A Model of Weak Heritage

the Development of 3D VGA Tools

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Abstract
The paper presents the development of a configurational model for the identification and analysis of what has been called "weak heritage", and its application on Valparaíso. The main objective of the paper is to contribute to the methods currently under development aimed at representing a person's visual field in the environment in an objective and automatic way. Nevertheless it chooses to test the new tools in a very special place: a city built in an abrupt topography that has been listed by the UNESCO World Heritage Committee, and in doing so it also aims at clarifying the "weak heritage" concept.

Weak heritage, also known as "modest heritage" refers to those aspects of a city that, while not related to monumental buildings or spaces, are nevertheless responsible for a large part of its identity and quality. The weak heritage concept presents a paradox from its very definition: how to protect and give boundaries to something that is defined as diffuse and ambiguous. The research started with the intuition that non-monumental heritage character depends to a great extent on configurational aspects of the urban grid.

Thus, the present paper has methodological and theoretical implications. From a methodological point of view, it hopes to contribute to solve a long-standing problem in isovist theory: its inadequacy to represent a person's visual experiences in urban scenarios with an abrupt geography. From a theoretical point of view, this paper's objectives are twofold. On the one hand, it aims to close the gap between Gibson's idea of "visual flow", which is considered as a fundamental precedent of contemporary theories of vision (MacEachren, 1995, Marr 1982, Gregory 1998), and existing mechanisms of visual analysis. On the other hand, by installing objective methods to describe a person's visual experience in urban scenarios, it aims to contribute to the current debate in relation to the weak heritage.

The paper has six parts. After a short introduction, the second section presents a review of the development of isovist analysis from the work of Tandy, Gibson and Benedikt to the configurational models by Turner et al. Thirdly, a brief recollection of the development of the heritage concept is presented; from the traditional vision centred in monuments to a more contemporary one that considers that an area or site can be considered monumental although none of the constituting elements are worthy of that designation by themselves.

The fourth part presents the development of a three dimensional configurational model of visual fields. The software exercise starts by developing a 3D Isovist model and later a 3D EVAS model. Finally based on the method developed by Turner a 3D configurational visibility model is developed and applied and the implications of the measurements produced by them are discussed. The fifth part of the paper presents the application of the three dimensional configurational visibility model in a sector of Valparaíso. Each of the previously selected measurements are discussed here in relation with the context. Also in this part the measurements are correlated with data brought from the photographic web page flickr, an open internet web page where users register pictures. The statistical analysis correlates the frequency of pictures taken by Chilean and non-Chilean versus the different configurational measurements brought from the models.

Finally, the paper puts forward some conclusions based on the statistical and representational analysis of the models, bringing forward the Small World theory proposed by Milgram. The study shows that the configurational visibility models can help to identify those nodes that –as in the Small World theory– create long links crossing from one local reality to another located in a far away part of the city. These fulfil the role of articulating the local with the global, building up that very special characteristic typical of Valparaíso where the spatial perception is at the same time extremely local while participating of the global structure of the city at the same time.

Introduction

Vision is considered by many as the most important of human senses. By virtue of vision, people can make sense of their environments and move in it in seemingly uncomplicated ways. Until the sixties, vision was mainly considered a physiological phenomenon. According to this view, people could see because some external stimuli activated the retina, forming as a result an image in their brains that corresponded to what was observable in the environment. It was hypothesized that vision had nothing to do with the viewer, but with the presence of distinguishable features existing in the world.

From the sixties onwards, a new paradigm emerged, that suggests that vision is an information-processing system, defined by the convergence of pre-attentive and attentive processes. The underlying idea is that people are not external to the phenomenon of seeing, but that they play an active role in determining what should be seen. Fundamental in this idea is the work of Gibson. He declared that "locomotion is guided by visual perception" (Gibson, 1979: 223), meaning that individuals move because they see, not see because they walk. By placing vision as a cause, rather than as a result of movement, Gibson made an important contribution to the development of more ecologically-centered theories of cognition, which have stressed the dynamic character of the act of seeing. (Marr 1982, Thompson, 2007).

This paper should be read in that context. Its main objective is to contribute to the methods currently under development aimed at representing a person's visual field in the environment in an objective and automatic way. Nevertheless it chooses to test the new tools in a very special place: a city built in an abrupt topography that has been listed by the UNESCO World Heritage Committee, and in doing so it also aims at clarifying the "weak heritage" concept.

Weak heritage, also known as "modest heritage" refers to those aspects of a city that, while not related to monumental buildings or spaces, are nevertheless responsible for a large part of its identity and quality. The weak heritage concept presents a paradox from its very definition: how to protect and give boundaries to something that is defined as diffuse and ambiguous. The research started with the intuition that non-monumental heritage character depends to a great extent on configurational aspects of the urban grid.

The case of Valparaíso, a port in the Pacific set in a natural amphitheatre, where colonizers from an array of European cultures built their home and business some two hundred years ago, seemed an especially interesting place to test the idea for several reasons. First, the cultural mix of its original colonisers left a very recognisable print on special areas of the city; second, the urban grid and visual connections are to a great extent, organic and un-planned, and mainly respond to the

very special and abrupt geographical context; and third, the city has an undeniable and essentially non-discursive charm which is generally associated to precisely the modest or weak heritage concept.

