	3	4	5	(6)	7	8	9	chaotic
predictable	1	2	3	(4)	5	6	7	8	9	unpredictable
familiar	1	2	3	4	5	(6)	7	8	9	unfamiliar
rational	1	2	3	4	(5)	6	7	8	9	irrational
interesting	1	2	(3)	4	5	6	7	8	9	monotonous
clearly structured	1	2	3	(4)	5	6	7	8	9	confusing

Environment 3

Code: P4

In a climax of 1-9, rank **the structure** of the environment according to your experience.

simple	1	2	3	(4)	5	6	7	8	9	complex
regular	1	2	3	4	(5)	6	7	8	9	irregular
large	1	2	(3)	4	5	6	7	8	9	small
repetitive	1	(2)	3	4	5	6	7	8	9	alternating
rhythmic	1	2	(3)	4	5	6	7	8	9	arrhythmic
ordered	1	2	3	(4)	5	6	7	8	9	chaotic
predictable	1	2	3	4	(5)	6	7	8	9	unpredictable
familiar	1	2	3	(4)	5	6	7	8	9	unfamiliar
rational	1	2	3	4	(5)	6	7	8	9	irrational
interesting	1	2	3	(4)	5	6	7	8	9	monotonous
clearly structured	1	2	3	4	(5)	6	7	8	9	confusing

Additional comments about the environment:

OVERALL THE ENVIRONMENT WAS QUITE CLEAR FOR MOVEMENT BUT THERE WAS A CERTAIN LOAF IN THE URBAN SPACE I WOULD IMAGINE AND THE TRANSITION THAT IT WAS GOING THROUGH.

Explain your strategy in completing the task in a few words

TO MOVE OUT OF THE DENSE TOWARDS THE SPARSE BUILT FORM, LOOK FOR NODES THAT WOULD OPEN OUT RATHER THAN CLOSE IN.

Which elements / characteristics of the environment helped you in completing your task and in what way?

THE DEMARCATION OF THE BUILT FORM AFTER A POINT WAS A CLEAR INDICATION FOR MOVEMENT.

Which elements / characteristics of the environment hindered you from completing your task and in what way?

SOME REPITIONS WHICH CONFUSED MY MOVEMENT WITHIN THE ENVIRONMENT.

Environment 4

Code: P6

In a climax of 1-9, rank **the structure** of the environment according to your experience.

simple	1	2	3	4	5	(6)	7	8	9	complex
regular	1	2	3	4	(5)	6	7	8	9	irregular
large	1	(2)	3	4	5	6	7	8	9	small
repetitive	1	2	3	(4)	5	6	7	8	9	alternating
rhythmic	1	2	3	4	5	6	(7)	8	9	arrhythmic
ordered	1	2	3	4	5	(6)	7	8	9	chaotic
predictable	1	2	3	4	5	(6)	7	8	9	unpredictable
familiar	1	2	3	4	5	6	(7)	8	9	unfamiliar
rational	1	2	3	(4)	5	6	7	8	9	irrational
interesting	(1)	2	3	4	5	6	7	8	9	monotonous
clearly structured	1	2	(3)	4	5	6	7	8	9	confusing

Additional comments about the environment:

THE MOVEMENT WAS MORE INTERESTING AND UNPREDICTABLE & EXCITING

Explain your strategy in completing the task in a few words

TO MOVE TOWARDS THE SPARSE URBAN FORM FROM THE DENSE CENTRE.

Which elements / characteristics of the environment helped you in completing your task and in what way?

MOVEMENTS THAT I COULD RETRACE SO EVEN IF I WENT ASTRAY I COULD ADJUST MYSELF AND COME BACK.

Which elements / characteristics of the environment hindered you from completing your task and in what way?

SOME ELEMENTS WHICH WERE REPITITIVE AND CONFUSED ME A LITTLE.

Environment 5

Code: R-YF

In a climax of 1-9, rank **the structure** of the environment according to your experience.

simple	1	2	3	4	5	6	7	(8)	9	complex
regular	1	2	3	4	5	(6)	7	8	9	irregular
large	1	2	(3)	4	5	6	7	8	9	small
repetitive	1	2	3	4	(5)	6	7	8	9	alternating
rhythmic	1	2	3	4	5	6	(7)	8	9	arrhythmic
ordered	1	(2)	3	4	5	6	7	8	9	chaotic
predictable	1	2	3	4	(5)	6	7	8	9	unpredictable
familiar	1	2	3	4	(5)	6	7	8	9	unfamiliar
rational	1	2	3	(4)	5	6	7	8	9	irrational
interesting	1	(2)	3	4	5	6	7	8	9	monotonous
clearly structured	1	2	(3)	4	5	6	7	8	9	confusing

Additional comments about the environment:

I WAS MOVING MORE AROUND THE BROADER ROADS AND LARGER URBAN SPACE TO AVOID GETTING LOST IN MEANDERING PATHWAYS.

Explain your strategy in completing the task in a few words

TO TRY AND MOVE AWAY FROM THE COMMERCIAL CITY CENTRE SPACE TO THE RESIDENTIAL SPACES AS IT WAS GETTING ITSELF (MOVED FROM THE CORNER SHOPS TOWARDS THE RESIDENCES)

Which elements / characteristics of the environment helped you in completing your task and in what way?

THE CLARITY IN SOME OF THE BUILDINGS THAT I IDENTIFIED AS I MOVED ALONG HELPED ME IN FORMING A MENTAL-MAP IN A WAY,

Which elements / characteristics of the environment hindered you from completing your task and in what way?

THE OVERALL INABILITY TO VIEW BEYOND A POINT AND THE RANDOMNESS IN CERTAIN PLACES.

Environment 6

Code: RMF

In a climax of 1-9, rank **the structure** of the environment according to your experience.

simple	1	2	3	(4)	5	6	7	8	9	complex
regular	1	2	3	4	5	(6)	7	8	9	irregular
large	1	2	(3)	4	5	6	7	8	9	small
repetitive	1	2	3	4	(5)	6	7	8	9	alternating
rhythmic	1	2	3	4	(5)	6	7	8	9	arrhythmic
ordered	1	2	3	(4)	5	6	7	8	9	chaotic
predictable	1	2	3	4	5	6	(7)	8	9	unpredictable
familiar	1	2	3	4	5	6	(7)	8	9	unfamiliar
rational	1	2	3	4	(5)	6	7	8	9	irrational
interesting	1	2	3	(4)	5	6	7	8	9	monotonous
clearly structured	1	2	(3)	4	5	6	7	8	9	confusing

Additional comments about the environment:

SAME AS ENVIRONMENT 5.

Explain your strategy in completing the task in a few words

SAME AS ENVIRONMENT 5.

Which elements / characteristics of the environment helped you in completing your task and in what way?

SAME AS ENVIRONMENT 5

Which elements / characteristics of the environment hindered you from completing your task and in what way?

SAME AS ENVIRONMENT 5.

Thank you very much for your participation!

The Bartlett School of Graduate Studies
MSc AAC (Adaptive Architecture & Computation)
Virtual Urbanity Thesis Experiment

Personal information

Your personal details will be treated confidentially as the data will be used only for analysis and evaluation.

Name: Participant F5 Age: 26 Gender: F Occupation: unemployed architect without a bike.

Are you familiar with immersive environments? Yeah Yeah

Are you familiar with video games? Yes dumbo.

Environment 1 Code: RG

In a climax of 1-9, rank **the structure** of the environment according to your experience.

simple	1	2	3	4	**5**	6	7	8	9	complex
regular	1	2	3	4	5	6	7	**8**	9	irregular
large	**1**	2	3	4	5	6	7	8	9	small
repetitive	1	2	**3**	4	5	6	7	8	9	alternating
rhythmic	1	**2**	3	4	5	6	7	8	9	arrhythmic
ordered	1	2	3	4	5	6	7	8	**9**	chaotic
predictable	1	2	3	4	5	6	7	8	**9**	unpredictable
familiar	1	2	3	**4**	5	6	7	8	9	unfamiliar
rational	1	2	3	4	5	6	7	8	**9**	irrational
interesting	**1**	2	3	4	5	6	7	8	9	monotonous
clearly structured	1	2	3	4	**5**	6	7	8	9	confusing

Environment 2 Code: RV

In a climax of 1-9, rank **the structure** of the environment according to your experience.

simple	1	2	3	4	**5**	6	7	8	9	complex
regular	1	2	3	4	5	6	**7**	8	9	irregular
large	1	2	**3**	4	5	6	7	8	9	small
repetitive	1	2	3	4	**5**	6	7	8	9	alternating
rhythmic	1	2	**3**	4	5	6	7	8	9	arrhythmic
ordered	1	**2**	3	4	5	6	7	8	9	chaotic
predictable	1	2	**3**	4	5	6	7	8	9	unpredictable
familiar	1	2	**3**	4	5	6	7	8	9	unfamiliar
rational	1	2	3	**4**	5	6	7	8	9	irrational
interesting	1	2	3	4	**5**	6	7	8	9	monotonous
clearly structured	1	**2**	3	4	5	6	7	8	9	confusing

Environment 3

Code: RG

In a climax of 1-9, rank **the structure** of the environment according to your experience.

simple	1	2	(3)	4	5	6	7	8	9	complex
regular	1	(2)	3	4	5	6	7	8	9	irregular
large	1	(2)	3	4	5	6	7	8	9	small
repetitive	1	2	(3)	4	5	6	7	8	9	alternating
rhythmic	1	2	(3)	4	5	6	7	8	9	arrhythmic
ordered	1	2	3	4	(5)	6	7	8	9	chaotic
predictable	1	2	3	4	5	6	(7)	8	9	unpredictable
familiar	1	2	(3)	4	5	6	7	8	9	unfamiliar
rational	1	2	3	4	5	6	(7)	8	9	irrational
interesting	1	2	3	4	5	6	(7)	8	9	monotonous
clearly structured	1	2	3	4	5	6	7	(8)	9	confusing

Additional comments about the environment:

Perfect.

Explain your strategy in completing the task in a few words

Just went on the wide path

Which elements / characteristics of the environment helped you in completing your task and in what way?

The Road width and actually the dead Ends.

Which elements / characteristics of the environment hindered you from completing your task and in what way?

The women in Red and the black patches on the Road. and ofcourse 'THE COURT'

Environment 4

Code: RGF

In a climax of 1-9, rank **the structure** of the environment according to your experience.

simple	1	2	3	4	5	6	7	8	9	complex
regular	1	2	3	4	5	6	7	8	9	irregular
large	1	2	3	4	5	6	7	8	9	small
repetitive	1	2	3	4	5	6	7	8	9	alternating
rhythmic	1	2	3	4	5	6	7	8	9	arrhythmic
ordered	1	2	3	4	5	6	7	8	9	chaotic
predictable	1	2	3	4	5	6	7	8	9	unpredictable
familiar	1	2	3	4	5	6	7	8	9	unfamiliar
rational	1	2	3	4	5	6	7	8	9	irrational
interesting	1	2	3	4	5	6	7	8	9	monotonous
clearly structured	1	2	3	4	5	6	7	8	9	confusing

Additional comments about the environment:

fantastic and irritating after a point because you don't know where u are going. I hate being a BLIND DRIVER.

Explain your strategy in completing the task in a few words

Just follow the path → can't have a strategy. when you don't know where you are.

Which elements / characteristics of the environment helped you in completing your task and in what way?

Just random guess of following the wide path.

Which elements / characteristics of the environment hindered you from completing your task and in what way?

The black screen.

