

# Thesis Proposal

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Assessing sustainability in cities. A complexity science approach to the concept of happiness in the urban environment



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**Barcelona, 19/6/2014**



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## Abstract

Cities are complex systems whose infrastructural, economic and social components are strongly interrelated and therefore difficult to understand in isolation. At the beginning of the century, developing a sound theory of urban living has become increasingly pressing. The worldwide trend towards urbanization is related to economic development and to profound changes in social organization, land use and patterns of behaviour. The scale of these changes will lead to important but still poorly understood impacts on the global environment. Yet the continuous accumulation of the population in cities, along with uncontrolled urban sprawl, is leading to a degraded habitat, seriously affecting the emotional and physical state of city dwellers. In recent years, however, urban spaces are being reconsidered as valuable for the health and well-being of individuals. Sustainability science is in great need of a predictive framework where dynamics involved in the on-going expansion processes of urban areas can be considered and comprehensive models where perceptions of cities' inhabitants can be properly assessed. In this context, individual happiness has become of substantial interest and several empirical studies have begun to explore the link between happiness and urban space. Following the same rationale, this thesis aims to find methods and tools for the measurement and quantification of the urban happiness. To achieve that, we first need to investigate, using a complex systems science approach, the happiness framework as scientists viewed it and constructed it during the past years. A study of the happiness-related keywords of scientific publications will be made with the aim to create and analyse the network of happiness. We then propose to expand this alternative, less theoretical approach to the quest of associations between the areas of knowledge of happiness, sustainability and urban planning, by means of reference analysis of scientific publications related to the three subjects. We finally develop an alternative method of studying happiness for the urban environment based on the accomplishment of the basic human needs. The results will allow us to define more liveable urban spaces, adequate infrastructural systems and sustainable futures for the dweller.

### Keywords:

happiness, sustainability, urban planning, life satisfaction, quality of life, need satisfaction, complex systems science, complex networks

## Resumen

Las ciudades son sistemas complejos cuya infraestructura y componentes económicos y sociales están estrechamente relacionados entre sí y por lo tanto difíciles de comprender de forma aislada. Al principio del siglo, el desarrollo de una teoría robusta de la vida urbana se ha convertido cada vez más acuciante. La tendencia mundial hacia la urbanización está relacionada con el desarrollo económico y con cambios profundos en la organización social, en el uso del suelo y en patrones de comportamiento. La magnitud de estos cambios generará impactos importantes, pero todavía poco conocidos para el medio ambiente global. Sin embargo, la acumulación continua de la población en ciudades, junto con la expansión urbana descontrolada, está dando lugar a un hábitat degradado, lo que afecta seriamente el estado emocional y físico de los habitantes de la ciudad. En los últimos años, sin embargo, los espacios urbanos se están reconsiderando como valiosos para la salud y el bienestar de los individuos. La ciencia de la sostenibilidad está en gran necesidad de un marco de predicción, donde las dinámicas involucradas en los continuos procesos de expansión de zonas urbanas pueden ser reconsiderados, así como también de modelos integrales donde las percepciones de los habitantes de las ciudades pueden ser evaluadas adecuadamente. En este contexto, la felicidad individual ha sido de gran interés y varios estudios empíricos han comenzado a explorar la relación entre la felicidad y el espacio urbano. Siguiendo la misma lógica, esta tesis tiene como objetivo encontrar métodos e instrumentos para la medición y cuantificación de la felicidad urbana. Para lograr el dicho, primero tendríamos que investigar, utilizando un enfoque de la ciencia de los sistemas complejos, el marco de la felicidad como lo percibió y construyó la comunidad científica durante los últimos años. Un estudio de las palabras clave relacionadas con la felicidad de diferentes publicaciones científicas se realizará con el objetivo de crear y analizar la red de la felicidad. Consecuentemente, se propone ampliar este enfoque alternativo y menos teórico a la búsqueda de asociaciones entre las áreas de conocimiento compartidas entre la felicidad, la sostenibilidad y la planificación urbana, por medio de análisis de referencias de las publicaciones científicas relacionadas con estos tres temas. Finalmente desarrollamos un método alternativo para el estudio de la felicidad relacionada con el ambiente urbano basado en el cumplimiento de las necesidades humanas básicas. Los resultados nos permitirán definir espacios urbanos más habitables, sistemas de infraestructura adecuados y un futuro sostenible para el habitante.

Palabras clave:

felicidad, sostenibilidad, planificación urbana, satisfacción de vida, calidad de vida, satisfacción de necesidades, sistemas complejos, redes complejas

## Resum

Les ciutats són sistemes complexos on la infraestructura i components econòmics i socials estan estretament relacionats entre si i per tant difícils de comprendre de forma aïllada. A principis del segle, el desenvolupament d'una teoria robusta de la vida urbana s'ha convertit cada vegada més urgent. La tendència mundial cap a la urbanització està relacionada amb el desenvolupament econòmic i amb canvis profunds en l'organització social, en l'ús del sòl i en patrons de comportament. La magnitud d'aquests canvis generarà impactes importants, però encara poc coneguts per al medi ambient global. No obstant això, l'acumulació contínua de la població en ciutats, juntament amb l'expansió urbana descontrolada, està donant lloc a un hàbitat degradat, el que afecta seriosament l'estat emocional i físic dels habitants de la ciutat. En els últims anys, però, els espais urbans s'estan reconsiderant com valuosos per a la salut i el benestar dels individus. La ciència de la sostenibilitat està en gran necessitat d'un marc de predicció, on les dinàmiques involucrades en els continus processos d'expansió de zones urbanes poden ser reconsiderats, així com també de models integrals on les percepcions dels habitants de les ciutats poden ser avaluades adequadament. En aquest context, la felicitat individual ha estat de gran interès i diversos estudis empírics han començat a explorar la relació entre la felicitat i l'espai urbà. Seguint la mateixa lògica, aquesta tesi té com a objectiu trobar mètodes i instruments per a la mesura i quantificació de la felicitat urbana. Per aconseguir la dita, primer hauríem d'investigar, utilitzant un enfocament de la ciència dels sistemes complexos, el marc de la felicitat com ho va percebre i construir la comunitat científica durant els últims anys. Un estudi de les paraules clau relacionades amb la felicitat de diferents publicacions científiques es realitzarà amb l'objectiu de crear i analitzar la xarxa de la felicitat. Conseqüentment, es proposa ampliar aquest enfocament alternatiu i menys teòric a la recerca d'associacions entre les àrees de coneixement compartides entre la felicitat, la sostenibilitat i la planificació urbana, per mitjà d'anàlisi de referències de les publicacions científiques relacionades amb aquests tres temes. Finalment es desenvoluparà un mètode alternatiu per a l'estudi de la felicitat relacionada amb l'ambient urbà basat en el compliment de les necessitats humanes bàsiques. Els resultats ens permetran definir espais urbans més habitables, sistemes d'infraestructura adequats i un futur sostenible per a l'habitant.

### Paraules clau:

felicitat, sostenibilitat, planificació urbana, satisfacció de vida, qualitat de vida, satisfacció de necessitats, sistemes complexos, xarxes complexes





## **I. Introduction**

At the face of the 21<sup>st</sup> century, cities emerged as the source of the greatest challenges that the planet has faced since humans became social. Although they have proven to be humanity's engines of creativity, wealth creation and economic growth, cities have also been the source of much pollution and disease (Bettencourt & West 2010). As recently as 1950, only 30% of the world's population was urbanised. Today, more than half of it lives in urban centres. In the more developed world this percentage reaches the 80% and this is expected to reflect the situation of the whole planet by around 2050, with some 2 billion people moving to cities, especially in China, India Southeast Asia and Africa (United Nations 2012).

The present worldwide trend toward urbanization is intimately related to economic development and to profound changes in social organization, land use and patterns of human behaviour (Angel et al. 2005). The demographic scale of these changes is unprecedented (Berry & Okulicz-Kozaryn 2009) and will lead to important but still poorly understood impacts on the global environment. Yet it seems clear that the continuous accumulation of the population in big cities worldwide, along with the uncontrolled urban sprawl, is leading to a doubtful, degraded habitat, seriously affecting the emotional and physical state of city dwellers (Costanza et al. 2007; Moro et al. 2008; Veenhoven 2007; Costanza et al. 2008; Kennedy & Adolphs 2011; Lederbogen et al. 2011).

The many problems associated with urban growth and global sustainability are typically treated as independent issues. This fact frequently results in ineffective policy and often leads to unfortunate and sometimes disastrous unintended consequences (Bettencourt & West 2010). Policies means to control population movements and the spread of slums in the megacities, or to reverse urban decay, have largely proven ineffective or counterproductive, despite huge expenditure (Davis 2006). In North America in the 1950s to 1970s (and earlier in Europe), policies of urban renewal intended to reduce high urban densities, by razing poorer old neighbourhoods and creating infrastructure, actually ended up encouraging urban sprawl (Jacobs 1961). The ways in which the urban need for food, water, shelter and social organization are met will not only determine the course of human civilization, but the very future of this planet (Newman & Jennings 2008). Urban demographic and economic growth has been increasing pressures on ecosystems globally, but affluent rural and suburban living often places even more pressure on ecosystems. As people are increasingly living in cities, and as cities act as both human ecosystem habitats and drivers of ecosystem change, it will become increasingly important to foster urban systems that contribute to human well-being and reduce ecosystem service burdens at all scales (Millennium Ecosystem Assessment, 2005).

The development of collaborative planning theories that see planning as dialogue between conflicting actors is in turn being influenced by conceptions of complexity. Cities are complex systems whose infrastructural, economic and social components are strongly interrelated and therefore difficult to understand in isolation (Jacobs 1961). The shift from static to dynamic, top-down to bottom-up, is problematic for traditional notions of the optimum city which is inevitably an equilibrium to be aspired to (Batty & Marshall 2012). However, in

recent years, the perception of citizens, urban planners and scientists has been changing slowly, mainly due to the aforementioned increased environmental, social and economic problems encountered in urban conurbations. Urban spaces are being re-evaluated and reconsidered as valuable for health, social integration and well-being of the individuals (Townsend et al. 2010). In this sense, happiness is a subject of increasing interest and several empirical studies have been developed in order to characterize, either by means of subjective or objective indicators, the links between happiness and urban societies (see (Delken 2007; O'Brien 2005; Wenz 1977; Easterlin et al. 2011; Kamp et al. 2003; Trkulja 2007; Marans 2012; Massam 2002; Berry & Okulicz-Kozaryn 2009) and references therein). Following this rationale, this thesis aims to find methods and tools for the measurement and quantification of the urban happiness. To achieve that, we first need to investigate, using a complex systems science approach, the happiness framework as scientists viewed it and constructed it during the past years. A study of the happiness-related keywords of scientific publications will be made with the aim to create and analyse the network of happiness. We then propose to expand this alternative, less theoretical approach to the quest of associations between the areas of knowledge of happiness, sustainability and urban planning, by means of reference analysis of scientific publications related to the three subjects. We finally develop an alternative method of quantification of happiness for the urban context, based both on the perception of people using the urban space and data of existing objective spatial indicators. These are finally compared in order to obtain a final integrative happiness index. To check whether personal happiness is accomplished, Max-Neef's conceptual frame on Human Scale Development has been used (Max-Neef 1992; Max-Neef et al. 1991).

The document is organized as follows. The state of art presents a literature review related to the development of complex theory for cities and an introduction to the concept of sustainability and to the concept of happiness. Chapter III suggests the main and secondary objectives of the Thesis and Chapter IV the timeline for the accomplishment of them. Chapter V explains the methodology that will be used and Chapter VI introduces some of the first results. An appendix is also included with a submitted article and some other indexes of quality such as presentations and interviews in media.

## II. State of art

### 1. Complexity theory in cities and planning

Etymologically, complexity comes from the Latin *plexus*, which means interwoven. A complex system is one in which elements interact and affect each other so that it is difficult to separate the behaviour of individual elements (Gershenson 2008).

Cities manifest remarkably universal, quantifiable features (Bettencourt & West 2010). A theoretical concern for structure of cities began to emerge in the late 19<sup>th</sup> century. The main idea was that cities grew in a disordered, chaotic way. Whereas the ideas about bottom-up structures were slowly appearing and developing in many different disciplines, for cities, it was assumed that although the disorder was produced during the organization process from the bottom-up, solutions should be found using a top-down planning control system (Batty & Marshall 2012). Soria y Mata, known for his model of “Linear City”, argued that the city needed an architect just as is needed an architect for a building or an Architect for the Universe. This claim for town planning gave rise to the establishment of structures that could control the city from the top-down, in the notion that it was only the intellectuals and professionals that knew how cities should work for the benefit of all, a disastrous assumption that began to fall apart as soon as structures were put in place to implement the model (Batty & Marshall 2012).

An interesting personality whose beliefs were quite counter to those emerging centralised top-down planning systems was Patrick Geddes, the father of British town planning. Being trained first as a biologist, he instinctively appreciated the organic complexity of cities, using analogies between urban and biological systems in both directions. He was of the first pioneers of town planning to face the problem of complexity in planning. The town or city had to be seen within the context of its historical development as well as its geographical hinterland. It grew in some way out of its urban and rural environment in a complex web of causes and effects, its interrelated parts interwoven through time. It had to be recognisable as something greater than the sum of its parts and the role of the planner was to help supply that something (Batty & Marshall 2012).

The stress here was related to the fact that town planning relied on the town being simple enough to be able to plan it while at the same time complex enough to require planning. And that provoked a kind of challenge to planners, wishing to replicate the functional complexity of traditional cities, but in an ordered way that often led to simplistic solutions (Marshall 2012). This connects to a paradox, the extent to which a city can be both something “organic” and yet artificial at the same time. This “organic” dimension is woven into the fabric of town planning historically. Along with Geddes, Ebenezer Howard, Lewis Mumford and other urban theorists evoked the idea of the city as an organism, in order to invoke the idea of a kind of organic unity to towns or cities. And that leads to a second paradox. In order to promote the need for planning as a whole, a biological analogy is invoked that compares a town or city to something – like an organism but unlike a machine – that was not the product of design. This provokes some confusion as to how to design a town or city. If it is like a machine, we can imagine study of mechanics could help for the design. But if it is like an organism, there is no clear rationale for the design.

Geddes, professed a concern for addressing these complexities through local action, for developing and improving urban life from the bottom up. Yet he was torn by the tension between Darwinian theses that saw life as competitive (based on the struggle for existence) in comparison with the sort of harmony and cooperation that he believed was necessary for more equitable and efficient forms of city and society. The contradiction between Darwin's sayings and the mechanisms established in the construction of different town planning systems in the industrial world was not seen as strongly as it is today, for Geddes believed that the logic competition and cooperation could be reconciled easily enough (Batty & Marshall 2009).

Others were not particularly aware of this tension. The garden cities movement initiated in 1898 by Ebenezer Howard coincided with the continuing move to modernism in architecture which has become ever more top down. This culminated in a new sense of order being imposed on cities and their planning such as the centralized systems approach of the 1960s, rational plan-making and policy analysis, and the quest to find higher forms of social order in political economy in the 1970s, all which slowly gave way to a sea change in the way we think about cities and their planning. By the late twentieth century, this top-down model was in disharmony in a world that was rapidly about to become bottom up (Batty & Marshall 2012).

By the 1920s, the notion of a general system with a distinct and usually top-down control mechanism gained ground. With respect to cities and their planning, the systems approach did not represent a radical departure. It just introduced a stronger rationale for seeing cities and their planning as a comprehensive activity to alleviate or resolve human problems defined in terms of equitable and efficient distributions of spatial activity. It represented one of the last gasps of a model established in the late 19<sup>th</sup> century, being introduced during a time when the concept of equilibrium to urban life was fast destroyed. From the 1970s, the focus began to shift from strategic comprehensive planning to local planning, from growth to regeneration and from a concern for housing to a concern for jobs, to economic development (Batty & Marshall 2012). Yet there were some critiques to the upcoming system approach.

At the time, rational models of the planning process, linked to a positive political science of government, public administration and management science, were widely developed and grafted onto an understanding of cities as systems, thus elaborating the control function which was seen as integral to steering, managing and designing the system of interest. One of the strongest critiques was received from Jane Jacobs, who with her book *The Death and Life of Great American Cities* made it her intent to attack the simplistic nature of modern planning solutions. She considered completely inappropriate the whole paraphernalia of plan-making to the problems of contemporary cities. She was no admirer of laissez-faire either. She did not recognise Adam Smith's invisible hand as being intrinsic to the variety and diversity she associated with cities. She felt that Smith's "pre-Darwinian" philosophy misplaced the role of division of labour as a creative force; she preferred to emphasise the role of economic and technological processes that added "new complexity... to an older simplicity" (Jacobs 1961). She was the first that saw planning as being a science of organised complexity.

Other post war critiques involved arguments against the emergent technocracy. Most were referred to the difficulty of applying large scale systems analysis, fashioned in the laboratory and treating cities like machines rather than intrinsically complex entities. Cities were seen as vehicles for articulating human conflict and generating diversity and could not be reduced to that kind of command and control mechanisms. There was a concern for the limits of science and the organisational difficulties that problems of urban planning posed. In general, this type of dissenters embrace a kind of emergent complexity theory, some had Jacob's concern for preserving the heterogeneity of cities, although they were largely couched in terms of the need to develop more politically sensitive vehicles for public policy (Batty & Marshall 2012). There were also a type of backwoodsman critiques, tended to see systems theory as being antithetical to social problems, or science as having little relevance to cities and their design. The specific analogy in systems theory and cybernetics between planning and control was seen as one of the worst excesses of scientism and technocracy. But, they did not embrace the bottom-up style of Jacob's response either. Instead, they were more centralised and remote from the day-to-day business of urban living.

Christopher Alexander was another intellectual who fought against top down planning. Being an architect himself, believed that bottom-up design was the only way to achieve good building because it was sympathetic to context and sufficiently sensitive to produce well-adapted solutions to complex problems (Alexander 1964). He considered that the problems with planned towns and urban developments could be linked to their structure: they were dysfunctional due to their simplistic tree-like hierarchy of systems and sub-systems (Alexander 1966). Naturally grown cities had a more complex structure that he identified with semi-lattice, which allowed for overlapping elements. In his book *A Pattern Language* (Alexander et al. 1977) captures the intrinsic complexity of the built environment, in terms of identifying elements at different scales and the ways they fit together. His list of 253 patterns, interdependent of each other, was seen as limited and received criticism as being top down in spirit if not in practice. However, his philosophy –like Jacob's – is rooted in the notion that individuals, not collectives, must take responsibility for their environment. He argued that constraints imposed on professionals in terms of the way they are forced to generate solutions to planning due to the top-down, rapid execution of the planning involved.

Since the 1970s, physical planning as an activity and function of government has massively fragmented as the vision of some central organizing force for good has weakened under the massive difficulties of demonstrating to all of us that centralized planning produces anything better than the status quo. The political consensus too has been broken in the last 50 years in the rise of individualism and the decline of the welfare state. (Batty & Marshall 2012)

Although it may have appeared in the mid-1970s that systems theory for cities and their planning was dead, with little chance of it transforming to a new dawn, complexity is intimately related to systems theory. The great mistake was to assume that what we see is an equilibrium that might need to be changed through design but in reality it is a snapshot of a highly dynamic system that is reacting on all levels to human endeavour and function (Batty & Marshall 2012). Three key developments that led to models and techniques that now form the essence of complexity theory were fashioned around dynamics and the

patterns that result from their functioning: i) models dealing with different kinds of dynamics, ii) models dealing with different patterns that emerge from a dynamics of change originating from the bottom-up and iii) models that deal with relationships between elements that comprise these patterns and their dynamics articulated in the form of networks (Batty & Marshall 2012).

The first computer models were closely linked to well-established location and transportation flow theories. They represented the city at a point in time and explained its functions as if the observed equilibrium structure was the norm. These models were closed and it was possible to see how their activities might be redistributed and controlled in a manner which would “improve” their functioning. Yet, there were signs of alternative ways of conceiving human and city systems. Dynamics was the main concern. Some of the early models were geared to simulating incremental change while time was becoming as important as space in these simulations. Jay Forrester for example attempted to demonstrate that cities and other human systems were subject to key resource limits. These new ideas mainly came from mathematics. The notion that change might not be smooth coincided with notions that various kinds of phase transition, tipping point or catastrophe might characterise the way city systems might behave.

During the 1980s, there was a revival in examining and understanding cities with respect to their form. The development of new kinds of geometry came through ideas about fractional or fractured systems, or fractals, named after Benoit Mandelbrot (see (Mandelbrot 1977)). They represent objects whose form recurs across different scales, embodying principles of self-similarity and scale invariance. The elements of fractal structures can be seen as automata which have local actions and interactions that give rise to patterns that have structure at the global level. The very fact that such structures are grown introduces the temporal dimension, allowing the development of dynamic urban models. In moving from the closed world of comparative statics where control and optimization link such models to the planning process, to the much open world of dynamics, disequilibrium, heterogeneous structures and processes, and patterns that emerge from the bottom up, the idea of optimisation is no longer central (Batty & Marshall 2012).

The dominant theory of urban planning insofar is based on collaboration between the many participants who make up a specific problem and its solution or resolution. Planning is regarded as a “dialogue” where the process is per se political. Rather than links between the key concepts of complexity theory and planning such as emergence and self-similarity, positive feedback and self-organisation have become the focus. It has proven much easier to see cities as tangible physical artefacts in terms of the elements of complex adaptive systems than it has been to articulate the processes of their planning in this way. The process of dialogue and consensus building, rather than the product, is becoming the main priority and thus a complexity theory for collaborative rationalism can only be developed through analogies and metaphors.

Cities are the crucible of human civilization, the drivers towards potential disaster and the source of the solution to humanity’s problems. It is therefore crucial that we understand

their dynamics, growth and evolution in a scientifically predictable, quantitative way (Bettencourt & West 2010).

## 2. The concept of sustainability

### 2.1 Definition of the concept

The contemporary sustainable basis of reasoning had its genesis within the Brundtland Report prepared for the World Commission on Environment and Development as Our Common Future. The Brundtland Commission brought the concept of “sustainable development” (SD) squarely into context by describing sustainability as “meeting the needs of the present without compromising the ability of future generations to meet their own needs” (Brundtland 1987). There were three main goals to be achieved:

- To ensure that all societies’ needs are met.
- To ensure that all members of societies have their needs met.
- To ensure that all development and conservation is sustainable over time in a social, economic and environmental sense.

Sustainability has become since a dominant concern of our age. A characteristic of its narrative is the persistence of emphasis on unimpaired environmental quality over time, with no loss of material wellbeing, yet exhibiting some social gain (Riddell 2004). As a concept, it is intimately bound up with maintaining some kind of desirable state (often seemingly implicitly in equilibrium) into the long term future. But in the long term, the concept is always changing in complex ways due to adaptation and feedback, and there may never be an optimum or equilibrium state. Hence, sustainability can seem difficult to achieve because the future is unpredictable, and the needs of future generations unknowable. In such a complex system, the goal-posts are always moving; what might seem sustainable now might not be sustainable in the future (Marshall 2010; Batty & Marshall 2012). Thus, the whole idea of sustainability is in transition; and there can be no single model for a desired future sustainable state.

In any case, it is not always clear if sustainability is simply an abstract ideal, a general direction of travel, or if it could be an actual achievable state. Sustainability could simply be regarded as a way of looking at the world: a perspective or paradigm in which the three dimensions of society, economy and environment are considered together, extending over the fourth dimension of time. In this case, sustainability is no longer an elusive property or an unattainable goal, but signifies a definite attitude: something we can adopt every time we design, plan or assess anything (Marshall 2010).

### 2.2 Urban sustainability

The same applies for cities. When we talk about urban sustainability, we are referring to the application of socially responsible, environmentally harmonious, and economically equitable actions in the design or planning of the cities. As a phrase, sustainable urban planning, connotes process, something practised and delivered. Planning usually portrays something democratic, spatially applied, and potentially flexible, in the public domain; a public-interest



prescriptive matter which, following consultation and discussion, is done and delivered. Planning is the actual bringing about of desirable changes for an improved overall future through the medium of predetermined human action. It also involves the interpositioning of design, particularly growth pattern (regional) design and urban physical design (Riddell 2004).

Within democracies these desirable changes implicate a vast complexity, with the path to sustainability being a shared one, relying on an informed citizenry and effective city governance, joined together in a global compact to ensure that urban humanity and all planetary life can coexist and thrive. Cities work best at bioregional and community scales, not just at the global scale where much of the economy is taking them. New, more sustainable solutions can arise if social, environmental, and economic factors can be integrated more effectively at these scales (Newman & Jennings 2008). Emphasis should be given then on local people, local politics, local action, local habitat, local well-being and locally beneficial outcomes (Riddell 2004). Traditional wisdom and eco-city social movements are providing a revitalized sense of place and demonstrating new ways of living, from simplicity circles to urban eco-villages. These voices demonstrate the concept of environmental citizenship, whereby people take responsibility for caring for their “life-places” and communities. The world is on an unsustainable path; setting a new direction for cities is a major part of turning the world to a new path, where cities first begin to mitigate their impacts and then become a source of regeneration as in natural ecosystems (Newman & Jennings 2008).

### **2.3 The human dimension**

An important element that must be injected in this type of planning is the human dimension. Urban design must be focused on the making of places for people and precisely on the process of making better places for people than would otherwise be produced (Carmona et al. 2003). For the past 50 years, this human dimension has been seriously neglected in connection with urban development. Whereas neglect has just about extinguished city life in some economically developed countries, pressure from developments has pushed city life into extremely adverse conditions in many countries with less developed economies (Gehl 2010). The methods for dealing with these issues are surprisingly similar in all geographical dimensions, as it all comes down to people, who have the same basic point of departure. They all have walking, a sensory apparatus, movement options and basic behaviour patterns in common.

Besides, a humane city not only creates pleasure for visitors and passers-by, but also for those who live, work, and play there every day (Gehl 2010). The socio-functional aspects of streets, sidewalks and parks have a role of containers of human activity and places of social interaction. A city should never be seen solely as a work of art because art is made by selection from life while a city is life at its most vital, complex and intense (Jacobs 1961). New Urbanists, committed to re-establishing the making of community, through citizen based participatory planning and design, agree with that state (Congress for the New Urbanism 2001). In their Chart they recognise that physical solutions alone cannot solve social and economic problems; neither can economic vitality, community stability and environmental health be sustained without a coherent and supportive physical framework.