Thus, the present paper has methodological and theoretical implications. From a methodological point of view, it hopes to contribute to solve a long-standing problem in isovist theory: its inadequacy to represent a person's visual experiences in urban scenarios with an abrupt geography. From a theoretical point of view, this paper's objectives are twofold. On the one hand, it aims to close the gap between Gibson's idea of "visual flow", which is considered as a fundamental precedent of contemporary theories of vision (MacEachren, 1995, Marr 1982, Gregory 1998), and existing mechanisms of visual analysis. On the other hand, by installing objective methods to describe a person's visual experience in urban scenarios, it aims to contribute to the current debate in relation to the weak heritage.

The paper has four parts. After this introduction, the second section presents a brief review of the development of isovist analysis. Thirdly, some perspectives towards the heritage concept will be discussed. The fourth part presents the method developed to construct 3D isovists, and the fifth its application in the world heritage area of Valparaiso. The final part discusses the main findings of this research.

A Brief Review of Isovist Analysis

Although the term isovist was first mentioned in the work of Tandy (1967), the concept has more in common with the work of Gibson (1979) and his idea of "visual flows". Gibson, an American psychologist preoccupied with the way in which the environment is visually perceived by people, posed a fundamental question: how do individuals form a unified version of the world if they only see partial images of it? Gibson responded to this question in an elegant way. He suggested that although persons have a partial view of the environment (what he called the visual field of the area potentially observable by an individual's eyes), motion allows them to infer the stability of the external world. As humans move, Gibson said, the visual field constantly shrinks and expands, reflecting the fact that opaque barriers appear and disappear from a person's retinal image. In order to form a unified and plausible representation of the world, a subject has to make inferences and to imagine the surfaces and objects abruptly disappearing from view. This would permit a person to detect "*the invariant structure of the house, the town, or the whole habitat*" (Gibson 1979:198).

Gibson's ideas were highly influential on the work of Benedikt (1979), who simplified them in order to construct what he called an isovist. Defined as the "*set of all points visible from a given vantage point in space and with respect to an environment*" (Benedikt 1979:47), an isovist is in fact a planar description of Gibson´s idea of field of view, without the inclusion of the vertical dimension.

Normally traced at eye-level, isovists were conceived as a way to depict, in an objective manner, how the world is visually perceived by humans. "*An observer's perception is thus circumscribed, if not determined, by the environment-as-presented at the point of observation. A cumulative understanding of the form of the environment is arrived at by perceiving variants and invariants in the transformation of the information available caused by the observer's movement* " (Benedikt 1979:48).

During the last twenty years, a growing number of researchers –especially from the space syntax community– have utilized this technique to assess the visual properties of spatial layouts. Batty (2001), for example, suggested that isovist analysis sheds light on two of the fundamental aspects of visual perception: how much and how far an individual can see in an environment. He employed isovist analysis to study these properties on three different scales of the built environment: a building, a neighbourhood and an entire village. Like Benedikt, he discovered that isovist analysis could not only picture the visual affordances of each of these environments, but also it could inform an external viewer about the visual experience of a person navigating in these worlds. Concordant with Batty, Conroy-Dalton (2001; 2007) has showed that people tend to intuitively

navigate along well-connected routes of ample and extended isovists, and that pauses are likely to occur at places with large and "spiky" isovists.

Turner and Penn (2002), discovered that isovists analysis can predict people's movement's patterns in indoor environments. The authors used data from a previous study that followed more than one-hundred persons during ten minutes at the Tate Britain Gallery in London, which recorded people's trajectories and pauses. This data was then compared against the gallery's visual configuration, finding that people tended to circulate along highly visible spaces. In 2003 Turner employed isovist analysis in a popular area of London (Turner 2003), revealing that visual properties of space could also predict people's dynamic occupancy of streets. Peponis et al (2004), on the other hand, discovered that the artefacts more visually connected to other artefacts received more attention (and hence, more visits), than those with lower degrees of visibility.

Similar results have been found by Campos de Arruda (Campos 1997), who observed static occupancy patterns in twelve squares in London. She discovered that stationary patterns of these squares occupancy were inversely related to how much these spaces could be seen from different points of view, meaning that highly exposed places were avoided by most people, who instead tended to choose more secluded locations. Chang and Penn (1998), on the other hand, found the length of an isovist was a reliable predictor of people's navigational performances in a multilevel building.

In an attempt to explain the role of visual perception on human locomotion, Penn and Turner (2001), have moved one step forward, by developing virtual agents provided with a simple stochastic architecture whose unique input is to retrieve the visual properties of space. In order to do so, they defined virtual agents and made them navigate an environment purely guided by its visual properties. Penn and Turner discovered that the agents, despite lacking any intentionality, could robustly reflect how people moved in real-world scenarios. "*The agent can infer the affordances of the environment, or at least information on the global spatial relations visible from their current position in the environment*" (Penn and Turner 2001:105),

Finally, in the development of visual analysis it is worth mentioning the work of two German psychologists (Wiener and Franz 2004; Wiener, Franz et al. 2007), who recently have undertaken a set of virtual experiments occupying isovist analysis as a means to disclose people's qualitative judgements of space. Through their experiments they discovered that individuals were highly effective in detecting both the most exposed and secluded locations of the different layouts. "*Isovist analysis provides generic descriptions of architectural spaces that have predictive power for subjects' spatial experience and behavior*" (Wiener and Franz 2004:56).