Environment 5

Code: [illegible]

In a climax of 1-9, rank **the structure** of the environment according to your experience.

simple	1	2	3	4	5	6	7	8	9	complex
regular	1	2	3	4	5	6	7	8	9	irregular
large	1	2	3	4	5	6	7	8	9	small
repetitive	1	2	3	4	5	6	7	8	9	alternating
rhythmic	1	2	3	4	5	6	7	8	9	arrhythmic
ordered	1	2	3	4	5	6	7	8	9	chaotic
predictable	1	2	3	4	5	6	7	8	9	unpredictable
familiar	1	2	3	4	5	6	7	8	9	unfamiliar
rational	1	2	3	4	5	6	7	8	9	irrational
interesting	1	2	3	4	5	6	7	8	9	monotonous
clearly structured	1	2	3	4	5	6	7	8	9	confusing

Additional comments about the environment:

It was annoying as went round
n round without solving it.
- didn't get the candy.

Explain your strategy in completing the task in a few words

I couldn't solve it - no strategy worked.
The wide path didn't end up anywhere
like the previous experiments (going round)

Which elements / characteristics of the environment helped you in completing your task and in what way?

Nothing helped - The repetitive environment
confused me more.

Which elements / characteristics of the environment hindered you from completing your task and in what way?

The repetitive texture of the buildings
I couldn't relate to it as the previous
one.

Environment 6

Code: R-V-F

In a climax of 1-9, rank **the structure** of the environment according to your experience.

simple	1	2	3	4	5	6	7	8	9	complex
regular	1	2	3	4	5	6	7	8	9	irregular
large	1	2	3	4	5	6	7	8	9	small
repetitive	1	2	3	4	5	6	7	8	9	alternating
rhythmic	1	2	3	4	5	6	7	8	9	arrhythmic
ordered	1	2	3	4	5	6	7	8	9	chaotic
predictable	1	2	3	4	5	6	7	8	9	unpredictable
familiar	1	2	3	4	5	6	7	8	9	unfamiliar
rational	1	2	3	4	5	6	7	8	9	irrational
interesting	1	2	3	4	5	6	7	8	9	monotonous
clearly structured	1	2	3	4	5	6	7	8	9	confusing

Additional comments about the environment:

You are making a fool of everyone. There is no end. I can just go in circles forever

Explain your strategy in completing the task in a few words

Just looking for the longest path to follow and change the route if the environment seemed the same.

Which elements / characteristics of the environment helped you in completing your task and in what way?

It was the texture and the road width which I kept following

Which elements / characteristics of the environment hindered you from completing your task and in what way?

The black screen and the repetitive environment.

Thank you very much for your participation!

The Bartlett School of Graduate Studies
MSc AAC (Adaptive Architecture & Computation)
Virtual Urbanity Thesis Experiment

Personal information

Your personal details will be treated confidentially as the data will be used only for analysis and evaluation.

Name: Participant F6 Age: 32 Gender: F Occupation: Student

Are you familiar with immersive environments?

Are you familiar with video games? NO

Environment 1 Code: RG

In a climax of 1-9, rank **the structure** of the environment according to your experience.

simple	1	2	3	(4)	5	6	7	8	9	complex
regular	1	2	3	(4)	5	6	7	8	9	irregular
large	1	2	3	4	(5)	6	7	8	9	small
repetitive	1	(2)	3	4	5	6	7	8	9	alternating
rhythmic	1	2	(3)	4	5	6	7	8	9	arrhythmic
ordered	1	(2)	3	4	5	6	7	8	9	chaotic
predictable	1	(2)	3	4	5	6	7	8	9	unpredictable
familiar	1	2	3	4	5	(6)	7	8	9	unfamiliar
rational	1	2	3	4	5	6	(7)	8	9	irrational
interesting	1	2	3	4	(5)	6	7	8	9	monotonous
clearly structured	1	2	3	4	5	6	(7)	8	9	confusing

Environment 2 Code: RV

In a climax of 1-9, rank **the structure** of the environment according to your experience.

simple	1	2	3	4	5	6	(7)	8	9	complex
regular	1	2	3	4	5	6	(7)	8	9	irregular
large	1	2	3	4	(5)	6	7	8	9	small
repetitive	1	2	3	4	(5)	6	7	8	9	alternating
rhythmic	1	2	3	4	5	6	(7)	8	9	arrhythmic
ordered	1	2	3	4	5	6	7	(8)	9	chaotic
predictable	1	2	3	4	5	(6)	7	8	9	unpredictable
familiar	1	2	3	4	5	6	7	(8)	9	unfamiliar
rational	1	2	3	4	5	6	7	8	(9)	irrational
interesting	1	2	3	4	(5)	6	7	8	9	monotonous
clearly structured	1	2	3	4	5	6	7	(8)	9	confusing

Environment 3 Code: H4

In a climax of 1-9, rank **the structure** of the environment according to your experience.

simple	1	2	3	(4)	5	6	7	8	9	complex
regular	1	2	3	(4)	5	6	7	8	9	irregular
large	1	2	3	4	(5)	6	7	8	9	small
repetitive	1	(2)	3	4	5	6	7	8	9	alternating
rhythmic	1	2	3	4	5	6	(7)	8	9	arrhythmic
ordered	1	2	3	4	5	(6)	7	8	9	chaotic
predictable	1	2	3	4	5	(6)	7	8	9	unpredictable
familiar	1	2	3	4	5	6	(7)	8	9	unfamiliar
rational	1	2	3	4	5	6	7	(8)	9	irrational
interesting	1	2	3	4	5	6	7	(8)	9	monotonous
clearly structured	1	2	3	4	5	6	7	(8)	9	confusing

Additional comments about the environment:

It was difficult to know where I was as I couldn't use buildings as a clue

Explain your strategy in completing the task in a few words

Not going into circle

Which elements / characteristics of the environment helped you in completing your task and in what way?

NONE

Which elements / characteristics of the environment hindered you from completing your task and in what way?

The same scenery (shops & buildings) ☺

Environment 4

Code: P-V

In a climax of 1-9, rank **the structure** of the environment according to your experience.

simple	1	2	(3)	4	5	6	7	8	9	complex
regular	1	2	3	4	(5)	6	7	8	9	irregular
large	1	2	(3)	4	5	6	7	8	9	small
repetitive	1	2	3	4	5	(6)	7	8	9	alternating
rhythmic	1	2	3	4	5	6	(7)	8	9	arrhythmic
ordered	1	2	(3)	4	5	6	7	8	9	chaotic
predictable	1	2	3	4	5	(6)	7	8	9	unpredictable
familiar	1	2	(3)	4	5	6	7	8	9	unfamiliar
rational	1	2	3	4	(5)	6	7	8	9	irrational
interesting	1	2	(3)	4	5	6	7	8	9	monotonous
clearly structured	1	2	3	4	(5)	6	7	8	9	confusing

Additional comments about the environment:

I thought I might have made a circle (as many European towns have circles and spider nets especially around its centre)

Explain your strategy in completing the task in a few words

Finding a different area.

Which elements / characteristics of the environment helped you in completing your task and in what way?

Buildings of a different appearance

Which elements / characteristics of the environment hindered you from completing your task and in what way?

Not being able to see things in distance. (and that I cannot guess where I am)

Environment 5

Code: RF

In a climax of 1-9, rank **the structure** of the environment according to your experience.

simple	1	2	3	4	5	6	7	8	9	complex
regular	1	2	3	4	5	6	7	8	9	irregular
large	1	2	3	4	5	6	7	8	9	small
repetitive	1	2	3	4	5	6	7	8	9	alternating
rhythmic	1	2	3	4	5	6	7	8	9	arrhythmic
ordered	1	2	3	4	5	6	7	8	9	chaotic
predictable	1	2	3	4	5	6	7	8	9	unpredictable
familiar	1	2	3	4	5	6	7	8	9	unfamiliar
rational	1	2	3	4	5	6	7	8	9	irrational
interesting	1	2	3	4	5	6	7	8	9	monotonous
clearly structured	1	2	3	4	5	6	7	8	9	confusing

Additional comments about the environment:

The darkness didn't affect me ...
There were more dead ends ... it seemed

Explain your strategy in completing the task in a few words

finding out a way to a different area

Which elements / characteristics of the environment helped you in completing your task and in what way?

Buildings (residential, shops, bars etc ... as a clue to know which part of a town I was in)

Which elements / characteristics of the environment hindered you from completing your task and in what way?

NONE

Environment 6

Code: P6P

In a climax of 1-9, rank **the structure** of the environment according to your experience.

simple	1	2	3	4	5	6	(7)	8	9	complex
regular	1	2	3	4	5	6	(7)	8	9	irregular
large	1	2	3	4	(5)	6	7	8	9	small
repetitive	1	(2)	3	4	5	6	7	8	9	alternating
rhythmic	1	2	3	4	5	6	(7)	8	9	arrhythmic
ordered	1	2	3	4	5	6	7	(8)	9	chaotic
predictable	1	2	3	4	5	6	(7)	8	9	unpredictable
familiar	1	2	3	4	5	6	7	(8)	9	unfamiliar
rational	1	2	3	4	(5)	6	7	8	9	irrational
interesting	1	2	3	4	5	6	(7)	8	9	monotonous
clearly structured	1	2	3	4	5	6	(7)	8	9	confusing

Additional comments about the environment:

Explain your strategy in completing the task in a few words

Leaving the centre (with shops & bars) to a residential area.

Which elements / characteristics of the environment helped you in completing your task and in what way?

Buildings and their appearnce.

Which elements / characteristics of the environment hindered you from completing your task and in what way?

There were too many dead ends.

Thank you very much for your participation!

The Bartlett School of Graduate Studies
MSc AAC (Adaptive Architecture & Computation)
Virtual Urbanity Thesis Experiment

Personal information

Your personal details will be treated confidentially as the data will be used only for analysis and evaluation.

Name: Participant F7 Age: 26 Gender: F Occupation: Architect

Are you familiar with immersive environments? Yes

Are you familiar with video games? No

Environment 1 Code: RG

In a climax of 1-9, rank **the structure** of the environment according to your experience.

simple	1	(2)	3	4	5	6	7	8	9	complex
regular	1	2	(3)	4	5	6	7	8	9	irregular
large	1	2	3	4	5	6	7	(8)	9	small
repetitive	1	(2)	3	4	5	6	7	8	9	alternating
rhythmic	1	(2)	3	4	5	6	7	8	9	arrhythmic
ordered	1	2	(3)	4	5	6	7	8	9	chaotic
predictable	1	(2)	3	4	5	6	7	8	9	unpredictable
familiar	1	(2)	3	4	5	6	7	8	9	unfamiliar
rational	1	2	(3)	4	5	6	7	8	9	irrational
interesting	1	2	3	4	5	(6)	7	8	9	monotonous
clearly structured	1	2	3	(4)	5	6	7	8	9	confusing

Environment 2 Code: RV

In a climax of 1-9, rank **the structure** of the environment according to your experience.

simple	1	(2)	3	4	5	6	7	8	9	complex
regular	1	2	(3)	4	5	6	7	8	9	irregular
large	1	(2)	3	4	5	6	7	8	9	small
repetitive	1	2	3	4	(5)	6	7	8	9	alternating
rhythmic	1	2	3	4	(5)	6	7	8	9	arrhythmic
ordered	1	2	3	4	5	(6)	7	8	9	chaotic
predictable	1	2	3	4	5	(6)	7	8	9	unpredictable
familiar	1	2	3	4	(5)	6	7	8	9	unfamiliar
rational	1	2	3	(4)	5	6	7	8	9	irrational
interesting	1	2	3	4	(5)	6	7	8	9	monotonous
clearly structured	1	2	3	(4)	5	6	7	8	9	confusing

Environment 3 Code: F-VF

In a climax of 1-9, rank **the structure** of the environment according to your experience.

simple	1	2	3	4	5	6	7	(8)	9	complex
regular	1	2	3	4	5	6	7	(8)	9	irregular
large	1	2	3	4	5	6	7	(8)	9	small
repetitive	1	2	3	4	5	6	7	(8)	9	alternating
rhythmic	1	2	3	4	5	6	(7)	8	9	arrhythmic
ordered	1	2	3	4	5	6	(7)	8	9	chaotic
predictable	1	2	3	4	5	6	7	(8)	9	unpredictable
familiar	1	2	3	4	5	6	7	8	(9)	unfamiliar
rational	1	2	3	4	5	6	7	(8)	9	irrational
interesting	1	(2)	3	4	5	6	7	8	9	monotonous
clearly structured	1	2	3	4	(5)	6	7	8	9	confusing

Additional comments about the environment:

Explain your strategy in completing the task in a few words

I tried to remember the ~~brief~~ order of the building. But I got lost. I was confused. I haven't completed the task.

