

Assessing sustainability in cities

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

Ioanna Anna Papachristou



Universitat Politècnica de Catalunya - Barcelona Tech

Supervisor: Martí Rosas Casals

Barcelona, September 2019

UNIVERSITAT POLITÈCNICA DE CATALUNYA – BARCELONA TECH
UNIVERSITY RESEARCH INSTITUTE FOR SUSTAINABILITY SCIENCE AND TECHNOLOGY (IS.UPC)
SUSTAINABILITY MODELING AND MEASUREMENT LAB. (SUMMLAB)
PhD Programme in Sustainability

Assessing Sustainability in Cities

A complexity science approach to the concept of happiness
for the urban environment

Ioanna Anna Papachristou

PhD Thesis

Supervisor
Dr. Martí Rosas Casals

Barcelona, 27/9/2019

Cover and chapters covers design
Birgit Palma



Contents on this PhD Thesis are licensed under Creative Commons Attribution-Non-Commercial-No Derivative Works 3.0 Spain License.

All images, figures, diagrams and other graphical material by the author, unless otherwise stated.

TABLE OF CONTENTS

TABLE OF CONTENTS	3
TABLE OF FIGURES	6
TABLE OF TABLES	10
ABSTRACT	11
ACRONYMS	13
ACKNOWLEDGEMENTS	14
1. INTRODUCTION	16
1.1 LAYOUT OF THIS THESIS	17
1.1.1 OBJECTIVES	19
1.2 URBAN ENVIRONMENTS AS SOCIAL SPACES	20
1.2.1 STUDYING THE NEIGHBOURHOOD	21
1.2.2 STUDYING THE PUBLIC SPACE	21
1.3 THE SOCIAL DIMENSION OF SUSTAINABILITY	22
1.3.1 HUMAN DEVELOPMENT & THE HUMAN SCALE DEVELOPMENT PARADIGM	23
1.4 HAPPINESS, QUALITY OF LIFE & WELL-BEING	25
1.4.1 QUALITY OF LIFE DIMENSIONS	26
1.5 SOCIETY. A COMPLEX SYSTEM CHARACTERISED BY COMPLEX PROBLEMS	28
1.5.1 SYSTEM THINKING	28
1.5.2 NETWORK THINKING	30
1.5.3 LANGUAGE NETWORKS & SOCIO-LINGUISTICS	33
1.6 REFERENCES	36
2. CONCEPTUAL ANALYSIS	46
2.1 UNDERSTANDING THE CONCEPT OF HAPPINESS	47
2.1.1 DATA COLLECTION	47
2.1.2 MAIN STATISTICS	48
2.1.3 THE “HAPPINESS” NETWORK	48
2.2 INTERSECTING HAPPINESS AND URBAN STUDIES FIELDS	52
2.2.1 “URBAN-HAPPINESS” NETWORK STATISTICS	52
2.2.2 TEMPORAL EVOLUTION	55
2.2.3 CLUSTER ANALYSIS	57
2.2.4 EGO-NETWORK ANALYSIS	59
2.3 MAIN POINTS IN REVIEW	65
2.4 REFERENCES	67
3. QUALITY OF LIFE DIMENSIONS	70
3.1 MEASURING QUALITY OF LIFE IN URBAN ENVIRONMENTS	71
3.1.1 PREPARATION PROCESS	71

3.1.2 CLASSIFICATION AND WEIGHTING PROCESS	71
3.1.3 TOWARDS AN INTEGRATIVE QOL	72
3.2 CAPTURING PERCEPTIONS ON SUBJECTIVE WELL-BEING	75
3.2.1 PREPARATION AND CLASSIFICATION PROCESS	75
3.2.2 SURVEY ANALYSIS	76
3.2.3 FIRST RESULTS ON SWB	79
3.2.4 INTERVENTION AXES	81
3.2.5 POTENTIAL SWB IMPROVEMENT	85
3.3 FIRST RESULTS ON OBJECTIVE AND INTEGRATIVE QOL	87
3.3.1 COMPARING SUBJECTIVE AND OBJECTIVE DIMENSIONS	87
3.3.2 WORKING TOWARDS THE INTEGRATIVE RESULT	88
3.3.3 AN HYPOTHETICAL CASE	89
3.4 MAIN POINTS IN REVIEW	91
3.5 REFERENCES	93
4. CATEGORISATION AND NEED CONNECTIVITY	95
<hr/>	
4.1 CATEGORISATION PROCESSES IN SOCIO-ECOLOGICAL SYSTEMS	96
4.1.1 DEFINING STUDY CATEGORIES	96
4.1.2 DATABASE SELECTION	97
4.1.3 CLASSIFICATION PROCESS	97
4.1.4 OVERALL CONNECTIVITY RETRIEVAL	98
4.2 CONNECTIVITY PATTERNS IN HUMAN NEEDS	100
4.2.1 STUDY CATEGORIES AND DATABASE SELECTION	100
4.2.2 CLASSIFICATION OF QUESTIONS INTO NEEDS	100
4.2.3 BUILDING THE CONNECTIVITY MAP	101
4.2.4 COMPREHENDING THE INFLUENCE OF THE DISTRIBUTION OF WEIGHTS	106
4.3 MAIN POINTS IN REVIEW	108
4.4 REFERENCES	110
5. FURTHER APPLICATIONS ON COLLECTIVE RESPONSE	111
<hr/>	
5.1 EXPERIMENTING WITH THE PUBLIC SPACE	112
5.1.1 CITIZEN PARTICIPATION	112
5.1.2 COLLECTIVE MAPPING	115
5.1.3 FINDING THE LIMIT BETWEEN PUBLIC AND PRIVATE SPACE	117
5.1.4 ONE DAY AT THE SQUARE: EPHEMERAL INTERVENTIONS AT THE PUBLIC SPACE	118
5.2 DISCOURSE ANALYSIS	123
5.2.1 DATA COLLECTION	123
5.2.2 NEIGHBOUR'S VS EXPERT'S DISCOURSE	123
5.2.3 NETWORK STATISTICS	128
5.2.4 IS CLOSING THE GAP POSSIBLE?	129
5.3 REACTION ON EMERGING URBAN PHENOMENA	133
5.3.1 2015'S MIGRATION FLOWS IN GREECE	133

5.3.2 STUDY CASE: MYTILENE, LESVOS	135
5.3.3 RESPONDERS' PROFILING	136
5.3.4 CAUSES OF MIGRATION	137
5.4 MAIN POINTS IN REVIEW	147
5.5 REFERENCES	150
6. IS THERE AN EQUATION FOR HAPPINESS? DISCUSSION AND PERSPECTIVES	154
<hr/>	
6.1 GENERAL POINTS FOR DISCUSSION	155
6.1.1 ON HAPPINESS	155
6.1.2 ON SUSTAINABILITY	158
6.1.3 ON CITIES	159
6.2 ONGOING AND FUTURE RESEARCH	161
6.3 ON OUR FUTURE	162
6.4 ONE LAST THOUGHT	164
6.5 REFERENCES	165
APPENDIX	167
<hr/>	
A. URBAN STUDIES JOURNALS	168
B. SURVEYS	169
B.1 QUESTIONS AND SATISFIERS	169
B.2 QUESTIONS, PRIORITIES AND AXES OF INTERVENTION	171
C. ARTICLES AND OTHER INDEXES OF QUALITY	175
C.1 ARTICLES	175
C.2 BOOK CHAPTERS	175
C.3 CONFERENCE PRESENTATIONS	175
C.4 OTHER INDEXES OF QUALITY	176

TABLE OF FIGURES

FIGURE 1: MIND MAP OF THE PUBLICATIONS RELATED TO THE THESIS AND THE CONNECTIONS BETWEEN THEM. IN GREEN THE PUBLISHED ONES AND IN YELLOW THE ONES IN PREPARATION.	17
FIGURE 2: KEYWORDS RELATED TO PUBLISHED WORK (ARTICLES AND CONFERENCE PAPERS).	17
FIGURE 3: THE EVOLUTION OF THE USE OF THE WORDS HAPPINESS, UTILITY, QUALITY OF LIFE AND WELL-BEING IN DIGITALISED BOOKS AND ARTICLES FROM 1650 TO 2008. SOURCE: (MICHEL ET AL. 2010).	26
FIGURE 4: COMPLEX SYSTEMS ORGANISATIONAL MAP.	29
FIGURE 5: DEGREE DISTRIBUTION FOR TWO DIFFERENT NETWORKS. FOR THE NETWORK IN (A) WE HAVE $N = 4$ AND $p_1 = \frac{1}{4}$, $p_2 = \frac{1}{2}$ AND $p_3 = \frac{1}{4}$. FOR THE NETWORK IN (B), AS EACH NODE HAS THE SAME DEGREE $k = 2$, WE HAVE $p_2 = 1$	31
FIGURE 6: THE LOCAL CLUSTERING COEFFICIENT, C_i , OF THE CENTRAL NODE WITH DEGREE $k_i = 4$ FOR THREE DIFFERENT CONFIGURATIONS OF ITS NEIGHBOURHOOD. THE CLUSTERING COEFFICIENT MEASURES THE LOCAL DENSITY OF LINKS IN A NODE'S VICINITY. THE BOTTOM FIGURE SHOWS A SMALL NETWORK, WITH THE LOCAL CLUSTERING COEFFICIENT OF A NODE SHOWN NEXT TO EACH NODE. NEXT TO THE FIGURE WE ALSO LIST THE NETWORK'S AVERAGE CLUSTERING COEFFICIENT $\langle C \rangle$, ACCORDING TO EQ. (13), AND ITS GLOBAL CLUSTERING COEFFICIENT C , ACCORDING TO EQ. (14). NOTE THAT FOR NODES WITH DEGREES $k_i = 0, 1$, THE CLUSTERING COEFFICIENT IS TAKEN TO BE ZERO.	32
FIGURE 7: (A) A PATH BETWEEN NODES i_0 AND i_N IS AN ORDERED LIST OF N LINKS $P_D = \{(i_0, i_1), (i_1, i_2), (i_2, i_3), \dots, (i_{N-1}, i_N)\}$. THE LENGTH OF THIS PATH IS D . THE PATH SHOWN IN (A) FOLLOWS THE ROUTE $1 \rightarrow 2 \rightarrow 5 \rightarrow 4 \rightarrow 2 \rightarrow 5 \rightarrow 7$, HENCE ITS LENGTH IS $N = 6$. (B) THE SHORTEST PATHS BETWEEN NODES 1 AND 7, REPRESENTING THE DISTANCE D_{17} , IS THE PATH WITH THE FEWEST NUMBER OF LINKS THAT CONNECT NODES 1 AND 7. THERE CAN BE MULTIPLE PATHS OF THE SAME LENGTH, AS ILLUSTRATED BY THE TWO PATHS SHOWN IN DIFFERENT COLOURS. THE NETWORK DIAMETER IS THE LARGEST DISTANCE IN THE NETWORK, BEING $D_{MAX} = 3$ HERE.	32
FIGURE 8 KEYWORDS ARE CONNECTED IF THEY APPEAR IN THE SAME PAPER. THE WEIGHT OF THE CONNECTION DEPENDS ON THE PROBABILITY OF CO-OCCURRENCE.	35
FIGURE 9: ASSESSING THE HAPPINESS CONCEPT.	47
FIGURE 10: CUMULATIVE NUMBER OF ARTICLES (PER JOURNAL AND IN TOTAL) AND UNIQUE AUTHOR KEYWORDS, PER YEAR.	48
FIGURE 11: THE FOUR GRAPHS REPRESENT THE CONNECTIONS BETWEEN THE MOST FREQUENT KEYWORDS OF I) THE J HAPPINESS STUD ARTICLES, II) THE J POSIT PSYCHOL ARTICLES, III) THE APPL RES QUAL LIFE ARTICLES AND IV) THE TOTAL OF ARTICLES. THE SIZE OF THE NODES REPRESENTS THE FREQUENCY OF OCCURRENCE WHILE THE THICKNESS OF THEIR LINKS THE TIMES THEY APPEAR TOGETHER (WEIGHT).	49
FIGURE 12: EMERGENCE OF HN IN TERMS OF AVERAGE DEGREE k , PERCENTAGE OF NODES IN GIANT CONNECTED COMPONENT S , DIAMETER D , AVERAGE PATH LENGTH d AND AVERAGE CLUSTERING COEFFICIENT C	50
FIGURE 13: CUMULATED DEGREE PROBABILITY DISTRIBUTION P_k FOR HN (BLUE DOTS) IN LOG-LOG PLOT.	51
FIGURE 14: TOPOLOGICAL DEGREE VS. WEIGHTED DEGREE AND CUMULATED PROBABILITY DISTRIBUTION OF WEIGHTS (INSET) FOR THE HN.	51
FIGURE 15: OVERALL ASPECT OF THE UH NETWORK. THE SIZE OF A NODE IS PROPORTIONAL TO ITS DEGREE AND THE COLOURS REPRESENT THE DIFFERENT CLUSTERS.	53
FIGURE 16: EMERGENCE OF UHN IN TERMS OF MEAN DEGREE, % OF NODES IN GIANT CONNECTED COMPONENT, DIAMETER, AVERAGE PATH LENGTH AND CLUSTERING COEFFICIENT.	54
FIGURE 17: CUMULATED DEGREE PROBABILITY DISTRIBUTION P_k FOR UHN (RED SQUARES) IN LOG-LOG PLOT.	54
FIGURE 18: PERCENTAGE OF ARTICLES RELATED WITH THE HAPPINESS FIELD AND WITHIN THE URBAN STUDIES CATEGORY PER YEAR AND CONTINENT.	56
FIGURE 19: PERCENTAGE OF NODES (CUMULATIVE) IN THE GIANT COMPONENTS AS A FUNCTION OF k IN LINEAR-LOG PLOT. GREEN CONTINUOUS ARROWS SHOW THE YEAR OF APPEARANCE OF THE MOST CONNECTED KEYWORDS OF HN IN UHN AND RED DASHED ARROWS THE YEAR OF CONNECTION OF THESE KEYWORDS TO THE UHN'S GIANT COMPONENT. KEYWORDS APPEAR DIRECTLY CONNECTED TO THE GIANT COMPONENT AS THE GRAPH INCREASES ITS SIZE (I.E., NUMBER OF KEYWORDS) OVER TIME.	57
FIGURE 20: THE FIRST THREE MOST IMPORTANT CLUSTERS IN TERMS OF SIZE, AND THEIR KEYWORDS PLOTTED ACCORDING TO CLOSENESS AND BETWEENNESS CENTRALITY MEASURES. BUBBLE SIZES REPRESENT THE DEGREE OF EACH KEYWORD. (I) THE THREE CLUSTERS TOGETHER. (II, III AND IV) CLUSTER 1, 2 AND 3 RESPECTIVELY.	59
FIGURE 21: EVOLUTION OF THE UHN EGO-NETWORKS OF THE MOST CONNECTED KEYWORDS OF HN. NETWORK SNAPSHOTS CREATED IN NODEXL USING HAREL-KOREN FAST MULTISCALE LAYOUT (HAREL AND KOREN 2000).	60
FIGURE 22: TEMPORAL EVOLUTION OF FOUR GLOBAL NETWORK INDICES (I.E., AVERAGE DEGREE, DIAMETER, AVERAGE CLUSTERING COEFFICIENT AND AVERAGE PATH LENGTH) OF THE EGO-NETWORKS RELATED WITH KEYWORDS QoL, WB, LS, SWB AND H.	61

FIGURE 23: EVOLUTION AND CORRELATION OVER TIME BETWEEN AVERAGE CLUSTERING COEFFICIENT AND AVERAGE DEGREE, FOR KEYWORDS QoL, WB, LS, SWB AND H. THE TWO MOST CONNECTED ELEMENTS (HUBS) WHICH DOMINATE THE GRAPH'S CONNECTIVITY FOR 2016 ARE QoL AND WB.	61
FIGURE 24: PAPERS AS NETWORKS OF KEYWORDS. THE MODEL CREATES NETWORKS (I.E., PAPERS) WITH NODES AS KEYWORDS, AND USES (A) PAPER-RADIUS AS A PARAMETER TO MAP A "CONCEPTUAL" DISTANCE INTO A EUCLIDEAN ONE, AND (B) KW-RADIUS (INVERSELY PROPORTIONAL TO PAPER-RADIUS) AS A PARAMETER TO LOCATE THE KEYWORDS OF A PAPER AT A CERTAIN DISTANCE.	62
FIGURE 25: RESULTS FOR TWO VALUES OF THE MODEL PARAMETER: (I) PAPER-RADIUS = 2 AND (II) PAPER-RADIUS = 10.	63
FIGURE 26: EVOLUTION OF THE H EGO-NETWORK IN TERMS OF AVERAGE DEGREE <K>, DIAMETER D, AVERAGE PATH LENGTH <D> AND CLUSTERING COEFFICIENT C.	64
FIGURE 27. QoL METHODOLOGY STEPS.	71
FIGURE 28. HYPOTHETICAL EXAMPLE OF CORRESPONDENCE OF FOUR QUESTIONS (Q1, Q2, Q3 AND Q4) INTO THREE NEEDS (N1, N2 AND N3) ACCORDING TO THE PERCEPTIONS OF THREE INDIVIDUALS (P1, P2 AND P3) BELONGING TO THE STUDY GROUP.	72
FIGURE 29: AVERAGES OF SATISFACTION WITH DIFFERENT ASPECTS (A) OF LIFE AND (B) OF QUALITY OF URBAN LIFE, IN Gn AND Vs RATED FROM 1 (NOT SATISFIED) TO 5 (COMPLETELY SATISFIED).	77
FIGURE 30: AVERAGE FREQUENCY OF POSITIVE (A) AND NEGATIVE (B) FEELINGS FOR Gn AND Vs RATED FROM 1 (RARELY) TO 5 (VERY OFTEN). FOR THE MAJORITY OF POSITIVE FEELINGS, A FREQUENCY CLOSE TO 4 (OFTEN) IS MOST COMMONLY OBSERVED. FREQUENCIES FOR NEGATIVE FEELINGS APPEAR TO BE MORE DISPERSE. MOST RESPONDERS SEEM TO EXPERIENCE WORRY AND STRESS OFTEN WHILE OTHER FEELINGS SUCH AS ANGER APPEAR THE LAST IN THE LIST, AS RARELY EXPERIENCED.	78
FIGURE 31: FEELINGS THAT WOULD CHANGE IN A DIFFERENT URBAN ENVIRONMENT FOR Gn (A) AND FOR Vs (B). FEELINGS WERE CONNECTED WHEN THEY APPEARED TOGETHER IN A RESPONSE. THE NODE SIZE REPRESENTS THE FREQUENCY OF APPEARANCE OF EVERY WORD WHILE THE THICKNESS OF THE STRINGS (EDGES) REPRESENTS THE WEIGHT BETWEEN EACH CONNECTION OR THE CO-APPEARANCE FREQUENCY. "STRESS", "CALMNESS", "FEAR" AND "LONELINESS" DOMINATE BOTH GRAPHS, WHILE IN (A) "SOLIDARITY", "TOLERANCE" AND "RESPECT" ALSO PLAY AN IMPORTANT ROLE. VISUALISATION CREATED IN GEPHI.	79
FIGURE 32: SWB ASSESSMENT SATISFACTION RESULTS PER NEED FOR Gn AND Vs.	81
FIGURE 33: CONNECTIVITY MAP AMONG HIGHEST-RANKED QUESTIONS (WHOSE THRESHOLDS WERE NOT SATISFIED) AND NEEDS, FOR Gn (A) AND Vs (B). VISUALISATION CREATED WITH NODEXL.	83
FIGURE 34: PERCENTAGE OF HIGHEST-RANKED UNSATISFIED QUESTIONS PER PRIORITY FOR Gn AND Vs.	84
FIGURE 35: INITIAL AND POTENTIAL NEED FULFILMENT AND SWB FOR Gn AND Vs.	86
FIGURE 36: GRAPHIC REPRESENTATION OF THE QoL ASSESSMENT IN Gn CASE COMPARING SUBJECTIVE (S), OBJECTIVE (O) AND INTEGRATIVE (QoL) RESULTS PER NEED (I) FOR THE REAL CASE AND (II) FOR THE HYPOTHETICAL CASE THAT EXCLUDES QUESTIONS WITHOUT OBJECTIVE INDICATORS.	90
FIGURE 37: GENERAL METHODOLOGICAL PROCESS.	96
FIGURE 38: DETAILED METHODOLOGICAL STEPS FOR THE SELECTED STUDY CASE.	100
FIGURE 39: CONNECTIVITY OF QUESTIONS (NODES IN GREEN) AND NEEDS (NODES IN BLUE). NODE SIZE IS PROPORTIONAL TO THE NUMBER OF CONNECTIONS (I.E., DEGREE) THAT A NEED OR QUESTION HAS. EDGE WIDTH IS PROPORTIONAL TO THE IMPORTANCE OF THAT QUESTION IN DEFINING THAT NEED (I.E., THE AVERAGE OF EXPERTS WHO ACKNOWLEDGE ITS IMPORTANCE). GRAPH FIGURE CREATED WITH NODEXL (HTTP://NODEXL.CODEPLEX.COM).	101
FIGURE 40: APPEARANCE OF NEEDS (DIFFERENT COLOURS) USING STRENGTH AS A FILTER FOR THE Gn NETWORK. GRAPH SNAPSHOTS WHEN 15% (A) AND 70% OF THE NODES WITH THE HIGHEST STRENGTH ARE SHOWN, RESPECTIVELY. GRAPH FIGURES CREATED WITH NODEXL (HTTP://NODEXL.CODEPLEX.COM).	103
FIGURE 41: STRENGTH (I.E., WEIGHTED DEGREE) CUMULATED PROBABILITY DISTRIBUTION AND THE EMERGENCE OF THE DATASET NETWORK. (A) DEGREE CUMULATED PROBABILITY DISTRIBUTIONS FOR Vs AND Gn, COMPARED TO A NORMAL DISTRIBUTION WITH THE SAME AVERAGE WEIGHTED DEGREE AND STANDARD ERROR (DASHED LINE). (B) SEGREGATED BY NEEDS. (V STANDS FOR Vs; G STANDS FOR Gn). GREY COLOUR WAS USED TO REDUCE OVERLAPPING. COLOURED STRIPS (I), (II) AND (III) ARE RELATED WITH TRANSITIONAL ZONES (SEE TEXT).	105
FIGURE 42: SYNTHETIC STRENGTH PROBABILITY DISTRIBUTIONS CREATED FROM WEIGHTS RANDOMLY DRAWN FROM EXPONENTIAL (GREY) AND POWER LAW (WHITE) DISTRIBUTIONS. STANDARD ERRORS SHOWN AS WHISKERS AND ONLY FOR THREE DISTRIBUTIONS TO AVOID FIGURE CRAMMING.	107
FIGURE 43: ACTUAL PERCEIVED AND IDEAL CONCEIVED CITIZEN PARTICIPATION LEVELS ACCORDING TO ARNSTEIN'S LADDER.	114

FIGURE 44: NETWORK OF THE DIFFERENT ENTITIES RELATED TO PLAÇA DE LA VIRREINA AND VILA DE GRÀCIA NEIGHBOURHOOD, CREATED ACCORDING TO THE SUGGESTIONS OF STAKEHOLDERS BELONGING TO EACH AND ONE OF THEM. THE SIZE INDICATES (REFLECTS) THE DEGREE OF IN-COMING AND OUT-COMING CONNECTIONS OF EACH ENTITY AND EVERY COLOUR CORRESPONDS TO A DIFFERENT CATEGORY. WE SEE THAT THE MOST CONNECTED ELEMENTS ARE BANC EXPROPIAT, AN OCCUPIED EX-BANK FUNCTIONING AS A SELF-MANAGED CIVIC CENTRE, AND LA FONTANA, A YOUTH CENTRE. MAP CREATED IN GEPHI.	114
FIGURE 45: EXAMPLES OF A MAPS OF PERCEPTIONS.....	115
FIGURE 46: EXAMPLES OF A MAPS OF OBSERVATIONS.	116
FIGURE 47: THE MAP OF STORIES AND PATHS. THE LIGHT BLUE YARN INDICATES VISITORS FROM INSIDE THE NEIGHBOURHOOD AND THE PURPLE ONE VISITORS FROM THE OUTSKIRTS OF THE NEIGHBOURHOOD.	117
FIGURE 48: EXPERIMENTING WITH PRIVATE SPACE AND OPEN ACTIVITIES.	118
FIGURE 49: POPULAR FREE MEAL ORGANISED BY “ÈL PLAT DE GRÀCIA”	122
FIGURE 50: CONVERSATION WITH THE NEIGHBOURS.....	122
FIGURE 51: EXAMPLE OF CONNECTIONS BETWEEN WORD TRIPLETS MENTIONED FIRSTLY BY THREE SEPARATED INDIVIDUALS AND THEN BY N PEOPLE, FORMING COMPLEX WORD-NETWORKS.	124
FIGURE 52: NEIGHBOURS’ DISCOURSE REPRESENTED IN GEPHI. THE NODES REPRESENT THE WORDS USE IN THE DISCOURSE AND THE LINKS THEIR CONNECTION IN SENTENCES. IT SEEMS THAT FREEDOM AND CREATIVITY HAD A CENTRAL PLACE IN THE CONVERSATION AS THEY ARE CONNECTED TO MOST OF THE WORDS USED. THE DIFFERENT COLOURS REPRESENT THE GROUPS OF THE WORDS THAT WERE USUALLY USED TOGETHER.	125
FIGURE 53: EXPERTS’ DISCOURSE REPRESENTED IN GEPHI. THE NODES REPRESENT THE WORDS USE IN THE DISCOURSE AND THE LINKS THEIR CONNECTION IN SENTENCES. THE SUBJECTS REPRESENTED BY DIFFERENT GROUP COLOURS SEEM TO BE CLEARLY SEPARATED THE ONE FROM THE OTHER. THE WORDS ARE GENERALLY LESS CONNECTED THAN THE ONES CHOSEN FROM THE NEIGHBOURS.....	126
FIGURE 54: VISUALISATION OF BOTH DISCOURSES, MERGED. WITH A RED LINE THERE ARE CONNECTED (LINKED) THE WORDS MENTIONED FROM THE NEIGHBOURS WHILE WITH A LIGHT BLUE ONE THERE ARE REPRESENTED THE CONNECTIONS OF THE WORDS USED BY THE EXPERTS...	127
FIGURE 55: CUMULATED DEGREE DISTRIBUTION FOR THE NEIGHBOURS’ (I) AND THE EXPERTS’ NETWORK (II). NETWORK (I) FOLLOWS A POWER-LAW DISTRIBUTION WHILE NETWORK (II) FOLLOWS AN EXPONENTIAL DISTRIBUTION.	128
FIGURE 56: TREATING THE NETWORK AS A RANDOM GRAPH, IN THIS GRAPH WE OBSERVE THE DECREASING OF THE AVERAGE PATH LENGTH AND THE INCREASING OF THE AVERAGE DEGREE AS THE NUMBER OF EDGES IS BEING INCREASED AND THE NUMBER OF NODES MAINTAINS THE SAME.....	129
FIGURE 57: VISUALISATION OF THE GIANT COMPONENT AS A RESULT OF THE MERGING THE TWO DISCOURSES. WITH A RED LINE THERE ARE CONNECTED (LINKED) THE WORDS MENTIONED FROM THE NEIGHBOURS WHILE THE BLUE INDICATES THE CONNECTIONS OF THE WORDS USED BY THE EXPERTS. THE GREEN COLOUR INDICATES THE ADDITIONAL CONNECTIONS ADDED BY THE RESEARCHERS BETWEEN THE WORDS THAT HAD THE SAME ROOT, SUCH AS “PROCESS” AND “PROCESSES” OR “EXPRESS” AND “EXPRESSION”.....	130
FIGURE 58: MIGRATORY FLOWS IN GREECE DURING 2015. SOURCE: (UNHCR 2016).....	133
FIGURE 59: ARRIVALS TO GREECE AND THE ISLAND OF LESVOS PER MONTH DURING 2015. PROPER ELABORATION, DATA FROM (UNHCR 2016).	134
FIGURE 60: (I) THE CAMP OF THE 55,000 REFUGEES IN MYTILENE DURING THE SECOND TURKISH PERSECUTION (1922-23). SOURCE: (PARASKEVAIDIS 2014). (II) THE PROVISIONAL CAMP OF REFUGEES IN THE PORT OF MYTILENE IN SEPTEMBER 2015. SOURCE: G. PAPADOPOULOU’ ARCHIEVE IN (ARTEMI 2015).	135
FIGURE 61: URBAN EVOLUTION OF MYTILENE AND NEIGHBOURHOODS OF INTEREST. SOURCE: MAP (ARTEMI 2015), PHOTOS: E. KATSENIU’S ARCHIVE.	136
FIGURE 62: NETWORK OF THE WORDS USED TO DESCRIBE THE CAUSES OF MIGRATION FROM THE LOCAL POPULATION.	138
FIGURE 63: USE OF WORDS ON CAUSES OF MIGRATION, SEPARATED BY GENDER. ONLY 39% OF WORDS ARE SHARED BETWEEN BOTH DISCOURSES.	139
FIGURE 64: NETWORKS OF CONNECTIONS BETWEEN THE WORDS USED TO EXPLAIN THE CAUSES OF MIGRATION. NETWORK (I) INDICATES THE WORDS CHOSEN BY WOMEN AND (II) THE WORDS CHOSEN BY MEN. THE COLOURS INDICATE THE DIFFERENT COMMUNITIES OR CLUSTERS OF WORDS DETECTED.	140
FIGURE 65: TYPE OF EMPLOYMENT PER GENDER.	141
FIGURE 66: DEGREE DISTRIBUTION OF WORDS MENTIONED ON BEHALF OF WOMEN, MEN AND ON BEHALF OF EVERYONE.....	141

FIGURE 67: NETWORK OF WORDS USED PER NEIGHBOURHOOD TO DESCRIBE THE CAUSES OF MIGRATION. THE COLOURS REPRESENT THE WORDS USED BY THE DIFFERENT NEIGHBOURHOODS.	143
FIGURE 68: TYPE OF EMPLOYMENT PER NEIGHBOURHOOD.....	144
FIGURE 69: WORD NETWORK REPRESENTING THE WORDS USED PER TYPE OF EMPLOYMENT TO DESCRIBE THE CAUSES OF MIGRATION. COLOURS INDICATE WORDS PER EMPLOYMENT CATEGORY.....	145
FIGURE 70: WORD NETWORK REPRESENTING THE WORDS USED PER AGE ASOCIATED WITH THE CAUSES OF MIGRATION. COLOURS INDICATE WORDS PER AGE CATEGORY.....	146
FIGURE 71: THE ISLAND OF UTOPIA, ILLUSTRATION FOR THE 1516 FIRST EDITION OF THOMAS' MORE UTOPIA.....	157
FIGURE 72: ACCELERATING CYCLES OF INNOVATION OR PARADIGM SHIFTS IN SOCIOECONOMIC SYSTEMS.....	160

TABLE OF TABLES

TABLE 1: EXAMPLE OF A MATRIX REPRESENTING SATISFIERS FOR SPIRITUALITY / TRANSCENDENCE ORGANISED IN FORMS OF BEING, HAVING, DOING AND INTERACTING.....	25
TABLE 2: MOST CONNECTED KEYWORDS IN J HAPPINESS STUD, J POSIT PSYCHOL, APPL RES QUAL LIFE AND HN, IN YEAR 2016 (CUMULATED DATA FROM 2000). DEGREE SHOWN IN PARENTHESIS.	50
TABLE 3: MOST CONNECTED ELEMENTS IN UHN, IN YEAR 2016 (CUMULATED DATA FROM 1984). DEGREE SHOWN IN PARENTHESIS.	54
TABLE 4: SUBJECTIVE, OBJECTIVE AND INTEGRATIVE DIMENSIONS MATRIX.	74
TABLE 5: MAIN STATISTICS OF THE SAMPLES.	76
TABLE 6: EXAMPLE FOR THE CALCULATION OF THE SATISFACTION PER NEED.	79
TABLE 7: CLASSIFICATION AND WEIGHTING EXAMPLE. GN QUESTIONS REFER TO THE NEIGHBOURHOOD OF VILA DE GRÀCIA AND VS QUESTIONS TO VIRREINA SQUARE.	80
TABLE 8: A SUMMARY OF THE INTERVENTION AXES FOR GN AND VS WITH THEIR PRIORITY AND SOME PROPOSED ACTIONS FOR MITIGATION. WE OBSERVE THAT MOST OF THE AXES ARE SIMILAR FOR BOTH SCALES. FOR DETAILED DATA SEE APPENDIX B2.	84
TABLE 9: INITIAL AND POTENTIAL SWB AND NEED FULFILMENT FOR GN AND VS AFTER APPLYING ACTIONS RELATED TO THE INTERVENTION AXES OF TABLE 8.	85
TABLE 10: EXAMPLE OF COMPARISON BETWEEN SUBJECTIVE AND OBJECTIVE INDICATORS OF QOL. RESULTS EXTRACTED FROM A STUDY FOR THE GN CASE.....	87
TABLE 11: QOL ASSESSMENT FOR GN CASE.	89
TABLE 12: EXAMPLES OF QUALITATIVE AND QUANTITATIVE DATA THAT MAY BE USED AS STUDY CATEGORIES AND VARIABLES CORRESPONDINGLY.	97
TABLE 13: VARIABLES ARE CLASSIFIED INTO CATEGORIES BY FOLLOWING AND AVERAGING A SIMPLE BINARY DECISION FROM THE FOCUS GROUP. HERE, CATEGORY A IS ASSUMED TO BE DEFINED BY VARIABLES 1,2,...,M AND BY INDIVIDUALS A,B,...,N. THE IMPORTANCE OF VARIABLE M IN DEFINING CATEGORY A IS THE AVERAGE OF INDIVIDUALS WHO ACKNOWLEDGE ITS IMPORTANCE IN THIS PARTICULAR CATEGORY.	98
TABLE 14: RESULTS FOR THE COEFFICIENT OF VARIATION OF THE MEAN VALUES OF THE MODEL AND PARAMETER A RUNNING FROM A=0.0 (EXPONENTIAL WEIGHT DISTRIBUTION) TO A=1.0 (POWER LAW WEIGHT DISTRIBUTION), COMPARED TO OUR REAL STUDY CASES PLAÇA DE LA VIRREINA SQUARE (VS) AND VILA DE GRÀCIA NEIGHBOURHOOD (GN).	107
TABLE 15: LIST OF OBSERVATIONS AND THEIR RELATED INTERVENTIONS IN VIRREINA SQUARE.	118
TABLE 16: MOST CONNECTED ELEMENTS OF THE THREE NETWORKS REPRESENTING I) THE DISCOURSE OF THE NEIGHBOURS, II) THE DISCOURSE OF THE EXPERTS, III) THE MERGED ONE AND THE COMMON WORDS IN THE DISCOURSES. IN PARENTHESIS IT IS INDICATED THE NUMBER OF CONNECTIONS OF EACH OF THE WORD TO THE OTHER WORDS OF THE NETWORK.	127
TABLE 17: CORRESPONDENCE OF WORDS WITH THE SAME ROOTS FOR THE MOST CONNECTED ELEMENTS (IN BOLD) OF THE TWO NETWORKS. THE SAME PROCESS WAS FOLLOWED FOR THE REST OF THE ELEMENTS OF THE TWO MAPS.	129
TABLE 18: COMPARATIVE TABLE OF THE STATISTICS OF THE FOUR NETWORKS, I) THE NEIGHBOURS' NETWORK, II) THE EXPERTS' NETWORK, III) THE MERGED NETWORK AND IV) AFTER THE ALTERATIONS OF THE RESEARCHERS.	131
TABLE 19: MAIN STATISTICS OF THE SAMPLE.	137
TABLE 20: MOST FREQUENT, CONNECTED AND CENTRAL WORDS ASSOCIATED WITH THE CAUSES OF MIGRATION.	138
TABLE 21: CLUSTERS OF WORDS THAT REFLECT THE CAUSES OF MIGRATION. IN BOLD THE MOST FREQUENT ONES.	138
TABLE 22: MOST FREQUENT, CONNECTED AND CENTRAL WORDS IN THE DISCOURSE OF WOMEN AND MEN.....	140
TABLE 23: PERCENTAGE OF WORDS SHARED PER NEIGHBOURHOOD.	142
TABLE 24: MOST FREQUENT, CONNECTED AND CENTRAL WORDS PER NEIGHBOURHOOD.....	143
TABLE 25: MOST FREQUENT, CONNECTED AND CENTRAL ELEMENTS PER TYPE OF EMPLOYMENT.	144
TABLE 26: MOST FREQUENT, CONNECTED AND CENTRAL ELEMENTS PER AGE.....	145

ABSTRACT

Where we live affects all aspects of our life and thus our happiness. In recent years, and now for more than half of the Earth's population, our place of residence or activity has been increasingly transformed into an urban one. We start our quest for happiness using bibliometric research to investigate its framework as scientists constructed it during the past years. We detect that while the impact of happiness studies has grown in importance during the last twenty years, happiness-related concepts find it difficult to penetrate the urban studies field of studies. We map the temporal evolution of both happiness and urban studies fields into dynamic networks obtained by paper keywords co-occurrence analysis. We identify the main concepts of "urban happiness" field and their capacity to agglomerate into coherent thematic clusters. We present a one-parameter spatial network model to reproduce the changes in the topology of these networks. Results explain the evolution and the level of interpenetration of these two fields as a function of "conceptual" distances, mapped into Euclidean ones. Complex networks science appears as a valid alternative to other approaches (i.e., co-frequency matrix of bibliometric analysis), and opens the way for the systematic study of other academic fields in terms of complex evolving networks.

We then present a methodology based on Max-Neef, et al. (1991) "human scale development" paradigm to measure current levels of Quality of Life (QoL) for urban environments. We use the fundamental human needs as our study domains. Drawing on the cases of Vila de Gràcia neighbourhood and Virreina square of Barcelona, we assess their fulfilment with a set of questions reflecting the subjective dimension of QoL. We use two consecutive processes to sort questions into needs: a qualitative involving local communities and/or expert groups, and a quantitative involving the definition of weights for each question and per need. We add objective indicators to reflect the objective dimension of QoL. We compare the two dimensions and define an integrative QoL. We identify intervention axes for a potential improvement in the results. We argue that this method can be used to define more holistic urban quality indexes to improve decision making processes, policies and plans. It is a tool to enhance bottom-up approaches and processes of urban analysis to create more liveable places for the dwellers.

Next, we present a methodology based on weighted networks and dependence coefficients aimed at revealing connectivity patterns between categories. Using the same case studies and human needs as our categories we show that diverse spatial levels present different and nontrivial patterns of need emergence. A numerical model indicates that these patterns depend on the probability distribution of weights. We suggest that this way of analysing the connectivity of categories (human needs in our case study) in social and ecological systems can be used to define new strategies to cope with complex processes, such as those related to transition management and governance, urban-making, and integrated planning.

We conclude our journey with applications that show the strength of collective response regarding social matters. We study dwellers perceptions through the following cases: experimental activities in the public space, discourse analysis and reaction on emerging urban phenomena such as the massive migration of population in the Mediterranean during 2015.

RESUMEN

Donde vivimos afecta todos los aspectos de nuestra vida y, por lo tanto, nuestra felicidad. En los últimos años, y para más de la mitad de la población de la Tierra, nuestro lugar de residencia o actividad se transforma a uno urbano. Comenzamos nuestra búsqueda de la felicidad aplicando investigación bibliométrica para investigar el marco su tal como lo construyeron los científicos durante los últimos años. Detectamos que si bien el impacto de los estudios de la felicidad ha crecido en importancia durante los últimos veinte años, los conceptos relacionados con la felicidad tienen dificultades en penetrar el campo de los estudios urbanos. Mapeamos la evolución temporal de los campos de felicidad y estudios urbanos en redes dinámicas obtenidas mediante análisis de coocurrencia de palabras clave en artículos científicos. Identificamos los conceptos principales del campo de "felicidad urbana" y su capacidad para aglomerarse en grupos temáticos coherentes. Presentamos un modelo de red espacial de un parámetro para reproducir los cambios en la topología de estas redes. Los resultados explican la evolución y el nivel de interpenetración de estos dos campos en función de las distancias "conceptuales", mapeadas en euclidianas. La ciencia de redes complejas aparece como una alternativa válida a otros enfoques (p.e., matriz de frecuencia conjunta de análisis bibliométrico) y abre el camino para el estudio sistemático de otros campos académicos en términos de redes complejas en evolución.

A continuación, presentamos una metodología basada en el paradigma de Max-Neef, et al. (1991) de "desarrollo a escala humana" para medir los niveles actuales de calidad de vida en entornos urbanos. Utilizamos las necesidades humanas fundamentales como nuestros campos de estudio. Basados en los casos del barrio de Vila de Gràcia y la plaza Virreina de Barcelona, evaluamos el cumplimiento de un conjunto de preguntas que reflejan la dimensión subjetiva de la calidad de vida. Utilizamos dos procesos consecutivos para clasificar las preguntas en necesidades: una cualitativa que involucra a las comunidades locales y / o grupos de expertos, y una cuantitativa que involucra la definición de pesos para cada pregunta y por necesidad. Agregamos indicadores objetivos para reflejar la dimensión objetiva de la calidad de vida. Comparamos las dos dimensiones y definimos una calidad de vida integrativa. Identificamos ejes de intervención para conseguir una posible mejora en los resultados. Argumentamos que este método puede usarse para definir índices de calidad urbana más holísticos para mejorar los procesos, políticas y planes de toma de decisiones. Es una herramienta para dinamizar los enfoques desde la base (bottom-up) y los procesos de análisis urbano para crear lugares más vivibles para los habitantes.

Seguimos con una metodología basada en redes ponderadas y coeficientes de dependencia destinados a revelar patrones de conectividad entre categorías. Usando los mismos casos de estudio y las necesidades humanas como nuestras categorías, mostramos que diversos niveles espaciales presentan patrones de emergencia diferentes y no triviales. Un modelo numérico indica que estos patrones dependen de la distribución de probabilidad de los pesos. Sugerimos que esta forma de analizar la conectividad de las categorías (necesidades humanas en nuestro caso de estudio) en los sistemas socio-ecológicos se puede utilizar para definir nuevas estrategias para hacer frente a procesos complejos, como los relacionados con la gestión de la transición y la gobernanza, la construcción urbana y planificación integrada.

Concluimos nuestro viaje con aplicaciones que muestran la fuerza de la respuesta colectiva en asuntos social. Estudiamos percepciones de habitantes a través de los siguientes casos: actividades experimentales en el espacio público, análisis del discurso y reacción ante fenómenos urbanos emergentes, como la migración masiva en el Mediterráneo durante el 2015.

ACRONYMS

Gn: Vila de Gràcia neighbourhood (Barcelona)

H: Happiness

HD: Human Development

HSD: Human Scale Development

LS: Life satisfaction

QoL: Quality of Life

SES: Socio-ecological systems

SDGs: Sustainable Development Goals

SWB: Subjective well-being

Vs: Virreina square (Barcelona)

WB: Well-being

AKNOWLEDGEMENTS

It was a sunny morning of September 2010 when I unexpectedly received an email from the UPC saying that the master's classes would start in five days. I arrived in Barcelona a couple of days later where my 'Italian' family, Marc and Clara, adopted me for more than a month. I remember getting lost and being late for my first class in Terrassa. I remember meeting great people that changed my view of the world, Adriana, Paola, Alfonso, Oriol, Natalia, Ioar. And of course, I remember my first class with Martí. Sistèmica i complexitat. A whole new world opened before my eyes. Complexity, chaos, networks, system dynamics, agent-based modelling. I felt like a small child with infinite possibilities to choose from in her plate. Who would know what use I would give to those networks of our first assignment on mapping our friends!

It was January 2012 when I shyly came to him with a curious request, to supervise my master's thesis on happiness. A few months later I embarked on my PhD journey. It's been a long way since then. I learned a lot, I experimented, I grew. And I couldn't have done that without your support, patience, knowledge. Thank you Martí, for everything. Those 'stranger' Thursdays we spent together, eventually became the high light of my weeks.

Finishing this thesis was quite a process for me. I had to surpass myself in many levels. No wonder that I feel that a big chapter in my life is also closing. I am now ready and confident enough to embark on new adventures. But not before thanking all those people that have been by my side during all these years in Barcelona. A big thanks ...

... to my SUMMLAB family Oriol, Adriana, Lina, Lorena, Fátima, Ginevra, Lizeth for the hours we spent working together and the infinite support we gave to each other.

... to Christy for her valuable inputs and comments from a qualitative and sociological research point of view and for the opportunity to collaborate with her and Elena on the Mediterranean refugees' part.

... to Miguel for trusting in me and making possible the preparation and studying of all experimental activities in Virreina square.

... to my friends Birgit, Diego, Raúl, Grant, Omar, Inés, Antia, Chrysa, Mariana, Felipe for always being there for me and for accepting me the way I am.

... to Stavroula and Achilleas for reminding me my roots and for all those summers we are spending together. They give me the power to survive the winter.

... to my Catalan family, Marc and his parents, for taking great care of me and making me feel at home since the first day.

... to Gresca group for all the memories we created together. It would have been difficult without you.

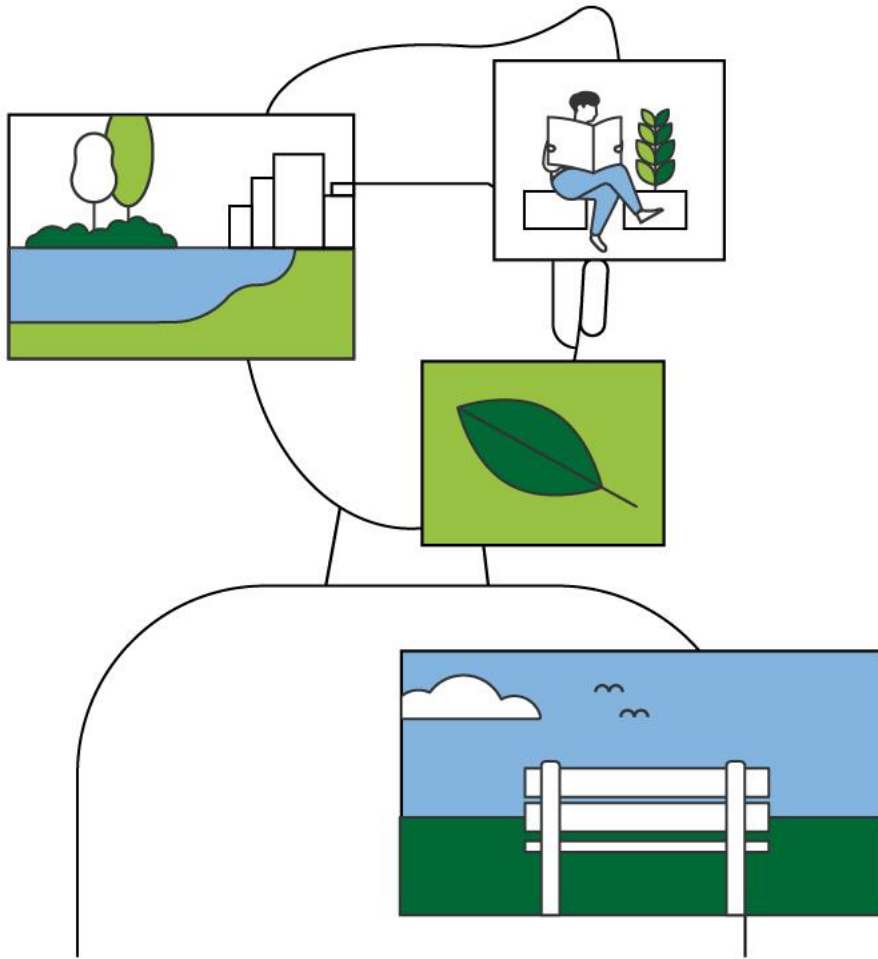
... to my roommates in Sant Antoni for the moments we lived together in the past five years.

... to Birgit again for the beautiful illustrations she prepared for my cover and chapters.

... to Isabel and Claudio for believing in me and supporting me to reach this closure. And to the rest of the Analytics team in Accenture for giving me a new place for the past year and a half where I learn and develop myself every day.

... And finally, to my family. For making me the person I am today and for giving me the best they can, always.

Poble Sec, September 2019



1.

Introduction

1.1 LAYOUT OF THIS THESIS

One of the most difficult tasks of this thesis was to separate my work into chapters and make it easy for the reader to follow from one subject to another. The second one was finding a title that would englobe them all. To help myself in the process of doing so, I started preparing a mind map of all relationships between the work I had already done and the one I was planning on doing. The first version was in my bedroom walls where I used coloured post-its and strings. But, I had to remove it after a while as it started causing me troubles sleeping... So I started preparing a digital version in CmapTools¹, the actualised version of which is that of Figure 1. Although it may seem complex enough, it did helped me a lot in achieving what I wanted to do.

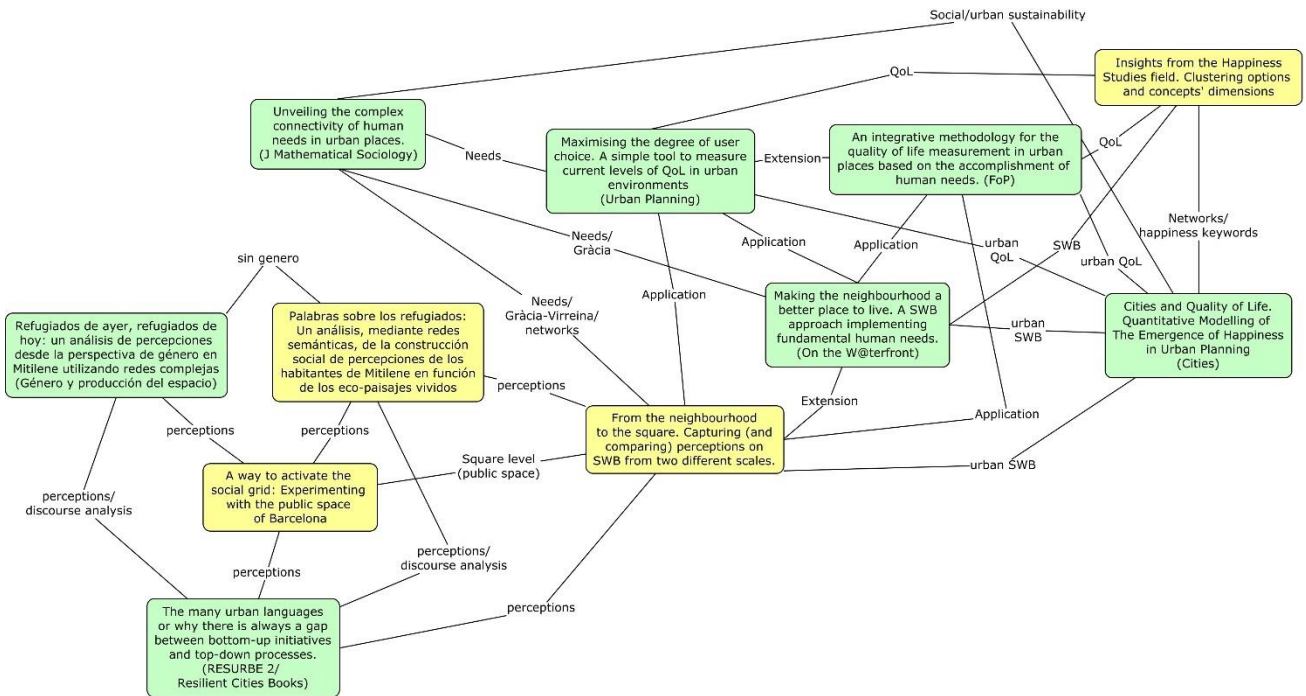


Figure 1: Mind map of the publications related to the Thesis and the connections between them. In green the published ones and in yellow the ones in preparation.

During the same process I also prepared a network of keywords (Figure 2) of my work ².

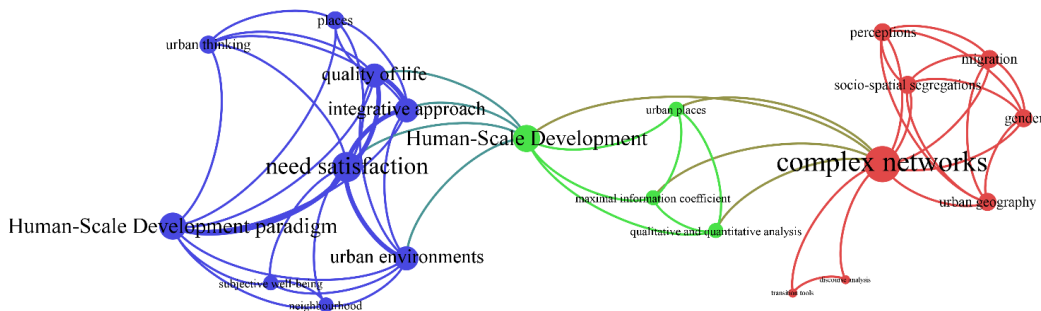


Figure 2: Keywords related to published work (articles and conference papers).

¹ <https://cmap.ihmc.us/cmaptools/>

² For further insights associated with my published work see Appendix C.

The final layout of the thesis as a result of the previous process has as follows. This chapter introduces the reader to the main concepts of this dissertation. Section 1.2 talks about what constitutes an urban environment and current issues related to it. It also introduces the main study cases we used. Section 1.3 refers to the social dimension of sustainability and Human Development. Section 1.4 talks about Happiness, Quality of Life and Well-being. Section 1.5 develops the idea of society as a complex system characterised by complex problems.

The quest to happiness starts with Chapter 2 where we use bibliometric research to investigate the happiness framework as scientists constructed it during the past years. We detect that while the impact of happiness studies has grown in importance during the last twenty years, happiness-related concepts find it difficult to penetrate the urban studies field of studies. We map the temporal evolution of both happiness and urban studies fields into dynamic networks obtained by paper keywords co-occurrence analysis. We identify the main concepts of “urban happiness” field and their capacity to agglomerate into coherent thematic clusters. We present a one-parameter spatial network model to reproduce the changes in the topology of these networks. Results explain the evolution and the level of interpenetration of these two fields as a function of “conceptual” distances, mapped into Euclidean ones. Complex networks science appears as a valid alternative to other approaches (i.e., co-frequency matrix of bibliometric analysis), and opens the way for the systematic study of other academic fields in terms of complex evolving networks.

In Chapter 3 we present a methodology based on Max-Neef, et al. (1991) “human scale development” paradigm to measure current levels of Quality of Life (QoL) for urban environments. We use the fundamental human needs as our study domains. Drawing on our two main study cases, we assess their fulfilment with a set of questions reflecting the subjective dimension of QoL. We use two processes to sort questions into needs: a qualitative involving local communities and/or expert groups, and a quantitative involving the definition of weights for each question and per need. We identify intervention axes for a potential improvement in the subjective results. We add objective indicators to reflect the objective dimension of QoL. We compare the two dimensions and define an integrative QoL. We argue that this method can be used to define more holistic urban quality indexes to improve decision making processes, policies and plans. It is a tool to enhance bottom-up approaches and processes of urban analysis to create more liveable places for the dwellers.

In Chapter 4 we present a methodology based on weighted networks and dependence coefficients aimed at revealing connectivity patterns between categories. Using the same case studies and human needs as our categories we show that diverse spatial levels present different and nontrivial patterns of need emergence. A numerical model indicates that these patterns depend on the probability distribution of weights. We suggest that this way of analysing the connectivity of categories in socio-ecological systems can be used to define new strategies to cope with complex processes, such as those related to transition management and governance, urban-making, and integrated planning.

In Chapter 3 and 4 we analyse the importance of the subjective assessment while advancing in the social dimension of sustainability. In Chapter 5, we use some more applications to show the strength of the collective response regarding social matters. We study dwellers perceptions through the following cases:

- i) A series of experimental activities that focus in the lecture of public space. We selected Virreina Square as our study case. The first phase of the project included activities such as collective mapping and open activities in a private space. We see them as a way to activate the social grid of the city of Barcelona. We used all results and conclusions made during this first phase to

- perform ephemeral interventions in the physical space of the square. We ended the project with an informal conversation with the neighbours.
- ii) We compare the previously mentioned conversation with a similar one corresponding to experts (urbanists, architects and engineers). Our aim is to foment the importance of communication and to check if it is possible to close the gap between local population's needs and local authorities' response. We present the two discourses in the form of networks. We find that the use of "different languages" segregates these two actors, creating communication barriers.
- iii) We focus on emerging urban phenomena such as the massive migration of new population in the Mediterranean during 2015. Our study case forms the city of Mytilene of the Greek island of Lesbos. The research focuses on four city neighbourhoods with socio-spatial differentiations. It has been carried out through surveys and semi-directed interviews in a sample of 200 individuals equally divided into the four neighbourhoods. To process the results, we have generated semantic networks, which represent the connections between the words that appear together in the discourse of the surveyed. Results show that not only gender but also the link with the place of residence, social status at work and age influence the formation of the perceptions of the dwellers.

As we deepen into the thesis' context, questions as the following will inevitably arise:

- How should we define Happiness and Quality of Life?
- In a world of increasing population and deteriorating human habitat, how could we achieve sustainability with a focus on human development?
- What type of city we want?
- Is analytic sociology / social physics able to help in answering these questions? How?
- What does the future hide?

There is no easy nor single answer to these questions. In Chapter 6 I close with some discussion on these subjects.

1.1.1 OBJECTIVES

The objectives of the thesis on hand are the following:

- To achieve a conceptual analysis of happiness and to obtain a global view point on the common areas of reference between the concepts of happiness and urban planning.
- To introduce a holistic method of measuring quality of life for the urban context, based both on the perception of people using the urban space and data of existing objective spatial indicators.
- To work on the human scale development paradigm finding applications on quality of life and hierarchies and / or connectivities between fundamental human needs.
- To further understand how people perceive the urban space through experiments and further sociological research.

1.2 URBAN ENVIRONMENTS AS SOCIAL SPACES

Natural space becomes a social phenomenon, or social space, once people begin to use it, boundaries are put on it, and meanings (including ownership, price, etc.) are attached to it. It becomes a lot or a plot, and if residential users obtain control over the bounded space, it becomes their place (Gans 2002). Space converts then into a complicated set of interlocking physical and social relations, patterns, and processes rather than an even, undifferentiated plain on which investment unfolds (Lefebvre 1974; Massey 1984, 1994; Harvey 1985). It forms an unavoidably social product created from a mix of legal, political, economic, and social practices and structures (Lefebvre 1974) that although has a material reality as environment (Martin et al. 2003), it is also experienced and conceptualised through the organisation of social life (Massey 1992).