Figure 1
Valparaíso's Amphitheatre

In spite of these results, isovist analysis has been subject of criticisms. Ervin and Steinitz (2003), for example, suggested that this technique is a necessary "but not sufficient" a means to provide a complete picture of the environment because it does not reflect how people see through soft boundaries, such as foliage, or how lightning condition affect a person's visual capacities. However, perhaps the main criticism regarding isovists analysis is that it cannot provide 3D information about the environment. This is especially relevant in cities with uneven geography like Valparaiso, where people can normally see places which are difficult to reach by foot. In fact this could be precisely what gives the city a unique flavor in terms of visual experience (see Figure 1).

Monumental and Weak Heritage

Weak heritage can be considered as a systematization of a contemporary understanding of heritage. It reflects the change in perspective from the traditional monumental heritage that values cathedrals, palaces and monuments, towards a perspective that focuses on other elements of the man made landscape, which are less evident but contribute significantly to the identity of our cities. This modest heritage does not depend on the historical value, aesthetics or symbolic meanings of its individual buildings, but rather on the sum of small buildings and public spaces, that might not have much individual value but that in their grouping and agglomeration create a valuable man made landscape. These places are also many times associated with the creation and conservation of a particular way of life, attaining an additional value.

The origin of the modern heritage concept can be traced to three European thinkers of the XIX century. The first of the theoretical thinkers, John Ruskin, considered the passage of time as a value in itself, something that the restorer did not have the right to erase. Ruskin stated that the greatest glory of a building does not lie in its stones or walls but in its age, in what he describes as a "*profound voice, rigorous vision or mysterious sympathy that we feel in its walls that have been washed by successive waves of humanity*" (Ruskin, 1925). From this stand he objects to all posterior interventions.

On the contrary, Eugene Emmanuel Viollet-le-Duc, a French architect and theoretician, opposed this very romantic and to a certain extent moralist perspective with a more rationalist vision. His approach to a heritage building would be to aim at improving it, by taking it to an a-historical state that did not necessarily relate to the building's past. Camilo Boito came out with an intermediate stand to these opposing views, where he allowed the recovery and intervention of buildings and monuments, but promoted a series of instructions tending to historical sincerity.

None of these positions were enough to face the heritage crisis brought up by the great European wars of the twentieth century. The need to restore and preserve the enormous architectonic heritage of the continent brought the promulgation of the Athens Charter for the Restoration of Historic Monuments in 1931, which aimed at agreeing on intervention criteria. In 1964 the Venice Charter changed the emphasis from a museum and scientific vision to one that included buildings and monuments because of their cultural or social relevance although of little aesthetic or historical value. Modest cultural heritage is thus considered for the first time, as follows: "*The concept of an historic monument embraces not only the single architectural work but also the urban or rural setting in which is found the evidence of a particular civilization, a significant development or an historic event. This applies not only to great works of art but also to more modest works of the past, which have acquired cultural significance with the passing of time.* (Venice Charter, 1964).

This change of perspective regarding heritage will be enlarged and strengthened by the Carta de Quito in 1964 and by the Carta de Veracruz in 1992. With these declarations and suggestions for interventions, the definition of the heritage concept is redefined from a museum piece, isolated and untouched (as inaugurated by Ruskin), to a social and cultural good that is extensive and imbricated with society itself. In fact the latest approaches, especially in countries with scarce resources, emphasize the need (and duty) to link the heritage buildings and places with the community that inhabits them in their everyday life. In the case of Valparaíso, after a long and hazardous process the UNESCO World Heritage Committee incorporated part of the city to the World Heritage List in 2003. The Chilean documents arguing for this inclusion put forward the case describing "*an indefinable and unnameable quality that makes this city, with its lights and shadows, the object of a profound valuation by its inhabitants, generates a deep admiration among Chileans and foreigners, and has transcended in artistic work of exceptional value*" (Gobierno de Chile, 2001). The same documents later mention the following attributes:

- Exceptional geographical and topographic conditions that imposes strong conditionings to its architecture and urban design.
- Spatial and visual integration, given by the natural amphitheatre, by the ravines and slopes, as well as by its public open space.

- Vernacular urban grid coherent with the geography and architecture, offering a human scale with various spaces of social encounter that also allow for the contemplation of the landscape.
- A unity achieved through diversity and complexity, which includes the plan and the hills as well as the connections between both.

These arguments, to a great extent based on the weak heritage concept, confirmed our initial intuition –that non-monumental heritage character depends largely on non discursive aspects of space– and gave focus to the next steps of the research. In the case of Valparaíso it was clear that the urban grid and especially the visual fields marked by the geographic conditions, gave to Valparaíso that indefinable unique condition. This in turn made it clear that the visual relations in a rugged geography required a 3 D model that could capture configurational relations from inhabited spaces at different topographic levels. Lastly, that the relations to be measured and tested had to be of a configurational type; that is the relations between parts and the relations between these relations (Hillier, 1996).

The 3d Configurational Model

The immediate precedent of this work can be found in the methodology called Visibility Graph Analysis (VGA), developed at University College London by Alasdair Turner and Alan Penn (Turner and Penn, 1999, Turner, Doxa et al Turner and Penn, 2002). This method consists in placing a two dimensional grid upon the open space of a layout and then calculating the topological relationships of the resulting grid cells.

The model developed in this paper implies a change from the two dimensional grid used in VGA analysis to a rectangular Digital Elevation Model (DEM), where a three-dimensional input model is represented as a grid of squares with associated elevations. For each square of this grid, a line of sight analysis is carried out with each other grid square. By treating each square as a node and each line of sight as an edge between two nodes, a three dimensional visibility graph can be constructed.