Which elements / characteristics of the environment helped you in completing your task and in what way?

The type of the buildings, shops or residences. And the size of streets - small streets in some areas and large street in some others

Which elements / characteristics of the environment hindered you from completing your task and in what way?

Some building. I thought I saw many times the same building in different areas I think I was turning around the same point.

Environment 4 Code: P6

In a climax of 1-9, rank **the structure** of the environment according to your experience.

simple	1	2	3	4	5	6	(7)	8	9	complex
regular	1	2	3	4	5	6	(7)	8	9	irregular
large	1	(2)	3	4	5	6	7	8	9	small
repetitive	1	2	3	4	(5)	6	7	8	9	alternating
rhythmic	1	2	3	4	(5)	6	7	8	9	arrhythmic
ordered	1	2	3	4	5	6	(7)	8	9	chaotic
predictable	1	2	3	4	5	6	(7)	8	9	unpredictable
familiar	1	2	3	4	5	(6)	7	8	9	unfamiliar
rational	1	2	3	4	5	(6)	7	8	9	irrational
interesting	(1)	2	3	4	5	6	7	8	9	monotonous
clearly structured	1	2	3	(4)	5	6	7	8	9	confusing

Additional comments about the environment:

Explain your strategy in completing the task in a few words

Tried to follow the big streets. ~~But preferably~~
I tore

Which elements / characteristics of the environment helped you in completing your task and in what way?

I fand some modern buildings that differ from the tradditional ones. The streets became bigger – I haven't competed the task

Which elements / characteristics of the environment hindered you from completing your task and in what way?

The ~~bored~~ repetative buildings.

Environment 5

Code: R6F

In a climax of 1-9, rank **the structure** of the environment according to your experience.

simple	1	2	3	4	5	6	7	8	9	complex
regular	1	2	3	4	5	6	7	8	9	irregular
large	1	2	3	4	5	6	7	8	9	small
repetitive	1	2	3	4	5	6	7	8	9	alternating
rhythmic	1	2	3	4	5	6	7	8	9	arrhythmic
ordered	1	2	3	4	5	6	7	8	9	chaotic
predictable	1	2	3	4	5	6	7	8	9	unpredictable
familiar	1	2	3	4	5	6	7	8	9	unfamiliar
rational	1	2	3	4	5	6	7	8	9	irrational
interesting	1	2	3	4	5	6	7	8	9	monotonous
clearly structured	1	2	3	4	5	6	7	8	9	confusing

Additional comments about the environment:

Explain your strategy in completing the task in a few words

I was trying to follow big streets.
I think I found my way by accident.
I didn't realised that I was close to the end.

Which elements / characteristics of the environment helped you in completing your task and in what way?

the streets, I think they became bigger when I was close to the end.

Which elements / characteristics of the environment hindered you from completing your task and in what way?

The repetative buildings.

Environment 6

Code: RV

In a climax of 1-9, rank **the structure** of the environment according to your experience.

simple	1	2	3	4	5	6	7	(8)	9	complex
regular	1	2	3	4	5	6	(7)	8	9	irregular
large	1	2	3	4	5	6	(7)	8	9	small
repetitive	1	2	3	4	5	(6)	7	8	9	alternating
rhythmic	1	2	3	4	5	(6)	7	8	9	arrhythmic
ordered	1	2	3	4	5	(6)	7	8	9	chaotic
predictable	1	2	3	4	5	(6)	7	8	9	unpredictable
familiar	1	2	3	4	5	(6)	7	8	9	unfamiliar
rational	1	2	3	4	5	6	(7)	8	9	irrational
interesting	1	(2)	3	4	5	6	7	8	9	monotonous
clearly structured	1	2	3	(4)	5	6	7	8	9	confusing

Additional comments about the environment:

I prefer big streets.

Explain your strategy in completing the task in a few words

like previous.

Which elements / characteristics of the environment helped you in completing your task and in what way?

like previous.

I didn't found my the way.

Which elements / characteristics of the environment hindered you from completing your task and in what way?

~~The~~ like previous

Thank you very much for your participation!

The Bartlett School of Graduate Studies
MSc AAC (Adaptive Architecture & Computation)
Virtual Urbanity Thesis Experiment

Personal information

Your personal details will be treated confidentially as the data will be used only for analysis and evaluation.

Age: 25 Gender: F Occupation: ARCHITECT

Are you familiar with immersive environments? YES Participant F8

Are you familiar with video games? YES

Environment 1

Code: RG

In a climax of 1-9, rank the environment according to your experience.

simple	1	2	3	4	5	**6**	7	8	9	complex
regular	1	2	3	**4**	5	6	7	8	9	irregular
large	1	2	3	4	5	**6**	7	8	9	small
repetitive	1	2	3	**4**	5	6	7	8	9	alternating
rhythmic	1	2	3	4	5	6	7	8	9	arrhythmic
ordered	1	2	3	4	5	**6**	7	8	9	chaotic
predictable	1	2	3	4	5	**6**	7	8	9	unpredictable
familiar	1	2	3	4	**5**	6	7	8	9	unfamiliar
rational	1	2	3	4	5	**6**	7	8	9	irrational
interesting	1	2	3	**4**	5	6	7	8	9	monotonous
clearly structured	1	2	3	4	5	6	**7**	8	9	confusing

Environment 2

Code: RV

In a climax of 1-9, rank the environment according to your experience.

simple	1	2	3	**4**	5	6	7	8	9	complex
regular	1	2	3	**4**	5	6	7	8	9	irregular
large	1	2	**3**	4	5	6	7	8	9	small
repetitive	1	2	3	4	5	**6**	7	8	9	alternating
rhythmic	1	2	**3**	4	5	6	7	8	9	arrhythmic
ordered	1	2	**3**	4	5	6	7	8	9	chaotic
predictable	1	2	3	**4**	5	6	7	8	9	unpredictable
familiar	1	2	3	**4**	5	6	7	8	9	unfamiliar
rational	1	2	**3**	4	5	6	7	8	9	irrational
interesting	1	2	3	4	**5**	6	7	8	9	monotonous
clearly structured	1	2	**3**	4	5	6	7	8	9	confusing

Environment 3 Code: RG

In a climax of 1-9, rank the environment according to your experience.

simple	1	2	3	4	5	6	**7**	8	9	complex
regular	1	2	3	4	5	**6**	7	8	9	irregular
large	1	**2**	3	4	5	6	7	8	9	small
repetitive	1	2	3	**4**	5	6	7	8	9	alternating
rhythmic	1	2	3	4	5	**6**	7	8	9	arrhythmic
ordered	1	2	**3**	4	5	6	7	8	9	chaotic
predictable	1	2	3	4	**5**	6	7	8	9	unpredictable
familiar	1	2	3	4	5	6	7	**8**	9	unfamiliar
rational	1	2	3	**4**	5	6	7	8	9	irrational
interesting	1	2	3	4	5	**6**	7	8	9	monotonous
clearly structured	1	2	3	4	5	6	**7**	8	9	confusing

Additional Comments about the environment:

Πολλές [illegible] τα [illegible] δεν [illegible] τουριστικά.

Explain your strategy in completing the task in a few words

Luck. Προσπαθούσα να κινηθώ σε ευθεία και όχι απομακρυνόμουν από τα κέντρα.

Which elements / characteristics of the environment helped you in completing your task?

Nothing ☹

Which elements / characteristics of the environment hindered you from completing your task?

Deadends.

Environment 4

Code: RV

In a climax of 1-9, rank the environment according to your experience.

simple	1	2	3	4	5	**6**	7	8	9	complex
regular	1	2	3	4	5	6	**7**	8	9	irregular
large	1	2	**3**	4	5	6	7	8	9	small
repetitive	1	2	3	4	5	**6**	7	8	9	alternating
rhythmic	1	2	3	**4**	5	6	7	8	9	arrhythmic
ordered	1	2	3	4	5	6	**7**	8	9	chaotic
predictable	1	2	3	4	**5**	6	7	8	9	unpredictable
familiar	1	2	3	4	5	6	7	**8**	9	unfamiliar
rational	1	2	3	**4**	5	6	7	8	9	irrational
interesting	1	2	3	**4**	5	6	7	8	9	monotonous
clearly structured	1	2	3	4	**5**	6	7	8	9	confusing

Additional Comments about the environment:

A lot of black holes.

Explain your strategy in completing the task in a few words

1. [illegible]
2. Going always Right
3. And then going always left.

Which elements / characteristics of the environment helped you in completing your task?

I thought people, but No.

Which elements / characteristics of the environment hindered you from completing your task?

Black holes, Deadends.

Environment 5

Code: VF

In a climax of 1-9, rank the environment according to your experience.

simple	1	2	3	4	5	6	7	8	9	complex
regular	1	2	3	4	5	6	7	8	9	irregular
large	1	2	3	4	5	6	7	8	9	small
repetitive	1	2	3	4	5	6	7	8	9	alternating
rhythmic	1	2	3	4	5	6	7	8	9	arrhythmic
ordered	1	2	3	4	5	6	7	8	9	chaotic
predictable	1	2	3	4	5	6	7	8	9	unpredictable
familiar	1	2	3	4	5	6	7	8	9	unfamiliar
rational	1	2	3	4	5	6	7	8	9	irrational
interesting	1	2	3	4	5	6	7	8	9	monotonous
clearly structured	1	2	3	4	5	6	7	8	9	confusing

Additional Comments about the environment:

A lot of empty lots.

Explain your strategy in completing the task in a few words

When in front of a block hole go back and turn left

Which elements / characteristics of the environment helped you in completing your task?

There were no light so I wasn't confused from the Buildings coming.

Which elements / characteristics of the environment hindered you from completing your task?

The empty lots because they seemed all the same.

Environment 6 Code: EYP

In a climax of 1-9, rank the environment according to your experience.

simple	1	2	3	4	5	6	**7**	8	9	complex
regular	1	2	**3**	4	5	6	7	8	9	irregular
large	1	2	**3**	4	5	6	7	8	9	small
repetitive	1	2	3	4	5	6	**7**	8	9	alternating
rhythmic	1	2	**3**	4	5	6	7	8	9	arrhythmic
ordered	1	2	**3**	4	5	6	7	8	9	chaotic
predictable	1	2	3	**4**	5	6	7	8	9	unpredictable
familiar	1	2	3	**4**	5	6	7	8	9	unfamiliar
rational	1	2	3	**4**	5	6	7	8	9	irrational
interesting	1	2	3	4	5	6	**7**	8	9	monotonous
clearly structured	1	2	3	4	**5**	6	7	8	9	confusing

Additional Comments about the environment:

A lot of ~~[illegible]~~ continuous street.

Explain your strategy in completing the task in a few words

Find and new ~~[illegible]~~ street and follow to the end.

Which elements / characteristics of the environment helped you in completing your task?

No light

Which elements / characteristics of the environment hindered you from completing your task?