Urban environments can form spaces that have traditionally attracted people by offering a wide choice of positive stimuli and opportunities for housing, work and leisure (Bonnes et al. 2013). This attraction has led to the creation of big urban settlements that accumulate today 55% of earth's total population, a number that is expected to grow up to 68% in 2050 (United Nations 2018). The present worldwide trend toward urbanisation is intimately related to economic development and to profound changes in social organisation, land use and patterns of human behaviour (Angel et al. 2005). The demographic scale of these changes is unprecedented (Berry and Okulicz-Kozaryn 2009; D'Acci et al. 2016) and will lead to important but still partially understood impacts on the global environment.

An increased number of negative – and potentially occurring – aspects of urban living can be identified. Examples are road traffic noise, poor air quality, high temperature and crowding, to name just a few. These sources of environmental stress have various physical and psychological consequences, including health-related problems, annoyance, negative emotions and diminished cognitive functioning (Bilotta and Evans 2013; Bonnes et al. 2013). In addition, environmental stressors can negatively impact social behaviour (Page 1977; Moser 1988). For example, noise and crowding may increase avoidance reactions and aggression and decrease prosocial behaviour (Regoeczi 2003). It seems thus clear that the continuous accumulation of the population in cities worldwide, along with uncontrolled urban sprawl, is leading to degraded urban habitats, seriously affecting the emotional and physical state of city dwellers (Veenhoven 2007; Costanza et al. 2007; Moro et al. 2008; Kennedy and Adolphs 2011; Lederbogen et al. 2011).

However, the past few decades have witnessed a tendency to consider the increasing complex spatialities of the globalising world (Paasi 2008). Both the perception of citizens and the conception of planners (Lefebvre 1974) on space have been changing slowly, mainly due to the increasing aforementioned environmental, social and economic problems encountered in urban conurbations. A spatial analysis that recognises the social production of space – as in (Lefebvre 1974) – should recognise its inherent and multiple social meanings and the spatiality of all human activity (Martin et al. 2003). The use of space needs to be carefully planned in line with a comprehensive, holistic vision (Timmermans et al. 2013). Although places are being seen both as progressive (open to the wider world) and regressive (self-enclosing, defensive, inward-looking, and reactionary) (Antonsich 2011), urban environments should be re-evaluated and reconsidered as valuable for health, social integration and well-being of the individuals (Townsend et al. 2010). Researchers should focus on the causal relations between space and society referring to (i) the few but important ways in which natural space affects social life and collectivities and (ii) the innumerable ways in which these collectivities turn natural space into social space and shape its uses (Gans 2002). Both depersonalisation of space and the obvious assumption that all social life exists in space should be avoided. Individuals and collectivities shape natural and

social space by how they use these, although each kind of space, and particularly the social, will also have effects on them.

Two types of social places or spaces are attracting the interest of this thesis: the neighbourhood and the public space.

1.2.1 STUDYING THE NEIGHBOURHOOD

Concerns associated with the neighbourhood have a long history in social policy and sociology (Forrest and Kearns 2001). But, there is no single, generalizable interpretation of the neighbourhood (Kearns and Parkinson 2001). Numerous definitions can be found in the social science literature, varying in their emphases and degree of ambiguity (Galster 1986). The uncontrolled urbanisation of the current period (United Nations 2018) was seen to be producing a social order in which the traditional ties of community—shared space, close kinship links, shared religious and moral values—are being replaced by anonymity, individualism and competition (Forrest and Kearns 2001). Everything is now connected (Orrell 2010) and in a sense, the neighbourhood becomes an extension of the home for social purposes and hence it becomes extremely important in identity terms: ‘location matters’ and the neighbourhood becomes part of our statement about who we are (Forrest and Kearns 2001).

The selection of Vila de Gràcia neighbourhood (Gn) of the Gràcia district of Barcelona (Spain) as the main study case of this dissertation was made to address exactly that. Gn is located at the north of the city. It is chosen for its cohesive urban and social fabric that provides high levels of participation and public engagement. Gn is characterised by an irregular urban grid with narrow streets and 16 public squares, many of which are considered emblematic³. The neighbourhood occupies the third position in terms of population in the city of Barcelona, with 50,448 inhabitants⁴ out of 120,273 living in the Gràcia district, distributed within 1.3 km² and with a population density of 38,806 inhabitants/km². It is characterised for preserving its ‘village’ identity with (still) strong social cohesion. The use of public spaces in this neighbourhood is very intense and subject to high demand, often creating the need for balance between the well-being of the residents and the activities conducted in the public space. This study case is used in Sections 3.2, 3.3 and 4.2.

Further research on emerging urban phenomena that may possibly affect the social and economic structure of neighbourhoods was made in Section 5.3 where we studied the effect of the 2015’s massive migration flows of the Mediterranean at the city of Mytilene, Lesbos island (Greece) from the dweller’s perspective and perceptions.

1.2.2 STUDYING THE PUBLIC SPACE

Few topics are as timely as that of public space (Silver 2014). Public space is partly what makes cities and as such it has been at the core of urban studies and many disciplines ranging from sociology, geography, political science, anthropology to planning, architecture, design and philosophy. Also in this case, the widely pronounced death of public space in the early 1990s (Davis 1992; Sorkin 1992) marked the birth of an extended debate on the topic itself (Bodnar 2015). Park conservancies, gated communities, special security districts, corporate campuses, festival marketplaces, mega-malls, and other new spatial forms composed the

³ <http://lameva.barcelona.cat/gracia/ca/home/el-barri-de-la-vila-de-gracia>

⁴ Ajuntament de Barcelona. (2014). Departament d’Estadística. Retrieved October 15, 2015, from <http://www.bcn.cat/estadistica/angles/index.htm>

emergence of concepts such as the ‘fortress city’ (Christopherson 1994; Low 1997) and new ends to which public space is oriented (Madden 2010). Along with its misinterpretation of some urbanists, architects and urban designers as void between constructions that has to be filled adequately to fulfil the objectives of promoters and authorities (Delgado 2011), this transformation may lead to a new type of publicity (Madden 2010; Langstraat and Van Melik 2013).

Due to its importance as an urban element the second main case study of this dissertation refers to a public space: Virreina square (Vs), also belonging to the Gràcia district of Barcelona, Spain. It forms one of Gn’s most emblematic public spaces. Vs was built in 1878 (when Gràcia was still a village at the outskirts of Barcelona) and continues to be one of the places within the area that gives the neighbourhood its “sense of village”⁵. This impression is created by the parish church of Sant Joan and a set of low-rise houses located to the right of the square, originally inhabited by workers from Vila de Gràcia’s once very important textile industry. This study case is used in Sections 3.2, 4.2, 5.1 and 5.2.

1.3 THE SOCIAL DIMENSION OF SUSTAINABILITY

Sustainability science is considered an emerging field of research.⁶ It occupies a central position in the social, economic and political agenda of many Western democracies. A landmark in the history of sustainability forms the Brundtland report (WCED 1987) as it broadened its definition to encompass the entire range of human values (Ascher 2007). Since then, scholars have incorporated many, usually complementary, frames of reference that include different categories, to facilitate the vision of sustainable futures (Sumi 2007; Kajikawa 2008). However, a genuine transition towards sustainability has not yet begun (Helne and Hirvilammi 2015), given the multiple significances of the word (Brown 2016), many times seen as an empty signifier (Laclau 2005) and a plastic word (Poerksen 1995). Approaches such as sustainable development or green economy seem to have failed to deliver a halt in the worsening of planetary health and the eradication of poverty and inequality (Kothari et al. 2014). Main reasons include the recent phase of accelerated expansion of capitalism (Harvey 2014), the complexities encountered when economy is embedded in a wider social and biophysical system (Dodds 1997), and the difficulties associated with defining and measuring the global condition of an individual or a group (e.g., happiness, subjective well-being or quality of life to name a few of the existing close-related terms in the literature). Such definitions must include social, economic, psychological, spiritual or medical states (Kullenberg and Nelhans 2015). It is thus necessary to enrich the understanding of concepts (like the ones previously mentioned) on the basis of a relational paradigm, internalising human well-being and the health of the ecosystems (Helne and Hirvilammi 2015).

Regarding urban environments, the way in which local policy has been understood and applied until now and the role of urban development projects have left a “complex map of underutilised infrastructure, public facilities without financial support, failed housing projects, unfinished industrial developments and urban vacant lots” (Fernandez 2015). Especially, during the last two decades’ severe housing crisis all major European cities have experienced (see (Altuzarra and Esteban 2011; De Weerd and Garcia 2016; Garcia and Haddock 2016; Vaiou and Kalandides 2016; Kutlukaya and Erol 2016)), the human parameter has been left behind as, under the pressure of fiscal austerity, many social needs such as social assistance, education and community amenities are officially characterised as unmet (Garcia and Haddock 2016).

⁵ <http://graciapedia.gracianet.cat>

⁶ <http://sustainability.pnas.org/>

Responses and solutions coming from the top-down such as the smart city concept – developed originally by a small number of multinational companies (Graham and Marvin 2001; Paroutis et al. 2014; Söderström et al. 2014; Vanolo 2016) and considered by many the new urban utopia (Townsend 2013; Datta 2015) – are not always functional as they appear frequently in isolation to the human dimension, disconnected from citizens' actual needs and with a main focus on the economic and technological growth (March and Ribera-Fumaz 2014; Niederer and Priester 2016; Suárez-Casado 2016; Thomas et al. 2016; Vanolo 2016; Bull and Azennoud 2016). Yet, in questions of resilience in socio-ecological systems such as a city is, the capacity of people to respond collectively to a disturbance is considered of great importance (Pretty 2003; Gómez-Baggethun et al. 2012; Suárez et al. 2016). To cope with this situation, we should give more weight at the many bottom-up initiatives and ideas that appear daily in different urban environments around the globe, examples being Do-It-Yourself urbanism, placemaking and other informal temporary actions (see (Deslandes 2013; Iveson 2013; Finn 2014; Talen 2015)). Practices of solidarity and claims around material spaces are currently becoming an important urban laboratory (Vaïou and Kalandides 2016). At the same time, dwellers are constantly demanding for more participatory and inclusive processes, and increasingly more local authorities are allowing a certain level of local engagement in planning, even though it does not yet meet the highest degree of Arnstein's ladder (Arnstein 1969). A demand for a more active public is thus becoming clearer and considering that participation is "interaction among individuals through the medium of language" (Webler et al. 1995), this is to be achieved through communication (Papachristou and Rosas-Casals 2015a).

1.3.1 HUMAN DEVELOPMENT & THE HUMAN SCALE DEVELOPMENT PARADIGM

Since the Brundtland report (WCED 1987), sustainability has included an evolving definition of the overall human well-being as a function of both the level of human needs met and the extent to which individuals or groups are satisfied with this level (Max-Neef et al. 1991; Costanza et al. 2007). This categorisation process of well-being through human needs and satisfiers has allowed researchers to better analyse and understand the social dimension of sustainability. The "human development" concept has its philosophical roots in Amartya's Sen capability approach (Sen 1999; Nussbaum 2000; Alkire 2002a; Robeyns 2005). The conceptual shift towards this type of development with a human face was embraced by the UNDP report of 1990 entitled *Concept and Measurement of Human Development* (UNDP 1990). It was a breakthrough to the mainstream thinking of development solely as economic growth. Although the capability approach has since become the reference point to all practical approaches regarding human well-being evaluation, in this dissertation we will focus on the HSD approach. Their main differences can be found on the way they define dimensions (Alkire 2002b), their philosophical bases (Schumacher 1973), the terminology and meaning of main concepts (i.e., needs and satisfiers versus functioning and capabilities) and the evaluation schemes (Cruz et al. 2009).

The HSD notion appeared for the first time in an article published by the Dag Hammarskjöld Foundation in 1986 (Max-Neef et al. 1986, 1989). It was then suggested that the best development process would be the one enabling improvement in people's QoL, allowing people and their communities to be self-coherent within themselves (Max-Neef 1986). The axis of this central thought is that HSD concentrates on, and is sustained by, (i) the satisfaction of fundamental human needs and the generation of growing levels of self-reliance, and (ii) the construction of "organic articulations of people with nature and technology, of global processes with local activity, of the personal with the social, of planning with autonomy, and of civil society with the State" (Max-Neef 1992).

The HSD approach differs from other need theories popular in previous decades such as Maslow's (1954), the International Labour Office's (1976) and Streeten's (1981), mostly because of the utilitarian view observed

within them (Cruz et al. 2009). Utilitarianism is known to be looking only at the individual level, favouring whatever maximises individual happiness as the best choice, and misleading the evolution of the satisfaction of needs in time, implying that more is always better. It promotes selfish decisions rather than collective ones (von Borgstede et al. 2013) and when a large number of people makes selfish choices, negative outcomes accumulate, creating a situation in which everybody would have been better off if they had not acted in their own interests (Dawes 1980). HSD takes a different appreciation acknowledging that because of our common human nature, we must satisfy a set of fundamental needs—common to all—to maintain a rich and meaningful life. These needs can indicate at the same time both “deprivations and individual and collective human potential” (Max-Neef et al. 1991). They are seen as “finite, few and classifiable” (p. 18), changing in a slow pace along with the evolution of our kind (Max-Neef et al. 1989; Elizalde 2003).

In this thesis we are building on the HSD paradigm (Max-Neef et al. 1991), taking into consideration the suggestions made by Costanza et al. (2007) on measuring QoL. We suggest the use of the axiological needs, corresponding to subsistence, protection, affection, understanding, participation, leisure, creation, identity and freedom. Protection is changed to security, and creation to creativity as suggested by Costanza et al. Subsistence is considered within reproduction, being the latter understood as a part of the former. Spirituality/transcendence is also included because of its importance, both in QoL studies and in the assessment as a need (Moberg and Brusek 1978; O’Brien 2005; Peterson and Webb 2006; Van Dierendonck 2011). The fulfilment of all needs is considered equally important since any unsatisfied or not adequately satisfied human need reveals a form of human poverty, hindering happiness and therefore developing potential pathologies (Cruz et al. 2009). What changes over time and between cultures are the satisfiers of these needs. 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 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, needs are satisfied (or not satisfied) through the generation (or destruction) of different types of satisfiers.

The satisfiers, whether of individual or collective nature, include all things that, by representing forms of being, having, doing and interacting, contribute to the realisation of human needs (Max-Neef et al. 1989). *Being* refers to personal or collective attributes (usually expressed as nouns related to the subject’s intrinsic attributes as our biological constitution, character and values); *having* registers institutions, norms, mechanisms, tools that can be expressed in one or more words (i.e., exosomatic tools, laws and information); *doing* is related with actions, personal or collective, that can be expressed as verbs. And *interacting* refers to locations and milieus (as times and spaces) and the way people relate to and articulate their environment (Max-Neef 1992).

Needs and satisfiers interrelate within a matrix, according to existential and axiological characteristics, where a larger description of their conceptual structure is explained (see Table 1 for an example of a matrix with satisfiers for the need Spirituality/ Transcendence, organised under the different forms of being, having, doing and interacting). The matrix represents a fundamental tool in the HSD paradigm and can be used for multiple purposes as it helps communities and individuals to gain self-awareness about their preferences for a given set of satisfiers and, moreover, the way these preferences interrelate and affect each other systemically. The processes of identification and classification of satisfiers, considering how each one affects the different dimensions of well-being, helps to highlight the way specific social and cultural settings and development patterns enhance or inhibit personal freedom, autonomy and well-being. It places emphasis on how people

satisfy their needs in terms of themselves and their own coherence, with respect to others and the community and respecting their environment (Max-Neef et al. 1989).

Table 1: Example of a matrix representing satisfiers for Spirituality / Transcendence organised in forms of being, having, doing and interacting.

Spirituality / Transcendence			
Being	Having	Doing	Interacting
Conscious	Nothing	Curiosity and conviction	Environment
Balanced	Fortress	Make love	Contact with nature
Emotionally imbalanced	Contact with the universe	Help	Be calm
Daily	Space	Share	Be still
Detached	Guide	Understand	Peace of mind
Tolerant	Inspiration	Reflection (processes)	Emotional peace
Peaceful	Confidence	Think	Athenaeum
Reflective	Ethics	Introspection	Church
Calm	Consciousness	Meditation	Social place
Explorer	Compassion	Study philosophy	Meditative environment
Curious	Knowledge	Pray	Be silent
Convicted	Feelings	Tantric sex	Depending on belief system
Believer	Values	Dialogic learning	
	Beliefs	Climb	
	Time for contemplative life	Look at	
		Observe	
		Passing (the ideas)	

1.4 HAPPINESS, QUALITY OF LIFE & WELL-BEING

One of the confusing things in the happiness literature is the proliferation of terms used to relate to the concept of happiness. In the past years, an increasing number of researchers have approached the conceptual analysis of the happiness field by means of concepts such as quality of life (see (Veenhoven 2000; Marans 2012)), happiness (see (Veenhoven 1997; Easterlin 2003; Layard 2005; Di Tella and MacCulloch 2006)), (subjective) well-being (see (Diener 1994; Diener et al. 1999; Veenhoven 2007; Layard 2010; Dolan et al. 2011)) and life satisfaction (Cummins 1996; Diener et al. 2013). As reported to the digitalised articles and books (Figure 3) from the Google Group work (Michel et al. 2010), the word 'happiness' seems to be in use by scholars since the beginning of the 16th century, with a peak between 1750 and 1850. The word 'utility' follows a similar trajectory but with a lower frequency. From the early 1960s, a more epistemological approach and vocabulary, such as quality of life or (subjective) well-being, has been used (Diener 1994), although well-being seems to have made its appearance since the early 19th century. Elsewhere in the literature we encounter other terms such as life satisfaction, welfare, hedonism and eudaimonia, sometimes confusing the reader in quest of a concrete definition of each of them.

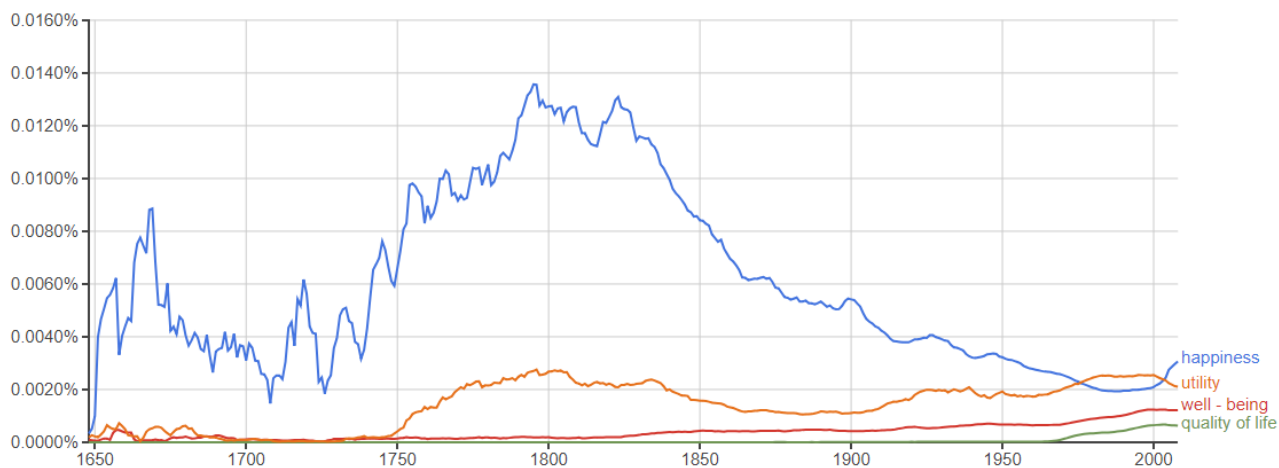


Figure 3: The evolution of the use of the words happiness, utility, quality of life and well-being in digitalised books and articles from 1650 to 2008. Source: (Michel et al. 2010).

1.4.1 QUALITY OF LIFE DIMENSIONS

Quality of Life (QoL) is directly related to obtaining the necessary conditions for happiness throughout a society (McCall 1975). These conditions can be identified with the availability of means for the satisfaction of human needs rather than human desires, and any lack of them may lead to unhappiness. QoL represents how well human needs are met or the extent to which individuals or groups perceive satisfaction or dissatisfaction in various life domains (Costanza et al. 2007). It forms a concept commonly expressing the overall assessment of human experience across multiple disciplines including psychology, medicine, economics, environmental science, and sociology. A search in the Web of Science⁷ database on Oct. 2015 revealed more than 530,000 results under the term “quality of life”, of which almost 39,000 under the research areas “sociology”, “social sciences” and “social sciences other topics” and more than 1,800 under the area “urban studies”.

From these results it is apparent that QoL is a multi-scale, multi-dimensional concept that contains interactive objective and subjective elements. Recent research in QoL focuses on either of these two elements in order to construct quantitative indicators (Veenhoven 2000). Both objective and subjective QoL dimensions independently constitute useful estimates of the QoL construct (Cummins 2000). The first one uses quantifiable social or economic indicators to reflect the extent to which human needs are met (Costanza et al. 2007), while the second looks to self-reported levels of happiness, pleasure, fulfilment, and the like, and has been termed “subjective well-being” (Diener 1984, 1994; Diener et al. 1999; Easterlin 2003; Veenhoven 2007; Layard 2010; Dolan et al. 2011). The so-called objective measures of QoL generally focus on social, economic, and health indicators (Cummins et al. 2003). They confine to the analysis and reporting of secondary data – usually aggregate data at different geographic or spatial scales – that are available mainly from official government data collections, including census, often associated with social indicators research (Andelman et al. 1998). That is to say they focus on measuring “hard” facts, such as income in local money or living accommodation in square meters (Veenhoven 2007) and represent frequencies or quantities that can be simultaneously verified by any number of persons (Cummins et al. 2003). They include for example indices of economic production, literacy rates, life expectancy and other data. And, they can be gathered without any direct survey and used uniquely or in combination to form composite indexes. While these measures may

⁷ <https://www.webofknowledge.com/>

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 QoL such as identity, affection or psychological security (Costanza et al. 2008), to name a few.

Subjective measurement tools typically focus on personal reports of life experience that complement social, economic, and health indicators (Andrews 1974), such as the degree to which a perceived need is being met and the importance of that “perceived need” to one’s overall QoL (Costanza et al. 2007). They take into consideration “soft” matters such as satisfaction with income or perceived adequacy of dwelling. The focus is on people’s behaviours and assessment, or evaluations of aspects of QoL in general (Andelman et al. 1998). They stem from survey research (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, 2008). The easiest and quite obvious technique is to simply ask people how they feel (Veenhoven 2003; Layard 2005, 2010; Weiner 2008) and evaluate their answers by means of either one-item scales, as in the Global Happiness Item (GHI) (Bradburn 1969) and the Delighted-Terrible Scale (DTS) (Andrews and Withey 1976), or multi-item scales, such as the Satisfaction with Life Scale (SWLS) (Diener et al. 1985), the Positive and Negative Affect Schedule (PANAS) (Watson and Clark 1994) and the Scale of Positive and Negative Experience (SPANE) (Diener et al. 2010). A problem encountered in these type of methods is that the majority of people want to present a happy face to the world (Kirita and Endo 1995; Rhodes et al. 2003). Other issues related to the individual response are those of internalisation of cultural norms, mental illness, lack of information, etc. (Moro et al. 2008). Cognitive problems caused by ordering effects, question wording and difference in scales may lead as well to biases in the answers obtained (Bertrand and Mullainathan 2001). Hence, subjective assessments 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. But, the response of a person should not be ignored or interpreted to mean the opposite (Costanza et al. 2007). If she says she is “pretty happy”, it means that this is what she really feels at the moment (Weiner 2008). There is a broad consensus among previous studies that self-reported well-being is a satisfactory empirical proxy for individual utility (Diener et al. 1999; Di Tella and MacCulloch 2006; Moro et al. 2008), showing adequate validity, reliability, factor invariance, and sensitivity to change (Diener 1994).

Although there have been numerous attempts to measure and analyse the factors that affect quality of life in cities and regions (Ballas 2013), and even construct alternative, non-monetary indices of social and economic well-being in urban planning (Khalil 2012), how happiness concepts have penetrated urban planning, at which pace, and how they have been included in the urban studies field has not yet been assessed in the literature (Papachristou and Rosas-Casals 2019a). Concepts such as liveability, living quality, living environment, quality of place, residential perception and satisfaction, have been introduced and transformed into indicators to evaluate the residential and living environment (Kamp et al. 2003). These different but closely connected concepts originate with the various research and policymaking traditions of health and safety. In any case, the combination of both objective and subjective measures towards an integrative QoL assessment enable the capture of a more holistic and effective image of the multiple social, special and temporal scales a place may have. If QoL is to embrace the totality of human life, then both, objective and subjective dimensions should be considered (Cummins 2000) as much as the cross-level interactions between them (Berry and Okulicz-Kozaryn 2009). QoL can then be related to the opportunities that are provided to meet human needs in the forms of built, human, social and natural capital (in addition to time) and the policy options that are available to enhance these opportunities (Mulder et al. 2006; Vemuri and Costanza 2006).

1.5 SOCIETY. A COMPLEX SYSTEM CHARACTERISED BY COMPLEX PROBLEMS

Early sociology was generally constructed following a type of implicit belief on the existence of 'physics of society' (Ball 2012):

- Thomas Hobbes based his social contract theory on the principle of inertia of the laws of motion by Galileo.
- The 18th century belief that social behavior follows rigorous laws that can be expressed and understood along mechanistic lines was influenced by Isaac Newton's gravitational model.
- Adam Smith's notion of an invisible hand that can create a stable and efficient economy from the self-centred behaviour of its actors integrates the image of a social self-organisation that required no authority.
- And finally, the same birth of statistical physics: such as the random, unpredictable movements of individual particles in a gas construct the gas laws that relate its pressure, temperature and volume, society may reveal predictable and regular behaviour when viewed as a whole.

Over the last decades, several new perspectives have emerged in the physical and natural sciences such as nonlinear dynamic systems theory, nonequilibrium thermodynamics, dissipative structures, self-organisation theory, self-organised criticality theory and chaos theory just to name a few, collectively referred to as complexity sciences. Additionally, a growing number of researchers are starting to incorporate concepts from the complexity sciences to analyse organisational phenomena. Five main reasons could be the i) increasing rates of change, ii) increasing emphasis on process research, iii) similarity to existing models of social behaviour, iv) disappointing results and lack of relevance and v) metatheoretical and philosophical implications (Mathews et al. 1999).

The most important novelty of our era stems from the profound impact of globalization: the linkages and interconnections that transcend states and societies. These inter-connectedness of global phenomena and in particular the roles of interactions between individuals, groups and institutions, give a new perspective to events that would otherwise look trivial (Ball 2012). We are now living in a data-rich world with highly dispersed information. We are all linked (Barabási 2002): Our lives have been remodeled by networks that combine people and computers, allowing much greater participation and much faster change. Events move faster every day and the available amount of information many times drowns us (Pentland 2014). But we still don't fully comprehend the basic essence of these human-machine networks and of this new society that combines humans and technology. Our current conception of society remains at the late 1700s where things were moving slowly and with powers and weaknesses totally different of today's hyperconnected world. As a result, the need to approach social sciences from the complexity perspective is urgent, calling for a collaboration between natural and social scientists to build a new picture of human behavior and its consequences (Ball 2012). The goal is to extend economic and political thinking by including exchanges of ideas, information, social pressure and status to explain human behavior in its whole (Pentland 2014). This could be made possible with social physics, the quantitative social science that describes reliable, mathematical connections between information and idea flow on the one hand and people's behavior on the other.

1.5.1 SYSTEM THINKING

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), specifically, one which *large networks of components with no central control and simple rules of operation give rise to complex collective behaviour, sophisticated information processing, and adaptation via learning or evolution* (Mitchell 2009). In Figure 4 we can see the complex systems organizational map: nonlinear dynamics, systems theory, pattern formation, evolution & adaptation, complex networks, collective behavior and game theory. In this dissertation, we will mainly focus on two aspects of complex systems, systems theory and complex networks.

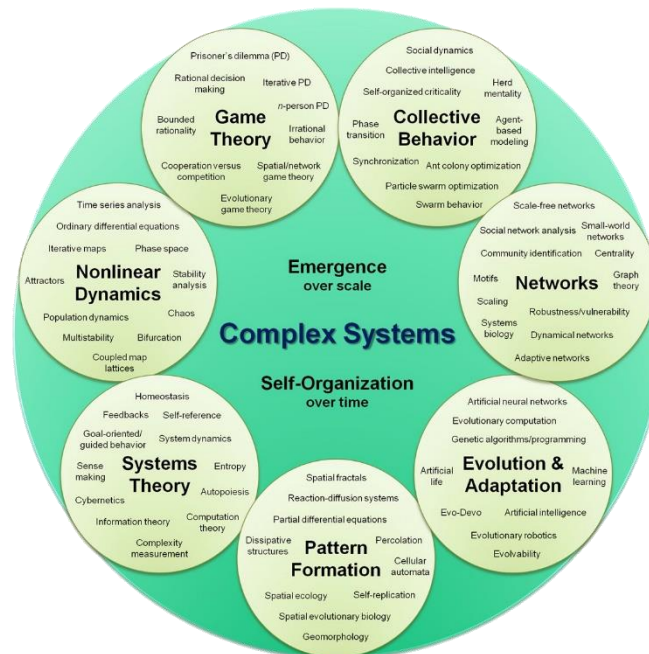


Figure 4: Complex systems organisational map.
Source: Wikipedia: https://en.wikipedia.org/wiki/Complex_system

The socio-ecological systems (SES) are usually defined as complex and adaptive “bio-geo-physical” units, delimited by spatial or functional boundaries, which include social actors and institutions (Gunderson and Holling 2002). As human impact on nature grows, SES have been increasingly analysed under systemic conceptual frameworks (i.e., systems theory and complexity science) and paradigms (i.e., sustainability), where natural and social sciences confront the need to approaching and complementing each other (Berkes and Folke 2000; Holling 2004). SES are both complex and adaptive, meaning that they require continuous testing, learning about, and developing knowledge and understanding in order to cope with change and uncertainty (Carpenter and Gunderson 2001).

Urban places are complex expressions of the varied interactions between these interconnected and interrelated spheres. The importance of urban environments as key SES is reflected in the efforts currently devoted to developing a unified theory of urban living (Bettencourt and West 2010; Batty 2012). With 55% of people now living in cities (United Nations 2018), sustainability science greatly needs to find a predictive framework where dynamics involved in the on-going expansion processes of urban areas can be included. The application of mathematics in social sciences is essential for the study of society and groups as more and more human systems are complex and interconnected (Bonacich and Lu 2012). In this regard, our understanding of urban places is being transformed by new approaches where cities are treated as complex adaptive systems—characterised by structures, processes, social and technological networks and interactions—that give rise to morphologies, which illustrate fractal patterns, self-similarity and scaling laws (Batty 2005; Bettencourt et al. 2007; West 2017). However, results so far have been concentrated essentially in the descriptive-analytical or

problem-focused domain, rather than in the transformational or solution-oriented mode (Wiek et al. 2012). Additionally, even though cities are being studied during the past decades as complex systems (Batty 2009, 2012; Marshall 2012) with strongly interrelated components (infrastructural, economic and social) that are difficult to understand in isolation, the many problems related to urban growth and urban transformation are typically dealt as independent issues, resulting in ineffective policies with occasionally unfortunate and unintended consequences (Bettencourt and West 2010). Since most people's sense of well-being depends on the social and cultural system in which they are living (Sumi 2007), any approach (coming from complexity science or not) that does not take into account, on an equitable basis, the human needs and the changing aspirations of a community is of very limited use (Kajikawa 2008).

1.5.2 NETWORK THINKING

Graph theory has its roots back to 1736, when Leonard Euler used it for the first time to solve the problem of Königsberg's bridges. By doing so he showed to the scientific community two things. First, that some problems become simpler and more treatable if they are represented as a graph. And second, that the existence of the path does not depend on our ingenuity to find it; rather it is a property of the graph (Barabási 2016). In other words, if we want to understand a complex system, we first need a map of its wiring diagram. Network thinking focuses exactly on that: on relationships between entities rather than entities themselves (Mitchell 2009). To investigate networks we have to define what we mean by network: A network is, in its simplest form, a collection of points joined together in pairs by lines (Newman 2010). The points are referred to as vertices or nodes and the lines are referred to as edges. The network representation offers a common language to study systems that may differ greatly in nature, appearance, or scope.

The following network metrics are some of the most common and the ones we used in this dissertation:

- **Average degree and degree distribution.** A key centrality measure of a node is its *degree*, k_i , representing the number of links node i has to other nodes. In an undirected network with N nodes (i.e., size of a network), the *average degree* is defined as:

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

where L is the total number of links. The degree distribution p_k is giving the probability that a randomly selected node in the network has k links (Figure 5). Since p_k is a probability, it must be normalised, i.e. $\sum_{k=1}^{\infty} p_k = 1$. For a fixed network of size N , the degree distribution is the normalised histogram $p_k = \frac{N_k}{N}$, where N_k is the number of degree k nodes, and its cumulative degree distribution P_k is giving the probability that a randomly selected node in the network has k or more links.

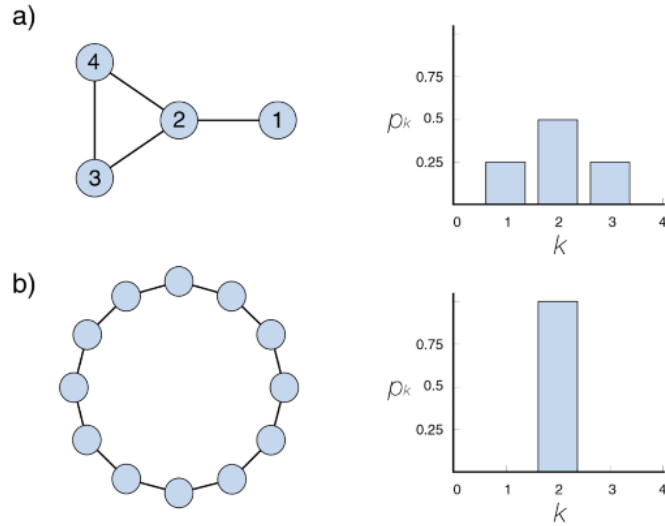


Figure 5: Degree distribution for two different networks. For the network in (a) we have $N = 4$ and $p_1 = \frac{1}{4}$, $p_2 = \frac{1}{2}$ and $p_3 = \frac{1}{4}$. For the network in (b), as each node has the same degree $k = 2$, we have $p_2 = 1$. Source: (Barabási 2016).

- **Weighted degree.** Also known as node strength, weighted degree is defined as the sum of weights attached to ties that belong to a node (Barrat et al. 2004). This measure is formalised as follows:

$$s_i = \sum_j^N w_{ij} \quad (\text{Eq. 2})$$

where w_{ij} is greater than 0 if the node i is connected to node j and the value represents the weight of the tie (i.e., Equation 1).

- **Clustering coefficient.** The local clustering coefficient captures the degree to which the neighbours of a given node link to each other (Watts and Strogatz 1998). For a node i with degree k_i the local clustering coefficient is defined as:

$$C_i = \frac{2L_i}{k_i(k_i - 1)} \quad (\text{Eq. 3})$$

where L_i represents the number of links between the k_i neighbours of node i . Here we use the average clustering coefficient of a network $\langle C \rangle$ as:

$$\langle C \rangle = \frac{1}{N} \sum_{i=1}^N C_i \quad (\text{Eq. 4})$$

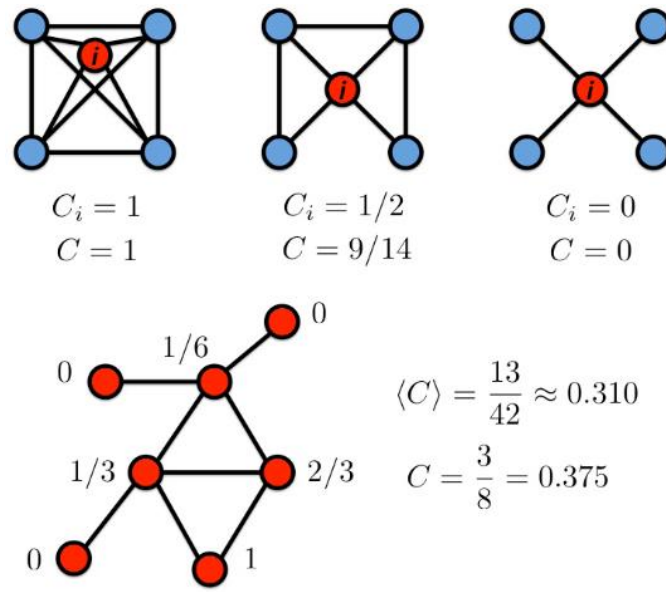


Figure 6: The local clustering coefficient, C_i , of the central node with degree $k_i = 4$ for three different configurations of its neighbourhood. The clustering coefficient measures the local density of links in a node's vicinity. The bottom figure shows a small network, with the local clustering coefficient of a node shown next to each node. Next to the figure we also list the network's average clustering coefficient $\langle C \rangle$, according to Eq. (13), and its global clustering coefficient C , according to Eq. (14). Note that for nodes with degrees $k_i = 0, 1$, the clustering coefficient is taken to be zero.
 Source: (Barabási 2016).

- Average path length and diameter.** 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. 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 d_{ij} between nodes i and j , has the fewest number of links. The average path length, denoted $\langle d \rangle$, is the average shortest paths between all pairs of nodes in the network. The network diameter, denoted D , is the maximal shortest path in the network (Figure 7).

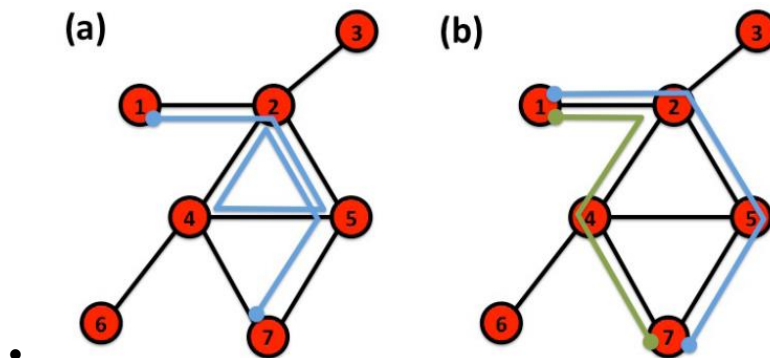


Figure 7: (a) A path between nodes i_0 and i_n is an ordered list of n links $P_d = \{(i_0, i_1), (i_1, i_2), (i_2, i_3), \dots, (i_{n-1}, i_n)\}$. The length of this path is d . The path shown in (a) follows the route $1 \rightarrow 2 \rightarrow 5 \rightarrow 4 \rightarrow 2 \rightarrow 5 \rightarrow 7$, hence its length is $n = 6$. (b) The shortest paths between nodes 1 and 7, representing the distance d_{17} , is the path with the fewest number of links that connect nodes 1 and 7. There can be multiple paths of the same length, as illustrated by the two paths shown in different colours. The network diameter is the largest distance in the network, being $d_{max} = 3$ here.
 Source: (Barabási 2016).

Complementarily, the structural features of the different modules found in the networks were characterised by the following centrality measures:

- **Betweenness centrality.** For every pair of vertices in a connected graph, there exists at least one shortest path between the vertices such that either the number of edges that the path passes through (for unweighted graphs) or the sum of the weights of the edges (for weighted graphs) is minimised. The betweenness centrality for each vertex is the number of these shortest paths that pass through the vertex (Barrat et al. 2004). This measure is formalised as follows:

$$b_i = \sum_{s \neq i \neq t} \frac{d_{st(i)}}{d_{st}} \quad (\text{Eq. 5})$$

where d_{st} is the total number of shortest paths from node s to node t , and $d_{st(i)}$ is the number of those paths that pass through vertex i .

- **Closeness centrality.** Calculated as the sum of the length of the shortest paths between the node and all other nodes in the graph. Thus the more central a node is, the closer it is to all other nodes (Bavelas 1950). This measure is formalised as follows:

$$c_i = \frac{N - 1}{\sum_j d_{ij}} \quad (\text{Eq. 6})$$

where all variables have been already introduced.

1.5.3 LANGUAGE NETWORKS & SOCIO-LINGUISTICS

One particular category of networks that we are interested in this dissertation is language networks. They are used in several methods and applications in natural language processing and information retrieval, such as syntax, semantics, and summarization. The most common language networks include co-occurrence networks, syntactic and semantic networks, similarity networks, and networks of summaries and machine translation (Mihalcea and Radev 2011). The focus here will be on co-occurrence networks.

A co-occurrence network can be defined in many ways: two words that appear in a window of N words of each other, in the same sentence, or in the same paragraph; or are connected to one another inside the network. Weighted edges then are drawn to indicate the strength of the connection between words. The networks can be directed or undirected. In some studies, only words that appear near one another with a significant frequency are considered; in other studies, only words that belong to a certain part of speech are added to the network. (Mihalcea and Radev 2011).

Word co-occurrence networks can be used in several applications, including discovery of semantic classes, part-of-speech tagging, and keyword extraction, among others. Although these applications are addressed in more detail in subsequent chapters, an overview of the general method for constructing word co-occurrence networks, as well as their properties, is presented here. (Mihalcea and Radev 2011).

Here, we apply them in discourse analysis and scientific papers keywords.

1.5.3.1 DISCOURSE ANALYSIS

Sustainable city planning must be understood as a communicative process connecting among others city architecture, technology, city district management and social infrastructure of neighbourhoods (see Sections 1.2 and 1.3). In this sense, urban communication is seen as a complex, historically and culturally specific process of negotiation (Hess-Lüttich 2016). The roll of discourse as a component of urban processes and

change (Hastings 1999), directly connected to communication, is considered thus of great importance. Discourse is often used simply to refer to a single instance or event of language use, usually spoken rather than written language (Mills 2004).

Discourse analysis, one of the main concepts of socio-linguistics, is interested in precisely how language is being used within this discursive event. Its objective is to situate the instance of language use within a social setting or context and to understand how the discourse event interacted with that context (van Dijk 1997). Nevertheless, being the analysis of language in use (Brown and Yule 1983) and seen as a “tremendously productive mode of qualitative research” (Steady et al. 2016), it cannot be restricted to the description of linguistic forms. It is employed to examine how any language produced by man is used to communicate for a purpose in a context, such as the urban one.

Communication is understood to be the transfer of ideas, concepts, thoughts, by one individual to another through the use of substitutes for these ideas that transport the meaning, or information (Villarroya 2013). A type of those substitutes are words. Words are not containers of meanings used for the transport from one person to another, but rather the medium used to make the interlocutor recognise what one wants to transmit, the keys with which the recipient will be able to reach the same place as the emitter. The meaning of a word corresponds to the network of units of experience in which a word is grounded. Accordingly, the reference of a word is an experience, and words should be understood as evocative, not symbolic. A word doesn't stand for an object, individual, property, or action, but functions as something that evokes a certain experience and the related perspective (Villarroya 2002). As a result, the human language cannot be conceived as a code, in the sense that each word corresponds to a specific meaning that, through rules of combination, allows for the creation of sentences in which the parts are combined and give a new meaning. Hence, communication cannot be based on the transmission of a “thing”, but on the completion of an “act”: the evocation of the right network of experiences (Villarroya 2013).

Words also appear in conversations. A conversation is an emergent function that becomes available to individuals through the maturation of their brains (mind reading and social intelligence), their interaction with the physical and social environment, their assimilation of their own culture, and so on (Martorell 2013). Conversation is complex and its origin is difficult to study because the study of interaction is often undertaken from obsolete stances. An analysis of the constituent parts of human conversation produces a series of aspects that are commonly studied in a fragmented way. We could call these verbal, non-verbal, cognitive, emotional contextual or body aspects (it is commonly believed that 55% of speech is non-verbal, 38% suprasegmental and only 7% verbal). In this dissertation we will mostly analyse verbal aspects. These are the elements traditionally studied in conversation and they are called speech. They are often associated with the study of language and are produced by a person who is speaking.

The sections related to discourse analysis are 5.2 and 5.3.

1.5.3.2 CO-WORD ANALYSIS

The co-word analysis is a bibliometric approach based on co-occurrence analysis. It has been widely applied to depict how “*concepts, ideas, and problems within a given scientific field interact and to explore the concept network within the relevant field*” (Callon et al. 1983, 1991). While traditional bibliometric techniques such as author and journal co-citation analysis represent alternative, possibly complementary, strategies (Law and Whittaker 1992) and lead to interesting results, they do not provide an immediate picture of the actual content of the research topics dealt with the literature (Callon et al. 1983). Co-word analysis on the other hand has the

potential to address precisely this kind of analytic problem (Callon et al. 1991) as the relatedness between words can be interpreted directly according to document contents (Lu and Wolfram 2012). It reduces and projects the data into a specific visual representation with the maintenance of essential information containing in the data (Ding et al. 2001) and it is based on the nature of words that form the important carrier of scientific concepts, idea and knowledge (van Raan and Tijssen 1993). Its main advantage is given by the same nature of words: they are the foremost carrier of scientific concepts making their use unavoidable and covering an unlimited intellectual domain (van Raan and Tijssen 1993).

For the analysis of the evolution of the concepts related to this thesis, we adopted co-word analysis for multiple reasons. Connectivity between articles by means of the paper's references list – be it co-citation or bibliographic coupling – implies that when an author cites an article, he or she “creates its meaning”: the citation adopts “a symbolic dimension” (Kullenberg and Nelhans 2015). This is a very strong assumption, since references lists rely on people openly citing papers rather than creating meanings. Besides, most citations are just copied from other papers, once a citation has reached a critical threshold, and they are not always read by the author who cites them (Newman 2010). A remarkable result coming from the quantification process of emerging scientific contexts shown in the literature is that a definite scientific field seems to emerge only once there exists a critical amount of commonly shared set of (a) research questions, (b) concepts, and (c) methods that allow multiple authors to cooperate and collaborate (Bettencourt and Kaiser 2015). Surprisingly enough, research questions, concepts and methods, which are normally coded into keywords and words in the papers, have been traditionally ignored in these studies. The co-word analysis is an important bibliometric approach based on co-occurrence analysis and has been widely applied to illustrate how concepts, ideas, and problems within a given scientific field interact and to explore the concept network within the relevant field (see (Liu et al. 2016) and references therein). It has been used in the literature for mapping conceptual networks of disciplines like consumer behaviour research (Muñoz-Leiva et al. 2012), patent analysis (Chang et al. 2010), urban sustainability concepts (Fu and Zhang 2017), biology (An and Wu 2011) and education (Ritzhaupt et al. 2010), to name a few.

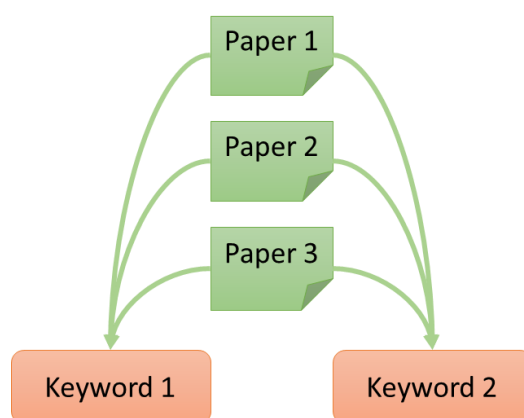


Figure 8 Keywords are connected if they appear in the same paper. The weight of the connection depends on the probability of co-occurrence.

In Chapter 2 we consider a network formed by keywords as nodes. Two keywords are connected if they appear in the same paper, and the weight of the link between them depends on their probability of co-occurrence across the various papers (Figure 8). This weight is normalised by means of bibliographic coupling (Kessler 1963):

$$w_{i,j} = \frac{|P_i \cap P_j|}{\sqrt{|P_i||P_j|}} \quad (\text{Eq. 7})$$

where P_i and P_j are the set of papers that contain keyword i and j correspondingly. By definition $w_{i,j} \in [0,1]$, is equal to zero when i and j do not share any paper and equal to one when their sets of papers are identical. Thus constructed, the structural analysis of this network serves as a proxy for the conceptual structure of a specific discipline. It allows a time-series record of the changes that occurred in the conceptual space and it can reveal patterns and trends in a specific discipline by measuring the association weight of representative terms in relevant publications (Ding et al. 2001).

1.6 REFERENCES

- Alkire S (2002a) Valuing Freedoms: Sen's Capability Approach and Poverty Reduction. Oxford University Press, Oxford
- Alkire S (2002b) Dimensions of human development. *World Dev* 30:181–205. doi: 10.1016/S0305-750X(01)00109-7
- Altuzarra A, Esteban M (2011) Land prices and housing prices: the case of Spain. *J Hous Built Environ* 26:397–409. doi: 10.1007/s10901-011-9235-8
- An XY, Wu QQ (2011) Co-word analysis of the trends in stem cells field based on subject heading weighting. *Scientometrics* 88:133–144. doi: 10.1007/s11192-011-0374-1
- Andelman R, Board R, Carman L, et al (1998) Quality of life definition and terminology: A discussion document from the International Society for Quality of Life Studies
- Andrews FM (1974) Social indicators of perceived life quality. *Soc Indic Res* 1:279–299. doi: 10.1007/BF00303860
- Andrews FM, Withey SB (1976) Social indicators of well-being: Americans' perceptions of life quality. Plenum Press, New York
- Angel S, Sheppard S, Civco D (2005) The dynamics of global urban expansion. Washington D.C.
- Antonsich M (2011) Grounding theories of place and globalisation. *Tijdschr voor Econ en Soc Geogr* 102:331–345. doi: 10.1111/j.1467-9663.2010.00614.x
- Arnstein SR (1969) A Ladder Of Citizen Participation. *J Am Inst Plann* 35:216–224. doi: 10.1080/01944366908977225
- Ascher W (2007) Policy sciences contributions to analysis to promote sustainability. *Sustain Sci* 2:141–149. doi: 10.1007/s11625-007-0031-z
- Ball P (2012) Why Society is a Complex Matter: Meeting Twenty-first Century Challenges with a New Kind of Science. Springer, London
- Ballas D (2013) What makes a 'happy city'? *Cities* 32:S39–S50. doi: 10.1016/j.cities.2013.04.009
- Barabási A-L (2002) *Linked: The New Science of Networks*. Perseus Publishing, Cambridge, Massachusetts
- Barabási A-L (2016) *Network Science*. Cambridge University Press, Cambridge, United Kingdom
- Barrat A, Barthélemy M, Pastor-Satorras R, Vespignani A (2004) The architecture of complex weighted networks. *Proc Natl Acad Sci U S A* 101:3747–52. doi: 10.1073/pnas.0400087101
- Batty M (2012) Building a science of cities. *Cities* 29:S9–S16. doi: 10.1016/j.cities.2011.11.008

- Batty M (2005) *Cities and complexity : understanding cities with cellular automata, agent-based models, and fractals*. MIT Press, Cambridge, Mass.
- Batty M (2009) *Cities as Complex Systems: Scaling, Interaction, Networks, Dynamics and Urban Morphologies*. In: Meyers RA (ed) *Encyclopedia of Complexity and Systems Science*. Springer, pp 1041–1071
- Bavelas A (1950) *Communication Patterns in Task-Oriented Groups*. *J Acoust Soc Am* 22:725–730. doi: 10.1121/1.1906679
- Berkes F, Folke C (eds) (2000) *Linking Social and Ecological Systems. Management Practices and Social Mechanisms for Building Resilience*. Cambridge University Press
- Berry B JL, Okulicz-Kozaryn A (2009) *Dissatisfaction with city life: A new look at some old questions*. *Cities* 26:117–124. doi: 10.1016/j.cities.2009.01.005
- Bertrand M, Mullainathan S (2001) *Do people mean what they say? Implications for subjective survey data*. *Am Econ Rev* 91:67–72
- Bettencourt LMA, Kaiser DI (2015) *Formation of Scientific Fields as a Universal Topological Transition*
- Bettencourt LMA, Lobo J, Helbing D, et al (2007) *Growth, innovation, scaling, and the pace of life in cities*. *Proc Natl Acad Sci U S A* 104:7301–6. doi: 10.1073/pnas.0610172104
- Bettencourt LMA, West GB (2010) *A unified theory of urban living*. *Nature* 467:912–3. doi: 10.1038/467912a
- Bilotta E, Evans GW (2013) *Environmental stress*. In: Steg L, van den Berg AE, de Groot JIM (eds) *Environmental Psychology: An Introduction*. BPS Blackwell, West Sussex, UK, pp 27–35
- Bodnar J (2015) *Reclaiming public space*. *Urban Stud* 52:2090–2104. doi: 10.1177/0042098015583626
- Bonacich P, Lu P (2012) *Introduction to Mathematical Sociology*. Princeton University Press, Princeton & Oxford
- Bonnes M, Scopelliti M, Fornara F, Carrus G (2013) *Urban environmental quality*. In: Steg L, Van den Berg AE, De Groot JIM (eds) *Environmental Psychology: An Introduction*. BPS Blackwell, West Sussex, UK, pp 113–1122
- Bradburn NM (1969) *The structure of psychological well-being*. Alpine, Chicago, IL
- Brown G, Yule G (1983) *Discourse analysis*. Cambridge University Press, Cambridge, United Kingdom
- Brown T (2016) *Sustainability as Empty Signifier: Its Rise, Fall, and Radical Potential*. *Antipode* 48:115–133. doi: 10.1111/anti.12164
- Bull R, Azennoud M (2016) *Smart citizens for smart cities: participating in the future*. *Proc Inst Civ Eng - Energy* 169:93–101. doi: 10.1680/jener.15.00030
- Callon M, Courtial JP, Laville F (1991) *Co-word analysis as a tool for describing the network of interactions between basic and technological research: The case of polymer chemistry*. *Scientometrics* 22:155–205. doi: 10.1007/BF02019280
- Callon M, Courtial JP, Turner WA, Bauin S (1983) *From translations to problematic networks: An introduction to co-word analysis*. *Soc Sci Inf* 22:191–235. doi: 10.1177/053901883022002003
- Carpenter SR, Gunderson LH (2001) *Coping with Collapse: Ecological and Social Dynamics in Ecosystem Management*. *Bioscience* 51:451. doi: 10.1641/0006-3568(2001)051[0451:CWCEAS]2.0.CO;2

- Chang PL, Wu CC, Leu HJ (2010) Using patent analyses to monitor the technological trends in an emerging field of technology: A case of carbon nanotube field emission display. *Scientometrics* 82:5–19. doi: 10.1007/s11192-009-0033-y
- Christopherson S (1994) The Fortress City: Privatized Spaces, Consumer Citizenship. In: Amin A (ed) *Post-Fordism: A Reader*. Blackwell, Cambridge, MA, pp 403–427
- Costanza R, Fisher B, Ali S, et al (2007) Quality of life: An approach integrating opportunities, human needs, and subjective well-being. *Ecol Econ* 61:267–276. doi: 10.1016/j.ecolecon.2006.02.023
- Costanza R, Fisher B, Ali S, et al (2008) An Integrative Approach to Quality of Life Measurement, Research, and Policy. *SAPIENS* 1:17–21
- Cruz I, Stahel AW, Max-Neef MA (2009) Towards a systemic development approach: Building on the Human-Scale Development paradigm. *Ecol Econ* 68:2021–2030. doi: 10.1016/j.ecolecon.2009.02.004
- Cummins RA (1996) The domains of life satisfaction: An attempt to order chaos. *Soc Indic Res* 38:303–328. doi: 10.1007/BF00292050
- Cummins RA (2000) Objective and Subjective Quality of Life: an Interactive Model. *Soc Indic Res* 52:55–72. doi: 10.1023/A:1007027822521
- Cummins RA, Eckersley R, Pallant J, et al (2003) Developing a national index of subjective wellbeing: The Australian Unity Wellbeing Index. *Soc Indic Res* 64:159–190. doi: 10.1023/A:1024704320683
- D'Acci L, Haas T, Bardhan R (2016) Inaugural Editorial of Urban Planning. *Urban Plan* 1:1. doi: 10.17645/up.v1i1.586
- Datta A (2015) A 100 smart cities, a 100 utopias. *Dialogues Hum Geogr* 5:49–53. doi: 10.1177/2043820614565750
- Davis M (1992) Fortress Los Angeles: The Militarization of Urban Space. In: Sorkin M (ed) *Variations on a Theme Park: The New American City and the End of Public Space*. The Noonday Press, New York
- Dawes RM (1980) Social Dilemmas. *Annu Rev Psychol* 31:169–193. doi: 10.1146/annurev.ps.31.020180.001125
- De Weerd J, Garcia M (2016) Housing crisis: the Platform of Mortgage Victims (PAH) movement in Barcelona and innovations in governance. *J Hous Built Environ* 31:471–493. doi: 10.1007/s10901-015-9465-2
- Delgado M (2011) *El espacio público como ideología*. Catarata, Madrid
- Deslandes A (2013) Exemplary Amateurism: Thoughts on DIY Urbanism. *Cult Stud Rev* 19:216. doi: 10.5130/csr.v19i1.2481
- Di Tella R, MacCulloch R (2006) Some uses of happiness data in economics. *J Econ Perspect* 20:25–46
- Diener E (1994) Assessing subjective well-being: Progress and opportunities. *Soc Indic Res* 31:103–157. doi: 10.1007/BF01207052
- Diener E (1984) Subjective well-being. *Psychol Bull* 95:542–575. doi: 10.1037/0033-2909.95.3.542
- Diener E, Emmons RA, Larsen RJ, Griffin S (1985) The Satisfaction With Life Scale. *J Pers Assess* 49:71–5. doi: 10.1207/s15327752jpa4901_13
- Diener E, Inglehart R, Tay L (2013) Theory and Validity of Life Satisfaction Scales. *Soc Indic Res* 112:497–527. doi: 10.1007/s11205-012-0076-y