This graph gives an abstract and relatively compact representation of the visual structure of the spaces or territories under consideration, and allows their quantitative analysis. Four measures from the graph theory were selected to measure the configurational properties of 3D visual fields in Valparaíso.

Closeness Centrality is the distance between two graph nodes is defined as the number of edges (steps) in the shortest path between the nodes. The closeness centrality of a node is calculated by summing over and normalizing the distances between itself and every other node in the graph. This measure is analogous to Hillier and Hanson's (1984) concept of integration and is a global measurement (i.e.: it takes into account the whole graph as seen from each node, not just its local neighbourhood). For formula definition see Sabidussi (1996).

Betweenness Centrality is the fraction of the shortest paths of the graph (or "geodesics") that pass through each node. It can be understood as a measurement of control, since the nodes with higher values will be more important for communication routes within the graph. It is a global measurement. For formula definition see Freemam (1977).

Degree Centrality is defined as the number of edges of a given node. This measurement is analogous to Isovist Size (Benedikt, 1979), representing the area visible from a given point. It's a strictly local measurement, as it only takes into account the nodes directly visible from each node (i.e. its neighbourhood).

Clustering Coefficient represents the number of connections between the nodes of a given node's neighbourhood divided by the total number of possible connections within this neighbourhood. This measurement was introduced by Watts and Strogatz (1998) in a discussion of the small world phenomenon (Milgram, 1967: 60-67). Even though this is a local measurement, it is a subtle sign

of how local or global a certain node is. It represents the extent to which a node (or place) creates links among unrelated nodes. A node with clustering coefficient = 1 would be only linked to nodes that are not linked among themselves, and would thus be instrumental in the generation of visual relations among areas that would be otherwise cut off from each other. A node with clustering coefficient = 0 would not create any new visual relations, but rather reinforce existing ones. For the formula definition see Schank and Wagner (2005).

Application to Valparaiso

General Model

To test the model and find its relevance in the case of Valparaíso, an area of 3.5 Km by 3.5 Km was chosen encompassing a large part of the central district and was represented through a digital elevation model of 2500 square cells (50 per side). Each of these cells measured approximately 70 metres, thus it did not consider the heights of individual buildings or streets, only that of the underlying topography (see Figure 2). The fact that most buildings had a similar height (two or three storeys), allowed for this simplification.

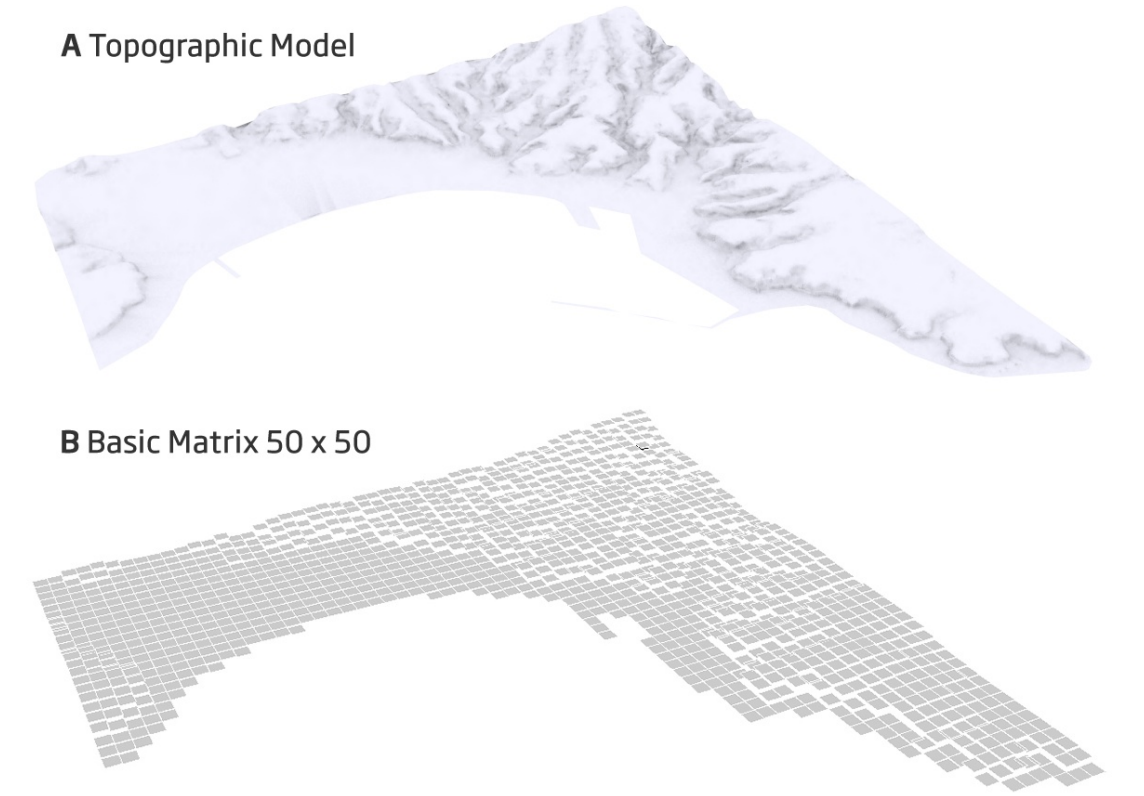

Figure 2
Basic Model for Valparaíso

A three-dimensional visibility graph was generated from this model, which is analysed with the measurements of centrality and clustering previously described (Figure 3). Despite the scale chosen, the models allow us to observe structural aspects of the visual relations in Valparaíso. The differentiation in the values of *betweenness centrality* (which refers to control over visual relations) with the homogeneous values in *degree centrality* (which refers to the size of view fields) shows that though many places in Valparaíso –both at high and low topographic levels– have ample visual fields, the hillsides and viewpoints, are special in the level of control they have over visual relationships (in terms of seeing and being seen from many different parts of the city). This quality depends on topography and not on relationships describable in two dimensions.