~~[illegible]~~ A lot of not ending streets. (street that not end to a junction)

Thank you very much for your participation!

The Bartlett School of Graduate Studies
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Virtual Urbanity Thesis Experiment

Personal information

Your personal details will be treated confidentially as the data will be used only for analysis and evaluation.

Name: Participant M9 Age: 27 Gender: M Occupation: ARCHITECT

Are you familiar with immersive environments? YES.

Are you familiar with video games? YES.

Environment 1 Code: RG

In a climax of 1-9, rank **the structure** of the environment according to your experience.

simple	1	2	3	4	5	6	(7)	8	9	complex
regular	1	2	(3)	4	5	6	(7)	8	9	irregular
large	(1)	2	3	4	5	6	7	8	9	small
repetitive	1	2	3	4	(5)	6	7	8	9	alternating
rhythmic	1	2	3	4	5	6	(7)	8	9	arrhythmic
ordered	1	2	3	4	5	6	(7)	8	9	chaotic
predictable	1	2	3	4	5	6	(7)	8	9	unpredictable
familiar	1	2	(3)	4	5	6	7	8	9	unfamiliar
rational	1	2	(3)	4	5	6	7	8	9	irrational
interesting	1	2	(3)	4	5	6	7	8	9	monotonous
clearly structured	1	2	3	4	5	6	7	8	(9)	confusing

Environment 2 Code: RV

In a climax of 1-9, rank **the structure** of the environment according to your experience.

simple	1	2	3	4	5	6	(7)	8	9	complex
regular	1	2	(3)	4	5	6	7	8	9	irregular
large	1	2	(3)	4	5	6	7	8	9	small
repetitive	1	2	3	4	(5)	6	7	8	9	alternating
rhythmic	1	2	3	4	(5)	6	7	8	9	arrhythmic
ordered	1	2	(3)	4	5	6	7	8	9	chaotic
predictable	1	2	3	4	(5)	6	7	8	9	unpredictable
familiar	1	2	(3)	4	5	6	7	8	9	unfamiliar
rational	1	2	(3)	4	5	6	7	8	9	irrational
interesting	1	2	(3)	4	5	6	7	8	9	monotonous
clearly structured	1	2	3	4	(5)	6	7	8	9	confusing

Environment 3

Code: PV

In a climax of 1-9, rank **the structure** of the environment according to your experience.

simple	1	2	3	4	5	6	(7)	8	9	complex
regular	1	2	(3)	4	5	6	7	8	9	irregular
large	1	2	(3)	4	5	6	7	8	9	small
repetitive	1	2	3	4	(5)	6	7	8	9	alternating
rhythmic	1	2	3	4	5	6	(7)	8	9	arrhythmic
ordered	1	2	(3)	4	5	6	7	8	9	chaotic
predictable	1	2	(3)	4	5	6	7	8	9	unpredictable
familiar	1	2	(3)	4	5	6	7	8	9	unfamiliar
rational	1	2	(3)	4	5	6	7	8	9	irrational
interesting	(1)	2	3	4	5	6	7	8	9	monotonous
clearly structured	(1)	2	3	4	5	6	7	8	9	confusing

Additional comments about the environment:

rational ~~x~~percentage of built/free spaces according to the distance from centre. ~~Very~~ rational structure of streets and their directions.

Explain your strategy in completing the task in a few words

I looked for the first wide street and followed a random direction ~~xxxxx~~ regardless the fact that I would prefer to change direction. When I encountered any obstacle I changed direction just until the first wide street ~~xxxxx~~ with the same direction as the initial one.

Which elements / characteristics of the environment helped you in completing your task and in what way?

As you walk away from the centre ~~the~~ you have the feeling that you go towards the suburbia as the density of the buildings degrades.

Which elements / characteristics of the environment hindered you from completing your task and in what way?

Environment 4

Code: PG7

In a climax of 1-9, rank **the structure** of the environment according to your experience.

simple	1	2	3	4	5	6	(7)	8	9	complex
regular	1	2	3	4	(5)	6	7	8	9	irregular
large	(1)	2	3	4	5	6	7	8	9	small
repetitive	1	2	3	4	(5)	6	7	8	9	alternating
rhythmic	1	2	(3)	4	5	6	7	8	9	arrhythmic
ordered	1	2	3	4	5	6	(7)	8	9	chaotic
predictable	1	2	3	4	5	6	(7)	8	9	unpredictable
familiar	1	2	3	4	(5)	6	7	8	9	unfamiliar
rational	1	2	3	4	(5)	6	7	8	9	irrational
interesting	1	2	(3)	4	5	6	7	8	9	monotonous
clearly structured	1	2	3	4	5	6	(7)	8	9	confusing

Additional comments about the environment:

More chaotic than the previous one. There ~~was~~ is not a clear structure. Suddenly wide enough streets lead to dead ends. So it is difficult to understand which street to follow and which one to avoid, as main or secondary streets. Also the gradient of the density was less obvious.

Explain your strategy in completing the task in a few words

Initially I followed the previous strategy. But as I explored this is an unattractive strategy in more labyrinth-like environments such as this one. So I changed ~~strategy~~ and I follow the strategy to find your way out of labyrinths. That is to turn always right (or left). I did that until I came up to a clearly bigger street, which I followed towards a random direction. While that street had a curvature I was thought that may be it was a ring road. Until I observed that the curvature was towards the left while I had exited to that street from the right. Consequently this street could not be a ring road since I had eg started from the centre. After that I followed the same general direction until I came out.

Which elements / characteristics of the environment helped you in completing your task and in what way?

A little bit the gradient of the density, and the difference of magnitude between the street that I followed in the end and the first medium-sized streets. This difference made clear that this should be a main road probably leading out of the city.

Which elements / characteristics of the environment hindered you from completing your task and in what way?

In the centre even the bit wide-enough streets can lead to dead ends and this was very confusing.

Environment 5

Code: RVF

In a climax of 1-9, rank **the structure** of the environment according to your experience.

simple	1	2	3	4	5	6	**(7)**	8	9	complex
regular	1	2	**(3)**	4	5	6	7	8	9	irregular
large	**(1)**	2	3	4	5	6	7	8	9	small
repetitive	1	2	3	4	**(5)**	6	7	8	9	alternating
rhythmic	1	2	3	4	**(5)**	6	7	8	9	arrhythmic
ordered	1	2	**(3)**	4	5	6	7	8	9	chaotic
predictable	1	2	3	4	5	6	**(7)**	8	9	unpredictable
familiar	1	2	**(3)**	4	5	6	7	8	9	unfamiliar
rational	1	2	3	4	5	6	**(7)**	8	9	irrational
interesting	1	2	3	4	**(5)**	6	7	8	9	monotonous
clearly structured	1	2	3	4	5	6	**(7)**	8	9	confusing

Additional comments about the environment:

Confusing. Seemed like you don't have any practical way to orientate.

Explain your strategy in completing the task in a few words

In the beginning the environment looked like the previous one. So I followed the previous strategy. That is turn always left untill you find a wide enough street whose direction you follow.

Which elements / characteristics of the environment helped you in completing your task and in what way?

Which elements / characteristics of the environment hindered you from completing your task and in what way?

The fact that while I managed to get to a wide street that had curvature both left and right (so it was not a ring road) I followed that street for a long time and still I didn't managed to get out. ~~Even if the~~ city wasn't enormous, I have no idea what happened.

Environment 6

Code: RGF

In a climax of 1-9, rank **the structure** of the environment according to your experience.

simple	1	2	3	4	(5)	6	7	8	9	complex
regular	1	2	(3)	4	5	6	7	8	9	irregular
large	1	2	(3)	4	5	6	7	8	9	small
repetitive	1	2	3	4	(5)	6	7	8	9	alternating
rhythmic	1	2	3	4	5	6	(7)	8	9	arrhythmic
ordered	1	2	(3)	4	5	6	7	8	9	chaotic
predictable	1	2	3	4	(5)	6	7	8	9	unpredictable
familiar	1	2	(3)	4	5	6	7	8	9	unfamiliar
rational	1	2	(3)	4	5	6	7	8	9	irrational
interesting	1	2	(3)	4	5	6	7	8	9	monotonous
clearly structured	1	2	3	4	(5)	6	7	8	9	confusing

Additional comments about the environment:

The night vision hinders the way finding. More rational than the previous one.

Explain your strategy in completing the task in a few words

Well, initially I followed the one direction strategy, but then I decided to swap to another one where basic idea is the successively change between two vertical direction. And when I reached a wide street I followed it and that led me out.

Which elements / characteristics of the environment helped you in completing your task and in what way?

The text that in some cases I couldn't see anything at all was a clue that I'm moving towards the suburbs.

Which elements / characteristics of the environment hindered you from completing your task and in what way?

Thank you very much for your participation!

The Bartlett School of Graduate Studies
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Personal information

Your personal details will be treated confidentially as the data will be used only for analysis and evaluation.

Name: Participant M10 Age: 24 Gender: M Occupation: STUDENT

Are you familiar with immersive environments? YES

Are you familiar with video games? YES

Environment 1 Code: RG

In a climax of 1-9, rank **the structure** of the environment according to your experience.

simple	1	2	3	4	5	6	**7**	8	9	complex
regular	1	2	3	4	**5**	6	7	8	9	irregular
large	1	2	3	4	**5**	6	7	8	9	small
repetitive	1	2	3	4	5	6	**7**	8	9	alternating
rhythmic	1	2	3	4	5	**6**	7	8	9	arrhythmic
ordered	1	2	3	4	**5**	6	7	8	9	chaotic
predictable	1	2	3	4	5	6	**7**	8	9	unpredictable
familiar	1	**2**	3	4	5	6	7	8	9	unfamiliar
rational	1	2	3	**4**	5	6	7	8	9	irrational
interesting	1	2	3	4	5	**6**	7	8	9	monotonous
clearly structured	1	2	3	4	5	**6**	7	8	9	confusing

Environment 2 Code: RV

In a climax of 1-9, rank **the structure** of the environment according to your experience.

simple	1	2	3	4	**5**	6	7	8	9	complex
regular	1	2	3	4	5	**6**	7	8	9	irregular
large	1	2	3	4	5	6	**7**	8	9	small
repetitive	1	2	3	4	5	6	**7**	8	9	alternating
rhythmic	1	2	3	4	5	**6**	7	8	9	arrhythmic
ordered	1	2	3	4	**5**	6	7	8	9	chaotic
predictable	1	2	3	4	5	6	**7**	8	9	unpredictable
familiar	1	2	**3**	4	5	6	7	8	9	unfamiliar
rational	1	2	3	**4**	5	6	7	8	9	irrational
interesting	1	2	3	4	5	6	**7**	8	9	monotonous
clearly structured	1	2	3	4	5	**6**	7	8	9	confusing

Environment 3 Code: RGF

In a climax of 1-9, rank **the structure** of the environment according to your experience.

simple	1	2	3	4	5	(6)	7	8	9	complex
regular	1	2	3	4	5	6	(7)	8	9	irregular
large	1	2	(3)	4	5	6	7	8	9	small
repetitive	1	2	3	4	5	6	(7)	8	9	alternating
rhythmic	1	2	3	(4)	5	6	7	8	9	arrhythmic
ordered	1	2	3	(4)	5	6	7	8	9	chaotic
predictable	1	2	3	(4)	5	6	7	8	9	unpredictable
familiar	1	2	3	4	5	6	(7)	8	9	unfamiliar
rational	1	2	3	4	5	(6)	7	8	9	irrational
interesting	1	2	3	4	5	(6)	7	8	9	monotonous
clearly structured	1	2	3	4	(5)	6	7	8	9	confusing

Additional comments about the environment:

Explain your strategy in completing the task in a few words

My strategy was to find the biggest street in terms of widght and follow the street. get away of restaurants and shops which are in the center.