- Diener E, Suh EM, Lucas RE, Smith HL (1999) Subjective well-being: Three decades of progress. *Psychol. Bull.* 125:276–302
- Diener E, Wirtz D, Tov W, et al (2010) New Well-being Measures: Short Scales to Assess Flourishing and Positive and Negative Feelings. *Soc Indic Res* 97:143–156. doi: 10.1007/s11205-009-9493-y
- Ding Y, Chowdhury GG, Foo S (2001) Bibliometric cartography of information retrieval research by using co-word analysis. *Inf Process Manag* 37:817–842. doi: 10.1016/S0306-4573(00)00051-0
- Dodds S (1997) Towards a ‘science of sustainability’: Improving the way ecological economics understands human well-being. *Ecol Econ* 23:95–111. doi: 10.1016/S0921-8009(97)00047-5
- Dolan P, Layard R, Robert M (2011) Measuring subjective well-being for public policy
- Easterlin RA (2003) Explaining happiness. *Proc Natl Acad Sci U S A* 100:11176–83. doi: 10.1073/pnas.1633144100
- Elizalde A (2003) Desde el Desarrollo Sustentable hacia sociedades sustentables. *Polis* 1:
- Fernandez M (2015) Adaptive cities: co-creating spaces. *EDGEcondition* 5:106–107
- Finn D (2014) DIY urbanism: implications for cities. *J Urban Int Res Placemaking Urban Sustain* 7:381–398. doi: 10.1080/17549175.2014.891149
- Forrest R, Kearns A (2001) Social Cohesion, Social Capital and the Neighbourhood. *Urban Stud* 38:2125–2143. doi: 10.1080/00420980120087081
- Fu Y, Zhang X (2017) Trajectory of urban sustainability concepts: A 35-year bibliometric analysis. *Cities* 60:113–123. doi: 10.1016/j.cities.2016.08.003
- Galster GC (1986) What is neighbourhood? *Int J Urban Reg Res* 10:243–263. doi: 10.1111/j.1468-2427.1986.tb00014.x
- Gans HJ (2002) The Sociology of Space: A Use-Centered View. *City Community* 1:329–339. doi: 10.1111/1540-6040.00027
- Garcia M, Haddock SV (2016) Special issue: housing and community needs and social innovation responses in times of crisis. *J Hous Built Environ* 31:393–407. doi: 10.1007/s10901-015-9466-1
- Gershenson C (ed) (2008) *Complexity: 5 Questions*. Automatic Press Publishing
- Gómez-Baggethun E, Reyes-García V, Olsson P, Montes C (2012) Traditional ecological knowledge and community resilience to environmental extremes: A case study in Doñana, SW Spain. *Glob Environ Chang* 22:640–650. doi: 10.1016/j.gloenvcha.2012.02.005
- Graham S, Marvin S (2001) *Splintering urbanism. Networked infrastructures, technological mobilities and the urban condition*. Routledge, London
- Gunderson LH, Holling CS (2002) *Panarchy. Understanding transformations in human and natural systems*. Island Press, Washington
- Harvey D (1985) *Consciousness and the urban experience: Studies in the history and theory of capitalist urbanization*. The Johns Hopkins University Press, Baltimore, MD
- Harvey D (2014) *Seventeen Contradictions and the End of Capitalism*. Oxford University Press, Oxford
- Hastings A (1999) Discourse and Urban Change: Introduction to the Special Issue. *Urban Stud* 36:7–12. doi: 10.1080/0042098993691

- Helne T, Hirvilammi T (2015) Wellbeing and Sustainability: A Relational Approach. *Sustain Dev* 23:167–175. doi: 10.1002/sd.1581
- Hess-Lüttich EWB (2016) Urban discourse – city space, city language, city planning: Eco-semiotic approaches to the discourse analysis of urban renewal. *Sign Syst Stud* 44:12. doi: 10.12697/SSS.2016.44.1-2.02
- Holling CS (2004) From Complex Regions to Complex Worlds. 9:
- International Labour Office (ILO) (1976) Employment, growth and basic needs: one world problem. Geneva, Switzerland
- Iveson K (2013) Cities within the City: Do-It-Yourself Urbanism and the Right to the City. *Int J Urban Reg Res* 37:941–956. doi: 10.1111/1468-2427.12053
- Kajikawa Y (2008) Research core and framework of sustainability science. *Sustain Sci* 3:215–239. doi: 10.1007/s11625-008-0053-1
- Kamp I Van, Leidelmeijer K, Marsman G (2003) Urban environmental quality and human well-being. Towards a conceptual framework and demarcation of concepts; a literature study. *Landsc Urban Plan* 65:5–18
- Kearns A, Parkinson M (2001) The Significance of Neighbourhood. *Urban Stud* 38:2103–2110. doi: 10.1080/00420980120087063
- Kennedy DP, Adolphs R (2011) Social neuroscience: Stress and the city. *Nature* 474:452–3. doi: 10.1038/474452a
- Kessler MM (1963) Bibliographic coupling between scientific articles. *Am Doc* 24:123–131
- Khalil HAAE (2012) Enhancing quality of life through strategic urban planning. *Sustain Cities Soc* 5:77–86. doi: 10.1016/j.scs.2012.06.002
- Kirita T, Endo M (1995) Happy face advantage in recognizing facial expressions. *Acta Psychol (Amst)* 89:149–163. doi: 10.1016/0001-6918(94)00021-8
- Kothari A, Demaria F, Acosta A (2014) Buen Vivir, Degrowth and Ecological Swaraj: Alternatives to sustainable development and the Green Economy. *Development* 57:362–375. doi: 10.1057/dev.2015.24
- Kullenberg C, Nelhans G (2015) The happiness turn? Mapping the emergence of “happiness studies” using cited references. *Scientometrics* 103:615–630. doi: 10.1007/s11192-015-1536-3
- Kutlukaya M, Erol I (2016) Analysis of cross-country variations in the depth of European mortgage markets. *J Hous Built Environ* 31:513–543. doi: 10.1007/s10901-015-9473-2
- Laclau E (2005) *On Populist Reason*. Verso, London
- Langstraat F, Van Melik R (2013) Challenging the ‘End of Public Space’: A Comparative Analysis of Publicness in British and Dutch Urban Spaces. *J Urban Des* 18:429–448. doi: 10.1080/13574809.2013.800451
- Law J, Whittaker J (1992) Mapping acidification research: A test of the co-word method. *Scientometrics* 23:417–461. doi: 10.1007/BF02029807
- Layard R (2005) *La felicidad. Lecciones de una nueva ciencia*. Tauros, Madrid
- Layard R (2010) Measuring subjective well-being. *Science (80-)* 327:534–535
- Lederbogen F, Kirsch P, Haddad L, et al (2011) City living and urban upbringing affect neural social stress processing in humans. *Nature* 474:498–501. doi: 10.1038/nature10190

- Lefebvre H (1974) *La production de l'espace*. Anthropos, Paris, France
- Liu Y, Li H, Goncalves J, et al (2016) Fragmentation or cohesion? Visualizing the process and consequences of information system diversity, 1993–2012. *Eur J Inf Syst* 25:509–533. doi: 10.1057/ejis.2016.5
- Low SM (1997) Urban Fear: Building the Fortress City. *City Soc* 9:53–71. doi: 10.1525/ciso.1997.9.1.53
- Lu K, Wolfram D (2012) Measuring author research relatedness: A comparison of word-based, topic-based, and author cocitation approaches. *J Am Soc Inf Sci Technol* 63:1973–1986. doi: 10.1002/asi.22628
- Madden DJ (2010) Revisiting the End of Public Space: Assembling the Public in an Urban Park. *City Community* 9:187–207. doi: 10.1111/j.1540-6040.2010.01321.x
- Marans RW (2012) Quality of Urban Life Studies: An Overview and Implications for Environment-Behaviour Research. *Procedia - Soc Behav Sci* 35:9–22. doi: 10.1016/j.sbspro.2012.02.058
- March H, Ribera-Fumaz R (2014) Una revisión crítica desde la Ecología Política Urbana del concepto Smart City en el Estado español. *Ecol Política Cuad debate Int* 47:29–36
- Marshall S (2012) Planning, Design and the Complexity of Cities. In: Portugali J, Meyer H, Stolk E, Tan E (eds) *Complexity Thories of Cities Have Come of Age. An Overview with Implications to Urban Planning and Design*. Springer, pp 191–206
- Martin D, McCann E, Purcell M (2003) Space, Scale, Governance, and Representation: Contemporary Geographical Perspectives on Urban Politics and Policy. *J Urban Aff* 25:113–121. doi: 10.1111/1467-9906.t01-1-00001
- Martorell X (2013) Conversation as Emergent Function. In: Massip-Bonet À, Bastardas-Boada A (eds) *Complexity Perspectives on Language, Communication and Society*. Springer Berlin Heidelberg, Berlin, Heidelberg, pp 75–84
- Maslow AH (1954) *Motivation and Personality*. Hoper & Row
- Massey D (1984) Introduction: Geography matters. In: Massey D, Allen J (eds) *Geography matters!* Cambridge University Press, Cambridge, New York & Melbourne
- Massey D (1994) *Space, place, and gender*. University of Minnesota Press, Minneapolis, MN
- Massey D (1992) Politics and space/time. *New Left Rev* 196:
- Mathews KM, White MC, Long RG (1999) Why Study the Complexity Sciences in the Social Sciences? *Hum Relations* 52:439–462. doi: 10.1177/001872679905200402
- Max-Neef MA (1986) *Desarrollo a escala humana: Conceptos, aplicaciones y algunas reflexiones*. Icaria Editorial, Barcelona
- Max-Neef MA (1992) Development and human needs. In: Max-Neef MA, Ekins P (eds) *Real life Economics: Understanding Wealth Creation*. Routledge, London, pp 197–213
- Max-Neef MA, Elizalde A, Hopenhayn M (1991) *Human Scale Development. Conception, application and further reflections*. The Apex Press, New York & London
- Max-Neef MA, Elizalde A, Hopenhayn M (1986) *Desarrollo a Escala Humana: una opción para el futuro*. Dev Dialogue
- Max-Neef MA, Elizalde A, Hopenhayn M (1989) *Human Scale Development: An Option for the Future*. Dev Dialogue 3–80
- McCall S (1975) Quality of life. *Soc Indic Res* 2:229–248. doi: 10.1007/BF00300538

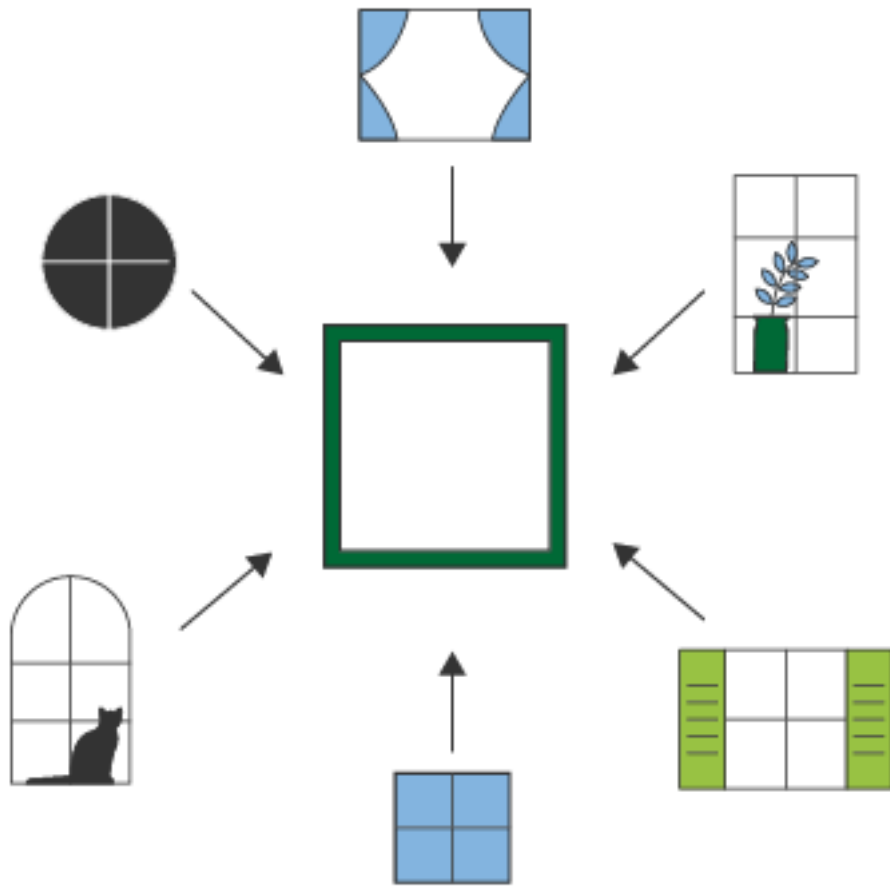
- Michel J-B, Kui Shen Y, Presser Aiden A, et al (2010) Quantitative Analysis of Culture Using Millions of Digitized Books. <http://books.google.com/ngrams/>. Accessed 30 May 2018
- Mihalcea R, Radev D (2011) Graph-Based Natural Language Processing and Information Retrieval. Cambridge University Press, New York
- Mills S (2004) Discourse. Routledge, London
- Mitchell M (2009) Complexity: A Guided Tour. Oxford University Press, New York
- Moberg DO, Brusek PM (1978) Spiritual well-being: A neglected subject in quality of life research. *Soc Indic Res* 5:303–323. doi: 10.1007/BF00352936
- Moro M, Brereton F, Ferreira S, Clinch JP (2008) Ranking quality of life using subjective well-being data. *Ecol Econ* 65:448–460. doi: 10.1016/j.ecolecon.2008.01.003
- Moser G (1988) Urban stress and helping behavior: Effects of environmental overload and noise on behavior. *J Environ Psychol* 8:287–298. doi: 10.1016/S0272-4944(88)80035-5
- Mulder K, Costanza R, Erickson J (2006) The contribution of built, human, social and natural capital to quality of life in intentional and unintentional communities. *Ecol Econ* 59:13–23. doi: 10.1016/j.ecolecon.2005.09.021
- Muñoz-Leiva F, Viedma-del-Jesús MI, Sánchez-Fernández J, López-Herrera AG (2012) An application of co-word analysis and bibliometric maps for detecting the most highlighting themes in the consumer behaviour research from a longitudinal perspective. *Qual Quant* 46:1077–1095. doi: 10.1007/s11135-011-9565-3
- Newman MEJ (2010) Networks: An introduction. Oxford University Press, Oxford
- Niederer S, Priester R (2016) Smart Citizens: Exploring the Tools of the Urban Bottom-Up Movement. *Comput Support Coop Work CSCW An Int J* 25:137–152. doi: 10.1007/s10606-016-9249-6
- Nussbaum MC (2000) Women and human development: The capabilities approach. Cambridge University Press, Cambridge
- O'Brien C (2005) Planning for Sustainable Happiness: Harmonizing Our Internal and External Landscapes. In: *Rethinking Development: 2nd International Conference on Gross National Happiness*. Antigonish, Nova Scotia, Canada, pp 1–22
- Orrell D (2010) *Economyths: How the science of complex systems is transforming economic thought*. Icon Books Ltd, London
- Paasi A (2008) Is the world more complex than our theories of it? TPSN and the perpetual challenge. *Environ Plan D Soc Sp* 26:405–410. doi: 10.1068/d9107c
- Page RA (1977) Noise and Helping Behavior. *Environ Behav* 9:311–334. doi: 10.1177/001391657700900302
- Papachristou IA, Rosas-Casals M (2015) The many urban languages or why there is always a gap between bottom-up initiatives and top-down processes. In: *Resurbe II: International conference on urban resilience*. Bogotá
- Papachristou IA, Rosas-Casals M (2019) Cities and quality of life. Quantitative modeling of the emergence of the happiness field in urban studies. *Cities* 88:191–208. doi: 10.1016/j.cities.2018.10.012
- Paroutis S, Bennett M, Heracleous L (2014) A strategic view on smart city technology: The case of IBM Smarter Cities during a recession. *Technol Forecast Soc Change* 89:262–272. doi: 10.1016/j.techfore.2013.08.041
- Pentland A (2014) *Social Physics*. Penguin Books, New York

- Peterson M, Webb D (2006) Religion and Spirituality in Quality of Life Studies. *Appl Res Qual Life* 1:107–116. doi: 10.1007/s11482-006-9006-y
- Poerksen U (1995) *Plastic Words: The Tyranny of a Modular Language*. Pennsylvania State University Press, Michigan
- Pretty J (2003) Social Capital and the Collective Management of Resources. *Science* (80-) 302:1912–1914. doi: 10.1126/science.1090847
- Regoeczi WC (2003) When context matters: a multilevel analysis of household and neighbourhood crowding on aggression and withdrawal. *J Environ Psychol* 23:457–470. doi: 10.1016/S0272-4944(02)00106-8
- Rhodes G, Jeffery L, Watson TL, et al (2003) Fitting the mind to the world: face adaptation and attractiveness aftereffects. *Psychol Sci* 14:558–566. doi: 10.1046/j.0956-7976.2003.psci_1465.x
- Ritzhaupt AD, Stewart M, Smith P, Barron AE (2010) An investigation of distance education in North American Research Literature using co-word analysis. *Int Rev Res Open Distance Learn* 11:37–60
- Robeyns I (2005) The Capability Approach: a theoretical survey. *J Hum Dev* 6:93–117. doi: 10.1080/146498805200034266
- Schumacher EF (1973) *Small is Beautiful: Economics as if people mattered*. Harper & Row, New York
- Sen A (1999) *Development as Freedom*. Oxford University Press, Oxford
- Silver H (2014) Editorial: The Centrality of Public Space. *City Community* 13:1–4. doi: 10.1111/cico.12056
- Söderström O, Paasche T, Klauser F (2014) Smart cities as corporate storytelling. *City* 18:307–320. doi: 10.1080/13604813.2014.906716
- Sorkin M (ed) (1992) *Variations on a Theme Park: The New American City and the End of Public Space*. The Noonday Press, New York
- Steaey CN, Williams BS, Pettersen CL, Kurtz HE (2016) Placing the “Analyst” in Discourse Analysis: Iteration, Emergence and Dialogicality as Situated Process. *Prof Geogr* 68:166–173. doi: 10.1080/00330124.2015.1065550
- Streeten P (1981) *First Things First: Meeting Basic Human Needs in Developing Countries*. Oxford University Press, Oxford, New York
- Suárez-Casado M (2016) De las smart cities a los smart citizens . La ciudadanía frente a la tecnología en la construcción de resiliencia urbana. *URBS Rev Estud urbanos y ciencias Soc* 6:121–129
- Suárez M, Gómez-Baggethun E, Benayas J, Tilbury D (2016) Towards an Urban Resilience Index: A Case Study in 50 Spanish Cities. *Sustainability* 8:774. doi: 10.3390/su8080774
- Sumi A (2007) On several issues regarding efforts toward a sustainable society. *Sustain Sci* 2:67–76. doi: 10.1007/s11625-006-0021-6
- Talen E (2015) Do-it-Yourself Urbanism: A History. *J Plan Hist* 14:135–148. doi: 10.1177/1538513214549325
- Thomas V, Wang D, Mullagh L, Dunn N (2016) Where’s wally? In search of citizen perspectives on the smart city. *Sustain* 8:1–13. doi: 10.3390/su8030207
- Timmermans W, Van den Goorbergh F, Slijkhuis J, Cilliers EJ (2013) *The Story behind the Place - Place-making and Storytelling*. Van Hall Larenstein, Delft

- Townsend A, Maguire R, Liebhold M, Crawford M (2010) *A planet of civic laboratories: The future of cities, information and inclusion*
- Townsend AM (2013) *Smart cities: big data, civic hackers, and the quest for a new utopia*. Norton & Co., New York
- UNDP (1990) *Human Development Report: Concept and Measurement of Human Development*. Washington D.C.
- United Nations (2018) *World Urbanization Prospects: The 2018 Revision*
- Vaiou D, Kalandides A (2016) Practices of collective action and solidarity: reconfigurations of the public space in crisis-ridden Athens, Greece. *J Hous Built Environ* 31:457–470. doi: 10.1007/s10901-015-9468-z
- Van Dierendonck D (2011) Spirituality as an Essential Determinant for the Good Life, its Importance Relative to Self-Determinant Psychological Needs. *J Happiness Stud* 13:685–700. doi: 10.1007/s10902-011-9286-2
- van Dijk TA (1997) The study of discourse. In: van Dijk TA (ed) *Discourse as Structure and Process*. Sage, London
- van Raan AFJ, Tijssen RJW (1993) The neural net of neural network research. *Scientometrics* 26:169–192. doi: 10.1007/BF02016799
- Vanolo A (2016) Is there anybody out there? The place and role of citizens in tomorrow's smart cities. *Futures* 82:26–36. doi: 10.1016/j.futures.2016.05.010
- Veenhoven R (2007) Subjective Measures of Well-being. In: McGillivray (ed) *Human Well-being, Concept and Measurement*. Palgrave /McMillan, Houndmills, New Hampshire, USA, pp 214–239
- Veenhoven R (2000) The four qualities of life. *J Happiness Stud* 1:1–39. doi: 10.1023/A:1010072010360
- Veenhoven R (1997) Advances in understanding happiness. *Rev québécoise Psychol* 18:29–74
- Veenhoven R (2003) Happiness. *Psychologist* 16:128–129
- Vemuri AW, Costanza R (2006) The role of human, social, built, and natural capital in explaining life satisfaction at the country level: Toward a National Well-Being Index (NWI). *Ecol Econ* 58:119–133. doi: 10.1016/j.ecolecon.2005.02.008
- Vilarroya Ò (2013) An Experientially-Based Informationless Communication. In: Massip-Bonet À, Bastardas-Boada A (eds) *Complexity Perspectives on Language, Communication and Society*. Springer Berlin Heidelberg, Berlin, Heidelberg, pp 61–73
- Vilarroya Ò (2002) *The Dissolution of Mind: A Fable of how Experience Gives Rise to Cognition*. Rodopi, Amsterdam
- von Borgstede C, Johansson L-O, Nilsson A (2013) Social dilemmas: Motivational, individual and structural aspects influencing cooperation. In: Steg L, van den Berg A, de Groot JIM (eds) *Environmental Psychology: An Introduction*. BPS Blackwell, West Sussex, UK, pp 175–184
- Watson D, Clark LA (1994) *The PANAS-X: Manual for the Positive and Negative Affect Schedule - Expanded Form*
- Watts DJ, Strogatz SH (1998) Collective dynamics of “small-world” networks. *Nature* 393:440–2. doi: 10.1038/30918
- WCED (1987) *Our Common Future*. Oxford University Press, USA
- Webler T, Kastenholz H, Renn O (1995) Public participation in impact assessment: A social learning perspective. *Environ Impact Assess Rev* 15:443–463. doi: 10.1016/0195-9255(95)00043-E
- Weiner E (2008) *The geography of Bliss*. Black Swan, London

West GB (2017) *Scale: The universal laws of life and death in organisms, cities and companies*. Weidenfeld & Nicolson, London

Wiek A, Ness B, Schweizer-Ries P, et al (2012) From complex systems analysis to transformational change: a comparative appraisal of sustainability science projects. *Sustain Sci* 7:5–24. doi: 10.1007/s11625-011-0148-y



2.

Conceptual analysis

2.1 UNDERSTANDING THE CONCEPT OF HAPPINESS

In this Section, we will deepen on the happiness literature with the use of bibliometric research and co-word analysis. We created our database using the author keywords of all articles published in three ISI-JCR indexed journals related to 'happiness studies': Journal of Happiness Studies, Journal of Positive Psychology and Applied Research in Quality of Life from 2000 to 2016. The aim is to investigate the happiness framework as scientists viewed it and constructed it during the past years (Papachristou and Rosas-Casals 2019a). We used this alternative, less theoretical approach to reveal further insides from this field.

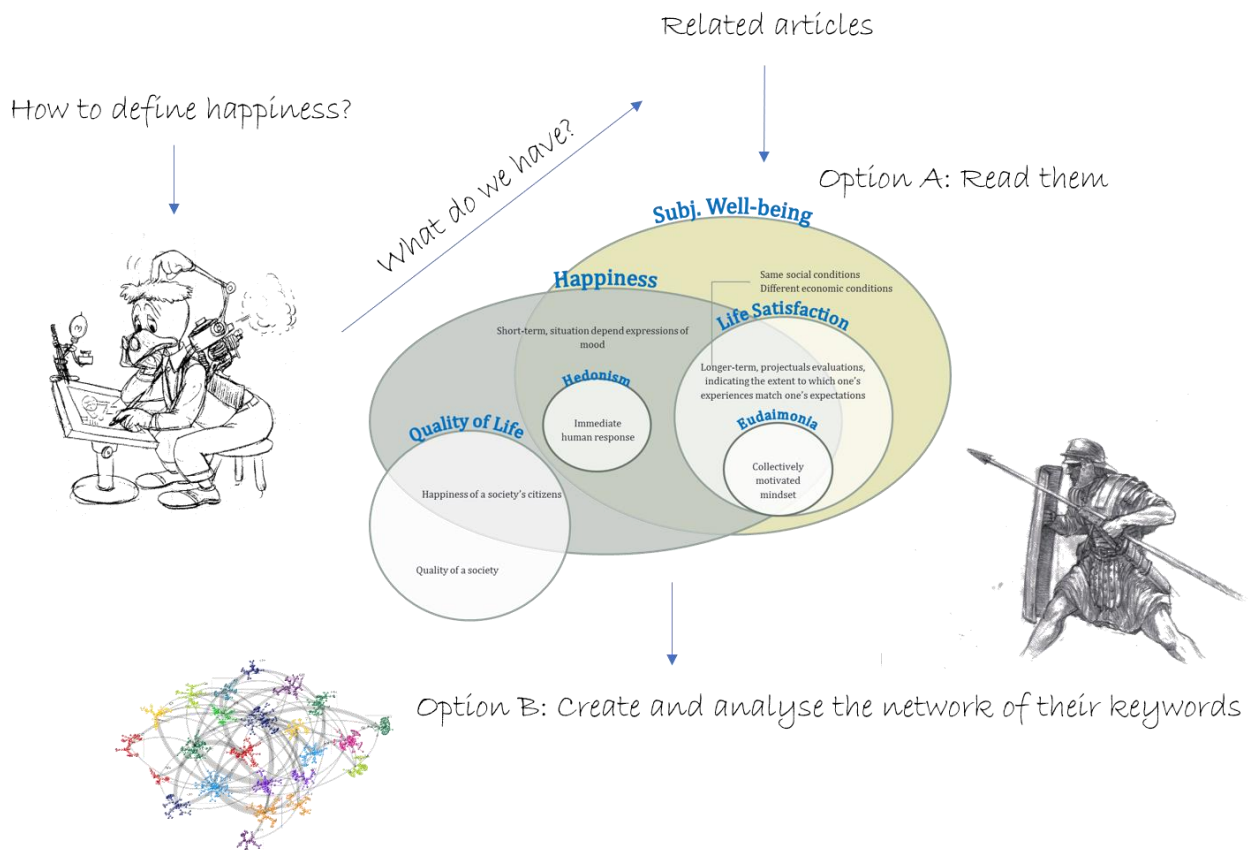


Figure 9: Assessing the happiness concept.

2.1.1 DATA COLLECTION

Our dataset is combined of author keywords from all papers of three ISI-JCR indexed journals that address the conceptualisation, measurement, explanation and evaluation of happiness, well-being, human satisfaction, human development, wellness and quality of life. These are the Journal of Happiness Studies (J HAPPINESS STUD), Journal of Positive Psychology (J POSIT PSYCHOL) and Applied Research in Quality of Life (APPL RES QUAL LIFE). All items in the collections are publications written in English between 2000 and 2016.⁸ Although considering publications only in English is a limitation, it represents by far the largest component of the scholarly literature. It also ensures consistency of records and facilitates automatic text parsing.

⁸ J HAPPINESS STUD is the only Journal existing since 2000. J POSIT PSYCHOL and APPL RES QUAL LIFE made their appearance in 2006. Nevertheless, for abbreviation, we will mention that our period span is between 2000 and 2016.

2.1.2 MAIN STATISTICS

Up until year 2016, our “happiness studies” dataset contains 1,607 records: 778 (48%), 442 (28%) and 387 (24%) from J HAPPINESS STUD, J POSIT PSYCHOL and APPL RES QUAL LIFE, respectively (Figure 10). We observe an increase in the cumulative number of published articles per year that follows an exponential function of the form $y \sim \exp(\alpha t)$ – where t represents time, with an exponential parameter $\alpha = 0.27 (R^2 = 0.97)$ – in accordance to other several cases of emergence of new scientific fields (Bettencourt and Kaiser 2015). The cumulative number of author keywords for the “happiness” network (Hn) reaches a value of 3,491 for year 2016 and follows a similar growth exponential trend – with $\alpha = 0.23 (R^2 = 0.98)$.

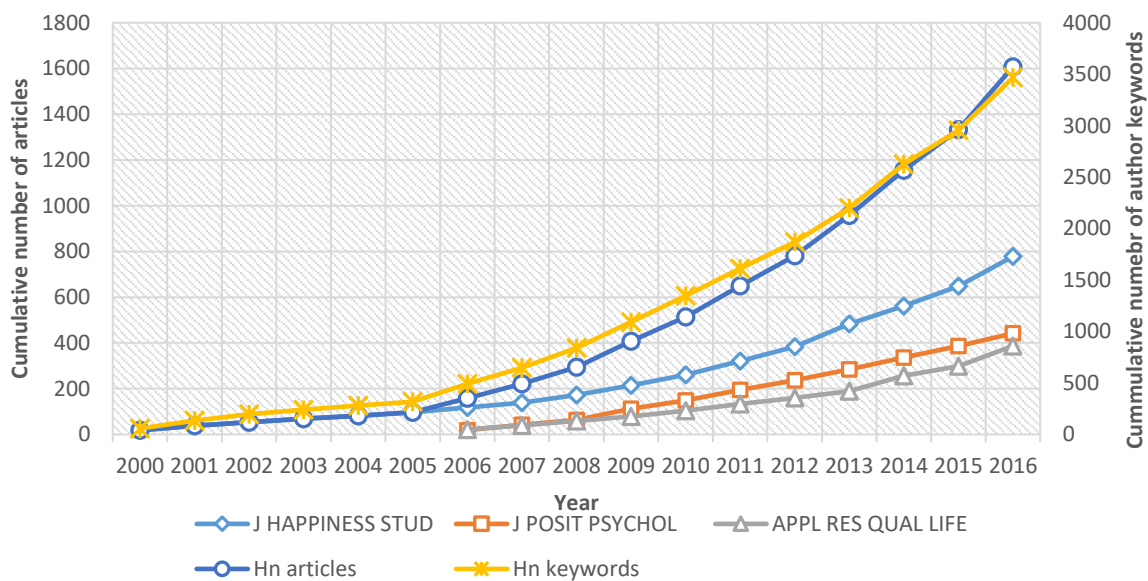


Figure 10: Cumulative number of articles (per journal and in total) and unique author keywords, per year.

2.1.3 THE “HAPPINESS” NETWORK

2.1.3.1 FREQUENT TERMS

We plotted the co-occurrence of the most frequent keywords in an article in the form of a network (Figure 11) for each journal separately and in total. We created the graphs using Gephi software (Bastian and Heymann 2009). For the layout we used ForceAtlas 2 algorithm (Jacomy et al. 2014). The size of the nodes (keywords) shows us their frequency and the thickness of the edges (links) the times they appeared together (weight). In Figure 5 (i) J HAPP STUDIES network topology is dense with a strong nucleus reflecting high frequency keywords such as “happiness”, “subjective well-being”, “life satisfaction” and “well-being” that have many connections to peripheral nodes (keywords). In (ii), J POSIT PSYCHOL network also appears with a strong nucleus combined by “positive psychology” and “well-being”, fewer connections to the peripheral nodes and more hierarchical structure than in (i). In (iii), APP RES QUAL LIFE forms a sparse network dominated mainly by “quality of life” and few connections to peripheral nodes. Finally, in (iv), the combined network of the three journals shows a topology similar to (i) but with many more connections and a clearer hierarchical structure.

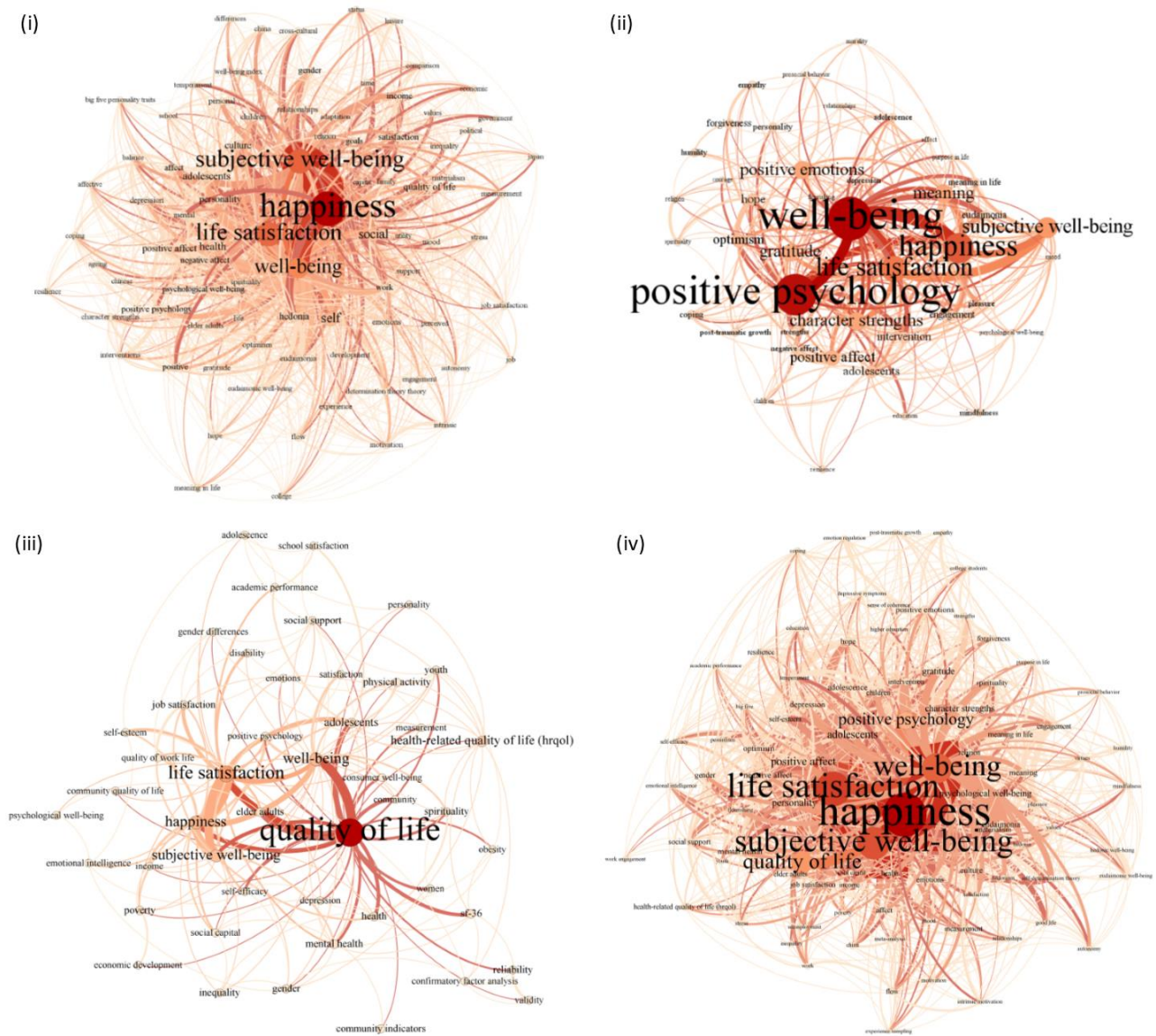


Figure 11: The four graphs represent the connections between the most frequent keywords of i) the J HAPPINESS STUD articles, ii) the J POSIT PSYCHOL articles, iii) the APPL RES QUAL LIFE articles and iv) the total of articles. The size of the nodes represents the frequency of occurrence while the thickness of their links the times they appear together (weight).

2.1.3.1 CONNECTIVITY

In Figure 12, we show the evolution of the topology of Hn in terms of four commonly used network centrality indices (i.e., degree, diameter, average path length and average clustering coefficient) and the percentage of nodes in the connected component (i.e., the subgraph in which any two vertices are connected to each other by paths). A giant connected component, which contains between 88% and 95% of the nodes (i.e., keywords) through the years, constantly dominates its topology. Average degree $\langle k \rangle$ increases from $\langle k \rangle = 7.66$ in year 2000 to $\langle k \rangle = 9.14$ in year 2016. Diameter D and average path length $\langle d \rangle$ increases as well over time with the number of new nodes added, but they seem to stabilise from year 2011 onwards. Clustering coefficient C decreases slightly, from 0.904 in year 2000 to 0.867 in year 2013, with a constant value up to 2016.

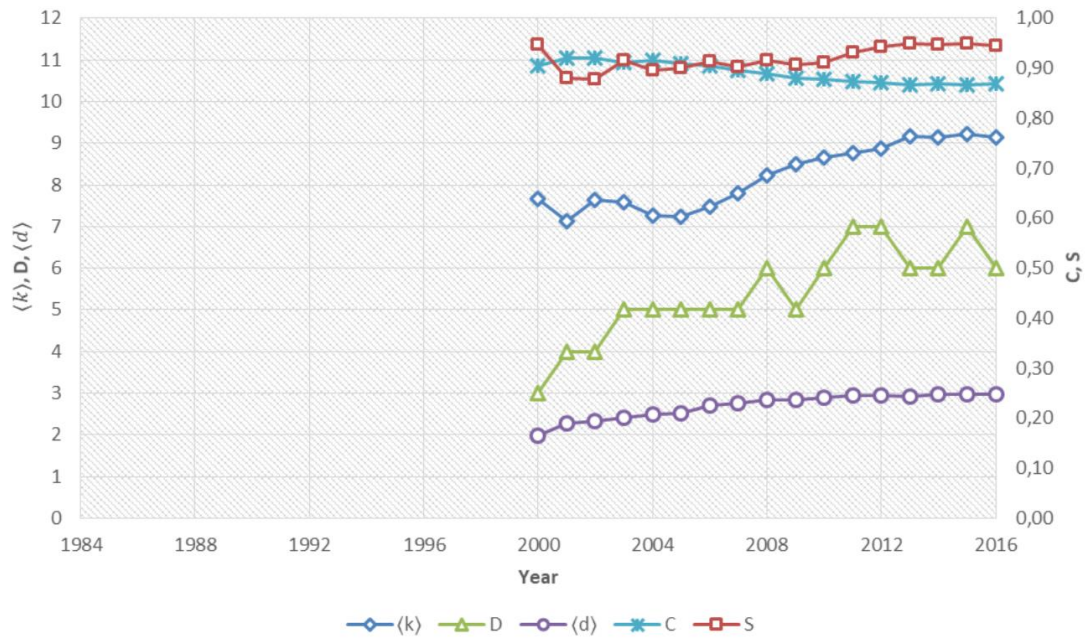


Figure 12: Emergence of Hn in terms of average degree $\langle k \rangle$, percentage of nodes in giant connected component S , diameter D , average path length $\langle d \rangle$ and average clustering coefficient $\langle C \rangle$.

At year 2016, the Hn degree cumulative probability distribution appears fat-tailed, with the most connected nodes being happiness (H), life-satisfaction (LS), subjective well-being (SWB), well-being (WB), quality of life (QoL) and positive psychology (PP) (see Figure 13 and Table 5). Hn shows a slightly negative nearest neighbour degree correlation (results not shown in the text), implying a disassortative behaviour where hubs tend to avoid each other, linking mainly to small-degree nodes, and making communities of similar keywords difficult to appear (Barabási 2016).

Table 2: Most connected keywords in J HAPPINESS STUD, J POSIT PSYCHOL, APPL RES QUAL LIFE and Hn, in year 2016 (cumulated data from 2000). Degree shown in parenthesis.

APPL RES QUAL LIFE	J HAPPINESS STUD	J POSIT PSYCHOL	Hn
Quality of life (224)	Happiness (535)	Positive psychology (178)	Happiness (652)
Life satisfaction (102)	Life satisfaction (324)	Well-being (167)	Life satisfaction (463)
Subjective well-being (69)	Subjective well-being (319)	Happiness (123)	Subjective well-being (429)
Happiness (66)	Well-being (228)	Life satisfaction (111)	Well-being (401)
Well-being (61)	Quality of life (91)	Subjective well-being (96)	Quality of life (309)
Health-related quality of life (61)	Positive affect (90)	Meaning/ positive emotions (87)	Positive psychology (244)

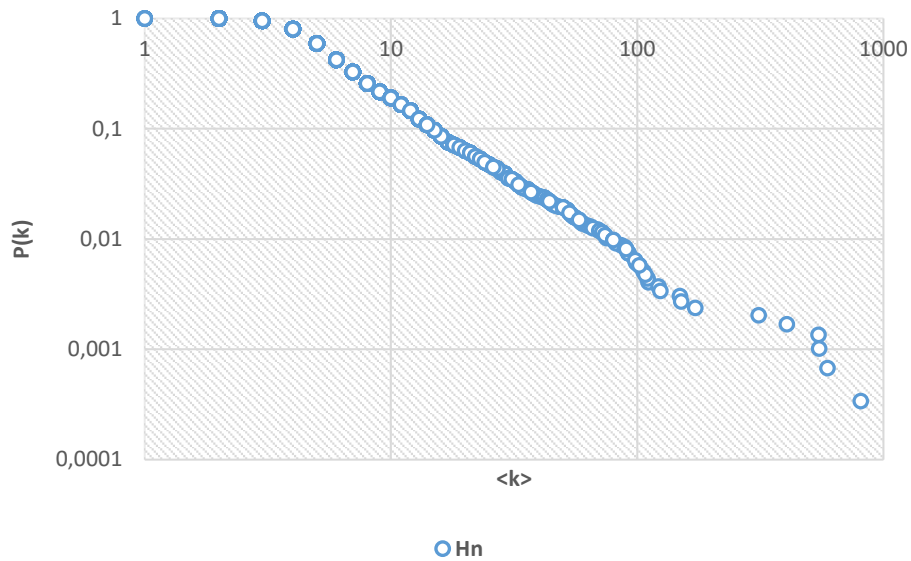


Figure 13: Cumulated degree probability distribution P_k for Hn (blue dots) in log-log plot.

Finally, we are interested in detecting possible pairwise correlations among keywords using weighted degree. As shown in Figure 14, node degree and node strength are not correlated, and nodes with extremely high degree values (Table 5, column Hn) are characterised by relatively low strengths. The variability in the weighted degree is marginal for the most connected nodes: in descending order, H ($k = 652$), LS, SWB, WB, QoL and PP ($k = 244$). Special mention deserves WB, with $k = 336$ but $s = 0.1$ (red triangle in the graph), which indicates a very low connectivity in terms of co-occurrence with the rest of the keywords. The probability distribution of edge weights (Figure 14, inset) – which fits an exponential function – shows that the connectivity is not dominated by especially strong links between keywords.

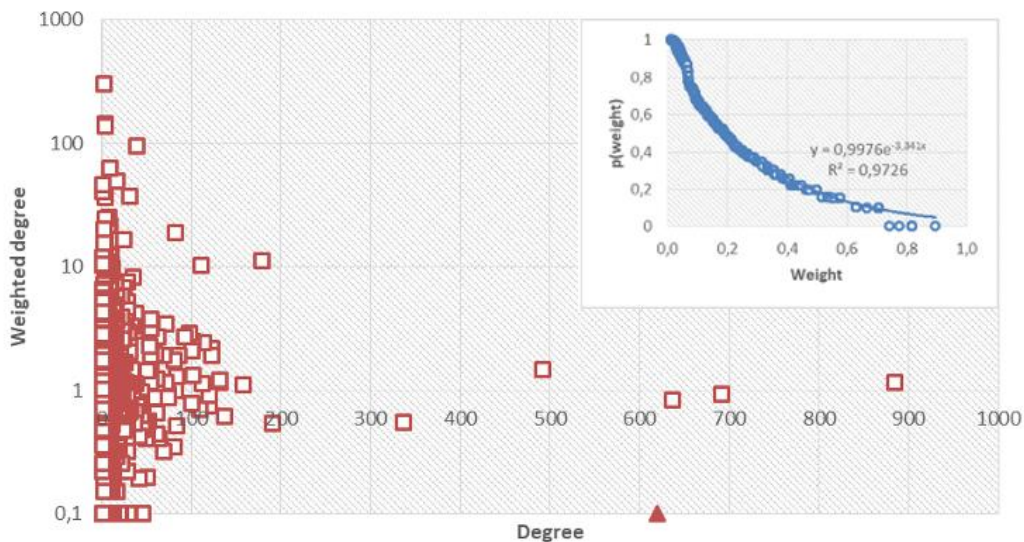


Figure 14: Topological degree vs. weighted degree and cumulated probability distribution of weights (inset) for the Hn.

2.2 INTERSECTING HAPPINESS AND URBAN STUDIES FIELDS

Although there have been numerous attempts to measure and analyse the factors that affect quality of life in cities and regions (Ballas 2013), and even construct alternative, non-monetary indices of social and economic well-being in urban planning (Khalil 2012), how happiness concepts have penetrated urban planning, at which pace, and how they have been included in the urban studies field has not yet been assessed in the literature (Papachristou and Rosas-Casals 2019a). In this Section, we map the temporal evolution of the fields of happiness and urban studies into dynamic networks obtained by paper keywords co-word analysis. We identify the main concepts of the “urban happiness” field and their capacity to agglomerate into coherent thematic clusters. We find that while quality of life and well-being are highly interconnected with some well-defined urban categories, other happiness-related concepts, as subjective well-being or happiness itself, are located in peripheral positions where their influence is minimised. We present a one-parameter spatial network model to reproduce the changes in the topology of these networks. Results explain the evolution and the level of interpenetration of these two fields as a function of “conceptual” distances, mapped into Euclidean ones. In addition to other approaches (i.e., co-frequency matrix of bibliometric analysis), complex networks science appears as a valid alternative and opens the way for the systematic study of other academic fields in terms of complex evolving networks.

2.2.1 “URBAN-HAPPINESS” NETWORK STATISTICS

For the “urban-happiness” network (Uhn), we conducted a search in Scopus database using the keywords with maximum degree in Hn (Table 5, column Hn).⁹ Our data include 793 published (or pre-published online) articles from the 39 journals indexed in Urban Studies category of ISI Web of Knowledge (see Appendix A) between years 1971 and 2016¹⁰. For the network analysis, we considered only articles with author keywords, resulting in a list of 1,826 unique keywords associated with both happiness and urban studies categories, and a network of 5,737 edges, as shown in Figure 15. We created the graph again using Gephi software (Bastian and Heymann 2009) and ForceAtlas 2 algorithm (Jacomy et al. 2014) for the layout representation. Here, the size of a node is proportional to its degree and colours represent clusters (also known as modules) according to Blondel et al.’s modularity algorithm (Blondel et al. 2008).

⁹ Positive psychology gave no search results in the bibliographic search of the Urban Studies category.

¹⁰ The first article of our database with author keywords appeared in 1984.

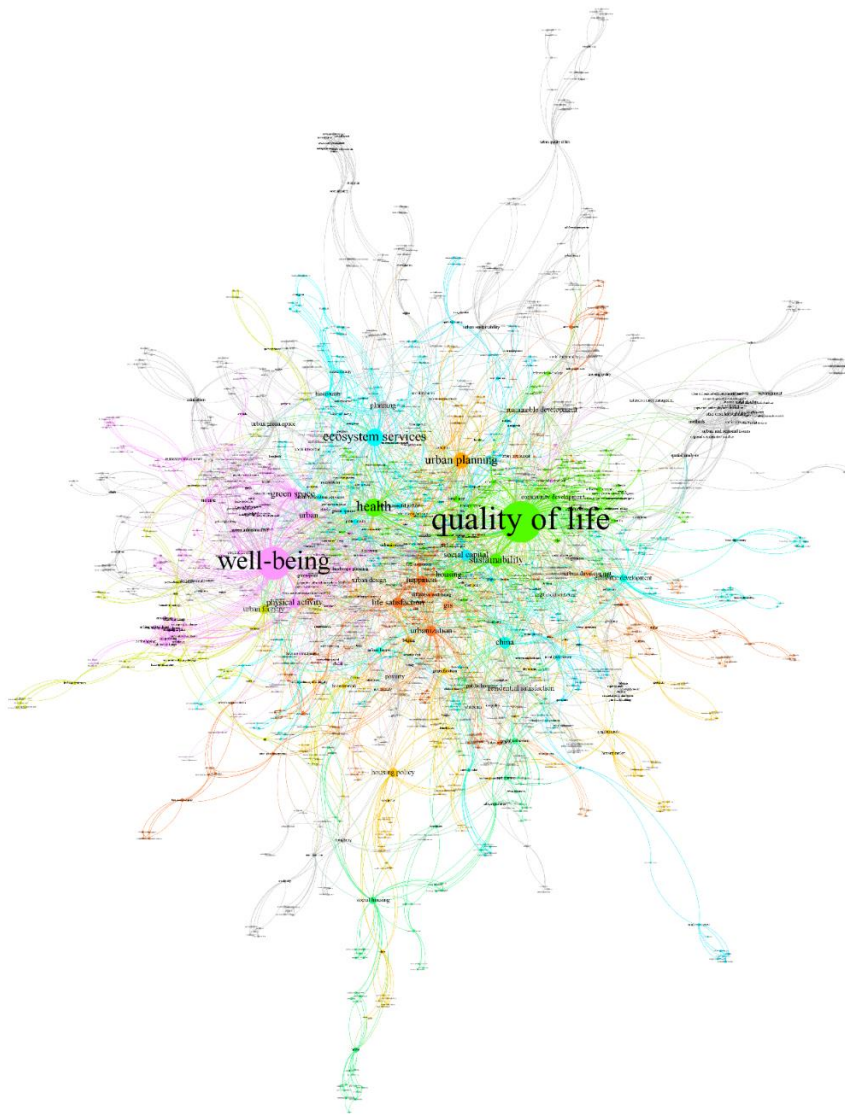


Figure 15: Overall aspect of the UH network. The size of a node is proportional to its degree and the colours represent the different clusters.

The evolution of the topology of Uhn in terms of the same centrality indices used for the Hn case (i.e., degree, diameter, average path length and clustering coefficient) and the percentage of nodes in the connected component is shown in Figure 16.¹¹ In this case, a primitive connected component appears in 1984, but the percentage of nodes in the giant connected component S begins to increase in 1998, including 15% of the total network, and reaches 80% of the nodes in 2016. Average degree $\langle k \rangle$ increases from $\langle k \rangle = 2.667$ in year 1998 to $\langle k \rangle = 6.828$ in year 2016. Here, diameter D and average path length $\langle d \rangle$ increase more steeply than in the Hn case, but unlike the later, they do not display a stable behaviour over time. The clustering coefficient C decreases slightly, from 1.0 (where keywords appear as cliques in each paper) to 0.872 in 2016. Similarly to Hn, at year 2016, the degree cumulative probability distribution appears fat-tailed, with most connected nodes being QoL (194) and WB (154) and followed by “health”, “ecosystem services”, “urban planning” and “sustainability” (Table 3). Uhn shows no nearest neighbour degree correlation and uncorrelated strength and degree (results not shown in the text).

¹¹ An interactive web widget to explore Fig. 11 can be found at <https://summlabbd.upc.edu/papachristou-et-al>. Widget created and designed in Gephi (<https://gephi.org>) and for Mozilla Firefox (<https://www.mozilla.org>) web browsers.

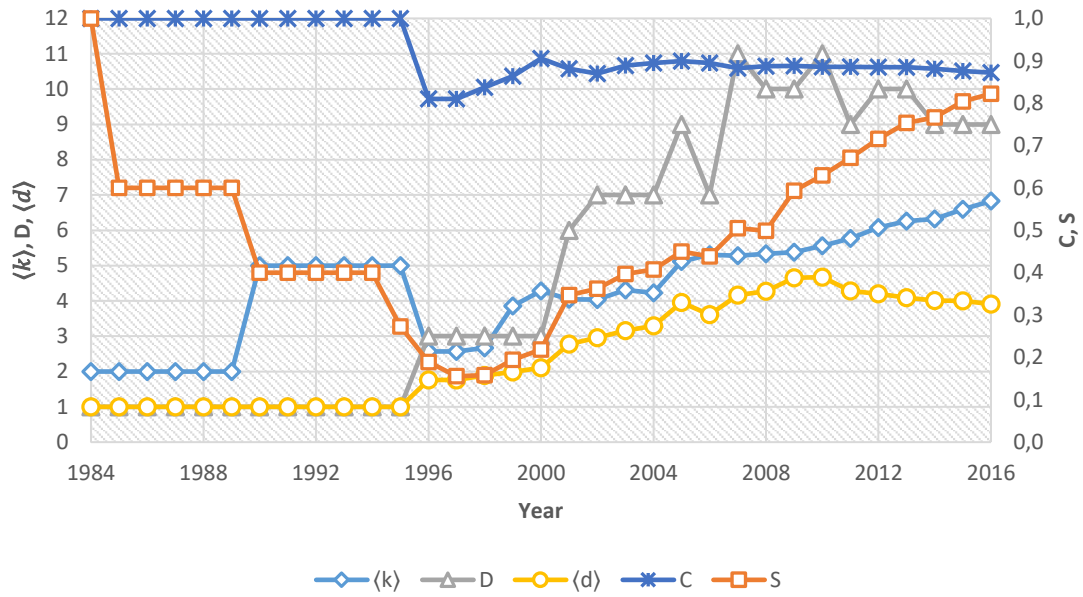


Figure 16: Emergence of Uhn in terms of mean degree, % of nodes in giant connected component, diameter, average path length and clustering coefficient.

Table 3: Most connected elements in Uhn, in year 2016 (cumulated data from 1984). Degree shown in parenthesis.

Uhn	
Quality of life	(194)
Well-being	(154)
Health	(81)
Ecosystem services	(77)
Urban planning	(68)
Sustainability	(65)

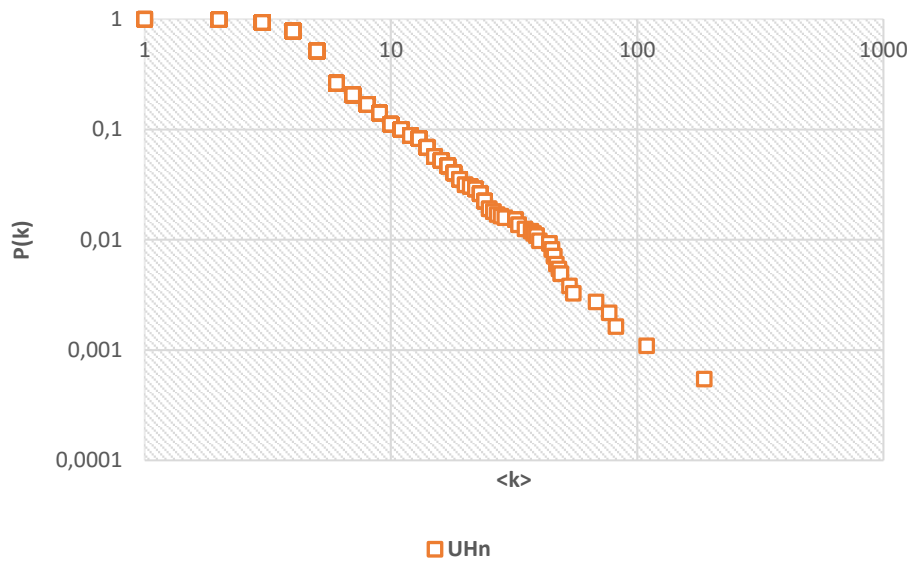


Figure 17: Cumulated degree probability distribution P_k for Uhn (red squares) in log-log plot.

2.2.2 TEMPORAL EVOLUTION

Although the first article of our database was published in 1971, the earliest one including author keywords appeared in 1984. To avoid bias, we firstly underwent a manual literature research within the initial database, based on the citations received by each article. We then focused on the results of the author keywords' network. Figure 18 represents the percentage of articles according to their year of publication and continent of origin. We observe the clear dominance of Europe and North America and a noticeable upsurge in Asia during the last decade, mostly led by Chinese scholars.

QoL first appeared in the early 1970s in North America, connected with free time activities and urban planning law (Chapin 1971). In fact, planning and measurement begin to dominate the narrative during this decade, including comprehensive urban planning of cities (Heskin 1972), aspects related with policies and metropolitan areas (Mogulof 1975) and optimum city size (Hoch 1977), and interspatial and intertemporal measurement methods (Gillingham and Reece 1979). WB first appearances were also connected with measurement, in relation with the potential role of remote sensing in human settlements (Hidalgo and Musa 1976). Soon enough, though, the concept connected with outdoor physical activities (Nash 1979) and urban green (Lewis and Sturgill 1979). During the 1980's, the most-cited article regarding the subject states that "highly valued urban open spaces are those which enhance the positive qualities of urban life: variety of opportunities and physical settings, sociability and cultural diversity" (Burgess et al. 1988). First publications in Europe turn the focus on "reconquering" the cities to re-achieve quality of life (Papageorgiou-Venetas 1983) and, for the first time, computer modelling for the urban settlement are considered to achieve efficiency, stimulate employment and sustain a good quality of life for all inhabitants (Juppenlatz 1983). In Asia, the initial paper in this field mentions "the need for public intervention to reduce urban congestion, ecological damage and protect QoL" (Plaut 1983), thus connecting QoL with pollution and environmental protection. The 1990's saw the appearance of the most-cited article in our database. Following the blossoming of land use and land cover computational techniques (i.e., GIS) and theories as means to understand environmental changes, Chester L. Arnold and C. James Gibbons first connected the quality of life of a community with water resources and impervious land cover in 1996 (Arnold and Gibbons 1996). Other complementary and also important topics of the period include how the use of public space by adults affects the well-being of children (Valentine 1996), how homeownership benefits both renters' and owners' life satisfaction (Rossi and Weber 1996) and how nature affects the well-being of workforce (Kaplan 1993). The appearance of South America, Africa and Oceania in the debate turn the focus on more concrete social urban problems like the participation of popular movements in the fight for improvements and the process of democratizing the local power (Bava 1990), spatial inequality (Chokor 1991) and housing stress (Kearns et al. 1992), to name just a few. The introduction of H is made through a criticism on Victor Gruen's view of a good urban form (Hill 1992) but its presence is minimal until year 2004, when it appears mostly related with socioeconomic issues (Priemus 2004; Andersson 2004).

With the turn of the century, we observe an important increase in the number of publications (see Figure 18), possibly affected by the appearance of the "happiness" journals (see Figure 10) rather than the appearance of new urban Journals¹². The focus on urban ecosystems and green is obvious. Urban parks and the sustainable city (Chiesura 2004), ecosystem and human health in urban areas using green infrastructure (Tzoulas et al. 2007), biodiversity concepts and urban ecosystems (Savard et al. 2000) and the effects of urban patterns on

¹² The 95% of the urban Journals appeared before the new millennium (see Appendix A).

ecosystem function (Alberti 2005) are some of the most important subjects associated with QoL and WB that concern scholars and scientists. The link between ecosystem services and well-being derives from the global scholarly discussion that the Millennium Ecosystem Assessment¹³ stimulated during the first decade of this century, with the objective to put at the front of the scientific debate the consequences of ecosystem change for human well-being.

During the current decade we still observe a focus on urban green, environmental justice (Wolch et al. 2014) and its positive effect on stress and WB (Ward Thompson et al. 2012). But we also clearly detect a new upcoming subject associated with the “smart” concept, like smart city initiatives and their potential on enhancing QoL (Neirotti et al. 2014). Last but not least SWB makes at last its appearance as a society’s measure of success during this decade (Leyden et al. 2011).