## 2.4 Can we talk about “sustainable happiness” in planning?

Different studies found proof for positive associations between dimensions of sustainable development for cities and happiness. Veenhoven and Vries (Veenhoven & Vries 1992) found that liveability – community design – (see (Jacobs & Appleyard 1987)) is associated with happiness, O’Brien (O’Brien 2001) found that walkability is also associated with happiness, Zidansek and Cloutier et al. (Zidanšek 2007; Cloutier et al. 2013) found that happiness is associated with sustainable development, Leyden et al. (Leyden et al. 2011) found that design and conditions of cities are associated with happiness, while White et al. (White et al. 2013) found that individuals are happier when living in green cities.

“Sustainable happiness” is defined by Katherine O’Brien (O’Brien 2005) as the happiness achieved without the exploitation of other people, the depletion of non-renewable resources, and the well-being of future generations. The concept of happiness as a planning objective is something that upgrades the concept of sustainability towards a desired society. It is not contradictory to the idea of sustainability which can be seen as a stage of happiness. Instead, it is something common to all human beings, a potential existing in people (Trkulja 2007). What is more, authentically happy people may be more inclined to engage in environmentally friendly behaviours, are more likely to be altruistic, and may even have a lower ecological footprint (Kasser 2006).

Bhutan’s Gross National Happiness (see (Centre For Bhutan Studies 2012; The Planning Commission Secretariat Royal Government of Bhutan 2000; Osmani et al. 2007; Gross National Happiness Commission Royal Government of Bhutan 2011; Hofmann 2006)) prompts us to explore the many ways that emotional well-being could be incorporated into policy and practice. Urban planning is no exception. In the hierarchy of aims in strategic development planning process the distinction can be made between goals as the most general, objectives as concrete fields of activity and targets as most specific. Happiness can be treated as a goal, as an objective and even become a target in specific urban or regional development projects (Trkulja 2007).

Happiness as a development objective may seem obvious but it is generally absent from existing development studies or well hidden behind differently defined objectives (Trkulja 2007). Politicians and their advisers are reported to have three ways to promote the well-being or happiness of citizens (Ott 2008). First, they can analyse the behaviour and the decisions of citizens to find out what they want (“revealed preferences”). These are preferences revealed in actual decisions and behaviour. In particular in economic decisions, are the dominant sources of information (p.e. GNP). A problem is the fact that revealed preferences depend on the actual supply of goods and services, the knowledge and disposable budgets of consumers, the honesty of producers, and the transparency of markets in general. Second, they can analyse the “stated preferences” of people as they express them explicitly in inquiries, referenda, polls and elections. Stated preferences speak for themselves and need relatively little additional interpretation and analysis. They are, therefore, the least vulnerable to manipulation. The weakness of stated preferences is that they also depend on the knowledge of respondents and that they are not binding: people can say whatever they like without personal consequences. Last, they can analyse the conditions that make people happy by comparing the conditions of people at different levels

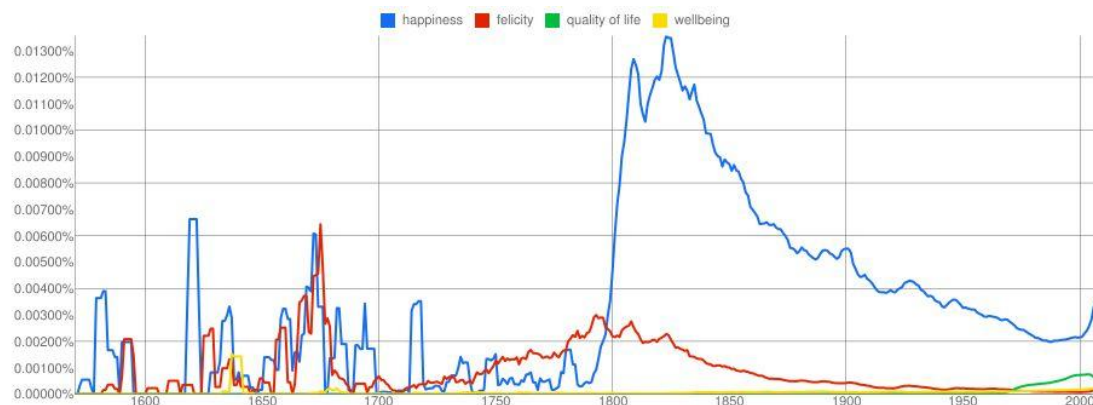
of happiness. Self-reported happiness has one important advantage compared to stated and revealed preferences: it is not dependent on the knowledge of people about specific options or about the conditions that make them happy.

The following chapter aims to a more profound understanding of the concept of happiness.

### 3. The concept of happiness

#### 3.1 Definition and evolution of the concept

The pursuit of happiness is as old as history itself. The psychological and philosophical search of happiness began in China, India and Greece nearly 2.500 years ago with Confucius, Buddha, Socrates, and Aristotle (The pursuit of happiness Organization 2012; White 2006). According to the evolution in the use of the different terms related to happiness, as reported to the digitalized articles and books (Fig. 1) from the Google Group work (Michel et al. 2010), the word 'happiness' seems to be used by scholars since the late 16<sup>th</sup> century, with a peak between 1800 and 1850. Between 1650 and 1700 the word 'felicity' was also used with approximately the same frequency. From the early 1960 a more epistemological approach and vocabulary, such as quality of life or (subjective) well-being, has been used (Diener 1994). Apart from this nomenclature, elsewhere in the literature are encountered other terms like life satisfaction, utility, welfare, hedonism and eudaimonia.

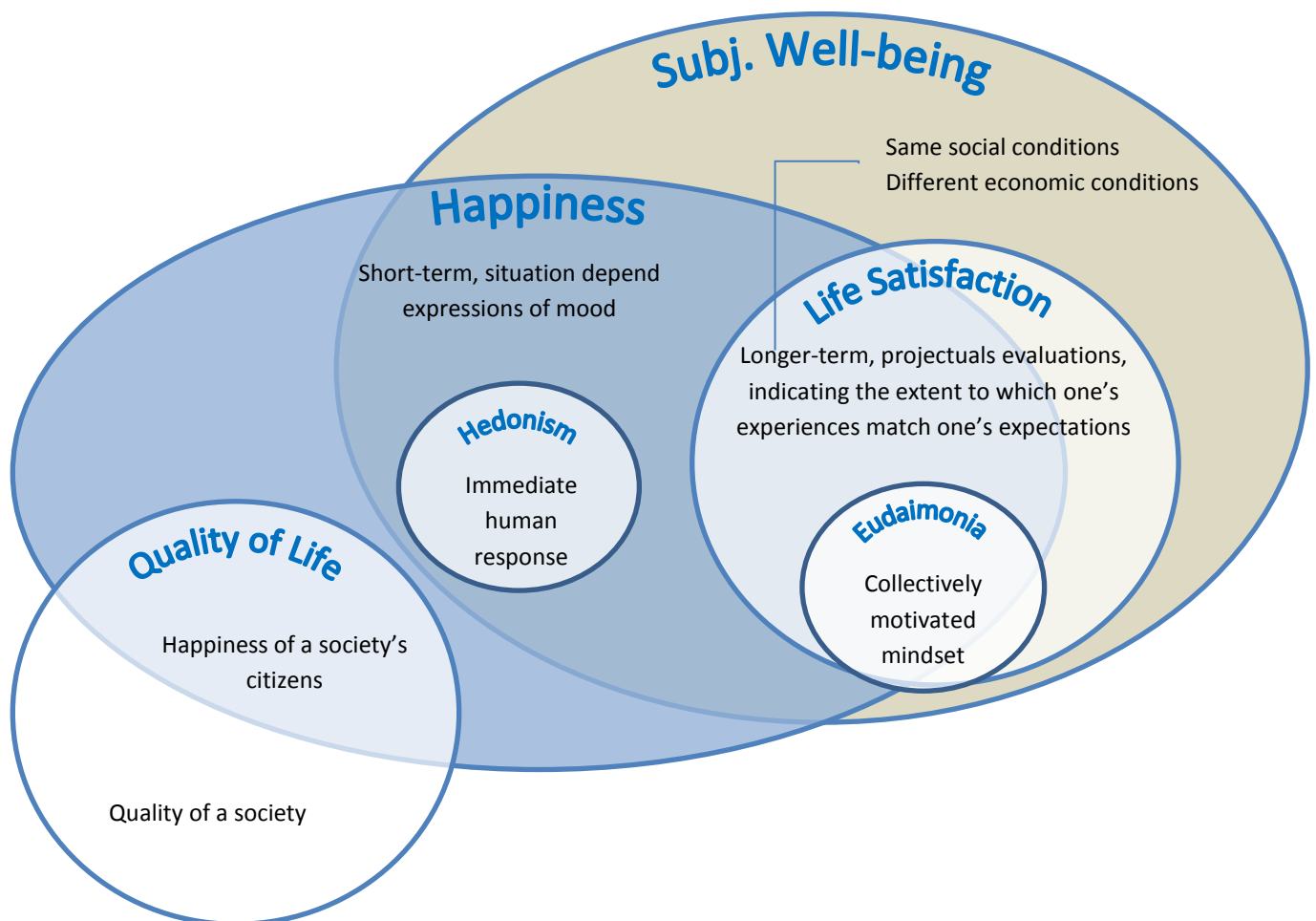


**Figure 1:** The evolution of the use of the words happiness, felicity, quality of life and wellbeing in digitized books and articles from 1570 to 2008.

**Source:** (Michel et al. 2010).

In many cases, these previously mentioned terms are being used interchangeably throughout the studies although subtle differences exist (Rehdanz & Maddison 2005; Easterlin 2003; Moro et al. 2008). The term well-being denotes that something is in a good state. It does not specify what that something is and neither what is considered good. Hence, when used alone it may be considered as a typical catchall term without a precise meaning (Veenhoven 2007), a plastic, adaptive word that is often used in many cases and has lost potential for precision, concreteness or exactitude (Poerksen 1995). In order to better define the former, 'subjective well-being' has been used in the literature, although it is not only used for satisfaction with life-as-a-whole, but also for specific (dis)comforts and moods (Veenhoven 1997). In the specific case of 'subjective well-being' two distinct spheres

can be found: happiness and life satisfaction. Both are affected in a similar way by social conditions, but rather differently by economic conditions. According to some studies, happiness is the degree to which a person evaluates the overall quality of his present life-as-a-whole (Veenhoven 1997). The basic difference found between happiness and life satisfaction<sup>1</sup> is that the latter emphasizes the subjective character of the concept, while the former is also used to refer to the objective good. For some authors happiness would be an emotional or affective state related to hedonism while life satisfaction would entail a cognitive process related to eudaimonia<sup>2</sup> (Peiró 2006; MacKerron & Mourato 2009). Hedonism then is considered a more immediate human response whereas eudaimonia refers to a more collectively motivated mind-set. In addition, self-ratings of 'happiness' tend to reflect short-term, situation-dependent expressions of mood, whereas self-ratings of 'life satisfaction' appear to measure longer-term, more projectual evaluations, indicating the extent to which one's experiences match one's expectations (Aslam & Corrado 2007).



**Figure 2:** Graphic representation of the definition of happiness according to the different theories. **Source:** Proper elaboration from (Veenhoven 1997; Veenhoven 2007; Veenhoven 2000; Peiró 2007; MacKerron & Mourato 2009).

<sup>1</sup> Happiness and life satisfaction are found to be correlated with a correlation coefficient of 0.56 (Di Tella et al. 2001).

<sup>2</sup> The concept of eudaimonia is understood by some authors as living a complete human life, or the realization of valued human potentials (Ryan et al. 2006).

### **3.2 Is Happiness measurable?**

Measuring happiness could be understood in a literal way, by measuring the brain activity or by examining the answers of the different parts of the brain that are being activated during the exposure to diverse emotional incentives (Layard 2005; Drago et al. 2010; Davidson et al. 2000; Davidson 2004; Weiner 2008). There are also other ways of measuring happiness such as stress hormones, cardiac activity or facial coding (e.g., counting how many times we smile). But the easiest and quite obvious technique is to simply ask people how happy they feel (Layard 2010; Veenhoven 2003; Weiner 2008; Layard 2005) and evaluate their answers by means of either one-item scales, as in (Andrews & Withey 1976) or multi-item scales, such as “Satisfaction with Life Scale” used in (Diener et al. 1985; Pavot & Diener 1993). A problem encountered in these type of methods is that the majority of people want to present a happy face to the world (Kirita & Endo 1995; Rhodes et al. 2003). As a consequence, they usually report higher happiness levels than in mail-in surveys (and even higher levels if the interviewer is of the opposite sex as Hugenberg and Sczesny have shown (Hugenberg & Sczesny 2006). Other problems that may affect the individual response are those of internalization of cultural norms, mental illness, lack of information, etc. Cognitive problems caused by ordering effects, question wording and difference in scales may lead as well to biases in the answers obtained (Bertrand & Mullainathan 2001). Furthermore, cultural differences and difficulties with translation may introduce further biases, and the extent to which these biases are problematic is a matter of debate (Moro et al. 2008). Hence, subjective assessments of happiness usually have troubles in delineating preference adaptation and the fact that people judge their level of happiness in comparison with peer groups rather than in absolute terms. However, the response of the person should not be ignored or interpreted to mean the opposite (Costanza et al. 2007). If a person says he is “pretty happy”, it means that this is what he really feels at the moment (Weiner 2008). There is a broad consensus among previous studies that self-reported happiness is a satisfactory empirical proxy for individual utility (Diener et al. 1999; Di Tella & MacCulloch 2006; Moro et al. 2008), showing adequate validity, reliability, factor invariance, and sensitivity to change (Diener 1994).

The subjective approach considers “soft” matters such as satisfaction with income or perceived adequacy of dwelling. It stems from survey research, which took off in the 1960’s (Veenhoven 2007), aiming to gather respondents’ own assessments of their lived experiences in the form of self-reports of happiness, satisfaction, fulfilment, well-being or some other near-synonym. Those surveys come to express the perceived significance of each domain of study to the respondent (Costanza et al. 2007; Costanza et al. 2008). Yet, there is also an objective part of measuring happiness. While subjective measurement tools focus on personal reports of life experience that complement social, economic and health indicators, objective measurements are generally focused on the same indicators, but using some already recognized tools and indexes. In other words, the objective approach focuses on measuring hard facts, such as income in local money or living accommodation in square meters (Veenhoven 2007) and represents frequencies or quantities that can be simultaneously verified by any number of persons (Cummins et al. 2003). It includes for example indices of economic production, literacy rates, life expectancy and other data. It can be gathered without any direct survey and used uniquely or in combination to form

composite indexes. Some methods of quantification would include quantifiable social or economic indicators to reflect the extent to which human needs are met. According to these methods, the objective elements would be described as the measure of human needs at a specific space and time (Costanza et al. 2007).

In trying to define and measure happiness we come across many different approaches that include either objective or subjective indicators. There are a number of limitations to using each of these approaches separately. While objective measurements may provide a snapshot of how well some physical and social needs are met, they are narrow, opportunity-biased, and cannot incorporate many issues that contribute to happiness such as identity, participation and psychological security. In other words, they fail to measure how people feel about their lives. They are actually proxies for experience identified through subjective associations of decision makers and many objective indicators merely assess the opportunities that individuals have to improve happiness rather than assessing happiness itself. Flaws in using only subjective measurements are also noted. They have trouble delineating preference adaptation and the fact that people judge their well-being in comparison with peer groups rather than in absolute terms (Costanza et al. 2007). Therefore, in any complete investigation of happiness both individual and contextual variables must be considered, as much as the cross-level interactions between them (Berry & Okulicz-Kozaryn 2009). In this paper we use an integrative definition of happiness that combines both objective and subjective elements, being transformed to a multi-scale, multidimensional concept and letting us obtain a more complete and useful picture of it at multiple spatial and temporal scales. When the object of study is the relation between human beings and society, the universality of the subjective cannot be ignored (Max-Neef et al. 1991). By integrating subjective and objective measures we obtain a more realistic picture of the important inputs and variables in order to improve happiness (Costanza et al. 2008), and a multi-method approach may create a more comprehensive depiction of the phenomenon (Diener 1994).

### **3.3 What makes us happy?**

In this chapter it will be investigated how a range of personal, economic and social factors are associated with happiness. The impact of income, of relative income, of health, of personal and community relationships and of employment status is important while doing the happiness assessment. Dolan, Peasgood and White (Dolan et al. 2008) formed an interesting study, as a result of a collection of papers talking about subjective well-being and happiness, according to which the potential influences on well-being fall under the following: income, personal characteristics, socially developed characteristics, how we spend our time, attitudes and beliefs towards self, others or life, relationships and wider economic, social and political environment.

#### **3.3.1 Income**

The relationship between income and happiness is rather complex. The results may generally show positive but diminishing returns to income. Some of this positive association is likely to be due to reverse causation and some due to unobserved individual characteristics, such as personality factors. Studies that include relative income suggest well-being is strongly affected by relativities and that additional income may not increase well-



being if those in the relevant comparison group also gain a similar increase in income. However, increases in income that result in increases in tax yield, which by its turn could be used to fund public services that may themselves enhance well-being. For a given income level, having high aspirations and expectations have a negative effect on happiness. Aspirations appear to be driven in part by past incomes, implying adaptation to higher levels of income. The perceptions of financial status seem to have stronger predictive power than actual income. As a result, additional income for those who are not at low levels of income is unlikely to increase happiness in the long run if the additional income serves to increase expectations of necessary income.

If the relative income effect dominates the absolute income effect, this would explain why wealthier individuals within a society are happier, but that average happiness levels remain constant as all members become wealthier. However, positive correlations between average happiness and national income found, particularly in lower income countries, requires either that comparisons of relative position are made across nations, or that an absolute income effect operates in many countries. (Dolan et al. 2008)

As a result, feeling satisfied with one's income depends on the comparison with a certain scale, which on its turn depends on the earnings of others and what he is accustomed to earn. In the first case, the feelings are ruled by social comparison in the second by habit. It is quite difficult for economic growth to be able to improve our happiness. As real incomes rise, the scale to which we compare such incomes will climb positions. (Layard 2005, pp. 51-52)

### **3.3.2 Personal characteristics**

The personal characteristics are about who we are, our genetic makeup and include our age, gender, ethnicity and personality. They include age, gender, ethnicity and personality.

In concrete, studies find a negative relationship between age and happiness and a positive relationship between age squared and happiness. About the gender, women tend to report higher happiness, although a few studies report no gender differences, maybe because other correlates are more important than gender per se. There is some suggestion that ethnicity may interact with age. Older respondents tend to show fewer differences as a function of ethnicity. Finally, about personality, people higher in self-esteem seem less likely to suffer from depression. (Dolan et al. 2008)

### **3.3.3 Socially developed characteristics**

The socially developed characteristics include education, health, type of work and unemployment.

As far as education concerns, some studies find a positive relationship between each additional level of education and happiness, while others find that middle level education is related to the highest life satisfaction. However, there is some evidence that education has more of a positive impact on low income countries. When it comes to health, there seems to be a strong relationship between happiness and both physical and psychological health, with the second to be more highly correlated given the close correspondence between psychological health and happiness. Health affects happiness and vice versa, happiness

affects health. Specific conditions, such as heart attacks and strokes reduce happiness. But, when coming to disability, individuals seem to adapt as the time passes, although the adaptation is never complete. About work, there is insufficient evidence to draw clear conclusions about the impact of type of work on happiness. Though, casual work seems to be detrimental to happiness. There is a little more evidence on self-employment. Some studies find a robust positive effect of self-employment to happiness, while others find that this positive effect is limited to the rich.

Finally, when talking about unemployment, there appears a large negative effect of individual unemployment on happiness. Unemployment reduces the probability of a high life satisfaction score and a high overall happiness score. The possibility that unhappy people have selected into unemployment has been raised in the past. Individuals who seem less happy may be more likely to become employed if they are less productive, have poorer health or are more likely to choose to become unemployed. People who are later unemployed do not start out with low life satisfaction, and when in the reaction phase (a year before the period of unemployment and a year after), they experience lower life satisfaction. Men, middle aged, those with high education, those with right wing political leanings and those in high income countries suffer most from unemployment. There is some mixed evidence of adaptation to unemployment. Some find that the negative coefficient on unemployment reduces with the length of unemployment while some others fail to find a duration effect or find that individuals unemployed for more than a year experience a more negative reaction to unemployment and once unemployment ended they never return to their pre-employment levels of satisfaction. (Dolan et al. 2008)

### 3.3.4 *How we spend our time*

How we spend our time stands for the work and activities we engage in our time and includes the hours worked, time spent in commuting, in caring for others, in community involvement and volunteering, in exercise and in religious activities.

In general, life satisfaction rises as hours worked increase. About part-time job there are some studies mentioning that it is associated with lower life satisfaction among men than full-time. However, other studies report no differences between full-time and part-time work and happiness. It is observed a negative relationship between the log of usual working hours and happiness. Also, an inverse U-shaped curve between life satisfaction and hours worked, suggesting that happiness rises as hours worked rise but only up to a certain point, before it then starts to drop as hours become excessive. There is little consideration given to the type of work undertaken. And of course, the impact of worked hours may vary if the hours worked are voluntarily chosen.

There is a lower life satisfaction with greater commuting time and this does not seem to result in greater happiness for other family members.

More care for others in general is associated with lower happiness and more depressive symptoms. The transition both into and out of care-giving is also associated with a range of negative happiness outcomes. Autonomy forms an essential pre-condition for happiness and well-being and the losses associated with caring may arise from a loss of autonomy and



choice a full-time caring role imposes. But, if the negative impact of personal circumstances were adequately accounted for, then the act of giving help to others may have potential beneficial impacts.

A positive relationship has been found between happiness and membership in non-religious organizations, as membership in more organizations increases life satisfaction. Both individual involvement in this type of organizations and national average membership are significantly positively related to life satisfaction. As regards volunteering, some studies indicate no relationship between volunteering and happiness. Among a sub-set of older people volunteering was associated with more positive affect, more meaning in life but not less negative affect. Also, it seems that happier people tend to do more voluntary work.

It is proved that even simple types of exercise may be associated with higher life satisfaction and happiness and especially for the over 60s. At the same time, the amount of time engaged in this type of activity at this age is also negative associated with depressive symptoms.

There is evidence that regular engagement in religious activities is positively related to happiness. Life satisfaction is associated with frequent church attendance, though less frequent attendance does not result in higher levels of life satisfaction than no attendance. (Dolan et al. 2008)

### ***3.3.5 Attitudes and beliefs towards self/others/life***

These attitudes and beliefs include attitudes towards our circumstances, trust, political persuasion and religion.

Perceptions of our circumstances can be very important predictors of happiness. For example, poorer perceptions of one's current financial situation are usually associated with lower life satisfaction. The same happens with perceptions of job security. It is important that perceptions of financial circumstances appear to fully mediate the effects of objective circumstances suggesting they have a more direct influence on global life satisfaction.

The effects of trust on happiness are relatively large. Social trust is associated with higher life satisfaction and happiness, and a lower probability of suicide. Neighborhood social trust also increases happiness and so does generalized trust. Moreover, trust in key public institutions (police, legal system, government) is associated with higher happiness.

As regards political persuasion, preferences for democracy and pro-market values are associated with higher life satisfaction in countries of Latin America and Russia. However, it may be that these attitudes are held by people who benefited more from these systems. What is interesting is that there is a differential impact of economic and social circumstances depending upon political view, via interaction effects. For example, unemployment and inflation have worse effects on the happiness of the "right wingers" but inequality seems to be worse for the "left wingers".

Beliefs affect happiness, with religious people generally being happier than non-religious people, irrespective of their faith. Belief in a God is associated with higher levels of life satisfaction, making little difference which religion one belongs to. The average happiness of

different countries is not affected by the proportion of the population with different religious beliefs. Although, there tend to be wide variances in happiness within the same religions as there are differences in the strength of people's beliefs, the degree to which they use God to help cope with difficulties and their degree of spirituality. Stronger religious beliefs may also help people overcome a loss of income or employment, since religious people's happiness drops half of the non-religious people following these negative shocks. Nevertheless, some negative shocks may be hard to deal with in a religious context (Dolan et al. 2008).

### 3.3.6 Relationships

Relationships include marriage and intimate relationship, having children and seeing family and friends.

Generally, being alone is worse for happiness than being a part of a partnership. Regular sex is also associated with more positive happiness and since the effects are strongest when this is with the same partner, it seems that being in a caring relationship is important for happiness rather than simply being in a string of less close relationships. Being married is associated with the highest level of happiness and being separated with the lowest, even lower than being divorced or widowed. The amount of happiness associated with being an unmarried cohabiter depends on the degree to which the relationship is perceived to be stable. Stable ones are associated with similar levels of happiness as married partnerships.

The evidence regarding to the happiness effects of having children is mixed and differs across measure and country. Controlling for income and financial satisfaction, children seem to have a non-significant effect on happiness but a positive and significant effect on life satisfaction. That happens because children put demands on day-to-day positive emotions but nonetheless people consider them an important part of their overall well-being at a more cognitive level. A positive relationship between children and life satisfaction is more likely to arise when income has equalized to account for household composition. Children generally affect happiness more negatively for single parents, divorced mothers, when they are over 3 years old, if the family has recently moved, if the family is poor or if the child is sick and needs more than average care.

Socializing with family and friends is positively associated with happiness and this positive effect applies into older age and remains even when controlling for levels of life satisfaction in previous periods. Despite the generally positively association, there may also be a few circumstances where greater contact with others is not indicative of better happiness. For example, global satisfaction is lower when contact involves care from friends and family and suggests potential problems when an adult is still living at home with his parents (Dolan et al. 2008).

### 3.3.7 Wider economic, social and political environment

This environment is about where we live. It includes income inequality, unemployment rates, inflation, welfare system and public insurance, degree of democracy, climate and natural environment, safety and deprivation of the area and urbanization.

The evidence on the impact inequality on happiness is mixed. There are findings that both increase and decrease life satisfaction depending on the selection of country inclusion. It is also likely to vary depending on how the inequality is interpreted or according to perceptions of mobility. Where mobility is perceived to be lower, inequality is found to have a negative impact.

National unemployment rates have found to reduce happiness. This may be due to fear of personal unemployment which arises from a higher national unemployment rate. Nevertheless, the above result is questionable and therefore, more research is needed to gain greater understanding on the extend of happiness losses form a higher unemployment rate.

Controlling for individual personal characteristics and country and year fixed effects inflation has been found to have a consistent negative effect on happiness. The inflation impact is worst for those with eight wing political leanings. A volatile inflation rate also reduces life satisfaction.

Evidence on the impact of the welfare state is limited. There seems to be no correlation between welfare expenditure and average happiness or average life satisfaction. However, a higher benefit replacement rate increases life satisfaction for both the unemployed and the employed.