Which elements / characteristics of the environment helped you in completing your task and in what way?

Which elements / characteristics of the environment hindered you from completing your task and in what way?

The fact that it was night. It is really difficult to find your way in night.

Environment 4 Code: RG

In a climax of 1-9, rank **the structure** of the environment according to your experience.

simple	1	2	3	(4)	5	6	7	8	9	complex
regular	1	2	3	4	(5)	6	7	8	9	irregular
large	1	2	3	4	5	(6)	7	8	9	small
repetitive	1	2	3	4	5	6	(7)	8	9	alternating
rhythmic	1	2	3	4	5	(6)	7	8	9	arrhythmic
ordered	1	2	3	4	5	6	(7)	8	9	chaotic
predictable	1	2	(3)	4	5	6	7	8	9	unpredictable
familiar	1	2	3	4	(5)	6	7	8	9	unfamiliar
rational	1	2	(3)	4	5	6	7	8	9	irrational
interesting	1	2	3	4	(5)	6	7	8	9	monotonous
clearly structured	1	2	3	4	(5)	6	7	8	9	confusing

Additional comments about the environment:

Explain your strategy in completing the task in a few words

the same as with the Environment 3

Which elements / characteristics of the environment helped you in completing your task and in what way?

I felt that there are many shops, ~~bored~~ restaurants and squares in the centre of the city. However, while you walk away from the centre ~~you~~ is you can see those buildings rarely.

Which elements / characteristics of the environment hindered you from completing your task and in what way?

Environment 5

Code: P-V

In a climax of 1-9, rank **the structure** of the environment according to your experience.

simple	1	2	3	4	5	6	7	(8)	9	complex
regular	1	2	3	4	5	6	(7)	8	9	irregular
large	1	2	3	4	5	6	(7)	8	9	small
repetitive	1	(2)	3	4	5	6	7	8	9	alternating
rhythmic	1	2	3	4	5	6	(7)	8	9	arrhythmic
ordered	1	2	3	4	5	6	(7)	8	9	chaotic
predictable	1	2	3	4	5	6	(7)	8	9	unpredictable
familiar	1	2	3	4	5	6	7	(8)	9	unfamiliar
rational	1	2	3	4	5	6	7	(8)	9	irrational
interesting	1	2	3	4	5	6	7	(8)	9	monotonous
clearly structured	1	2	3	4	5	6	7	(8)	9	confusing

Additional comments about the environment:

Explain your strategy in completing the task in a few words

Which elements / characteristics of the environment helped you in completing your task and in what way?

Which elements / characteristics of the environment hindered you from completing your task and in what way?

There were repetition of the buildings f.e. i saw the church for the several times. The map as a whole was really confusing.

Environment 6 Code: PNF

In a climax of 1-9, rank **the structure** of the environment according to your experience.

simple	1	2	3	(4)	5	6	7	8	9	complex
regular	1	2	3	(4)	5	6	7	8	9	irregular
large	1	2	(3)	4	5	6	7	8	9	small
repetitive	1	2	3	4	5	(6)	7	8	9	alternating
rhythmic	1	2	3	4	5	6	(7)	8	9	arrhythmic
ordered	1	2	(3)	4	5	6	7	8	9	chaotic
predictable	1	2	3	(4)	5	6	7	8	9	unpredictable
familiar	1	2	3	4	(5)	6	7	8	9	unfamiliar
rational	1	2	3	(4)	5	6	7	8	9	irrational
interesting	1	2	3	4	5	6	(7)	8	9	monotonous
clearly structured	1	2	3	4	(5)	6	7	8	9	confusing

Additional comments about the environment:

Explain your strategy in completing the task in a few words

The same

Which elements / characteristics of the environment helped you in completing your task and in what way?

Which elements / characteristics of the environment hindered you from completing your task and in what way?

Same as in the environment N°3.

Thank you very much for your participation!

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Personal information

Your personal details will be treated confidentially as the data will be used only for analysis and evaluation.

Age: 27 Gender: M Occupation: Student Participant MM

Are you familiar with immersive environments? no

Are you familiar with video games? yes

Environment 1

Code: RG

In a climax of 1-9, rank the environment according to your experience.

simple	1	2	3	4	5	6	**7**	8	9	complex
regular	1	2	3	4	5	**6**	7	8	9	irregular
large	1	2	3	4	**5**	6	7	8	9	small
repetitive	1	2	3	4	5	6	7	**8**	9	alternating
rhythmic	1	2	3	4	5	6	7	8	**9**	arrhythmic
ordered	1	2	3	4	5	6	**7**	8	9	chaotic
predictable	1	2	3	4	5	**6**	7	8	9	unpredictable
familiar	1	2	**3**	4	5	6	7	8	9	unfamiliar
rational	1	**2**	3	4	5	6	7	8	9	irrational
interesting	1	2	**3**	4	5	6	7	8	9	monotonous
clearly structured	1	2	3	4	5	6	7	**8**	9	confusing

Environment 2

Code: RV

In a climax of 1-9, rank the environment according to your experience.

simple	1	2	3	4	**5**	6	7	8	9	complex
regular	1	2	3	4	**5**	6	7	8	9	irregular
large	1	2	3	**4**	5	6	7	8	9	small
repetitive	1	2	3	4	5	6	**7**	8	9	alternating
rhythmic	1	2	3	4	5	6	7	**8**	9	arrhythmic
ordered	1	2	3	4	**5**	6	7	8	9	chaotic
predictable	1	2	3	4	5	**6**	7	8	9	unpredictable
familiar	1	2	**3**	4	5	6	7	8	9	unfamiliar
rational	1	2	**3**	4	5	6	7	8	9	irrational
interesting	1	2	**3**	4	5	6	7	8	9	monotonous
clearly structured	1	2	3	4	5	**6**	7	8	9	confusing

Environment 3

Code: RG

In a climax of 1-9, rank the environment according to your experience.

simple	1	2	3	4	(5)	6	7	8	9	complex
regular	1	2	(3)	4	5	6	7	8	9	irregular
large	1	2	(3)	4	5	6	7	8	9	small
repetitive	1	2	3	4	5	6	(7)	8	9	alternating
rhythmic	1	2	3	4	5	6	(7)	8	9	arrhythmic
ordered	1	2	3	(4)	5	6	7	8	9	chaotic
predictable	1	2	3	4	5	(6)	7	8	9	unpredictable
familiar	1	2	(3)	4	5	6	7	8	9	unfamiliar
rational	1	(2)	3	4	5	6	7	8	9	irrational
interesting	1	2	(3)	4	5	6	7	8	9	monotonous
clearly structured	1	2	(3)	4	5	6	7	8	9	confusing

Additional Comments about the environment:

Once on the "broadway", I felt that ~~the exit~~ I would reach the outskirts of the city easily.

Explain your strategy in completing the task in a few words

I tried to reach a wide long road and see if it would lead me outs

Which elements / characteristics of the environment helped you in completing your task?

The wide streets.

Which elements / characteristics of the environment hindered you from completing your task?

Dead ends (incomplete) or labyrinthy-like narrow streets.

Environment 4 Code: RV

In a climax of 1-9, rank the environment according to your experience.

simple	1	2	3	4	5	6	7	(8)	9	complex
regular	1	2	(3)	4	5	6	7	8	9	irregular
large	(1)	2	3	4	5	6	7	8	9	small
repetitive	1	(2)	3	4	5	6	7	8	9	alternating
rhythmic	1	2	3	4	5	6	(7)	8	9	arrhythmic
ordered	1	2	3	4	(5)	6	7	8	9	chaotic
predictable	1	2	3	4	5	6	(7)	8	9	unpredictable
familiar	1	2	3	4	5	6	7	(8)	9	unfamiliar
rational	1	2	3	4	5	6	7	8	(9)	irrational
interesting	1	2	3	4	5	6	(7)	8	9	monotonous
clearly structured	1	2	3	4	5	6	(7)	8	9	confusing

Additional Comments about the environment:

It looked huge, with wide streets that didn't seem to lead anywhere. Felt I was going in circles

Explain your strategy in completing the task in a few words

Same strategy as previous, but - guess what? - didn't work!

Which elements / characteristics of the environment helped you in completing your task?

None. I didn't complete the task.

Which elements / characteristics of the environment hindered you from completing your task?

Many dead ends (narrow streets) and endless wide streets that kept going and going...

Environment 5 Code: RGF

In a climax of 1-9, rank the environment according to your experience.

simple	1	2	3	**4**	5	6	7	8	9	complex
regular	1	2	**3**	4	5	6	7	8	9	irregular
large	1	2	**3**	4	5	6	7	8	9	small
repetitive	1	2	3	4	5	6	**7**	8	9	alternating
rhythmic	1	**2**	3	4	5	6	7	8	9	arrhythmic
ordered	1	2	3	**4**	5	6	7	8	9	chaotic
predictable	1	2	3	**4**	5	6	7	8	9	unpredictable
familiar	1	2	3	**4**	5	6	7	8	9	unfamiliar
rational	1	2	**3**	4	5	6	7	8	9	irrational
interesting	1	**2**	3	4	5	6	7	8	9	monotonous
clearly structured	1	2	**3**	4	5	6	7	8	9	confusing

Additional Comments about the environment:

~~Shouldn't be~~ I don't think it is as confusing as the previous one, ~~apart~~ but the darkness makes it difficult.

Explain your strategy in completing the task in a few words

~~I don't~~ I was trying to stay on the widest path.

Which elements / characteristics of the environment helped you in completing your task?

The wide streets ~~where~~ kept their direction (more or less) without straying much.

Which elements / characteristics of the environment hindered you from completing your task?

Darkness that obscured the roads and the possible routes (eg at junctions)

Environment 6

Code: 12VF

In a climax of 1-9, rank the environment according to your experience.

simple	1	2	3	4	5	6	7	8	9	complex
regular	1	2	3	4	5	6	7	8	9	irregular
large	1	2	3	4	5	6	7	8	9	small
repetitive	1	2	3	4	5	6	7	8	9	alternating
rhythmic	1	2	3	4	5	6	7	8	9	arrhythmic
ordered	1	2	3	4	5	6	7	8	9	chaotic
predictable	1	2	3	4	5	6	7	8	9	unpredictable
familiar	1	2	3	4	5	6	7	8	9	unfamiliar
rational	1	2	3	4	5	6	7	8	9	irrational
interesting	1	2	3	4	5	6	7	8	9	monotonous
clearly structured	1	2	3	4	5	6	7	8	9	confusing

Additional Comments about the environment:

I seemed I was missing some major element of the city's structure.

Explain your strategy in completing the task in a few words

Same strategy but didn't work.

Which elements / characteristics of the environment helped you in completing your task?

None!

Which elements / characteristics of the environment hindered you from completing your task?

felt I was doing a big same circle. The path that felt "safe" to follow" was not straight but curved.

Thank you very much for your participation!

The Bartlett School of Graduate Studies
MSc AAC (Adaptive Architecture & Computation)
Virtual Urbanity Thesis Experiment

Personal information

Your personal details will be treated confidentially as the data will be used only for analysis and evaluation.