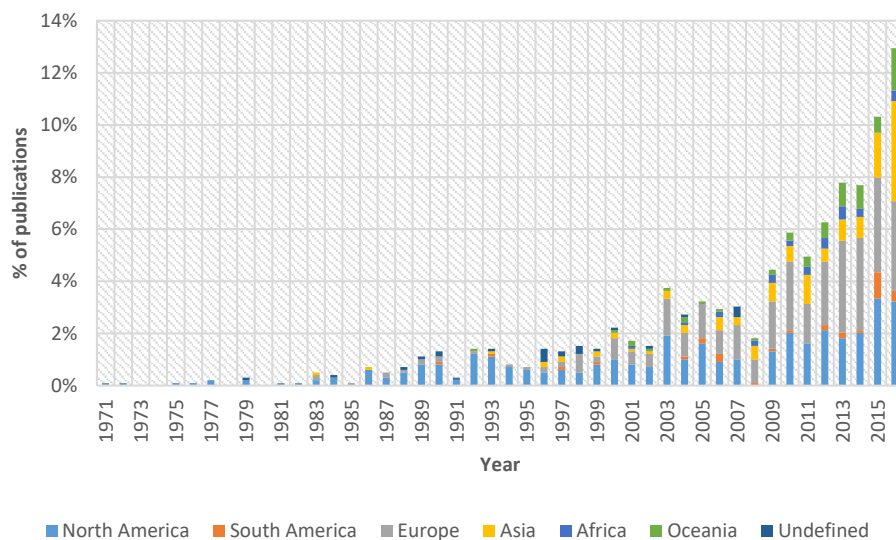


Figure 18: Percentage of articles related with the happiness field and within the urban studies category per year and continent.

The analysis of the temporal evolution of Uhn offers the possibility to observe the coalescence of several urban fields around concepts related with happiness (Figure 19). We observe the predominance of QoL and WB and the late entrance of SWB and H, in years 2004 and 2011 respectively. Regarding the rest of Uhn’s most connected keywords (Table 3), *health* entered the graph in 2003, *ecosystem services* in 2009, *urban planning* in 2000 and *sustainability* in 2006.

¹³ Reports spanning years 2000 – 2005 (<http://millenniumassessment.org/>).

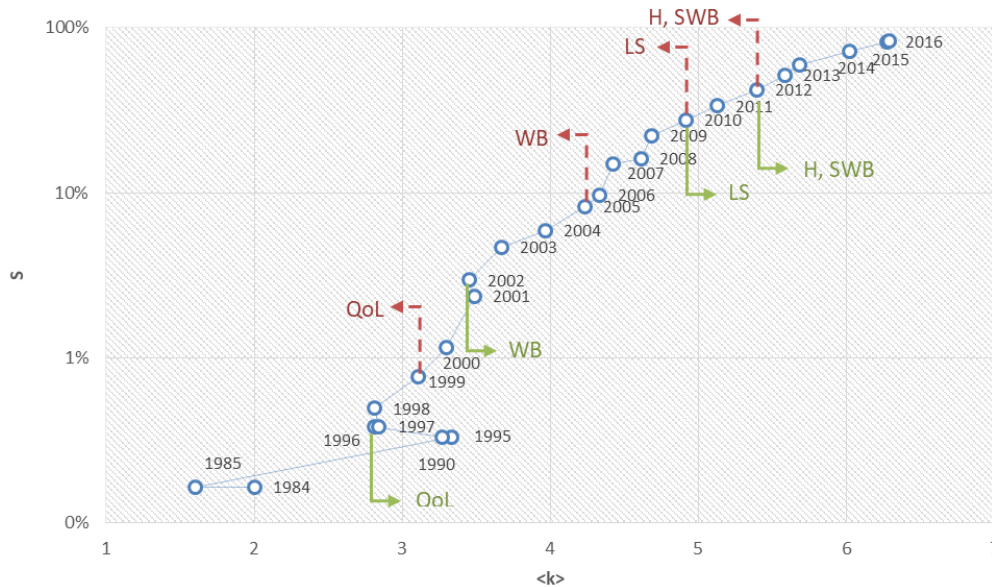


Figure 19: Percentage of nodes (cumulative) in the giant components as a function of $\langle k \rangle$ in linear-log plot. Green continuous arrows show the year of appearance of the most connected keywords of Hn in Uhn and red dashed arrows the year of connection of these keywords to the Uhn's giant component. Keywords appear directly connected to the giant component as the graph increases its size (i.e., number of keywords) over time.

2.2.3 CLUSTER ANALYSIS

We use cluster (or modularity) analysis to recognise communities (also called modules, groups or clusters). Networks with high modularity have dense connections between the nodes within modules but sparse connections between nodes in different modules. We run a modularity algorithm (Blondel et al. 2008) over the giant connected component of Uhn (Figure 15), which segregates the network into 27 clusters, with 40.4% of all keywords included in the first eight of them (sorted by decreasing size). Remarkably, except for *positive psychology*, all Hn keywords in Table 2 are included in the first three clusters. Clusters 1, 2 and 3 are shown in Figure 20(ii), (iii) and (iv) respectively, where keywords are plotted according to their closeness c_i , betweenness b_i and degree k_i (size of the bubble) centrality measures. All three measures are positively correlated. Cluster 2 (Figure 20(iii) in red) shows a more significant dispersion in terms of b_i . For the keywords in this cluster, this trend suggests a more distributed capacity to act as separated connectors (i.e., to be in the shortest paths) between other words. That is, a cluster with truly differentiated words and meanings. On the contrary, cluster 1 (Figure 20(ii) in blue) shows a higher concentration of words in the range $10^3 < b_i < 10^5$ and with little variance in k_i , which implies a more densely connected community with stronger connections between concepts and words. This kind of connectivity suggests a cluster with undifferentiated words, maybe with similar meanings, and a lower capacity for them to act as distinctive connectors. Cluster 3 (Figure 20 (iv) in green) shows similarities with cluster 1 in terms of b_i and with cluster 3 in terms of k_i . In a more precise way:

- Cluster 1 (253 keywords) is dominated by ecosystem services and urban design and planning. *Social capital*, *urban green*, and *biodiversity*, including tools such as *geographical information systems* (GIS) are also part of this cluster. Although H, SWB and LS appear in the cluster, they are not central elements of the system, with intermediate values of c_i , b_i and k_i (Figure 20(ii)). LS enters the graph in 2009 and directly connects to the giant component (Figure 19). It makes an entrance in its cluster externally, directly depending on *urbanisation* and indirectly from the central concept of *urban*

planning. In 2011 LS is still peripheral in the cluster that contains it. SWB and H join both the graph and the giant component in 2011. They both form part of the cluster dominated by *urban design*. H has a higher centrality than SWB. In the period between 1984 and the end of 2016, the biggest cluster changes from that of QoL to that of LS, SWB and H. The three keywords are still not central but connected to the rest of the graph through *urbanisation, social capital* and *urban design*.

- Cluster 2 (245 keywords) is clearly dominated by QoL and includes economic development (with *income* and *low-income housing*) and *health* related aspects of *urbanisation* (Figure 20(iii)). *QoL* appears in 1996 and connects to the giant component in 1999 (Figure 19). At this point of time, it belongs to the biggest cluster and shares a triangle with *urban environment* and *information technology*. It also connects to *public housing, housing policy* and *urban transport*. In 2005, the module containing QoL evolves into a more hierarchical structure, while it continues forming the larger cluster of the giant component. In 2011, QoL module has a similar, although more expanded, form in comparison to the previous period, agglomerating a greater quantity of nodes. *Sustainability, urban planning* and *urbanisation* are some of the concepts connected to it. At the end of 2016, this module shows a clear hierarchical form. High degree and centrality keywords such as *health, housing, sustainability, community development* and *economic development* are connecting QoL to the notions that define the concept itself.
- Cluster 3 (191 keywords) is clearly dominated by WB and includes words more related to the human dimension, like *psychological benefits, attitude, culture* and *deprivation*. *WB* appears in the graph in 2002 (Figure 19) and connects to the giant component in 2005. Two keywords dominate the graph during this period: *WB* and *elderly*. In the 2009 snapshot, *WB* has a dominant centrality shared with *landscape planning* and *recreation*, and it is connected to *leisure activities* and *healing environments*. In 2011, we also observe a triangle of three central elements where *WB* maintains its predominant centrality, and *health* and *physical activity* form the new poles. At the end of 2016, *WB* appears associated with the environment and *green space*.

The remaining clusters (not shown in the text) include keywords interconnected in very specific areas of study. For example, cluster 4 (140 keywords) is certainly dominated by housing-related concepts (i.e., *housing policy, poverty, social housing, housing conditions, homeownership, housing affordability*, etc.) while cluster 5 (135 keywords) is dominated by *China* and Chinese urban issues. Cluster 6 (118 keywords) refers to *sustainable development* regarding *environmental quality, sanitation* and *waste in developing countries*, while clusters 7 (74 keywords) and 8 (58 keywords) are associated with the *sociological aspects of urbanization*, and *landscape perceptions* and *environmental psychology*, respectively.

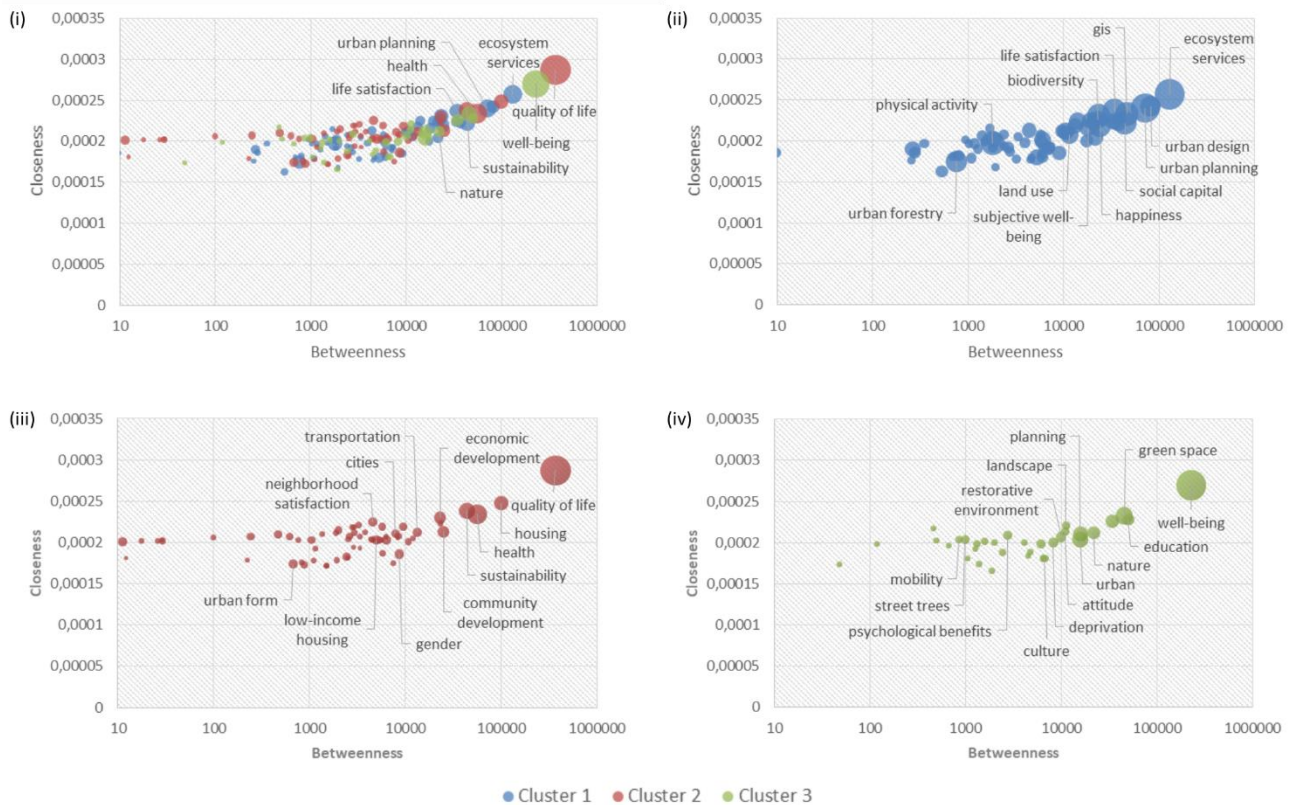


Figure 20: The first three most important clusters in terms of size, and their keywords plotted according to closeness and betweenness centrality measures. Bubble sizes represent the degree of each keyword. (i) The three clusters together. (ii, iii and iv) Cluster 1, 2 and 3 respectively.

2.2.4 EGO-NETWORK ANALYSIS

An ego-network consists of a focal node (ego), a set of alters who have ties to ego, and measurements on the ties from ego to alters and on the ties between alters (Wasserman and Faust 1994). Figure 21 shows ego-networks related to the five main keywords: QoL, WB, LS, SWB and H. Subgraphs were created in NodeXL¹⁴ and took place in five temporal snapshots, corresponding with the connection of each of the keywords to the giant component of the graph (Figure 19). The snapshots of Figure 21 focus on the neighbours and the neighbours of neighbours of the keywords and the connections between them. We observe a star-like structure repeated each time a keyword enters the connected component and characterised by cliques (i.e., keywords in one particular paper) randomly distributed around hubs (i.e., most connected nodes).

¹⁴ <http://nodexl.codeplex.com/>

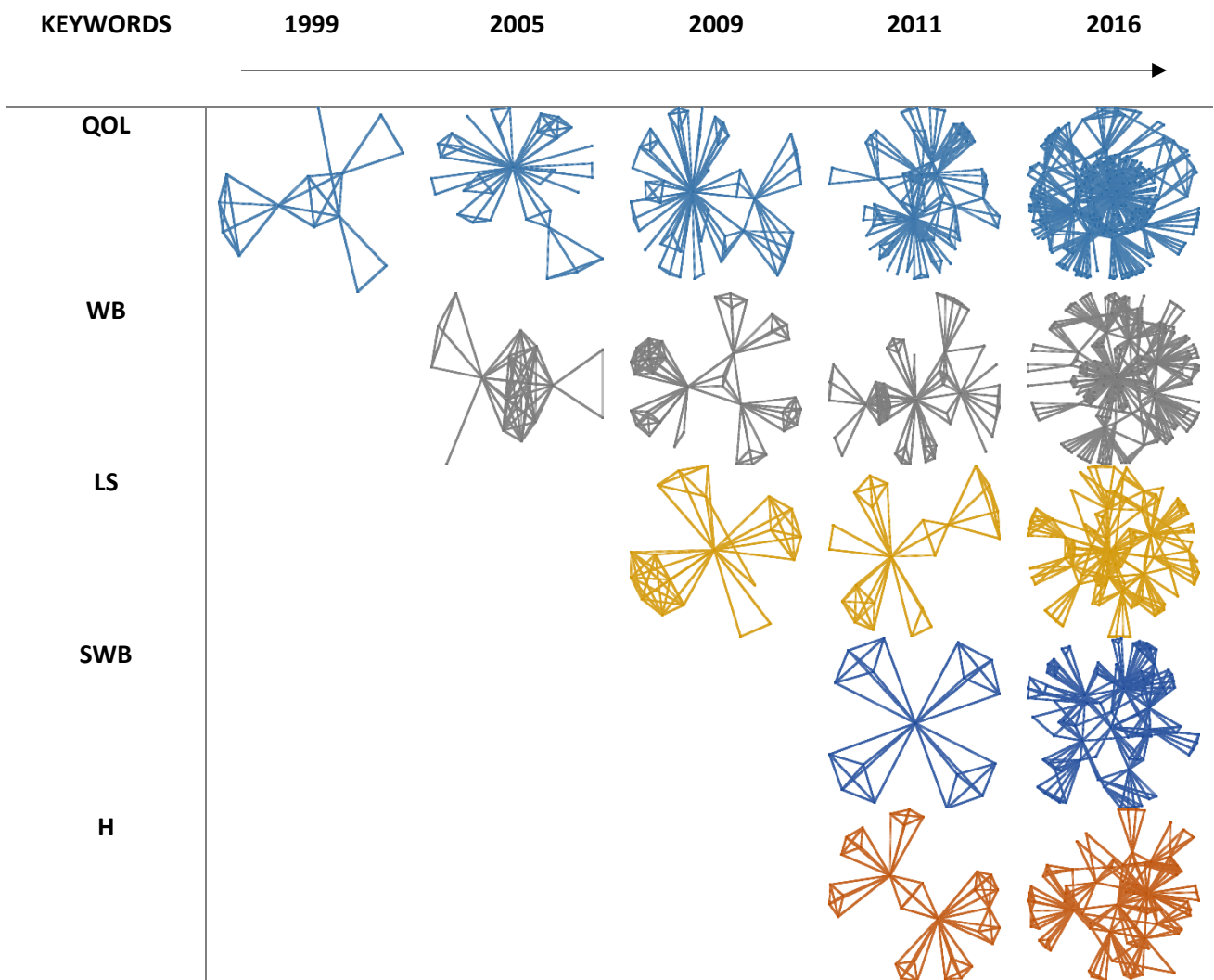


Figure 21: Evolution of the Uhn ego-networks of the most connected keywords of Hn. Network snapshots created in NodeXL using Harel-Koren Fast Multiscale layout (Harel and Koren 2000).

The temporal evolution of network indices for the ego-networks related with keywords QoL, WB, LS, SWB and H, show a striking similarity (Figure 22). For our keywords, the rate of increase of $\langle k \rangle$ (Figure 22, i) and d (Figure 21, ii) is similar, the only difference being the point in time when that a particular keyword makes its entrance in the field. The average increase in $\langle k \rangle$ per year is $\Delta \langle k \rangle = 0.300$, while for the diameter is $\Delta d = 0.793$. The evolution over time of the average path length $\langle d \rangle$ for QoL and WB (Figure 22, iv) reaches a common value in logarithmic form, while the clustering coefficient $\langle C \rangle$ shows more variability, since it depends on how first neighbour keywords of keywords are linked to each other.

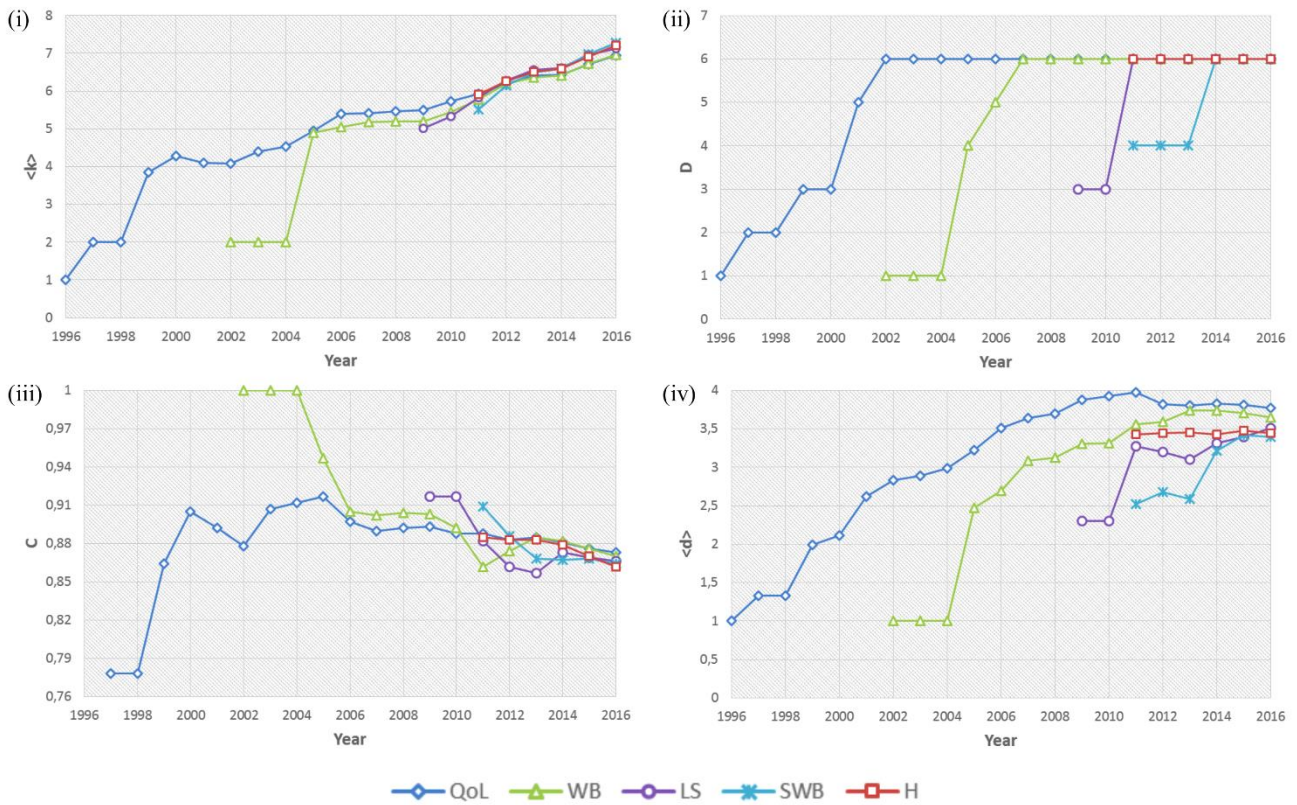


Figure 22: Temporal evolution of four global network indices (i.e., average degree, diameter, average clustering coefficient and average path length) of the ego-networks related with keywords QoL, WB, LS, SWB and H.

Finally, and in order to detect how the connectivity of the network ends up dominated by hubs, we plot the evolution over time (years 1999, 2005, 2009, 2011 and 2016) between average clustering coefficient $\langle C \rangle$ and degree $\langle k \rangle$ for the ego-networks related with keywords QoL, WB, LS, SWB and H (Figure 23). It shows a non-linear power law correlation of the form $\langle C \rangle \sim \langle k \rangle^{-\alpha}$, where $\alpha = 1.035$ ($R^2 = 0.89$), with clustering and degree decreasing and increasing in time respectively.

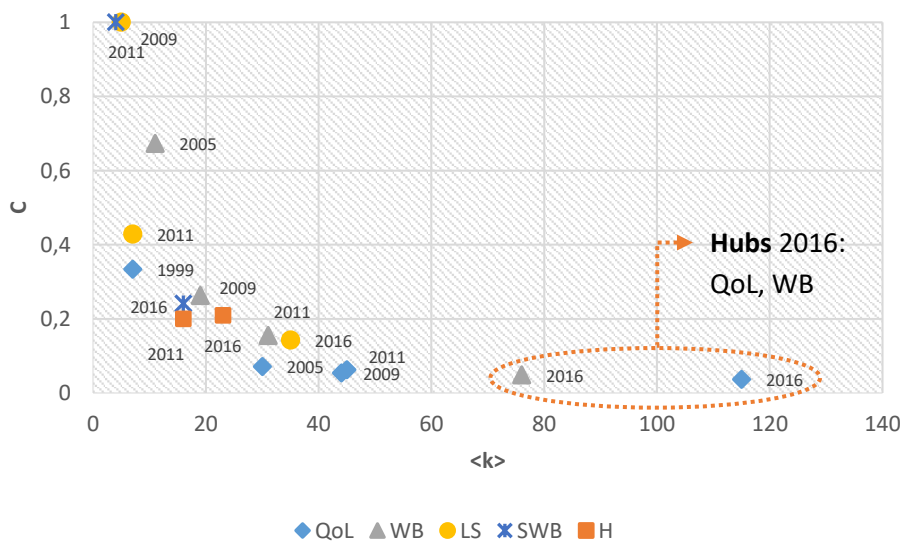


Figure 23: Evolution and correlation over time between average clustering coefficient and average degree, for keywords QoL, WB, LS, SWB and H. The two most connected elements (hubs) which dominate the graph's connectivity for 2016 are QoL and WB.

2.2.4.1 EGO-NETWORKS EVOLUTION MODEL

To explain the structural evolution of the Uhn, we present a simple model of a spatial network that maps spatial Euclidean distances onto categorical (i.e., conceptual) ones.¹⁵ Spatial networks have nodes and edges that are constrained by some geometry and are usually embedded in a two- or three-dimensional space (Barthélemy 2011). Although most research in this field has been focused in searching optimal topologies (Barrat et al. 2004; Marza et al. 2015; Luo et al. 2016), our model aims at reproducing the connectivity pattern of keywords in papers, as a function of the Euclidean spatial distance that acts as the separation (i.e, virtual distance) between academic/scientific fields. The model starts with a node (known as *keyword 0*) placed at the centre of a squared two-dimensional space, linked with other nodes that act as the keywords of the same paper. At every time step t a new paper is located at a randomly chosen position governed by the parameter *paper-radius* (Figure 24). This parameter models the virtual distance between academic fields in terms of Euclidean distance between papers. In this sense, the distance among the keywords of one same paper, *kw-radius*, is inversely proportional to *paper-radius*. The higher the value of this parameter, the longer the distance between keywords of two different papers and the shorter the distance between keywords of one paper. The connectivity between an existing and a new appearing keyword n_t at time t is established with decreasing exponential probability on the Euclidean distance d that separates them:

$$p(n_t, d) \sim \exp(-d) \quad (\text{Eq. 8})$$

To model the fact that keywords located far-away from the central one could be more similar than expected, we introduce a second parameter known as *redundancy*: a random probability of connection between two nodes at a shorter distance than *kw-radius*.

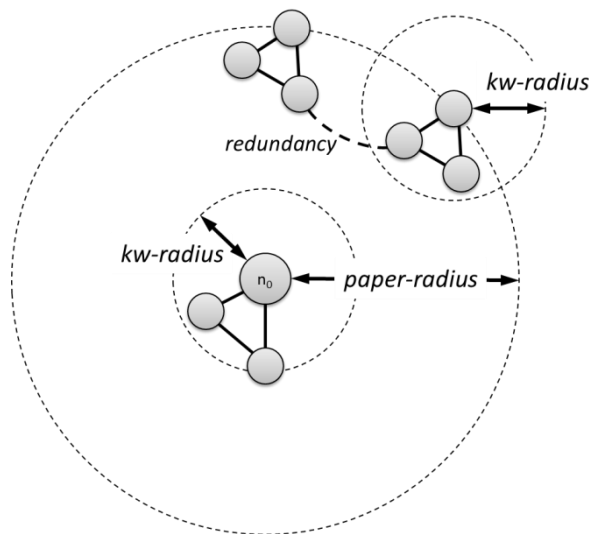


Figure 24: Papers as networks of keywords. The model creates networks (i.e., papers) with nodes as keywords, and uses (a) *paper-radius* as a parameter to map a “conceptual” distance into a Euclidean one, and (b) *kw-radius* (inversely proportional to *paper-radius*) as a parameter to locate the keywords of a paper at a certain distance.

The results of the model for two values of the parameter *paper-radius* and a *redundancy* value of 0.005 show qualitatively a transition between two kinds of networks (Figure 25): (1) When *paper-radius* is low (*paper-radius* = 2), keywords appear in the same geographical zone, i.e., papers appear in very specific and closely

¹⁵ The model is implemented in NetLogo™ 6.0. The descriptive (ODD) information of the model can be found in the “Info” tab. It can be downloaded from <http://tinyurl.com/ycdwpprp>

related, academic fields. The average degree increases almost exponentially, while the diameter decreases over time (Figure 25, i). (2) When *paper-radius* is high (*paper-radius* ≥ 10), keywords appear separated from each other, in different and distant geographical (i.e., conceptual) zones, i.e., papers emerge in very specific but unrelated, academic fields. The average degree is kept constant and the diameter increases over time (Figure 22, ii). At a value of *radius-paper* = 10 (Figure 25, ii) we obtain results that reproduce the particular evolution of the individual keywords presented in Figure 22. We observe a linear increase in the average degree $\langle k \rangle$, and a decrease in the clustering coefficient $\langle C \rangle$. The average path length $\langle d \rangle$ approaches asymptotically a constant value, and the diameter D increases suddenly and remains fixed for the rest of the experiment. Finally, with this particular combination of values, the model also reproduces the behaviour shown in Figure 23, that is a non-linear power law correlation of the form $\langle C \rangle \sim \langle k \rangle^{-\alpha}$, where $\alpha = 1.2$ ($R^2 = 0.96$), with clustering and degree decreasing and increasing in time respectively (results not shown in the text, but replicable and shown in the model).

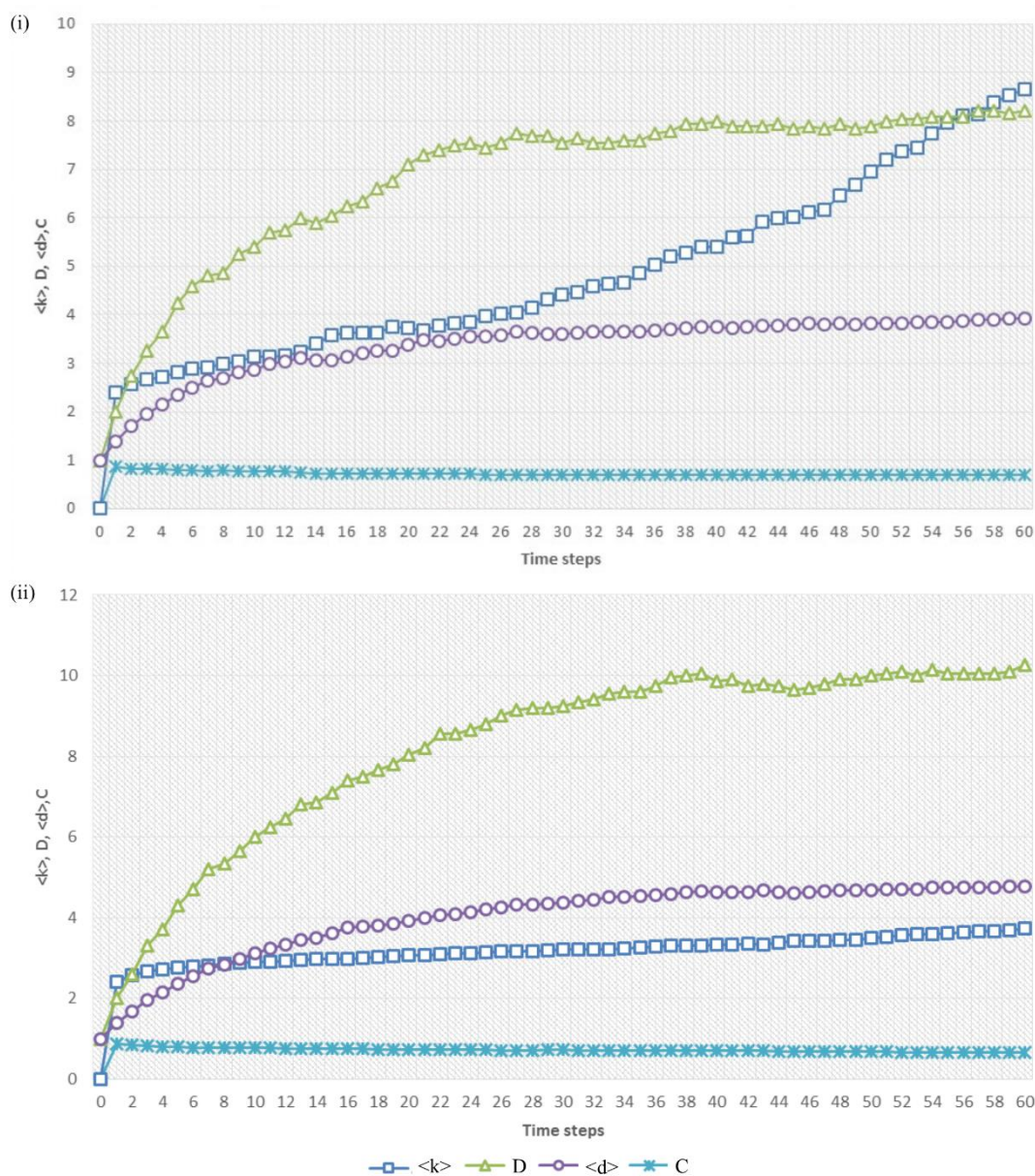


Figure 25: Results for two values of the model parameter: (i) *paper-radius* = 2 and (ii) *paper-radius* = 10.

The robustness of the model is suggested by how well it reproduces the real temporal behaviour of the ego-network of the keyword “happiness”, extracted from Hn (Figure 26). The ego-network metrics of Figure 26 are the same for the rest of the most connected keywords (QoL, WB, LS and SWB) of Hn, as all of them are closely connected to the giant component since the beginning of the history of the network. In this case, “happiness” appears in a field with similar concepts and short conceptual distances between keywords. We observe a trend like the initial states of Figure 25(i), where average degree, diameter and average path length slightly increase, and average clustering coefficient decreases. The differences observed between the model and the Hn are mainly concentrated in the first time steps of the model; the model starts with only one keyword (keyword 0) while the real network starts with much more keywords and connections. Some differences arise when the temporal scale of the model exceeds that of the real network: $\langle C \rangle$ is decreasing following a small pace, maintained close to 0.9 for both networks; $\langle k \rangle$ increases slowly over time after the initial quick increase in the model. D increases following a quicker pace than the rest of the metrics, stabilises and then slowly decreases. $\langle d \rangle$ increases slowly and starts decreasing after the 22nd step in the model.

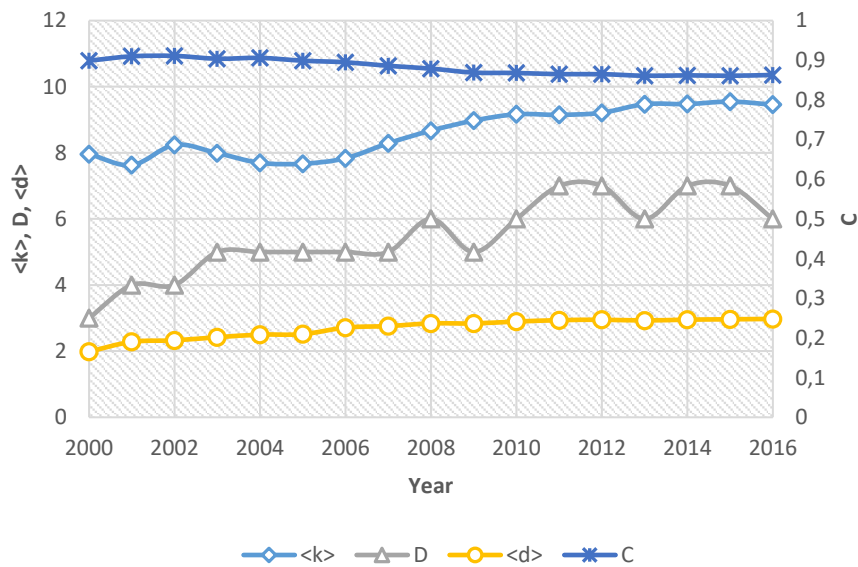


Figure 26: Evolution of the H ego-network in terms of average degree $\langle k \rangle$, diameter D , average path length $\langle d \rangle$ and clustering coefficient C .

2.3 MAIN POINTS IN REVIEW

- During the initial analysis of the Hn we noted that the exponential increase in the cumulative number of articles and keywords (Figure 10) follows a trend similar to those of emerging new scientific fields (Bettencourt et al. 2009; Bettencourt and Kaur 2011; Bettencourt and Kaiser 2015). Both the graph diameter and the average path length grow, and eventually stabilise from year 2010 onwards (Figure 11).
- The increase in $\langle k \rangle$ over time indicates that a densification process is at play. Although in other study cases the network diameter d tends to decrease as a graph grows (Leskovec et al. 2007) implying a more tightly woven connected component, in this case, Hn shows an initial fast growth in its diameter that tends to stabilise at $d \sim 6 - 7$. We observe the same behaviour in collaboration graphs for scientific and technological fields (Bettencourt et al. 2009). Thus, even when the keyword graph densifies, it stays globally connected in a way that does not affect the diameter of its largest component. This process comes essentially from linear connections between keywords, rather than local increase in connectivity.
- The decreasing trend over time in $\langle C \rangle$ and the disassortative behaviour of the network supports also this feature. This behaviour deviates from other examples where the establishment of central conceptual or experimental techniques are primordial. In our case, new concepts do not need to be closely related to others to appear in the Hn graph.
- The homogeneity in link weights (Figure 13, inset) imply that weighted degree and degree do not correlate: keywords connect to other keywords, but this connectivity implies no co-occurrence. The most connected keywords in Hn are used indistinctly to categorise many different parts of the field, but not univocally: these are used as plastic words with interchangeable meanings (Poerksen 1995). Given this particular character, the capacity of keywords such as H, QoL, SWB, etc., to penetrate other fields should be significant, as it happens in general with words able to be twisted to fit various circumstances, or those with disputed definitions (Nature 2008). This behaviour is not observed, for example, in social networks, where degree and strength (and even their probability distributions) can be highly correlated (Panzarasa et al. 2009).
- Regarding the Uhn, we observe an ever-growing network, with irregular evolution but constant increase in its structural measures (Figure 11, ii). The network undergoes a transition in year 1998, when it reaches a minimum value for S and begins to increase again in an incipient connected component. The current giant component is still growing, and it includes slightly over 80% of the nodes. This fact reveals that the field is still emerging. The increase in $\langle k \rangle$ over time indicates that a densification process is also at play. Its diameter D is far from stabilising and it grows faster than its average path length $\langle d \rangle$, suggesting that as the Uhn graph densifies, the distance between concepts increases further, in a process that comes essentially from linear connections between keywords, and not from an increase in local (i.e., neighbourhood) connectivity. It is the typical process of transition (also undergone by the urban studies field) from a still single discipline to a multidisciplinary one with the inter- and transdisciplinary transitions yet to come (Ramadier 2004).
- In the “urban happiness” sphere, we observe that H, LS and SWB do not rank high. These three particular words are peripheral in the urban literature, with low connectivity and centrality measures. Given their malleable and combinable character, they might have not been yet properly defined inside the field. Scholars prefer the use of QoL and WB keywords instead, with QoL clearly related to housing, economic development and health, and WB more related to psychosocial urban issues (Figure 22). From the overall view of the Uhn topology (Figure 15), QoL and WB are well defined in the urban field,

with ecosystem services as the in-between connecting cluster, and their common ground being environmental issues. Complementary literature review results coming show that it is after year 2000 that this common ground is clarified, and a distinction is made between these two concepts, with QoL associated with urban green and urban parks, and WB connected with biodiversity and ecosystems.

- During 2000s we also have *sustainability* (year 2006) and *ecosystem services* (year 2009) keywords entering Uhn. This focus on environmental research, especially associated with ecosystem services and sustainability, comes in contrast to previous findings regarding the urban studies field (Kamalski and Kirby 2012), where sustainability appears still as a very low ranking keyword.
- Co-word analysis draws attention to non-obvious keywords for the narrower “urban happiness” studies literature (Kirby 2012): along with expected keywords as QoL, WB and urban planning, others as health, ecosystem services, and sustainability appear also as high ranked keywords (i.e., most connected elements of Table 3) of our ‘field inside field’ context. Thus, we suggest the utilization of these concepts in policy debates and assessments, instead of other words with ambiguous meaning in the urban studies field as life satisfaction, subjective well-being or happiness itself.
- Other new appearing keywords in the current urban debate such as urban resilience (Zhang and Li 2018) or smart city (Fu and Zhang 2017) are rather non-existent or with low connectivity. We assume that this fact will change in the following years, mainly because of the upcoming publications in Asia (Figure 18) – predominantly in China – that are already showing a great interest in these subjects.
- The descriptive capacity of a keyword to reflect the current content of an article depends both on the authors’ free will and on the review and publishing processes. Original keywords are sometimes modified, and new ones can be added at various stages in the manuscript submission phase until it is published. One possible approach to address this issue would be to correlate the percentage of keywords created by authors against those chosen from standardized lists and/or suggested/entered by editors after the submission is accepted. The rationale behind this procedure is that a significant difference between the amount of keywords used to reflect the actual content of an article (i.e., those coming from authors) and keywords used to categorize its content into already well-established research spheres (i.e., those coming editors/lists) suggests which conceptual framework should be used to analyse results (i.e., a truly descriptive one or a more categorizing one). Unfortunately, on the one hand, our data structure made it impossible to obtain this information at a meaningful statistical level; on the other hand, we have not found any reference in the literature assessing this issue either.
- We also study the topology of the dynamic networks related with the aforementioned fields, transforming conceptual distances into Euclidean ones in a spatial network model. Despite its simplicity, the model reproduces remarkably well the growth of ego-networks and different levels of penetrations, depending on the “conceptual” distance. How in general an alien conceptual field penetrates another and, how in particular a field like happiness studies penetrates other fields as economics, ecology, etc., is a matter of future work and research.
- We believe that our results and methodologies developed in the context of the happiness and urban studies keyword networks can be useful for a systematic discussion on both, the utilization and assumed meaning of these concepts, and the study of other complex evolving networks related with conceptual aspects of academic or other fields.

2.4 REFERENCES

- Alberti M (2005) The Effects of Urban Patterns on Ecosystem Function. *Int Reg Sci Rev* 28:168–192. doi: 10.1177/0160017605275160
- Andersson E (2004) From Valley of Sadness to Hill of Happiness: The Significance of Surroundings for Socioeconomic Career. *Urban Stud* 41:641–659. doi: 10.1080/0042098042000178726
- Arnold CL, Gibbons CJ (1996) Impervious Surface Coverage: The Emergence of a Key Environmental Indicator. *J Am Plan Assoc* 62:243–258. doi: 10.1080/01944369608975688
- Ballas D (2013) What makes a ‘happy city’? *Cities* 32:S39–S50. doi: 10.1016/j.cities.2013.04.009
- Barabási A-L (2016) *Network Science*. Cambridge University Press, Cambridge, United Kingdom
- Barrat A, Barthélemy M, Pastor-Satorras R, Vespignani A (2004) The architecture of complex weighted networks. *Proc Natl Acad Sci U S A* 101:3747–52. doi: 10.1073/pnas.0400087101
- Barthélemy M (2011) Spatial networks. *Phys Rep* 499:1–101. doi: 10.1016/j.physrep.2010.11.002
- Bastian M, Heymann S (2009) Gephi: An Open Source Software for Exploring and Manipulating Networks. In: *International AAAI Conference on Weblogs and Social Media*. San Jose, CA, USA
- Bava SC (1990) Urban policies for social transformation. *Cities* 7:60–64. doi: 10.1016/0264-2751(90)90009-V
- Bettencourt LMA, Kaiser DI (2015) Formation of Scientific Fields as a Universal Topological Transition
- Bettencourt LMA, Kaiser DI, Kaur J (2009) Scientific discovery and topological transitions in collaboration networks. *J Informetr* 3:210–221. doi: 10.1016/j.joi.2009.03.001
- Bettencourt LMA, Kaur J (2011) Evolution and structure of sustainability science. *Proc Natl Acad Sci* 108:19540–19545. doi: 10.1073/pnas.1102712108
- Blondel VD, Guillaume J-L, Lambiotte R, Lefebvre E (2008) Fast unfolding of communities in large networks. *J Stat Mech Theory Exp* 2008:P10008. doi: 10.1088/1742-5468/2008/10/P10008
- Burgess J, Harrison CM, Limb M (1988) People, Parks and the Urban Green: A Study of Popular Meanings and Values for Open Spaces in the City. *Urban Stud* 25:455–473. doi: 10.1080/00420988820080631
- Chapin FS (1971) Free Time Activities and Quality of Urban Life. *J Am Inst Plann* 37:411–417. doi: 10.1080/01944367108977391
- Chiesura A (2004) The role of urban parks for the sustainable city. *Landsc Urban Plan* 68:129–138. doi: 10.1016/j.landurbplan.2003.08.003
- Chokor BA (1991) The Perception of Spatial Inequalities in a Traditional Third World City. *Urban Stud* 28:233–253. doi: 10.1080/00420989120080221
- Fu Y, Zhang X (2017) Trajectory of urban sustainability concepts: A 35-year bibliometric analysis. *Cities* 60:113–123. doi: 10.1016/j.cities.2016.08.003
- Gillingham R, Reece WS (1979) A New Approach to Quality of Life Measurement. *Urban Stud* 16:329–332. doi: 10.1080/713702532
- Harel D, Koren Y (2000) A Fast Multi-Scale Method for Drawing Large. *Work Conf Adv Vis Interfaces* 282–285
- Heskin A (1972) A New Approach to Planning Law. *J Am Inst Plann* 38:250–253. doi: 10.1080/01944367208977614
- Hidalgo H, Musa S (1976) The role of remote sensing in habitat. *Habitat Int* 1:143–155. doi: 10.1016/0197-3975(76)90029-1

Hill DR (1992) Sustainability, Victor Gruen, and the Cellular Metropolis. *J Am Plan Assoc* 58:312–326. doi: 10.1080/01944369208975810

Hoch I (1977) Quality of life related to city size. *Habitat Int* 2:219–234. doi: 10.1016/0197-3975(77)90051-0

Jacomy M, Venturini T, Heymann S, Bastian M (2014) ForceAtlas2, a Continuous Graph Layout Algorithm for Handy Network Visualization Designed for the Gephi Software. *PLoS One* 9:e98679. doi: 10.1371/journal.pone.0098679

Juppenlatz M (1983) Modelling for urban policy. *Cities* 1:22–27. doi: 10.1016/0264-2751(83)90054-9

Kamalski J, Kirby A (2012) Bibliometrics and urban knowledge transfer. *Cities* 29:S3–S8. doi: 10.1016/j.cities.2012.06.012

Kaplan R (1993) The role of nature in the context of the workplace. *Landsc Urban Plan* 26:193–201. doi: 10.1016/0169-2046(93)90016-7

Kearns RA, Smith CJ, Abbott MW (1992) The stress of incipient homelessness. *Hous Stud* 7:280–298. doi: 10.1080/02673039208720743

Khalil HAAE (2012) Enhancing quality of life through strategic urban planning. *Sustain Cities Soc* 5:77–86. doi: 10.1016/j.scs.2012.06.002

Kirby A (2012) Current Research on Cities and its contribution to urban studies. *Cities* 29:S3–S8. doi: 10.1016/j.cities.2011.12.004

Leskovec J, Kleinberg J, Faloutsos C (2007) Graph Evolution: Densification and Shrinking Diameters. *ACM Trans Knowl Discov Data* 1:

Lewis CA, Sturgill S (1979) Comment: Healing in the Urban Environment A Person/Plant Viewpoint. *J Am Plan Assoc* 45:330–338. doi: 10.1080/01944367908976971

Leyden KM, Goldberg A, Michelbach P (2011) Understanding the Pursuit of Happiness in Ten Major Cities. *Urban Aff Rev* 47:861–888. doi: 10.1177/1078087411403120

Luo L, Pagani GA, Rosas-Casals M (2016) Spatial and Performance Optimality in Power Distribution Networks. *IEEE Syst J* 1–9. doi: 10.1109/JSYST.2016.2590473

Marza V, Dehghan M, Akbari B (2015) A new Peer-to-Peer topology for video streaming based on complex network theory. *J Syst Sci Complex* 28:16–29. doi: 10.1007/s11424-015-3154-9

Mogulof MB (1975) A Modest Proposal for the Governance of America’s Metropolitan Areas. *J Am Inst Plann* 41:250–257. doi: 10.1080/01944367508977887

Nash JE (1979) Weekend Racing as an Eventful Experience. *Urban Life* 8:199–217. doi: 10.1177/089124167900800205

Nature (2008) Language: Disputed definitions. *Nature* 455:1023–1028. doi: 10.1038/4551023a

Neirotti P, De Marco A, Cagliano AC, et al (2014) Current trends in Smart City initiatives: Some stylised facts. *Cities* 38:25–36. doi: 10.1016/j.cities.2013.12.010

Panzarasa P, Opsahl T, Carley KM (2009) Patterns and dynamics of users’ behavior and interaction: Network analysis of an online community. *J Am Soc Inf Sci Technol* 60:911–932. doi: 10.1002/asi.21015

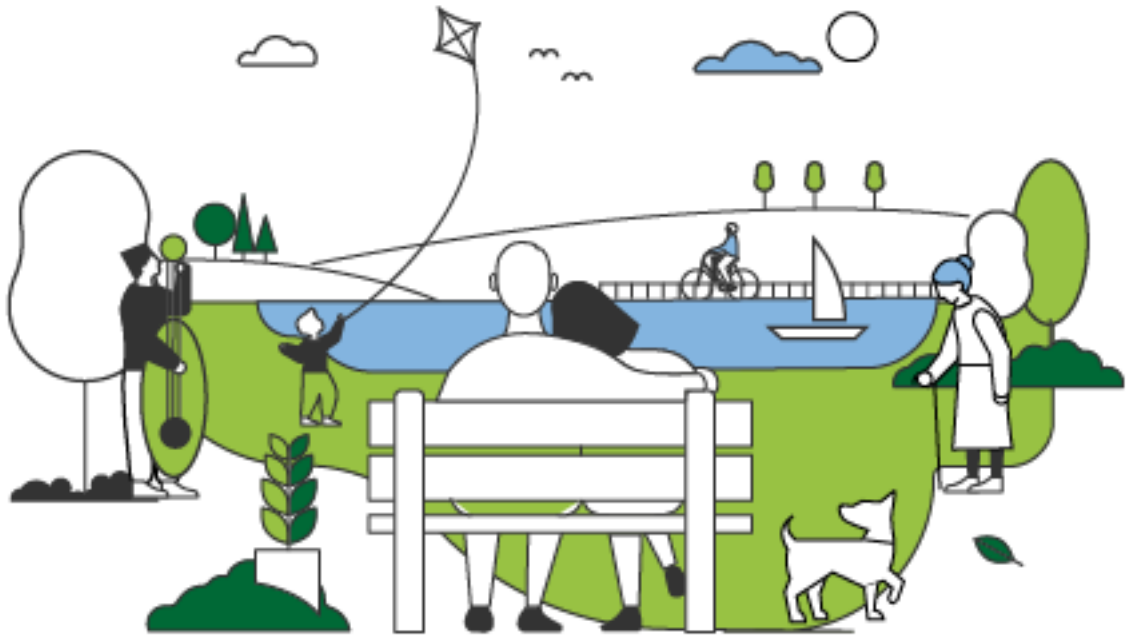
Papachristou IA, Rosas-Casals M (2019) Cities and quality of life. Quantitative modeling of the emergence of the happiness field in urban studies. *Cities* 88:191–208. doi: 10.1016/j.cities.2018.10.012

Papageorgiou-Venetas A (1983) Reconquering the city. *Cities* 1:132–138. doi: 10.1016/0264-2751(83)90005-7

Plaut SE (1983) The Economics of Population Dispersal Policy. *Urban Stud* 20:353–357. doi: 10.1080/00420988320080581

Poerksen U (1995) *Plastic Words: The Tyranny of a Modular Language*. Pennsylvania State University Press, Michigan

- Priemus H (2004) Changing urban housing markets in advanced economies. *Housing, Theory Soc* 21:2–16. doi: 10.1080/14036090410032872
- Ramadier T (2004) Transdisciplinarity and its challenges: the case of urban studies. *Futures* 36:423–439. doi: 10.1016/j.futures.2003.10.009
- Rossi PH, Weber E (1996) The social benefits of homeownership: Empirical evidence from national surveys. *Hous Policy Debate* 7:1–35. doi: 10.1080/10511482.1996.9521212
- Savard J-PL, Clergeau P, Mennechez G (2000) Biodiversity concepts and urban ecosystems. *Landsc Urban Plan* 48:131–142. doi: 10.1016/S0169-2046(00)00037-2
- Tzoulas K, Korpela K, Venn S, et al (2007) Promoting ecosystem and human health in urban areas using Green Infrastructure: A literature review. *Landsc Urban Plan* 81:167–178. doi: 10.1016/j.landurbplan.2007.02.001
- Valentine G (1996) Children should be seen and not heard: the production and transgression of adults' public space. *Urban Geogr* 17:205–220. doi: 10.2747/0272-3638.17.3.205
- Ward Thompson C, Roe J, Aspinall P, et al (2012) More green space is linked to less stress in deprived communities: Evidence from salivary cortisol patterns. *Landsc Urban Plan* 105:221–229. doi: 10.1016/j.landurbplan.2011.12.015
- Wasserman S, Faust K (1994) *Social Networks Analysis: Methods and Applications*. Cambridge University Press, Cambridge, United Kingdom
- Wolch JR, Byrne J, Newell JP (2014) Urban green space, public health, and environmental justice: The challenge of making cities 'just green enough.' *Landsc Urban Plan* 125:234–244. doi: 10.1016/j.landurbplan.2014.01.017
- Zhang X, Li H (2018) Urban resilience and urban sustainability: What we know and what do not know? *Cities* 72:141–148. doi: 10.1016/j.cities.2017.08.009



3.

Quality of life
dimensions

3.1 MEASURING QUALITY OF LIFE IN URBAN ENVIRONMENTS

This section introduces the methodology of measurement of QoL for urban environments, presented in (Papachristou and Rosas-Casals 2019b). It is based both on the perception of people using the urban space and data on existing objective spatial indicators. To check the levels of QoL per domain, Max-Neef et al.'s (1991) conceptual framework on “human scale development” (HSD) is used (see Sections 1.3.1 and 1.4.1), taking into consideration the suggestions made by Costanza et al. (2007). The main steps of the methodology are presented in Figure 27. The first four of them form the preparation process, the next two the classification and weighting process and the final three the final process toward an integrative QoL.

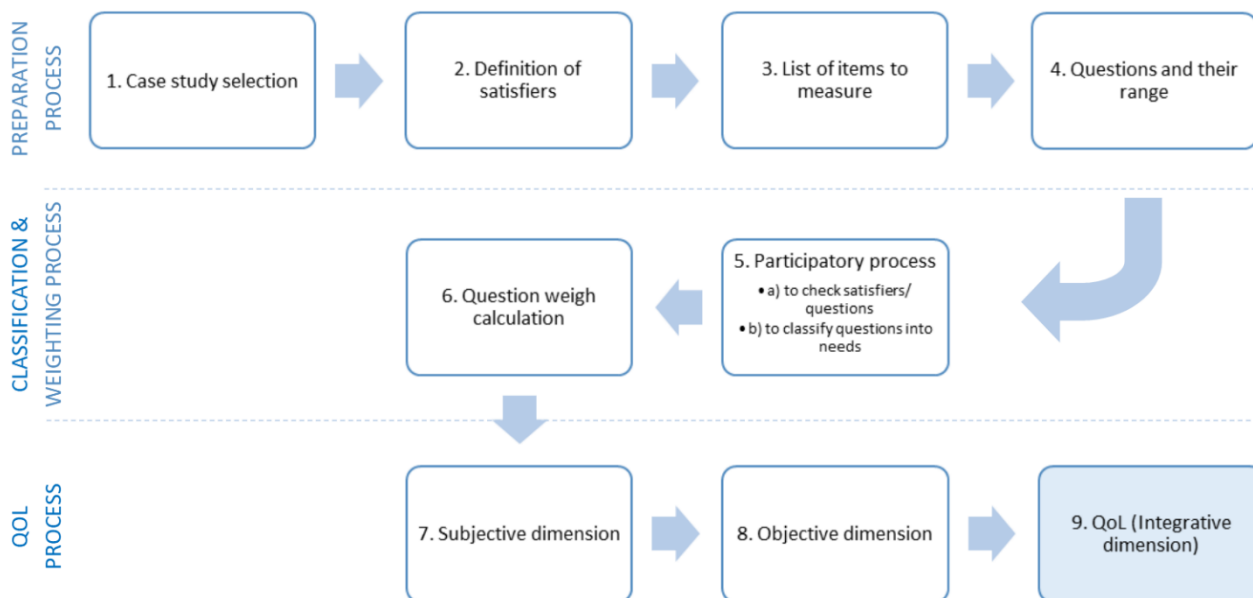


Figure 27. QoL methodology steps.
Source: (Papachristou and Rosas-Casals 2019b).

3.1.1 PREPARATION PROCESS

Following the steps of Figure 27, we suggest starting from the definition of the place corresponding to the study case (step 1). Seeing this place as a system and defining its boundaries in terms of time, space, culture, history, etc., is essential for the second step of the methodology, the definition of the satisfiers (see Section 1.3.1). To do so, we should respond to the following question: what do we consider important to assess, focusing on the socioeconomic and geographical characteristics of our study case?

After completing the list of the satisfiers we should ask ourselves what we would like to measure related to them. This list of items corresponds to step 3. We should also think of how we would want to do so. The second question will give us the questions and their thresholds we will later incorporate in our survey (step 4) to complete the subjective dimension. In Table B1 of the Appendix B.1 we include an example of some satisfiers with their items and questions.

3.1.2 CLASSIFICATION AND WEIGHTING PROCESS

Steps 5 and 6 suggest a participatory process to (1) check if the satisfiers, items and questions are corresponding to the place selected as our study case, and (2) to classify and weight the questions inside each need. The process should involve the local community and/or experts. From now on, we will refer to them as

our study group. Their engagement depends on the study case: it could be the neighbourhood committee of a neighbourhood we would like to study, an interdisciplinary group of experts with special interest to these subjects, an emerging social group wanting to give life to a public space, etc. They shouldn't necessarily be the same participants of the survey, but people with knowledge of the needs of the place in question. We will focus here in point (2). The main function of the study group is to classify the survey questions into the human needs corresponding to Subsistence, Security, Affection, Understanding, Participation, Leisure, Creativity, Identity, Freedom and Spirituality or Transcendence (see Section 1.3.1).

The matching of the questions to one or more needs is a subjective choice related to personal understanding and interpretation. Consequently, we should ask the study group to individually classify the questions to each need. The easiest way to do so would be to match each question only to one need, but, as questions may be related to more than one need, it is recommended to give the freedom of selection to the participants. The categorisation of questions performed by the study group implies a subsequent process of weighting, where the importance of each question in the definition of a need will depend on the aggregated results of all members of the study group. To clarify this weighting process, a hypothetical example is given in Figure 28, where a study group composed by three people (P1, P2 and P3) is asked to classify four questions (Q1, Q2, Q3 and Q4) into three needs (N1, N2 and N3). Regarding need N1, all three members of the study group consider it is assessed by question Q1, while only two of them consider that it is also assessed by question Q2. The question weight is the ratio between the number of people who considered that question (Q1) related to that need (N1), and the total number of people who considered a question (Q1 and Q2) for that same need (N1). In this case, the weights for questions Q1 and Q2 would be 3/5 and 2/5, respectively. In this sense, same questions may have different weights for different needs. For instance, bearing in mind the study group's classification of questions for need N2 in our example, all four questions would have the same weight corresponding to 1/4, which is different from the weight assigned to them in assessing need N1 (i.e., 3/5 and 2/5 respectively).

If the number of questions is large, the study group may use the items (see Table B1 of Appendix B.1) for the classification or even work directly with the satisfiers.