As regards the degree of democracy, extended individual participation in the form of initiatives and referenda, and of decentralized government structures raises life satisfaction. Controlling for income and language group a positive link between democracy and life satisfaction is found.

Current evidence of the impact of pollution and environmental factors on well-being is limited. There is a difficulty in isolating any effect of pollution due to the high negative correlation between income and pollution. However, pollution, as measured by nitrogen dioxide, has a detrimental impact on overall happiness. Environmental problems where one lives reduce life satisfaction but although income is controlled for this model, this could still be picking up socio-economic status and household wealth. There is little evidence on the impact of climate on happiness but there is an indication that extreme weather is detrimental to happiness. In relation to attitudinal variables, caring about the ozone layer is negatively associated with happiness whilst caring about species extinction is positively associated with happiness.

As it comes to safety and deprivation of the area, controlling for one's own income, living in an unsafe or deprived area is detrimental to life satisfaction.

There is some evidence that living in large cities is detrimental to life satisfaction and living in rural areas is beneficial. However, some results are non-significant and population density does not affect happiness or mental health or life satisfaction. But, many of these studies control for income, and since incomes are likely to be lower in rural areas; this may give a deceptive appearance of greater rural happiness. (Dolan et al. 2008) According to Veenhoven (Veenhoven, 1994, p. 41), in developed countries rural people tend to be equally

satisfied with life as city-people. But, in the underdeveloped countries rural dwellers are markedly less happy than city-dwellers. Berry and Okulixz-Kozaryn (Berry & Okulicz-Kozaryn 2009) studying happiness and unhappiness of rural as opposed to big-city residents in various parts of the world, and by extension of the residential preferences that both drive and are driven by urbanward migration, state that there is no evidence that either rural or big-city residence raise or reduce unhappiness at the global level.

### 3.4 Happiness indexes

*“We need many indicators because we have many different purposes – but there may be over-arching purposes that transcend nations and cultures, and therefore there may be overarching indicators.”*

(Donella H. Meadows)

#### 3.4.1 Why not GDP or GNP?

The Gross Domestic Product (GDP) and Gross National Product (GNP) are two indexes that represent the size and strength of the economy. While, GDP is an estimated value of the total worth of a country's production and services, calculated over the course on one year, GNP is GDP plus the total capital gains from overseas investment minus the income earned by foreign nationals domestically. (Diffen n.d.)

Back in March, 1968, during a speech at the University of Kansas, Robert F. Kennedy (Kennedy 1968) noted that the Gross National Product includes everything, whether good or bad, that makes money, including the manufacture of a prison lock, a nuclear missile, a cigarette and a knife used in a murder. *“Yet the Gross National Product does not allow for the health of our children, the quality of their education, or the joy of their play,” he said. “It does not include the beauty of our poetry or the strength of our marriages; the intelligence of our public debate or the integrity of our public officials. It measures neither our wit nor our courage; neither our wisdom nor our learning; neither our compassion nor our devotion to our country. It measures everything, in short, except that which makes life worthwhile. And it tells us everything about America except why we are proud that we are Americans.”*

What is measured reflects what is valued and what matters most. Robert Kennedy reminded us just how limited our measures of economic progress can be. The GDP was designed to account for the total monetary value of consumption and production in an economy and only. (Anielski 2007, pp. 27-30)

In measuring different values such as happiness or wellbeing, many fallacies have been detected. The main of them are (Anielski 2007, pp. 30-32):

1. The GDP regards every expenditure as an addition to well-being, regardless what that expenditure is for and its effects. By this reasoning a healthy person in a solid marriage that cooks at home, walks to work and doesn't smoke or gamble is an economic villain. The hero borrows and spends; the villain pays cash and saves for

the kids' education. What economists call "growth," in other words, is not always the same as what most people would consider good.

2. The GDP ignores the crucial economic functions that lie outside the realm of monetary exchange. Excludes the value of unpaid housework, child care, volunteer work and leisure. Parents do real work. So do neighbors, communities, open spaces, rivers and oceans, the atmosphere and trees. Such things contribute more to well-being than does much that we buy from the market. Yet the GDP regards these life-sustaining functions as worthless — until the economy destroys them and we have to buy substitutes from the market or from government. Then the GDP says that the economy has "grown." When parents default and kids need counseling or foster care, the GDP goes up because money has changed hands. When a parent cares for kids at home the GDP stagnates; when that same parent takes care of other peoples' kids and calls it "daycare" the GDP goes up. When the city cuts down shade trees to widen a street and homeowners have to buy air conditioners for cooling, the GDP goes up again. It looks like economic growth, but no real increases have occurred. Instead, something that used to be free now costs money; social and environmental decay has been transformed into "growth" through the myopic lens of the GDP.
3. The GDP does not account for natural resources that are required to sustain current and future economic development — implying that the future has no value. The GDP excludes natural resource capital, environmental resources services, human resources, research and development. All that matters is the present. The implications of current economic activity for our kids and grandkids do not enter the calculation. For example, the GDP counts the depletion of natural resources as current income rather than as the liquidation of an asset. This violates both basic accounting principles and common sense. Similarly, saving doesn't add much to the GDP; economists actually chide Japan for its high savings rate. But maxing out on credit cards makes the GDP soar.
4. The GDP ignores totally the distribution of income, the social costs of inequality and poverty. Changes in the GDP are insensitive to income inequality, poverty and the distribution of personal consumption and wealth. Even assuming that the GDP represents a rising tide of beneficence, it can't have that effect unless all share. If the economy is getting bigger but the benefits are going mainly to those who need it least, the results are material accretion not economic advance. This is true even in conventional economic terms. For a family struggling on the minimum wage, a tenth that amount can mean the difference between macaroni and chicken for many nights.
5. The GDP contains intermediate and regrettable expenditures that do not contribute to economic welfare. It includes government spending for weapons. It also includes personal costs related to commuting, crime, environmental protection and automobile accidents.
6. The GDP minimizes the value of expenditures on education, health care, social services and environmental protection because it does not respect the outcomes or returns on investment from such expenditures. Such outcomes might include physical well-being (e.g. life expectancy), intellectual and labor market skills, educational attainment and improved quality of the environment.

7. The GDP does not directly measure investment in social capital. Social capital includes investments in the health and wellness of communities, social institutions and democratic processes.

### 3.4.2 Gross National Happiness (GNH)

#### 3.4.2.1 Definition of GNH

Gross National Happiness is a term coined by the Fourth King of Bhutan, Jigme Singye Wangchuck, who based on the Legal code of 1629: *“if the government cannot create happiness for its people, then there is no purpose for government to exist”* established it in 1972. It was incorporated in the Constitution of Bhutan in 2008 with the Article 9: *“The State shall strive to promote those conditions that will enable the pursuit of Gross National Happiness”* (Centre For Bhutan Studies 2012).

Bhutan’s gross national happiness concept resides in the belief that the key to happiness is to be found, once basic materials needs have been met, in the satisfaction of non-material needs and in emotional and spiritual growth (The Planning Commission Secretariat Royal Government of Bhutan, 2000, p.17; Trkulja, 2007). According to the report of Club of Rome *“Limits of Growth”*, any human activity that does not require a large flow of irreplaceable resources or produce severe environmental degradation might continue to grow indefinitely. In particular, those pursuits that many people would list as the most desirable and satisfying activities of man are education, art, music, religion, basic scientific research, athletics and social interactions and are those that could be flourish. (Pestel, 1972, p.7) Those activities correspond to the satisfaction in the non-material and emotional needs of the gross national happiness corresponding to food, shelter, clothing and medicine (The Planning Commission Secretariat Royal Government of Bhutan, 2000, p.16,17; Trkulja, 2007).

The concept of GNH implies that sustainable development should take a holistic approach towards notions of progress and give equal importance to non-economic aspects of wellbeing, explained by its four pillars (Centre For Bhutan Studies 2012; The Planning Commission Secretariat Royal Government of Bhutan 2000; Trkulja 2007):

1. Good governance
2. Sustainable socio-economic development
3. Cultural preservation
4. Environmental conservation

There can be distinguished two stages of the indicator, conditions of happiness and level of happiness. The first one corresponds to sustainability. The second one can be seen as a qualitative indicator and combination from nine domains that are the evolution of the above four pillars. (Trkulja 2007) This classification was made in order to create widespread understanding of GNH and to reflect the holistic range of GNH values:

- |   |   |                  |
|---|---|------------------|
| <ol style="list-style-type: none"> <li>1. <i>Psychological wellbeing</i></li> <li>2. <i>Health</i></li> </ol> | } | Standard Domains |
|---|---|------------------|

- |   |   |                    |
|---|---|--------------------|
| 3. <i>Education</i>                           |   |                    |
| 4. <i>Time use</i>                            | } | Newer Domains      |
| 5. <i>Cultural diversity and resilience</i>   |   |                    |
| 6. <i>Good governance</i>                     |   |                    |
| 7. <i>Community vitality</i>                  | } | Innovative Domains |
| 8. <i>Ecological diversity and resilience</i> |   |                    |
| 9. <i>Living standards</i>                    |   |                    |

The first three domains are the standard, the second three the newer and the last three the innovative. The domains represent each of the components of wellbeing of the Bhutanese people, and the term 'wellbeing' here refers to fulfilling conditions of a 'good life' as per the values and principles laid down by the concept of Gross National Happiness. (Centre for Bhutan Studies, nd)

The Gross National Happiness Index is a single number index developed from 33 indicators categorized under the nine domains (Table 1). The indicators are selected taking into consideration normative values, statistical properties, accuracy across time, policy relevance and clarity of interpretation.

**Table 1: Domains and indicators of GNH.**

Domain	Indicator
1. Psychological well-being	Life satisfaction
	Spirituality
	Positive emotion
	Negative emotion
2. Health	Self-reported health status
	Healthy days
	Disability
	Mental health
3. Education	Literacy
	Schooling
	Knowledge
	Value
4. Cultural diversity and resilience	Speak native language
	Cultural participation
	<i>Zorig chusum</i> skills (Artisan skills)
	<i>Driglam Namzha</i> (code of etiquette and conduct)
5. Good Governance	Government performance
	Fundamental rights
	Services
	Political participation
6. Community vitality	Donation (time & money)
	Community relationship

7. Ecological diversity and resilience	Family
	Safety
	Ecological issues
	Responsibility towards environment
	Wildlife damage
8. Living standards	Urban issues
	Asset
	Housing
	Household per capita income
9. Time use	Work
	Sleep

Source: Proper elaboration from (Centre For Bhutan Studies 2012).

#### 3.4.2.2 Methodology of calculation of GNH

The GNH Index is constructed based upon a robust multidimensional methodology known as the Alkire-Foster method (Centre For Bhutan Studies 2012). The domains are equally weighted. Within each domain, the objective indicators are given higher weights while the subjective and self-reported indicators are assigned lower weights (Table 2).

In this perspective, ‘happiness’ comprises having sufficient achievements in six out of the nine domains. In practice, we look for achievement in 66% of the weighted indicators, whichever domains they come from.

The Gross National Happiness Index is constructed in two steps, one which pertains to identification and one to aggregation. We describe each of these steps and then describe the mechanism for breaking the index down to report domain achievements for each district or group.



Table 2: Weighting of the indicators of GNH.

Domain	Indicators	Individual indicator weight		Domain weight	Total weight	
		Fraction form	Percentage form		Fraction form	Decimal form
Psychological wellbeing	Life satisfaction	1/3	40%	1/9	1/27	0.037037
	Positive emotion	1/6	10%	1/9	1/54	0.018519
	Negative emotion	1/6	10%	1/9	1/54	0.018519
	Spirituality	1/3	40%	1/9	1/27	0.037037
Health	Self reported health status	1/10	10%	1/9	1/90	0.011111
	Number of healthy days	3/10	30%	1/9	1/30	0.033333
	Disability	3/10	30%	1/9	1/30	0.033333
	Mental health	3/10	30%	1/9	1/30	0.033333
Time use	Work	1/2	50%	1/9	1/18	0.055556
	Sleep	1/2	50%	1/9	1/18	0.055556
Education	Literacy	3/10	30%	1/9	1/30	0.033333
	Schooling	3/10	30%	1/9	1/30	0.033333
	Knowledge	1/5	20%	1/9	1/45	0.022222
	Value	1/5	20%	1/9	1/45	0.022222
Cultural diversity and resilience	Zorig chusum skills (Artisan skills)	3/10	30%	1/9	1/30	0.033333
	Cultural participation	3/10	30%	1/9	1/30	0.033333
	Speak native language	1/5	20%	1/9	1/45	0.022222
	Driglam Namzhi (code of etiquette and conduct)	1/5	20%	1/9	1/45	0.022222
Good Governance	Political participation	2/5	40%	1/9	2/45	0.044444
	Services	2/5	40%	1/9	2/45	0.044444
	Governance performance	1/10	10%	1/9	0/1	0.011111
	Fundamental rights	1/10	10%	1/9	1/90	0.011111
Community vitality	Donation (time & money)	3/10	30%	1/9	1/30	0.033333
	Safety	3/10	30%	1/9	1/30	0.033333
	Community relationship	1/5	20%	1/9	1/45	0.022222
	Family	1/5	20%	1/9	1/45	0.022222
Ecological diversity and resilience	Wildlife damage	2/5	40%	1/9	2/45	0.044444
	Urban issues	2/5	40%	1/9	2/45	0.044444
	Responsibility towards environment	1/10	10%	1/9	1/90	0.011111
	Ecological issues	1/10	10%	1/9	1/90	0.011111
Living Standard	Household per capita income	1/3	33%	1/9	1/27	0.037037
	Assets	1/3	33%	1/9	1/27	0.037037
	Housing	1/3	33%	1/9	1/27	0.037037
	Total	9/1			1/1	1.000000

Source: (Centre For Bhutan Studies 2012).

The methodology basically provides three types of results: headcount, intensity and the overall GNH index. Headcount refers to the percentage of Bhutanese who are considered happy, and intensity is the average sufficiency enjoyed by the Bhutanese.

- Headcount: Shows the percentage of people who have sufficiency in six or more of the nine domains and are considered 'happy'.
- Intensity: Shows the percentage of the domains that those considered as not happy lack sufficiency in.
- GNH Index: Reflects the percentage of people who are happy and the percentage of domains in which not-yet-happy people have achieved sufficiency (headcount and intensity). Ranges from 0 to 1, where a higher number is considered as better. (Centre For Bhutan Studies 2012)

### 3.4.2.3 Criticism on GNH

Critics state that because GNH depends on a series of subjective judgments about well-being, governments may be able to define GNH in a way that suits their interests. Critics say that international comparison of well-being will be difficult on this model; proponents

maintain that each country can define its own measure of GNH as it chooses, and that comparisons over time between nations will have validity. GDP provides a convenient, international scale. Research demonstrates that markers of social and individual well-being are remarkably transcultural: people generally report greater subjective life satisfaction if they have strong and frequent social ties, live in healthy ecosystems, experience good governance, etc. Nevertheless, it remains true that reliance on national measures of GNH would render international comparisons of relative well-being more problematic, since there is not and is not likely ever to be a common scale as "portable" as GDP has been. Nevertheless, Bhutan's stated goal is to maximize whatever they see as GNH, not compare numbers with other countries. (Diener et al. 1995)

### 3.4.3 Human Development Index (HDI)

#### 3.4.3.1 Definition HDI

This index was developed for United Nations Development Program which describes the progress in all countries of the world in its annual "Human Development Reports".

It is a composite index measuring average achievement in three basic dimensions of human development—a long and healthy life, knowledge and a decent standard of living. The HDI is the geometric mean of normalized indices measuring achievements in each dimension (UNDP 2011). Its indicators and dimension indexes for its calculation can be seen at the following graph (Fig. 3).

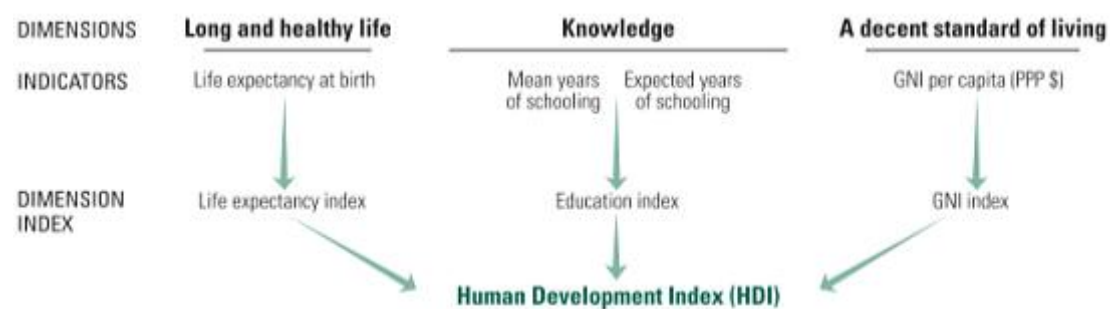


Figure 3: Graphical representation of the calculation of HDI.

Source: (UNDP 2011)

#### 3.4.3.2 Methodology of calculation of HDI

The data used for the calculation of HDI are scores from national statistical aggregates and not individual responses to questionnaires.

According to UNDP (UNDP 2011), to calculate the HDI there are two steps. The first step is about creating the dimension indices. For that we need to know the minimum and the maximum values, in order to transform the indicators into indices between 0 and 1. The maximums are the highest observed values in the time series (1980–today). The minimum values can be appropriately conceived of as subsistence values. They are set at 20 years for life expectancy, at 0 years for both education variables and at \$100 for per capita gross national income (GNI).

Having defined the minimum and maximum values, the sub- indices are calculated as follows:

$$\text{Dimension index} = \frac{\text{actual value} - \text{minimum value}}{\text{maximum value} - \text{minimum value}} \quad (1)$$

So, for life expectancy we have:

$$\text{Life expectancy index} = \frac{\text{actual value} - 20}{\text{maximum value} - 20} \quad (2)$$

For education, the equation is applied to each of the two subcomponents, then a geometric mean of the resulting indices is created and finally, the equation is reapplied to the geometric mean of the indices using 0 as the minimum and the highest geometric mean of the resulting indices for the time period under consideration as the maximum. This is equivalent to applying the equation directly to the geometric mean of the two subcomponents. So we have:

$$\text{Mean years of schooling index} = \frac{\text{actual value} - 0}{\text{maximum value} - 0} \quad (3)$$

$$\text{Expected years of schooling index} = \frac{\text{actual value} - 0}{\text{maximum value} - 0} \quad (4)$$

$$\begin{aligned} &\text{Education index} \\ &= \frac{\sqrt{\text{Mean years of schooling index} \times \text{Expected years of schooling index}} - 0}{\text{maximum value} - 0} \quad (5) \end{aligned}$$

For income, the natural logarithm of the actual minimum and maximum values is used.

$$\text{Income index} = \frac{\ln(\text{actual value}) - \ln(100)}{\ln(\text{maximum value}) - \ln(100)} \quad (6)$$

The second step is about aggregating the subindices to produce the HDI. HDI is the geometric mean of the three dimension indices. The equation used is the following:

$$\text{HDI} = I_{\text{Life}}^{1/3} \times I_{\text{Education}}^{1/3} \times I_{\text{Income}}^{1/3} \quad (7)$$

#### 3.4.3.3 Criticism on HDI

According to Veenhoven (Veenhoven 2007), HDI indicates how well developing nations meet some attainments that are characteristic for the leading nations of this world. Yet it cannot be used to measure the overall wellbeing or happiness of a nation because it adds different types of data that cannot be compared with each other. Also, HDI is not suited for monitoring progress in wellbeing in advanced nations, since its items are subject to the law

of diminishing utility. Further, life expectancy is of value only if life remains satisfying in old age, but the HDI does not take the enjoyment of life into account.

### 3.4.4 Happy Planet Index (HPI)

#### 3.4.4.1 Definition of HPI

The HPI measures the extent to which countries deliver long, happy, sustainable lives for the people that live in them. The Index uses global data on life expectancy, experienced well-being and Ecological Footprint to calculate this.

The index is an efficiency measure; it ranks countries on how many long and happy lives they produce per unit of environmental input.

The 2012 HPI report ranks 151 countries and is the third time the index has been published (Nef 2012a; Nef 2012b).

#### 3.4.4.2 Methodology of calculation of HPI

The index uses global data on life Footprint.

$$HPI = \frac{\text{Experienced wellbeing} \times \text{Life expectancy}}{\text{Ecological Footprint}} \quad (8)$$

Each of these components is based on a separate measure:

*Experienced well-being:* In 2012's HPI, experienced well-being is assessed using a question called the 'Ladder of Life' from the Gallup World Poll. This asks respondents to imagine a ladder, where 0 represents the worst possible life and 10 the best possible life, and report the step of the ladder they feel they currently stand on.

*Life expectancy:* Alongside experienced well-being, the HPI includes a universally important measure of health – life expectancy. Life expectancy data used are from the 2011 UNDP Human Development Report.

*Ecological Footprint:* The HPI uses the Ecological Footprint promoted by the environmental charity WWF as a measure of resource consumption. It is a per capita measure of the amount of land required to sustain a country's consumption patterns, measured in terms of global hectares (g ha) which represent a hectare of land with average productive biocapacity (Nef 2012a; Nef 2012b).

#### 3.4.4.3 Criticism on HPI

Countries that do well on the HPI suffer many problems and many high-ranking countries are tainted by important human rights issues. And though one would expect the infringement of rights to negatively impact on the well-being of some people in the country, the HPI does not set out to directly measure those rights. Furthermore, because it is likely that people directly affected by extreme human rights abuses represent a minority, the population average well-being score may not fully reflect this harm. (Nef 2012a; Nef 2012b)

### 3.4.5 Index of sustainable economic welfare (ISEW)

#### 3.4.5.1 Definition of HPI

According to Lawn (Lawn 2003), the ISEW is designed to more closely approximate the sustainable economic welfare or progress of a nation's citizens. The sustainable economic welfare implied here is the welfare a nation enjoys at a particular point in time given the impact of past and present activities. The notion of sustainable economic welfare being approximated is critical.

According to Max-Neef (Max-Neef 1995), the quality of life is not increasing with constant economic growth. He states that for every society there seems to be a period in which economic growth (conventionally measured) brings about an improvement in the quality of life, but only up to a point, the threshold point, beyond which, if there is more economic growth, quality of life may begin to deteriorate. Later, he compared this hypothesis with the Index of Sustainable Economic Welfare (ISEW) that combines social factors, income inequalities and environmental deterioration (components that have an evident impact on peoples' quality of life). ISEW analyses show that in all studied countries economic welfare per capita rose in the early parts of the study period and then began to decline despite the continued growth of per capita GNP.

And the following graphs for United States and United Kingdom both ISEW and GNP run in parallel between 1950 and early 1970's (Fig. 4). From then on GNP continues to grow but ISEW begins to decline. As a result, economic growth is qualitatively better in the earlier rather than in the latter stages.

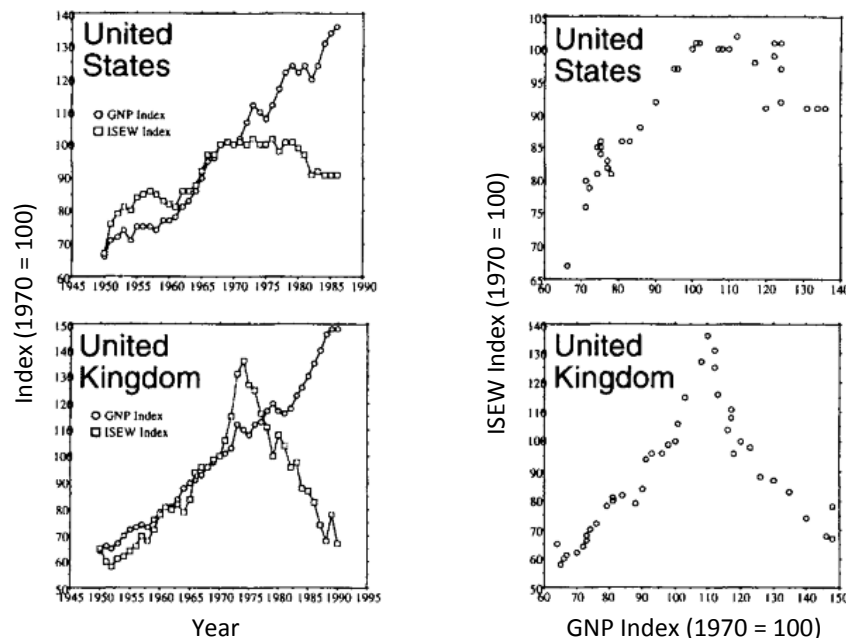


Figure 4: GNP and ISEW indexes evolution from 1950 and on.  
Source: (Max-Neef 1995).

#### 3.4.5.2 Methodology of calculation of ISEW

As for the calculation of the ISEW, the index begins with the extraction from the national accounts of the transactions deemed directly relevant to human well-being. Further

adjustments are made to account for the many benefits and costs of economic activity that GDP ignores. Accordingly, the ISEW includes a number of social and environmental benefits and costs that invariably escape market valuation. The items are valued in monetary terms. The final index number is usually calculated in real rather than nominal values (Lawn 2003).

### 3.4.6 Genuine Progress Indicator (GPI)

#### 3.4.6.1 Definition of GPI

The Genuine Progress Indicator (GPI) was developed in 1995 by Cliff Cobb, an economist with the San Francisco economic-think tank Redefining Progress as an alternative measure of economic well-being and progress to the GDP. If the GDP was designed to account for the total monetary value of consumption and production in an economy, GPI was designed to indicate genuine progress in people's quality of life and overall economic, social and environmental well-being (Anielski 2007).

The GPI attempted to measure the social and environmental costs and benefits which the GDP either ignores or counts as economic progress. In other words, the GPI reveals hidden environmental costs as well as several measures of both social progress (value of unpaid work) and decline which the GDP obfuscates. The results are expressed in the same monetary terms as the GDP.

The difference between GDP and GPI may be seen at the following Graph (Fig. 5), representing both measures for the US between 1950 and 1995.