Age: 27 Gender: M Occupation: student Participant M12

Are you familiar with immersive environments? yes

Are you familiar with video games? yes

Environment 1 Code: RG

In a climax of 1-9, rank the environment according to your experience.

simple	1	2	3	4	5	6	7	8	9	complex
regular	1	2	3	4	5	6	7	8	9	irregular
large	1	2	3	4	5	6	7	8	9	small
repetitive	1	2	3	4	5	6	7	8	9	alternating
rhythmic	1	2	3	4	5	6	7	8	9	arrhythmic
ordered	1	2	3	4	5	6	7	8	9	chaotic
predictable	1	2	3	4	5	6	7	8	9	unpredictable
familiar	1	2	3	4	5	6	7	8	9	unfamiliar
rational	1	2	3	4	5	6	7	8	9	irrational
interesting	1	2	3	4	5	6	7	8	9	monotonous
clearly structured	1	2	3	4	5	6	7	8	9	confusing

Environment 2 Code: RV

In a climax of 1-9, rank the environment according to your experience.

simple	1	2	3	4	5	6	7	8	9	complex
regular	1	2	3	4	5	6	7	8	9	irregular
large	1	2	3	4	5	6	7	8	9	small
repetitive	1	2	3	4	5	6	7	8	9	alternating
rhythmic	1	2	3	4	5	6	7	8	9	arrhythmic
ordered	1	2	3	4	5	6	7	8	9	chaotic
predictable	1	2	3	4	5	6	7	8	9	unpredictable
familiar	1	2	3	4	5	6	7	8	9	unfamiliar
rational	1	2	3	4	5	6	7	8	9	irrational
interesting	1	2	3	4	5	6	7	8	9	monotonous
clearly structured	1	2	3	4	5	6	7	8	9	confusing

Environment 3

Code: RG

In a climax of 1-9, rank the environment according to your experience.

simple	1	2	3	4	5	6	7✓	8	9	complex
regular	1	2	3	4	5	6✓	7	8	9	irregular
large	1✓	2	3	4	5	6	7	8	9	small
repetitive	1	2	3	4✓	5	6	7	8	9	alternating
rhythmic	1	2	3	4	5✓	6	7	8	9	arrhythmic
ordered	1	2	3	4	5	6✓	7	8	9	chaotic
predictable	1	2	3	4✓	5	6	7	8	9	unpredictable
familiar	1	2	3	4	5	6✓	7	8	9	unfamiliar
rational	1	2	3	4✓	5	6	7	8	9	irrational
interesting	1	2	3	4	5✓	6	7	8	9	monotonous
clearly structured	1	2	3	4	5✓	6	7	8	9	confusing

Additional Comments about the environment:

I get some sense of a Metropolitan city.

Explain your strategy in completing the task in a few words

keep follow the main road, or the same direction.

Which elements / characteristics of the environment helped you in completing your task?

texture & size of road, density of building

Which elements / characteristics of the environment hindered you from completing your task?

Blocking building at the end of junction, junction that force me to turn and can't keep walking to the same direction.

Environment 4

Code: PY

In a climax of 1-9, rank the environment according to your experience.

simple	1	2	3	4	5	6	7	8	9	complex
regular	1	2	3	4	5	6	7	8	9	irregular
large	1	2	3	4	5	6	7	8	9	small
repetitive	1	2	3	4	5	6	7	8	9	alternating
rhythmic	1	2	3	4	5	6	7	8	9	arrhythmic
ordered	1	2	3	4	5	6	7	8	9	chaotic
predictable	1	2	3	4	5	6	7	8	9	unpredictable
familiar	1	2	3	4	5	6	7	8	9	unfamiliar
rational	1	2	3	4	5	6	7	8	9	irrational
interesting	1	2	3	4	5	6	7	8	9	monotonous
clearly structured	1	2	3	4	5	6	7	8	9	confusing

Additional Comments about the environment:

feel like ~~catching or found~~ I was in some rules that protect me to the goal

Explain your strategy in completing the task in a few words

keep the direction like the last task, avoid highrise

Which elements / characteristics of the environment helped you in completing your task?

highrise, scale of space

Which elements / characteristics of the environment hindered you from completing your task?

junction that can't go through

Environment 5

Code: RGT

In a climax of 1-9, rank the environment according to your experience.

simple	1	2	3	4	5	6	7	8	9	complex
regular	1	2	3	4	5	6	7	8	9	irregular
large	1	2	3	4	5	6	7	8	9	small
repetitive	1	2	3	4	5	6	7	8	9	alternating
rhythmic	1	2	3	4	5	6	7	8	9	arrhythmic
ordered	1	2	3	4	5	6	7	8	9	chaotic
predictable	1	2	3	4	5	6	7	8	9	unpredictable
familiar	1	2	3	4	5	6	7	8	9	unfamiliar
rational	1	2	3	4	5	6	7	8	9	irrational
interesting	1	2	3	4	5	6	7	8	9	monotonous
clearly structured	1	2	3	4	5	6	7	8	9	confusing

Additional Comments about the environment:

dark!

Explain your strategy in completing the task in a few words

direction, pavement

Which elements / characteristics of the environment helped you in completing your task?

color and element of pavement and building

Which elements / characteristics of the environment hindered you from completing your task?

darkness

Environment 6

Code: KVF

In a climax of 1-9, rank the environment according to your experience.

simple	1	2	3	4	5	6	7	8	9	complex
regular	1	2	3	4	5	6	7	8	9	irregular
large	1	2	3	4	5	6	7	8	9	small
repetitive	1	2	3	4	5	6	7	8	9	alternating
rhythmic	1	2	3	4	5	6	7	8	9	arrhythmic
ordered	1	2	3	4	5	6	7	8	9	chaotic
predictable	1	2	3	4	5	6	7	8	9	unpredictable
familiar	1	2	3	4	5	6	7	8	9	unfamiliar
rational	1	2	3	4	5	6	7	8	9	irrational
interesting	1	2	3	4	5	6	7	8	9	monotonous
clearly structured	1	2	3	4	5	6	7	8	9	confusing

Additional Comments about the environment:

of course, in darkness and a bigger space, I cant find any clue to get off!

Explain your strategy in completing the task in a few words

find bigger space, space building, green pavement

Which elements / characteristics of the environment helped you in completing your task?

pavement, density of buildy, people (character in b

Which elements / characteristics of the environment hindered you from completing your task?

darkness, too less building (walking in the ~~sea~~ dark door without anything.

Thank you very much for your participation!

The Bartlett School of Graduate Studies
MSc AAC (Adaptive Architecture & Computation)
Virtual Urbanity Thesis Experiment

Personal information

Your personal details will be treated confidentially as the data will be used only for analysis and evaluation.

Name: Participant M13 Age: 35 Gender: M Occupation: Student

Are you familiar with immersive environments? No

Are you familiar with video games? No

Environment 1 Code: RG

In a climax of 1-9, rank **the structure** of the environment according to your experience.

simple	1	2	3	4	5	6	(7)	8	9	complex
regular	1	2	3	4	5	(6)	7	8	9	irregular
large	1	2	3	(4)	5	6	7	8	9	small
repetitive	1	2	3	(4)	5	6	7	8	9	alternating
rhythmic	1	2	3	(4)	5	6	7	8	9	arrhythmic
ordered	1	2	3	4	5	6	(7)	8	9	chaotic
predictable	1	2	3	(4)	5	6	7	8	9	unpredictable
familiar	1	2	3	(4)	5	6	7	8	9	unfamiliar
rational	1	2	3	4	5	6	(7)	8	9	irrational
interesting	1	2	3	(4)	5	6	7	8	9	monotonous
clearly structured	1	2	3	4	5	6	(7)	8	9	confusing

Environment 2 Code: RV

In a climax of 1-9, rank **the structure** of the environment according to your experience.

simple	1	2	3	4	5	6	7	(8)	9	complex
regular	1	2	3	4	5	6	7	(8)	9	irregular
large	1	2	3	4	5	(6)	7	8	9	small
repetitive	1	2	3	(4)	5	6	7	8	9	alternating
rhythmic	1	2	3	(4)	5	6	7	8	9	arrhythmic
ordered	1	2	3	4	5	(6)	7	8	9	chaotic
predictable	1	2	(3)	4	5	6	7	8	9	unpredictable
familiar	1	2	3	4	5	6	(7)	8	9	unfamiliar
rational	1	2	3	4	5	6	(7)	8	9	irrational
interesting	1	2	3	4	5	(6)	7	8	9	monotonous
clearly structured	1	2	3	4	5	6	7	(8)	9	confusing

Environment 3

Code: R-V

In a climax of 1-9, rank **the structure** of the environment according to your experience.

simple	1	2	3	4	5	6	7	(8)	9	complex
regular	1	2	3	4	5	6	7	(8)	9	irregular
large	1	2	3	4	5	(6)	7	8	9	small
repetitive	1	2	3	4	(5)	6	7	8	9	alternating
rhythmic	1	2	3	4	5	(6)	7	8	9	arrhythmic
ordered	1	2	3	4	5	6	(7)	8	9	chaotic
predictable	1	2	(3)	4	5	6	7	8	9	unpredictable
familiar	1	2	3	4	5	(6)	7	8	9	unfamiliar
rational	1	2	3	4	5	6	(7)	8	9	irrational
interesting	1	2	3	4	5	(6)	7	8	9	monotonous
clearly structured	1	2	(3)	4	5	6	7	8	9	confusing

Additional comments about the environment:

Explain your strategy in completing the task in a few words

Initially I thought that the widest street would permit me to reach the city's outskirts. However, this did not work, so I thought it was a one instead, so taking any perpendicular street will permit me to reach the outskirts. This strategy did not work either, so I somehow gave up at the end.

Which elements / characteristics of the environment helped you in completing your task and in what way?

/

Which elements / characteristics of the environment hindered you from completing your task and in what way?

basically dead ends

Environment 4

Code: RGF

In a climax of 1-9, rank **the structure** of the environment according to your experience.

simple	1	2	3	4	5	6	7	(8)	9	complex
regular	1	2	3	4	5	6	7	(8)	9	irregular
large	1	2	3	4	(5)	6	7	8	9	small
repetitive	1	2	3	(4)	5	6	7	8	9	alternating
rhythmic	1	2	3	4	5	(6)	7	8	9	arrhythmic
ordered	1	2	3	4	5	6	7	(8)	9	chaotic
predictable	1	2	(3)	4	5	6	7	8	9	unpredictable
familiar	1	2	3	(4)	5	6	7	8	9	unfamiliar
rational	1	2	3	4	5	6	7	(8)	9	irrational
interesting	1	2	3	4	(5)	6	7	8	9	monotonous
clearly structured	1	2	3	4	5	6	7	(8)	9	confusing

Additional comments about the environment:

Explain your strategy in completing the task in a few words

Initally I followed the opposit strategy used before, that is, I followed ~~[illegible]~~ narrow, somehow local streets. I then realised that this strategy did not necessarily work, because the author suggested that the environment could be radically different. I followed my initial feeling that I could not find the exit!

Which elements / characteristics of the environment helped you in completing your task and in what way?

/

Which elements / characteristics of the environment hindered you from completing your task and in what way?

I couldn't perceive any structure

Environment 5

Code: F-G1

In a climax of 1-9, rank **the structure** of the environment according to your experience.

simple	1	2	3	4	5	6	7	(8)	9	complex
regular	1	(2)	3	4	5	6	7	8	9	irregular
large	1	2	3	4	5	(6)	7	8	9	small
repetitive	1	2	3	(4)	5	6	7	8	9	alternating
rhythmic	1	2	3	(4)	5	6	7	8	9	arrhythmic
ordered	1	2	(3)	4	5	6	7	8	9	chaotic
predictable	1	2	3	4	5	6	7	(8)	9	unpredictable
familiar	1	2	(3)	4	5	6	7	8	9	unfamiliar
rational	1	2	3	4	5	6	7	(8)	9	irrational
interesting	1	2	3	4	(5)	6	7	8	9	monotonous
clearly structured	1	2	3	4	5	6	7	8	(9)	confusing

Additional comments about the environment:

Explain your strategy in completing the task in a few words

I simply couldn't find the exit ~~even~~ even though I tried to imagine the environment's structure.

Which elements / characteristics of the environment helped you in completing your task and in what way?

/

Which elements / characteristics of the environment hindered you from completing your task and in what way?