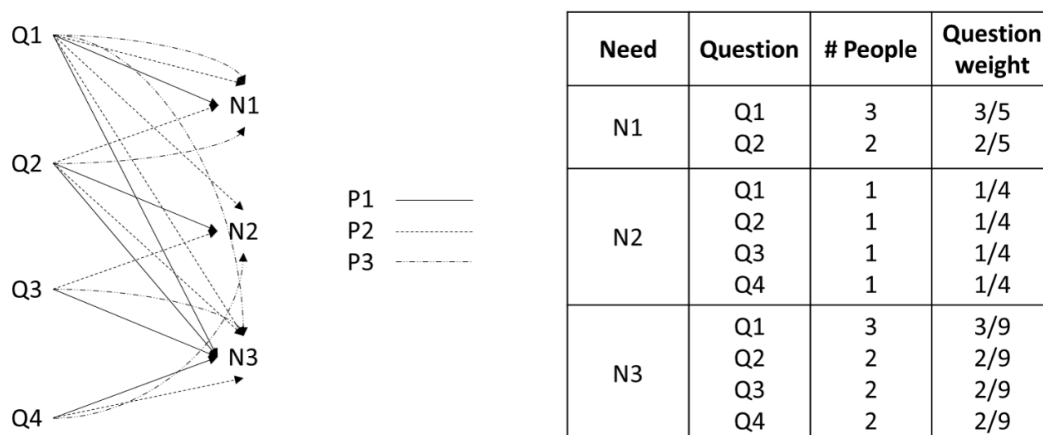


Figure 28. Hypothetical example of correspondence of four questions (Q1, Q2, Q3 and Q4) into three needs (N1, N2 and N3) according to the perceptions of three individuals (P1, P2 and P3) belonging to the study group.

3.1.3 TOWARDS AN INTEGRATIVE QOL

Step 6 points to the subjective dimension of QoL. To begin the assessment, we start from the realisation of the survey, created using the corrected list of questions. It should be answered by a random and diverse sample of the target population related to the study case. It should be anonymous and could be completed both online and in person (Papachristou and Rosas-Casals 2015b). The web survey mode is proposed 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 and Ozdemiroglu 2002). Moreover, a vast improvement in response speed over traditional mail surveys is widely reported and the financial expenditure (Wolfgang 2002) and environmental impact of surveys on the Internet is smaller due to the elimination of postage, printing and data entry (Dillman and Bowker 2002). The lack of any clarification of questions (MacKerron and 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) can be catalogued as some of the disadvantages of web surveys. Using only online surveys thus can cause some bias and may be considered as non-representative. Therefore, the use of in-person surveys is also suggested by the authors. To complete this dimension, we should calculate the statistics regarding each question's answers. 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 well-being (Papachristou and Rosas-Casals 2015b).

Once the subjective approach is completed, the objective one should be added (step 7). It consists of adding related objective indicators and their values for every question of our list. After doing so, thresholds should be also added for every objective indicator (see Table 4). Although it is sometimes difficult for the researcher to obtain data at a local scale, depending on the available data source, actual final considered threshold values should be obtained in decreasing order from the local to the regional scale. Objective thresholds come also in decreasing order from established local, regional or world legal limits and regulations.

Generalised thresholds and norms do not always work for all (urban) environments and should be adjusted to our selected study case: space, place and its residents' culture, habits, customs and traditions. And even doing so, subjective perceptions and thresholds do not always coincide with the objective reality, where thresholds are usually quantified under unbiased assumptions. This fact might influence QoL and the perception that people obtain from their surrounding space and environment, curtailing initiatives that would be otherwise beneficial. Consequently, objective and subjective indicators and their thresholds should be considered altogether to detect possible deviations (step 9). This can be done with a matrix (see Table 4), where columns are identified in the following way:

1. **Need.**
2. **Questions**, related to each need. Each need is assessed by means of a number n of questions. Some questions can be used to assess different needs (i.e., question 2 is included to assess need A and need B).
3. **Question weight**, includes the partial weight w_n as % of each question, following the weighting process conducted by the group of experts and/or the community. Recall that a need is related to a particular group of questions, and weights for these questions must add up 100%.
4. **Subjective dimension of QoL measurement** (see Section 1.4.1), with:
 - a. **Answer**, expressed in terms of the highest satisfaction percentage (i.e., related to values 4 and 5 in the case of a 1 to 5 scale, or Yes in the binary case).
 - b. **Threshold**, normally when more than 50% of the sample answers positively to a question.

- c. **Satisfaction** related to this threshold, identified with the binary variable b_n^S , showing whether the percentage of satisfied people is higher than the threshold (with a numerical value of 1) or not (with a numerical value of 0).
 - d. **Subjective score** (S_N^S), for each need, and as the summation of the product of each question weight (column 3) by its satisfaction (column 4.c).
5. **Objective** dimension of **QoL** measurement (see Section 1.4.1), with:
- a. **Actual value** of the item (i.e., current level of air quality, etc.).
 - b. **Threshold**, being it an upper or lower legally admitted limit for a particular dimension (i.e., maximum levels of Nox concentration in ppm, etc.)
 - c. **Satisfaction** related to this threshold, identified with the binary variable b_n^O , showing whether the current value of this dimension is lower/higher than the threshold (with a numerical value of 1) or not (with a numerical value of 0).
 - d. **Objective score** (S_N^O), for each need, as the summation of the product of each question weight (column 3) by its satisfaction (column 5.c).
6. **Integrative** dimension of **QoL** measurement, with:
- a. The integrative dimension of QoL includes a ternary variable β_n for each question to **check** whether the final value of the comparison between the two types of measurements for each question is positive, negative or neutral. When both, subjective and objective, indicators are satisfied, this result equals to 1 unit. When both are not satisfied, the result equals to 0 units. When only one of the two thresholds is satisfied, the result equals to 0.5 units.
 - b. **Integrative score** (S_N^I), for each need, as the summation of the product of each question weight (column 3) by its check variable (column 6.a).

The score per need corresponds to the sum of all the total scores of the questions classified under that same need. Totals above and below 50% are considered as strong and weak satisfaction respectively. Final QoL scores for objective ($\overline{S_N^O}$), subjective ($\overline{S_N^S}$) and integrative ($\overline{S_N^I}$) dimensions (Table 4, last row) correspond to the average of the individual objective, subjective and integrative scores per each need, respectively.

Table 4: Subjective, objective and integrative dimensions matrix.

(1) Need	(2) Question	(3) Weight	(4) Subjective				(5) Objective				(6) Integrative	
			(a)	(b)	l	(d)	(a)	(b)	l	(d)	(a)	(b)
			Answer	Threshold	Satisfaction	Score	Value	Threshold	Satisfaction	Score	Check	Score
A	1	w_1			b_1^S	$S_A^S = \sum_n b_n^S w_n$			b_1^O	$S_A^O = \sum_n b_n^O w_n$	β_1	$S_A^I = \sum_n \beta_n w_n$
	2	w_2			b_2^S				b_2^O		β_2	
	
	n	w_n			b_n^S				b_n^O		β_n	
B	2	w_2			b_2^S	$S_B^S = \sum_n b_n^S w_n$			b_2^O	$S_B^O = \sum_n b_n^O w_n$	β_2	$S_B^I = \sum_n \beta_n w_n$
	3	w_3			b_3^S				b_3^O		β_3	
	
	n	w_n			b_n^S				b_n^O		β_n	
...
N	i	w_i			b_i^S	$S_N^S = \sum_n b_n^S w_n$			b_i^O	$S_N^O = \sum_n b_n^O w_n$	β_i	$S_N^I = \sum_n \beta_n w_n$
	j	w_j			b_j^S				b_j^O		β_j	
	
	n	w_n			b_n^S				b_n^O		β_n	
QoL					$\overline{S_N^S}$				$\overline{S_N^O}$		$\overline{S_N^I}$	

3.2 CAPTURING PERCEPTIONS ON SUBJECTIVE WELL-BEING

In this Section the focal point is on the subjective dimension of QoL corresponding to SWB (see Section 1.4.1). Drawing on the cases of Vila de Gràcia neighbourhood and Virreina square of the Gràcia district in Barcelona (see Sections 1.2.1 and 1.2.2) and given the primacy of needs in QoL, we seek to show the easiness of application of the first part of the methodology presented in (Papachristou and Rosas-Casals 2015b, 2019b) and resumed in the previous Section (3.1) to achieve a higher level of SWB for urban environments. To check the levels of satisfaction, two surveys were created – one for each case – using the fundamental human needs of the Human Scale development paradigm as study categories. Results show scores per need and in total (SWB) are lower for the neighbourhood scale. Additional to the steps described in Figure 27 for the total QoL assessment, we proceeded to the identification of intervention axes for a potential improvement of SWB results. The classification of questions per need favours the identification of potential problems and can be used to implement measures of improvement. By using combined intervention axes we prove that an average 20% increase in SWB is possible for both cases.

3.2.1 PREPARATION AND CLASSIFICATION PROCESS

For this part of the methodology we will use steps 1-7 of Figure 27, described in the previous Section.

- **Step 1.** The selected places constituting our case studies refer to two different scales of the same urban area corresponding to Gn and Vs (see Section 1.2.1 and 1.2.2).
- **Steps 2-4.** According to the socioeconomic and geographical characteristics of the chosen places (i.e., Gn and Vs), a first draft of a survey was edited. At this stage, all possible subjects assumed to affect individual and collective well-being were taken into consideration “to capture the perceptions of the dwellers and in relation to the selected places” (Papachristou and Rosas-Casals 2019b). The survey – when applied – answers directly to the subjective dimension of well-being (see Section 3.1.3).
- **Step 5.** For the question classification into categories¹⁶, and as explained in Section 1.3.1 and Section 3.1.2, Max-Neef et al.’s (1991) axiological needs were used. To classify the survey questions into the ten fundamental human needs, the survey draft was elaborated along with a study group of experts formed by researchers of the Sustainability Measurement and Modelling Lab¹⁷ (SUMMLab) and the University Research Institute for Sustainability Science¹⁸ (IS.UPC), both at the Universitat Politècnica de Catalunya–Barcelona Tech, from now on called our study group. Those were selected considering their knowledge on subjects related to sustainability issues. Questions (and groups of questions) associated to satisfiers can be found in the Appendix B.1, Table B1. The selected study group was asked (i) to review the questionnaires to detect any missing aspects, and (ii) to match the given questions to the needs. The first task was undertaken in group, while the second was performed individually, bearing in mind that a question could be classified to more than one needs, according to each individual’s personal point of view (e.g., a question such as “How satisfied are you with your health?” can be categorised under Subsistence, Security, Freedom, and/ or Spirituality/ Transcendence).
- **Step 6.** For the question weighting inside each need we followed the process explained extensively in Section 3.1.2.

¹⁶ For other possibilities of classification of variables into categories see (Papachristou and Rosas-Casals 2016).

¹⁷ <http://summlab.upc.edu/en>

¹⁸ https://is.upc.edu/?set_language=en

Step 7 will be separated in the following two sections containing the analysis of surveys results and the final results on SWB calculation.

3.2.2 SURVEY ANALYSIS

For our case study and to capture the perceptions of the locals related to SWB, we conducted two surveys for the two levels (Gn and Vs) of the same urban area of Barcelona, Spain. They were available between May-June 2012 for Gn and between September-October 2014 for Vs, leading to a total number of 174 and 51 responses respectively. The target was people using the space and not only people living there. For the Gn case (see Section 1.2.1), the surveys could be completed both online and in person. Here we undertook a process of engagement (of the people) by contacting local associations and social groups. The online format of the survey was proposed by most of those groups as a means of reaching their members easily. To complement, we used in-situ surveys to obtain a complete view of the perceptions of the people using the space. For the Vs case (see Section 1.2.2), surveys could only be completed in person due to its reduced spatial scale: there were no active associations or social groups associated with the square and as result the online format of the survey did not apply.

We can see the main statistics for the total of responses for Gn and Vs in Table 5. To maximally avoid any exclusion, we addressed the survey to all types of citizens: people living in the place of reference and also people using the urban space for recreational, family reasons, shopping, working, etc. From those not living in Gn, a majority was living in a nearby neighbourhood such as Sant Gervasi, Eixample, and Sagrada Família. For Vs, there was also a 10% living in close neighbourhoods such as Camp d'en Grassot, Eixample or Vallcarca. Although we observed an over-participation of responders with degrees in higher education, it seems it is often the case in this type of surveys (see (Brenner 2002; Wolfgang 2002)).

Table 5: Main statistics of the samples.

	Groups	Gn %	Vs %		Groups	Gn %	Vs %
Gender	Female	50.6	58.8	Place of origin	Vila de Gràcia	51.6	68.6
	Male	49.4	41.2		Other neighbourhoods of Barcelona	35.6	31.4
					Metropolitan area	9.2	-
Age	14-17	0.6	0.0	Activity	Public sector	38.9	17.7
	18-24	10.9	5.9		Private sector	27.9	37.3
	25-30	21.3	33.3		Student	25.0	19.6
	31-44	35.6	41.2		Unemployed	3.5	3.9
	45-64	28.2	15.7		Pensioner	3.5	3.9
	65+	3.5	3.9		Self-employed	3.4	11.8
Relation with selected space	Lives there	51.6	9.8		Education level	Primary education	1.7
	Had lived there	1.7	2.0	Lower secondary		0.6	2.0
	Lives close	1.2	27.6	Upper secondary		2.3	17.7
	Works there (or close)	4.0	43.1	Technical studies		7.5	13.7
	Recreational reasons	29.9	13.7	Bachelor		11.5	11.8
	Shopping	5.8	3.9	2 nd cycle of studies		36.6	45.1
	Family reasons	1.7	0.0	Master		20.7	-
				PhD		20.1	5.9

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 (Figure 29a), the average of the answers were above 3 over 5 with the exception of money for Vs. The collective average satisfaction with life aspects was

3.8 over 5 for Gn and 3.6 for Vs. At the same time, there was a significant percentage that considered their time spent at work as no creative (31.6% for Gn and 32.7% for Vs). Despite this fact, they appeared rather satisfied of their time distribution (with an average of 3.1 over 5 for both sites).

Regarding aspects associated with quality of urban life in the two sites (Figure 29b) such as traffic, noise, pedestrian areas, green spaces, sanitation facilities, and air and water quality, responders seemed rather dissatisfied, with the average satisfaction reaching 2.9 units over 5 for Gn and 3.2 for Vs. The least punctuated aspect appears to be green spaces, reaching an average of 2.2 for Gn and 2.3 for Vs. There was also a rather low satisfaction regarding noise, traffic and air quality.

Although most respondents were renters (50.6% for Gn and 62.6% for Vs), they stated “feeling at home” when they were there (87.4% for Gn and 86.3% for Vs). The great majority also felt absolutely or rather safe around the neighbourhood and the square (79.3% for Gn and 82.4% for Vs). Notwithstanding, there was a 6.9% for Gn and a 13.7% for Vs that had experienced violence in the familiar environment, and a 12.6% and 23.5% respectively that did not feel free as persons. Another interesting datum is that besides the turbulences in the economic and political spheres both in Barcelona and Spain recorded in this period, the great majority (74.1% for Gn and 76.5% for Vs) appeared optimistic, stating that they could make plans for the future.

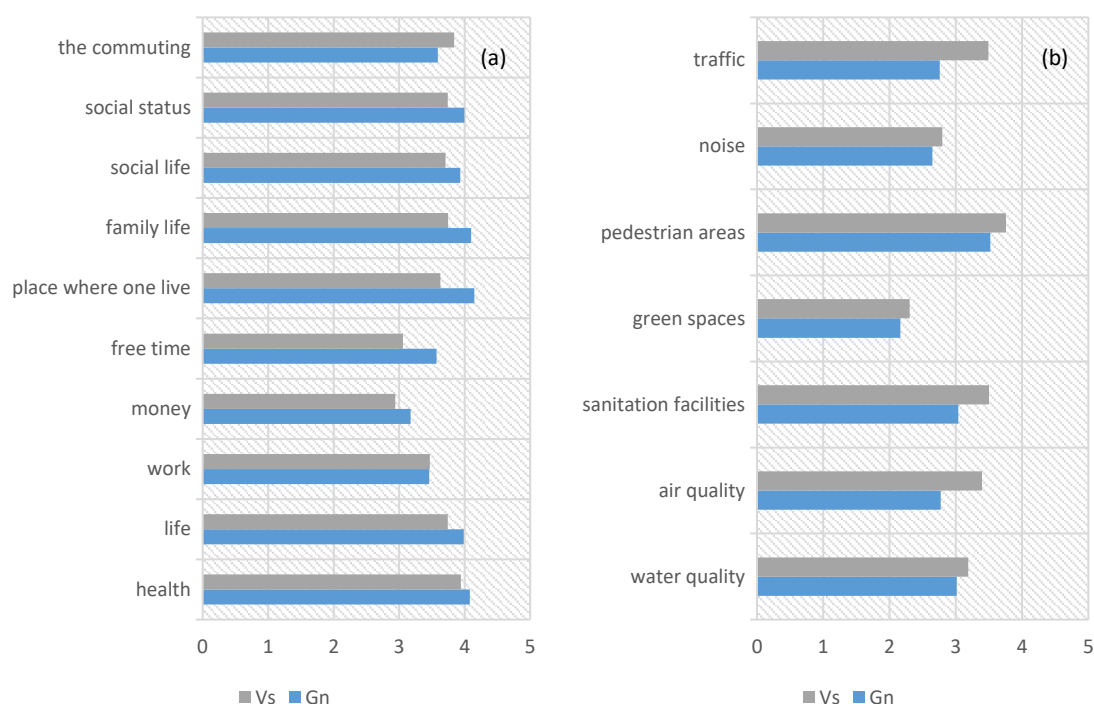


Figure 29: Averages of satisfaction with different aspects (a) of life and (b) of quality of urban life, in Gn and Vs rated from 1 (not satisfied) to 5 (completely satisfied).

As far as environmental practices are concerned, the questioned claimed they do recycle, save energy and water, with values ranging from 86% to 94% for Gn and from 78% to 86% for Vs. They also prefer walking to their destinations (86.8% for Gn and 64.7% for Vs) or using the public transport (90.2% and 82.6% respectively). But they did not show a preference for bicycle as a common means of transport (52.9% and 47.1% respectively). They neither tended to share their homes (only 31.0% and 47.1% respectively) or cars (only 23% and 43% respectively).

About the level of attachment to significant others, the Gn sample seemed emotionally dependent on other people. 46% scored their emotional dependence on their family with 4 or 5 over 5 (with an average of 3.2) and 23% scored the same dependence on their friends (with an average of 2.7). For Vs scores were lower, with 20% appearing fully or mostly dependent on their family and only 8% on their friends. Averages in this case were of 2.6 units over 5 for their family and 2.2 for their friends.

When it came to feelings, a majority stood for positive ones in both sites (see Figure 30(a)), giving them an average frequency higher than 3 over 5. A greater dispersion was observed regarding the negative ones (see Figure 30(b)). In this latter case, worry was the most frequent feeling, reaching an average of 3.5 for Gn and a 3.4 for Vs. Stress seemed to be another concern for the responders, with an average frequency of 3.3 and 3.5 respectively. The least frequent negative feeling was anger, with an average frequency of 1.5 and 1.7 respectively.

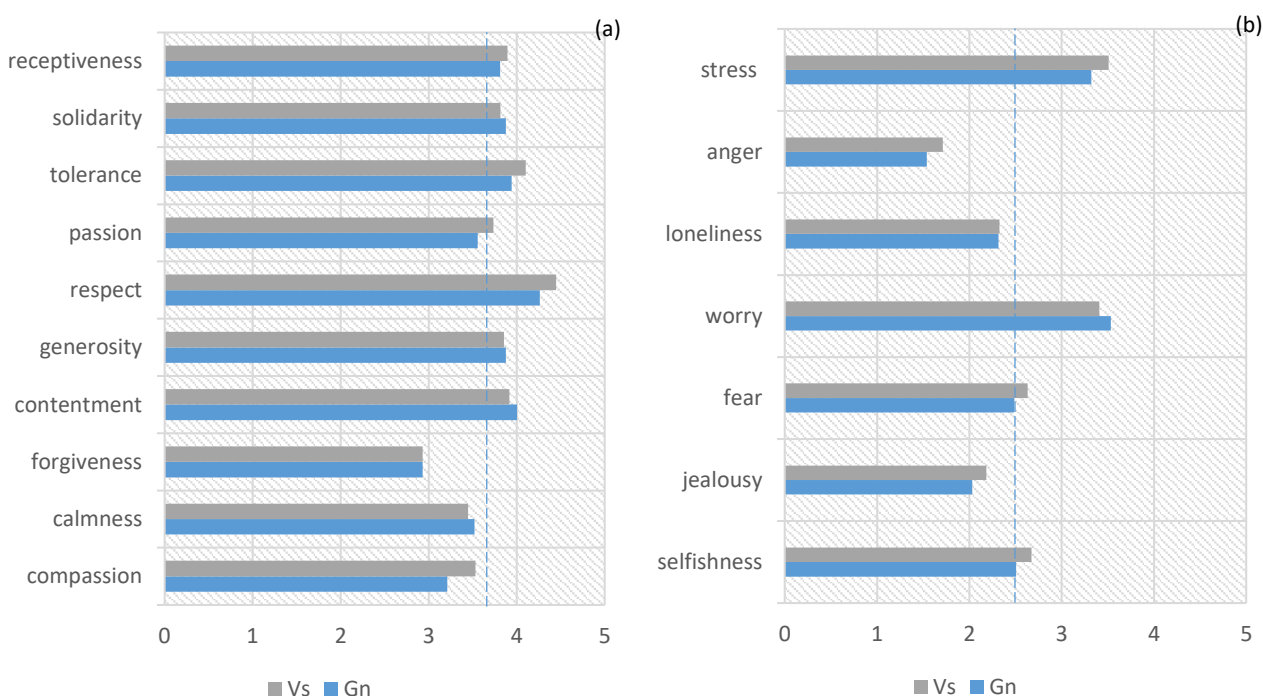


Figure 30: Average frequency of positive (a) and negative (b) feelings for Gn and Vs rated from 1 (rarely) to 5 (very often). For the majority of positive feelings, a frequency close to 4 (often) is most commonly observed. Frequencies for negative feelings appear to be more disperse. Most responders seem to experience worry and stress often while other feelings such as anger appear the last in the list, as rarely experienced.

Figure 31: shows connectivity graphs with feelings that, according to the questionnaires' answers, would change in a different urban environment, both for Gn (a) and Vs (b). In this representation, feelings were connected when appearing together in a response. The node size represents the frequency of appearance of every word while the thickness of the links (edges) represents the weight between each connection or the co-appearance frequency. Stress, calmness, fear and loneliness dominate both graphs, while in (a) solidarity, tolerance and respect also play an important role. At the bottom of the list appear compassion, jealousy and forgiveness for Gn, and compassion, generosity, passion, selfishness and jealousy for Vs as feelings that would be least affected by a change in the urban environment.

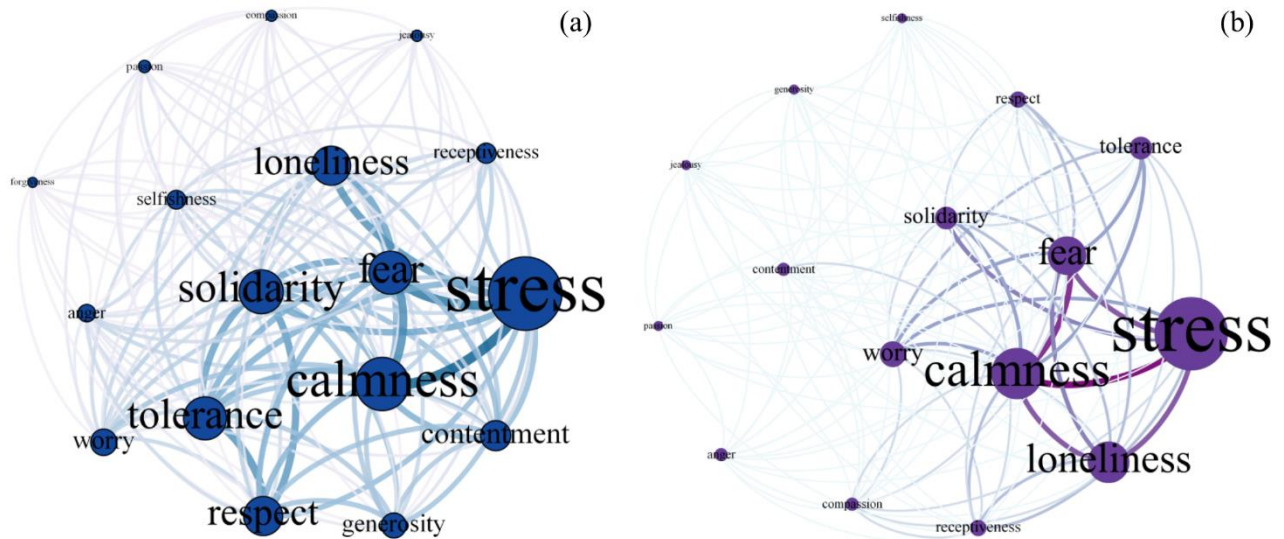


Figure 31: Feelings that would change in a different urban environment for Gn (a) and for Vs (b). Feelings were connected when they appeared together in a response. The node size represents the frequency of appearance of every word while the thickness of the strings (edges) represents the weight between each connection or the co-appearance frequency. “Stress”, “calmness”, “fear” and “loneliness” dominate both graphs, while in (a) “solidarity”, “tolerance” and “respect” also play an important role. Visualisation created in Gephi.

3.2.3 FIRST RESULTS ON SWB

To calculate the percentage of satisfaction for each need, we created a matrix per need, following columns 1-4 of Table 4 (Section 3.1.3). Taking for instance N3 of Figure 28, and knowing both, the responses to the questions classified in it and the threshold related to each question, we can proceed to the calculation of its satisfaction as shown in Table 6. Q2 for example does satisfy the threshold as it reaches an 82% which is higher than the 50% of the threshold. As a result, the threshold is recorded as satisfied (“Yes”) and the question weight is added to the final column of the total score. When the answers for a question do not satisfy the threshold (as in the cases of Q1 and Q3 of Table 6), their weight is not added to the total score. The need satisfaction is the sum of the total scores per question related to that need. For example, for N3 we have a total score of 4/9.

Table 6: Example for the calculation of the satisfaction per need.

Need	Question	# People	Question weight	Threshold	Answer	Threshold satisfaction	Total score
N3	Q1	3	3/9	> 50%	37%	No	0
	Q2	2	2/9	> 50%	82%	Yes	2/9
	Q3	2	2/9	< 50%	52%	No	0
	Q4	2	2/9	> 50%	63%	Yes	2/9
N3 satisfaction							4/9

Step 7. Result on SWB for our selected place(s) and time(s). We calculate the mean value of the percentages of satisfaction for the ten needs as we did in the previous example for N3 (Table 6). This final value corresponds to the total satisfaction regarding SWB.

Table 7 shows an example of the process of classification and weighting of the survey questions into the corresponding needs, where Gn questions refer to the neighbourhood of Vila de Gràcia and Vs questions to Virreina square. For example, for question Gn7, associated with the satisfaction with one’s health, we can see that 83% of the study group classified it in Subsistence, resulting in a weighting score of 2.75% for that need.

At the same time, 67% of the experts classified it in Freedom, resulting in a weighting score of 1.72% for that need. The threshold remains the same for both needs (or study categories) representing that if more than 50% percent of the responders are satisfied (5 over 5) or rather satisfied (4 over 5), the weighting score will be added to the total of each need (last column). For this Question, and according to the “Answer” column, the score reaches 81% and the threshold is satisfied. The same happens with question Gn41, which is only related to Security need according to the experts’ opinion. This is not the case, though, for question Vs75 related to the frequency that one is experiencing stress, where the threshold is not satisfied, and the question weight is not added to the total score of the need. The same process was followed for the rest of the questions of both surveys to obtain a result for each need individually and for the SWB as a total.

Table 7: Classification and weighting example. Gn questions refer to the neighbourhood of Vila de Gràcia and Vs questions to Virreina square.

Need	ID	Question	# People	Question weight	Threshold	Answer	Threshold satisfaction	Total score
Subsistence	Gn7	How satisfied are you with your health?	83%	2.75%	4-5 > 50%	4-5: 81.03%	Yes	2.75%
Freedom	Gn7	How satisfied are you with your health?	67%	1.72%	4-5 > 50%	4-5: 81.03%	Yes	1.72%
Security	Gn41	How safe do you feel at the neighbourhood of Vila de Gràcia?	100%	3.02%	4-5 > 50%	4-5: 79.31%	Yes	3.02%
Creativity	Vs75	How often do you experience stress?	67%	3.13%	1-2 > 50%	1-2: 17.65%	No	0.00%

Final results per need are given as a percentage and they are shown in Table 9 and Figure 32. The most satisfied needs for Gn are Participation and Identity with 67.3 and 71.6% correspondingly. Leisure (50%), Creativity (51.9%) and Spirituality/ Transcendence (46.1%) seem to be the least satisfied needs. The rest of the needs related to Subsistence, Security, Affection, Understanding and Freedom are found in between, with percentages varying from 56.9 to 59.2%. The total satisfaction corresponding to SWB appears to be rather low, reaching only 57.7%.

For Vs, results both per need and in total are slightly higher in most categories, excluding Participation, Leisure and Creativity needs. The three most satisfied needs appear to be Subsistence, Security and Affection with percentages surpassing 70% (73.2, 70.7 and 73.2% correspondingly). The least satisfied needs are Leisure (50%) and Creativity (51.6%). Needs such as Understanding, Participation, Freedom and Spirituality/ Transcendence range from 58.7% to 67.7%. Total satisfaction or SWB reaches 63.1%.

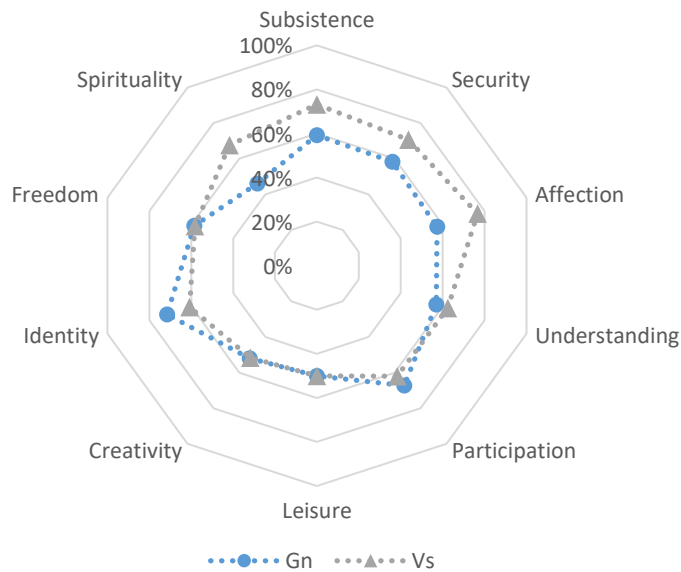


Figure 32: SWB assessment satisfaction results per need for Gn and Vs.

3.2.4 INTERVENTION AXES

The identification of intervention axes allows the creation of potential future scenarios for SWB improvement. The procedure is carried out per need and the focus is on their related questions that fulfil two important conditions: (i) the majority of the study group individuals has classified them into the reference need and (ii) they do not satisfy the threshold and consequently their weight has not been added to the total score column (e.g., as in the case of Q1 for N3 presented in the example of Table 6)¹⁹. Making a list of these questions per need and classifying them into bigger thematic classes allows a qualitative analysis on urban or social deficiencies for the selected place. These bigger classes will correspond to the axis of intervention. To perform the classification, we represent the questions' connections with their pertaining needs graphically in a network (see Section 1.5.2) where, the aforementioned questions and needs are represented as nodes and the connections between them as edges. The width of the edges illustrates the weight of each question inside each need, according to the classification conducted by the expert group. The node size represents the number of its connections (i.e., node degree). Consequently, the satisfaction of questions with bigger node size (i.e., higher degree) affects more needs and it is where priority should be given. Questions are grouped in thematic classes according to their geographical proximity in the graph. These classes form the intervention axes where a community, neighbourhood or city would have to focus to achieve a better satisfaction result per need and, consequently, a higher SWB value.

Our two networks, regarding Gn and Vs respectively, are created in NodeXL²⁰ (see Figure 33(a) for Gn and (b) for Vs). For both places there are highest-ranked questions connected to more than one need. Leisure, Freedom and Creativity share most of the questions in both networks, while Spirituality and Affection share many questions only in the case of Gn. Particularly,

- in Gn (Figure 33(a)):

¹⁹ From now on those questions will be referred to as highest-ranked questions.

²⁰ <https://nodexl.codeplex.com/>

- The most connected questions are Gn69, Gn86 and Gn82²¹, classified and affecting four or five (in the case of Gn82) different needs. They form the first intervention priority represented by red colour.
 - The second priority questions are Gn81, Gn88, Gn112 and Gn114-19; they are connected to three needs and represented by green colour.
 - The third priority questions are Gn19, Gn47, Gn48, Gn59, Gn70, Gn73, Gn74, Gn76, Gn87, Gn90, and Gn128, influencing two needs and represented in dark blue colour.
 - The rest of the questions, being the most peripheral in the network, form the fourth priority and are represented with light blue colour.
- In Vs (Figure 33(b)):
 - The most connected questions are Vs93 and Vs 94²², forming the first priority.
 - The second priority form questions Vs99, Vs114 and Vs116-20.
 - In the third priority belong the following questions: Vs13, Vs20, Vs21, Vs24, Vs52-54, Vs72, Vs75, Vs88, Vs91, Vs95, Vs100, and Vs123.
 - The rest of the questions form the fourth priority.
 - Colours represent priorities and follow the same pattern as in Figure 33(a).

²¹ For the question decoding see Appendix B.2, Table B2.

²² For the question decoding see Appendix B.2, Table B3.

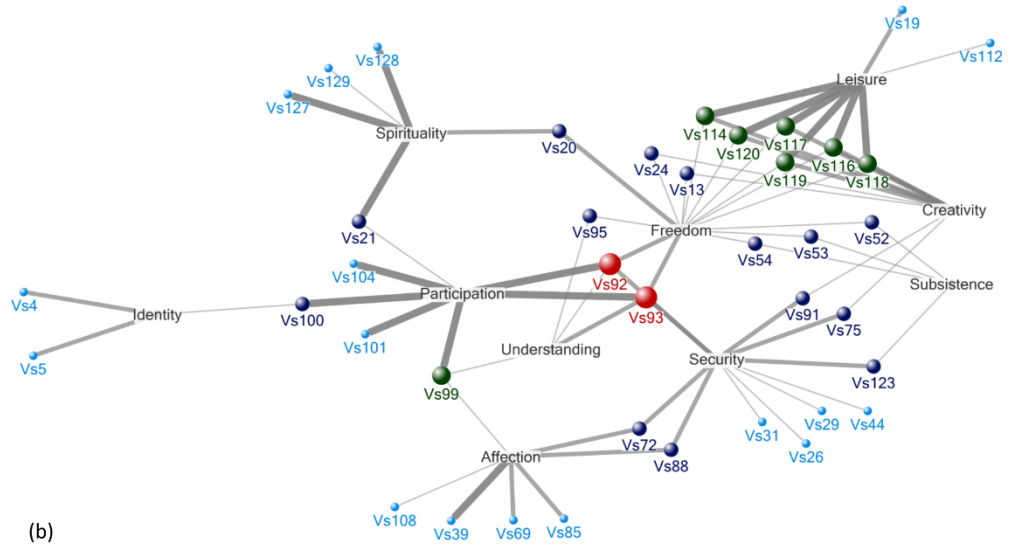
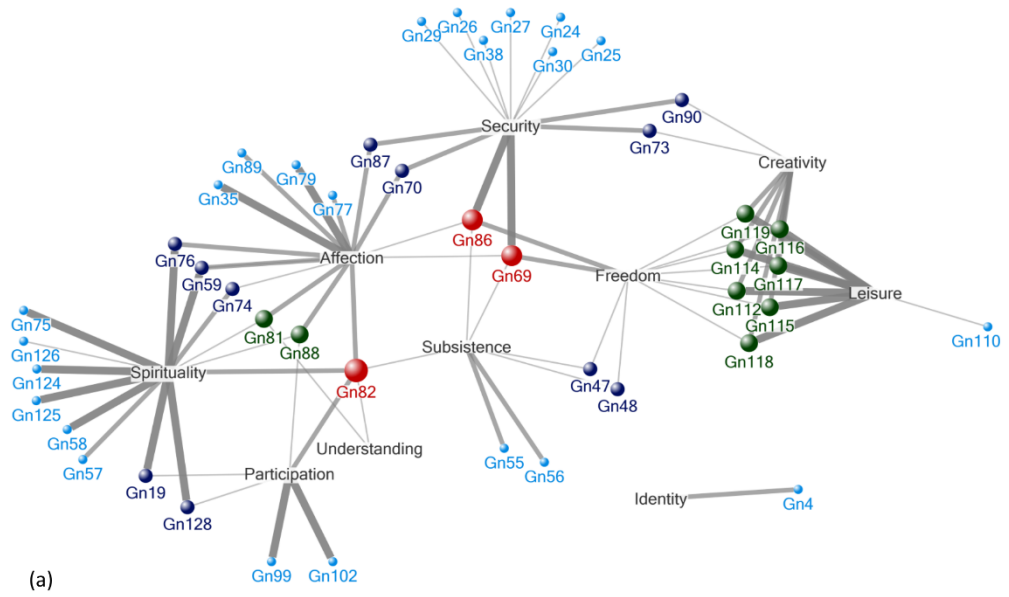


Figure 33: Connectivity map among highest-ranked questions (whose thresholds were not satisfied) and needs, for Gn (a) and Vs (b). Visualisation created with NodeXL.

In Figure 34 we detect percentages of questions belonging to each priority for Gn and Vs. Most unsatisfied highest-ranked questions for both sites are of fourth priority. Very few questions (around 6%) are of first priority. This fact facilitates the intervention axes procedure.

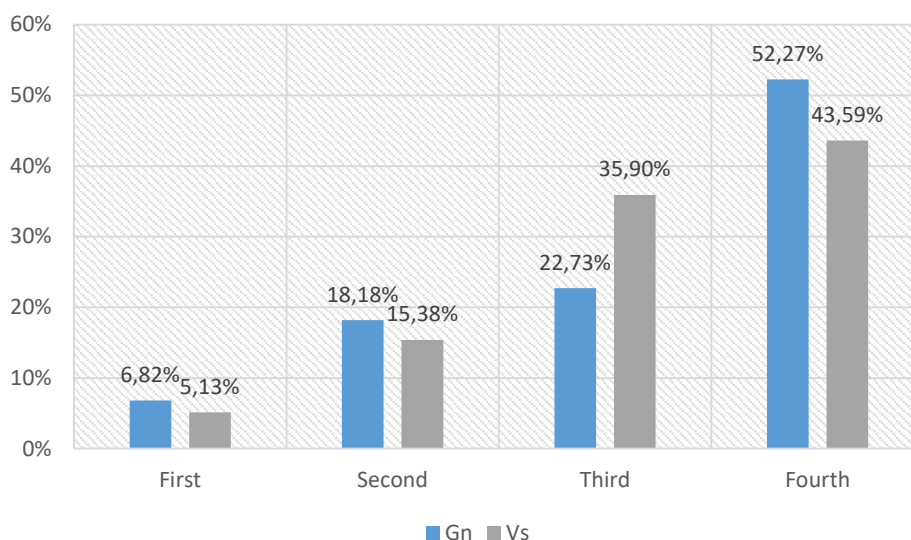


Figure 34: Percentage of highest-ranked unsatisfied questions per priority for Gn and Vs.

The above questions are classified into bigger thematic classes according to their position in the graph (see Figure 33(a) and (b)). Their topographic distribution is a result of their connections to the ten needs. Close-appearing questions belong to the same class. These classes correspond to the intervention axes where the community, the neighbourhood or the city would have to focus to achieve a better satisfaction result per need and in total. Highest-ranked unsatisfied questions for Gn (Table B2) and for Vs (Table B3) classified per Priority and Axis can be found in Appendix B.2. The last column of those tables corresponds to the axis priority, calculated as the average of the priorities of the questions classified in each Axis. Highest-ranked questions referring to Identity need (Gn4, Vs4 and Vs5) are not included in the improvement axes as they depend on the sample (i.e., age and gender) and not on improvable elements of the urban sphere. In Table 8, we can see a summary of all axes, along with the corresponding axis priority per each site. A new column is added with proposed actions for mitigation.

Table 8: A summary of the Intervention Axes for Gn and Vs with their priority and some proposed actions for mitigation. We observe that most of the axes are similar for both scales. For detailed data see Appendix B2.

Intervention Axes	Axis priority		Actions examples
	Gn	Vs	
Eliminate fear	1	-	Make neighbourhood more walkable, illuminate dark areas, transform empty lots into public spaces, etc.
Encourage perception of inclusiveness	-	1	Citizen involvement, enhance participatory processes, activate social grid, promote social platforms, etc.
Promote free-time activities and improve time distribution	2.25	2.6	Promote public and accessible to all expositions, projections, music festivals, time management courses, effective and on-time public transport, etc.
Increase caring feelings	2.89	-	Promote voluntary programs, promote social engagement, etc.
Promote sharing/ Sustainable way of living	3	3	Car-sharing platforms, flat-sharing platforms, bicycle lines, bicycle parking infrastructure, etc.
Eliminate stress	3	3	Effective circulation management, on time public transport, more green areas, more pedestrian areas, etc.
Eliminate worry	3	3	

Be informed	-	3	Metro news spots, emissions regarding the commons in local channels, etc.
Surviving	-	3	Establish minimum salary, etc.
Facilitate connection with nature and inner self	3.75	3.6	Facilitate access to nature, create more green spaces, help in the understanding of the importance of spirituality, etc.
Improve civic commitment	4	3.25	Encourage participation in community life, etc.
Improve urban life quality	4	4	Reduce noise levels, improve water quality; implement traffic reduction/regulation measures, promote public transport, more green areas, facilitate home ownership, establish maximum rent per neighbourhood, facilitate long-term rents, etc.
Diminish dependence on others	4	-	University scholarships, student help programs, start-ups supporting, new entrepreneur programs, etc.
Responsibilities/ Having children	4	4	Make neighbourhood more walkable and safer, facilitate public school entrance to single parents, establish more days of maternity and paternity leave, etc.
Eliminate selfishness	-	4	
Enhance sociability	-	4	Create meeting points, invest in embracing urban furniture, etc.

3.2.5 POTENTIAL SWB IMPROVEMENT

The implementation of actions per Axis such as the ones proposed in Table 8, allows the satisfaction of the highest-ranked initially unsatisfied questions. The satisfaction of these questions permits an increase in the satisfaction of each need. The new, potential value of SWB is again calculated as in *step 7*, using the mean of the potential satisfaction per need and per place. In general, we can observe an increase per need varying between 4.3% and 38.9% for Gn and 7% and 35.9% for Vs as shown in Table 9 and Figure 35. The categories or needs that accept the least potential increase (less than 10%) is Understanding for both places and Subsistence for Vs. Needs that accept the highest potential increase (more than 30%) are Security, Leisure, Creativity and Spirituality/ Transcendence for Gn and Leisure and Creativity for Vs. These results show that a potential increase in the total SWB up until 22% for Gn and 18% for Vs can be reached.

Table 9: Initial and potential SWB and need fulfilment for Gn and Vs after applying actions related to the intervention axes of Table 8.

Need	Gn SWB			Vs SWB		
	Initial %	Potential increase %	Potential %	Initial %	Potential increase %	Potential %
1. Subsistence	59.22%	16.76%	75.98%	73.20%	8.25%	81.44%
2. Security	58.29%	30.15%	88.44%	70.70%	21.86%	92.56%
3. Affection	57.31%	28.08%	85.38%	73.20%	13.49%	86.69%
4. Understanding	56.91%	4.42%	61.33%	62.37%	6.99%	69.35%
5. Participation	67.29%	13.55%	80.84%	61.99%	18.10%	80.09%
6. Leisure	50.00%	33.33%	83.33%	50.00%	31.25%	81.25%
7. Creativity	51.91%	32.82%	84.73%	51.56%	35.94%	87.50%
8. Identity	71.55%	-	71.55%	61.29%	-	61.29%
9. Freedom	58.62%	19.83%	78.45%	58.68%	26.03%	84.71%
10. Spirituality/ Transcendence	46.11%	38.86%	84.97%	67.65%	15.88%	83.53%
Total/ SWB	57.72%	21.78%	79.50%	63.06%	17.78%	80.84%

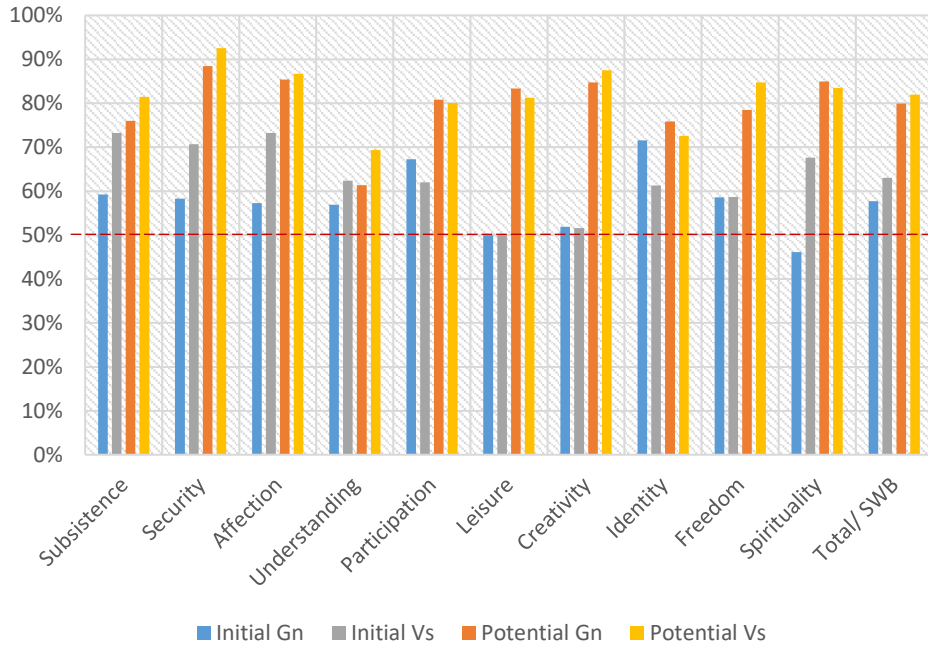


Figure 35: Initial and potential need fulfilment and SWB for Gn and Vs.

3.3 FIRST RESULTS ON OBJECTIVE AND INTEGRATIVE QOL

In this Section, we continue with the application of Section’s 3.1 proposed methodology. This time the focal point is on the objective and integrative dimension of QoL. Using Gn (see Section 1.2.1) as our study case we come to some first observations and results while validating and discussing the methodology’s last steps (8 and 9) and usefulness.

3.3.1 COMPARING SUBJECTIVE AND OBJECTIVE DIMENSIONS

The objective dimension of QoL forms the 8th step of the methodology presented in Figure 27 and Section 3.1.3. It follows the completion of the subjective dimension. For its assessment, a list of indicators related to the question items and the objective thresholds should be added (see Table 4). Specifically, for the Gn case and depending on the available data sources, we obtained the actual values regarding the objective indicators with an emphasis to the local scale when available. Objective thresholds correspond to established local, state, European or world legal limits and regulations.

Generalised thresholds and norms do not always function for all environments and should be adjusted to the selected space and place and its residents’ culture, habits, customs and traditions (see Section 3.1.3). Consequently, objective and subjective indicators and their thresholds should be compared to detect possible deviations. The integrative dimension calculation is the last step of Figure 27 explained in detail in Section 3.1.3. A filled example of the matrix introduced in that Section (Table 4) is shown in Table 10, where results for the objective and subjective scores have been omitted to avoid overloading the table with excessive data. We observe that one same question (i.e., “How satisfied are you with the air quality in the neighbourhood?”) has a different weight for two different needs (i.e., Subsistence and Security). The study group has given to this question more importance inside the Security need. Regarding the subjective thresholds, questions included answers in a scale range from 1 to 5 and, as it has been explained in Section 3.1.3, the thresholds in these cases are satisfied if more than 50% of the population sample rates them above 3. Objective values correspond to local (and in this example, environmental) indicators, and their thresholds correspond either to (a) limits pre-established by the indicators or (b) globally established limits.

Table 10: Example of comparison between subjective and objective indicators of QoL. Results extracted from a study for the Gn case.

(1) Need	(2) Question	(3) Weight	(4) Subjective			(5) Objective			(6) Integrative	
			(a) Answer	(b) Threshold	I Satisfaction	(a) Value	(b) Threshold	I Satisfaction	(a) Check	(b) Score
SUBSISTENCE	How satisfied are you with the air quality in the neighbourhood ?	1.65%	4-5: 9,20%	4-5 > 50%	No	ICQA average (2010) = 52 ¹	50<ICQA<75 ²	Yes	0.5	0.83%
SECURITY	How satisfied are you with the air quality in the neighbourhood ?	2.01%	4-5: 9,20%	4-5 > 50%	No	ICQA average (2010) = 52 ¹	50<ICQA<75 ²	Yes	0.5	1.01%

SUBSISTENCE	How satisfied are you with the green spaces in the neighbourhood ?	1.65%	4-5: 8.62%	4-5 > 50%	No	Urban green: 6,55 m ² /hab ³	WHO optimum: 14m ² / hab Minimum: 10m ² / hab ⁴	No	0	0%

¹ Air quality index (ICQA) for Barcelona (Idescat 2013).

² (Generalitat de Catalunya 2019).

³ (Ajuntament de Barcelona 2008).

⁴ (WHO 2015).

As shown in Table 10, there appeared questions only satisfied in one of the first two dimensions (rather subjective or objective). Among them, the most significant are those referring to the living environment and to significant others. Starting from the air quality (see Table 10), 34.5% of the sample declared not satisfied (cumulated percentage of 1 and 2 scores over 5), when according to the Generalitat de Catalunya and the Index ICQA (Idescat 2013; Generalitat de Catalunya 2019) there is a satisfactory air quality at the city of Barcelona. Similarly, a 40.8% reported not satisfied with the traffic conditions in Gn 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 Gn has (Herman 2009). Following the same rationale, a 52.9% of the sample seemed to opt for 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 correspond to only 53.9% and 69.6% respectively (ATM 2006). As far as energy and water consumption is concerned, people seemed to consider that they 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). Similarly, the water consumption per capita per day in Barcelona (Àrea Metropolitana de Barcelona 2010), is slightly over the limits imposed by European Union (European Green Capital 2012).

As far as significant-others and socio-family items are concerned, it seems there exists a general desire to form a family (90.2%), yet it does not necessary imply to have children, considering the low birth rate in the area (Idescat 2013). 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. Regarding disabilities or mental health problems, official statistics show important limitations concerning activities of people with these characteristics (Ajuntament de Barcelona 2007). Nonetheless according to the responders (only 6 of the interviewed) a 66.67% declared no restrictions provoked by their disability. Concerning participation in the community and voting at the elections, a 82.2% of the responders declared active participation, rather than the 52.3% that attended the municipal elections in May 2011 in Barcelona and the 69.9% the Parliament elections in November 2012 (Idescat 2013).

3.3.2 WORKING TOWARDS THE INTEGRATIVE RESULT

The process presented in Table 10 was followed for the rest of the questions to achieve a total score (i.e., satisfaction) per need and dimension, and the final QoL score for this neighbourhood. These values are shown in Table 11 and Figure 36(i). Results show a significant difference between total objective and subjective scores on average terms, with the objective score well below the subjective one, indicating that either people answered trying to appear more satisfied than they really are, or objectively established thresholds are rather

strict related to the reality and they do not correspond to what people truly need or feel (Papachristou and Rosas-Casals 2019b). Regarding the subjective dimension, all needs obtain a medium level of satisfaction (around 50%), exception made for two extremes: spirituality/transcendence, with the lowest one (46.1%), and participation and identity, with the highest ones (67.3% and 71.6% correspondingly). In the objective dimension, needs obtain a much lower satisfaction than in the subjective one. The lowest satisfaction corresponds again to spirituality/transcendence (8.8%), followed by creativity (10.1%) and leisure (13.0%). Since the final integrative result depends on the value of β_n for each question, integrative results do not necessarily correspond to an average of both previous dimensions (i.e., objective and subjective). In our study case, integrative QoL stands between subjective and objective scores. At the need level, integrative satisfaction appears between subjective and objective dimensions, but with no need over 50%. Spirituality/Transcendence reaches again the lowest satisfaction level (23.6%), indicating the poorest fulfilment of this need for the Vila de Gràcia neighbourhood.

Table 11: QoL assessment for Gn case.

Human needs (Domains)	Scores (%)		
	Subjective	Objective	Integrative
1. Subsistence	59.2%	37.4%	48.3%
2. Security	58.3%	29.2%	43.7%
3. Affection	57.3%	12.3%	34.8%
4. Understanding	56.9%	19.3%	38.1%
5. Participation	67.3%	17.8%	42.5%
6. Leisure	50.0%	13.0%	31.5%
7. Creativity	51.9%	10.7%	31.3%
8. Identity	71.6%	37.1%	54.3%
9. Freedom	58.6%	25.9%	42.2%
10. Spirituality/ Transcendence	46.1%	8.8%	27.5%
Total	57.7%	21.1%	39.4%

3.3.3 AN HYPOTHETICAL CASE

The application of this methodology for Gn revealed one particularly difficult task related to the search of objective data and indicators. The application of this methodology for Vila de Gràcia revealed one particularly difficult task related with the search of objective data and indicators. For this specific case study only 36% of the questions appears to have corresponding objective values public and openly accessible. If we excluded questions with no objective corresponding data, results would have been those shown in Figure 36(ii). All needs of the three categories in this case would have had higher scores. However, integrative results would not have been between the two dimensions as in the original case, but they would have had lower scores. This fact indicates that (i) most questions are satisfied either subjectively or objectively, and (ii) that previous results were too low mainly because of the missing objective values (especially in the case of Spirituality and Creativity, that could be considered as more subjective needs). The fact that self-reported happiness is subjective, does not mean that it is unrelated to relatively objective variables (Lyubomirsky et al. 2005). In this sense, the scale of reference also affects the result and should be considered of great importance. It is true that researchers often encounter difficulties in finding legal limits and regulations or data at a local scale. However, it is recommended to always concentrate their inquest from the local to the regional and the global to maintain the same reference scale and to enable a comparison with the subjective data. At the same time, further caution should be taken both (i) during the selection of the objective indicators, as they cannot be based in subjective perceptions (Papachristou and Rosas-Casals 2015c), and (ii) while making inferences about improvements in subjective QoL based on improvements in objective QoL (McCrea et al. 2006).

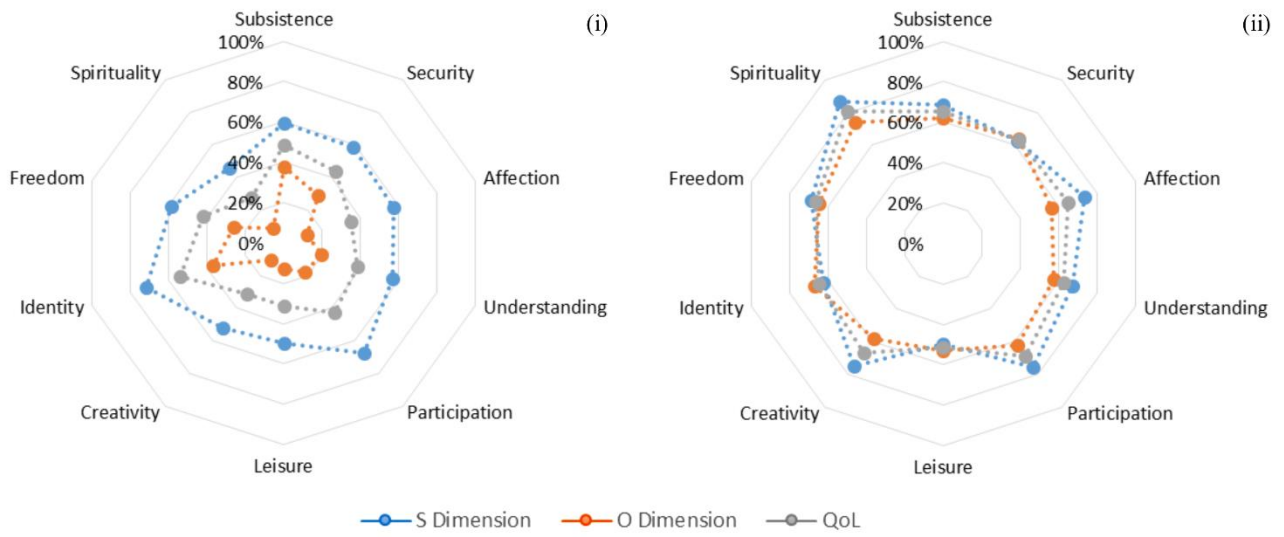


Figure 36: Graphic representation of the QoL assessment in Gn case comparing subjective (S), objective (O) and integrative (QoL) results per need (i) for the REAL case and (ii) for the hypothetical case that excludes questions without objective indicators.

3.4 MAIN POINTS IN REVIEW

- The methodology favours a small-scale, human-oriented, democratic approach, potentially leading to a more social design of urban space, while respecting the urban environment. It may be of significant help when having to decide the focus of a decision-making process, concerning future policies, plans and measures of improvement. Keeping in mind that the fulfilment of all needs is considered equally important since any unsatisfied or not adequately satisfied human need reveals a form of human poverty (Max-Neef 1992) –, the methodology can be considered as a useful tool both to evaluate and promote feasible solutions regarding the selected space with the aim to achieve a better one, concentrating the efforts on the QoL of the dwellers.
- The use of human needs as domains of study aims at understanding the category where a problem may be concentrated. Needs indicate deprivations and at the same time individual and collective human potential. Each economic, social and political system adopts different methods for the satisfaction of the same fundamental human needs. In every system, they are either satisfied or not through the generation or non-generation of different types of satisfiers.
- The focus on the subjective dimension of QoL corresponding to SWB aims at examining perceptions related to the satisfaction with two types of social spaces, that of a neighbourhood (Gn) and that of a square (Vs). The steps towards this dimension challenge the established orthodoxy – inherent in urban studies practices – by focusing on a ‘bottom up’ approach to the perception of social space. This, community-led perspective allows a critical examination of the many facets of the social, physical, cultural, economic and environmental space that have a central role in the planning system.
- Humans are seen here as entities directly related to and constantly interacting with the urban system. The subjective dimension takes into consideration the diversity summed up by those collectivities from each individual participant. It can be catalogued as a user-centred approach – particularly one where both users and uses involved determine what happens to the natural or social space, and that its effects on them are brought about by social agents and their actions, as in (Gans 2002) – with a focus on collectivities rather than on an individual-based well-being.
- A good interpretation of the survey data may lead to the creation of a visual representative image of the sample for the selected time and space and foresee in it what is missing, what goes wrong and what affects personal happiness (Papachristou and Rosas-Casals 2015b).
- Although such subjective measurements are useful for social policy (Veenhoven 2002), we should always keep in mind that drawbacks encountered in most subjective measurement tools, such as the ones underlined in Section 1.4.1, are also possible to be found in our case. And this is because perception does not depend just on the physical space components, elements and features but also on the values, past experience and socio-cultural conditioning of the observer (Brabyn 1996).
- Results show that scores per need and in total (SWB) are lower for the neighbourhood (Gn) scale except for Participation and Identity needs. Three characteristic events associated with social, economic and political instability occurred in the studied area during the period that also justify the high levels of worry and stress in the population. Firstly, the severe economic and social crisis in which Spain entered since 2008. Secondly, not long after the opening of the Gn survey a great demonstration was organised in Barcelona, on May 12th, to commemorate 2011’s 15M movement (Buesa et al. 2010), probably affecting the responses of the questioned. Thirdly, the Vs survey concurred with the petition for a referendum from the part of Catalan people to the Spanish government, directly related to their sense of Participation and Identity. Indeed, there were two responses in the survey indicating that their well-being is also affected by “pressure coming from government and financial institutions” and

the “present political situation associated with the referendum”. There are some survey results contradicting the expected perceptions on the subject. For example, the percentage of dwellers sharing their home with other people is low despite the significant growth in housing prices that has been observed during these past decades (Altuzarra and Esteban 2011; De Weerd and Garcia 2016). Also, regardless of the pressure of fiscal austerity, the reduction and privatisation of public services such as social and health assistance, education and community amenities (Garcia and Haddock 2016), most do feel safe living in this, middle-income neighbourhood and appear optimistic, stating that they can make plans for the future. Finally, dwellers appear to complain about the low levels of citizen participation but, at the same time, they do not work as volunteers, participate to any association, have any control of the communitarian, political or social life or even participate in neighbourhood assemblies.