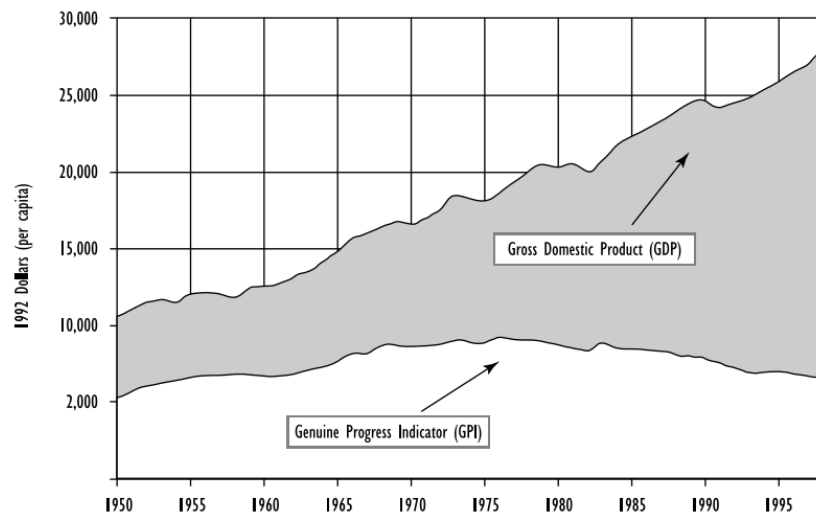


Figure 5: US GPI versus GDP, 1950–1997.

Source: (Anielski & Rowe 1999).

#### 3.4.6.2 Methodology of calculation of GPI

To calculate the GPI, we begin with the personal consumption expenditures. We include capital investment, government spending and net exports. But the GPI adjusts personal consumption expenditures by (Anielski 2007):

- Adjusting GDP for income inequality — the gap between rich and poor
- Adding the values of unpaid housework, parenting and volunteer work

- Adding the value of the service from household infrastructure
- Adding the value of the service from streets and highways
- Subtracting the value of time including costs of lost leisure time, family breakdown, commuting time, unemployment and underemployment
- Subtracting the costs of crime, auto accidents and cost of consumer durables
- Subtracting the costs of long-term environmental degradation, air pollution, water pollution, ozone depletion, noise pollution, loss of farmland, loss of forests, loss of wetlands and
- Adjusting for net capital formation and net foreign borrowing.

At the following graph (Fig. 6) there are representing the results of a measurement of GPI in Alberta in 1999.

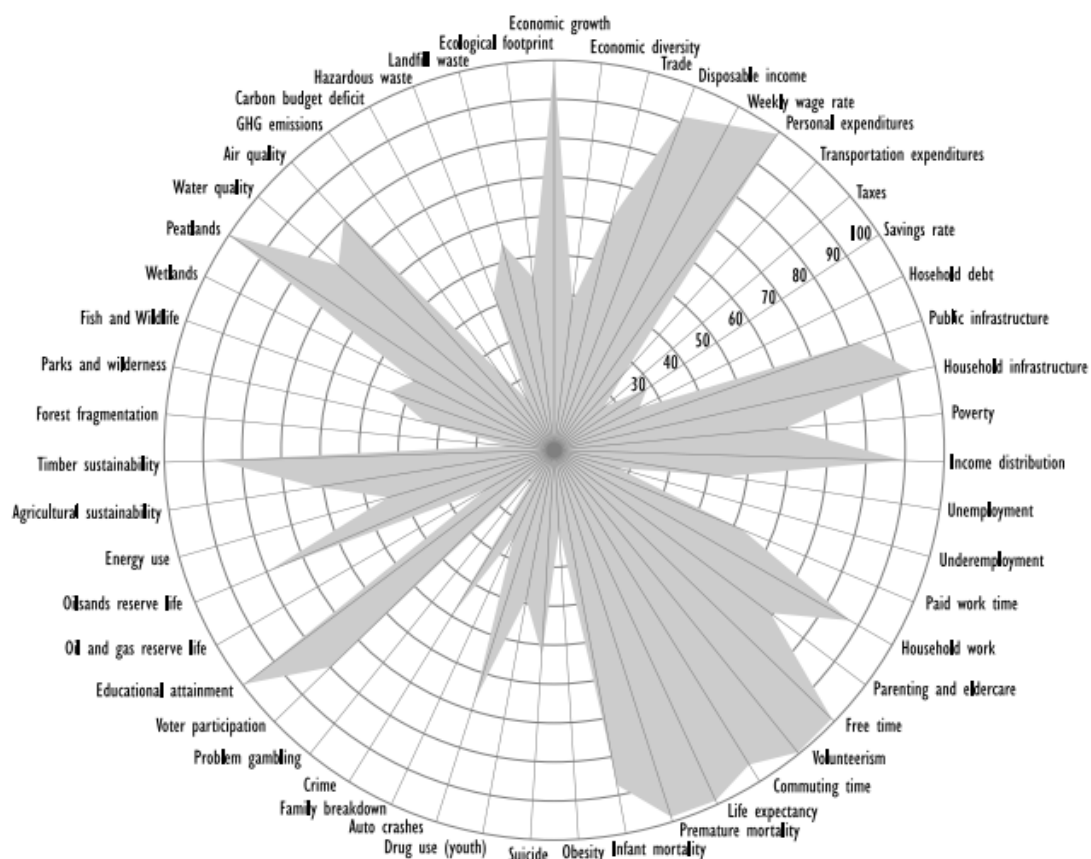


Figure 6: The Alberta GPI Sustainable Well-being Circle Index for 1999.

Source: (Anielski 2007, p. 44).

### 3.4.6.3 Criticism on GPI

According to Anielski (Anielski 2007), GPI is incomplete and methodologically challenging.

### 3.4.7 Democracy Index

According to Laza Kekic (Kekic 2007), The Economist Intelligence Unit's Democracy index is based on the view that measures of democracy that reflect the state of political freedoms and civil liberties are not thick enough. They do not encompass sufficiently or at all some features that determine how substantive democracy is or its quality. Freedom is an essential



component of democracy, but not sufficient. In existing measures, the elements of political participation and functioning of government are taken into account only in a marginal way.

The Economist Intelligence Unit's democracy index is based on five categories: electoral process and pluralism; civil liberties; the functioning of government; political participation; and political culture. The five categories are interrelated and form a coherent conceptual whole. The condition of having free and fair competitive elections, and satisfying related aspects of political freedom, is clearly the basic requirement of all definitions.

#### **3.4.8 Physical quality-of-life Index (PQLI)**

The Overseas Development Council (ODC) provides a measurement called the Physical Quality of Life (PQLI). The PQLI combines infant mortality, life expectancy, and literacy into a single index for each of 150 countries (Larson & Wilford 1979).

#### **3.4.9 Satisfaction With life Scale (SWLS)**

According to Pavot and Diener (Pavot & Diener 1993), the Satisfaction With Life Scale (SWLS) was developed to assess satisfaction with the respondent's life as a whole. The scale does not assess satisfaction with life domains such as health or finances but allows someone to integrate and weight these domains in whatever way he choose. Normative data are presented for the scale, which shows good convergent validity with other scales and with other types of assessments of subjective well-being. Life satisfaction as assessed by the SWLS shows a degree of temporal stability (e.g., .54 for 4 yrs), yet the SWLS has shown sufficient sensitivity to be potentially valuable to detect change in life satisfaction during the course of clinical intervention. Further, the scale shows discriminant validity from emotional well-being measures. The SWLS is recommended as a complement to scales that focus on psychopathology or emotional well-being because it assesses an individual's conscious evaluative judgment of his or her life by using the person's own criteria.

#### **3.4.10 Allardt's Welfare Index**

##### **3.4.10.1 Definition of Allardt's Welfare Index**

In his study on comparative welfare, Allardt (Allardt & Uusitalo 1972; Allardt 1976) measured wellbeing in Scandinavian nations by means of self-reports on the following matters: income, quality of housing, political support, social relations, health, education, being irreplaceable, doing interesting things and life-satisfaction. He classified these indicators using his distinction between "having", "loving" and "being".

##### **3.4.10.2 Criticism on Allardt's Welfare Index**

According to Veenhoven (Veenhoven 2007), this Welfare Index cannot be used to measure the overall wellbeing or happiness because the classification between "having", "loving" and "being" was appealing at that time, expressing the rising conviction that welfare is more than just material wealth but, has not proven to be useful. Further, he states that the index adds different types of data that cannot be compared with each other.



### **3.4.11 WHO Quality Of Life scale**

#### **3.4.11.1 Definition of WHOQOL scale**

The WHOQOL scale is a questionnaire about self-perceived wellbeing during the last two weeks. It contains the following domains: physical health, psychological health, social relation and environmental conditions. It involves also an item on perceived overall quality of life. The full questionnaire involves 100 items and the short version 26 items. (The WHOQOL Group 1998)

#### **3.4.11.2 Criticism on WHOQOL scale**

According to Veenhoven (Veenhoven 2007), WHOQOL scale cannot be used to measure the overall wellbeing or happiness because it adds different types of data that cannot be compared with each other.

### III. Objectives

The objectives of the Thesis are divided into main and secondary. The main objective is to define happiness, to obtain a global view point on the common areas of reference between the concepts of happiness, sustainability and urban planning and to introduce a method of quantification of happiness for the urban context, based both on the perception of people using the urban space and data of existing objective spatial indicators with the aim to establish more liveable urban spaces, adequate infrastructural systems and sustainable futures for the dweller.

The secondary objectives are divided into two main categories. The first category is related to the better understanding i) of the concept of happiness as scientists viewed it and constructed it during the past years and ii) of its relation with the concepts of sustainability and urban planning. The objectives have as follows:

- Mapping the happiness network
  - To investigate - using an alternative, less theoretical approach of complex theory - the happiness framework the happiness framework as scientists viewed it and constructed it during the past years. To achieve that, a study of the happiness-related keywords of scientific publications will be made so as to create and analyse the network of happiness.
  - To identify the main keywords (hubs) that will correspond to the main ideas related to happiness.
  - To define the community structure of happiness keywords. This will allow us to observe the different subcommunities that scientists believe are related to happiness.
  - To investigate the keyword complementarity with the aim to find which keywords co-appear frequently and which are considered equivalent.
- Associations between happiness, sustainability and urban planning
  - To obtain a global view point on the common areas of reference between the three concepts of happiness, sustainability and urban planning. This will be achieved by expanding the previous approach by means of reference analysis of scientific publications related to the three subjects.
  - To establish the connections between sustainability, happiness and urban planning identifying the keyword performing as bridges linking them.
  - To define the community structure of the network and to detect which subcommunities are located in the intersection of the three.

The second category is related to the introduction and application of a new methodology for the study and measurement of dwellers' happiness in a concrete urban environment.

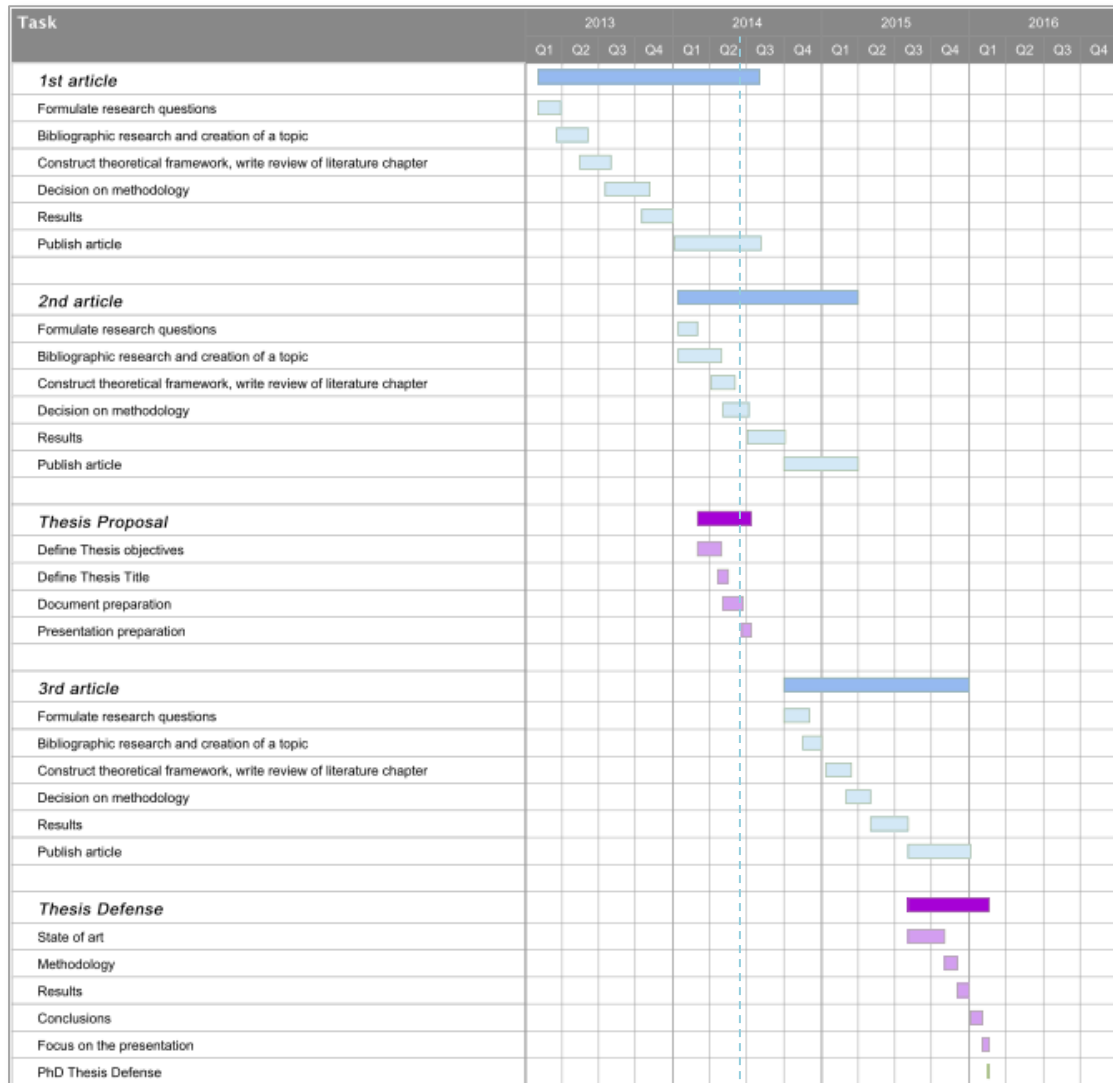
- Case study
  - To introduce a method of quantification of happiness for the urban context, based both on the perception of people using the urban space and data of existing objective spatial indicators. To check whether personal happiness is

accomplished, Max-Neef's conceptual frame on Human Scale Development has been used (Max-Neef et al., 1991).

- To obtain a final integrative happiness index for the urban environment.

## IV. Timeline

Table 3: Gant Diagram for the Thesis tasks.





## V. Methodology

### 1. Mapping the happiness keywords

In this stage, a study of the happiness-related scientific is made so as to create and analyse the network of happiness. To form the network, there will be taken into consideration the different keywords sited in each article, issue and volume of the selected journals. The aim is to investigate - using an alternative, less theoretical approach - the happiness framework as scientists viewed it and constructed it during the past years.

For the analysis, we used the keywords of the articles belonging to three indexed scientific journals related with happiness. The first of those was the Journal of Happiness Study (J HAPPINESS STUD) addressing the conceptualization, measurement, prevalence, explanation, evaluation, imagination and study of happiness with a coverage that includes both cognitive evaluations of life such as life-satisfaction, and affective enjoyment of life, such as mood level. The second was the Journal of Positive Psychology (J POSIT PSYCHOL) focusing on aspects of the human condition that lead to happiness, fulfillment, and flourishing, with subjects related to behavioral sciences, career and lifestyle development, coaching, counseling, health psychology, mental health, personal development, positive psychology, psychological science and social psychology. The third corresponded to Applied Research in Quality of Life (APPL RES QUAL LIFE) that publishes conceptual, methodological and empirical papers dealing with quality-of-life studies in the applied areas of the natural and social sciences with the goal to help decision makers apply performance measures and outcome assessment techniques based on concepts such as well-being, human satisfaction, human development, happiness, wellness and quality-of-life.

The visualizations where made in Gephi, an open source network and manipulation software (Bastian & Heymann 2009). Gephi is an intuitive and interactive software allowing, in which force-directed layout algorithms are implemented. These algorithms produce a graph by simulating the dynamics of the network as if it were a physical system (the nodes being charged particles and the edges springs). The simulation is run until the system comes to an equilibrium state (Grauwin & Jensen 2011). The layout of the graph is obtained thanks to a spring-based algorithm implemented in it. ForceAtlas2 is a force-directed layout: it stimulates a physical system (Jacomy et al. 2012). Nodes repulse each other (like magnets) while edges attract the nodes they connect (like springs). These forces create a movement that converges to a balanced state, which helps in the interpretation of the data.

#### 1.1 Network topology

A list of network metrics will be analysed according to (Barabási et al. 2002; Barabási 2014), as they are important for the understanding of the network topology.

##### 1.1.1 Degree, average degree and degree distribution

A key property of a node is its *degree*, representing the number of links it has to other nodes. We denote  $k_i$  the degree of the  $i^{th}$  node in the network. In an undirected network total number of links,  $L$ , can be expressed as the sum of the node degrees:

$$L = \frac{1}{2} \sum_{i=1}^N k_i \quad (9)$$

The  $\frac{1}{2}$  factor corrects for the fact that in the sum (9) each link is counted twice.

An important property of a network is its *average degree*, which for an undirected network is

$$\langle k \rangle = \frac{1}{N} \sum_{i=1}^N k_i = \frac{2L}{N} \quad (10)$$

where  $N$  is the total number of nodes in the system or the *size of the network*.

The degree distribution  $p_k$  is giving the probability that a randomly selected node in the network has  $k$  links. Since  $p_k$  is a probability, it must be normalized, i.e.  $\sum_{k=1}^{\infty} p_k = 1$ . For a fixed network of  $N$  nodes the degree distribution is the normalised histogram  $p_k = \frac{N_k}{N}$ , where  $N_k$  is the number of degree  $k$  nodes. Networks for which  $p_k$  has a power-law tail, are known as scale-free networks (Barabási & Albert 1999).

In real networks the number of nodes ( $N$ ) and links ( $L$ ) can vary widely. In a network of  $N$  nodes the number of links is between  $L = 0$  and  $L_{max}$ , where  $L_{max}$  is the total number of links present in a complete graph,

$$L_{max} = \binom{N}{2} = \frac{N(N-1)}{2} \quad (11)$$

a graph in which each node is connected to all other nodes. In real networks  $L$  is much smaller than  $L_{max}$ , indicating that real networks are sparse. Sparseness has important consequences on the way we explore and store real networks.

### 1.1.2 Adjacency matrix

To keep track of links a complete list of the links may be structured, representing the network through its adjacency matrix. The adjacency matrix of a network of  $N$  nodes has  $N$  rows and  $N$  columns, its elements being:

$A_{ij} = 1$  if there is a link between the node  $i$  and the node  $j$

$A_{ij} = 0$  if there is no connection between nodes  $i$  and  $j$ .

The adjacency matrix of an undirected and unweighted network has two entries for each link,  $A_{ij} = 1$ , a link pointing from node  $j$  to node  $i$ , and  $A_{ji} = 1$ , and a link pointing from  $i$  to  $j$ . Hence it is symmetric. The sparsity of real networks implies that the adjacency matrices are also sparse. Only a tiny fraction of the matrix elements are nonzero.

### 1.1.3 Paths and distances in networks

The next metric studied was the *path* of a network. A *path* is a route that runs along the links of the network, its length representing the number of links the path contains. The *shortest path* between nodes  $i$  and  $j$  is the path with fewest number of links. It is also called *distance*,

denoted  $d_{ij}$  or simply  $d$ . In an undirected network  $d_{ij} = d_{ji}$ . The *network diameter*, denoted  $d_{max}$ , is the maximal shortest path in the network, the largest distance recorded between any pair of nodes. The *average path length*, denoted by  $\langle d \rangle$ , is the average distance between all pairs of nodes in the network.

#### 1.1.4 Connectedness and components

Most networks are built to ensure connectedness. In an undirected network two nodes  $i$  and  $j$  are connected if there is a path between them on the graph. They are disconnected if such a path does not exist, in which case we have  $d_{ij} = \infty$ . A network is connected if all pairs of nodes in it are connected. It is disconnected if there is at least one pair with  $d_{ij} = \infty$  and we call its two subnetwork components or clusters. A component is a subset of nodes in a network, so that there is a path between any two nodes that belong to the component, but one cannot add any more nodes to it that would have the same property. If a network consists of two components, a properly placed single link can connect them, making the network connected. Such a link is called a *bridge*. It is any link that, if cut, disconnects the graph.

#### 1.1.5 Clustering coefficient

The local clustering coefficient captures the degree to which the neighbors of a given node link to each other (Watts & Strogatz 1998). For a node  $i$  with degree  $k_i$  the local clustering coefficient is defined as

$$C_i = \frac{2L_i}{k_i(k_i - 1)} \quad (12)$$

where  $L_i$  represents the number of links between the  $k_i$  neighbors of node  $i$ .  $C_i$  is between 0 and 1:

- $C_i = 0$  if none of the neighbors of node  $i$  link to each other.
- $C_i = 1$  if the neighbors of node  $i$  form a complete graph, i.e. they all link to each other.
- $C_i$  is the probability that two neighbors of a node link to each other:  $C = 0.5$  implies that there is a 50% chance that two neighbors of a node are linked.
- $C_i$  measures the networks' local density: the more densely interconnected the neighborhood of a node  $i$ , the higher is  $C_i$ .

The degree of clustering of a whole network is captured by the *average clustering coefficient*,  $\langle C \rangle$ , representing the average of  $C_i$  over all nodes  $i = 1, \dots, N$

$$\langle C \rangle = \frac{1}{N} \sum_{i=1}^N C_i \quad (13)$$

$\langle C \rangle$  is the probability that two neighbors of a randomly selected node link to each other. For nodes with degrees  $k_i = 0, 1$ , the clustering coefficient is taken to be zero.

The *global clustering coefficient*, measures the total number of closed triangles in a network.



$$C = \frac{3 \times \text{NumberOfTriangles}}{\text{NumberOfConnectedTriples}} \quad (14)$$

where the number of triangles that node  $i$  participates in is  $L_i$  and a connected triplet consists of three nodes that are connected by two (open triplet) or three (closed triplet) undirected links. The factor of 3 in the denominator of the equation is due to the fact that each triangle is counted three times in the triple count.  $C$  is often called the number of transitive triplets. The average clustering coefficient  $\langle C \rangle$  and the global clustering coefficient are not equivalent.

## 1.2 Community structure

To find the community structure in our network we need to study the weighted network, where each link  $(i,j)$  has a unique weight  $w_{ij}$ . The data was analysed through co-keyword analysis as suggested by (Börner et al. 2005), a method similar to the Bibliographic Coupling one (Newman 2010) where instead of article references we use the article keywords. Two keywords  $i$  and  $j$  are linked whenever the number  $n_{ij}$  of articles in which they both appear is nonzero. More specifically, there were used weighted links, where the co-occurrence normalised weight is chosen as:

$$w_{ij} = \frac{n_{ij}}{\sqrt{n_i n_j}} \quad (15)$$

Thus we have to deal with a bipartite graph where the network can be divided into two disjoint sets corresponding to the articles and the keywords. For the purpose of this study the keyword projection was used.

To keep track of links we structured a complete list of the links, representing the network through its adjacency matrix. As our network is weighted, the elements of the adjacency matrix carry the weight of the link:

$$A_{ij} = w_{ij} \quad (16)$$

Community structure often maximises the modularity measure. We computed the partition using the algorithm presented in (Blondel et al. 2008). More precisely, we used weighted modularity  $Q$  based on (Fortunato 2010; Newman & Girvan 2004).

## 1.3 Complementarity of keywords

To find the complementarity of the keywords we applied the pointwise mutual information (PMI) defined on pairs of keywords  $(i,j)$  as described in (Church & Hanks 1990):

$$PMI(i,j) = \log \frac{p(i,j)}{p(i)p(j)} \quad (17)$$

where:

$$p(i,j) = \frac{\# \text{ of papers containing } i \text{ and } j}{\# \text{ of papers}} \quad (18)$$

$$p(i) = \frac{\# \text{ of papers containing } i}{\# \text{ of papers}} \quad (19)$$

$$p(j) = \frac{\# \text{ of papers containing } j}{\# \text{ of papers}} \quad (20)$$

The PMI gives the probability that two keywords occur together against the probability that they occur separately. PMI is zero if  $i$  and  $j$  are independent and it maximizes when  $i$  and  $j$  are perfectly associated, yielding the following bounds:

$$-\infty \leq PMI(i, j) \leq \min[-\log p(i), -\log p(j)]$$

Two keywords share an edge if they appear together more than would be expected by chance and if their PMI exceeds a threshold. For each paper we recorded the minimum, average and maximum pairwise PMI between the keywords and we searched for possible correlations between them.

## 2. Associations between happiness, sustainability and urban planning

The aim here is to establish the connections between sustainability, happiness and urban planning. Scientific disciplines cannot easily communicate or be linked. So how are those connections established? An alternative method is used as an intention to find a link between the disciplines through scientific publications related to the three of them.

### 2.1 Data extraction

Our data were extracted from the ISI Web of Knowledge database. We selected all the articles in the database whose title, abstract (for articles published after 1990), or keywords contained at least one of a chosen list of topic keywords. These keywords were derived for happiness as a result of the previous work based on happiness keywords (see Chapter V.1), for sustainability from a discussion with experts of our laboratory (Sustainability Modeling and Measurement Lab of Universitat Politècnica de Catalunya) and for urban planning from science categories of the Journal Citation Ranking database. Each record contains authors, journal name, year of publication, article title, keywords (given by authors and/or ISI Web of Science), and the list of references included in the article. Any choice of article might be potentially biased and partial; therefore, our strategy was to risk choosing too many keywords.

### 2.2 Bibliographic Coupling

The weight of the links between articles is calculated through their common references by the Bibliographic Coupling (BC) method. Two papers are said to be bibliographically coupled if they cite the same other papers (rather than being cited by same papers). BC can be taken as an indicator that papers deal with related material and one can define a strength or weight of coupling by the number of common citations between two papers (Newman 2010).

We define the BC matrix  $A_{ij}$  as in the equation (16). The BC matrix is a symmetric matrix and the off-diagonal elements can be used to define a weighted undirected network, the bibliographic coupling network, in which there is an edge with weight  $w_{ij}$  between any pair  $i, j$  for which  $w_{ij} > 0$ .

The BC similarity between two keywords  $i$  and  $j$  is defined as (Grauwin et al. 2012):

$$\omega_{ij} = \frac{|R_i \cap R_j|}{\sqrt{|R_i||R_j|}} \quad (21)$$

where  $R_i$  is the set of references of article  $i$ . By definition  $\omega_{ij} \in [0,1]$ , is equal to zero when  $i$  and  $j$  do not share any reference and is equal to 1 when their sets of references are identical. In comparison to co-citation link (which is the more usually used measure of articles similarity), BC offers the following advantages (Grauwin & Jensen 2011; Grauwin et al. 2012): it allows to map recent papers (which have not yet been cited) and it deals with all published papers (whether cited or not). Moreover, the links are established on the basis of the author's own decisions rather than retrospectively from other scientists' citations. Thus, BC can be used to analyse the research community as it builds itself rather than how it is perceived by scientists who later cite its publications.