On the other hand, *closeness centrality*, related to the concept of integration, varied considerably within the hills and ravines, creating a mix of spaces that was strongly integrated visually into their urban context while others were heavily segregated. This matched the perception on the ground in terms of the quality of public spaces and constructions: the areas located within closed ravines with little or no visual relationships, are in poorer conditions than those on more advantageous visual positions.

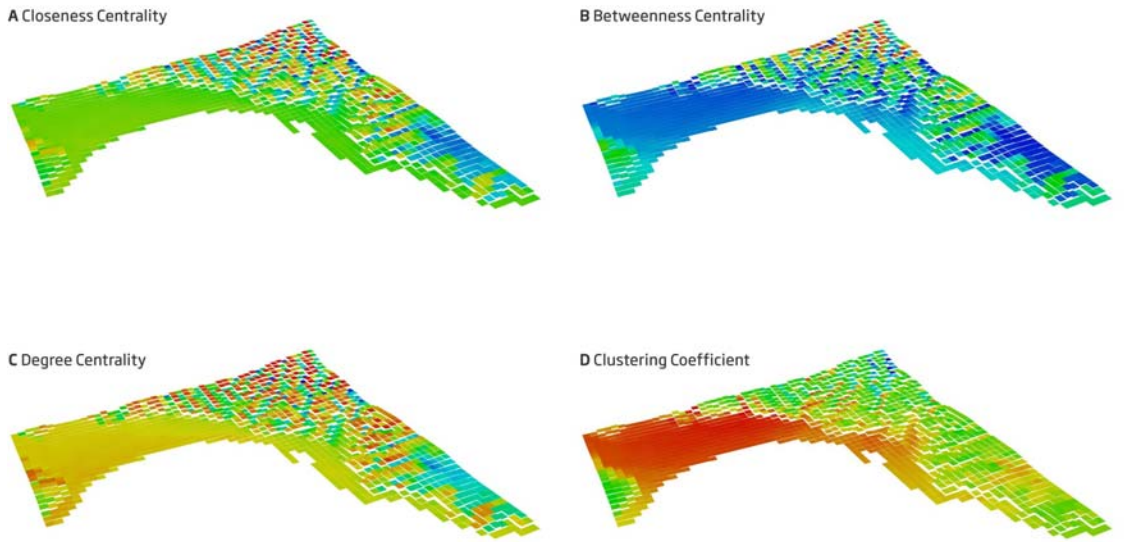

Figure 3
3D VGA Analysis of Valparaíso

This first analysis, while fairly rough grained, helped to understand underlying characteristics that could help identify and characterize valuable as well as vulnerable areas.

Area Model
A second exercise was carried out in a square area of 950 meters per side around Cerro Concepción. This area has been under a strong development process in the last few decades with land prices rising, new constructions, commerce and an emerging tourist industry. The area was modeled with a grid of 10,000 units (100 $\times$100) of 9.5 $\times$ 9.5 meters each, representing only those surfaces where an observer could stand, excluding rooftops and building interiors (Ma). A second matrix (Mb) was generated representing the surfaces and buildings that could be observed from the units in Ma, and that could block the sightlines within the analysis area. The visibility graph C is then generated between every square of Ma, taking into account the occlusion effect of Mb (see Figure 4).

The *betweenness centrality* analysis of this graph reaches its highest values at the corners of the streets on the elevated part of the hills, especially those that look out over significant fall offs. Counter intuitively, main streets have lower centrality measurements, which relates to the fact that for the most part they follow the bottom of the natural ravines and consequently are visually isolated. It follows that the visual structure of the area is not tied to its vehicular pattern, but rather to its pedestrian system. This is coherent with the zone's character, composed of highly idiosyncratic paths, stairs and viewpoints (Figure 5).

The closeness centrality shows a different pattern, varying more gradually and reaching its local maximum values at the hills' edges where the slope breaks out onto the low flat area near the water. Two important viewpoints, Gervasoni and Yugoslavo, and the slopes of the hills around an important road (José Tomás Ramos Street), though not the street itself, have especially high values. The area's *clustering coefficient*has a looser structure. The lower values (those that refer to

more global relationships) are related not only with the edges and terraces, but also with inner areas, such as Templeman Street, which is an important street in the area, connecting the Gervasoni viewpoint and Concepción and Alegre Hills. This area of strong global relations between local systems has a high concentration of tourist oriented restaurants and shops. The importance of this street within the structure of the area can be understood as an intermediary between two visual systems.