- By using combined intervention axes we prove that an average 20% increase in SWB is possible for both cases. Most axes are similar for both sites permitting an integral policy or strategy implementation for the whole neighbourhood, according to their priority (see Table 8). Starting from suppressing fear for Gn and encouraging perception of inclusiveness for Vs, actions are proposed for all axes. Leisure, Freedom and Creativity seem to share most highest-ranked, not satisfied questions which means that a first focus on the satisfaction of these needs for both sites would have a direct multiplier effect on the total result. The same serves for Spirituality/ Transcendence and Affection but for Gn case only. The least satisfied needs are those with the highest potential increase once intervention axes are considered while the most satisfied ones are those with the least possibilities to increase their satisfaction. The low (or zero) potential increase in Understanding and Identity is due to the lack of highest-ranked unsatisfied questions.
- The objective and integrative dimensions of QoL were only checked in the Gn case due to limitations of the available data. Subjective dimension and needs achieve higher scores than the objective ones with the integrative standing in between the other two. Objective indicators and their thresholds should be chosen wisely starting always from the local to the regional and the global to maintain the same reference scale and to enable a comparison with the subjective data.
- The low satisfaction of Spirituality/ Transcendence, Creativity and Leisure observed in all three dimensions suggests the where the prioritisation focus should be in future policies and plans. The low representation of these needs also in the objective dimension indicates that they are mainly connected to the individual. In these cases, literature argues that linking objective and subjective measures of QoL may be relatively straightforward (McCrea et al. 2006): By making interventions in the urban grid of the neighbourhood, like adding establishments and equipment, we may also obtain a higher perceived satisfaction.
- In the specific case of Spirituality/ Transcendence the example of satisfiers organised in forms of being, having, doing and interacting presented in Table 1 (Section 1.3.1) can be taken into consideration: actions such as facilitating access to nature and the creation of green spaces or the promotion of social centres and athenaeums would probably help in generating feelings such as calmness, compassion, peace, and understanding, directly connected to the need in question.
- Regarding Leisure and Creativity, these two spheres are considered as highly interrelated by the modern societies. Our present-day extremely (pre)occupied and stressed way of life clearly affects the satisfaction of these needs. In the actual economic model, human creativity (i.e., 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). Hours spent on television, on the Internet, using smart

phones, video games, etc. along with the low participation in productive processes might be the possible answer to the low Creativity and Leisure scores.

- When the methodology is slightly extended to make use of weighted networks and dependence coefficients, it can be used to (a) reveal connectivity patterns between needs and to (b) allow the identification and use of more strongly satisfied needs for the fulfilment of others less so favoured (Papachristou and Rosas-Casals 2016). This option is further explored in Section 4.2.
- Objective and integrative results for Gn indicate difficulties associated with the search of objective data and indicators. The hypothetical case explained in Section 3.3.3 and Figure 36(ii) reveals that (a) most questions are satisfied either subjectively or objectively, and (b) that final results were too low mainly because of the missing objective values (especially for needs such as Spirituality, Creativity and Affection that could be considered as more subjective ones). The fact that self-reported happiness is subjective, does not mean that it is unrelated to relatively objective variables (Lyubomirsky et al. 2005). In this sense, the scale of reference also affects the result and should be considered of great importance. It is true that researchers often encounter difficulties in finding legal limits and regulations or data at a local scale. However, it is recommended to always concentrate their inquest from the local to the regional and the global to maintain the same reference scale and to enable a comparison with the subjective data. Further caution should be taken both (a) during the selection of the objective indicators, as they cannot be based in subjective perceptions (Papachristou and Rosas-Casals 2015c), and (b) while making inferences about improvements in subjective QoL based on improvements in objective QoL (McCrea et al. 2006).

3.5 REFERENCES

- Agència d'Ecologia Urbana de Barcelona (2007) Propuesta de supermanzanas en Gràcia. In: BCN Ecol. http://bcnecologia.net/index.php?option=com_content&task=view&id=47&Itemid=108&lang=SP. Accessed 16 Jan 2012
- Ajuntament de Barcelona (2008) Programa d'Actuació Municipal 2008-2011. Barcelona
- Ajuntament de Barcelona (2007) Estadística Gràcia, Barcelona. <http://www.bcn.es/estadistica/castella/dades/tvida/edemo/a2007/dte6/poblacio/>. Accessed 20 Jun 2012
- Altuzarra A, Esteban M (2011) Land prices and housing prices: the case of Spain. *J Hous Built Environ* 26:397–409. doi: 10.1007/s10901-011-9235-8
- Àrea Metropolitana de Barcelona (2010) Cicle de l'aigua, Consum domèstic per municipi. http://www.dadesambientals.cat/2010/aigua/consum_domestic.html. Accessed 20 Jun 2012
- ATM (2006) La mobilitat a les grans ciutats: Barcelona. Barcelona
- Brabyn L (1996) Landscape classification using GIS and national digital databases. *Landsc Res* 21:277–300. doi: 10.1080/01426399608706493
- Brenner V (2002) Generalizability Issues in Internet-Based Survey Research: Implications for the Internet Addiction Controversy. In: Batinic B, Reips U-D, Bosnjak M, Werner A (eds) *Online social sciences*. Hogrefe & Huber Publishers, Ashland, OH, US, pp 117–139
- Buesa C, Sust T, Gascó M (2010) Decenas de miles de indignados reavivan el espíritu del 15-M en Barcelona. *el Periódico*
- Costanza R, Fisher B, Ali S, et al (2007) Quality of life: An approach integrating opportunities, human needs, and subjective well-being. *Ecol Econ* 61:267–276. doi: 10.1016/j.ecolecon.2006.02.023
- Csikszentmihalyi M (1996) *Creativity Flow and the Psychology of Discovery and Invention*. HarperCollins, New York
- De Weerd J, Garcia M (2016) Housing crisis: the Platform of Mortgage Victims (PAH) movement in Barcelona and innovations in governance. *J Hous Built Environ* 31:471–493. doi: 10.1007/s10901-015-9465-2
- Dillman DA, Bowker DK (2002) The Web Questionnaire Challenge to Survey Methodologists. In: Batinic B, Reips U-D,

- Bosnjak M, Werner A (eds) *Online social sciences*. Hogrefe & Huber Publishers, Ashland, OH, US, pp 53–71
- European Environment Agency (2007) Electricity consumption per capita. <http://www.eea.europa.eu/data-and-maps/figures/electricity-consumption-per-capita-in>. Accessed 20 Jun 2012
- European Green Capital (2012) World Water Day. In: Eur. Comm. <http://ec.europa.eu/environment/europeangreencapital/events/events-archive/world-water-day/index.html>. Accessed 20 Jun 2012
- Gans HJ (2002) The Sociology of Space: A Use-Centered View. *City Community* 1:329–339. doi: 10.1111/1540-6040.00027
- Garcia M, Haddock SV (2016) Special issue: housing and community needs and social innovation responses in times of crisis. *J Hous Built Environ* 31:393–407. doi: 10.1007/s10901-015-9466-1
- Generalitat de Catalunya (2019) Air quality index (ICQA). Methodology. <https://tinyurl.com/y4ue2qtw>. Accessed 15 May 2019
- Herman L (2009) Traffic Parameters
- Idescat (2013) Statistical Yearbook of Catalonia. <http://www.idescat.cat/pub/?id=aec&lang=en>. Accessed 11 Feb 2013
- Johnson S (2010) *Where Good Ideas Come From: The Natural History of Innovation*. Riverhead Books, New York
- Lyubomirsky S, Sheldon KM, Schkade D (2005) Pursuing happiness: The architecture of sustainable change. *Rev Gen Psychol* 9:111–131. doi: 10.1037/1089-2680.9.2.111
- MacKerron G, Mourato S (2009) Life satisfaction and air quality in London. *Ecol Econ* 68:1441–1453. doi: 10.1016/j.ecolecon.2008.10.004
- Max-Neef MA (1992) Development and human needs. In: Max-Neef MA, Ekins P (eds) *Real life Economics: Understanding Wealth Creation*. Routledge, London, pp 197–213
- Max-Neef MA, Elizalde A, Hopenhayn M (1991) *Human Scale Development. Conception, application and further reflections*. The Apex Press, New York & London
- McCrea R, Shyy T-K, Stimson R (2006) What is the Strength of the Link Between Objective and Subjective Indicators of Urban Quality of Life? *Appl Res Qual Life* 1:79–96. doi: 10.1007/s11482-006-9002-2
- Papachristou IA, Rosas-Casals M (2019) Maximising the Degree of User Choice: A Simple Tool to Measure Current Levels of Quality of Life in Urban Environments. *Urban Plan* 4:207–222. doi: 10.17645/up.v4i2.2006
- Papachristou IA, Rosas-Casals M (2015a) Making the neighbourhood a better place to live. A SWB approach implementing fundamental human needs. *On the W@terfront* 40:31–50
- Papachristou IA, Rosas-Casals M (2015b) An integrative methodology for the quality of life measurement in urban places based on the accomplishment of human needs. In: UN-Habitat Future of Places III Conference. Stockholm
- Papachristou IA, Rosas-Casals M (2016) Unveiling connectivity patterns of categories in complex systems: An application to human needs in urban places. *J Math Sociol* 40:219–238. doi: 10.1080/0022250X.2016.1219855
- Pearce D, Ozdemiroglu E (2002) *Economic Valuation with Stated Preference Techniques: Summary Guide*. Edward Elgar Publishing Ltd, London
- Vásquez C (2011) Las grandes ciudades se suben a la bicicleta. *El País*
- Veenhoven R (2002) Why social policy needs subjective indicators. *Soc Indic Res* 58:33–46. doi: 10.1023/A:1015723614574
- WHO (2015) World Health Organization. <http://www.who.int/en/>. Accessed 5 May 2015
- Wolfgang B (2002) Web-Surveys - An Appropriate Mode of Data-Collection for the Social Sciences? In: Batinic B, Reips U-D, Bosnjak M, Werner A (eds) *Online social sciences*. Hogrefe & Huber Publishers, Ashland, OH, US, pp 1–6



4.

Categorisation and
need connectivity

4.1 CATEGORISATION PROCESSES IN SOCIO-ECOLOGICAL SYSTEMS

People use concepts both to provide a taxonomy of things in the world and to express relations between classes in that taxonomy (Smith and Medin 2014). One component of this taxonomic function is categorisation, the process in which a specific instance is recognised as a member of a concept (i.e., this inanimate thing is an automobile) or that one particular concept is a subset of another (i.e., this automobile is a sport utility vehicle). Concepts and categories thus (a) give our world some coherence and (b) capture the notion that many objects or events are alike in some important respects, and hence can be thought about and responded to in ways we already comprehend. This process has been particularly helpful in assessing the many problems related with SES (see Section 1.5.1). The aim in doing so is to recognise and differentiate concepts and objects, and, ideally, to illuminate relationships between subjects and objects of knowledge (Cohen and Lefebvre 2005).

Once concepts, ideas and objects are categorised, the global pattern of possible conceptual connections among them is strongly constrained by the categorising process itself. In this Chapter, we present a methodology based on weighted networks and dependence coefficients aimed at revealing the connectivity between categories in systems where the classificatory divisions can be defined. Any categorisation process implies by definition a loss of some structural information on the overall system (Papachristou and Rosas-Casals 2016). It is hypothesised that recovering the connectivity pattern of categories in general, and in SES in particular, offers the possibility to add information back to the system to facilitate its comprehension and analysis in at least three ways: (i) there is a hidden map of subjacent connections between categories that cannot be observed unless a process of direct enquiry to the elements (i.e., actors) of a system is used as a proxy of how a community builds its particular social contract based on preferences; (ii) the connectivity pattern obtained along this process of information retrieval is necessarily a function of both, spatial and temporal constraints, and the strength of the different connections between categories; and (iii) connectivity patterns can be used to design strategies to act on the function and aspect of the system under study.

4.1.1 DEFINING STUDY CATEGORIES

The methodology presented is a mixed method that allows the classification of quantitative data into qualitative categories and the retrieval of the overall connectivity pattern of the variables within the study categories. The particular steps proposed in the methodology are shown in Figure 37.

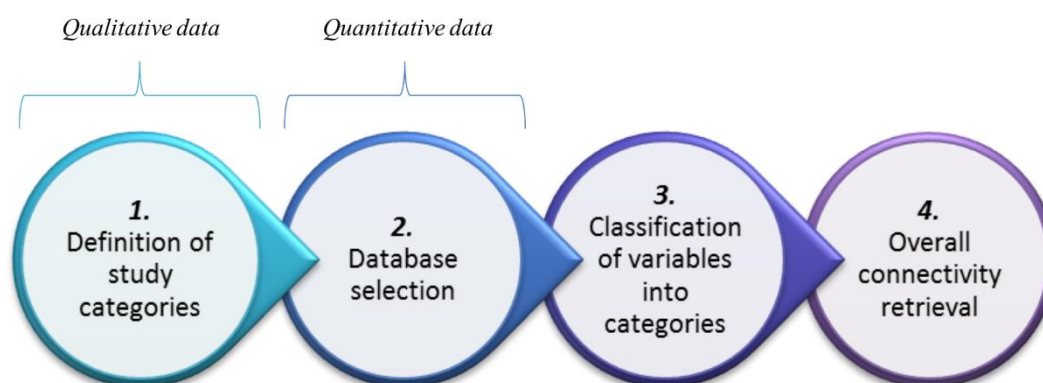


Figure 37: General methodological process.
Source: (Papachristou and Rosas-Casals 2016).

The *first step* in the process is the definition of the study categories. These categories correspond to the qualitative variables according to which we would like to classify our quantitative ones. Categories could be

either pre-established or assumed, depending on the assessment and given that categorization processes require and consider subjective opinion as necessary (Cohen and Lefebvre 2005). Table 12 offers a sample of quantitative and qualitative data systems where this methodology can be applied.

Table 12: Examples of qualitative and quantitative data that may be used as study categories and variables correspondingly.

Qualitative Data	Quantitative data
Human needs (Max-Neef et al. 1991)	World Values Survey Database (http://www.worldvaluessurvey.org/)
Constituents of well-being (Millennium Ecosystem Assessment 2005)	The Survey of Health, Ageing and Retirement in Europe (http://www.share-project.org/)
Gross National Happiness Index Domains (http://www.grossnationalhappiness.com/)	Environmental conflicts (Temper et al. 2015)
Planetary boundaries (Rockstrom et al. 2009)	

4.1.2 DATABASE SELECTION

The *second step* (Figure 37) involves the database selection. The quantitative variables may correspond to closed survey responses, indexes, measures, and other numerical data or numeric databases. For example (Table 12), we may want to know how the impacts of environmental conflicts (Temper et al. 2015) may affect the constituents of well-being (Millennium Ecosystem Assessment 2005). We have a list of variables related to possible impacts of environmental conflicts. In this case, the responses for each conflict are binary (i.e., either yes or no). We also have a list of categories to classify those impacts, corresponding to the constituents of well-being according to the Millennium Ecosystem Assessment. Those are: Existence, health, security, good social relations, and freedom of choice and action. Or, we may want to see how environmental impacts related to environmental conflicts (Temper et al. 2015) have an effect on the nine planetary boundaries categories corresponding to climate change: Ocean acidification, stratospheric ozone, biogeochemical nitrogen (N) and phosphorus (P) cycle, global freshwater use, land system change, rate of biological diversity lost, chemical pollution, and atmospheric aerosol loading (Rockstrom et al. 2009). Another alternative could be to check the fulfilment of human needs of the human-scale development paradigm (Max-Neef et al. 1991) for a specific European country (or a comparison between them) according to data coming from the Survey of Health, Ageing, and Retirement in Europe (SHARE) questionnaire²³.

4.1.3 CLASSIFICATION PROCESS

The *third step* (Figure 37) corresponds to the classification of the variables into the selected categories following a generalised process of that presented in Section 3.1.2. We again use a focus or study group consisting of i) experts on the subject, ii) a sample of the local and directly affected population or iii) some random population sample. The matching of the variables to one or more categories is seen as a subjective choice related to individual understanding and interpretation (Papachristou and Rosas-Casals 2016). During this process a variable can be related to more than one category (Table 13). Variables are classified into categories by following and averaging the binary decision process from individuals belonging to the focus group. In Table 13, category A is assumed to be defined by variables 1; 2; ...; m and by individuals a; b; ...; n.

²³ <http://www.share-project.org/>

The importance of variable m in defining category A is the average of individuals who acknowledge its importance in this particular category.

Table 13: Variables are classified into categories by following and averaging a simple binary decision from the focus group. Here, category A is assumed to be defined by variables $1, 2, \dots, m$ and by individuals a, b, \dots, n . The importance of variable m in defining category A is the average of individuals who acknowledge its importance in this particular category.

Category A					
Variable	Individual a	Individual b	...	Individual n	Average
1	1	1		1	$3/n$
2	1	1		0	$2/n$
...					
m	1	0		i	$\frac{\sum_{i=1}^m i}{n}$

For the sake of clarity, we will consider the examples of Table 12. World Values Survey (WVS) Database²⁴ can be used to measure the Gross National Happiness Index (GNH)²⁵ levels per country, continent, or globally. To do so, variables in WVS database should be classified by a focus group to the GNH's domains (or categories) corresponding to psychological well-being, standard of living, good governance, health, education, community vitality, cultural diversity and resilience, time use, and ecological diversity and resilience. Each variable may belong to more than one domain according to each individual perception coming from the members of the focus group. For instance, a question coming from the WVS like "How democratically is this country being governed today?" may be directly classified under GNH categories like "good governance," but for some it may also affect "psychological well-being." Another question like "How secure somebody feels in the neighbourhood" may be classified under "psychological well-being", "standard of living", and/or "community vitality" among others.

To (a) detect the relevance of each variable in defining each category, and (b) balance the number of variables per category, so every category is defined by a similar number of variables, we select variables per category in decreasing average order (see last column of Table 13). When the average punctuation for a variable is equivalent for more than one need, we use a sequential criterion, based firstly on an equal number of variables per need, and secondly on a random selection of pertinence. To detect any possible bias in the results when introducing this randomising step, we must reproduce this process several times with different sets of randomised values.

4.1.4 OVERALL CONNECTIVITY RETRIEVAL

In the *fourth* and final *step* (Figure 37), we retrieve the overall connectivity between categories. This process makes use of a correlation value between variables to establish how strongly they are connected. Depending on the researcher's personal choice and the type of variables, different methods can be used. Linear (i.e., Pearson, X^2 , Spearman) and/or nonlinear (i.e., maximal information) correlation coefficients are more suitable for analogic variables, while methods like entailment analysis (White et al. 1977; White 1996) or partial order models (Wiley and Martin 1999) can be more suitable in the particular case of binary only data. Although a process of dichotomisation of variables is always possible, it usually comes as a trade-off for complexity, and must be implemented with care to avoid an oversimplification of our connectivity map. The relation between

²⁴ <http://www.worldvaluessurvey.org/>

²⁵ <http://www.grossnationalhappiness.com/>

two variables (or the relation between the categories those variables are associated with) is not of interest in this methodology; rather, the overall connectivity map between variables and how this map emerges are relevant. To provide an intuitive and efficient interpretation of how the different variables in a dataset are related to each other, we construct a network-type visualisation of the datasets (see Section 1.5.2). Variables in the dataset are represented by nodes, while relationships between variables are represented by edges, weighted according to the results of the selected coefficient for each pair of variables.

Finally, we obtain the weighted degree of each node as a proxy of its significance and as a function of its relations with the rest of variables. In network theory, the degree of a node is simply the number of connections or edges that that node has to other nodes. Weighted degree has generally been extended to the sum of weights when analysing weighted networks (Newman 2001; Barrat et al. 2004; Opsahl et al. 2010), and it is labelled *node strength*. This measure is formalised as follows:

$$s_i = \sum_j^N w_{ij} \quad (\text{Eq. 9})$$

where w is the weighted adjacency matrix, in which w_{ij} is greater than 0 if the node i is connected to node j and the value represents the weight of the tie (i.e., correlation coefficient). Once a network is thus created, graph theory can be applied to reveal other structural properties based on network centrality measures (Newman 2010). Here, strength (i.e., weighted degree) cumulated probability distribution $P_{>}(s_i)$ is primarily used, which measures the percentage of nodes with strength s_i or higher. A remarkable attribute of cumulated distributions, compared to histograms and other binning procedures, is that no statistical information is lost. In many ways, it is a much more useful and convenient method for plotting the data (Newman 2005).

4.2 CONNECTIVITY PATTERNS IN HUMAN NEEDS

We applied the methodology previously presented in Section 4.1 to two urban SESs, corresponding to Gn and Vs (see Sections 1.2.1 and 1.2.2), with the aim to reveal the topological structure of human needs (defined as existential categories – see Section 1.3.1) in urban places (see Section 1.2). It is based on complex networks (see Section 1.5.2) and maximal information approaches. It addresses the dimension of social science theory from an empirically informed bottom-up perspective and with the objective of devising new strategies to cope with the complexity of place-making process in general and urban-making process in particular.

4.2.1 STUDY CATEGORIES AND DATABASE SELECTION

For the application of the proposed methodology exposed in Section 4.1, Max-Neef et al.'s (1991) human needs of the HSD paradigm are used as the study categories (see Section 1.3.1). Here, dwellers' perceptions on the urban places corresponding to Gn and Vs (see Sections 1.2.1 and 1.2.2) act as variables and fundamental human needs (Max-Neef et al. 1991) act as categories. Figure 38 represents in detail the methodology applied for the two cases. For the database creation, and in order to assess possible differences in spatial scales in terms of perceptions related to urban places, we used the surveys for Gn and Vs analysed in Sections 1.2.1, 1.2.2 and 3.2.2 following the principles mentioned in Section 3.1.3 for subjective procedures. The main statistics of the samples are shown in Table 5 and general survey questions can be found at Appendix B, Table B1.

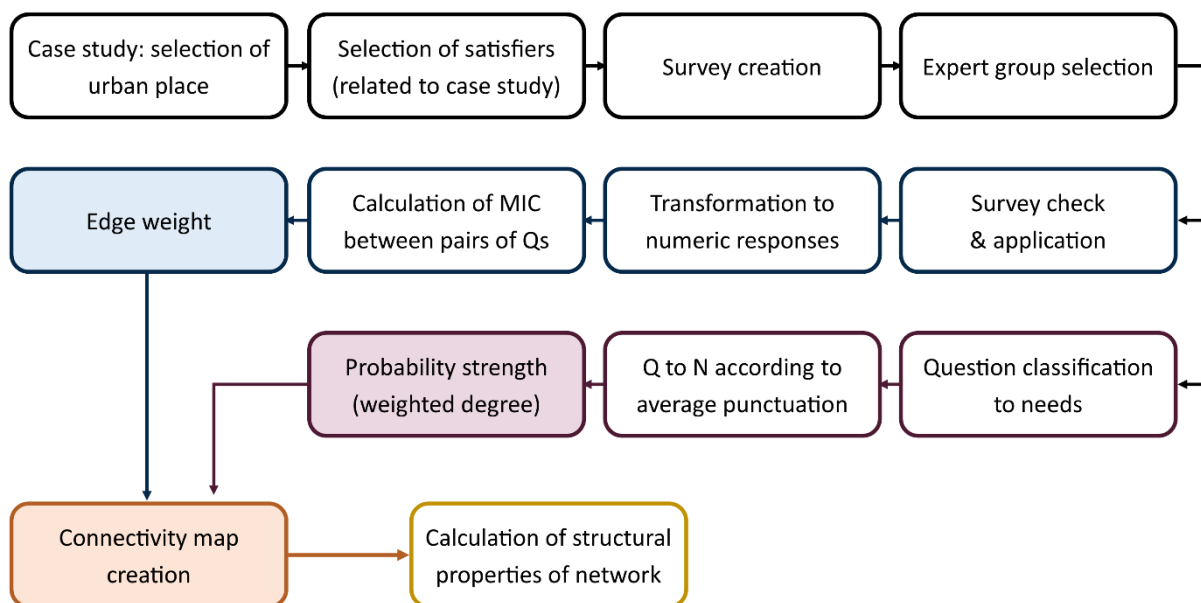


Figure 38: Detailed methodological steps for the selected study case.
Source: (Papachristou and Rosas-Casals 2016).

4.2.2 CLASSIFICATION OF QUESTIONS INTO NEEDS

The classification between categories and variables in our study case follows the one presented in Section 3.1.2. Results presented here are related to the two test cases of the previous section. The outcomes are shown in Figure 39. This representation in the form of a network (see Section 1.5.2) displays a first classification of the survey questions into fundamental human needs by the experts. Nodes in green represent questions and groups of questions (used when one question in the survey was split into others and to prevent

the figure from being overloaded). Nodes in blue colour represent needs. Node size is proportional to the number of connections a need or question has. Edge width is proportional to the importance of that question in defining that need (i.e., the average of experts who acknowledge its importance, a value taken from column *Average* in Table 13). Even though most questions are connected to more than one need, we observe that each question is notably important in defining one particular need alone (i.e., its connecting edge having a wider width).

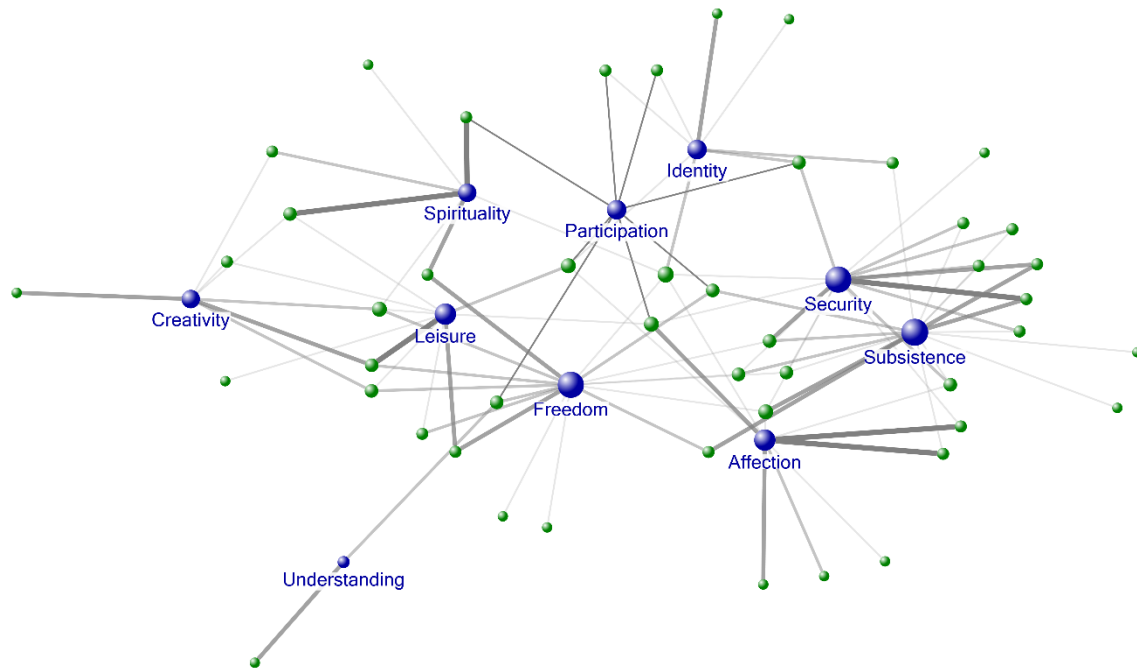


Figure 39: Connectivity of questions (nodes in green) and needs (nodes in blue). Node size is proportional to the number of connections (i.e., degree) that a need or question has. Edge width is proportional to the importance of that question in defining that need (i.e., the average of experts who acknowledge its importance). Graph figure created with NodeXL (<http://nodexl.codeplex.com>).

Unlike the process followed in Sections 3.1, 3.2 and 3.3, in this case and although many questions (or group of questions) were originally related to more than one need, a subsequent processing of sequential selection was performed, where questions were selected in decreasing average order per need. This balanced the number of questions per need, so every need was defined by a similar number q of questions on average; in this case $\bar{q} = 12$ and standard deviation $SD_{\bar{q}} = 2.5$.

4.2.3 BUILDING THE CONNECTIVITY MAP

The correlation coefficient used in this case study is the maximal information coefficient (MIC) which allows many-dimensional datasets to be explored, assuming generality (i.e., it captures a wide range of associations, not limited to specific functions such as linear, exponential, etc.) and equitability (i.e., it gives similar scores to equally noisy relationships of different types) (Reshef et al. 2011). It is calculated from a matrix of scores generated from a given set of two-variable data²⁶. This matrix is created by searching for grids that maximise the penalised mutual information of the distribution induced on each grid's cells by the data. Different relationship types give rise to characteristic matrices with different properties. For instance, strong relationships yield characteristic matrices with high peaks, monotonic relationships yield symmetric

²⁶ MIC code can be downloaded from <http://www.exploredata.net>. The page also offers real data examples, the necessary steps to compute MIC value and an explanation regarding its parameters.

characteristic matrices, and complex relationships yield characteristic matrices whose peaks are far from the origin. In our case, the input data is a matrix where columns correspond to variables (i.e., survey questions), rows correspond to individual subjects (i.e., survey responses) and a MIC value is obtained for each pair of variables.

MIC values for independently taken pairs of variables cannot give a true account of the aggregate outcome of the answers. To show how the different questions in the dataset are related to each other, we created a network-type visualisation of the dataset. Questions in the dataset were represented by nodes, while relationships between questions were represented by edges, weighted according to the MIC strength of each pair of variables (equation 9). Once a network was thus created for each case (Gn and Vs), we applied graph theory to obtain weighted degree cumulated probability distributions $P_{>}(s_i)$. To be able to compare the two networks, s_i was normalised using the highest degree s_i^{max} for each network as the normalising constant:

$$\hat{s}_i = \frac{s_i}{s_i^{max}} \quad (Eq. 10)$$

As previously commented, here strength (i.e., weighted degree) cumulated probability distribution $P_{>}(s_i)$ was used as the fundamental measure to reveal the connective pattern of categories (i.e., human needs). Since $P_{>}(s_i)$ measures the percentage of nodes (i.e., questions) in the network with strength equal to or greater than s_i and, these nodes have been divided into needs, $P_{>}(s_i)$ offers the possibility to observe the evolution in the emergence of each need in accordance with the appearance of each question in the network, ordered from highest to lowest strength. This process can be qualitatively (Figure 40) and quantitatively (Figure 41) presented. Figure 40 shows two screenshots corresponding to the emergence of the graph for Gn at two stages, with questions spatially grouped and coloured according to HSD categories. The first stage is when 15% of the nodes with the highest strength are shown (a), where Affection and Security appear as the two most prominent needs in terms of correlations between questions. When strength is decreased to make 70% of the nodes present (b), nodes related to Affection and Security have fully appeared, while other needs' nodes have not appeared yet (i.e., Participation). At this second stage, the graph is still far from being fully connected and all non-present nodes have strengths lower than 0.35.

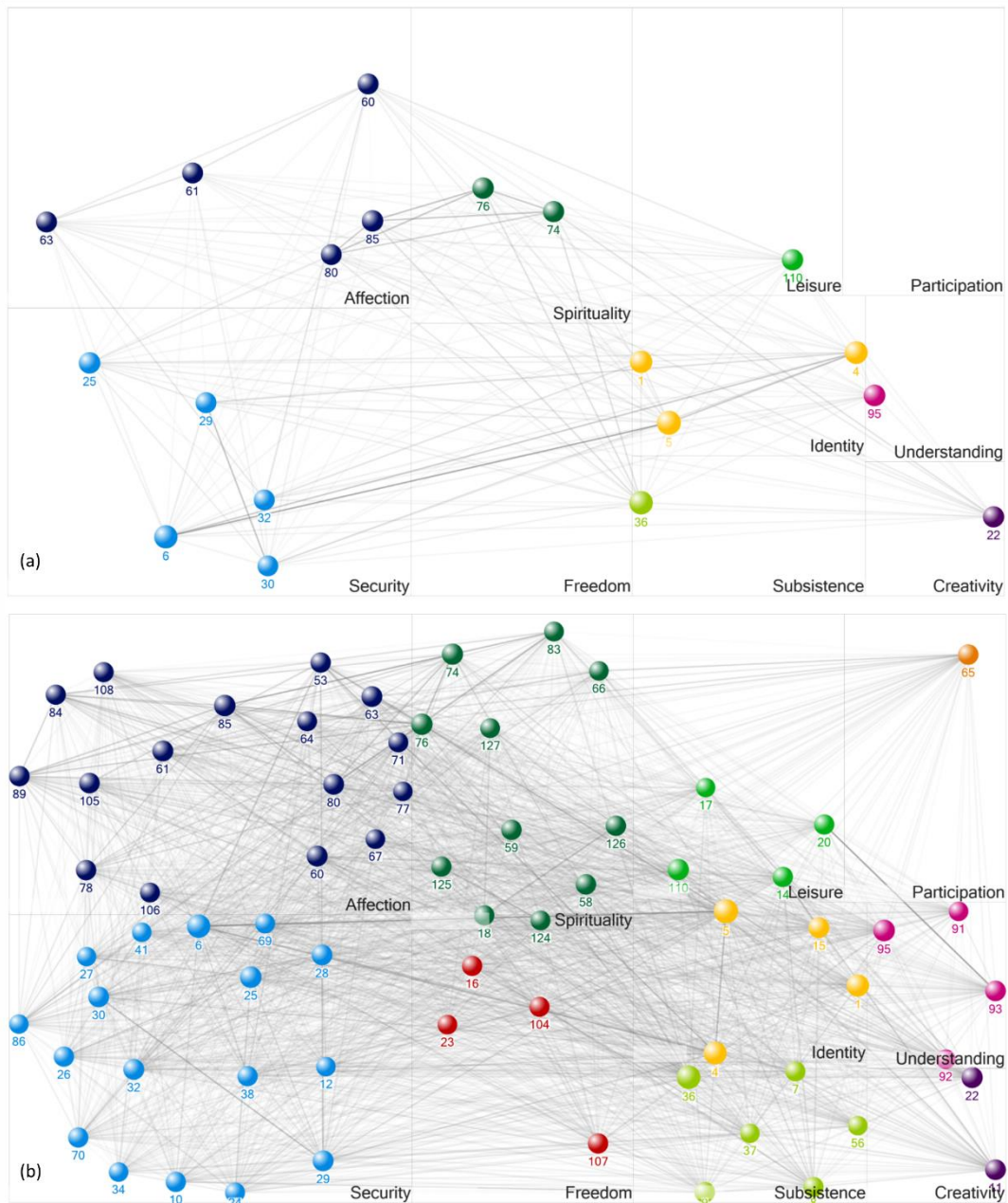


Figure 40: Appearance of needs (different colours) using strength as a filter for the G_n network. Graph snapshots when 15% (a) and 70% of the nodes with the highest strength are shown, respectively. Graph figures created with NodeXL (<http://nodexl.codeplex.com>).

Results for the normalised strength cumulated probability distribution for both networks, G_n and V_s , are shown in Figure 41. $P_{>}(s_i)$ exhibits a bimodal distribution for both networks, with two similar sigmoid behaviours after and before strength value $\hat{s}_i = 0.35$ for G_n , and $\hat{s}_i = 0.25$ for V_s . Figure 41(a) shows its deviation from the corresponding cumulated probability distribution for a random graph (i.e., a graph with Gaussian degree distribution) with the same average node strength and number of nodes (shown with dashed lines). A random graph is a graph in which properties such as the number of graph vertices, graph edges, and connections between them are determined in some random way (Bollobás 2001) and thus, uses the least amount of assumptions in its generation process. This deviation is more substantial in the case of Vila de Gràcia. Figure 41(b) shows $P_{>}(s_i)$ for the same nodes, but this time, it is grouped by needs. Here, we observe the particular characteristics of every need and how its importance (in terms of more connected nodes or

questions) emerges gradually from the entire connected network and at some particular transitional zones, numbered from (I) to (III). The features we can observe are the following:

- One striking difference between both distributions is shown in Figure 41(a). Gn presents a more spread normalised strength distribution than Vs. This can be clearly observed by the number of nodes existing in the range $0.5 < \hat{s}_i < 1.0$ for both networks: $P_{>}^{Gn}(s_i \geq 0.5) = 0.4$ whereas $P_{>}^{Vs}(s_i \geq 0.5) = 0.02$. Although qualitatively similar, this characteristic keeps both distributions segregated and quantitatively distinct, as it will be commented later.
- For both networks, nodes related with Identity are detected first – reading the graphs from the right to the left –, indicating their highest normalised strength (i.e., $\hat{s}_i = 1.0$). In the case of the Gn network, nodes representing Security and Understanding appear as early as for $\hat{s}_i > 0.89$ and $\hat{s}_i > 0.67$, respectively.
- Zone (I). For $\hat{s}_i = 0.55$, a first sudden transition for Gn is observed when nodes related with Affection, Creativity, Freedom, Leisure, Participation and Spirituality / Transcendence categories mostly appear. This implies the presence of 30% of the nodes in Gn, while barely 2% of the nodes in Vs are present for this same value of \hat{s}_i . Nodes related with Subsistence have already completely appeared in the distribution from normalised strength $\hat{s}_i = 0.45$.
- Zone (II). There is not a second transition until $\hat{s}_i = 0.34$, this time, for the Vs network. At this point, nodes related to all categories have already appeared, although some of them only with a reduced presence (i.e., for Freedom, Leisure and Participation). Here, 70% of the nodes are already present in the Gn connected component of the graph, while only 35% of their counterparts in Vs have appeared.
- Zone (III). Finally, for $\hat{s}_i < 0.3$, the remaining nodes appear in a process of slow convergence between the two networks shown in Figure 41(a). For the Vs case, however, some sudden transitions occur for the Creativity, Freedom, Leisure and Participation categories. Curiously enough, the two only needs in Vn that reach a final presence in the network with percentages similar to those of Gn are Affection and Security.

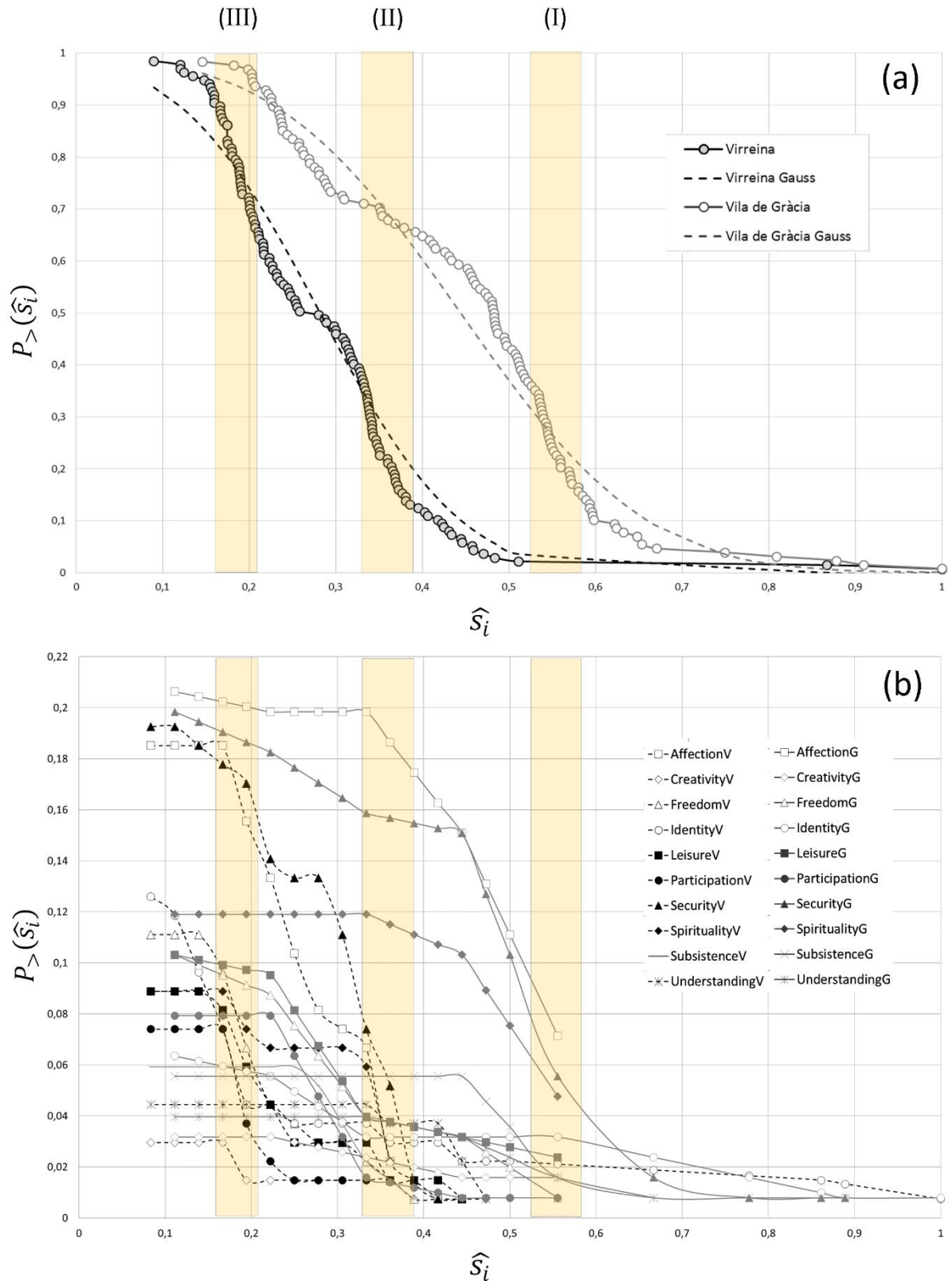


Figure 41: Strength (i.e., weighted degree) cumulated probability distribution and the emergence of the dataset network. (a) Degree cumulated probability distributions for Vs and Gn, compared to a normal distribution with the same average weighted degree and standard error (dashed line). (b) Segregated by needs. (V stands for Vs; G stands for Gn). Grey colour was used to reduce overlapping. Coloured strips (I), (II) and (III) are related with transitional zones (see text).

4.2.4 COMPREHENDING THE INFLUENCE OF THE DISTRIBUTION OF WEIGHTS

Although we assume the impossibility of formulating a generative null model for comparative purposes in this case, a very simple numerical model can help us comprehend the influence of the distribution of weights in the observed probability distributions of Figure 40. Modelling in this case is not used to predict experimental outcomes, neither to generate testable hypotheses. We use it as a vehicle of understanding for our particular case study (Lander 2010). Let assume a fully connected graph $G(m, n)$ with n nodes and $m = n(n - 1)/2$ edges, as it is the case in our original network, where every node i is connected to every other node j . Our objective is to detect qualitative differences in cumulated probability distributions of strengths coming from different probability density functions of weights $f(W_{i,j})$. To do so, the following algorithm is used:

1. A number $m_{W_{i,j}} = n(n - 1)/2$ of weights is generated from two different probability density functions: exponential ($W_{i,j} \leftarrow q(x) \sim e^{-x}$) and power law ($W_{i,j} \leftarrow p(x) \sim x^{-\beta}$). We have considered these two functions as they imply the statistical signature of two extreme phenomena commonly considered in the literature (Mitchell 2009; Gros 2015): that of randomness and that of some sort of complexity, respectively. In the particular case of networks, a fat-tailed probability distribution signature (i.e., power law) in terms of degree indicates a hub-dominated topology, where the probability of finding a node with high degree is significantly higher than in a homogenous graph case (Newman 2010). In other words, these networks do not arise by chance alone and non-trivial underlying mechanisms are usually at play for the generative processes involved in their evolution and growth (Newman 2005).
2. We use α as a threshold in the range $0 < \alpha \leq 1$ to parameterise the steps of assigning values to the weighted adjacency matrix of our particular synthetic network, with weights $W_{i,j}$ randomly drawn from $p(x)$ if $k \leq \alpha$ and from $q(x)$ otherwise, where k is a random number in the range $0 < k \leq 1$, generated at every step. For $\alpha = 0$, the model fills a weighted adjacency matrix with weights purely coming from an exponential probability density functions of weights, whereas for $\alpha = 1$, the model fills a weighted adjacency matrix with weights solely coming from a power law one.
3. For different values of α , the corresponding normalised strengths are calculated for every node (Eq. 10) to finally obtain the corresponding cumulated strength probability distribution $P_{>}(s_i)$ for each α .

Figure 42 shows averaged values (with standard errors shown as whiskers) for $P_{>}(s_i)$ and for 100 realisations over a network with $n = 100$ nodes using some values of α . Although we observe differences as α varies from 0 to 1, each cumulated strength probability distribution qualitatively follows a cumulated normal distribution (p-value < 0.001 for all of them, results not shown in the text). We use the coefficient of variation $c_v = \sigma/\mu$, where σ is the standard deviation and μ is the mean, to quantitatively distinguish the results of our model (Table 14). The coefficient of variation changes from $c_v = 0.53 \pm 0.07$ for the exponential case (i.e., $\alpha = 0.0$) to $c_v = 0.12 \pm 0.01$ for the power law case (i.e., $\alpha = 1.0$), indicating how an increasing probability of having nodes with larger strengths tends to diminish c_v . Table 14 also shows real c_v values for Plaça de la Virreina (Vs) and Vila de Gràcia (Gn), obtained from a fitting of a cumulated normal distribution (Figure 41(a), dashed lines).

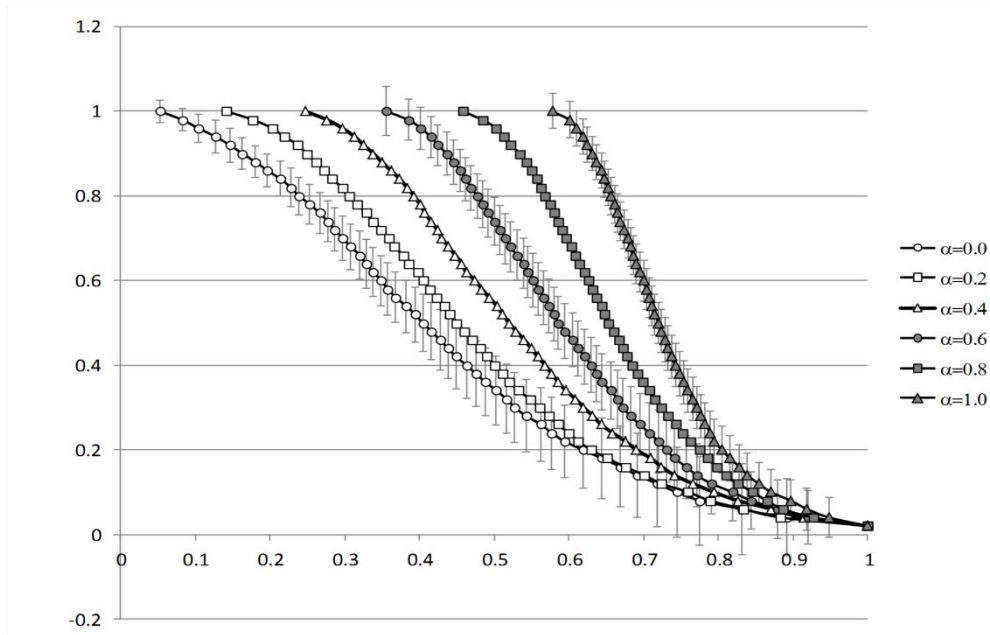


Figure 42: Synthetic strength probability distributions created from weights randomly drawn from exponential (grey) and power law (white) distributions. Standard errors shown as whiskers and only for three distributions to avoid figure cramping.

Table 14: Results for the coefficient of variation of the mean values of the model and parameter α running from $\alpha=0.0$ (exponential weight distribution) to $\alpha=1.0$ (power law weight distribution), compared to our real study cases Plaça de la Virreina square (Vs) and Vila de Gràcia neighbourhood (Gn).

α	c_v
0.0	0.53 ± 0.06
0.2	0.41 ± 0.05
0.4	0.33 ± 0.05
0.6	0.24 ± 0.03
0.8	0.18 ± 0.01
1.0	0.12 ± 0.01
Square (Vs)	0.42
Neighbourhood (Gn)	0.38

4.3 MAIN POINTS IN REVIEW

- In this Chapter we presented a methodology based on weighted networks and dependence coefficients aimed at revealing connectivity patterns of categories. This process has been particularly helpful in assessing the many problems related with SES (see Section 1.5.1). We aim at incorporating emerging models and conceptualisations on collective dynamic interactions to integrate social development and sustainability. The final objective is to reveal ways to improve social capacity to guide interactions between nature and society towards more sustainable trajectories. We suggest that this way of analysing the connectivity of categories in social and ecological systems can be used to define new strategies to cope with complex processes, such as those related to transition management and governance, urban-making and integrated planning.
- Although we acknowledge the necessity for an axiomatic approach to the concept of complexity and its many applications in the form of network in general, and social networks in particular (Butts 2000), the analysis introduced in this paper aims at presenting a proxy of how a community builds its particular social contract based on preferential needs. Other kind of conclusions that may be derived from it must be taken with due care for at least three reasons. Firstly, null models for comparative purposes cannot be formulated in the case of such specific graph construction processes. Secondly, the strength probability used as a question classifier is a statistical index derived from maximal information coefficients between pairs of questions. Thus, in a group of n questions, the importance of a question depends on its (co-)relation with the remaining $(n - 1)$ questions. Lastly, the classification of questions into human needs comes, in this case, from a pool of people who, despite being experts in their fields, share a particular and time- and space-limited vision and definition of HSD.
- It would also be inappropriate to examine the importance of the different questions by means of their individual connectivity, i.e., which particular question is connected to which other particular question.
- On both Gn and VS scales, Identity appears as the most prominent need. Under HSD's existential categories (i.e., being, having, doing and interacting), Identity implies belonging (to a place), language, habits, traditions and values. It is thus a fundamental need in the definition of any social group and a reference for the recognition of one's self in the social sphere. This is the only common trait shared by both networks. At the local scale (Gn), Security appears in second place, a need related with solidarity, family, rights and job. Again, it is a fundamental need in the definition of vital and social domains. On the other hand, the striking difference between Gn and Vs networks is the \hat{s}_i value at which the rest of the needs appear: above and below $\hat{s}_i = 0.5$, respectively. This difference comes essentially from a fundamental change in the strength homogeneity. Gn presents a much more evenly spread distribution in terms of \hat{s}_i than Vs: in Vs questions for all needs appear suddenly, in a much more concentrated manner. In Gn, normalised strength spans in a wider range than in Vs, with nodes occupying the whole spectrum of \hat{s}_i values. From a structural point of view, this means that some questions in the Gn network are connected with stronger links than in the Vs one. These questions make Affection (related with self-esteem, friendship and family), Creativity, Leisure and Participation (related with imagination, humour and curiosity), and Spirituality / Transcendence (related with beliefs and personal growth) characteristic needs at this level of scale.
- The simple numerical model used to comprehend the influence of the distribution of weights in the observed probability distributions of Figure 40 (see Section 4.2.4) shows how adjacency matrices filled with weights coming from different probability density functions give rise to qualitatively similar cumulated strength probability distributions. Table 14 also indicates that although both cases differ slightly, our model sets Vs closer to the exponential case than Gn. From a network's structural point of view, the exponential probability distribution in the case of Vs implies more trivial underlying generative mechanisms than in the case of Gn. The correlation between answers for questions related

with some needs in the case of Gn is considerably stronger than in Vs, thus making (a) the sub-local level correlations between needs much looser and (b) the underlying social network at this level less clearly dominated by particular needs.

- Figure 41(b) shows that for $\hat{s}_i < 0.15$, the value of $P_{>}(s_i)$ for questions related with Affection and Security attains $0.18 < P_{>}(s_i) < 0.22$ in contrast with questions related with the remaining needs, where $P_{>}(s_i) < 0.13$. When all questions are considered, the probability of having nodes connected and classified under the needs Affection and Security is similar, suggesting a more relevant social importance of these two needs and at both spatial levels. One difference, though, is the value of \hat{s}_i at which these similar values of $P_{>}(s_i)$ are attained; much lower in the case of Vs than in Gn. Thus, Vs withstands a much more abrupt transition than Gn for these two same needs. Although we cannot account for a plausible explanation of this fact based on sociological facts, there exists a topological explanation and it comes from the difference in strength distribution between Vs and Gn, as previously commented. Since the probability of having nodes classified under the needs Affection and Security is the same in both networks, a network with a more homogenous distribution of correlation strengths among questions, and thus needs, such as Vs, will necessarily have to generate this level of connectivity between the questions related with these two needs much more suddenly than a more inhomogeneous (i.e., hub-dominated) network such as Gn.
- The map of subjacent connections between categories can be observed thanks to a process of direct enquiry to the actors of our urban system. The results of this process are used as a proxy of how this community builds its particular social contract based on preferences. Our numerical model shows that connectivity patterns are a function of spatial and temporal constraints, together with the strength of the different connections between categories.
- Under the HSD paradigm, one main assumption is that the presence of all needs (or categories) is equally important to avoid any form of human poverty (see Section 1.3.1). In this case, Identity dominates the global need connectivity on both scales, which is somehow an expected trend considering the idiosyncratic neighbourhood of Gràcia with a close-knitted social fabric that allows high levels of public engagement. While Affection and Security are the most connected needs on both scales, different probabilities of occurrence are observed for questions belonging to some human needs and at different scales. These probabilities are a function of how satisfiers are perceived. A dissimilar probability of occurrence implies a different presence of satisfiers for the same needs. From the results of our two case studies, it is possible to devise more operational ways to balance the presence of those less-connected needs and to promote integration policies and actions in this direction.
- Communities do not only make decisions based on people's perceptions of needs, but because of events, problems, or actions in the community or even a broader urban system or SES. Things that are more global to the community may have local consequences, with this scalar shift being termed a process of glocalisation in the broad literature (Martin et al. 2003), involving a simultaneous globalisation and localisation of things and processes. At the same time events in the community may motivate plans of action that are not necessarily based on perceptions of needs in the community per se. How a process of assessment of needs can be improved to encompass and address these issues remains thus an open question and it gives several different alternatives for further work.
- Introducing a spatial and temporal perspective to this analysis is also fundamental. An important issue would be to reproduce this kind of analysis in other temporal and spatial lines, since temporal perspective raises public awareness of intergenerational phenomena (i.e., trade-off between short-term gains and long-term concerns) and spatial perspective brings an emphasis to intra-generational equity (Martens 2006; Kajikawa 2008).

4.4 REFERENCES

- Barrat A, Barthélemy M, Pastor-Satorras R, Vespignani A (2004) The architecture of complex weighted networks. *Proc Natl Acad Sci U S A* 101:3747–52. doi: 10.1073/pnas.0400087101
- Bollobás B (2001) *Random Graphs*. Cambridge University Press, New York
- Butts CT (2000) An axiomatic approach to network complexity. *J Math Sociol* 24:273–301. doi: 10.1080/0022250X.2000.9990239
- Cohen H, Lefebvre C (eds) (2005) *Handbook of Categorization in Cognitive Science*. Elsevier Ltd, Oxford, United Kingdom
- Gros C (2015) *Complex and Adaptive Dynamical Systems*. Springer International Publishing, Cham
- Kajikawa Y (2008) Research core and framework of sustainability science. *Sustain Sci* 3:215–239. doi: 10.1007/s11625-008-0053-1
- Lander A (2010) The edges of understanding. *BioMed Cent Biol* 8:40
- Martens P (2006) Sustainability: science or fiction? *Sustain Sci Pract Policy* 2:
- Martin D, McCann E, Purcell M (2003) Space, Scale, Governance, and Representation: Contemporary Geographical Perspectives on Urban Politics and Policy. *J Urban Aff* 25:113–121. doi: 10.1111/1467-9906.t01-1-00001
- Max-Neef MA, Elizalde A, Hopenhayn M (1991) *Human Scale Development. Conception, application and further reflections*. The Apex Press, New York & London
- Millennium Ecosystem Assessment (2005) *Ecosystems and Human Well-being: General Synthesis*. Island Press
- Mitchell M (2009) *Complexity: A Guided Tour*. Oxford University Press, New York
- Newman MEJ (2001) Scientific collaboration networks (II). Shortest paths, weighted networks, and centrality. *Phys Rev E* 64:
- Newman MEJ (2010) *Networks: An introduction*. Oxford University Press, Oxford
- Newman MEJ (2005) Power laws, Pareto distributions and Zipf's law. *Contemp Phys* 46:323–351. doi: 10.1080/00107510500052444
- Opsahl T, Agneessens F, Skvoretz J (2010) Node centrality in weighted networks: Generalizing degree and shortest paths. *Soc Networks* 32:245–251
- Papachristou IA, Rosas-Casals M (2016) Unveiling connectivity patterns of categories in complex systems: An application to human needs in urban places. *J Math Sociol* 40:219–238. doi: 10.1080/0022250X.2016.1219855
- Reshef DN, Reshef Y a, Finucane HK, et al (2011) Detecting novel associations in large data sets. *Science* 334:1518–24. doi: 10.1126/science.1205438
- Rockstrom J, Steffen W, Noone K, et al (2009) Planetary boundaries: exploring the safe operating space for humanity. *Ecol Soc* 14:
- Smith EE, Medin DL (2014) *Categories and Concepts*. Harvard University Press
- Temper L, del Bene D, Martinez-Alier J (2015) Mapping the frontiers and front lines of global environmental justice: the EJAtlas. *J Polit Ecol* 22:255–278
- White DR (1996) Statistical entailments and the Galois lattice. *Soc Networks* 18:201–215
- White DR, Burton ML, Brudner LA (1977) Entailment theory and method: A cross-cultural analysis of the sexual division of labor. *Cross-Cultural Res* 12:1–24
- Wiley JA, Martin JL (1999) Algebraic representations of beliefs and attitudes: Partial order models for item responses. *Sociol Methodol* 29:113–146



5.