### 2.3 Community detection

Weighted links are used to reinforce the dense (in terms of links per article) regions of the BC networks (Grauwin & Jensen 2011). This reinforcement facilitates the partition of the network into meaningful groups of cohesive articles, or communities. To structure the network into groups of cohesive articles, we portioned the set of articles by maximizing the modularity function. Given a partition of the nodes of the network, the modularity is the number of edges inside clusters (as opposed to crossing between clusters), minus the expected number of such edges if the network was randomly conditioned on the degree of each node (Grauwin et al. 2012). Community structure often maximises the modularity measure. We computed the partition using the algorithm presented in (Blondel et al. 2008). More precisely, we used weighted modularity  $Q$  based on (Fortunato 2010; Newman & Girvan 2004).

Simple frequency analysis (Grauwin & Jensen 2011) allows then to characterise each community through its more frequent items (keywords, authors, etc...). The significance  $\sigma$  of the presence of a given item into a community is computed by comparing its frequency  $f$  in the community to its frequency  $f_0$  within the whole database. More precisely, we use the normalised deviation:

$$\sigma = \sqrt{N} \frac{f - f_0}{\sqrt{f_0(1 - f_0)}} \quad (22)$$

where  $N$  is the total number of articles in the database. The links between two communities  $I$  and  $J$  can also be characterized qualitatively by analysing their shared references and quantitatively by computing the mean weight  $\omega_{IJ} = \langle \omega_{ij} \rangle_{i \in I, j \in J}$ .

In contrast to the networks created in the previous study, the result will be here directed networks.

### 3. Case study

This section paper introduces a method of quantification of happiness for the urban context, based both on the perception of people using the urban space and data of existing objective spatial indicators. These are finally compared in order to obtain a final integrative happiness index. To check whether personal happiness is accomplished, Max-Neef's conceptual frame on Human Scale Development has been used (Max-Neef 1992; Max-Neef et al. 1991).

The case study corresponds to the neighbourhood of Vila de Gràcia, at the Gràcia district of Barcelona. It was chosen for being a consolidated urban environment of a controllable scale which allows the implementation of the methodology. In addition, it is a neighbourhood of mixed residential, services and culture uses. The area is characterized by its dynamism and heterogeneity, which ensures participation and a variety of responses. Further, it has recently undergone a process of urban transformation in order to improve its urban quality (Agència d'Ecologia Urbana de Barcelona 2007).

#### 3.1 Data compilation

##### 3.1.1 Organization of the domains of study

The methodology used in this study is built on Manfred Max-Neef's Human Scale Development (HSD) approach to sustainable development and happiness, which is based on the definition of human needs and their corresponding satisfiers (Max-Neef et al. 1991), partially modified by Robert Costanza (Costanza et al. 2007). Human needs indicate deprivations and at the same time individual and collective human potential. Needs are seen as finite, few and classifiable, changing only in a very slow pace along with the evolution of our kind, and they can be satisfied according to many criteria. For the purpose of this study, the axiological needs category was used, with domains corresponding to Subsistence, Protection, Affection, Understanding, Participation, Leisure, Creation, Identity and Freedom. Protection was changed by Security, as suggested by Costanza (Costanza et al. 2007; Costanza et al. 2008), and Subsistence has been considered within Reproduction, being the latter understood as a part of the former. Spirituality has been also included because of its importance in the assessment as a need (see (Van Dierendonck 2011; O'Brien 2005)). The fulfilment of all needs (domains) is considered equally important as any unsatisfied or not adequately satisfied human need reveals a form of human poverty, hindering happiness and therefore developing pathologies (Cruz et al. 2009). What changes over time and between cultures are the satisfiers of these needs. Max-Neef organizes the satisfiers within the grid of a matrix which, on the one hand, classifies needs according to the existential categories of Being, Having, Doing and Interacting and, on the other hand, according to the axiological categories mentioned before. There is no one-to-one correspondence between needs and satisfiers. One satisfier may contribute simultaneously to the satisfaction of different needs or, conversely, a need may require various satisfiers in order to be met, and these relations are not fixed, they may vary according to time, place and circumstance (Max-Neef et al.

1991). Each economic, social and political system adopts different methods for the satisfaction of the same fundamental human needs. In every system, they are satisfied (or not satisfied) through the generation (or non-generation) of different types of satisfiers. For this study, the satisfiers correspond to the different objective and subjective indicators (see Table A1 of Supplementary material).

### **3.1.2 Survey**

The survey was created online (<http://docs.google.com>). The format was simple and accessible to everyone. Its design satisfied the survey principles under Dillman et al. (Dillman et al. 1998). It was developed in Spanish, Catalan and English<sup>3</sup>, as Barcelona's citizens consist of many nationalities, and started running on the 10<sup>th</sup> of May 2012 and kept open for one month, until the 10<sup>th</sup> of June 2012. The web survey mode was chosen because it has several advantages. It does not suffer from interviewer bias, and responders may feel more comfortable answering sensitive questions or moving through a survey at their own pace (Pearce & Ozdemiroglu 2002). Moreover, a vast improvement in response speed over traditional mail surveys is widely reported and the financial expenditure (Wolfgang 2002) and ecological impact of surveys on the Internet is smaller due to the elimination of postage, printing and data entry (Dillman & Bowker 2002). It also has some disadvantages, as for example the lack of any clarification of questions (MacKerron & Mourato 2009) and the over-participation of responders with degrees in higher education, that tend to belong mainly to middle class and be more liberal (Brenner 2002; Wolfgang 2002). The total number of questions included in the survey was 104. These were grouped among the ten needs as follows: 18 for Subsistence, 12 for Security, 22 for Affection, 5 for Understanding, 8 for Participation, 8 for Leisure, 15 for Identity, 9 for Creativity, 2 for Freedom and 5 for Spirituality (see Table A2 of Supplementary material).

### **3.2 Correlation between pairs of variables and network structure**

Identifying significant relationships between pairs of variables in data sets is increasingly important. Data sets with thousands of variables are more and more common in fields as varied as genomics, physics, political and social science, or economics. And these may hide valuable relationships among variable pairs really difficult to detect. In order to help us better explain both individual answers and aggregate results, a measure of dependence for two-variable relationships called maximal information coefficient (MIC) has been used (Reshef et al. 2011). It allows exploring a many-dimensional dataset assuming generality (i.e., MIC captures a wide range of associations, not limited to specific functions such as linear, exponential, etc.) and equitability (i.e., MIC gives similar scores to equally noisy relationships of different types).

MIC values for independently taken pairs of variables cannot give a true account of the aggregate outcome of the answers. To endow an intuitive and efficient interpretation of how the different variables in a dataset are related to each other, a network type of visualization of our dataset has been obtained. The questions in our dataset are represented by nodes, and the relationships between them are represented by edges, weighted by means of the MIC strength of every pair of variables. The weighted degree  $d_w$  of each node

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<sup>3</sup> The English version of the online survey can be visited at: <http://goo.gl/OM1il>


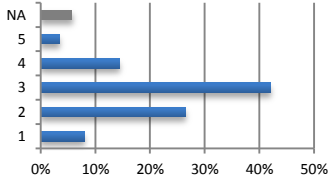


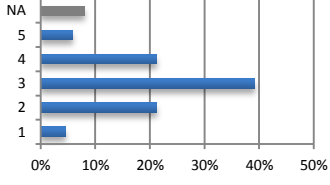


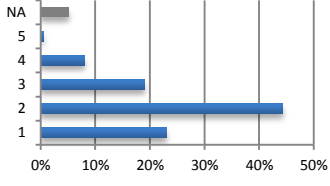

has been then obtained. It indicates the importance of that node in relation with the rest of the nodes it is connected to, but taking into account the strength of every link (Opsahl 2010). Once a network is so created, graph theory can be applied to uncover other structural properties based on centrality measures like closeness (i.e., how long it will take to spread information from one node to all other nodes sequentially), betweenness (i.e., the number of times a node acts as a bridge along the shortest path between two other nodes) or degree (Newman 2010).

### 3.3 Comparison between subjective and objective indicators

Generalised thresholds and norms do not always function for all places, and should be adjusted according to the kind of people living in each place and their culture, habits, customs and traditions. Even so, subjective perceptions and thresholds do not always coincide with the objective reality, where thresholds are usually quantified under unbiased assumptions. This fact, though, might influence happiness and the perception that people obtain from their surrounding space and environment, curtailing initiatives that would be otherwise beneficial. Here objective (i.e., quality of life) and subjective (i.e., life satisfaction) indicators and their thresholds are compared in order to detect possible deviations.

Table 4 shows an example of comparison between subjective and objective indicators (see table A3 of Supplementary material for the complete list). The first column contains the Need and the second the particular item under study. The following three columns correspond to the objective part of happiness measurement: actual value of the item, threshold and objective check respectively (with a tick if the actual value corresponds to the threshold and a cross otherwise; if it could not be measured, a line has been chosen as symbol). Depending on the available data source, actual values have been obtained in decreasing order from Vila de Gràcia, District of Gràcia, city of Barcelona, autonomous region of Catalonia and finally Spain. Thresholds in quality of life come from established local, European or world legal limits and regulations. The following three columns correspond to the subjective part of the measurement: question made at the survey, perception according to the answers of the sample and final check, performed as previously stated. Thresholds in life satisfaction depend on each formulated question but, in general terms they are obtained by contrasting either the answers with scores 1 and 2 against those with scores 4 and 5, or the percentage of cumulated “yes” or “no” answers when the question is categorical (see Table A1 of Supplementary material). The final column evaluates whether the final value of the comparison between the two types of measurements is positive, negative or neutral. When positive (i.e., both checks with a tick) the result is equal to 1 unit. When negative (i.e., both checks with a cross), the result is equal to 0 units. When there is a tick and a cross, the result is neutral and the result equal to 0.5 units. Finally, when one of the checks or both cannot be quantified the cell remains blank.

Table 4: Example of comparison between subjective and objective indicators from a specific Need.

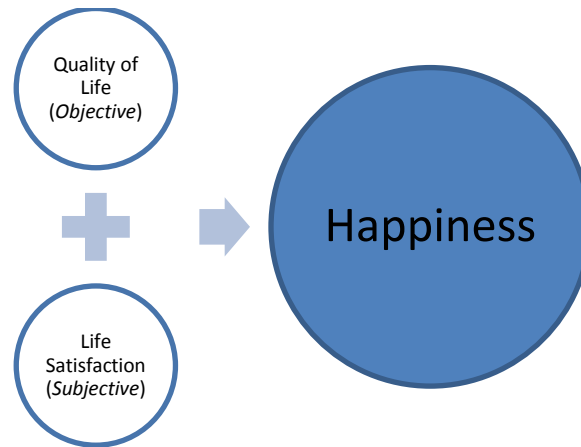
Need	Item	Objective			Subjective			Total
		Actual Value	Threshold	Objective check	Question	Perception	Subjective check	
Subsistence	Air quality	Barcelona ICQA average (2010) = 52 <sup>1</sup>	50 < ICQA < 75: Satisfactory air quality <sup>2</sup>		9-Q25 How satisfied are you of the below in Gràcia? - air quality	 4-5: 9,20% 1-2: 34,48%		0.5
	Sanitation facilities	Treated flow of water in Catalonia ≈ 67,89% <sup>3</sup>	Positive if > 50%		9-Q26 How satisfied are you of the below in Gràcia? - sanitation facilities	 4-5: 27,01% 1-2: 25,86%		1
	Green spaces	Barcelona: Urban green: 6,55 m2/hab <sup>4</sup>	WHO: optimum: 14m2/ hab Minimum: 10m2/ hab <sup>5</sup>		9-Q27 How satisfied are you of the below in Gràcia? - green spaces	 4-5: 8,62% 1-2: 67,24%		0

<sup>1</sup> Índice de calidad del aire (ICQA) in (Idescat 2013).<sup>2</sup> (Generalitat de Catalunya 2012)<sup>3</sup> Treatment capacity in Catalonia: 2.850x1.000 m3/day, according to Estaciones depuradoras de aguas residuales - Por tipos in (Idescat 2013) and treated flow: 1934,8x1.000 m3/day, according to Estaciones depuradoras de aguas residuales - Rendimientos globales in (Idescat 2013).<sup>4</sup> (Ajuntament de Barcelona 2008)<sup>5</sup> (Por la reserva n.d.)

### 3.4 Valuation and measurement of happiness

In this study the term *happiness* (H) is mainly used as a global term, including *life satisfaction* (LS) from the subjective point of view and *quality of life* (QoL) from the objective one. Quality of life is understood by some studies as referring to the quality of society and in other instances to the happiness of its citizens (Veenhoven 2000), while others make a distinction between quality of life in social sciences, where it has a focus on positive mood, and in health sciences, where the main domains of reference are negative constructs of health (Cummins 2010). In this study it is understood as a more objective or theoretical measure that may possibly lead to happiness but not as the total indicator to characterize one person as happy. In this sense, questions about both quality of life and life satisfaction have been formulated to better quantify happiness.

Happiness is used in this study as a global term, including LS from the subjective side and QoL from the objective one (Fig. 7). As a consequence, for its quantification both subjective and objective measurements have been used.



**Figure 7:** Simplification of the concept of happiness.

**Source:** Proper elaboration from (Papachristou & Rosas-Casals 2014).





## VI. Results

### 1. Mapping the happiness keywords

#### 1.1 Network topology

In numbers, our database contained a total of 957 papers and 2199 keywords for the time period from 2000 to 2013 (Fig. 8). Those were interpreted as a map of keywords where the keywords were represented as nodes, and a connection (edge) were established between them if they appeared at the same article (Fig. 9). The total number of nodes ( $N$ ) was equal to 2,199 and the total number of edges ( $L$ ) was equal to 10,074. This number is way to smaller than  $L_{max} = 2,416,701$ , indicating that our network is sparse.

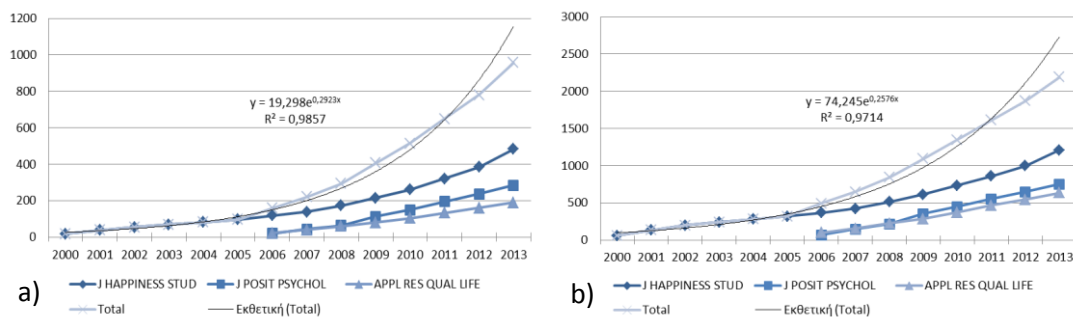


Figure 8: Cumulative number of papers (a) and keywords (b) for the time period 2000 – 2013 per Journal and in total. Two of the Journals (J POSIT PSYCHOL and APPL RES QUAL LIFE) started publishing in 2006, provoking though an exponential growth to the total number of articles and keywords from this year and on.

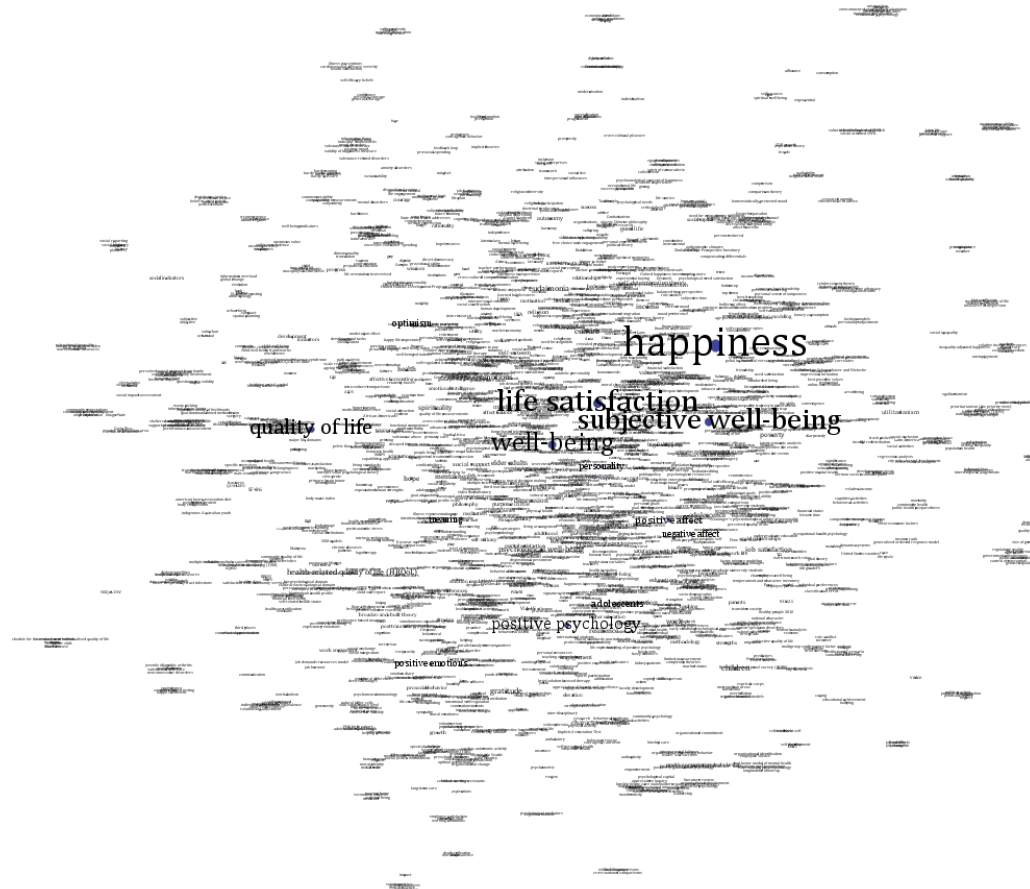


Figure 9: Happiness keyword network, excluding the disconnected components. A bigger size of label indicates a more connected keyword. Six keywords stand out, happiness, life satisfaction, subjective well-being, well-being, quality of life and positive psychology.

With the adding of new keywords, year by year, the average degree distribution is gradually changing from 7 to 9 for the J HAPPINESS STUD and the total, from 5 to 8.5 for J POSIT PSYCHOL and from 7 to 6 the APPL RES QUAL LIFE. The diameter of the network ( $d_{max}$ ) is rising for the J HAPPINESS STUD from 3 in 2000 to 7 in 2013, while for the J POSIT PSYCHOL and the APPL RES QUAL LIFE it remains more or less constants to 6 and 7 correspondingly. The average path length ( $\langle d \rangle$ ) is tending to three for all networks. The number of shortest paths ( $d$ ) is exponentially growing as seen in the next diagram. The number connected components of the graph seems to be augmenting from 2006 along with the introduction of the two latest journals. From the clustering coefficient comes that the whole network is densely interconnected. All networks are approximating a value of 0.8 with the exception of the APPL RES QUAL LIFE that reaches a higher value of 0.92.

After calculating the weighted degree we observed that 103 of the nodes have degree zero. Those were excluded from the analysis. The total number of edges was reduced to 8,485. The graph geography (Fig. 10) has changed but the first six more connected keywords remain the same, corresponding to happiness, life satisfaction, subjective well-being, well-being, quality of life and positive psychology.

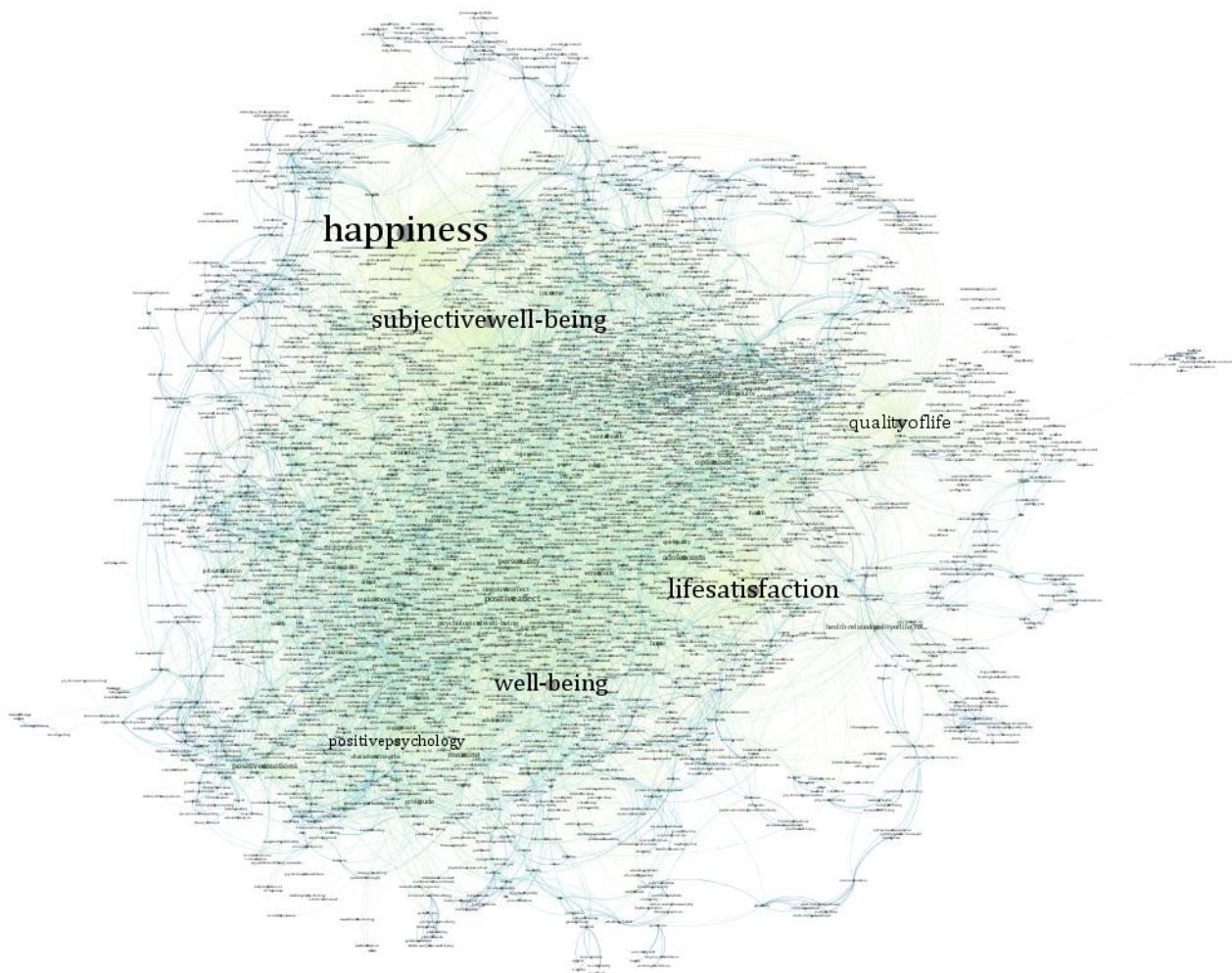


Figure 10: Weighted happiness keyword network. A bigger size of label indicates a more connected keyword. Six keywords stand out, happiness, life satisfaction, subjective well-being, well-being, quality of life and positive psychology.

## 2. Case study

### 3.1 Survey statistics

The most important results that come directly from the survey analysis are the following (for more information see the publications section of the Appendix and of the Supplementary material, Table A3).

Firstly, as far as the satisfaction with different aspects of life (such as health, life in general, free time, place where they live, family life, social life and social status) is concerned, most of the answers were between 4 and 5 (with values ranging from 77.0% to 81.0%) over a maximum value of 5. People seemed a little bit less satisfied about money (43.1%), work (53.5%) and commuting (51.2%)<sup>4</sup>. There was a 31.6% that considered their time spent at work as no creative. And a 39.1% declared they were quite happy (4 of 5) of their time distribution, while only a 3.5% was totally happy (5 of 5). Another interesting question was about quality of life in Vila de Gràcia, where the responders seemed rather dissatisfied, with most of the aspects scoring between 3 and 2 in the satisfaction scale. Water quality, air quality and sanitation facilities punctuated with 3 for the majority of the sample (values ranging from 39.1% to 42.0%), while pedestrian areas scored a little bit more, between 3 (28.7%) and 4 (33.3%). Noise and traffic were between 2 and 3 (cumulative values of 62.6% and 54.0% correspondingly), while people seemed really dissatisfied with green spaces, giving those 2 (44.3%) and 1 (23.0%). Although most of them were renters (50.6%), they did feel “at home” when they were there (87.4%). They also felt really safe around the neighbourhood (cumulative value of 79.3% for 4 and 5). Notwithstanding, there was a 6.9% of the total that had experienced violence in the familiar environment, and a 12.6% did not feel free as human being. Another interesting datum is that besides the actual turbulences in the economic and political spheres, the great majority (74.1%) was optimistic, stating that they can make plans for the future.

As far as environmental practices are concerned, the questioned claimed that they do recycle, save energy and water (values ranging from 85% to 94%) but they tend not to share their homes and cars (65% and 60% respectively) and only 11% did prefer going on foot and even less (8%) by public transport, although 53% of them chose bicycle as a common mode of transport.

About the level of attachment to significant others, the sample seemed emotionally dependent on other people. In the scale from 1 to 5, 46% scored with 4 and 5 their emotional dependence on the family and 23% their dependence on their friends.

When it comes to feelings, a majority stood for positive ones (around 4) and a greater dispersion is observed for those negative (Fig. 11 and 12). In this latter case, worry is often experienced by 41.4% of the sample, with a 55.2% feeling anger rarely. Stress seemed to be another concern for the responders, as 60.9% gave it a score of 3 or 4. When they were asked which of those feelings they thought may change in a different urban environment (Fig. 13), stress and calmness lead the list, followed by solidarity, tolerance, fear and

<sup>4</sup> All the above values are cumulative, corresponding to the satisfaction of 4 and 5 in the scale of 5.

loneliness, while at the bottom appear compassion, jealousy and forgiveness as those feelings least affected by a change in urban environment.