It seems to be that there's no a ~~clear~~ clearly recognizable structure.

Environment 6

Code: KVT

In a climax of 1-9, rank **the structure** of the environment according to your experience.

simple	1	2	3	4	5	6	7	(8)	9	complex
regular	1	2	(3)	4	5	6	7	8	9	irregular
large	1	2	3	4	5	(6)	7	8	9	small
repetitive	1	2	3	(4)	5	6	7	8	9	alternating
rhythmic	1	2	3	(4)	5	6	7	8	9	arrhythmic
ordered	1	2	3	4	5	6	7	(8)	9	chaotic
predictable	1	2	(3)	4	5	6	7	8	9	unpredictable
familiar	1	2	3	4	5	(6)	7	8	9	unfamiliar
rational	1	2	(3)	4	5	6	7	(8)	9	irrational
interesting	1	2	3	(4)	5	6	7	8	9	monotonous
clearly structured	1	2	3	4	5	6	7	(8)	9	confusing

Additional comments about the environment:

Explain your strategy in completing the task in a few words

I couldn't grasp the structure of the network.

Which elements / characteristics of the environment helped you in completing your task and in what way?

Which elements / characteristics of the environment hindered you from completing your task and in what way?

dead ends and the absence of a ~~dead end~~ clear guiding principle.

Thank you very much for your participation!

The Bartlett School of Graduate Studies
MSc AAC (Adaptive Architecture & Computation)
Virtual Urbanity Thesis Experiment

Personal information

Your personal details will be treated confidentially as the data will be used only for analysis and evaluation.

Name: Participant M14 Age: 23 Gender: M Occupation: Student

Are you familiar with immersive environments? ~~No~~ Yes

Are you familiar with video games? Yes

Environment 1 Code: RG

In a climax of 1-9, rank **the structure** of the environment according to your experience.

simple	1	2	(3)	4	5	6	7	8	9	complex
regular	1	(2)	3	4	5	6	7	8	9	irregular
large	1	2	3	4	5	6	(7)	8	9	small
repetitive	1	2	3	4	5	(6)	7	8	9	alternating
rhythmic	1	2	3	4	5	6	(7)	8	9	arrhythmic
ordered	1	2	3	(4)	5	6	7	8	9	chaotic
predictable	1	2	3	4	5	6	7	(8)	9	unpredictable
familiar	1	(2)	3	4	5	6	7	8	9	unfamiliar
rational	1	2	3	4	(5)	6	7	8	9	irrational
interesting	1	2	(3)	4	5	6	7	8	9	monotonous
clearly structured	1	2	3	(4)	5	6	7	8	9	confusing

Environment 2 Code: RV

In a climax of 1-9, rank **the structure** of the environment according to your experience.

simple	1	2	3	4	5	(6)	7	8	9	complex
regular	1	2	3	4	(5)	6	7	8	9	irregular
large	1	(2)	3	4	5	6	7	8	9	small
repetitive	1	2	3	4	5	6	7	(8)	9	alternating
rhythmic	1	2	3	4	5	(6)	7	8	9	arrhythmic
ordered	1	2	3	(4)	5	6	7	8	9	chaotic
predictable	1	2	3	4	5	6	7	(8)	9	unpredictable
familiar	1	2	3	4	5	6	(7)	8	9	unfamiliar
rational	1	2	3	(4)	5	6	7	8	9	irrational
interesting	1	(2)	3	4	5	6	7	8	9	monotonous
clearly structured	1	2	3	4	5	(6)	7	8	9	confusing

Environment 3

Code: RVF

In a climax of 1-9, rank **the structure** of the environment according to your experience.

simple	1	2	3	4	5	6	7	8	9	complex
regular	1	2	3	4	5	6	7	8	9	irregular
large	1	2	3	4	5	6	7	8	9	small
repetitive	1	2	3	4	5	6	7	8	9	alternating
rhythmic	1	2	3	4	5	6	7	8	9	arrhythmic
ordered	1	2	3	4	5	6	7	8	9	chaotic
predictable	1	2	3	4	5	6	7	8	9	unpredictable
familiar	1	2	3	4	5	6	7	8	9	unfamiliar
rational	1	2	3	4	5	6	7	8	9	irrational
interesting	1	2	3	4	5	6	7	8	9	monotonous
clearly structured	1	2	3	4	5	6	7	8	9	confusing

Additional comments about the environment:

Explain your strategy in completing the task in a few words

I tried to use the big roads * to get out of city and also loading the ~~ess~~ houses.

* and then tried to the smaller roads

Which elements / characteristics of the environment helped you in completing your task and in what way?

The structure of the roads and the houses

Which elements / characteristics of the environment hindered you from completing your task and in what way?

The parks. Confusing me where is the rural parts of the city.

Environment 4

Code: PG1F

In a climax of 1-9, rank **the structure** of the environment according to your experience.

simple	1	2	3	4	5	6	7	(8)	9	complex
regular	1	2	3	4	5	6	(7)	8	9	irregular
large	(1)	2	3	4	5	6	7	8	9	small
repetitive	1	2	3	4	5	6	(7)	8	9	alternating
rhythmic	1	2	3	4	5	6	(7)	8	9	arrhythmic
ordered	1	2	3	4	(5)	6	7	8	9	chaotic
predictable	1	2	3	4	5	6	7	8	(9)	unpredictable
familiar	1	2	3	4	5	6	(7)	8	9	unfamiliar
rational	1	2	3	4	5	(6)	7	8	9	irrational
interesting	(1)	2	3	4	5	6	7	8	9	monotonous
clearly structured	1	2	(3)	4	5	6	7	8	9	confusing

Additional comments about the environment:

Explain your strategy in completing the task in a few words

See previous

Which elements / characteristics of the environment helped you in completing your task and in what way?

See previous

Which elements / characteristics of the environment hindered you from completing your task and in what way?

The complexity of city and it's size.
The order of city make me to get confused where exactly I am.

Environment 5

Code: [illegible]

In a climax of 1-9, rank **the structure** of the environment according to your experience.

simple	1	2	3	4	5	6	7	**8**	9	complex
regular	1	2	3	4	5	**6**	7	8	9	irregular
large	1	**2**	3	4	5	6	7	8	9	small
repetitive	1	2	3	4	5	6	7	**8**	9	alternating
rhythmic	1	2	3	4	5	**6**	7	8	9	arrhythmic
ordered	1	2	**3**	4	5	6	7	8	9	chaotic
predictable	1	2	3	4	5	6	**7**	8	9	unpredictable
familiar	1	2	3	**4**	5	6	7	8	9	unfamiliar
rational	1	2	3	**4**	5	6	7	8	9	irrational
interesting	**1**	2	3	4	5	6	7	8	9	monotonous
clearly structured	1	2	**3**	4	5	6	7	8	9	confusing

Additional comments about the environment:

Explain your strategy in completing the task in a few words

I try to find my position in town using the structure of buildings. Then using the big roads, tried to found the [illegible] area of the city

Which elements / characteristics of the environment helped you in completing your task and in what way?

The structure of the buildings and the roads

Which elements / characteristics of the environment hindered you from completing your task and in what way?

The complex structure of the city and large number of big roads

Environment 6 Code: P-V

In a climax of 1-9, rank **the structure** of the environment according to your experience.

simple	1	2	3	4	5	6	7	8	**9**	complex
regular	1	2	**3**	4	5	6	7	8	9	irregular
large	1	**2**	3	4	5	6	7	8	9	small
repetitive	1	2	3	4	5	6	7	**8**	9	alternating
rhythmic	1	2	3	**4**	5	6	7	8	9	arrhythmic
ordered	1	2	3	**4**	5	6	7	8	9	chaotic
predictable	1	2	3	4	5	6	7	**8**	9	unpredictable
familiar	1	2	3	4	**5**	6	7	8	9	unfamiliar
rational	1	2	3	4	**5**	6	7	8	9	irrational
interesting	**1**	2	3	4	5	6	7	8	9	monotonous
clearly structured	1	**2**	3	4	5	6	7	8	9	confusing

Additional comments about the environment:

Explain your strategy in completing the task in a few words

I try to find my position in town using the structure of building. Then using the roads I tried to found the road Even of the city

Which elements / characteristics of the environment helped you in completing your task and in what way?

The structure of the building and the roads

Which elements / characteristics of the environment hindered you from completing your task and in what way?

The complex structure of the city and [redacted] buildings.

Thank you very much for your participation!

The Bartlett School of Graduate Studies
MSc AAC (Adaptive Architecture & Computation)
Virtual Urbanity Thesis Experiment

Personal information

Your personal details will be treated confidentially as the data will be used only for analysis and evaluation.

Age: 27 Gender: Male Occupation: Architect

Are you familiar with immersive environments? Yes Participant M15

Are you familiar with video games? Yes.

Environment 1 Code: RG

In a climax of 1-9, rank the environment according to your experience.

simple	1	2	3	(4)	5	6	7	8	9	complex
regular	1	2	3	4	5	(6)	7	8	9	irregular
large	1	2	(3)	4	5	6	7	8	9	small
repetitive	1	2	3	4	5	(6)	7	8	9	alternating
rhythmic	1	2	3	4	5	6	(7)	8	9	arrhythmic
ordered	1	2	3	(4)	5	6	7	8	9	chaotic
predictable	1	2	3	4	5	6	(7)	8	9	unpredictable
familiar	1	2	3	(4)	5	6	7	8	9	unfamiliar
rational	1	2	(3)	4	5	6	7	8	9	irrational
interesting	1	2	3	(4)	5	6	7	8	9	monotonous
clearly structured	1	2	3	4	5	(6)	7	8	9	confusing

Environment 2 Code: RV

In a climax of 1-9, rank the environment according to your experience.

simple	1	2	3	4	5	(6)	7	8	9	complex
regular	1	2	3	4	5	(6)	7	8	9	irregular
large	1	2	3	4	5	6	(7)	8	9	small
repetitive	1	2	3	4	5	6	(7)	8	9	alternating
rhythmic	1	2	3	4	5	(6)	7	8	9	arrhythmic
ordered	1	2	3	4	(5)	6	7	8	9	chaotic
predictable	1	2	3	4	5	6	(7)	8	9	unpredictable
familiar	1	2	3	4	(5)	6	7	8	9	unfamiliar
rational	1	2	3	(4)	5	6	7	8	9	irrational
interesting	1	2	(3)	4	5	6	7	8	9	monotonous
clearly structured	1	2	3	4	5	(6)	7	8	9	confusing

Environment 3

Code: RG

In a climax of 1-9, rank the environment according to your experience.

simple	1	2	3	(4)	5	6	7	8	9	complex
regular	1	2	3	(4)	5	6	7	8	9	irregular
large	1	(2)	3	4	5	6	7	8	9	small
repetitive	1	2	3	4	5	(6)	7	8	9	alternating
rhythmic	1	2	3	4	5	(6)	7	8	9	arrhythmic
ordered	1	2	3	(4)	5	6	7	8	9	chaotic
predictable	1	2	3	(4)	5	6	7	8	9	unpredictable
familiar	1	2	3	4	(5)	6	7	8	9	unfamiliar
rational	1	2	3	(4)	5	6	7	8	9	irrational
interesting	1	2	3	(4)	5	6	7	8	9	monotonous
clearly structured	1	2	3	(4)	5	6	7	8	9	confusing

Additional Comments about the environment:

Wider streets had higher buildings
The fact that wide streets with high buildings ~~de~~ are not laid with asphalt seemed ~~un~~familiar.

Explain your strategy in completing the task in a few words

Choose a random direction initially. Keep going and choose directions at junctions that seem to send you in the opposite direction of where you started

Which elements / characteristics of the environment helped you in completing your task?