Further applications
on collective
response

5.1 EXPERIMENTING WITH THE PUBLIC SPACE

In this Section we will present a series of experimental activities that focus in the lecture of public space. We selected Vs as our study case for the advantages it has as a space (explained in Section 1.2.2). During September-October 2014 we established Thursday as the day of our experimental activities to better understand the perception of the inhabitants for the place in question. Those included the previously mentioned surveys, collective mapping and open activities in a private space. We saw them as a way to activate the social grid in the city of Barcelona. We used all results and conclusions made during this first phase to perform ephemeral interventions in the physical space of the square. We ended the project with an informal conversation with the neighbours.

5.1.1 CITIZEN PARTICIPATION

The incorporation of citizen participation in urban planning has its origin in the advocacy planning model, that took place in the United States and Western Europe during the 1960s (Davidoff 1965). To this demand we add the impact of the social protests that shook the Western world, reaching its maximum exponent in 1968 with the events of May in Paris and the Italian hot autumn. The echo of these protests provoked a process of theoretical and practical radicalisation in urban theory. This was established with the proposal of the “right to the city” by Henri Lefebvre (Lefebvre 1968), which served as a theoretical basis for the ideals of participatory urbanism.

During this period in Spain we encounter a different political and social context induced by Franco’s dictatorial regime. It wasn’t until after his death in 1975 that new grounds for citizen participation were broken through the appearance of the neighbourhood movement (Alberich Nistal 2016). Neighbourhood associations’ field of action focused on improving the living conditions of people in the city and its neighbourhoods (Pérez Quintana and Sánchez León 2008). In this context appear the first popular urban plans, where the neighbourhood dwellers had the opportunity to express their opinion on the urban model of their living territory (Bonet i Martí 2011). This period of incipient participatory urbanism came into crisis in the early 80s as a result of the election of the first democratic city councils. The need to legitimise the institutions and the system of political parties that arose during the transition led to a decline in the participatory activity built from the bottom-up. It was considered that representative democracy already guaranteed the right to citizen participation: citizens were participating through the free choice of their representatives. Thus, the break-in participation that characterised the pre-crisis period led to a participation by invitation, where the public administrations previously agreed on the content, format and actors called to participate (Bonet i Martí 2014).

However, the democratisation of local institutions opened the doors to the first institutionalisation of citizen participation, through the approval of regulations and rules that crystallised in an institutional architecture of advisory councils in charge of the canalisation of the participation of the entities during the new democratic period (Pindado 2008). In 1986, the first norms of citizen participation were approved in the city of Barcelona, where a system of sectoral advisory councils was institutionalised. But, it wasn’t until the approval of Law 2/2002, of urbanism, that the city councils were authorised to create urban planning advisor counsels.

To examine the intensity of participation, we must analyse the degree of openness to the citizens in the decision-making process. Arnstein’s ladder (Arnstein 1969) remains a key reference in ongoing efforts to determine what does constitute participation by the public (Thorpe 2017). The bottom rungs of the ladder are (1) Manipulation and (2) Therapy. These two rungs describe levels of “non-participation”. Their real objective is to hinder people from participating in planning or conducting programs, while enabling powerholders to

“educate” or “cure” the participants. Rungs 3 and 4 progress to levels of “tokenism” that allow the have-nots to hear and to have a voice: (3) Informing and (4) Consultation. When they are proffered by power-holders as the total extent of participation, citizens may indeed hear and be heard. But under these conditions they lack the power to ensure that their views will be heeded by the powerful, when participation is restricted to these levels, there is no follow through, no “muscle,” hence no assurance of changing the status quo. Rung (5) Placation, is simply a higher-level tokenism because the ground rules allow have-nots to advise but retain for the powerholders the continued right to decide. Further up the ladder are levels of citizen power with increasing degrees of decision-making clout. Citizen can enter into a (6) Partnership that enables them to negotiate and engage in trade-offs with traditional powerholders. At the topmost rungs, (7) Delegated Power and (8) Citizen Control, have-not citizens obtain most decision-making seats, or full managerial power.

According to this scale, participation in urban development developed during the 1980s and 1990s could be included in the category of minimum symbolic participation (grades 3, 4 and 5 of the table), as this did not go further away from conciliation of interests between the Administration and its citizen counterpart. Only, from the legislative changes in the urban planning legislation and the beginning of participatory processes, we find cases that would increase at level 6 of cooperation between population and expert knowledge. However, we are still far from reaching levels 7 and 8 of the table, which would represent a delegation of power (as in some successful cases of participatory budgets) or of citizen control, the highest degree of citizen empowerment (Bonet i Martí 2014).

5.1.1.1 PERCEIVED LEVEL OF PARTICIPATION IN THE STUDY CASE

From the survey results on Gn and Vs presented in Section 3.2.2, we have seen that the need for Participation achieves a rather high satisfaction in the subjective dimension both for Gn and Vs cases, reaching the 67.3% and 62% correspondingly, with a potential increase of up until 13.6% for Gn and 18.1% for Vs (see Table 9, Section 3.2.5). We have also seen that although dwellers appear to complain for the low levels of citizen participation, the percentages of working as volunteers, participating to any association, having any control of the communitarian, political or social life or even participating in neighbourhood assemblies are low.

The focus here is in one specific question of the Vs survey related to (i) the perceived actual and (ii) conceived ideal level of participation (see Figure 43). The levels of participation correspond to the eight rungs of Arnstein’s ladder (Arnstein 1969), representing the “*extent of citizens’ power in determining the end product*”.

- (i) Regarding the actual perceived level, we have an average close to the third rung (3.22 points), corresponding to Informing. Specifically, 17.4% of the sample considers Manipulation, 17.4% Therapy, 21.7% Informing, 23.9% Consultation, 17.4% Placation, 2.2 Partnership.
- (ii) Regarding the ideal conceived level, we observe an average closer to the seventh rung (6.76 points), corresponding to Delegated power. Specifically, 2.4% of the sample would consider Placation as the ideal situation, 50% Partnership, 7.2% Delegated Power and 40.5% Citizen Control.

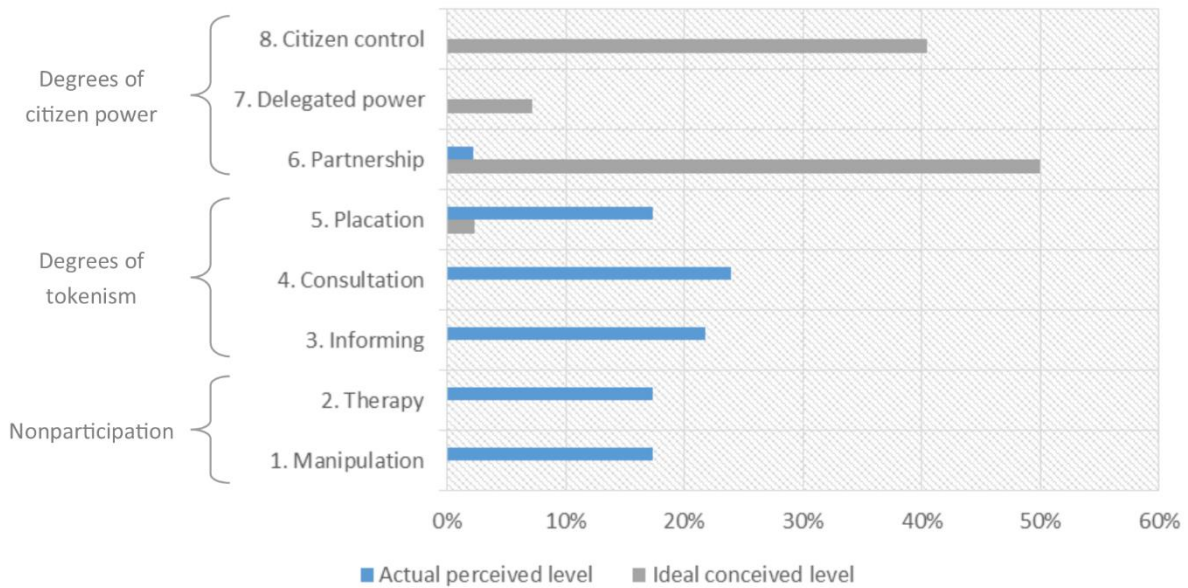


Figure 43: Actual perceived and ideal conceived citizen participation levels according to Arnstein's ladder.

To achieve a greater level of participation and starting in July 2014, we contacted as many of the stakeholders related to and having an important role in the square and neighbourhood as possible. The following graph (Figure 44) represents the relationships between the different entities with the arrows indicating their suggestions on which entity we should visit next. The size of the elements indicates the number of their connections and the colours the type of the entity (e.g., cultural association, neighbourhood association, etc.). From the analysis comes that the most interconnected entities are Banc Expropiat, an occupied ex-bank functioning as a self-managed civic centre, and La Fontana, a youth centre.



Figure 44: Network of the different entities related to Plaça de la Virreina and Vila de Gràcia neighbourhood, created according to the suggestions of stakeholders belonging to each and one of them. The size indicates (reflects) the degree of in-coming and out-coming connections of each entity and every colour corresponds to a different category. We see that the most connected elements are Banc Expropiat, an occupied ex-bank functioning as a self-managed civic centre, and La Fontana, a youth centre. Map created in Gephi.

During September-October 2014 we established Thursday as the day of our experimental activities to better understand the perception of the inhabitants for the place in question. Those included the previously mentioned surveys, collective mapping and open activities in a private space. We used all results and

conclusions made during this previous phase to perform an informal intervention in the square at the end of October, finalised with a conversation with the neighbours.

5.1.2 COLLECTIVE MAPPING

We have seen that the perceived level of participation for Vs dwellers is rather low. One way towards perceiving the situation and finally reaching their conceived ideal level is guiding the dwellers through making maps. Based on the work of both Iconoclasistas²⁷ and Gehl Architects²⁸, we applied a different approach for the analysis of the square from the bottom-up, that of collective mapping. We gave the square users and dwellers three types of maps to complete: (i) the map of perceptions, (ii) the map of observations and (iii) the map of stories and paths.

The *map of perceptions* corresponds to a blank map where the participants could draw or identify the points of the square generating a positive or negative feedback. Some examples are shown in Figure 45. In map (i) for example, the participant indicated graphically her favourite spots and the points that needed improvement in the square. In map (ii) the person classified the spots in pleasant, opportunity and unpleasant using green, yellow and red correspondingly. In map (iii) we observe a similar classification in things that the participant liked (green) and things to improve (yellow). Finally, in map (iv) the participant decided to draw attention at only one spot that she liked, that of the stairs of the church.

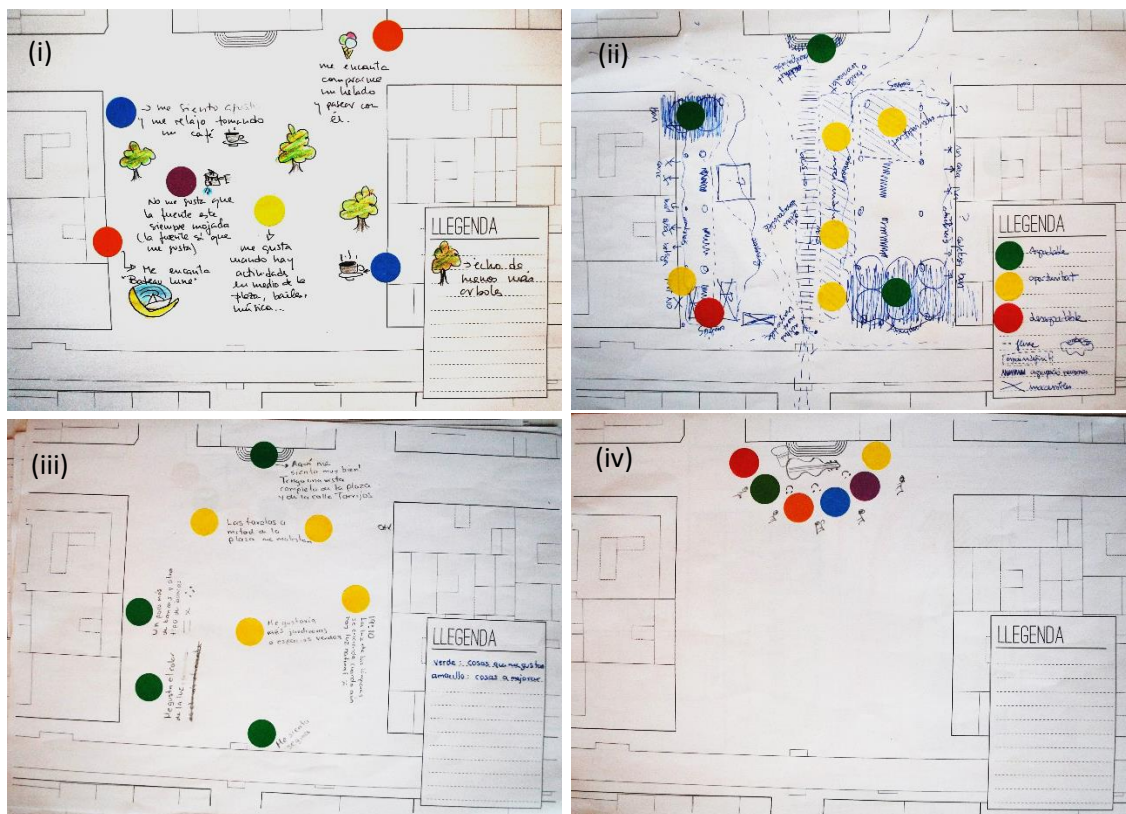


Figure 45: Examples of a maps of perceptions.

²⁷ <http://www.iconoclasistas.net/>

²⁸ <http://gehlpeople.com/>

For the *map of observations*, we motivated the participants towards a direct observation of the public space and its life²⁹. We instructed the participants to do so by mapping the square users' activities and behaviour, while responding to questions such as how many (are moving, are stationed), who (e.g., gender, age, etc.), where (e.g., on the edges, in the middle, evenly distributed in space, in public or private zones, etc.), what (e.g., walking, standing, sitting, playing, etc.) and how long (e.g., to cover a certain distance, they stay in a certain place, the activity lasts, etc.). Questions divide the variety of activities and people into subcategories that help in getting specific and useful knowledge about the complex interaction of life and form in public space. Weather and time play an important role and the observed activities can also be influenced by a careful planning or design. Some examples are shown in Figure 46 where we observe a general focus in fluxes and obstacles.

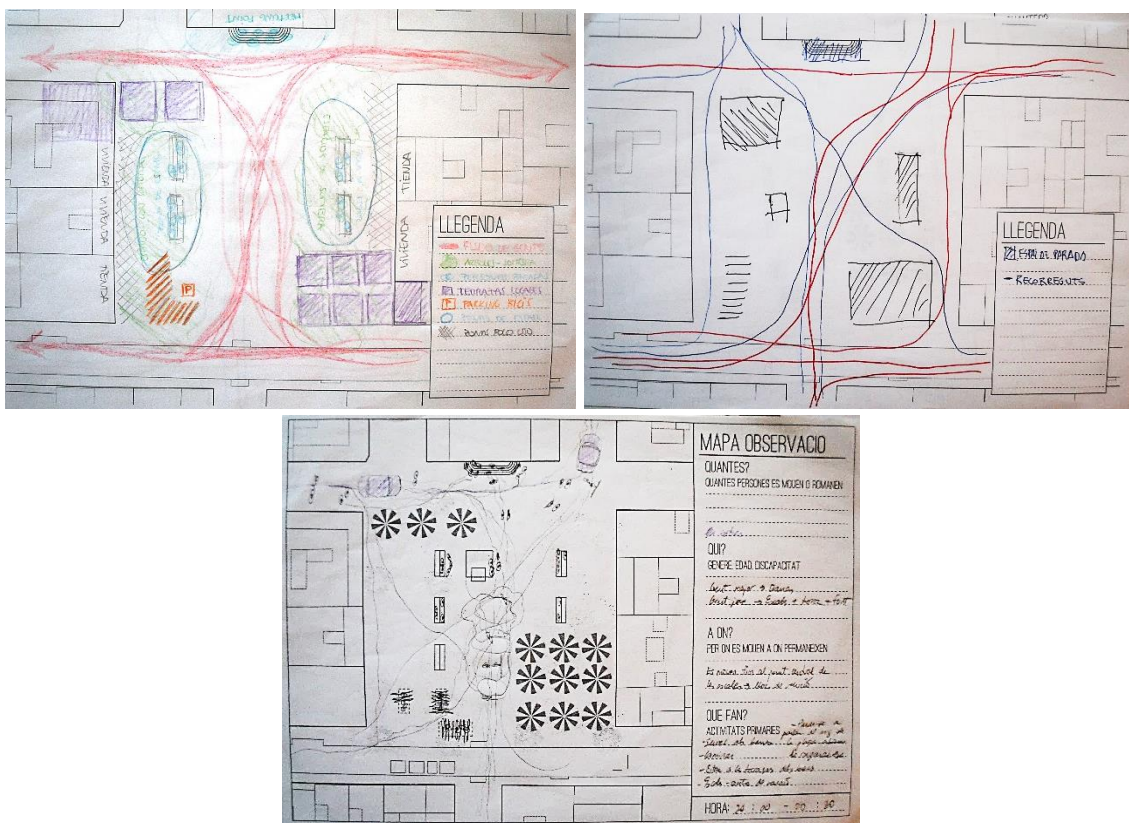


Figure 46: Examples of a maps of observations.

The *map of stories and paths*, is a collective map where the participants marked their favourite path to arrive to the square while explaining the reason for choosing it (Figure 47). The light blue yarn was used by the inhabitants of the neighbourhood and the purple one by those visiting from the outskirts of the neighbourhood. The initial simple instruction gave rise to interesting conversations regarding both the square and the neighbourhood, their history and memories related to it. *Stories play an exceptionally important role in how people assign value to a place. Taken together, all those stories essentially give a place an identity* (Cilliers et al. 2015). In general, we observed a denunciation of the privatization of the south of the

²⁹ Public space refers to everything that can be considered part of the built environment (streets, alleys, buildings, squares, bollards, etc.). Public life refers to everything that takes place between buildings, something usually forgotten by architects and urban planners as it is considerably easier to work with and communicate about form and space; life is ephemeral and difficult to describe (Gehl and Svarre 2013).

neighbourhood with big constructions and hotel lines as a frontier. This is not the case with the interior and norther limit where the character of the neighbourhood is maintained. Squares in specific, seem to exalt this traditional character of the neighbourhood. Finally, people usually enter directly and rapidly the neighbourhood but take their time when leaving.

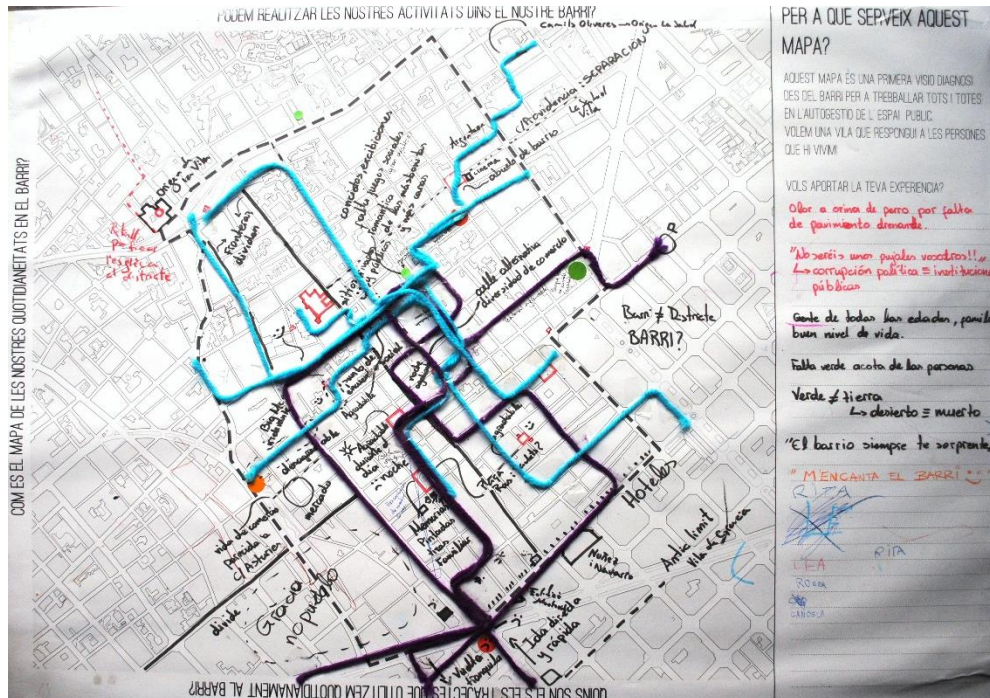


Figure 47: The map of stories and paths. The light blue yarn indicates visitors from inside the neighbourhood and the purple one visitors from the outskirts of the neighbourhood.

5.1.3 FINDING THE LIMIT BETWEEN PUBLIC AND PRIVATE SPACE

Public and private spaces and lives are two spheres ultimately interconnected in our actual life. We exist in both private and public realms (Sennett 1977). But, the devastating impact of industrial capitalism in the 19th century made public life “more intense and less sociable”. The modern type of living is mostly associated with the intimate society. The public culture has ended. We try to program intimacy everywhere, ending up with a dormant genuine, urbane and civilised life. In this context and while trying to find the limit between public and private space, we opened to the Virreina square a ground-floor apartment and organised free and open activities for all, such as documentary and short-films projections and concerts. The question we proposed to ourselves was: Do people feel comfortable to cross the limit between public and private space?

Results showed a high level of curiosity from all types of public. People were asking about our activities and some also showed interest in co-organising the following. But still, they were finding it difficult to cross the “limit” of the open door and enter the private property. Most preferred watching from the outside, while still standing in the public space. Only children had no limits in entering the private space. Figure 48 shows some characteristic photos of the organised activities. All activities were followed by an open conversation in the square with subjects related to the matter.

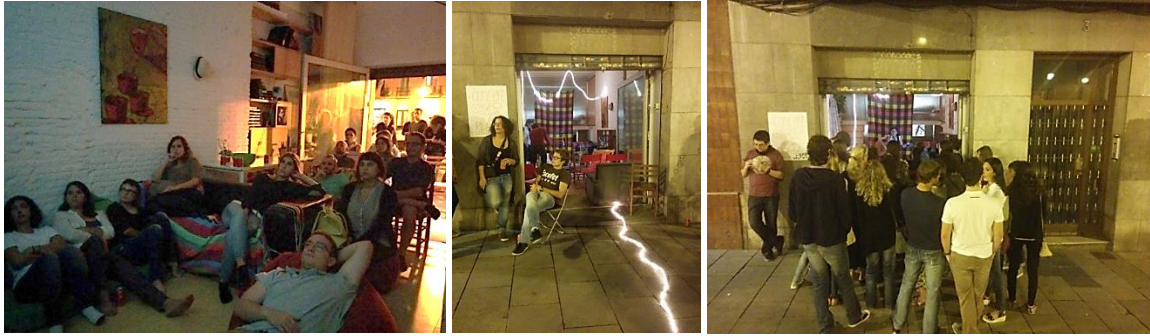



Figure 48: Experimenting with private space and open activities.

5.1.4 ONE DAY AT THE SQUARE: EPHEMERAL INTERVENTIONS AT THE PUBLIC SPACE

To complement and conclude the analysis explained in the previous sections, we organised an open and participatory day at Virreina square, held on the 26th of October 2014. The activity formed part of the special edition of 48h Open House Barcelona that included public spaces for the first time as a celebration for their 5th year anniversary. The main idea was to fill the square with life, inviting people to participate and propose activities with the aim to transform it into a space of interchange and encounter. The day was divided into three stages:

- (i) From 10.00 a.m. to 14.30 p.m. the different entities and people having a (direct or indirect) link with the square and being in some way aware of the social environment of the public space, organised and proposed a series of workshops and activities, e.g., activities for children, arts and crafts workshops, etc. In parallel to these activities, the first results of the experiments and studies we carried on during the previous two months were open and available to everyone. We also used these results to perform some small ephemeral interventions at the square with the aim to improve the use and habitability of the space, as well as to raise awareness of the dynamics that occur and to intervene directly on a path towards a higher level of participation for and appropriation of the public space (Table 15).

Table 15: List of observations and their related interventions in Virreina square.

Observations from experimental activities	Interventions (photos)
<p>Active ground flours in blind walls: We gave an artistic view to this reclaim.</p>	

Clean up badly organised areas with low maintenance:
An amusing decoration was chosen as a response to this claim.



Compensate for the lack of public space:

Claim the city for the pedestrian:



Give colour to the square to compensate for its greyish tone:
The power was given to the children who with the use of chinks and their imagination transformed the grey pavement.



Enable rest areas and benches:
Hammocks, sofas, chairs and armchairs draw attention to this claim.



Provide playgrounds for children to interact with space:
For this purpose, a local toy store organised an activity.



Claim the power of intervention that children have:
Children were asked to paint their square of tomorrow.



Exalt joy and rest areas that are present in the square:
The best point of the square according to the collective mapping activity was marked with



Encourage people to become aware of the importance of the link with the square:
Exposition of FemPlaça activities, vindication of the public space on behalf of the Ciutat Vella neighbourhood network.



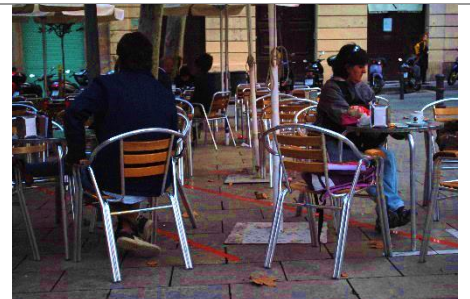
Recognise the square:
A poster inviting the neighbours to participate "The square is also yours, participate".



Create green spaces at the human level:
Workshop for children for the creation of a paper garden.



Reporting the privatisation of public space by the terraces:
The area occupied by the terraces was marked with red stripes.



Create a link between local associations and square:
Cultural association explaining their activities and inviting the neighbours to participate.



- (ii) From 14.30 to 16.00 p.m. we organised a popular meal at will (Figure 49), coordinated by the neighbourhood association, “El plat de Gràcia”³⁰: a socially transformative space that takes advantage of wasteful food to make it an accessible right for all, and generate a space that promotes equity relationships regardless of the socio-economic situation of the person as well as a culture of exploitation, responsible consumption and food sovereignty.

³⁰ <https://elplatdegracia.blogspot.com.es/>

5.2 DISCOURSE ANALYSIS

To foment the importance of communication and to close the gap between local population's needs and local authorities' response, in this Section, we analyse two discourses associated with a specific place in Barcelona (Spain), that of Vila de Gràcia neighbourhood (see Sections 1.2.1 and 1.2.2). The first discourse corresponds to the neighbours and the second to experts (urbanists, architects and engineers). We consider that it is the use of "different languages" that segregate these two actors, creating communication barriers. For the analysis, we present the two discourses in the form of networks.

The clarification of the socio-linguistic concepts analysed in Section 1.5.3 is considered fundamental for the understanding of the methodology followed in this research.

5.2.1 DATA COLLECTION

The interest of this study is focused on the analysis of discourses related to urban contexts. In this specific case the focus is on public space and its resonance on an urban neighbourhood. Public space is partly what makes cities (see Section 1.2.2). In this context, the aim of this research is to bring this debate closer to the people and analyse and comprehend their thesis. The motivation source was a project realised in Virreina square (see Section 1.2.2) located in Vila de Gràcia neighbourhood (see Section 1.2.1) of Barcelona³¹, which was held in collaboration with 48h Open House Barcelona on October 26th 2014 (see Section 5.1). The last phase of the project included a conversation with the neighbours about their square and neighbourhood, and generally about the public space today and its interaction with the private sphere. The results of the project were then presented in the City Sessions of the World Sustainable Building Conference³² on October 29th 2014, organised by GBCe, and provoked a similar dialogue, related to public and private space, but this time among experts (urbanists, architects and engineers assisting the congress) with special interest to (social) sustainability matters (see Section 1.3).

The information proceeding from the two discourses was stored in the form of detailed personal notes and was used to facilitate the following analysis.

5.2.2 NEIGHBOUR'S VS EXPERT'S DISCOURSE

Both conversations were held in a bilingual environment with the individuals mixing Catalan and Spanish. For the purpose of this study, all data were first homogenised and translated to Spanish. No alteration was made in the selection of the words or their grammatical form. A further translation in English was not realised until the final stage of the map production as Spanish and English language have many differences in grammar and syntaxes and a literal translation – as applied in the case of Catalan – was not possible without provoking semantical bias to the data.

The graphical representation of the data follows the form of a network (see Section 1.5.2). The words relate to each other when belonging to the same sentence, forming the nodes of the network. The connections between them form the network's links or edges. All articles and prepositions were excluded. In Figure 51, an example of the construction of connections between words mentioned by different people is represented. As a simplification for clarification, it is assumed that each person expresses herself by the use of phrases that

³¹ More data on the project available online on: <https://plazavirreina.wordpress.com/>

³² <http://www.wsb14barcelona.org/>

only have three words each. We observe how the triplets of words “a”, “b” and “c” of the first person (i), “b”, “c” and “d” of the second (ii) and “a”, “e” and “f” of the third (iii) are combined in the graph a, b, c, d, e, f (iv). The size of the nodes depends on the degree of the words (that is, the number of connections between this word and other words). The word “a” for example has the highest degree in the network (iv) since it relates to 4 more words, “b”, “c”, “e” and “f”. The strength of the connection between two words (that is, the weight of the edges that unites them) is a function of the times they both have emerged together in a phrase. For example, the connection between the words “c” and “b” appears twice (since they were mentioned by both the first and the second person) and for this reason the edge between them (the line that connects them) is thicker. A set of word triplets mentioned by n people would give a more complex network than the (iv), such as the (v). That would correspond to the discourse of a group of people such as in our study case.

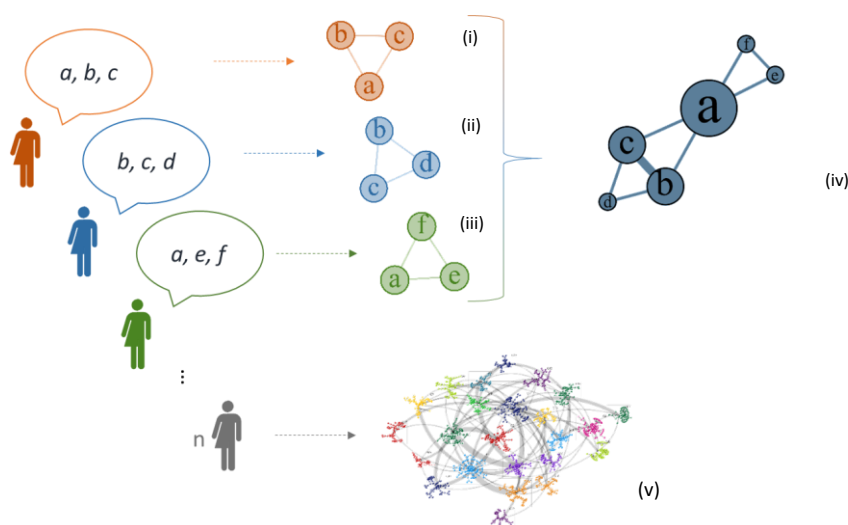


Figure 51: Example of connections between word triplets mentioned firstly by three separated individuals and then by n people, forming complex word-networks.

The visualisations are made in Gephi (Bastian and Heymann 2009). The layout of the graph is obtained thanks to a spring-based algorithm implemented in it: ForceAtlas2. It is a force-directed layout, it stimulates a physical system (Jacomy et al. 2014). 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.

After completing the analysis of the two networks per separated – one for the neighbour’s discourse and one for the expert’s discourse, we also created a merged network that combined the two discourses. This process allows the direct comparison between the connections of the words used in the initial two networks.

5.2.2.1 NEIGHBOURS’ DISCOURSE

The first discourse analysis reflects the neighbours’ opinions (see Figure 52 and Table 16). It seems that the central element of this network is “freedom”. It relates to constant *creation, creativity, permitting to feel, expression* and is seen as a *personal process, a possibilities’ generator* and as a concept that must *be understood*. The second most connected word is “creativity”. It is seen as a *tool for transformation, as freedom, an enemy of fear* and *personal frustration*, as something *different from classification* that allows to *express and feel* and as connected to *participative spaces* and to *physical affection* and its elements (*dancing, contact, etc.*). “Transformation” comes next and is related to *motivation, creation, creativity* and *change* while often

Public space (8)	Inertias (5)	Public space (10)	Square
Creation (7)	Citizenship (5)	Transformation (10)	To have
Physical affection (6)	People (5)	Citizen (7)	Can
Contact (6)	Conscience (5)	Creation (7)	Problems
To be (6)		Power (7)	Barcelona
		Utilise (7)	To reach

5.2.3 NETWORK STATISTICS

In Table 18 we observe that the neighbours' network (i) exceeds the experts' one (ii) in the number of nodes (words) and edges (links) showing that the neighbours did use more words than the experts but there were also more connections in their discourse, making their statements clearer. The merged network (iii) has two times the nodes and edges of (i). The average degree and the average weighted degree are close to 2.5 for all networks with the experts' network showing slightly lower degree. Cumulated degree distributions of both networks differ substantially. While network (ii) can be approximated by an exponential distribution, network (i) seems to approximately follow a fat-tailed (i.e., power-law) form (Figure 55). In this case, the two more extreme points to the right correspond to "freedom" and "creativity" and are the words that dominate the whole network's connectivity.

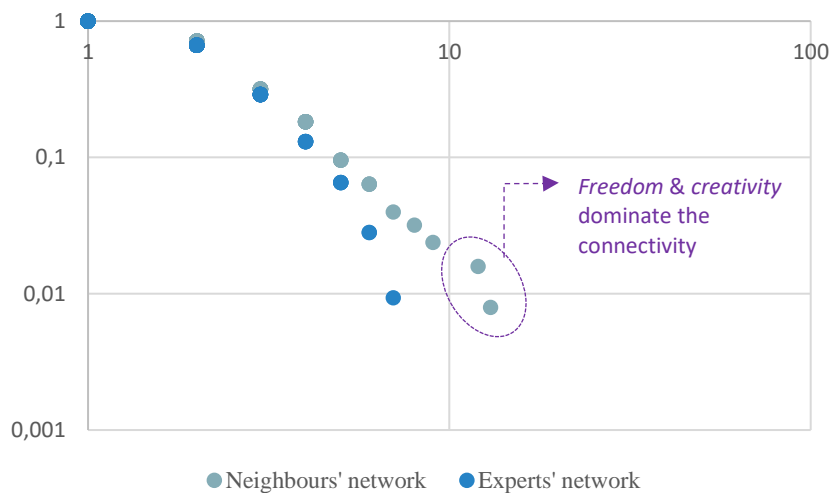


Figure 55: Cumulated degree distribution for the neighbours' (i) and the experts' network (ii). Network (i) follows a power-law distribution while network (ii) follows an exponential distribution.

Network (ii) has a diameter of 13, being in between of networks (i) and (iii). The average path length is close to 5 for network (i) and to 5.5 for (ii) and (iii). Networks (i) and (ii) are 2% completed while (iii), 1.2%. The three networks have a similar modularity, around 0.8 for (i) and 0.82 for (ii) and (iii). When we merge the graphs, the communities are multiplied from 18 for (i) and 19 for (ii) to 27 for (iii). The same happens to the connected components that goes from 11 for (i) and 12 for (ii) to 17 for (iii). The average clustering coefficient is between 0.3 and 0.4 for all networks. Network (ii) shows a small number of closed triangles (17) in comparison to the others: network (i) shows 44 and network (iii) 61. Network (iii) is the most connected network with its giant component including 84% of its nodes and 90% of its edges. The same percentages for network (ii) are 69 and 78% and for (i) 63 and 72%.

5.2.4 IS CLOSING THE GAP POSSIBLE?

In Figure 54 and Table 16 we observe that the two discourses have very little words in common and their separation is visually obvious in the graph, meaning that there is a clear communication gap between the two groups. To check if closing this gap is somehow possible, we consider the simplest graph model: the random graph model (Newman 2010). In the random graph model, the average shortest path L_{RG} scales logarithmically with the number of nodes N and inversely with the logarithm of the mean degree $\langle k \rangle$:

$$LRG = \ln N / \ln \langle k \rangle \quad (\text{Eq.11})$$

Considering L_{RG} as an indicative metric of how difficult it is to “move” from one node to another within the network (i.e., how difficult it is to communicate by means of links among words), we want to know how many edges should be added to decrease L_{RG} in a substantial amount. To do so, the number of nodes N is kept constant (i.e., $N = 219$) and we increase the number of edges to also increase the average degree $\langle k \rangle$ (Figure 56). We observe that to diminish the average path length to the half, we would need an increase of 155% in the number of edges.

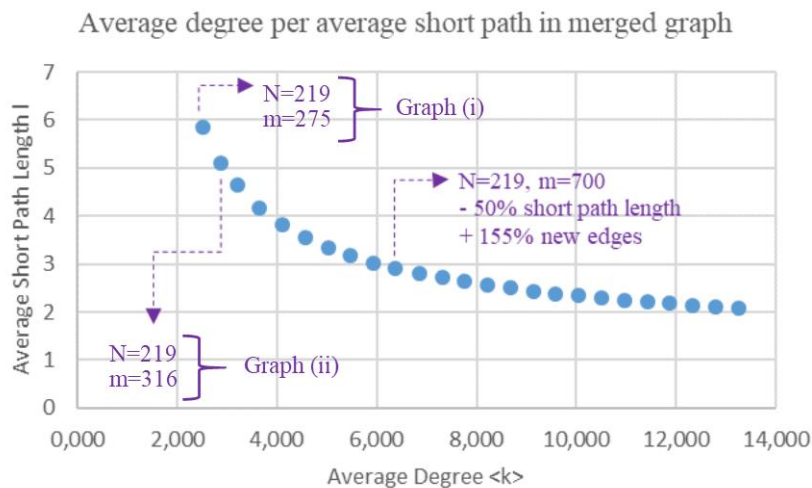


Figure 56: Treating the network as a random graph, in this graph we observe the decreasing of the average path length and the increasing of the average degree as the number of edges is being increased and the number of nodes maintains the same.

To test the previous hypothesis, we added a link to all words with the same root. For “freedom” of network (i) for example we detect and connect “no freedom” in network (ii) and “free” in network (i). After completing the process with all words shown in Table 16, the number of edges reaches the 316, representing a 15% of increase, which theoretically will not cause many changes to the structure of our network.

Table 17: Correspondence of words with the same roots for the most connected elements (in bold) of the two networks. The same process was followed for the rest of the elements of the two maps.

i) Neighbours	ii) Experts
Freedom, free	No freedom
Creativity, creation, create, creative	Creatives
Transformation, change (n)	Change (v)
Public space, space	Public space, public, space
Creation, creativity, create, creative	Creatives
Physical affection	-
Contact	-
-	Utilise, utilization

Table 18: Comparative table of the statistics of the four networks, i) the neighbours' network, ii) the experts' network, iii) the merged network and iv) after the alterations of the researchers.

Statistics	i) Neighbours	ii) Experts	iii) Merged	iv) New merged
Number of Nodes	126	107	219	219
Number of Edges	159	117	275	316
Average Degree	2.524	2.187	2.511	2.886
Average Weighted Degree	2.524	2.206	2.530	2.904
Network Diameter	14	13	12	14
Average Path Length	5.066	5.721	5.559	5.542
Number of Shortest Paths	7,608	4,712	24,448	37,112
Graph Density	0.020	0.021	0.012	0.013
Modularity	0.803	0.823	0.820	0.753
Number of Communities	19	18	27	21
Connected Components	11	12	17	10
Number of Nodes Giant Component	87 (69.05%)	68 (63.55%)	156 (71.23%)	193 (88.13%)
Number of Edges Giant Component	125 (78.62%)	85 (72.65%)	258 (80.36%)	297 (93.99%)
Average Clustering Coefficient	0.464	0.305	0.388	0.365
Total triangles	44	17	61	83

But, the forced increase of the common words is not provoking many changes to the structural data of the network. This means that the communication between groups is still difficult despite the changes applied by the researchers to the initial merged network to generate more connections. To propose a solution to the problem we number some suggestions:

- (i) Experts could choose words that are broadly used from both parts such as *citizen* instead of *citizenship*.
- (ii) Referring to *people* instead of just *older people* could have the same result for the neighbours.
- (iii) A rather disconnected part on the experts' discourse is the one related to "inertias" and "entropy". They could change those with some other, broadly understandable and less technical words or use them in more sentences to clarify their meaning and to foment more connections to and from them.
- (iv) Something similar happens with the use of "physical affection" and its elements from the part of the neighbours, although here the meaning of the word appears more connected and thus understandable. At this case a suggestion could be to link this word with the word "person", a word that is well connected in both discourses.
- (v) When the experts are talking about the city of Barcelona, they mention general problems, while the neighbours mention concrete problems related to their lives.
- (vi) The experts are talking about "no freedom" but they are not trying to define what "freedom" is – as the neighbours do – to treat the problem at its root.

Of course, the place that a conversation takes place plays an important role to the expression or the communication of the individuals. An informal meeting taking place in an open and public space allows much more liberty of expression to the interlocutors than a formal one taking place in a conference room. Apart from the place, the dress code, the homogeneity or heterogeneity of someone's conversation partners, all affect the words she chooses to use in her discourse. A formal situation provokes stiffer, more technical vocabulary and the use of "catchy" words that usually attach prestige to the speaker. An informal situation leaves space for the communication of personal feelings thoughts and needs. Nevertheless, an architect or an urbanist should be always able to adapt his discourse to the target team as his roll is that of an intermediary between the dwellers and the city. It must be stated here that the whole analysis based in personal notes may provoke some bias as it does not include non-verbal speech and emotional or physical information of the individuals (see Chapter 2). Also, the presented study case forms only an example and to generalise between discourses of different actors and examine possible similarities in network behaviours related to various urban contexts, we should analyse more cases. Last but not least, what we learned through the whole process and as Bull and Azennoud (2016) put it, the benefits of the "unplanned" should not be underestimated. The dedication of time in informal activities ensures the connection between the involved groups and facilitates conversations and opinion exchange. And it is common knowledge that dialogue, and other forms of communication have the power to change people and situations.

5.3 REACTION ON EMERGING URBAN PHENOMENA

This last section further investigates dwellers perception, this time related to emerging urban phenomena such as the massive migration of new population in the Mediterranean during 2015. Our study case forms the city of Mytilene of the Greek island of Lesbos, an important passage of international migration flows from the East to the West. The research focuses on four city neighbourhoods with socio-spatial differentiations. It has been carried out through surveys and semi-directed interviews in a sample of 200 individuals equally divided into the four neighbourhoods. To process the results, we have generated semantic networks, which represent the connections between the words that appear together in the discourse of the surveyed. In Section 5.2 we applied discourse analysis in order to compare oral information. In this Section, we use discourse analysis to analyse data coming from open or semi-open survey questions. The results show that not only gender but also the link with the place of residence, social status at work and age seem to influence the formation of the perceptions on migration of the inhabitants of Mytilene.

5.3.1 2015'S MIGRATION FLOWS IN GREECE

The migration flows in Greece became a major issue during 2015, especially along the summer and autumn months. At the end of the year, 851,319 people have entered and crossed the country (Figure 58) according to United Nations data (UNHCR 2016). Most of the incoming population originated from Syria, Afghanistan and Iraq and the main entrance corresponded to the islands on the border with Turkey, mainly Lesbos, Chios and Samos, located in the North of the Aegean.

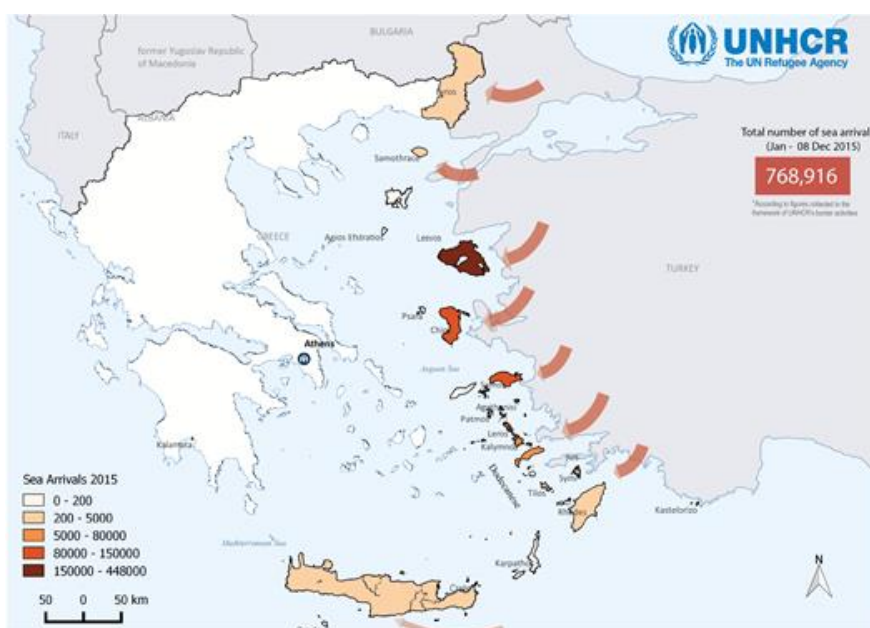


Figure 58: Migratory flows in Greece during 2015. Source: (UNHCR 2016).

Lesbos constitutes an important passage of international migration flows from the East to the West. Specifically, during 2015, 500,018 people arrived by boat from Turkey, corresponding to 58.7% of the total incoming population in the country, with the majority coming from Syria or Afghanistan. The peak was at the month of October, reaching 27% of the incoming population of the year (Figure 59).

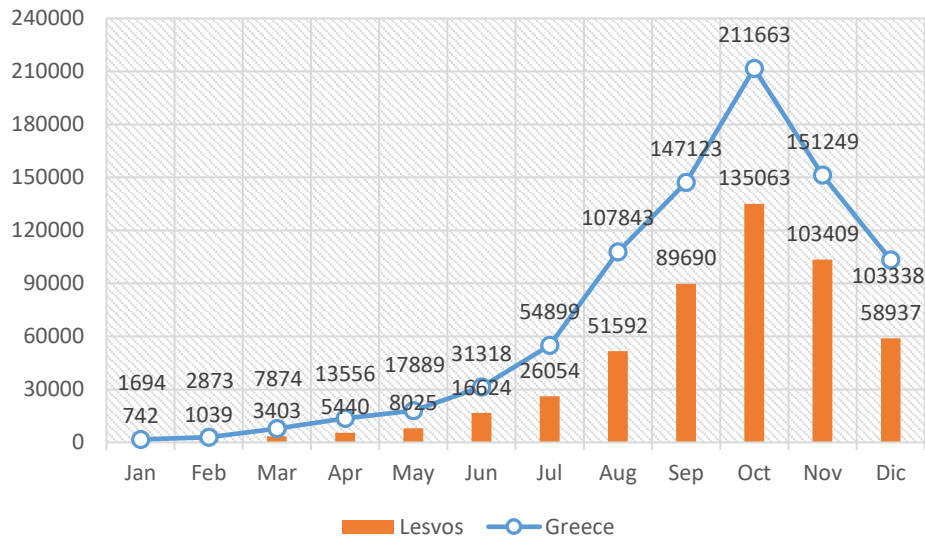


Figure 59: Arrivals to Greece and the island of Lesbos per month during 2015. Proper elaboration, data from (UNHCR 2016).

To better understand how the situation was perceived during the two summer months that correspond to our analysis, we have consulted in Google News³³ the international press articles published between July and August 2015. At the beginning of July there was a general concern regarding i) the Greek crisis, ii) the possible bankruptcy of the country and iii) the refugees. At the end of the same month, the focus was on i) how these waves of migration would affect local tourism, ii) how tourists and international celebrities helped the incoming population and iii) how terrorists could enter the European ground camouflaged into immigrants. At the beginning of August, the press wrote about i) a double crisis (twin crisis) ii) the arrival of the first international volunteers, iii) the safety of unaccompanied children, considered as a major issue for most of the political figures in Europe, and iv) the halting of the migratory flows by Turkey. At the end of August, northern Europe closed its borders. Along with the fear of epidemics, and despite the international aid, there was a record number of people who raised concerns about the trafficking of illegal immigrants. Europe began taking the situation seriously even if that only meant strengthening its borders without establishing reception measures and showing no interest to help the migrant population. The first flows reached Athens and the first deaths at the Mediterranean Sea were witnessed. There was also a growing debate regarding the difference between immigrants, refugees and economic migrants.

At a local level, the society of Lesbos demonstrated diverse positions. In the coastal towns the reception of the refugees was organised spontaneously. There were also cases of populations refusing to receive the refugees. In the period from June – July 2015³⁴, the most outstanding organisation: “the People of All Together”³⁵ and others, tried to organise the reception of the migrants in PIKPA squat and other buildings, but their numbers were much higher than expected. Faced with this situation and without government support (elections and political transition periods), the opinions of the inhabitants of Lesbos showed great dissimilarity.

³³ <https://news.google.com/>

³⁴ Before the arrival to the island of more than 100 NGOs and collectives.

³⁵ Network of collectives and NGOs of Lesbos.

5.3.2 STUDY CASE: MYTILENE, LESVOS

The case study corresponds to the city of Mytilene, capital of the Greek island of Lesbos. It is a place characterised by its constant exchange of population, incorporated in Greece with the Treaty of Lausanne in 1923. The timeline of the research coincides with the months of July and August of 2015, when 22.6% of the total incoming migrants for 2015 (112,919 people) had already crossed the island (Figure 58). The number is considerably high if we consider that Mytilene has only 37,890 registered inhabitants (ELSTAT 2011) plus a fairly high number of university students not quantified in any official media. Although most migratory flows are considered transient, the constant presence of immigrants in the public spaces of the capital of the island contributes to a different social production of urban space Figure 60(ii), which repositions the meanings of the concept of public space as a shared resource through an intercultural vision.

However, these are not the first migratory flows arrived on the island. Lesbos had previously received, during the periods 1914-18 and 1922-23 (Figure 60(i)), large migratory flows (of 30,000 and 55,000 people respectively) coming from the persecutions of Greek-Christian origin population, inhabitants of Asia Minor (Paraskevaidis 2013). Especially, in Mytilene, poorer social groups settled on the outskirts of the city in refugee housing and self-built popular neighbourhoods (such as Synoikismos). The population census of 1928 for the city of Mytilene showed that out of a total of 31,661 citizens, 47% were refugees (Anagnostopoulou 2006). As a result, Mytilene today has a long history, clearly reflected in its urban structure.



Figure 60: (i) The camp of the 55,000 refugees in Mytilene during the second Turkish persecution (1922-23). Source: (Paraskevaidis 2014). (ii) the provisional camp of refugees in the port of Mytilene in September 2015. Source: G. Papadopoulou' archive in (Artemi 2015).

The research here presented is focused on four neighbourhoods of the city, with different cultural and urban characteristics (Artemi 2015): Synoikismos, Chryssomalousa, Centre and Akleidiou (Figure 61).

The first neighbourhood we chose is Synoikismos. It was one of the places that received the greatest wave of immigration historically, when, with the Treaty of Lausanne in 1923 and the integration of Lesbos in Greece, the permanent exchange of Christian and Muslim populations between Turkey and Greece was effectuated (Anagnostou 2011). The urban population doubled and due to their needs, there was a massive reconstruction of housing for the refugees. Because of its history, the area was considered worthy of research regarding the perception of its inhabitants about migration. In addition, it is a place where we detected a strong relationship with the current flow of immigration.

The next neighbourhood is Chryssomalousa, characterised by strong variations in the residential space. Between 1966 and 1990 a new model of construction aimed at a new middle class (mainly descendants of refugee families in search of better living conditions) appeared there. It is one of the many urban areas where many mansions and towers are sacrificed, and blocks of flats are built in their position.

The Centre is the oldest neighbourhood of the city. It was characterised a traditional area in 1979 and some buildings became of official protection. In 1985, the first construction restrictions were applied to the historic centre (BOE 731/A/12.31.1985). It has a mixed group of people who even if they do not reside all there, they help with their daily life to form a complete image of the area. For the city dwellers, it is considered a social and cultural nucleus. It accommodates most of the recent migration flows.

Finally, we chose the neighbourhood of Akleidiou, an area characterised by strong economic and residential development. Its history as part of the city is more recent since it was incorporated with the urban plan of 1992. There, we observe the massive reconstruction of houses – of duplex type – in the lands of the great mansions of the precious century. It is considered a zone of high economic level where a means of transport for the daily mobility is required and a private car is mainly used.



Figure 61: Urban evolution of Mytilene and neighbourhoods of interest. Source: Map (Artemi 2015), Photos: E. Katseniou's archive.

5.3.3 RESPONDERS' PROFILING

To study and compare the perceptions of local people regarding the emerging phenomenon of mass migration, we conducted 50 surveys and semi-directed interviews per neighbourhood. An average of 30 people per neighbourhood refused to respond (outside the final sample of 50). The surveys were conducted during the months of July and August 2015 and the basic question was: "Mention 3 words that justify the entry of refugees in Greece." The rest of the questions of the survey helped us in the profiling of each interviewee (e.g. (gender, type of employment, age). We then analysed the basic statistics, shown in Table 19. The sample is detected rather balanced with respect to gender, age and neighbourhood. Regarding the type of employment, the most dominant categories are Private Sector, Student and Pensioner, corresponding to 62% of the sample.

Table 19: Main statistics of the sample.

	Grups	%		Grups	%
Gender	Female	53.1	Activity	Private sector	26.6
	Male	46.9		Public sector	6.8
Age	< 30	36.1		Student	20.3
	30-60	36.1		Unemployed	7.3
	> 60	27.8		Pensioner	15.1
Neighbourhood	Centro	26.0		Freelance	6.3
	Synoikismos	26.0		Domestic tasks	6.8
	Chrysomalousa	26.0		Entrepreneur	10.1
	Aklidiou	21.9			

5.3.4 CAUSES OF MIGRATION

We next analysed the connections between words coming from the survey responses. We further investigated the causes of migration by categories (gender, neighbourhood, type of employment and age). The graphical representation of the data follows the form of a network (see Section 1.5.2). The words are connected to each other when belonging to the same response, forming the nodes of the network. The connections between them form the network's links or edges. The construction of connections between words follows the process explained in Figure 51. The visualisations are made again in Gephi (Bastian and Heymann 2009), using the ForceAtlas2 layout (Jacomy et al. 2014).

Detecting the structure of the communities that appear in the graph is fundamental for the discovery of the links between structure and function in complex networks. A criterion widely used to measure the quality of a partition is the modularity function (Newman and Girvan 2004; Fortunato and Barthélemy 2007), which corresponds to the number of edges within the communities, less the expected number of edges if the network is produce at random. The partition of the graph was performed using the efficient heuristic algorithm presented by Blondel et al. (2008). Figure 63 shows the network of the words used to describe the causes of migration from the local population. The size of nodes (words) indicates their number of connections with other words and the width of these connection (edges) indicate the times the words appear together in a response. The colours represent the 7 clusters calculated by the Blonder et al. (2008) algorithm (see also Table 21). The most frequent, connected and central words³⁶ are presented in Table 20. We see that all three categories are dominated by “war”, “work”, “Europe” and “life”. Almost all words of Table 20 (with the exception of “access”) are also the most dominant words of the three largest of the seven clusters (Table 21, most frequent in bold) of the network.

³⁶ We chose betweenness centrality to find those words belonging in the largest number of shortest paths between all the nodes of the network.

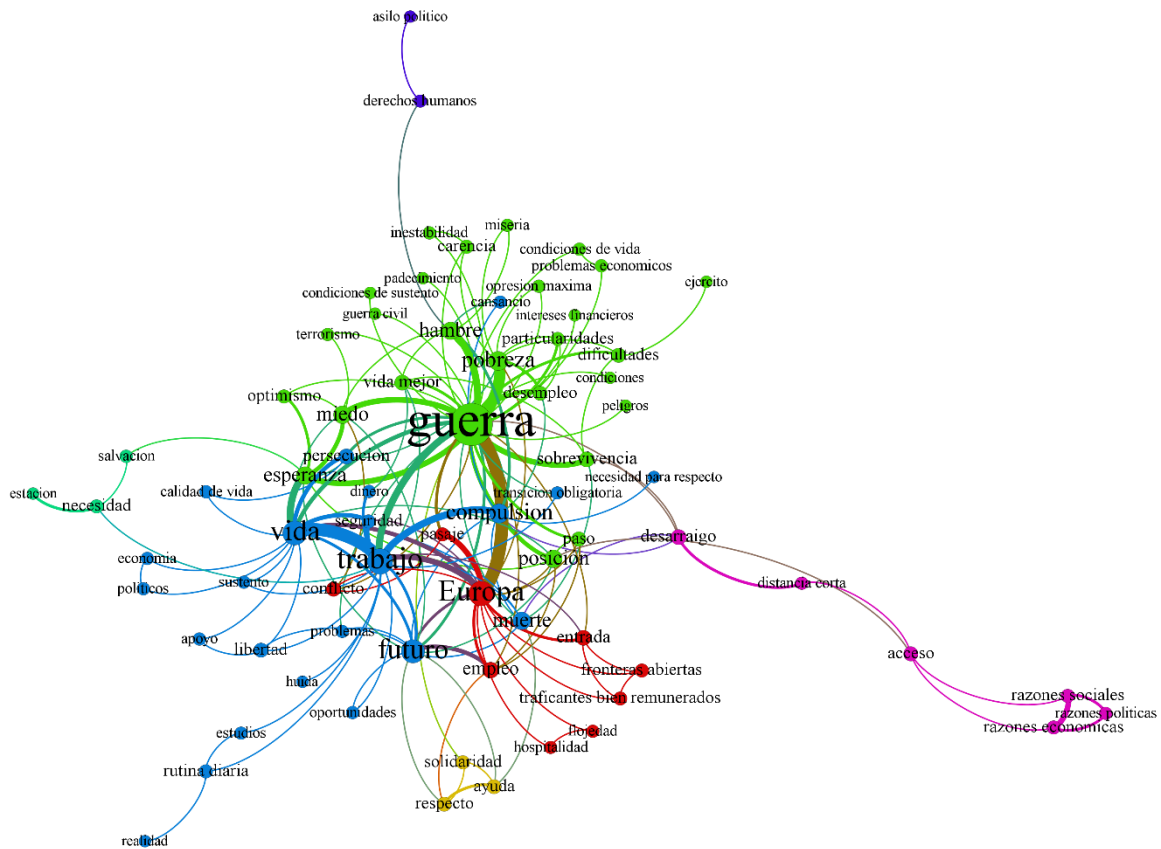


Figure 62: Network of the words used to describe the causes of migration from the local population.