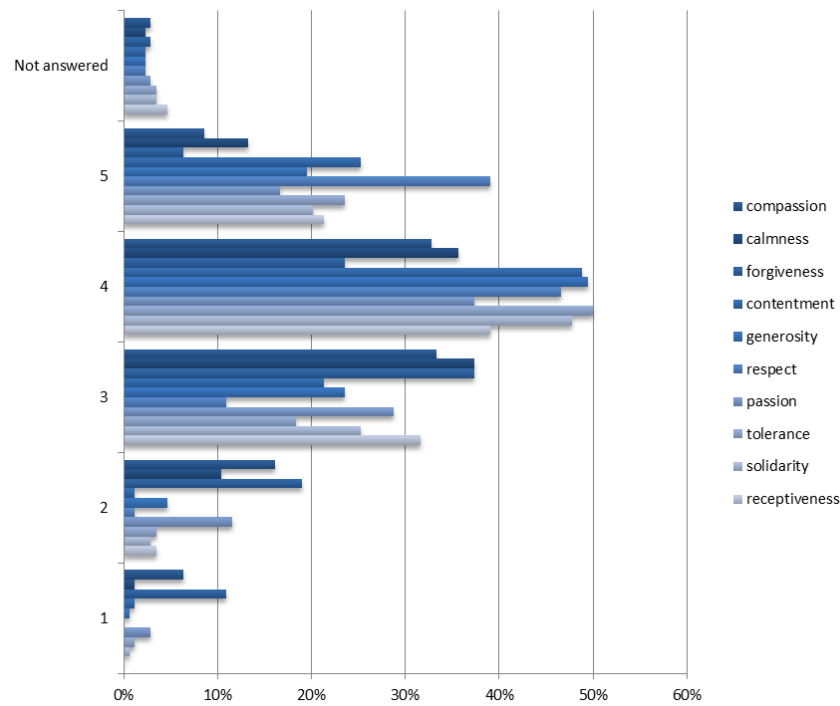


Figure 11: Frequency of positive feelings (1, rarely, 5, very often).

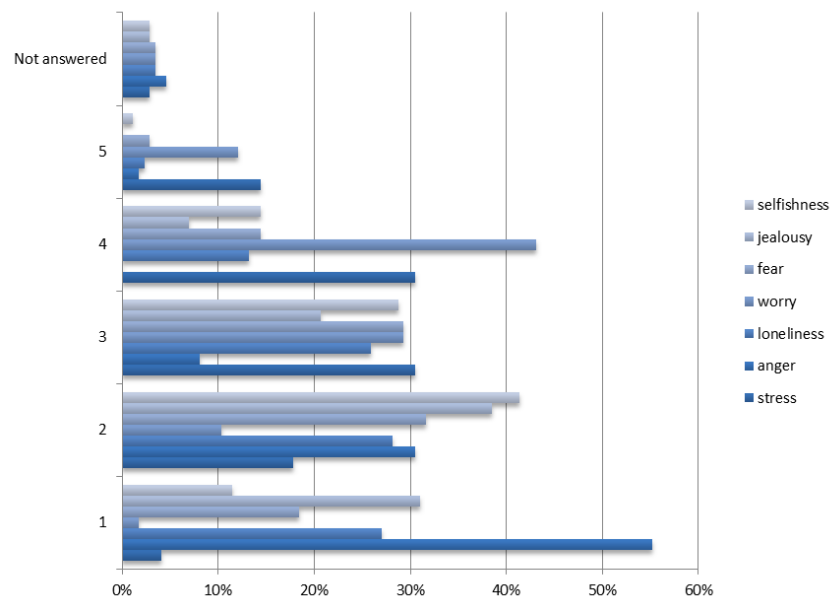


Figure 12: Frequency of negative feelings (1, rarely, 5, very often).

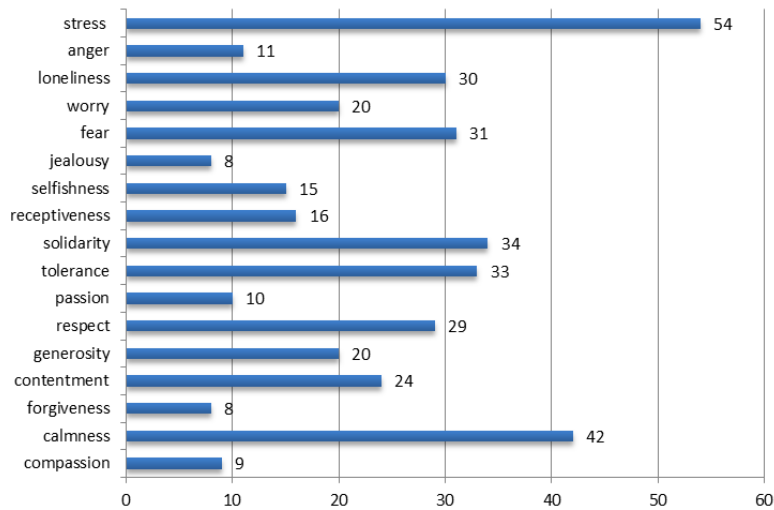


Figure 13: Feelings that may change in a different urban environment (absolute number of answers).

### 3.2 Correlations between pairs of variables and network structure

As mentioned in the Methodology, to better explain both individual answers and aggregate results the MIC measure has been used (see Publications section of Appendix for more information).

The most significant centrality measure appears to be the corresponding weighted degree cumulated probability distribution  $P_{\geq}(d_w)$ , which measures the percentage of nodes with degree  $d_w$  or higher. Results for this topological measure are shown in Fig. 14, where weighted degree cumulated probability distribution  $P_{\geq}(d_w)$  has been connected with three screenshots corresponding to the graphical emergence of the graph. Questions have been spatially grouped and coloured according to HSD categories.  $P_{\geq}(d_w)$  exhibits a nontrivial bimodal behaviour (with two similar sigmoid behaviours after and before degree value  $d_w = 3$ ) and the deviation from the degree cumulated probability distribution for a random graph with the same average weighted degree and number of nodes (dashed line) is remarkable. This deviation from random graph behaviour can be explained with the help of the closeness and betweenness centrality measures, both of them positively correlated with degree (results not shown in the paper). This fact would imply some kind of hierarchy in the graph, where the most connected nodes are also central in terms of information transmission and shortest paths. As it is observed, questions related with HSD categories Identity and Subsistence belong to the first snapshot of the connected component of the graph (right upper subgraph), which contains 5% of the nodes with degree 5 or higher. When weighted degree is reduced to 4, an abrupt transition occurs and Affection, Leisure and Understanding categories appear, together with an increasing number of nodes of the previous two categories (centre subgraph). When degree is further reduced to 3, the rest of categories begin to appear, although with only reduced presence (i.e., Security) or none at all (i.e., Participation). At this point, 70% of the nodes are already present in the connected component of the graph (left upper subgraph). The remaining 30% of the nodes appear following a similar, though not so abrupt, transitional pattern.

This analysis allows an intuitive interpretation of how the different questions are related. Any type of conclusion derived from it though, must be taken with care, since null models for comparative purposes are impossible to formulate in the cases of such specific graph construction processes. The probable main outcome is that questions in our dataset are non-trivially related to each other: the topological structure of the graph clearly deviates from that of a random network and its degree probability distribution offers a characteristic bimodal pattern. In particular, questions in Identity and Subsistence HSD categories offer the strongest correlations, suggesting an intense consideration of one's self. Only when the first transition occurs, at  $d_w = 5$ , Understanding and Affection, categories more related with "the other" in an absolute sense, begin to appear. It is remarkable that categories involving deeper feelings and inner growth as human being, like Security, Spirituality and Freedom, are the last ones to appear in the graph. Significantly, Participation is the only one with no representative node at the end of this first sigmoid step, maybe suggesting the actual disaffection with political and social spheres. For values of  $d_w = 3$  and lower, a similar sigmoid pattern appears and the remaining 30% of nodes come into view (not shown in Fig. 14).



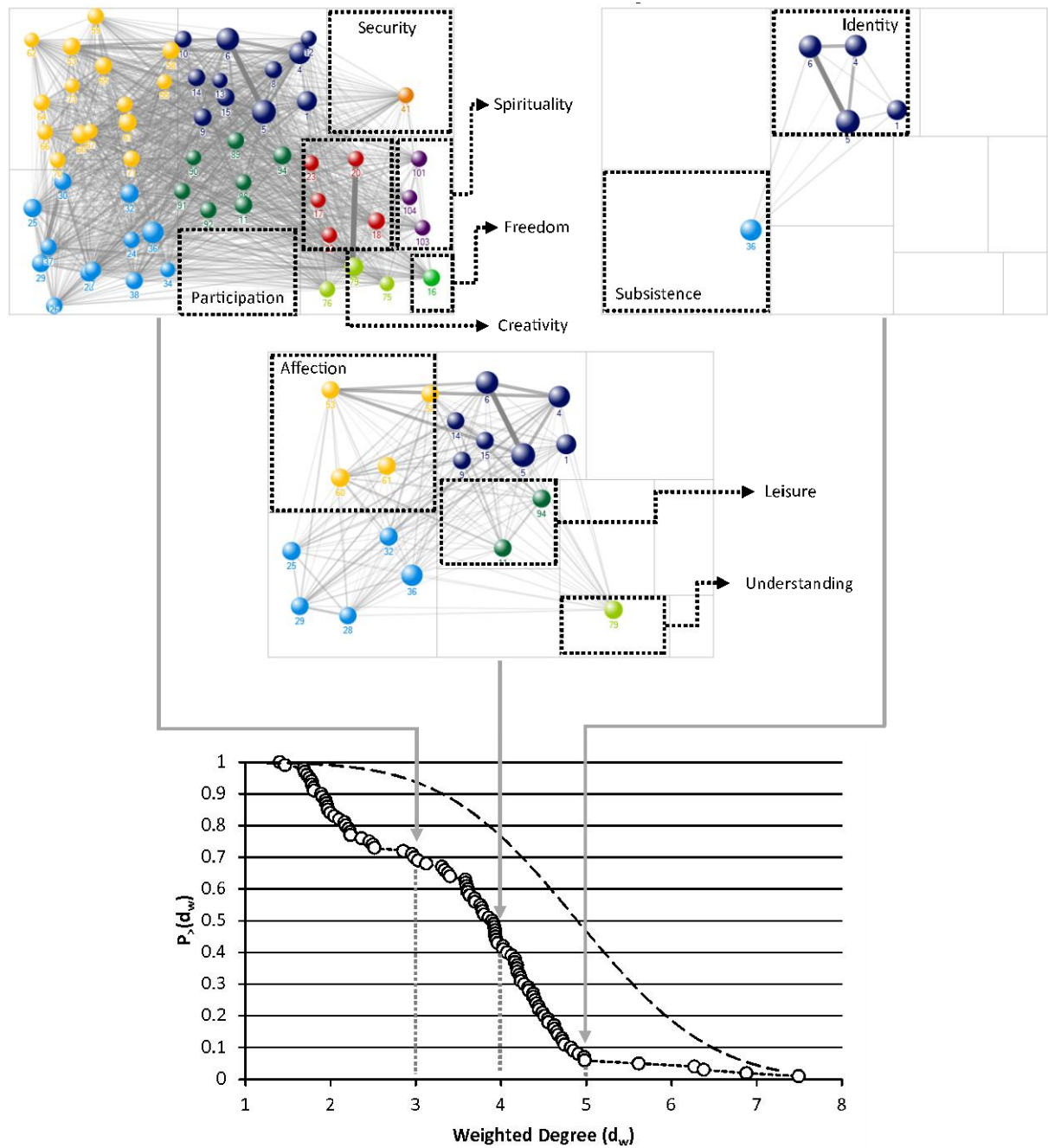


Figure 14: Weighted degree cumulated probability distribution and the emergence of the dataset network. Questions related with HSD categories Identity and Subsistence belong to the first snapshot of the connected component of the graph (right upper subgraph), which contains 5% of the nodes with degree 5 or higher. When weighted degree is reduced to 4, Affection, Leisure and Understanding categories appear (centre subgraph). When this is further reduced to 3, the rest of categories begin to appear except Participation (left upper subgraph). At this point, 70% of the nodes are present. Degree cumulated probability distribution for a random graph with the same average weighted degree is shown (dashed line) for comparison purposes. For every edge, opacity and thickness are proportional to its MIC strength. For every node, size is proportional to its weighted degree. Weighted degree values have been calculated with R-package *tnet*, developed by Tore Opsahl (<http://toreopsahl.com/tnet>) and statistical program R (<http://www.r-project.org/>). Network figures have been created with NodeXL (<http://nodexl.codeplex.com>).



### **3.3 Comparison between subjective and objective indicators**

Among indicators that showed conflictive answers (a tick and a cross, in no specific order), some of those included in environment and significant-others related items are remarkable. When it comes to air quality for example, a 34.5% was not satisfied (cumulated percentage of 1 and 2 scores), while according to Generalitat de Catalunya and the Index ICQA (Idescat 2013; Generalitat de Catalunya 2012) there is a satisfactory air quality at whole Barcelona. Similarly a 40.8% was unsatisfied by traffic conditions in Vila de Gràcia but, according to the Urban Ecology Agency of Barcelona (Agència d'Ecologia Urbana de Barcelona 2007), most of the streets do not exceed 350-700 vehicles per hour, which corresponds to a free-flow (maximum of 420 vehicles per hour) or a reasonable-free flow (max. 750 vehicles per hour) for the type of streets that Vila de Gràcia has (see (Herman 2009)). In this sense, a 52.9% of the sample seemed to favour the bicycle, even though 98% of Barcelonans do not opt for this kind of transport system for their displacements (Vásquez 2011). Paradoxically, the sample seemed to dislike walking (86.8%) or taking the public transportation (90.2%), while this percentages for the metropolitan area are only 53.9% and 69.6% respectively (ATM 2006). As far as energy and water consumption is concerned, people do save electricity (89.7%) and water (85.6%), although the levels of electricity consumption per capita are slightly over the European average (European Environment Agency 2007) and similarly for the water consumption per capita per day in Barcelona (Àrea Metropolitana de Barcelona 2010), a bit over the limits imposed by European Union (European Green Capital 2012).

As far as significant-others and socio-family items is concerned, it seems there exists a general desire to have or form a family (90.2%), yet it does not necessary imply to have children, considering the low birth rate in Barcelona (Idescat 2013). About the education level, the sample was above the average, with 87.9% with tertiary education. The contrary happens to the rest of the people in Gràcia and Barcelona, where only an average of 41% continues to higher education (Ajuntament de Barcelona 2007). Population that may enjoy the privileges of public health care in Catalonia only reaches 24.4% (Idescat 2013) when the percentage of the responders in Gràcia reached 60.3% for the public and 98.8% for both public and private. In relation with disabilities or mental health problems, official statistics show important limitations concerning activities of people with these attributes (Ajuntament de Barcelona 2007). Nonetheless according to the responders (only 6 of the interviewed) a 66.67% declared no restrictions provoked by his disability. Passing now to participation in the community and in voting at the elections, a 82.2% of the responders declared active participation, rather than 52.3% in Barcelona that attended the municipal elections in May 2011 and 69.9% for the Parliament elections in November 2012 (Idescat 2013).

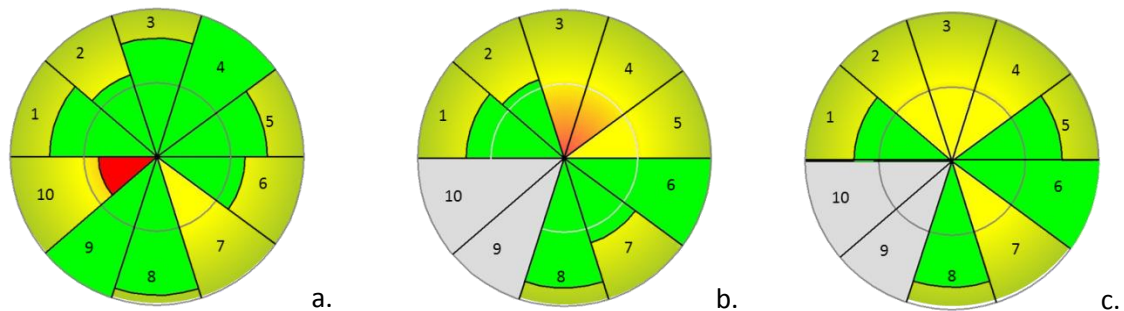
### **3.4 Valuation and measurement of happiness**

Although several items can be related with each Need, items belonging to each and every one of them and quantifiable items in objective indicators are not necessarily coincident with those evaluated in subjective ones (see Publication section of Appendix for more information). Totals above 5 are considered as strong happiness and below 5 as weak happiness.

As a general procedure, both LS (subjective happiness) and QoL (objective happiness) were measured summing up the corresponding existing ticks for each need (Supplementary material Table A3), with a final numerical value in a scale of 10 (see Publications section of Appendix for more information). As far as LS is concerned, total subjective happiness reached 7.30 units (Figure 15a). Needs for Subsistence, Security, Affection, Participation, Leisure and Identity have a high score (from 6 to 8), with the top corresponding to the needs for Understanding and Freedom that both score 10. Satisfaction and Creativity has a middle score of 5 and Spirituality has a weak one, reaching only 4 units.

Concerning QoL, total objective happiness scores 5.25 units in the scale of ten (Figure 15b). The scores are all of them lower than subjective ones, but for Leisure and Creativity. Needs for Subsistence, Security and Creativity score between 5.56 and 6.67, while the top scores coincide with Identity (8.75) and Leisure (10). Participation has a middle score of 5.00 and Affection and Understanding get 0. Freedom and Spirituality were not counted, because there exists no objective indicator corresponding to them.

Happiness was quantified in the same way but using quantifiable items for the total, based on the comparative table previously presented (Table 4 and Supplementary material, Table A3). Other possible combinations (i.e., total colour white or a non-quantifiable question) were not considered in the total. The final result reaches the 6.45 units (Figure 15c). It is a positive score but less than life satisfaction (i.e., subjective happiness). Needs for Participation and Identity seem satisfied, scoring from 7.50 to 8.75. The best score corresponds to Leisure with 10. Subsistence, Security, Affection, Understanding and Creativity have a middle score of five. Freedom and Spirituality were not counted due to the absence of objective indicators that would lead to their calculation.



**Figure 15: Happiness assessment.** (a) Life satisfaction, (b) quality of life and (c) happiness. Each number corresponds to a Need; 1: Subsistence, 2: Security, 3: Affection, 4: Understanding, 5: Participation, 6: Leisure, 7: Creativity, 8: Identity, 9: Freedom, 10: Spirituality. Positive scores (>5) are presented in green, neutral (5) in yellow and negative (<5) in red colours. Grey colour reflects needs that cannot be quantified for the specific approach and the inner circle indicates the average value of 5.

In the case Freedom and Spirituality Needs, results are included into Happiness, as measured for the LS, the final result is slightly modified, changing from 6.62 to 6.69.



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## VIII. Appendix

### 1. Publications

#### 1.1 Quantification of happiness in the urban context. The case of Vila de Gràcia, Barcelona.

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#### Abstract

Happiness and its perception is a subject that has raised the interest of scientists during the last years. With more than half of the world population now living in cities, defining and measuring happiness in urban contexts can be particularly helpful in urban design and planning processes. In this article, a method for measuring the perception of happiness in urban environments based on the accomplishment of the basic human needs according to Max-Neef (Max-Neef, Elizalde, & Hopenhayn, 1991) is developed. It proposes a direct comparison between objective and subjective happiness indicators in order to obtain a final happiness index. Applied as case study to Vila de Gràcia (Barcelona, Spain), it shows that although objective happiness measurements stand at the limit of the accepted levels, subjective perception is considerably higher. This fact would raise doubts about the usefulness of some objective measurements and their assessment, and, at the same time, would suggest the need for an integrative approach in measuring happiness. A spring graph analysis of the relationships between pairs of questions and human-scale development categories is also presented in order to explain this result. For this particular social sample, the graph is non-trivially connected, and questions related with categories like identity and subsistence appear much more strongly interconnected than others, suggesting an intense consideration of one's self. In summary, the method defines a simple and useful tool to quantify and evaluate current levels of urban happiness and it can be used to define more useful urban quality indexes in order to improve decision making processes, policies and plans.

#### Keywords

Happiness, life satisfaction, quality of life, urban analysis, need satisfaction



## **1. Introduction**

Urban systems are built environments with high human density. The world's urban population increased from about 200 million in 1900 to 2.9 billion in 2000, and the number of cities with populations exceeding 1 million increased from 17 in 1900 to 388 in 2000 (Millennium Ecosystem Assessment, 2005). In fact, humanity has just crossed a major landmark in its history with the majority of people now living in cities (United Nations, 2010).

The present worldwide trend toward urbanization is intimately related to economic development and to profound changes in social organization, land use and patterns of human behavior (Angel, Sheppard, & Civco, 2005). The demographic scale of these changes is unprecedented (Berry & Okulicz-Kozaryn, 2009) and will lead to important but still poorly understood impacts on the global environment. Yet it seems clear that the continuous accumulation of the population in big cities worldwide, along with the uncontrolled urban sprawl, is leading to a doubtful, degraded habitat, seriously affecting the emotional and physical state of city dwellers (Costanza et al., 2007, 2008; Kennedy & Adolphs, 2011; Lederbogen et al., 2011; Moro, Brereton, Ferreira, & Clinch, 2008; Veenhoven, 2007).

However, in recent years, the perception of both citizens and urban designers has been changing slowly, mainly due to the increased environmental, social and economic problems encountered in urban conurbations. Urban spaces are being reevaluated and reconsidered as valuable for health, social integration and well-being of the individuals (Townsend, Maguire, Liebhold, & Crawford, 2010). In this sense, happiness is a subject of increasing interest and several empirical studies have been developed in order to characterize, either by means of subjective or objective indicators, the links between happiness and urban societies (see (Berry & Okulicz-Kozaryn, 2009; Delken, 2007; R. A. Easterlin, Angelescu, & Zweig, 2011; Kamp, Leidelmeijer, & Marsman, 2003; Marans, 2012; Massam, 2002; O'Brien, 2005; Trkulja, 2007; Wenz, 1977) and references therein). Following this rationale, this paper introduces a method of quantification of happiness for the urban context, based both on the perception of people using the urban space and data of existing objective spatial indicators. These are finally compared in order to obtain a final integrative happiness index. To check whether personal happiness is accomplished, Max-Neef's conceptual frame on Human Scale Development has been used (Max-Neef et al., 1991; Max-Neef, 1992).

The paper is organized as follows. Section 2 presents a literature review which includes the definition and evolution of the concept of happiness, how happiness can be measured and its role in urban design and planning. Section 3, materials and methods, includes the methodology used for the compilation of data, the survey and case study, and finally the comparison and measurement of subjective and objective indicators. Section 4 presents the results and includes the survey analysis, significant correlations between pairs of variables, the comparison between subjective and objective indicators and finally the evaluation and measurement of each type of happiness. The paper ends with Section 5, discussion and conclusions, and an Appendix with supplementary information.

## 2. Literature review

### 2.1 Definition and evolution of the concept

The pursuit of happiness is as old as history itself. The psychological and philosophical search of happiness began in China, India and Greece nearly 2.500 years ago with Confucius, Buddha, Socrates, and Aristotle (The pursuit of happiness Organization, 2012; White, 2006). According to the evolution in the use of the different terms related to happiness, as reported to the digitalized articles and books from the Google Group work (Michel et al., 2010), the word 'happiness' seems to be used by scholars since the late 16th century, with a peak between 1800 and 1850. Between 1650 and 1700 the word 'felicity' was also used with approximately the same frequency. From the early 1960 a more epistemological approach and vocabulary, such as quality of life or (subjective) well-being, has been used (Diener, 1994). Apart from this nomenclature, elsewhere in the literature are encountered other terms like life satisfaction, utility, welfare, hedonism and eudaimonia.

In many cases, these previously mentioned terms are being used interchangeably throughout the studies although subtle differences exist (R. A. Easterlin, 2003; Moro et al., 2008; Rehdanz & Maddison, 2005). The term well-being denotes that something is in a good state. It does not specify what that something is and neither what is considered good. Hence, when used alone it may be considered as a typical catchall term without a precise meaning (Veenhoven, 2007), a plastic, adaptive word that is often used in many cases and has lost potential for precision, concreteness or exactitude (Poerksen, 1995). In order to better define the former, 'subjective well-being' has been used in the literature, although it is not only used for satisfaction with life-as-a-whole, but also for specific (dis)comforts and moods (Veenhoven, 1997). In the specific case of 'subjective well-being' two distinct spheres can be found: happiness and life satisfaction. Both are affected in a similar way by social conditions, but rather differently by economic conditions. According to some studies, happiness is the degree to which a person evaluates the overall quality of his present life-as-a-whole (Veenhoven, 1997). The basic difference found between happiness and life satisfaction is that the latter emphasizes the subjective character of the concept, while the former is also used to refer to the objective good. For some authors happiness would be an emotional or affective state related to hedonism while life satisfaction would entail a cognitive process related to eudaimonia (MacKerron & Mourato, 2009; Peiró, 2006). Hedonism then is considered a more immediate human response whereas eudaimonia refers to a more collectively motivated mindset. In addition, self-ratings of 'happiness' tend to reflect short-term, situation-dependent expressions of mood, whereas self-ratings of 'life satisfaction' appear to measure longer-term, more projectual evaluations, indicating the extent to which one's experiences match one's expectations (Aslam & Corrado, 2007).

In this study the term happiness (H) is mainly used as a global term, including life satisfaction (LS) from the subjective point of view and quality of life (QoL) from the objective one. Quality of life is understood by some studies as referring to the quality of society and in other instances to the happiness of its citizens (Veenhoven, 2000), while others make a distinction between quality of life in social sciences, where it has a focus on positive mood, and in health sciences, where the main domains of reference are negative constructs of

health (Cummins, 2010). In this study it is understood as a more objective or theoretical measure that may possibly lead to happiness but not as the total indicator to characterize one person as happy. In this sense, questions about both quality of life and life satisfaction have been formulated to better quantify happiness.