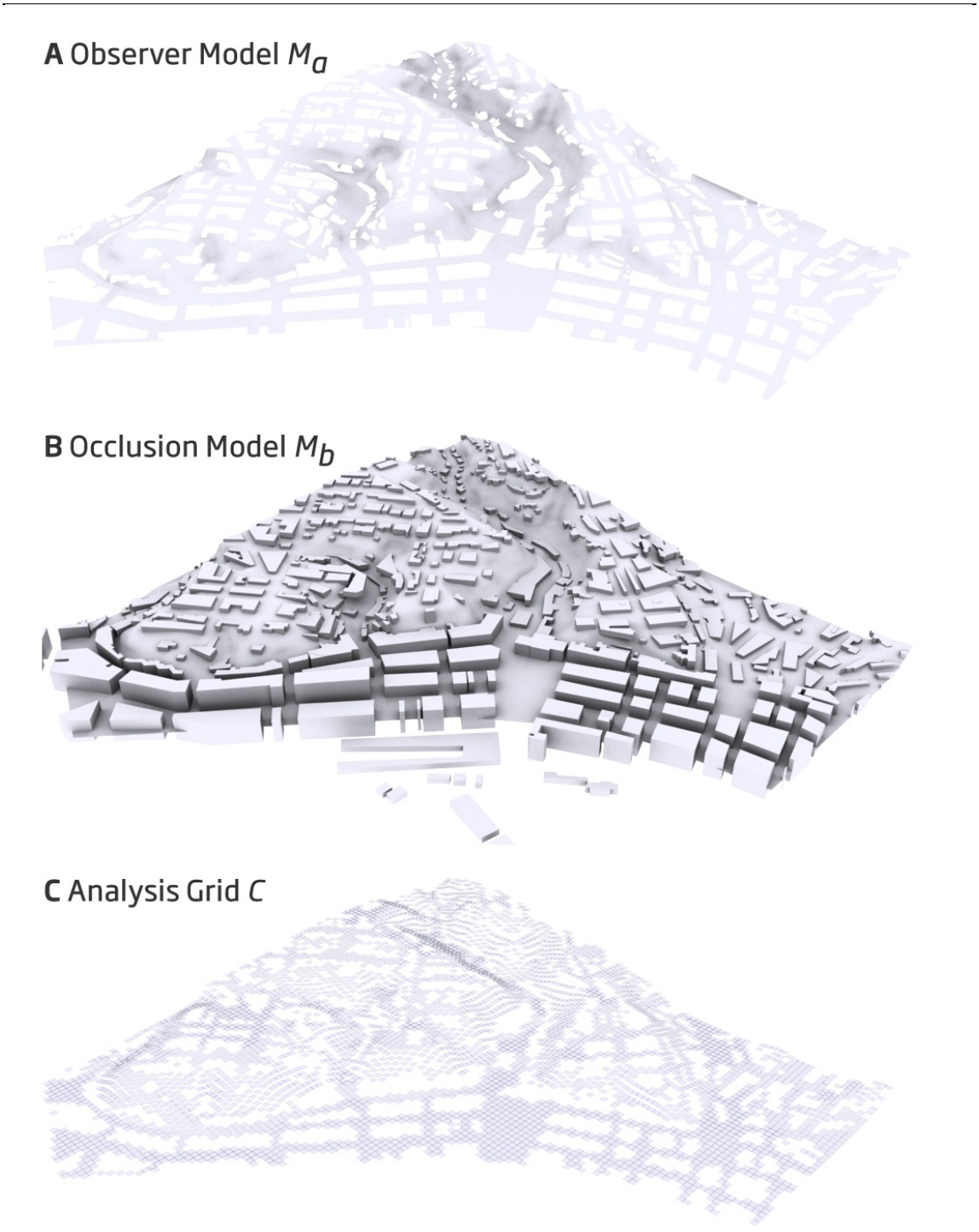

Figure 4
Area Model in Valparaíso: around Cerro Concepción

None of these results could be observed in the axial map of Valparaiso. For example neither Gervasoni nor Yugoslavo, two of the most important viewpoints of the city, are captured by axial analysis, but are clearly distinguishable in the 3D method proposed in this paper. Similarly, the sinuous streets that occupy the space in between the hills, and which are in most cases concealed from the eye in real life, appeared as spaces of poor visibility in the 3D model presented here.

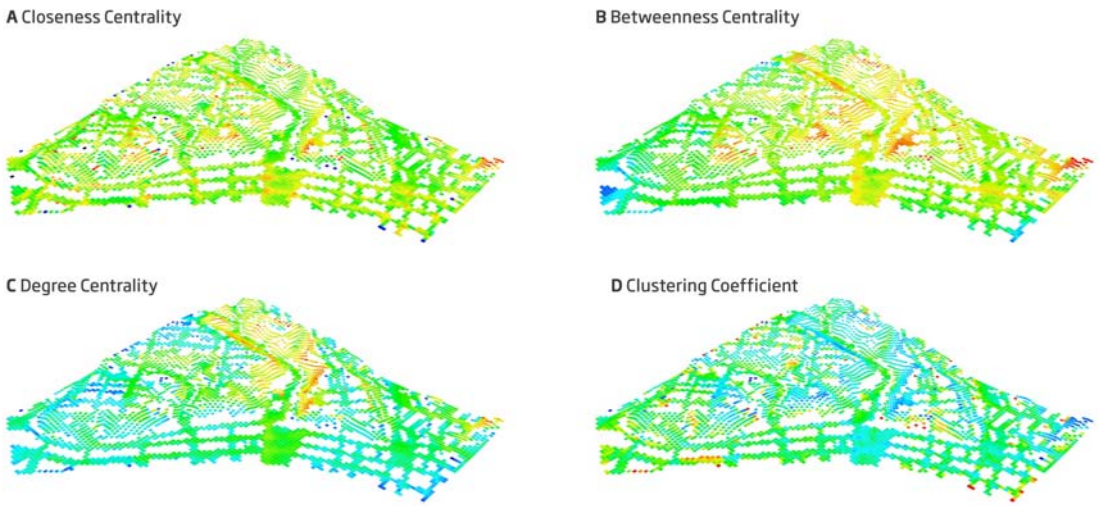

Figure 5
3D VGA Analysis of an Area in Valparaíso

Correlation with User Data

Aiming to see whether some of the findings suggested above had practical implications, the next stage of the analysis employed contrasted isovist measurements with a dataset collected via the Flickr.com photography website.