When I found a wide street I just followed it to the end. ~~As it had few deviations~~

Which elements / characteristics of the environment hindered you from completing your task?

No map.
I didn't visit any alleys, but I imagine that if I did I would have had a harder time getting out of them.

Environment 4

Code: RV

In a climax of 1-9, rank the environment according to your experience.

simple	1	2	3	4	5	6	(7)	8	9	complex
regular	1	2	3	4	5	6	(7)	8	9	irregular
large	1	2	(3)	4	5	6	7	8	9	small
repetitive	1	2	3	4	5	6	(7)	8	9	alternating
rhythmic	1	2	3	4	5	(6)	7	8	9	arrhythmic
ordered	1	2	3	4	5	(6)	7	8	9	chaotic
predictable	1	2	3	4	5	6	(7)	8	9	unpredictable
familiar	1	2	3	4	(5)	6	7	8	9	unfamiliar
rational	1	2	3	4	(5)	6	7	8	9	irrational
interesting	1	2	3	(4)	5	6	7	8	9	monotonous
clearly structured	1	2	3	4	5	6	(7)	8	9	confusing

Additional Comments about the environment:

Curved streets are interesting in that the pedestrian can look at the facades of more buildings.

Explain your strategy in completing the task in a few words

I thought that the city was organized in concentric rings when I found two concentric main roads so I thought that by taking a street perpendicular to them I would get out. But it didn't work and I got lost in the alleys.

Which elements / characteristics of the environment helped you in completing your task?

Curvature of streets. ~~I tried to take a street~~ when I noticed that a street was being curved for a long distance, I tried to find another street that would lead me the opposite way from the curvature

Which elements / characteristics of the environment hindered you from completing your task?

Curved streets can be confusing when there are several of them.

Environment 5

Code: RG F

In a climax of 1-9, rank the environment according to your experience.

simple	1	2	3	4	5	6	7	8	9	complex
regular	1	2	3	4	5	6	7	8	9	irregular
large	1	2	3	4	5	6	7	8	9	small
repetitive	1	2	3	4	5	6	7	8	9	alternating
rhythmic	1	2	3	4	5	6	7	8	9	arrhythmic
ordered	1	2	3	4	5	6	7	8	9	chaotic
predictable	1	2	3	4	5	6	7	8	9	unpredictable
familiar	1	2	3	4	5	6	7	8	9	unfamiliar
rational	1	2	3	4	5	6	7	8	9	irrational
interesting	1	2	3	4	5	6	7	8	9	monotonous
clearly structured	1	2	3	4	5	6	7	8	9	confusing

Additional Comments about the environment:

Explain your strategy in completing the task in a few words

I was on
Same as before. When noticing a street being curved too much I started look for another street that would take me away in the other direction. But I didn't go into any alley. Instead I waited # until a suitable wide street would come up.

Which elements / characteristics of the environment helped you in completing your task?

Which elements / characteristics of the environment hindered you from completing your task?

Darkness - Shorter vision can obstruct decision making

Environment 6

Code: RVF

In a climax of 1-9, rank the environment according to your experience.

simple	1	2	3	4	5	6	**7**	8	9	complex
regular	1	2	3	4	5	**6**	7	8	9	irregular
large	1	2	**3**	4	5	6	7	8	9	small
repetitive	1	2	3	4	5	**6**	7	8	9	alternating
rhythmic	1	2	3	4	5	**6**	7	8	9	arrhythmic
ordered	1	2	3	4	5	**6**	7	8	9	chaotic
predictable	1	2	3	4	5	6	**7**	8	9	unpredictable
familiar	1	2	3	4	5	**6**	7	8	9	unfamiliar
rational	1	2	3	4	**5**	6	7	8	9	irrational
interesting	1	2	3	4	**5**	6	7	8	9	monotonous
clearly structured	1	2	3	4	5	6	**7**	8	9	confusing

Additional Comments about the environment:

It seemed more complex

Explain your strategy in completing the task in a few words

Same as before.

Which elements / characteristics of the environment helped you in completing your task?

Which elements / characteristics of the environment hindered you from completing your task?

Darkness, complexity of city.

Thank you very much for your participation!

The Bartlett School of Graduate Studies
MSc AAC (Adaptive Architecture & Computation)
Virtual Urbanity Thesis Experiment

Personal information

Your personal details will be treated confidentially as the data will be used only for analysis and evaluation.

Name: Participant M16 Age: 26 Gender: M Occupation: Student/Architect

Are you familiar with immersive environments? Yes

Are you familiar with video games? Yes

Environment 1 Code: RG

In a climax of 1-9, rank **the structure** of the environment according to your experience.

simple	1	2	3	4	5	6	7	8	9	complex
regular	1	2	3	4	5	6	7	8	9	irregular
large	1	2	3	4	5	6	7	8	9	small
repetitive	1	2	3	4	5	6	7	8	9	alternating
rhythmic	1	2	3	4	5	6	7	8	9	arrhythmic
ordered	1	2	3	4	5	6	7	8	9	chaotic
predictable	1	2	3	4	5	6	7	8	9	unpredictable
familiar	1	2	3	4	5	6	7	8	9	unfamiliar
rational	1	2	3	4	5	6	7	8	9	irrational
interesting	1	2	3	4	5	6	7	8	9	monotonous
clearly structured	1	2	3	4	5	6	7	8	9	confusing

Environment 2 Code: RV

In a climax of 1-9, rank **the structure** of the environment according to your experience.

simple	1	2	3	4	5	6	7	8	9	complex
regular	1	2	3	4	5	6	7	8	9	irregular
large	1	2	3	4	5	6	7	8	9	small
repetitive	1	2	3	4	5	6	7	8	9	alternating
rhythmic	1	2	3	4	5	6	7	8	9	arrhythmic
ordered	1	2	3	4	5	6	7	8	9	chaotic
predictable	1	2	3	4	5	6	7	8	9	unpredictable
familiar	1	2	3	4	5	6	7	8	9	unfamiliar
rational	1	2	3	4	5	6	7	8	9	irrational
interesting	1	2	3	4	5	6	7	8	9	monotonous
clearly structured	1	2	3	4	5	6	7	8	9	confusing

Environment 3

Code: RV

In a climax of 1-9, rank **the structure** of the environment according to your experience.

simple	1	2	3	4	5	6	(7)	8	9	complex
regular	1	2	3	4	5	6	(7)	8	9	irregular
large	1	(2)	3	4	5	6	7	8	9	small
repetitive	1	2	3	4	5	6	7	(8)	9	alternating
rhythmic	1	(2)	3	4	5	6	7	8	9	arrhythmic
ordered	1	(2)	3	4	5	6	7	8	9	chaotic
predictable	1	2	(3)	4	5	6	7	8	9	unpredictable
familiar	1	2	(3)	4	5	6	7	8	9	unfamiliar
rational	1	(2)	3	4	5	6	7	8	9	irrational
interesting	(1)	2	3	4	5	6	7	8	9	monotonous
clearly structured	(1)	2	3	4	5	6	7	8	9	confusing

Additional comments about the environment:

Tall buildings reminded me of offices, ~~but~~ that could signify either center, but if an old city probably the edge. Rational in its expansion – Nodal points = elements of decoding of ~~the city~~

Explain your strategy in completing the task in a few words

I was following a zic-zac route. ~~Pursue~~ Followed ~~by~~ direct lines. Moved away from the "organic center." Tried to identify landmarks. Tried to make sence of what of buildings.

Which elements / characteristics of the environment helped you in completing your task and in what way? (GRID)

Hights of buildings, width of street, directness – length of the route, the shape of the nodes (a Y tells that the center of the city is on the bottom point of the Y)

Which elements / characteristics of the environment hindered you from completing your task and in what way?

The hight of the buildings, the repeditiveness of some buildings (prevent from setting landmarks).

Environment 4

Code: RGF

In a climax of 1-9, rank **the structure** of the environment according to your experience.

simple	1	2	(3)	4	5	6	7	8	9	complex
regular	1	2	(3)	4	5	6	7	8	9	irregular
large	1	2	3	(4)	5	6	7	8	9	small
repetitive	1	2	(3)	4	5	6	7	8	9	alternating
rhythmic	1	(2)	3	4	5	6	7	8	9	arrhythmic
ordered	1	(2)	3	4	5	6	7	8	9	chaotic
predictable	1	(2)	3	4	5	6	7	8	9	unpredictable
familiar	1	2	3	(4)	5	6	7	8	9	unfamiliar
rational	(1)	2	3	4	5	6	7	8	9	irrational
interesting	1	2	3	4	5	(6)	7	8	9	monotonous
clearly structured	1	2	3	4	(5)	6	7	8	9	confusing

Additional comments about the environment:

Easy to navigate ~~through~~ by following the wide routes.

Explain your strategy in completing the task in a few words

moving to wider streets and doing the zic zac movement, while doing stops to check alternative routs.

Which elements / characteristics of the environment helped you in completing your task and in what way?

direct lines, the density of structures, width of streets
By not seeing what followed I sticked to a few elements.

Which elements / characteristics of the environment hindered you from completing your task and in what way?

Environment 5

Code: R-VF

In a climax of 1-9, rank **the structure** of the environment according to your experience.

simple	1	2	(3)	4	5	6	7	8	9	complex
regular	1	2	3	(4)	5	6	7	8	9	irregular
large	1	2	(3)	4	5	6	7	8	9	small
repetitive	1	(2)	3	4	5	6	7	8	9	alternating
rhythmic	1	2	3	4	5	6	(7)	8	9	arrhythmic
ordered	1	2	3	4	5	(6)	7	8	9	chaotic
predictable	1	2	3	4	5	6	(7)	8	9	unpredictable
familiar	1	2	3	4	5	6	(7)	8	9	unfamiliar
rational	1	2	3	4	(5)	6	7	8	9	irrational
interesting	1	(2)	3	4	5	6	7	8	9	monotonous
clearly structured	1	2	3	4	5	6	7	(8)	9	confusing

Additional comments about the environment:

Felt as making U Turns. The highways led to the center I thought, or it could be an area at the edge but with an old center??

Explain your strategy in completing the task in a few words

Zig zag route - ~~follow~~ rather than following the wide routes.

Which elements / characteristics of the environment helped you in completing your task and in what way?

Some paths that connected wide routes, I think. Also the existence of ~~suburbia~~ empty plots or indicate an edge.

Which elements / characteristics of the environment hindered you from completing your task and in what way?

The existence of a multitude of wide streets.

Environment 6

Code: RG1

In a climax of 1-9, rank **the structure** of the environment according to your experience.

simple	1	2	3	(4)	5	6	7	8	9	complex
regular	1	2	(3)	4	5	6	7	8	9	irregular
large	1	2	3	4	(5)	6	7	8	9	small
repetitive	1	2	3	4	5	(6)	7	8	9	alternating
rhythmic	1	(2)	3	4	5	6	7	8	9	arrhythmic
ordered	1	(2)	3	4	5	6	7	8	9	chaotic
predictable	1	2	(3)	4	5	6	7	8	9	unpredictable
familiar	(1)	2	3	4	5	6	7	8	9	unfamiliar
rational	1	(2)	3	4	5	6	7	8	9	irrational
interesting	1	2	(3)	4	5	6	7	8	9	monotonous
clearly structured	1	(2)	3	4	5	6	7	8	9	confusing

Additional comments about the environment:

I think I ~~ee experienced~~ was here before.

Explain your strategy in completing the task in a few words

Zic zac + memory ~~if~~ (or ~~if not~~ built experience from previous environments)

Which elements / characteristics of the environment helped you in completing your task and in what way?

The wide streets, fast connection of two things - center - to some other center, thus edge.

Which elements / characteristics of the environment hindered you from completing your task and in what way?

Thank you very much for your participation!