## **2.2 Measuring happiness**

Measuring happiness could be understood in a literal way, by measuring the brain activity or by examining the answers of the different parts of the brain that are being activated during the exposure to diverse emotional incentives (Davidson, Jackson, & Kalin, 2000; Davidson, 2004; Drago, Heilman, & Foster, 2010; Layard, 2005; Weiner, 2008). There are also other ways of measuring happiness such as stress hormones, cardiac activity or facial coding (e.g., counting how many times we smile). But the easiest and quite obvious technique is to simply ask people how happy they feel (Layard, 2005, 2010; Veenhoven, 2003; Weiner, 2008) and evaluate their answers by means of either one-item scales, as in (Andrews & Withey, 1976) or multi-item scales, such as “Satisfaction with Life Scale” used in (Diener, Emmons, Larsen, & Griffin, 1985; Pavot & Diener, 1993). A problem encountered in these type of methods is that the majority of people want to present a happy face to the world (Kirita & Endo, 1995; Rhodes, Jeffery, Watson, Clifford, & Nakayama, 2003). As a consequence, they usually report higher happiness levels than in mail-in surveys (and even higher levels if the interviewer is of the opposite sex as Hugenberg and Sczesny have shown (Hugenberg & Sczesny, 2006). Other problems that may affect the individual response are those of internalization of cultural norms, mental illness, lack of information, etc. Cognitive problems caused by ordering effects, question wording and difference in scales may lead as well to biases in the answers obtained (Bertrand & Mullainathan, 2001). Furthermore, cultural differences and difficulties with translation may introduce further biases, and the extent to which these biases are problematic is a matter of debate (Moro et al., 2008). Hence, subjective assessments of happiness usually have troubles in delineating preference adaptation and the fact that people judge their level of happiness in comparison with peer groups rather than in absolute terms. However, the response of the person should not be ignored or interpreted to mean the opposite (Costanza et al., 2007). If a person says he is “pretty happy”, it means that this is what he really feels at the moment (Weiner, 2008). There is a broad consensus among previous studies that self-reported happiness is a satisfactory empirical proxy for individual utility (Di Tella & MacCulloch, 2006; Diener, Suh, Lucas, & Smith, 1999; Moro et al., 2008), showing adequate validity, reliability, factor invariance, and sensitivity to change (Diener, 1994).

The subjective approach considers “soft” matters such as satisfaction with income or perceived adequacy of dwelling. It stems from survey research, which took off in the 1960’s (Veenhoven, 2007), aiming to gather respondents’ own assessments of their lived experiences in the form of self-reports of happiness, satisfaction, fulfilment, well-being or some other near-synonym. Those surveys come to express the perceived significant of each domain of study to the respondent (Costanza et al., 2007, 2008). Yet, there is also an objective part of measuring happiness. While subjective measurement tools focus on personal reports of life experience that complement social, economic and health indicators, objective measurements are generally focused on the same indicators, but using some

already recognized tools and indexes. In other words, the objective approach focuses on measuring hard facts, such as income in local money or living accommodation in square meters (Veenhoven, 2007) and represents frequencies or quantities that can be simultaneously verified by any number of persons (Cummins, Eckersley, Pallant, Van Vugt, & Misakon, 2003). It includes for example indices of economic production, literacy rates, life expectancy and other data. It can be gathered without any direct survey and used uniquely or in combination to form composite indexes. Some methods of quantification would include quantifiable social or economic indicators to reflect the extent to which human needs are met. According to these methods, the objective elements would be described as the measure of human needs at a specific space and time (Costanza et al., 2007).

In trying to define and measure happiness we come across many different approaches that include either objective or subjective indicators. There are a number of limitations to using each of these approaches separately. While objective measurements may provide a snapshot of how well some physical and social needs are met, they are narrow, opportunity-biased, and cannot incorporate many issues that contribute to happiness such as identity, participation and psychological security. In other words, they fail to measure how people feel about their lives. They are actually proxies for experience identified through subjective associations of decision makers and many objective indicators merely assess the opportunities that individuals have to improve happiness rather than assessing happiness itself. Flaws in using only subjective measurements are also noted. They have trouble delineating preference adaptation and the fact that people judge their well-being in comparison with peer groups rather than in absolute terms (Costanza et al., 2007). Therefore, in any complete investigation of happiness both individual and contextual variables must be considered, as much as the cross-level interactions between them (Berry & Okulicz-Kozaryn, 2009). In this paper we use an integrative definition of happiness that combines both objective and subjective elements, being transformed to a multi-scale, multidimensional concept and letting us obtain a more complete and useful picture of it at multiple spatial and temporal scales. When the object of study is the relation between human beings and society, the universality of the subjective cannot be ignored (Max-Neef et al. 1991). By integrating subjective and objective measures we obtain a more realistic picture of the important inputs and variables in order to improve happiness (Costanza et al., 2008), and a multimethod approach may create a more comprehensive depiction of the phenomenon (Diener, 1994).

### 3. Materials and methods

#### 3.1 Data compilation

The methodology used in this study is built on Manfred Max-Neef's Human Scale Development (HSD) approach to sustainable development and happiness, which is based on the definition of human needs and their corresponding satisfiers (Max-Neef et al., 1991), partially modified by Robert Costanza (Costanza et al., 2007). Human needs indicate deprivations and at the same time individual and collective human potential. Needs are seen

as finite, few and classifiable, changing only in a very slow pace along with the evolution of our kind, and they can be satisfied according to many criteria. For the purpose of this study, the axiological needs category was used, with domains corresponding to Subsistence, Protection, Affection, Understanding, Participation, Leisure, Creation, Identity and Freedom. Protection was changed by Security, as suggested by Costanza (Costanza et al., 2007, 2008), and Subsistence has been considered within Reproduction, being the latter understood as a part of the former. Spirituality has been also included because of its importance in the assessment as a need (see (O'Brien, 2005; Van Dierendonck, 2011)). The fulfilment of all needs (domains) is considered equally important as any unsatisfied or not adequately satisfied human need reveals a form of human poverty, hindering happiness and therefore developing pathologies (Cruz et al. 2009). What changes over time and between cultures are the satisfiers of these needs. Max-Neef organizes the satisfiers within the grid of a matrix which, on the one hand, classifies needs according to the existential categories of Being, Having, Doing and Interacting and, on the other hand, according to the axiological categories mentioned before. There is no one-to-one correspondence between needs and satisfiers. One satisfier may contribute simultaneously to the satisfaction of different needs or, conversely, a need may require various satisfiers in order to be met, and these relations are not fixed, they may vary according to time, place and circumstance (Max-Neef et al., 1991). Each economic, social and political system adopts different methods for the satisfaction of the same fundamental human needs. In every system, they are satisfied (or not satisfied) through the generation (or non-generation) of different types of satisfiers. For this study, the satisfiers correspond to the different objective and subjective indicators (see Table A1 of Appendix).

### **3.2 Survey and case study**

The survey was created online (<http://docs.google.com>). The format was simple and accessible to everyone. Its design satisfied the survey principles under Dillman et al. (Dillman, Tortora, & Bowker, 1998). It was developed in Spanish, Catalan and English<sup>5</sup>, as Barcelona's citizens consist of many nationalities, and started running on the 10<sup>th</sup> of May 2012 and kept open for one month, until the 10<sup>th</sup> of June 2012. The web survey mode was chosen because it has several advantages. It does not suffer from interviewer bias, and responders may feel more comfortable answering sensitive questions or moving through a survey at their own pace (Pearce & Ozdemiroglu, 2002). Moreover, a vast improvement in response speed over traditional mail surveys is widely reported and the financial expenditure (Wolfgang, 2002) and ecological impact of surveys on the Internet is smaller due to the elimination of postage, printing and data entry (Dillman & Bowker, 2002). It also has some disadvantages, as for example the lack of any clarification of questions (MacKerron & Mourato, 2009) and the over-participation of responders with degrees in higher education, that tend to belong mainly to middle class and be more liberal (Brenner, 2002; Wolfgang, 2002). The total number of questions included in the survey was 104. These were grouped among the ten needs as follows: 18 for Subsistence, 12 for Security, 22 for Affection, 5 for Understanding, 8 for Participation, 8 for Leisure, 15 for Identity, 9 for Creativity, 2 for

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<sup>5</sup> The English version of the online survey can be visited at: <http://goo.gl/OM1il>

Freedom and 5 for Spirituality (see Table A2, Appendix). The case study corresponds to the neighbourhood of Vila de Gràcia, at the Gràcia district of Barcelona. Gràcia is located at the north of the city and the neighbourhood of Vila de Gràcia is located at the south of the district. Vila de Gràcia was chosen for being a consolidated urban environment of a controllable scale which allows the implementation of the methodology. In addition, it is a neighbourhood of mixed residential, services and culture uses. The area is characterized by its dynamism and heterogeneity, which ensures participation and a variety of responses. Further, it has recently undergone a process of urban transformation in order to improve its urban quality (Agència d'Ecologia Urbana de Barcelona, 2007).

#### 4. Results

General information data of the sample is shown in Table 1, with main statistics for a total of 174 responses. The focus was in all people using the space and not only to those living in the neighbourhood. So as to not to exclude anybody, the survey was addressed to all types of citizens: people living in Vila de Gràcia and also people using the urban space for recreational or familiar reasons, shopping, working, etc. Of those not living in Vila de Gràcia, a majority was living in nearby neighbourhoods like Sants, Sant Gervasi, Eixample, Gòtic and Sagrada Família. The educational level of the sample seemed to be really high, with the 88% having tertiary studies, but as mentioned previously, an over-participation of responders with degrees in higher education is the usual outcome in this type of survey.

**Table 1: Main statistics of the sample.**

	<b>Groups</b>	<b>%</b>
<b>Gender</b>	Female	50.6
	Male	49.4
<b>Age</b>	14-17	0.6
	18-24	10.9
	25-30	21.3
	31-44	35.6
	45-64	28.2
	65+	3.5
<b>Relation with space</b>	Lives there	51.6
	Recreational reasons	29.9
	Shopping	5.8
	Works there	4.0
	Familiar reasons	1.7
	Had lived there	1.7
	Lives close	1.2
<b>Place of origin</b>	Vila de Gràcia	51.6
	Other neighbourhoods	35.6
	Metropolitan area	9.2
<b>Activity</b>	Public sector	38.9
	Private sector	27.9
	Student	25.0
	Unemployed	3.5
	Pensioner	3.5
	Self-employed	3.4
<b>Education level</b>	Primary education	1.7
	Lower secondary	0.6
	Upper secondary	2.3
	Technical studies	7.5
	Bachelor	11.5
	2 <sup>nd</sup> cycle of studies	36.6
	Master	20.7
	PhD	20.1

#### **4.1 Life satisfaction**

As mentioned in the literature review section, life satisfaction involves the subjective character of happiness. In our case, the most important results coming directly from the survey analysis are the following (for more information see Appendix, Table A3).

Firstly, as far as the satisfaction with different aspects of life (such as health, life in general, free time, place where they live, family life, social life and social status) is concerned, most of the answers were between 4 and 5 (with values ranging from 77.0% to 81.0%) over a maximum value of 5. People seemed a little bit less satisfied about money (43.1%), work (53.5%) and commuting (51.2%)<sup>6</sup>. There was a 31.6% that considered their time spent at work as no creative. And a 39.1% declared they were quite happy (4 of 5) of their time distribution, while only a 3.5% was totally happy (5 of 5). Another interesting question was about quality of life in Vila de Gràcia, where the responders seemed rather dissatisfied, with most of the aspects scoring between 3 and 2 in the satisfaction scale. Water quality, air quality and sanitation facilities punctuated with 3 for the majority of the sample (values ranging from 39.1% to 42.0%), while pedestrian areas scored a little bit more, between 3 (28.7%) and 4 (33.3%). Noise and traffic were between 2 and 3 (cumulative values of 62.6% and 54.0% correspondingly), while people seemed really dissatisfied with green spaces, giving those 2 (44.3%) and 1 (23.0%). Although most of them where renters (50.6%), they did feel “at home” when they were there (87.4%). They also felt really safe around the neighbourhood (cumulative value of 79.3% for 4 and 5). Notwithstanding, there was a 6.9% of the total that had experienced violence in the familiar environment, and a 12.6% did not feel free as human being. Another interesting datum is that besides the actual turbulences in the economic and political spheres, the great majority (74.1%) was optimistic, stating that they can make plans for the future.

As far as environmental practices are concerned, the questioned claimed that they do recycle, save energy and water (values ranging from 85% to 94%) but they tend not to share their homes and cars (65% and 60% respectively) and only 11% did prefer going on foot and even less (8%) by public transport, although 53% of them chose bicycle as a common mode of transport.

About the level of attachment to significant others, the sample seemed emotionally dependent on other people. In the scale from 1 to 5, 46% scored with 4 and 5 their emotional dependence on the family and 23% their dependence on their friends.

When it comes to feelings, a majority stood for positive ones (around 4) and a greater dispersion is observed for those negative (Figure 1 and 2). In this latter case, worry is often experienced by 41.4% of the sample, with a 55.2% feeling anger rarely. Stress seemed to be another concern for the responders, as 60.9% gave it a score of 3 or 4. When they were asked which of those feelings they thought may change in a different urban environment (Figure 3), stress and calmness lead the list, followed by solidarity, tolerance, fear and loneliness, while at the bottom appear compassion, jealousy and forgiveness as those feelings least affected by a change in urban environment.

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<sup>6</sup> All the above values are cumulative, corresponding to the satisfaction of 4 and 5 in the scale of 5.



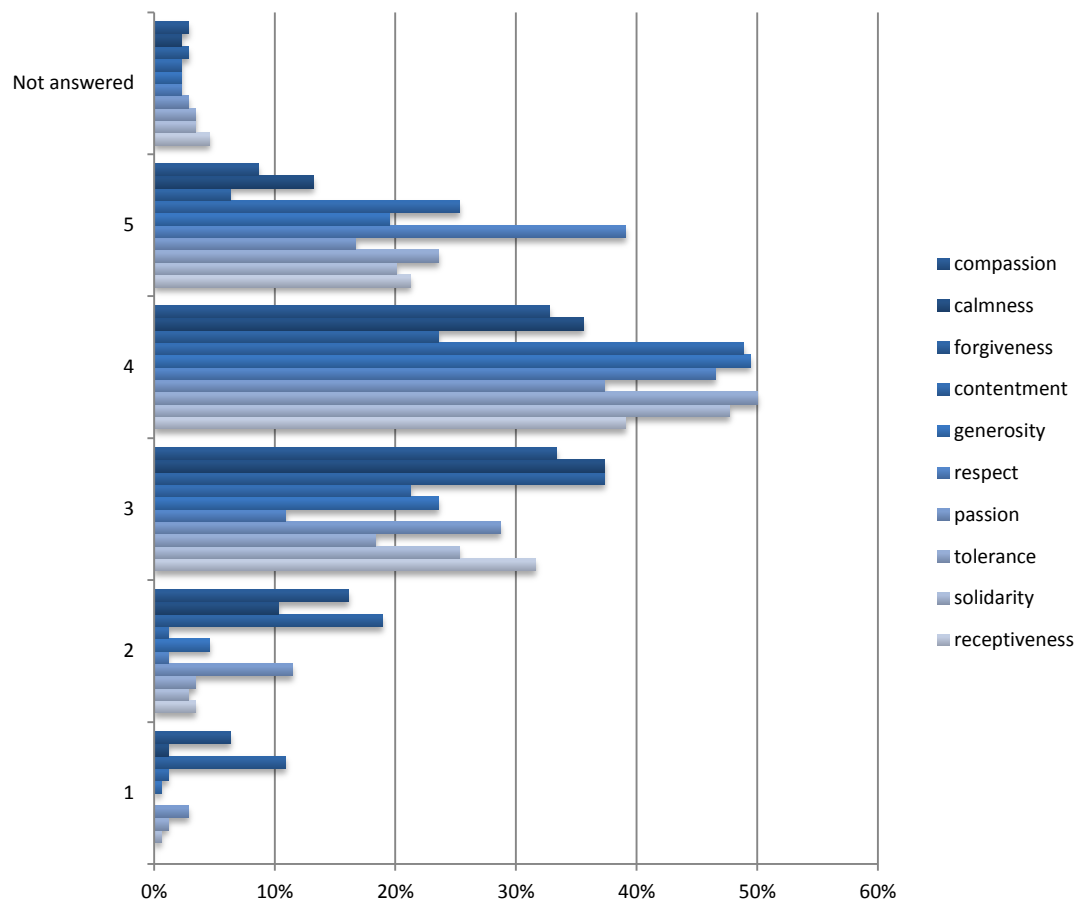


Figure 1: Frequency of positive feelings (1, rarely, 5, very often).



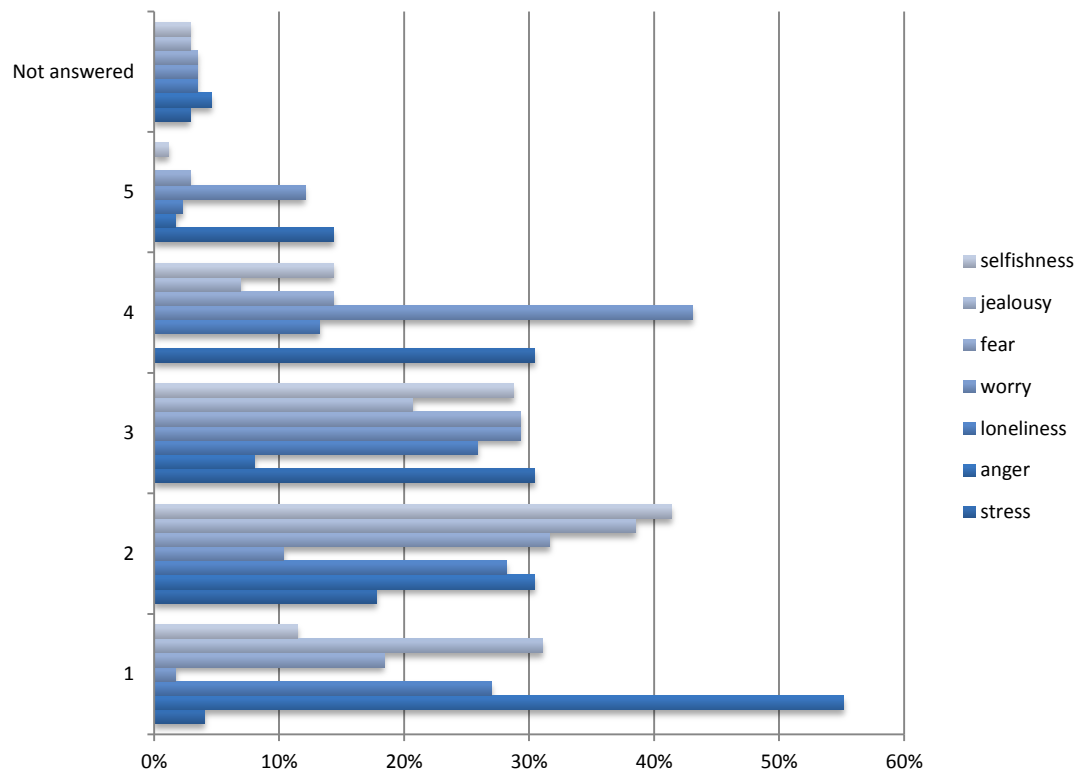


Figure 2: Frequency of negative feelings (1, rarely, 5, very often).

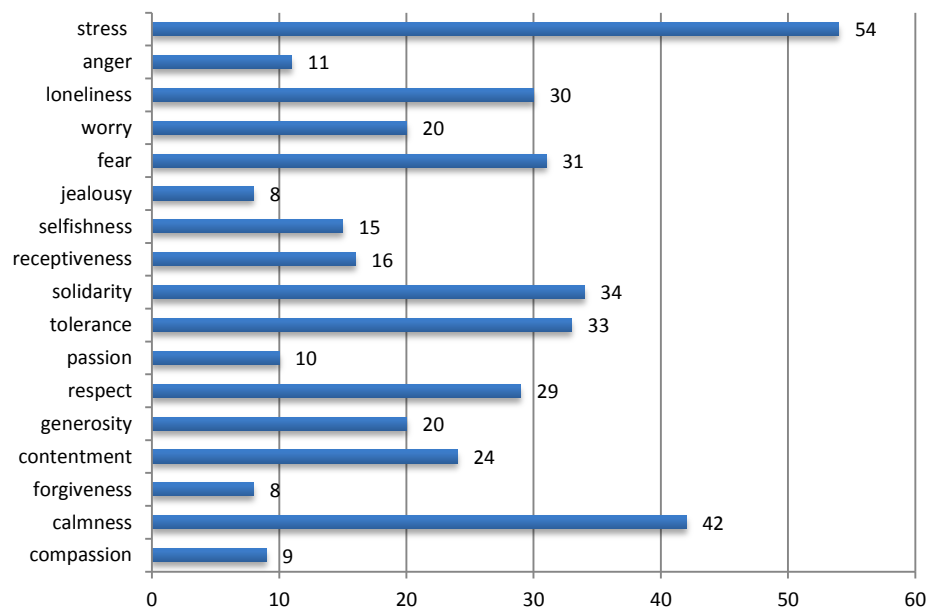


Figure 3: Feelings that may change in a different urban environment (absolute number of answers).

## 4.2 Correlations between pairs of variables and network structure

Identifying significant relationships between pairs of variables in data sets is increasingly important. Data sets with thousands of variables are more and more common in fields as varied as genomics, physics, political and social science, or economics. And these may hide valuable relationships among variable pairs really difficult to detect. In order to help us better explain both individual answers and aggregate results, a measure of dependence for two-variable relationships called maximal information coefficient (MIC) has been used (Reshef et al., 2011). It allows exploring a many-dimensional dataset assuming generality (i.e., MIC captures a wide range of associations, not limited to specific functions such as linear, exponential, etc.) and equitability (i.e., MIC gives similar scores to equally noisy relationships of different types). For example, with a value of  $MIC = 0.328$  we find a positive correlation between salaries (question number 6) and age (question number 4) (Figure 4). Underage do not earn any money at all; between 18 and 24 years, the majority earn not more than 500 €; between 25 to 30 years, this value goes from 500€ to 1000€, etc.; finally those older than 65 years, earn from 2000€ to 2500€. Likewise, the fourth strongest correlation ( $MIC = 0.365$ ) appears between the spirituality of oneself (question number 100) and the frequency of meditation or pray (question number 101).

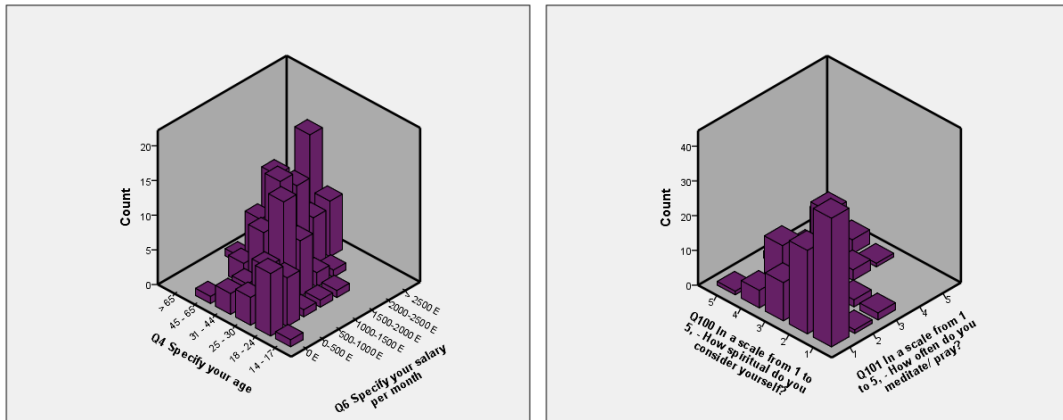


Figure 4: Measures based on maximal and mutual information methods are useful to detect differences in correlations of answers. While questions 4 and 6 show low correlation (left), questions 100 and 101 (right) offer a more significant one.

MIC values for independently taken pairs of variables cannot give a true account of the aggregate outcome of the answers. To endow an intuitive and efficient interpretation of how the different variables in a dataset are related to each other, a network type of visualization of our dataset has been obtained. The questions in our dataset are represented by nodes, and the relationships between them are represented by edges, weighted by means of the MIC strength of every pair of variables. The weighted degree  $d_w$  of each node has been then obtained. It indicates the importance of that node in relation with the rest of the nodes it is connected to, but taking into account the strength of every link (Opsahl, 2010). Once a network is so created, graph theory can be applied to uncover other structural properties based on centrality measures like closeness (i.e., how long it will take to spread information from one node to all other nodes sequentially), betweenness (i.e., the number of times a node acts as a bridge along the shortest path between two other nodes) or degree

(Newman, 2010). Maybe the most significant one here is the corresponding weighted degree cumulated probability distribution  $P_{>}(d_w)$ , which measures the percentage of nodes with degree  $d_w$  or higher. Results for this topological measure are shown in Figure 5, where weighted degree cumulated probability distribution  $P_{>}(d_w)$  has been connected with three screenshots corresponding to the graphical emergence of the graph. Questions have been spatially grouped and coloured according to HSD categories.  $P_{>}(d_w)$  exhibits a nontrivial bimodal behaviour (with two similar sigmoid behaviours after and before degree value  $d_w = 3$ ) and the deviation from the degree cumulated probability distribution for a random graph with the same average weighted degree and number of nodes (dashed line) is remarkable. This deviation from random graph behaviour can be explained with the help of the closeness and betweenness centrality measures, both of them positively correlated with degree (results not shown in the paper). This fact would imply some kind of hierarchy in the graph, where the most connected nodes are also central in terms of information transmission and shortest paths. As it is observed, questions related with HSD categories Identity and Subsistence belong to the first snapshot of the connected component of the graph (right upper subgraph), which contains 5% of the nodes with degree 5 or higher. When weighted degree is reduced to 4, an abrupt transition occurs and Affection, Leisure and Understanding categories appear, together with an increasing number of nodes of the previous two categories (centre subgraph). When degree is further reduced to 3, the rest of categories begin to appear, although with only reduced presence (i.e., Security) or none at all (i.e., Participation). At this point, 70% of the nodes are already present in the connected component of the graph (left upper subgraph). The remaining 30% of the nodes appear following a similar, though not so abrupt, transitional pattern.

This analysis allows an intuitive interpretation of how the different questions are related. Any type of conclusion derived from it though, must be taken with care, since null models for comparative purposes are impossible to formulate in the cases of such specific graph construction processes. The probable main outcome is that questions in our dataset are non-trivially related to each other: the topological structure of the graph clearly deviates from that of a random network and its degree probability distribution offers a characteristic bimodal pattern. In particular, questions in Identity and Subsistence HSD categories offer the strongest correlations, suggesting an intense consideration of one's self. Only when the first transition occurs, at  $d_w = 5$ , Understanding and Affection, categories more related with "the other" in an absolute sense, begin to appear. It is remarkable that categories involving deeper feelings and inner growth as human being, like Security, Spirituality and Freedom, are the last ones to appear in the graph. Significantly, Participation is the only one with no representative node at the end of this first sigmoid step, maybe suggesting the actual disaffection with political and social spheres. For values of  $d_w = 3$  and lower, a similar sigmoid pattern appears and the remaining 30% of nodes come into view (not shown in Figure 5).