This site allows registered users to upload pictures to publicly viewable web galleries. Each photograph can register the place, time and date it was taken on. The Flickr site has an Application Programming Interface (API) that allows programmatic access. Using this API, 3,453 photographs were identified as having been taken within the general study area before august 22nd 2007 and their attributes where downloaded into a local database.

The attributes were: ID, owner, location (where the photograph was taken expressed as decimal coordinates in WGS 84), owner origin (declared country or city of origin of the uploader), tags (user created descriptors applied to each photograph) and date. The owner origin data was used to differentiate foreigners from local inhabitants. Tags do not follow a fixed taxonomy or controlled vocabulary, but are created and used freely, allowing both the description of individual photographs and the creation of relationships between otherwise unrelated images (for instance, two users who have never met but who both tag an image as 'tragedy').

This distributed and spontaneous description of urban space creates a semantic layer of data that can be superimposed on the syntactic one studied in the previous stage. In this study, a georeferenced tag cloud is generated, where the size of each word relates to its frequency of use in each location. The information used to generate it is freely available online and the methodology could be replicated by any interested researcher (Figure 6). This data allows the measurement of the amount of photographs taken in any square of the analysis grid under consideration and discriminate between those taken by locals, by non-local Chileans and by foreigners. A series of linear regressions were carried out, using the different measures of centrality and clustering as independent variables and the frequency of photographs in each location for each Owner Location group as dependent variables. A significant correlation was found between foreigners and the measurements of closeness centrality (R2=0.19) and degree centrality (R2=0.21), while no significant correlation was found for those who live in Valparaíso and Chile, nor for the foreigners with the other measurements (see Figure 7). This can be interpreted as a tendency for foreigners to take pictures at (and thus occupy) places that are highly integrated visually and that have wider view fields. The fact that they choose to take pictures in places with a wider view is not surprsing and can be considered rather obvious, but the fact that they choose visually integrated places is showing that people are able to perceive configurational properties; that is underlying nondiscursive –in this case visual– relations.