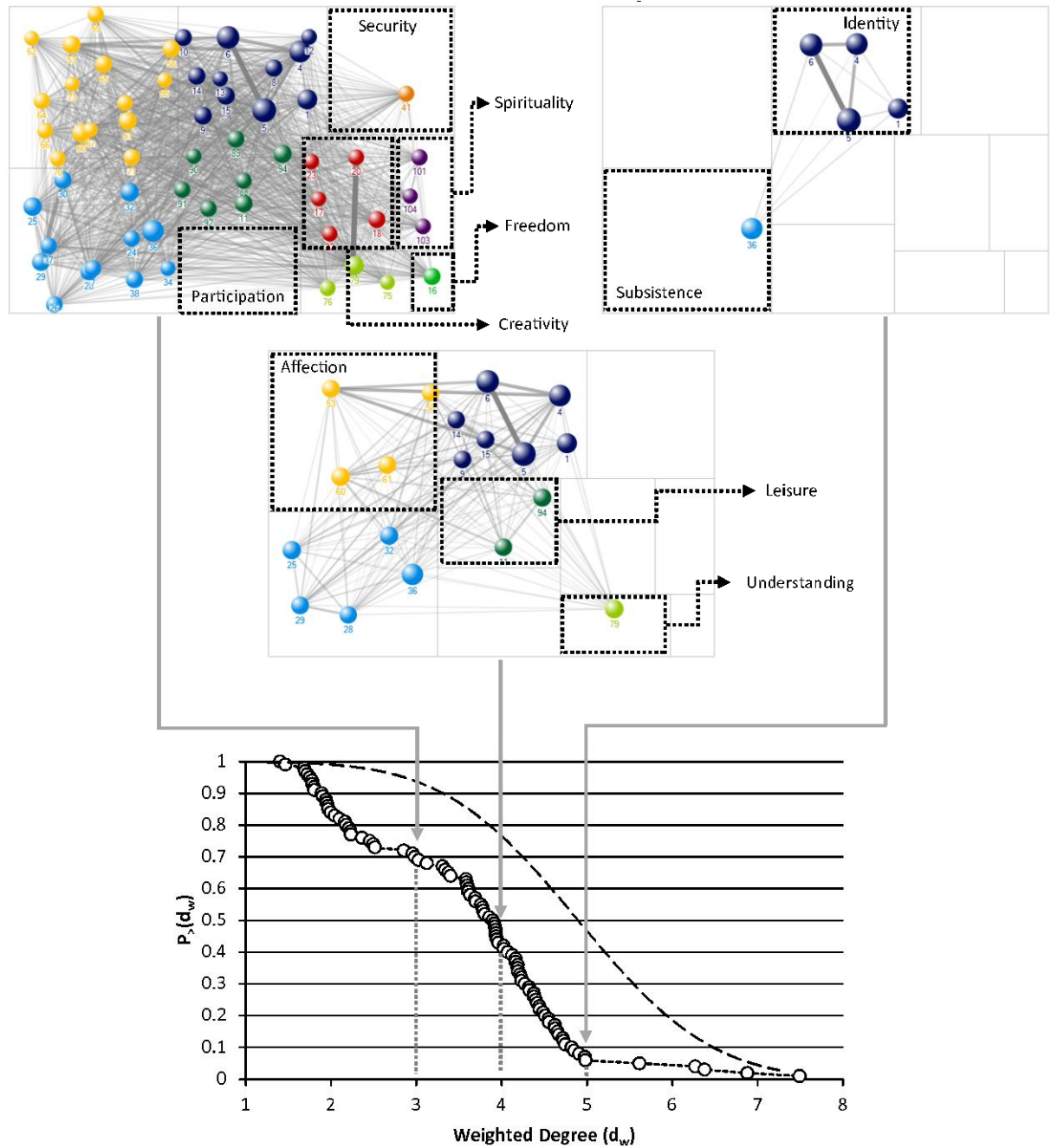


Figure 5: Weighted degree cumulated probability distribution and the emergence of the dataset network. Questions related with HSD categories Identity and Subsistence belong to the first snapshot of the connected component of the graph (right upper subgraph), which contains 5% of the nodes with degree 5 or higher. When weighted degree is reduced to 4, Affection, Leisure and Understanding categories appear (centre subgraph). When this is further reduced to 3, the rest of categories begin to appear except Participation (left upper subgraph). At this point, 70% of the nodes are present. Degree cumulated probability distribution for a random graph with the same average weighted degree is shown (dashed line) for comparison purposes. For every edge, opacity and thickness are proportional to its MIC strength. For every node, size is proportional to its weighted degree. Weighted degree values have been calculated with R-package *tnet*, developed by Tore Opsahl (<http://toreopsahl.com/tnet>) and statistical program R (<http://www.r-project.org/>). Network figures have been created with NodeXL (<http://nodexl.codeplex.com>).

### **4.3 Life satisfaction and quality of life**

Generalised thresholds and norms do not always function for all places, and should be adjusted according to the kind of people living in each place and their culture, habits, customs and traditions. Even so, subjective perceptions and thresholds do not always coincide with the objective reality, where thresholds are usually quantified under unbiased assumptions. This fact, though, might influence happiness and the perception that people obtain from their surrounding space and environment, curtailing initiatives that would be otherwise beneficial. Here objective (i.e., quality of life) and subjective (i.e., life satisfaction) indicators and their thresholds are compared in order to detect possible deviations.

Table 3 shows an example of comparison between subjective and objective indicators (see table A3 in Appendix for the complete list). The first column contains the Need and the second the particular item under study. The following three columns correspond to the objective part of happiness measurement: actual value of the item, threshold and objective check respectively (with a tick if the actual value corresponds to the threshold and a cross otherwise; if it could not be measured, a line has been chosen as symbol). Depending on the available data source, actual values have been obtained in decreasing order from Vila de Gràcia, District of Gràcia, city of Barcelona, autonomous region of Catalonia and finally Spain. Thresholds in quality of life come from established local, European or world legal limits and regulations. The following three columns correspond to the subjective part of the measurement: question made at the survey, perception according to the answers of the sample and final check, performed as previously stated. Thresholds in life satisfaction depend on each formulated question but, in general terms they are obtained by contrasting either the answers with scores 1 and 2 against those with scores 4 and 5, or the percentage of cumulated “yes” or “no” answers when the question is categorical (see Table A1). The final column evaluates whether the final value of the comparison between the two types of measurements is positive, negative or neutral. When positive (i.e., both checks with a tick) the result is equal to 1 unit. When negative (i.e., both checks with a cross), the result is equal to 0 units. When there is a tick and a cross, the result is neutral and the result equal to 0.5 units. Finally, when one of the checks or both cannot be quantified the cell remains blank.

Table 3: Example of comparison between subjective and objective indicators from a specific Need.

Need	Item	Objective			Subjective			Total
		Actual Value	Threshold	Objective check	Question	Perception	Subjective check	
Subsistence	Air quality	Barcelona ICQA average (2010) = 52 <sup>1</sup>	50<ICQA<75: Satisfactory air quality <sup>2</sup>	✓	9-Q25 How satisfied are you of the below in Gràcia? - air quality	<p>4-5: 9,20% 1-2: 34,48%</p>	✗	0.5
	Sanitation facilities	Treated flow of water in Catalonia ≈ 67,89% <sup>3</sup>	Positive if > 50%	✓	9-Q26 How satisfied are you of the below in Gràcia? - sanitation facilities	<p>4-5: 27,01% 1-2: 25,86%</p>	✓	1
	Green spaces	Barcelona: Urban green: 6,55 m2/hab <sup>4</sup>	WHO: optimum: 14m2/ hab Minimum: 10m2/ hab <sup>5</sup>	✗	9-Q27 How satisfied are you of the below in Gràcia? - green spaces	<p>4-5: 8,62% 1-2: 67,24%</p>	✗	0

<sup>1</sup> Índice de calidad del aire (ICQA) in (Idescat, 2013).

<sup>2</sup> (Generalitat de Catalunya, 2012)

<sup>3</sup> Treatment capacity in Catalonia: 2.850x1.000 m3/day, according to Estaciones depuradoras de aguas residuales - Por tipos in (Idescat, 2013) and treated flow: 1934,8x1.000 m3/day, according to Estaciones depuradoras de aguas residuales - Rendimientos globales in (Idescat, 2013).

<sup>4</sup> (Ajuntament de Barcelona, 2008)

<sup>5</sup> (Por la reserva, n.d.)

Among indicators that showed conflictive answers (a tick and a cross, in no specific order), some of those included in environment and significant-others related items are remarkable. When it comes to air quality for example, a 34.5% was not satisfied (cumulated percentage of 1 and 2 scores), while according to Generalitat de Catalunya and the Index ICQA (Generalitat de Catalunya, 2012; Idescat, 2013) there is a satisfactory air quality at whole Barcelona. Similarly a 40.8% was unsatisfied by traffic conditions in Vila de Gràcia but, according to the Urban Ecology Agency of Barcelona (Agència d'Ecologia Urbana de Barcelona, 2007), most of the streets do not exceed 350-700 vehicles per hour, which corresponds to a free-flow (maximum of 420 vehicles per hour) or a reasonable-free flow (max. 750 vehicles per hour) for the type of streets that Vila de Gràcia has (see (Herman, 2009)). In this sense, a 52.9% of the sample seemed to favour the bicycle, even though 98% of Barcelonans do not opt for this kind of transport system for their displacements (Vásquez 2011). Paradoxically, the sample seemed to dislike walking (86.8%) or taking the public

transportation (90.2%), while this percentages for the metropolitan area are only 53.9% and 69.6% respectively (ATM, 2006). As far as energy and water consumption is concerned, people do save electricity (89.7%) and water (85.6%), although the levels of electricity consumption per capita are slightly over the European average (European Environment Agency, 2007) and similarly for the water consumption per capita per day in Barcelona (Àrea Metropolitana de Barcelona, 2010), a bit over the limits imposed by European Union (European Green Capital, 2012).

As far as significant-others and socio-family items is concerned, it seems there exists a general desire to have or form a family (90.2%), yet it does not necessary imply to have children, considering the low birth rate in Barcelona (Idescat, 2013). About the education level, the sample was above the average, with 87.9% with tertiary education. The contrary happens to the rest of the people in Gràcia and Barcelona, where only an average of 41% continues to higher education (Ajuntament de Barcelona 2007). Population that may enjoy the privileges of public health care in Catalonia only reaches 24.4% (Idescat 2013) when the percentage of the responders in Gràcia reached 60.3% for the public and 98.8% for both public and private. In relation with disabilities or mental health problems, official statistics show important limitations concerning activities of people with these attributes (Ajuntament de Barcelona, 2007). Nonetheless according to the responders (only 6 of the interviewed) a 66.67% declared no restrictions provoked by his disability. Passing now to participation in the community and in voting at the elections, a 82.2% of the responders declared active participation, rather than 52.3% in Barcelona that attended the municipal elections in May 2011 and 69.9% for the Parliament elections in November 2012 (Idescat 2013).

#### **4.4 Happiness**

As stated in section 2.2, happiness is used in this paper as a global term, including LS from the subjective side and QoL from the objective one. As a consequence, for its quantification both subjective and objective measurements have been used. Although several items can be related with each Need, items belonging to each and every one of them and quantifiable items in objective indicators are not necessarily coincident with those evaluated in subjective ones (Table 4). Totals above 5 are considered as strong happiness and below 5 as weak happiness.

Table 4: Number of items corresponding to each type of indicator and Need.

Human needs (Domains)	Total items	Quantifiable items in subjective indicators (LS)	Quantifiable items in objective indicators (QoL)	Quantifiable items in both (H)
1. Subsistence	18	15	12	12
2. Security	12	12	9	8
3. Affection	22	20	1	1
4. Understanding	5	5	1	1
5. Participation	8	8	2	2
6. Leisure	8	5	1	1
7. Creativity	9	8	5	5
8. Identity	15	15	8	8
9. Freedom	2	2	0	0
10. Spirituality	5	5	0	0

As a general procedure, both LS (subjective happiness) and QoL (objective happiness) were measured summing up the corresponding existing ticks for each need (Table A3), with a final numerical value in a scale of 10. As far as LS is concerned, total subjective happiness reached 7.30 units (Table 5 and Figure 4a). Needs for Subsistence, Security, Affection, Participation, Leisure and Identity have a high score (from 6 to 8), with the top corresponding to the needs for Understanding and Freedom that both score 10. Satisfaction and Creativity has a middle score of 5 and Spirituality has a weak one, reaching only 4 units.

Table 5: Life satisfaction (subjective happiness) assessment.

Human needs (Domains)	Numeric subjective happiness result	Subjective happiness in scale 1 to 10
1. Subsistence	11/15	7.33
2. Security	7/12	5.83
3. Affection	16/20	8.00
4. Understanding	5/5	10.00
5. Participation	6/8	7.50
6. Leisure	3/5	6.00
7. Creativity	4/8	5.00
8. Identity	14/15	9.33
9. Freedom	2/2	10.00
10. Spirituality	2/5	4.00
<b>Total</b>		<b>7.30</b>

Concerning QoL, total objective happiness scores 5.25 units in the scale of ten (Table 6 and Figure 4b). The scores are all of them lower than subjective ones, but for Leisure and Creativity. Needs for Subsistence, Security and Creativity score between 5.56 and 6.67, while the top scores coincide with Identity (8.75) and Leisure (10). Participation has a middle score of 5.00 and Affection and Understanding get 0. Freedom and Spirituality were not counted, because there exists no objective indicator corresponding to them.



Table 6: Quality of life (objective happiness) assessment.

Human needs (Domains)	Numeric objective happiness result	Objective happiness in scale 1 to 10
1. Subsistence	8/12	6.67
2. Security	5/9	5.56
3. Affection	0/1	0.00
4. Understanding	0/1	0.00
5. Participation	1/2	5.00
6. Leisure	1/1	10.00
7. Creativity	3/5	6.00
8. Identity	7/8	8.75
9. Freedom	-	-
10. Spirituality	-	-
<b>Total</b>		5.25

Happiness was quantified in the same way but using quantifiable items for the total, based on the comparative table previously presented (Table 3 and Appendix A3). Other possible combinations (i.e., total colour white or a non-quantifiable question) were not considered in the total. The final result reaches the 6.45 units (Table 7 and Figure 4c). It is a positive score but less than life satisfaction (i.e., subjective happiness). Needs for Participation and Identity seem satisfied, scoring from 7.50 to 8.75. The best score corresponds to Leisure with 10. Subsistence, Security, Affection, Understanding and Creativity have a middle score of five. Freedom and Spirituality were not counted due to the absence of objective indicators that would lead to their calculation.

Table 7: Happiness assessment.

Human needs (Domains)	Numeric integral happiness result	Integral happiness in scale 1 to 10
1. Subsistence	8/12	6.67
2. Security	4/8	5.00
3. Affection	0,5/1	5.00
4. Understanding	0,5/1	5.00
5. Participation	1,5/2	7.50
6. Leisure	1/1	10.00
7. Creativity	2,5/5	5.00
8. Identity	7/8	8.75
9. Freedom	-	-
10. Spirituality	-	-
<b>Total</b>		6.62

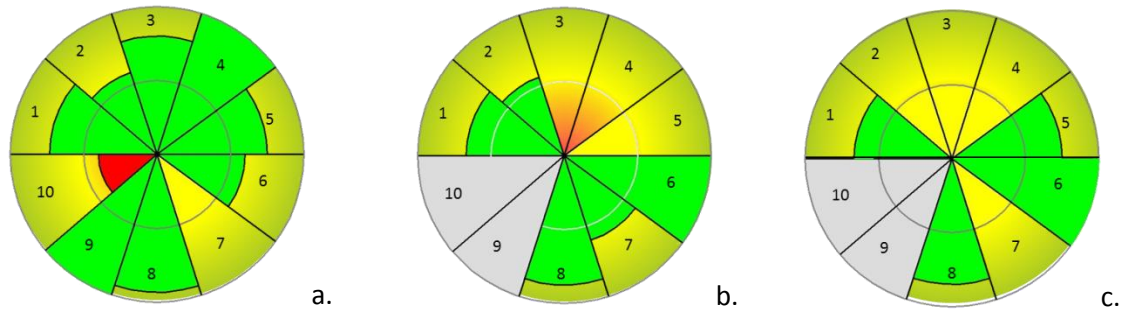


Figure 6: Happiness assessment. (a) Life satisfaction, (b) quality of life and (c) happiness. Each number corresponds to a Need; 1: Subsistence, 2: Security, 3: Affection, 4: Understanding, 5: Participation, 6: Leisure, 7: Creativity, 8: Identity, 9: Freedom, 10: Spirituality. Positive scores ( $>5$ ) are presented in green, neutral (5) in yellow and negative ( $<5$ ) in red colours. Grey colour reflects needs that cannot be quantified for the specific approach and the inner circle indicates the average value of 5.

In the case Freedom and Spirituality Needs, results are included into Happiness, as measured for the LS, the final result is slightly modified, changing from 6.62 to 6.69.

## 5. Discussion

The present worldwide trend toward urbanization is not only leading to significant impacts on the global environment but also seriously affecting the emotional and physical state of city dwellers. How benevolent, unfriendly, creative or unproductive can we expect a city to be depends essentially on how its citizens behave, work and live and, complementary, on how the physical environment receives them and accommodates their daily demands. As it is shown in this paper, people truly believe that some of their feelings would change in different types of urban environment, with stress and calmness leading the list, followed by solidarity, tolerance, fear and loneliness. Although urban planners, architects and sociologists tend to evaluate city dwellers' demands in order to define the best possible urban context to apply their theories, they usually rely on either objective measures and indexes or subjective ones, only partially addressing the polyedric urban dweller reality. The subjective perception and feelings that a city dweller obtains from its surroundings is usually more than the mere sum of its isolated, and objectivized, forming parts. Thus an integrative assessment methodology is needed to conflate objective (i.e., quality of life) and subjective (i.e., life satisfaction) spheres in order to evaluate happiness in the particular case of the urban environment. The methodology presented in this paper allows an integrative approach considering both aspects and incorporating different questions into axiological domains, in order to evaluate it under the Human Scale Development frame of reference. The division of the questions by needs aids in understanding the category in which a problem can be concentrated. As a consequence, the method here presented may also be of great help when having to decide the focus of a decision making process, concerning future policies, plans and measures of improvement. At the same time, the method used during all the process of quantification of happiness can be considered as a useful tool both to evaluate the current urban environment and to achieve a better one, concentrating our efforts on the happiness of the dwellers. With this methodology it is, though, not possible to obtain clear results about how much each one of the aspects incorporated into questions

separately affects happiness. Conclusions can only be drawn from ensembles of questions as there are many interactions between them. That is why the questions were separated by needs following Max-Neef's conceptual framework. Thus, clear conclusions can only be made for the set of questions corresponding to each need.

The impact of cross correlations should be stressed, as satisfaction or discontent on a specific issue (i.e., noise and water quality) influences other related issues (i.e., traffic and sanitation services quality). Since MIC values for independently taken pairs of variables cannot give a true account of the aggregate outcome of the answers, a network type of visualization of our dataset has been obtained. Although conclusions must be taken with care, the probable main outcome of this analysis is that the topological structure of the graph clearly deviates from that of a random network. The main observed consequence is that questions in categories related with one's self are much more strongly correlated among themselves than with others. Categories more related with "the other" in an absolute sense, appear when the intensity of the links begin to decay (i.e., lower degree values). It is remarkable that categories involving deeper feelings and inner growth as human being, like Security, Spirituality and Freedom, are the last to appear in the graph, with Participation as the only one with no representative node at a value of degree as low as  $d_w = 3$ . We suggest that the basis of these patterns could be indirectly linked to the current postmodern way of life, perceived as much more ego-centred, self-indulgent and less devoted to others, due to technological and efficiency-related reasons (Morin, 1982; Mumford & Winner, 1934; Princen, 2005).

Results show a significant difference between objective and subjective scores in average terms, with the objective score (QoL) below the subjective one (LS). One first conclusion drawn from this result is categorical: either people have responded trying to seem happier than they really are, or objectively established thresholds are really strict according to the reality and they do not correspond to what people truly need or feel. The final integrative happiness approach stands in between QoL and LS scores, balancing the results of these two. Among domains, it is worth to stress how two particular needs like Freedom and Spirituality could not have been evaluated in the overall result, since no answers were reflecting the objective part. This fact evidences that those needs represent clearly the endogenous or inner happiness of a person and thus are inherently difficult to be evaluated by objective criteria. But even when it comes to LS, those questioned do not seem to have a clear view of the meaning or the importance of Spirituality (a score of 4 in the scale of ten), tending to connect it only with religion and not with nature or well-being, as suggested by (Kamitsis & Francis, 2013). Two other low scored domains are Creativity (5 in LS, 6 in QoL and 5 in H) and Security (5.83 in LS, 5.56 in QoL and 5 in H). These spheres, highly praised in modern societies and cities, are generally considered closely related to freedom, though from our analysis it comes that the perceived Freedom as a need has a really high score (Table 5), clearly above the other Needs. As far as Creativity is concerned, hours spent on television, on the internet, using smart phones, video games and the zero participation to productive processes might be the possible answer to the obtained low creativity score. In the actual economic model, human creativity, thinking of novel and productive ways to do things, is generally declining and being replaced by high-tech apparels and gadgets (Csikszentmihalyi, 1996; Johnson, 2010).

Similarly, security is generally decreased by signs of disorder, which generate insecurity and fear. Although fear is a positive signal against dangerous situations, when it becomes dysfunctional problems appear (Body-Gendrot, 2012). What usually shape the perception of insecurity or fear are personal experiences. Yet, such perceptions are selective (Svendsen, 2008). The demand for security results from a transfer of anxiety. The collective contamination of negative perceptions testifies to the solitude and anonymity of individuals in cities confronted with changes they cannot understand and that the state seems unable to alleviate (Body-Gendrot, 2012; Wirth, 1938). Despite people in Western countries nowadays have less familiarity with pain and suffering than before, they are surrounded and blockaded by an economic instability, fed by the global economic crisis. And crisis is found to have profound effects on happiness levels, as well as on individuals' assessments of their standards of living and of their future (Graham, Chattopadhyay, & Picon, 2010). That makes fear an ever-expanding part of personal life and leads many social scientists to claim that today's society can be best described as a "culture of fear" as there is no longer any area left where a perspective of fear does not apply (Davis, 2006; Svendsen, 2008). As a result, scaremongering is increasingly represented as the act of a concerned and responsible citizen (Furedi, 2002). Indeed, two characteristic events associated with the aforementioned social instability occurred in the studied area during the period. Firstly, the severe economic and social crisis in which Spain entered since 2008 and secondly, not long after the opening of the survey a great manifestation was organized in Barcelona, on 12th of May, as a reminder of the one year since the first manifestation of the 15M movement (Buesa, Sust, & Gascó, 2010), probably affecting the responses of the questioned.

In order to obtain a more reliable result, caution should be taken with those quantifiable items (see Table 3) that sum less than two. Checking the QoL assessment for example, we have an accumulation of zeros based on negative responses. This drawback appears for Affection and Understanding (Table 4), where the quantified items are only one per each need. Following the same pattern and for the same reason, these needs are quantified by 5 in the overall happiness. The same happens with Leisure, though its result corresponds to 10 for both assessments. In an extended application of this methodology (currently ongoing for five different Mediterranean cities) which aims at a more significant sample, issues related with the aggregation of data and adjustments made in order to take into account distorting factors in questions to get a weighted score of a need, will be considered. Although self-report measures of well-being appear to possess adequate psychometric properties, as they show adequate validity and reliability (Diener, 1994) and it is estimated that half of the variance in happiness measures is due to the underlying well-being construct and only about one tenth of the variance is normally due to the method, when it comes to mixed measures of both subjective and objective character (Rodgers, Herzog, & Andrews, 1988), aspects related with psychometric testing will also be considered.

It must be stated here that these happiness measures represent a snapshot in time. Any measurement data used for predictive purposes would need to be collected over sufficiently long time periods and samples to successfully capture or model the co-evolution of humans with their environment and develop an effective knowledge base.

## **6. Conclusions**

This paper defines a simple tool to quantify and evaluate current levels of urban happiness. It can be used to define more useful urban quality indexes in order to improve decision making processes, policies and plans. It is based on the accomplishment of the basic human needs according to the Human Scale Development framework. Applied to Vila de Gràcia (Barcelona, Spain), it shows fundamental differences between objective measurements and subjective perceptions. This fact would raise doubts about the usefulness of some objective measurements and their assessment, and, at the same time, would suggest the need for a true integrative approach in measuring happiness. Happiness is interpreted as something complex and multidimensional. It depends on the chosen spatial and temporal scales, methodology, the inclusion or exclusion of the different factors and indicators, the target group, etc. It is mandatory to try to incorporate all the different options and aspects that may make a person happy, and that affect the fulfilment of a person's needs. A good interpretation of the accumulated data may lead to the creation of a visual representative image of the sample and foresee in it what is missing, what goes wrong and what is affecting personal happiness. By incorporating the objective dimension and comparing it with the subjective one, more holistic results can be obtained.

Urban design must be focused on the making of places for people and precisely on the process of making better places for people than would otherwise be produced. To achieve happiness, there is a need for a more democratic and enriching environment that maximize the degree of user choice, giving emphasis on the correlation between designed space, activities and use. We hope this methodology could help scholars, decision makers and citizens to finally understand that urban planning should be about planning for people who live in the city rather than planning for the city.

## **Acknowledgements**

We thank Tore Opsahl for developing 'tnet', the R-package that allows the calculation of weighted degree values for complex networks, and above all, for making it freely accessible from his website.

## **Appendix A. Questions and Numeric values for each answer**

The tables A1 - A5 are included in the Supplementary material of the CD.

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## 2. Other indexes of quality

### 2.1 Presentations

- *Dynamic Networks in Gephi*, (15/01/2014). Sustainability Measurement and Modeling Lab., Escola d'Enginyeria de Terrassa (EET), Terrassa.
- *Cuantificación de la percepción de la felicidad en el contexto urbano. Análisis de la metodología*, (08/10/2012). Escola Tècnica Superior d'Arquitectura del Vallès (ETSAV), Sant Cugat de Valles.

### 2.2 Media

- Bassi Clara, (09/08/2013). *La felicidad en las ciudades*, Eroski Consumer Bulletin. Available at: <http://goo.gl/kptwHF> [Accessed May 21, 2014].

## 3. Supplementary material

The supplementary material is included in digital form in the CD.