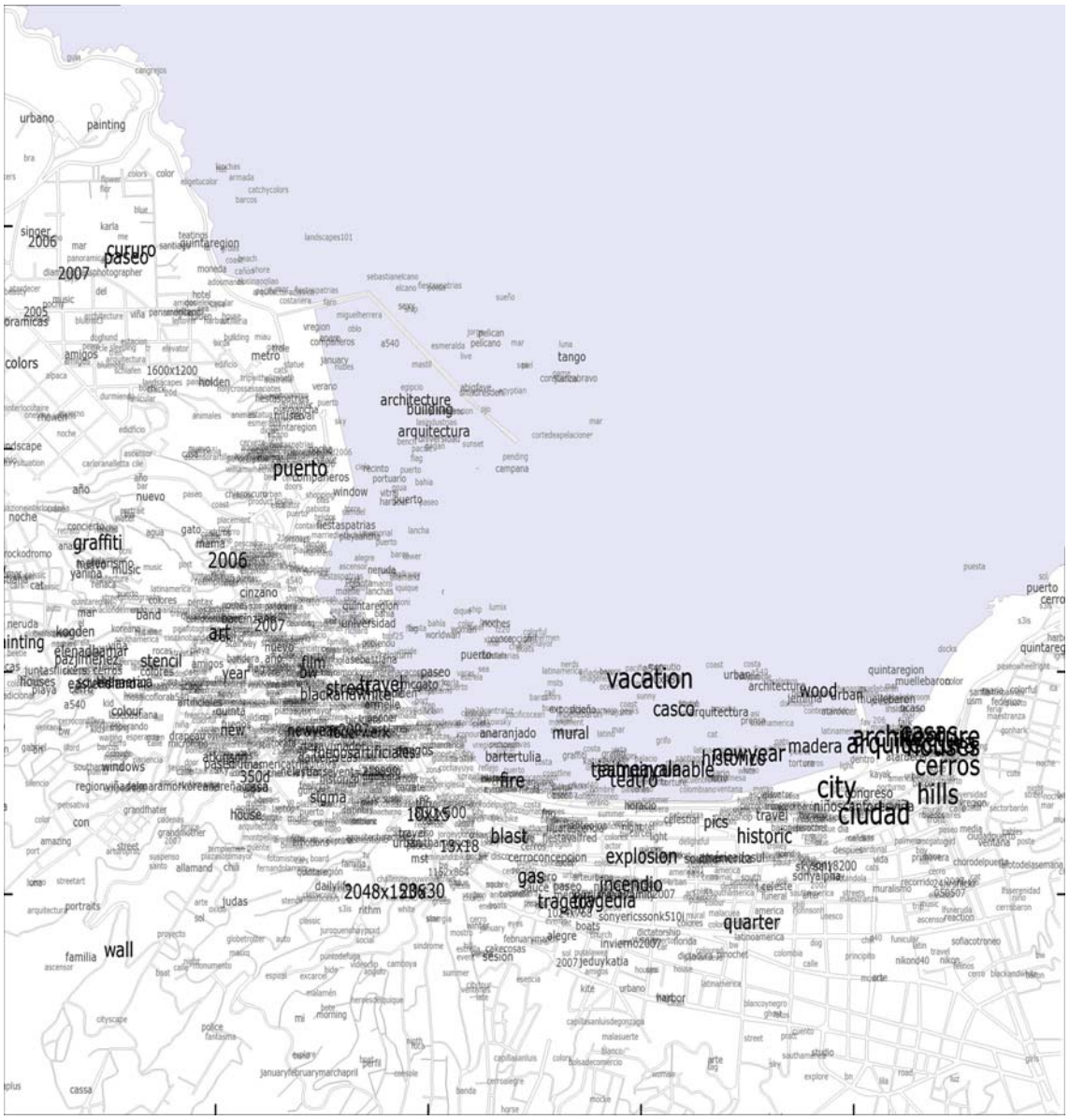

Figure 6

Tags Cloud Showing Frequency of Pictures in Flickr

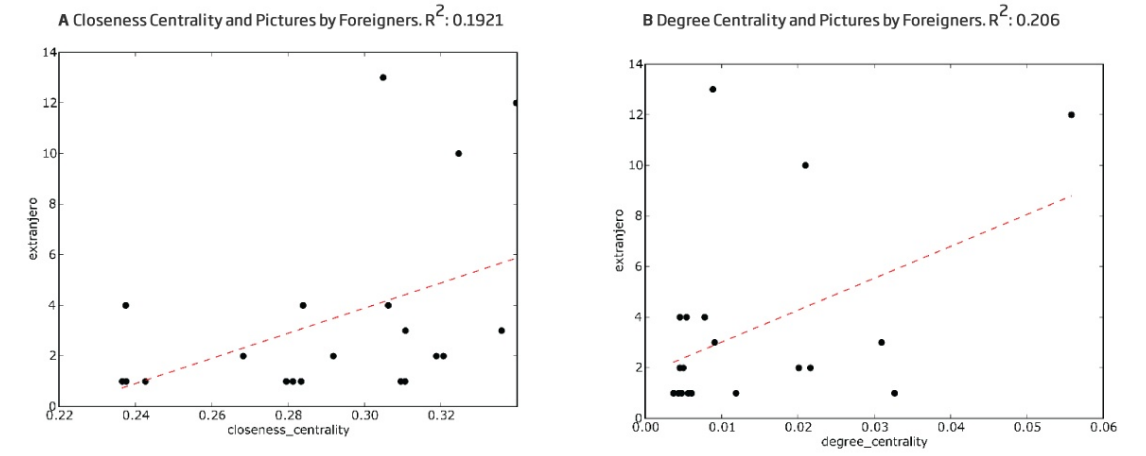

Figure 7

Visual Centrality and Frequency of Pictures Taken by Foreigners

Discussion and Conclusion

Although the method presented here is currently under development, its findings are encouraging. This is because this model captured one of the most distinctive spaces of the city: its system of *miradores*, (viewpoints), which serve as the main public spaces of Valparaiso's hills. These miradores are in fact places where neighbors gather and rest in a daily basis, as well as the places where they celebrate the arrival of the New Year, the city's most important event.

What seemed to be especially relevant is that the miradores are relatively segregated places, for they are several steps away of the streets that climb the hills. On the contrary, most of these streets use the space in between the hills (the ravines) to access the miradores, meaning that they are visually segregated but configurationally integrated. The result is that walking in Valparaiso seems to encompass a continuous change in the visual affordances of space. It follows that a person wanting to reach the hills has to embark in a rather interesting adventure, which starts by taking one of the sinuous streets that start of the Plan (how Valparaiso's inhabitants call the flat land of the city), continues through intimate and broken paths combininig staircases up the hill, and ends when reaching the miradores. Once there, the person does not only enjoy the scenic pleasure of seeing the entire bay, but can also understand the city as a unique artefact, for she can see its otherwise concealed structure. As Gibson suggested "*when the vistas are put in order by explanatory locomotion, the invariant structure of the house, the town, or the whole habitat will be apprehended*" *(Gibson, 1979:198).*

We believe that this constant shift in the scale of and nature of seeing, from high traffic but rather intimate places to highly segregated but exposed areas is one of the key aspects of the weak heritage concept. It is in fact a spatial heritage, since it owes itself to the cumulative effect of vistas produced by the organic structure of the fabric. It is, at the same time, a special form or heritage, for it does not depend on a single building, but on their articulation and aggregation. We would even like to venture that some of the most interesting visually attractive cities share this quality although maybe through different artiluges: Rome with its visually articulated squares, Paris with its Hausmanian avenues, and San Francisco, with its topography.

Future research in this line should attempt to increase the resolution of the analysis and capture a more detailed description of the spaces under consideration, enlarge the area capacity of analysis, and refine the method to calculate visibility depending on the position of cells. In the present paper the method of representing and measuring a person's visual field was applied to a particular concept –that of the weak heritage– but this type of model could be applied to many other circunstances where 3D visual perception plays a fundamental role.

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