Table 20: Most frequent, connected and central words associated with the causes of migration.

	<i>Most frequent</i>	<i>Frequency</i>	<i>Most connected</i>	<i>Degree</i>	<i>Most central</i>	<i>Betweenness</i>
1	War	65	War	39	War	1,390.26
2	Work	30	Work	18	Work	558.89
3	Europe	27	Europe	17	Europe	341.24
4	Life	24	Life	16	Life	340.50
5	Position	17	Future	15	Position	272.06
6	Future	13	Poverty	10	Access	214.32
7	Compulsion	13	Compulsion	10	Hunger	193.91

Table 21: Clusters of words that reflect the causes of migration. In bold the most frequent ones.

<i>Clusters/ Modules</i>	
1	War, position , poverty, hunger, difficulties, better life, survival, pass, misery, particularities, problems, lack, suffering, living conditions, life conditions, civil war, conditions, army, instability, economic problems, obligatory transition, dangers, financial interests, fatigue, maximal oppression
2	Work, life, compulsion, future , death, security, freedom, money, daily routine, economy, opportunities, politicians, reality, livelihood, studies, escape, need for respect, support
3	Europe , employment, passage, open borders, conflict, entrance, well-paid traffickers, looseness, hospitality,
4	Hope, fear, persecution, necessity, optimism, quality of life, salvation, station
5	Economic reasons, social reasons, uprooting, access, short distance, political reasons
6	Help, respect, solidarity
7	Human rights, political asylum

5.3.4.1 PER GENDER

From the analysis per gender, we have seen that of the 85 words used in total, only 38.8% are shared between men and women (Figure 63). Of the rest, 38.6% are mentioned only by women and 23.5% only by men. The total number of words used by women are 62 and by men 57. In the common words we find words such as “Europe”, “war”, “poverty”, “work”, “hunger”, etc. As for the words used only by women, we find words such as “freedom”, “racism”, “terrorism”, “human rights”, etc. and only by men: “studies”, “future”, “civil war”, “salvation”, etc.

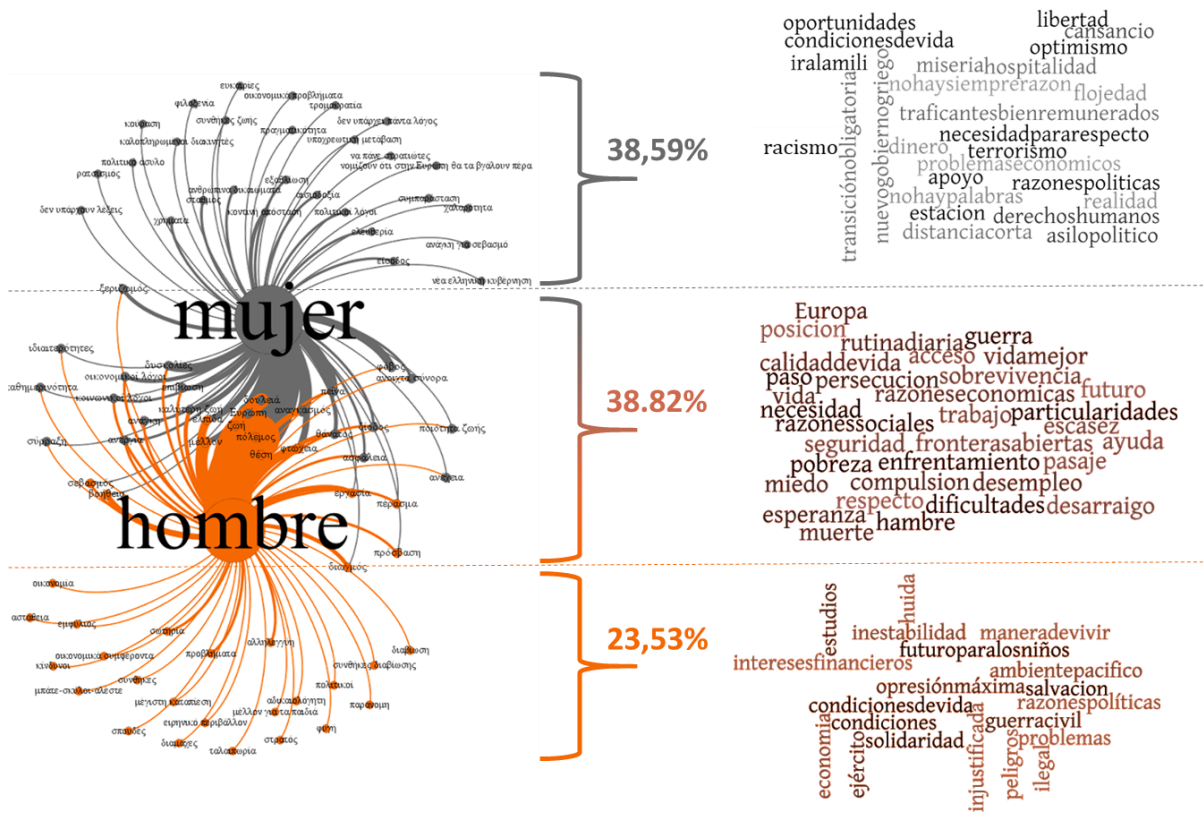


Figure 63: Use of words on causes of migration, separated by gender. Only 39% of words are shared between both discourses.

While creating the two networks that represent the discourse of men and women separately (Figure 64), we observe that the network of women appears more interconnected than that of men. For women, we detect 5 large communities dominated by the following words i) “war” and “hunger” (purple) ii) “Europe” (red) iii) “work” and “life” (green), iv) “uprooting” (yellow) and v) “human rights” (blue). For men, we identify 6 clusters dominated by i) “war”, “Europe”, “position” and “poverty” (light blue), ii) “future” (dark blue), iii) “work” and “life” (red), and “hope” (green) and v) “access” (yellow) and vi) “death” (purple).

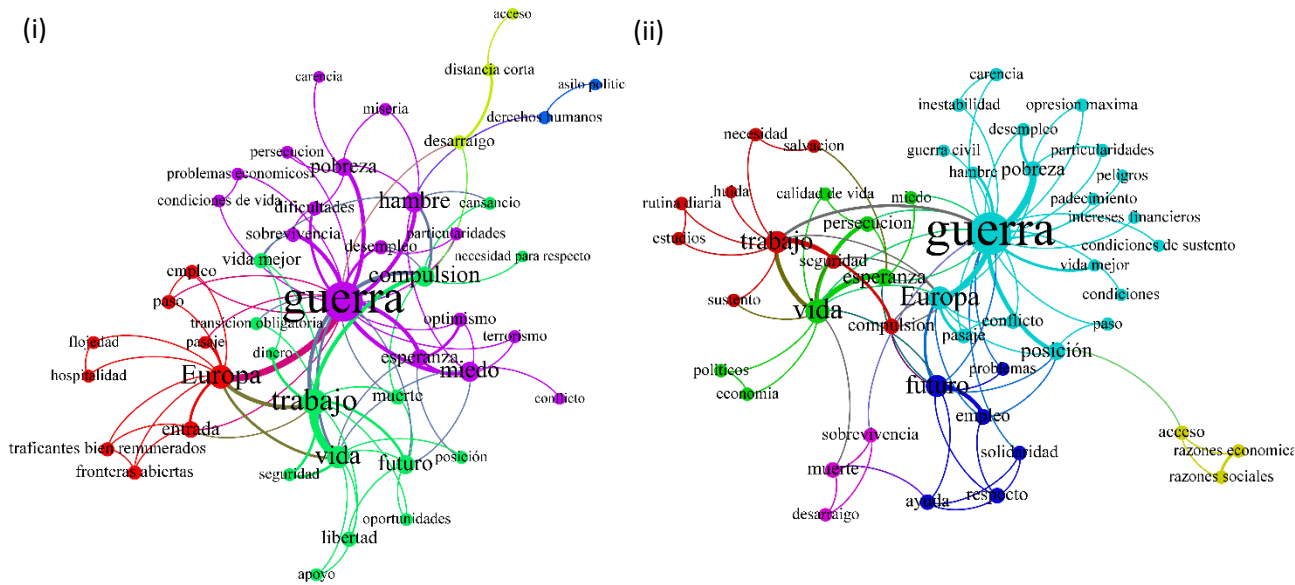


Figure 64: Networks of connections between the words used to explain the causes of migration. Network (i) indicates the words chosen by women and (ii) the words chosen by men. The colours indicate the different communities or clusters of words detected.

Table 22 shows the most frequent, connected and central words per gender. In all three cases, the first word in order of appearance is “war”. The second most frequent and connected is “work” for women. If we compare this result with the profile of women, we see that 6.9% are unemployed (Figure 65). Adding those declaring domestic work the percentage rises to 19.6%. It is possible that these women perceive work as something very important and perhaps one of the main causes of migration. The second most frequent word for men has to do with geographical criteria and the “position” of the island and Greece in general. Another important word for women seems to be “obligation”. From their part, men seem more interested in the “future” and “poverty”. As for “life” and “Europe”, they appear with similar importance. All these words are linked to the history of the population and their ancestors. Many, with the exchange of population in 1923, were forced to leave their homes in Asia Minor and start again in Greece. A large percentage of the respondents had family members who also forced themselves to migrate in the second half of the last century mostly for economic reasons to other European countries, United States and Australia. Others (few in our survey), were previous migrants from other European and Balkan countries (Albania, Bulgaria, Germany).

Table 22: Most frequent, connected and central words in the discourse of women and men.

	Women			Men		
	Most frequent	Most connected	Most central	Most frequent	Most connected	Most central
1	War	War	War	War	War	War
2	Work	Work	Europe	Position	Life	Work
3	Europe	Europe	Work	Europe	Europe	Life
4	Life	Life	Hunger	Life	Work	Position
5	Obligation	Hunger	Life	Work	Future	Access
6	Hunger	Obligation	Obligation	Future	Position	Future
7	Difficulties	Fear	Uprooting	Poverty	Hope	Europe

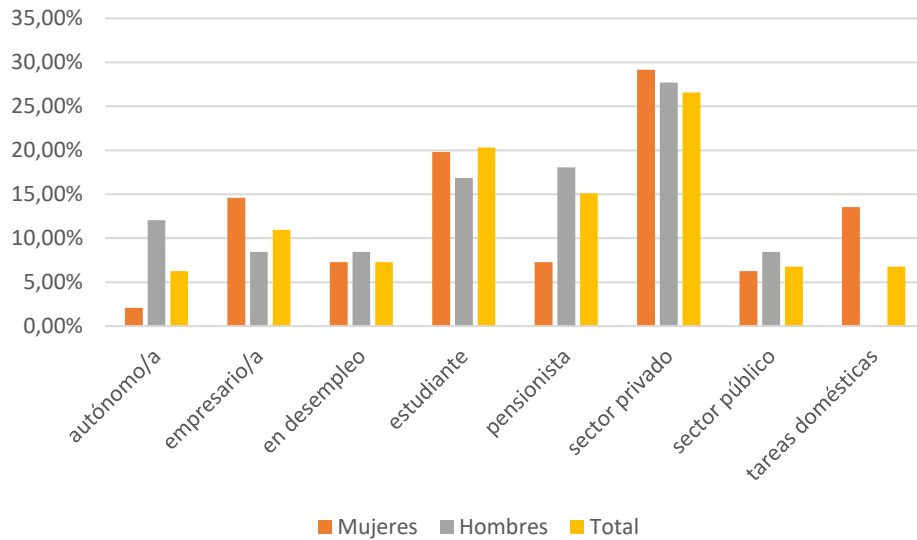


Figure 65: Type of employment per gender.

Cumulative degree probability distributions i) of the total number of words, ii) of women’s words and iii) of men’s words follow a potential function (Figure 66). In this case we measure the probability of finding a word that has a certain degree or greater. If this probability were random, the characteristic distribution would be in the form of a Gaussian bell, which in its accumulated version is translated into a negative concave exponential function. On the contrary in this case these probabilities are expressed as $y = bx^{-a}$, where for i) we have $y = 1,89x^{-1,435}$, for ii) $y = 1,96x^{-1,486}$ and for iii) $y = 1,79x^{-1,435}$. The existence of power laws usually indicate underlying non-trivial generation (Newman 2005; Clauset et al. 2009). That is to say, these networks present a connectivity that is not only the result of the random union of words but also of the presence in them of some (few) dominant concepts, which have a much higher degree of connection than the rest of the elements. In our case, the three networks are basically dominated by one word: “war”. The geographical frontal position of the island of Lesbos sensitises the inhabitants to the consequences of the war, considering that many times in the past, their families left the island in front of the fear of a possible war.

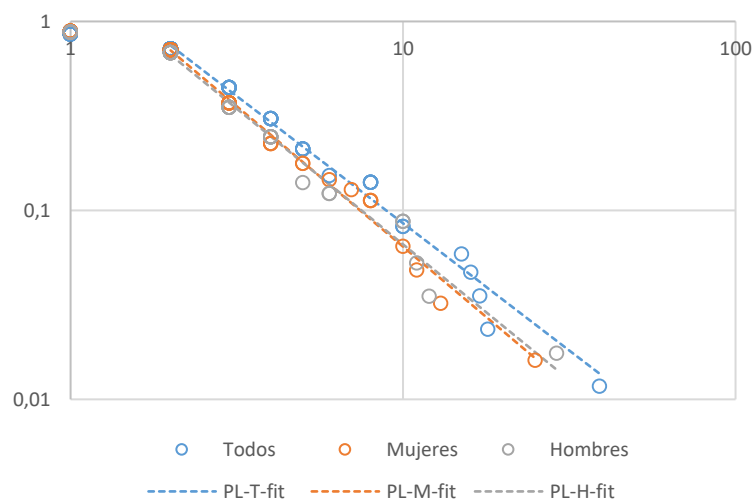


Figure 66: Degree distribution of words mentioned on behalf of women, men and on behalf of everyone.

5.3.4.2 PER NEIGHBOURHOOD

The aim here was to check if the characteristics and history of each neighbourhood affect the perceptions of its people. In Table 23 and Figure 67, we examine the relationship between the words chosen by dwellers of each neighbourhood. In general, we detect that all neighbourhoods share between 71 and 77% of their words with the rest. We detected that i) Synoikismos' dwellers share most of their words with Centre (64.7%) and Chrysomaloussa (58.8%), ii) Centre shares most with Chrysomaloussa (54.2%), iii) Chrysomaloussa with Centre (57.8%) and iv) Aklidiou both with Centre (55.6%) and Chrysomaloussa (52.7%). The least connections were found between Aklidiou and Synoikismos (17.3%). From the history of the two neighbourhoods we would expect a bigger exchange between Synoikismos and Chrysomaloussa, something that is detected from Synoikismos to Chrysomaloussa (58.82%) but not so clearly the other way around (44.4%). We would also expect more words in common between Synoikismos and Centro since they are the two neighbourhoods that currently host the largest number of people, but it seems that the residents of these two neighbourhoods perceive the phenomenon differently: the relation is again not bilateral.

Table 23: Percentage of words shared per neighbourhood.

NEIGHBOURHOODS	# OF WORDS	SYNOIKISMOS	CENTRE	CHRYSOMALOUSSA	AKLIDIOU
SYNOIKISMOS	34	23.53%	64.70%	58.82%	47.06%
CENTRE	48	45.83%	27.08%	54.17%	41.67%
CHRYSOMALOUSSA	45	44.44%	57.78%	28.89%	42.22%
AKLIDIOU	36	17.34%	55.56%	52.78%	27.78%
TOTAL SHARING		76.47%	72.92%	71.11%	72.22%

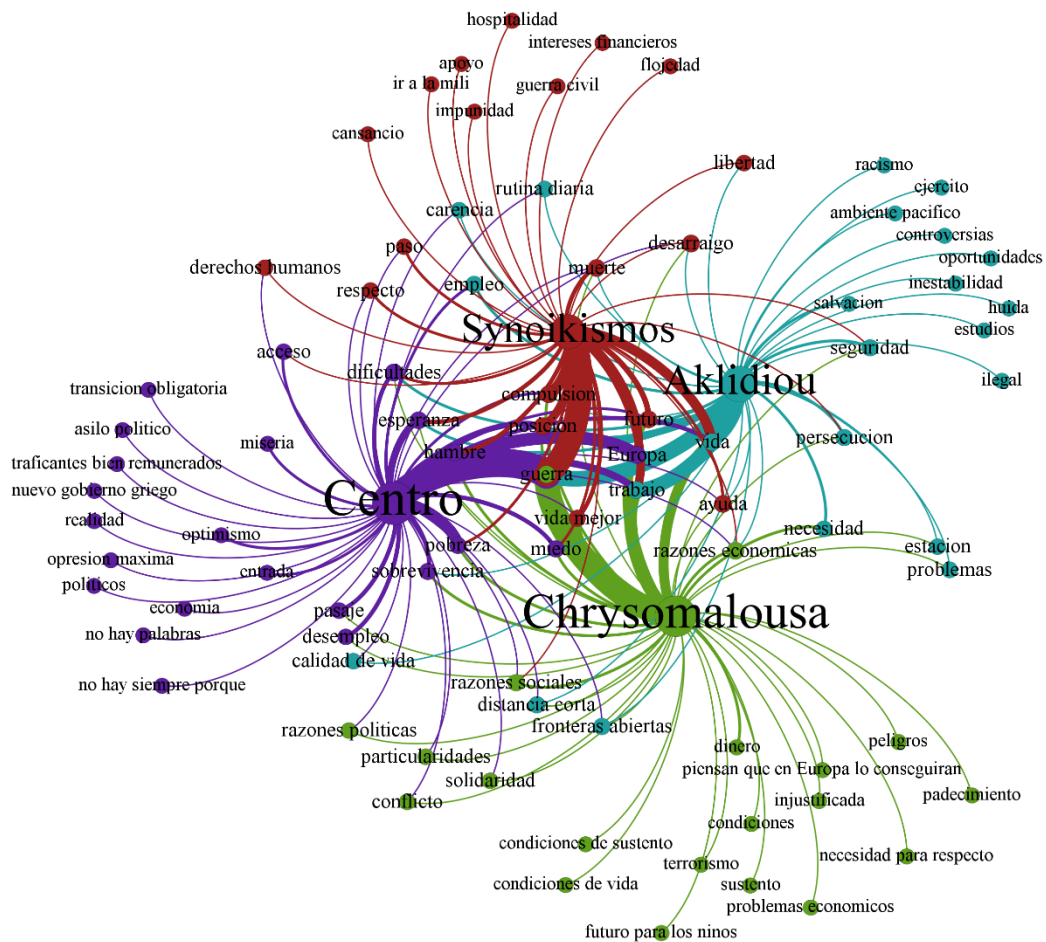


Figure 67: Network of words used per neighbourhood to describe the causes of migration. The colours represent the words used by the different neighbourhoods.

In Table 24 we see that the most frequent, connected and central word remains “war” for almost all neighbourhoods (for Aklidiou the first position is shared between “war” and “work”). The second position is occupied by different words, depending on the neighbourhood: we spot the importance of “compulsion” and “life” for Synoikismos, “Europe” and “survival” for Centre, “work” for Chrysolaloussa and “war” and “work” for Aklidiou. We also observe that in Synoikismos (and Centre) “work” is of secondary importance, regardless the high unemployment (Figure 68).

Table 24: Most frequent, connected and central words per neighbourhood.

	Synoikismos			Centre			Chrysolaloussa			Aklidiou		
	frequent	connected	central	frequent	connected	central	frequent	connected	central	frequent	connected	central
1	War	War	War	War	War	War	War	War	War	War	Work	Work
2	Compulsion	Life	Life	Europe	Europe	Survival	Work	Work	Work	Work	War	War
3	Life	Compulsion	Future	Poverty	Poverty	Life	Life	Life	Hunger	Life	Life	Life
4	Europe	Europe	Europe	Hope	Work	Poverty	Europe	Europe	Better life	Europe	Position	Hope
5	Position	Work	Work	Work	Hope	Europe	Future	Fear	Europe	Position	Future	Position
6	Work		Hunger	Hunger	Life	Work	Better life	Future	Future	Future	Europe	Salvation
7	future		Compulsion		Entry	Hope		Better life	Life		Hope	Europe

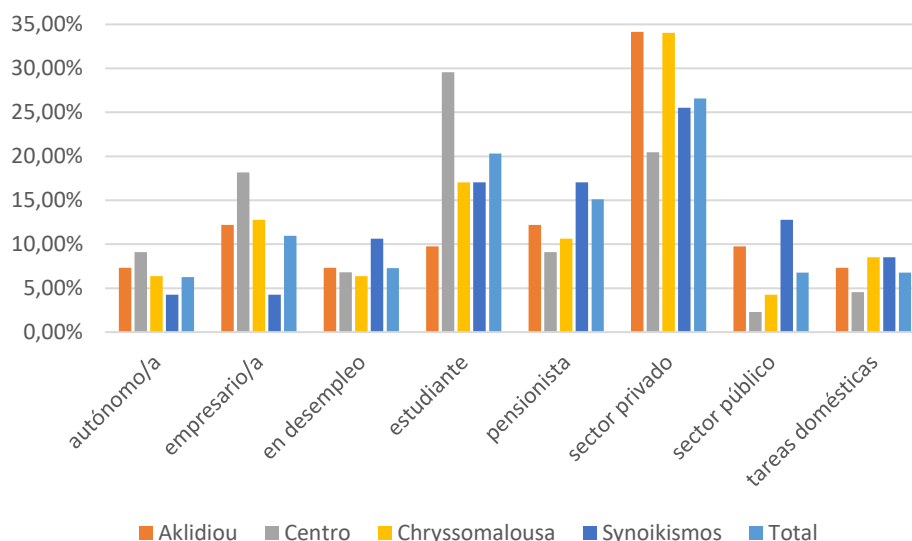


Figure 68: Type of employment per neighbourhood.

5.3.4.3 PER TYPE OF EMPLOYMENT

Table 25 shows the most frequent, connected and central words per type of employment. The discourse of the private sector and of the students is clearly dominated by “war”. It is also between the dominant words of freelancers and entrepreneurs, complemented by “future” and “Europe” for the former and “poverty” for the latter, clearly reflecting their economic situation. For the public sector, “life” appears as the most important. The most differentiated words appear in the domestic tasks sector: “work”, “uprooting” and “compulsion”. In Figure 69 we highlight the proximity of the words used (i) between the private sector and students (central core), and (ii) between entrepreneurs and freelancers.

Table 25: Most frequent, connected and central elements per type of employment.

	MOST FREQUENT	MOST CONNECTED	MOST CENTRAL
PRIVATE SECTOR	War	War	War
PUBLIC SECTOR	Life, work, security	Life, war	War, life, position
STUDENT	War	War	War
UNEMPLOYED	Work	Europe	Death, help
PENSIONEER	War, position	War	War, hope
FREELANCE	War, Europe, future	War, Europe, future	War, Europe, future
DOMESTIC TASKS	Work, uprooting, compulsion	Compulsion, uprooting	Compulsion, uprooting
ENTREPRENEUR	War, Europe, poverty	War, Europe, poverty	War, poverty, misery

As we can see in Figure 70, the under 30 share more words with those between 30 and 60 years old (42%) and the other way around (40.9%) and those over 60 with those under 30 (45.3%). The women who connect most with the rest of the age groups are those over 60 (young women have a more political discourse on migration, many of them are students and / or unemployed). The same happens with men over 60.

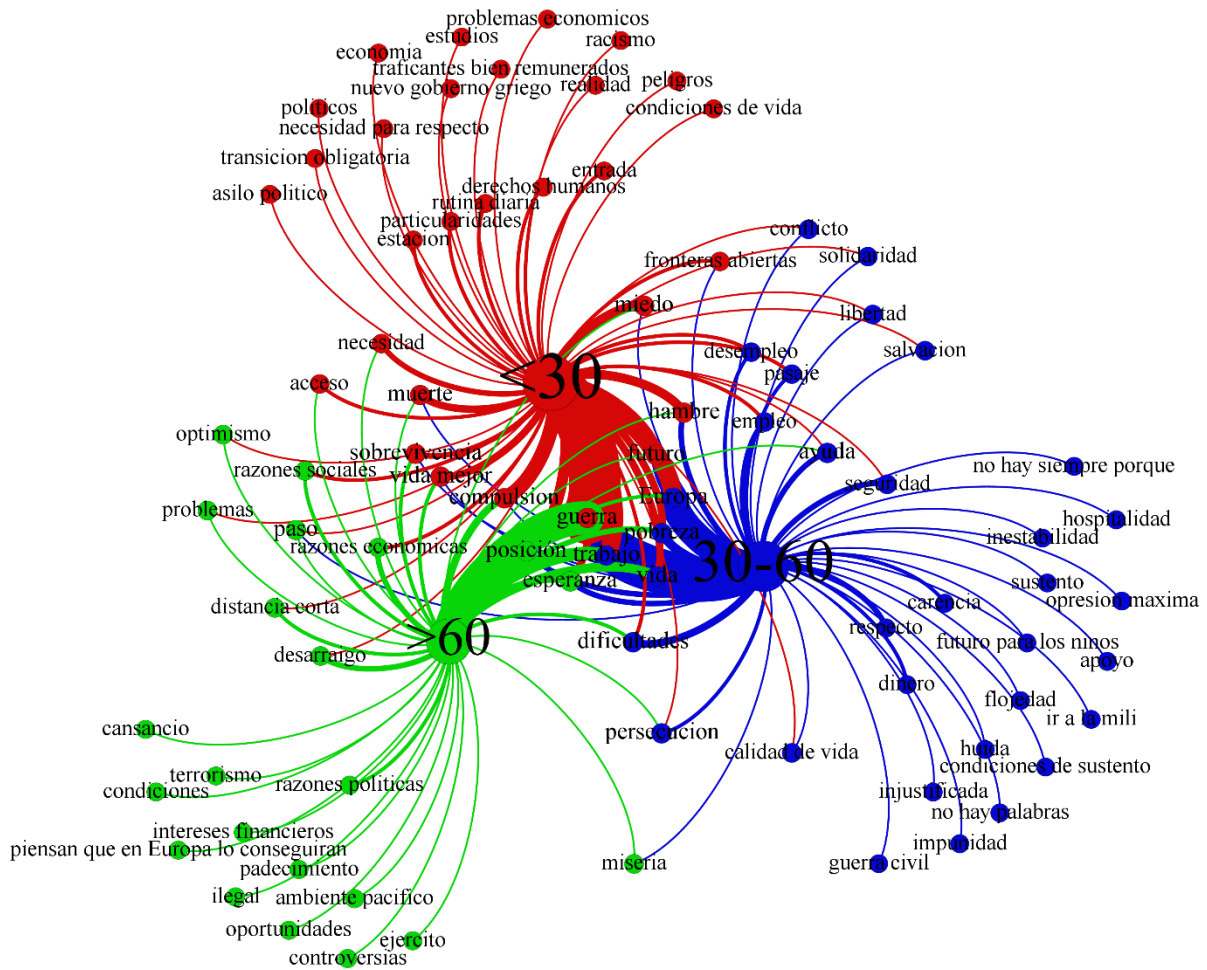


Figure 70: Word network representing the words used per age associated with the causes of migration. Colours indicate words per age category.

5.4 MAIN POINTS IN REVIEW

- In Chapters 3 and 4 we analysed the importance of the subjective assessment while advancing in the social dimension of sustainability. In this chapter, we use some more applications to show the strength of the collective response regarding social matters. Dwellers in most urban (and rural) contexts are constantly demanding for more participatory and inclusive processes, and increasingly more local authorities are allowing a certain level of local engagement in planning. A demand for a more active public is thus becoming clearer and considering that participation is *“interaction among individuals through the medium of language”* (Webler et al. 1995), this is to be achieved through communication (Papachristou and Rosas-Casals 2015a) as explained in detail in Section 5.2.
- From the survey results on Gn and Vs presented in Section 3.2.2, we have seen that the need for Participation achieves a rather high satisfaction in the subjective dimension for both Gn and Vs cases, reaching the 67.3% and 62% correspondingly, with a potential increase of up until 13.6% for Gn and 18.1% for Vs (see Table 9, Section 3.2.5). Also, although dwellers appear to complain for the low levels of citizen participation, the percentages of working as volunteers, participating to any association, having any control of the communitarian, political or social life or even participating in neighbourhood assemblies are low (see Section 3.2).
- This result is further reflected in a question we treated separately in Section 5.1 related to (i) the perceived actual and (ii) the conceived ideal level of participation. An average of 3.22 in Arnstein’s ladder corresponding to the third rung (Informing) shows that, at least at the perception level (i), we have not yet escaped the 1980’s and 1990’s reality (Bonet i Martí 2014). Dwellers are allowed to hear and have a voice regarding their space (Arnstein 1969) but further managerial power is far from being accomplished. The sample conceive as ideal (ii) that of 6.76 units. The paradox here is that the seventh rung (Delegated Power) did not obtain as many votes as rung 6 (Partnership) or 8 (Citizen Control) according to the survey, most probably because of the appearance of the word “power” in it.
- Similar observations and critique were made in previous research stating that: *“Arnstein’s model, by solely emphasising power, limits effective responses to the challenge of involving users in services and undermines the potential of the user involvement process. Such an emphasis on power assumes that it has a common basis for users, providers and policymakers and ignores the existence of different relevant forms of knowledge and expertise. It also fails to recognise that for some users, participation itself may be a goal”* (Tritter and McCallum 2006). Others pointed out social learning as a more appropriate method in measuring participation levels (Collins and Ison 2009).
- *“Arnstein’s ladder remains a key reference in ongoing efforts to determine what does and does not constitute participation by the public”* (Thorpe 2017). Participation reflects our right to the city (Lefebvre 1968) and enacting our right to the city is a matter of building ‘cities within the city’, by both declaring new forms of authority based on a presupposition of the equality of urban inhabitants, and finding ways to stage a disagreement between these competing forms of authority (Iveson 2013). However, and in spite of the considerable increase of participatory processes, the role that participation must have in urban planning remains a matter of debate in the political, technical and citizen sphere (Bonet i Martí 2014).
- The experimental activities explained next have come to amplify this study on perceptions regarding a specific space (in this case a square, Vs) linked to a bigger one (that of a neighbourhood, Gn). A possible solution for the enhancement of participation would be to focus on the creation of contact zones and spaces of interaction (Askins and Pain 2011). And this was our intention. From the three types of collective mapping we elaborated, we obtained a wide range of observations and viewpoints.

The maps of observations showed us a general focus on the fluxes crossing the square. The maps of perceptions gave us a different and varied perspective of the life and elements of the square approached by a closer look. Finally, and in agreement with previous research associated with storytelling in planning (Sandercock 2003; Cilliers et al. 2015) we consider the map of stories the most interesting of the three in terms of information acquired. It was the one that (metaphorically) transformed the physical space of the square to a place with many realities (social, psychological, mythical, historical, etc.) where people were attached, each in its own way. It also showed us that Virreina square is an important but still partial element of the Vila de Gràcia neighbourhood.

- The second experiment of Section 5.1 revealed the difficulty modern adults have to cross from the public space to a certain private limit even after an invitation to do so and regardless of the activity. The only age group showing no hesitation in surpassing the limit were the children. This was not necessarily the reaction we expected considering that the distinction between public and private realms has long been lost (Sennett 1977) or even surpassed. Especially now, with the effect information technology has in our lives, a continuum of the two realms seems more adequate than a dichotomy (Ford 2011). Our assumptions are that the users of the space needed more time or repetitions to take a trust leap (Botsman 2017) to feel comfortable in a mixed space like this while surrounded by strangers. The behaviour of children was different as they *“tend to be more naturally trusting than grown-ups, having had less experience in being let down or in worrying about distant outcomes. For adults, trust becomes more complicated as it works both in the heart and in the head”* (Botsman 2017).
- All previous experiments made possible an alternative lecture of Vs space, which, along with the survey results (see Chapter 3) gave us a more complete image on both physical and social space of the square. Some related first conclusions led us to a list of ephemeral interventions (Table 15) realised during “our day at the square”. We can see them as a temporal use project with a focus in vindicating the public space of the square for the people. Combined with other ludic and educational activities, they created a different dynamic that concluded many hours after the expected end of our program.
- These types of DIY urbanism (Iveson 2013) projects are increasingly recognised as a real driver of *urban “change, renewal and revitalisation”* even if they are the least likely to uphold a lasting change (Vallance et al. 2017) among other similar urbanistic approaches such as informal (Roy 2005), tactical (Lydon and Garcia 2015) or insurgent (Hoe 2010; Friedmann 2011) urbanism. It is actually their transience and not their permanence that facilitates innovative ways to exploit the void between the actual and the potential of a specific space (Vallance et al. 2017). Also, *“ephemerality, recurrence or migration”* may be seen as an opportunity to the use and the produced quality of the space (Lehtovuori and Ruoppila 2017) and should be considered in future projects. As David Harvey mentions: *“the spontaneous coming together in a moment of ‘irruption’, when disparate heterotopic groups suddenly see, if only for a fleeting moment, the possibilities of collective action to create something radically different”* (Harvey 2012). And that day at Virreina square was indeed something different, a place where strangers met (Sennett 2014), where all ages participated giving life at the square.
- All these experiments, activities and process followed helped us understand the question related to the future of our public space and introduced the need for more bottom-up structures, new ways to activate and convert the aforementioned passives into public assets and room opening for emerging and spontaneous activities understanding the city as an open system (Sennett 2006).
- Attention should be taken when successful projects can lead to gentrification and the displacement of those who took the initiative as very well Muzner and Shaw (2015) point out, especially, in a city

such as Barcelona where gentrification is a current issue directly linked to the creation of inequalities, socio-economical segregations and tourist bubbles (Navarro Yáñez 2013; Hernández-Cordero and Tutor-Anton 2014; Montaner-Angel 2017).

- Adding the possibility of expression of citizen voices to policy processes would deliver the desired result as openness, transparency and inclusive dialogue are currently missing in regular institutional and political practice (Carvalho et al. 2016). Language is seen as a vital component of how we conceptualise the world (Jacobs 1999) and can be used by communities or groups of people with diverse or common interests to reach agreement on collective action under a shared problem or issue (Webler et al. 1995).
- In Section 5.2, we conducted the analysis of the discourse coming from the open conversation with the neighbours of the day at the square (Section 5.1) along with a conversation held with experts. These, although referring to the same urban context (Gn), showed important differences in the use of words (see Figure 52, Figure 53 and Figure 54). We consider that fact one of the reasons we usually observe issues regarding communication in many participatory or bottom-up processes. A more “shared” selection of words would foment better understanding between the two groups, and in extension between different groups formed of dwellers, experts or the local administration.
- Neighbours used more words than the experts to express themselves using also more connections in their discourse and making their statements more clear (see Figure 52, Figure 53). The aggrupations (clustering) of their words appeared also closer together with blurred limits. The experts’ discourse seemed more disconnected, with the aggrupations of words clearly separated in blocks. What neighbours perceive and what experts conceive of the same space is not the same. The vision of the experts is clearly a vision looking and evaluating the situation as they observe it from the outside, using words such as “to utilise”, “to be”, “regulation”, “inertias”, “citizenship”, “people” and “conscience”. Instead, the neighbours explain the situation they are seeing and witnessing as they live it, from the inside, using words such as: “creativity”, “freedom”, “transformation”, “public space”, “creation”, “physical affection”, “contact”. Differences apart, we consider both discourses as valuable and important. A dialogue between the interested parts in these cases should be the solution.
- The place that a conversation takes place plays an important role to the expression or the communication of the individuals. An informal meeting taking place in an open and public space allows much more liberty of expression to the interlocutors than a formal one taking place in a conference room. Apart from the place, the dress code, the homogeneity or heterogeneity of someone’s conversation partners, all affect the words she chooses to use in her discourse. A formal situation provokes stiffer, more technical vocabulary and the use of “catchy” words that usually attach prestige to the speaker. An informal situation leaves space for the communication of personal feelings thoughts and needs. Nevertheless, an architect or an urbanist should be always able to adapt his discourse to the target team as his roll is that of an intermediary between the dwellers and the city.
- The whole analysis based in personal notes may provoke some bias as it does not include non-verbal speech and emotional or physical information of the individuals.
- The presented study case forms only an example and in order to generalise between discourses of different actors and examine possible similarities in network behaviours related to various urban contexts, we should analyse more cases.
- What we learned through the whole process and as Bull and Azennoud (2016) state, the benefits of the “unplanned” should not be underestimated. The dedication of time in informal activities ensures the connection between the involved groups and facilitates conversations and opinion exchange. And

it is common knowledge that dialogue, and other forms of communication have the power to change people and situations.

- We also consider that more groups trigger more variation to the discourses. That is the case of Section 5.3 for example where we get more insights analysing the discourse by gender, neighbourhood, type of employment and age groups. Here we treat a different urban issue associated with emerging urban phenomena and especially with that of massive migration flows crossing from the East coasts to the Greek island of Lesbos over 2015. There is still a relation with the public space and specifically it was its informal occupation from the new comers in the city of Mytilene that initially prompted our interest to this study, but the focus was quickly transferred to the perceptions of the receiving population on the causes of this migration.
- We have shown that analysing the different neighbourhoods, the habitat of people and the local history first is essential for the study and understanding of human perceptions, especially in the case of women (Papachristou et al. 2015). Space influences our way of thinking and speaking, i.e., our selection of words. The words themselves are only an abstraction of reality. Without the context, which the researcher can conceive through interviews and studies of the history and morphology of landscapes, they may lose part of their meaning. Having said that, in general, the perception of the inhabitants of Mytilene is considered as diversified rather than unique and generalised (Ventoura 2011): it depends on the social context and the contact with the new comers and it is linked both to the social construction of the notion of migration (Green 2002) and the words used in daily life.
- Results showed that not only gender but also the link with the place of residence, the social status at work and the pertaining age groups seem to influence the formation of the perceptions of the inhabitants of Mytilene on the issue of migration. One must always consider the context to be able to understand in depth the reality of a space in a specific time. That the connectivity is leaded by the word “*war*” for most of the discourses is not something trivial. They are familiar with what is happening to those people. The island (and the country) received previous flows of migration and many of them have relatives or family that found themselves obligated to migrate there or from there to a different place during the past century for political or economic reasons. And that is why words such as “*work*”, “*life*”, “*future*”, “*Europe*” and “*hope*” make a frequent appearance. They know what war, poverty, oppression, losing your home, your family and your identity is. They understand that those people have not many options as the proliferation of war zones across much of the world will not come to an end soon. Those refugees or “*refuge seekers*” suffered a massive loss of habitat and are currently in a search for a “*bare life*” as very well Saskia Sassen states (Sassen 2016).

5.5 REFERENCES

- Alberich Nistal T (2016) Desde las Asociaciones de Vecinos al 15M y las mareas ciudadanas. Breve historia de los movimientos sociales. Dykinson
- Anagnostopoulou M (2006) Scala from Mitilene: The dream neighbourhood [in greek]. Enteleheia
- Anagnostou S (2011) Local History. References to the Modern History of Lesbos [in greek]. Enteleheia
- Arnstein SR (1969) A Ladder Of Citizen Participation. J Am Inst Plann 35:216–224. doi: 10.1080/01944366908977225
- Artemi E (2015) Comparative analysis of urban landscapes Mytilene-Aivali [in greek]. University of the Aegean
- Askins K, Pain R (2011) Contact zones: participation, materiality, and the messiness of interaction. Environ Plan D Soc Sp 29:803–821. doi: 10.1068/d111109

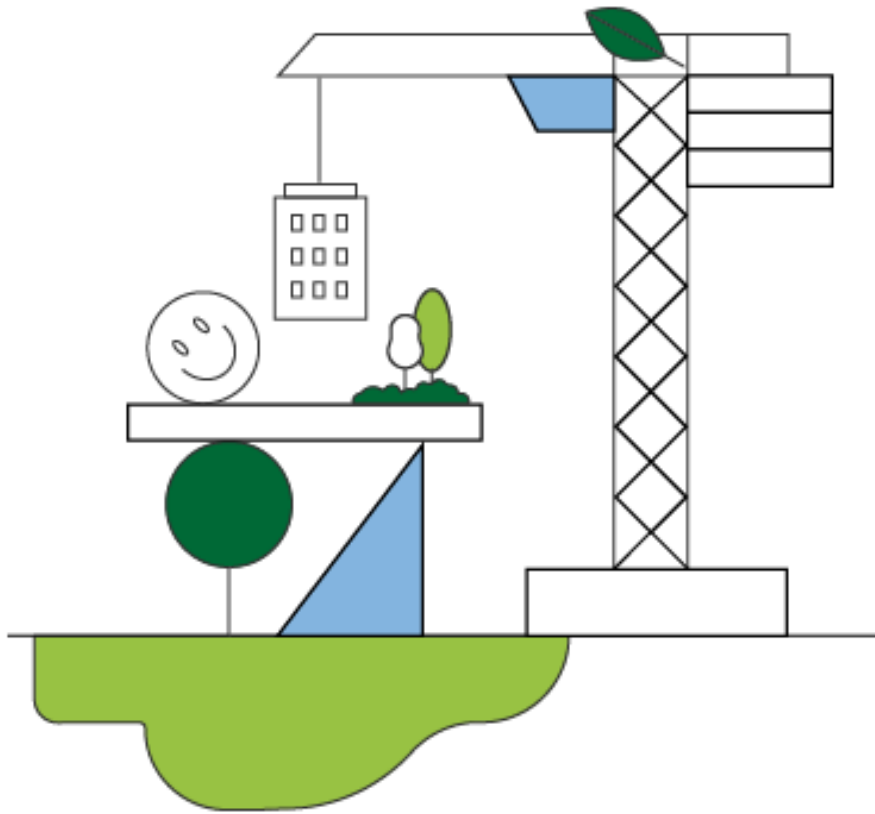
- Bastian M, Heymann S (2009) Gephi: An Open Source Software for Exploring and Manipulating Networks. In: International AAAI Conference on Weblogs and Social Media. San Jose, CA, USA
- Blondel VD, Guillaume J-L, Lambiotte R, Lefebvre E (2008) Fast unfolding of communities in large networks. *J Stat Mech Theory Exp* 2008:P10008. doi: 10.1088/1742-5468/2008/10/P10008
- Bonet i Martí J (2011) Cuando cómo participar importa. Análisis de los impactos de la participación ciudadana en las políticas de regeneración del centro histórico de Barcelona. *Rev Estud Urbanos y Ciencias Soc* 1:4–26
- Bonet i Martí J (2014) La participació ciutadana en l'urbanisme: potencials i límits. *Pap Regió Metropol Barcelona* 57:63–70
- Botsman R (2017) *Who can you trust? How technology brought us together and why it might drive us apart*. Hachette Book Group, New York
- Bull R, Azenoud M (2016) Smart citizens for smart cities: participating in the future. *Proc Inst Civ Eng - Energy* 169:93–101. doi: 10.1680/jener.15.00030
- Carvalho A, Pinto-Coelho Z, Seixas E (2016) Listening to the Public – Enacting Power: Citizen Access, Standing and Influence in Public Participation Discourses. *J Environ Policy Plan* 1–19. doi: 10.1080/1523908X.2016.1149772
- Cilliers EJ, Timmermans W, Van den Goorbergh F, Slijkhuis JSA (2015) The Story Behind the Place: Creating Urban Spaces That Enhance Quality of Life. *Appl Res Qual Life* 10:589–598. doi: 10.1007/s11482-014-9336-0
- Clauset A, Shalizi CR, Newman MEJ (2009) Power-Law Distributions in Empirical Data. *SIAM Rev* 51:661–703. doi: 10.1137/070710111
- Collins K, Ison R (2009) Jumping off Arnstein's ladder: social learning as a new policy paradigm for climate change adaptation. *Environ Policy Gov* 19:358–373. doi: 10.1002/eet.523
- Davidoff P (1965) Advocacy and pluralism in planning. *J Am Inst Plann* 31:331–338. doi: 10.1080/01944366508978187
- ELSTAT (2011) Hellenic Statistical Authority. statistics.gr
- FEK 731/D/12.31.1985 (1985) Designation as a traditional segment of the city of Mytilene (Historic Center), characterisation as listed buildings and imposition of special conditions and building restrictions for them [in greek]
- Ford SM (2011) Reconceptualizing the public/ private distinction in the age of information technology. *Information, Commun Soc* 14:550–567. doi: 10.1080/1369118X.2011.562220
- Fortunato S, Barthélemy M (2007) Resolution limit in community detection. *Proc Natl Acad Sci U S A* 104:36–41. doi: 10.1073/pnas.0605965104
- Friedmann J (2011) *Insurgencies: Essays in Planning Theory*. Routledge, New York & London
- Gehl J, Svarre B (2013) *How to study public life*. Island Press, Washington D.C.
- Green NL (2002) *Repenser les migrations*. Presses Universitaires de France, Paris, France
- Harvey D (2012) *Rebel Cities: From the Right to the Cities to the urban revolution*. Verso, London
- Hernández-Cordero A, Tutor-Anton A (2014) Espacio público: entre la dominación y la(s) resistencia(s). *Ciutat Vella, Barcelona y la(s) resistencia(s)*. Ciutat Vella, Barcelona. *Encrucijadas* 8:129–149
- Hoe J (ed) (2010) *Insurgent public space: Guerrilla urbanism and the remaking of contemporary cities*. London and New York
- Iveson K (2013) Cities within the City: Do-It-Yourself Urbanism and the Right to the City. *Int J Urban Reg Res* 37:941–956. doi: 10.1111/1468-2427.12053
- Jacobs K (1999) Key Themes and Future Prospects: Conclusion to the Special Issue. *Urban Stud* 36:203–213. doi: 10.1080/0042098993826
- Jacomy M, Venturini T, Heymann S, Bastian M (2014) ForceAtlas2, a Continuous Graph Layout Algorithm for Handy Network Visualization Designed for the Gephi Software. *PLoS One* 9:e98679. doi: 10.1371/journal.pone.0098679

- Lefebvre H (1968) *Le droit à la ville*. Anthropos, Paris, France
- Lehtovuori P, Ruoppila S (2017) Temporary Uses Producing Difference in Contemporary Urbanism. In: Henneberry J (ed) *Transience and Permanence in Urban Development*. Wiley & Sons, Hoboken, NJ, pp 47–63
- Lydon M, Garcia A (2015) *Tactical Urbanism: Short-term Action for Long-term Change*. Island Press, Washington D.C.
- Montaner-Angel M (2017) Paisajes de la gentrificación en el barrio del Raval de Barcelona. Universitat Autònoma de Barcelona.
- Munzner K, Shaw K (2015) Renew Who? Benefits and Beneficiaries of Renew Newcastle. *Urban Policy Res* 33:17–36. doi: 10.1080/08111146.2014.967391
- Navarro Yáñez CJ (2013) Do ‘creative cities’ have a dark side? Cultural scenes and socioeconomic status in Barcelona and Madrid (1991–2001). *Cities* 35:213–220. doi: 10.1016/j.cities.2013.05.007
- Newman MEJ (2010) *Networks: An introduction*. Oxford University Press, Oxford
- Newman MEJ (2005) Power laws, Pareto distributions and Zipf’s law. *Contemp Phys* 46:323–351. doi: 10.1080/00107510500052444
- Newman MEJ, Girvan M (2004) Finding and evaluating community structure in networks. *Phys Rev E* 69:026113. doi: 10.1103/PhysRevE.69.026113
- Papachristou IA, Katseniou E, Petropoulou C, Rosas-Casals M (2015) Refugiados de ayer, refugiados de hoy: un análisis de percepciones desde la perspectiva de género en Mitilene utilizando redes complejas. In: *Jornadas GRECS-GRACU: Género y producción del espacio. De la exclusión a la reivindicación del derecho a la ciudad*. Universidad de Barcelona, Barcelona, Spain
- Papachristou IA, Rosas-Casals M (2015) The many urban languages or why there is always a gap between bottom-up initiatives and top-down processes. In: *Resurbe II: International conference on urban resilience*. Bogotá
- Paraskevaïdis P (2013) The refugees of the Second persecution in Lesvos [in greek]. Tartarouga
- Paraskevaïdis P (2014) The refugees changed the look of Mytilene [in greek]. Eleftherotypia
- Pérez Quintana V, Sánchez León P (eds) (2008) *Memoria ciudadana y movimiento vecinal: Madrid, 1968-2008. Los libros de la Catarata*, Madrid
- Pindado F (2008) *La participación ciudadana es la vida de las ciudades*. Ediciones del Serbal, Barcelona
- Roy A (2005) Urban Informality: Toward an Epistemology of Planning. *J Am Plan Assoc* 71:147–158. doi: 10.1080/01944360508976689
- Sandercock L (2003) Out of the Closet: The Importance of Stories and Storytelling in Planning Practice. *Plan Theory Pract* 4:11–28. doi: 10.1080/1464935032000057209
- Sassen S (2016) A Massive Loss of Habitat: New Drivers for Migration. *Sociol Dev* 2:204–233. doi: 10.1525/sod.2016.2.2.204
- Sennett R (1977) *The Fall of Public Man*. Knopf, New York
- Sennett R (2014) *L’èspai públic*. Arcàdia, Barcelona
- Sennett R (2006) The Open City. *Urban Age* 1–5
- Thorpe A (2017) Rethinking Participation, Rethinking Planning. *Plan Theory Pract* 1–17. doi: 10.1080/14649357.2017.1371788
- Tritter JQ, McCallum A (2006) The snakes and ladders of user involvement: Moving beyond Arnstein. *Health Policy (New York)* 76:156–168. doi: 10.1016/j.healthpol.2005.05.008
- UNHCR (2016) The UN Refugee Agency. <http://www.unhcr.org/>

Vallance S, Dupuis A, Thorns D, Edwards S (2017) Temporary use and the onto-politics of 'public' space. *Cities* 70:83–90. doi: 10.1016/j.cities.2017.06.023

Ventoura L (2011) *Migración y fronteras sociales* [en griego]. Nea Synora, Athens

Webler T, Kastenholz H, Renn O (1995) Public participation in impact assessment: A social learning perspective. *Environ Impact Assess Rev* 15:443–463. doi: 10.1016/0195-9255(95)00043-E



6.

Discussion,
conclusions and
perspectives /
Discussion and future
work

6.1 GENERAL POINTS FOR DISCUSSION

6.1.1 ON HAPPINESS

Almost 2,5 thousand years ago Aristotle reached to the conclusion that humans' ultimate goal is to achieve happiness (Aristotle 2002). Since then, we have witnessed a series of thrilling revolutions affecting our lives at all levels. Following Aristotle's view, the Victorian founders of economic theory claimed that the main objective of growing the economy is to make people happy (Orrell 2010). And the economy has grown exponentially permitting wealth that we have never dreamed before. The technological and Industrial Revolution gave humans 'superpowers' and practically limitless energy³⁷. The social order, politics, daily life and human psychology have been completely transformed (Harari 2011). But the question remains: are we happier? If not, what was the point of any kind of development? What would be capitalism's benefit if for example economic growth and self-reliance do not make people happier?

These are all hypothetical possibilities as we haven't studied yet extensively historical data on happiness. What we do know for sure is that human capabilities have increased in the past years (Sen 1999; Nussbaum 2000; Alkire 2002a; Robeyns 2005). And as we, humans, use them to relieve miseries and accomplish aspirations, we should be happier than our ancestors. The thing is new skills do not necessarily give us a better life. And given human's tendency for the misuse of power, it is naïve to think that the more influence humans may have the happier they would be. Over the past few decades we have been threatening the ecological equilibrium of our planet in countless ways (Diamond 2005). The consequences are already dire and will be even worse (see Section 1.2). We are eradicating all foundations of our prosperity through our urge for irresponsible and continuous consumption. As a result, when evaluating global happiness, we shouldn't just measure the happiness of the elite. Maybe we shouldn't either consider only the happiness of humans (Harari 2011).

6.1.1.1 MEASURING HAPPINESS

Friedrich Nietzsche wrote in 1891: *"Only man assigned values to things in order to maintain himself- he created the meaning of things, a human meaning! Therefore, calls he himself: 'Man,' that is: the evaluator"* (Nietzsche 1966). We are obsessed with measuring things. This is how we think we understand them better. The same happens with happiness. How can we measure something intangible? Something abstract? That's when new, close-related terms such as 'utility', 'well-being', 'life satisfaction', 'quality of life', etc. appear (see Sections 1.4, 2.1 and 2.2), used *"indistinctly to categorise many different parts of the field, but not univocally"* (Papachristou and Rosas-Casals 2019a).

And starting from the utility concept, Jeremy Bentham, founder of modern utilitarianism, defined the principle that "it is the greatest happiness of the greatest number that is the measure of right and wrong" as the "fundamental axiom" of his philosophy (Burns 1989). So, to compute the human impulse to action we should add all values of pleasure on one side and those of pain on the other (Orrell 2010). That would give us the total utility. Neoclassic thinkers thought they could create a physics of happiness. What they seem to have forgotten is that people are not machines. We cannot put a price on happiness. Free markets aren't exactly a machine for maximising pleasure. And neither happiness is the balance of pleasant over unpleasant moments. It is rather related to seeing one's life in its total as meaningful. The important cognitive and ethical component of happiness that define how we see ourselves is our values. A meaningful life can be extremely satisfying even

³⁷ I am not entering yet here on the sustainability dimension and/ or ecological impact of this 'limitless' energy.

in the middle of difficulties, whereas a meaningless life is unbearable no matter how comfortable it is (Harari 2011). The actual economic theory promises a road to happiness but offers an illusion. *“We built a machine for optimising happiness, only to find out that we’re not happy living in a machine”* (Orrell 2010).

Recently, psychologists and biologists have started studying scientifically what makes people happy. The first step was again to define what is to be measured. Here, the accepted definition would be that of subjective well-being (SWB), associated with what I feel inside myself, either immediate pleasure or long-term contentment with my life. What is difficult, is to measure from the outside something that we feel from the inside. One way to do so (see Section 1.4) is to just ask people how they feel. Those questionnaires are used to correlate happiness with various objective factors. That’s how we know that money only brings happiness up to a point and that family or community affect more our happiness than money and health. But most importantly, that happiness does not really depend on objective conditions per se but, on the correlation between them and subjective expectations. As a result, when things improve, expectations inflate. When things deteriorate, expectations diminish (Harari 2011).

Biologists now, correlate the same questionnaire answers with biochemical and genetic factors. They hold that *“our SWB is not determined by external parameters but by a complex system of nerves, neurons, synapses and various biochemical substances such as serotonin, dopamine and oxytocin”* (Harari 2011). People can be happy only by pleasant feelings in their bodies. The thing is we cannot just keep our pleasure always at a high level, our internal biochemical system are programmed to keep happiness levels relatively constant. They also differ from person to person.

Technological development can change the external factors that cause serotonin to be emitted, yet it does not change the resulting serotonin levels, and hence it cannot make people happier. There is only one thing that could help: manipulating our biochemistry. Could this be a solution? Designing a ‘new world’, an utopia³⁸ of happy people? *“A lifetime of happiness! No man could bear it: It would be hell on Earth!”* wrote George Bernard Shaw in his play *Man and Superman* in 1903 (Shaw 1903). But also Ruut Veenhoven states that happiness requires liveable conditions but not paradise (Veenhoven 1984). Why would that be? Aldous Huxley perfectly described this type of society in his book *Brave New World* (Huxley 1932). There, everyday people were taking a dose of ‘soma’, a drug that would allow them to have a perfect happy day without harming their productivity and efficiency. This way the World State was never threatened by wars, revolutions, strikes or demonstrations. Everyone was having a perfectly predetermined, organised life. So what was the problem?

³⁸ “Utopia” comes from ancient Greek: οὐ (“not”) and τόπος (“place”) which translates as “no-place” and literally means any non-existent society. Also, in Greek εὖ (“good” or “well”) and τόπος (“place”), hence eutopia means “good place”, which would be the more appropriate term for the concept the word “utopia” has in modern English. The pronunciations of eutopia and utopia in English are identical, which may have given rise to the shift in meaning: usually describing a non-existent society that is intended to be viewed as considerably better than contemporary society (Lyman Tower 2005). The first known utopia is Platon’s Republic. The word utopia was coined from Ancient Greek by Sir Thomas More in 1516 were he carefully pointed out the similarity of utopia to eutopia.



Figure 71: The Island of Utopia, illustration for the 1516 first edition of Thomas' More Utopia.
Source: Wikipedia: [https://en.m.wikipedia.org/wiki/Utopia_\(book\)](https://en.m.wikipedia.org/wiki/Utopia_(book))

It is difficult to explain why the idea of such place terrifies us so much. Many would classify it as an even worse dystopia³⁹ than George Orwell's *1984* (Orwell 1949). Wasn't happiness our final objective? What's wrong with having a way to get what we were searching for? Would we agree to trade happiness off with our freedom? And even if we had this type of place functioning, would everyone choose the blue pill of the beautiful prison? Would there be any Neos (Wachowski and Wachowski 1999) choosing the red pill of the ugly truth? Or Alices (Lewis Carroll 1865) choosing the bottles that would enable them to continue the adventure? Again, we are not machines. Our survival instincts shouldn't accept us living in a similar world. Some would wake up, some would resist at some point.

6.1.1.2 THE NEGLECTED EFFECTS OF COMMUNITY

Margaret Thatcher said in an interview in 1987 for the *Women's Own* magazine: "*There is no such thing as society. There are individual men and women, and there are families. And no government can do anything except through people, and people must look to themselves first.*" (Thatcher 1993). We live in atomised societies where the central institutions are geared to individuals rather than to communities. The whole idea that individuals are in a competition for maximum utility is exactly what makes people unhappy. Our less 'developed' ancestors found much happiness in community, religion and nature (Harari 2011). According to Daniel Kahneman, today's high-earners spend more time working and commuting, and less time relaxing and hanging out with friends (Kahneman 2006). People with above-average income are satisfied with their lives but are barely happier than others in momentary experience, they are more stressed and spend less time in free-time activities. They suffer from alienation and vainness despite their prosperity (Harari 2011). And that's

³⁹ Dystopia comes from the Greek *δυσ-* ("bad") and *τόπος* ("place"), a community or society that is undesirable or frightening.

one of the biggest issues of modern affluent societies. It is not questionable that in most of them there is also a high index of suicides. The loneliness becomes unbearable in many cases.

We are often glad to do tasks for free and sometimes even happier than if we were paid. That is because happiness and money are connected to different parts of our brains and personalities (Orrell 2010). According to Dan Ariely, (Ariely 2009) we simultaneously live in two worlds: one characterised by market and the other by social exchanges. Market exchanges are based on numerical calculations of wages, payments, and prices. Social exchanges include offers of help, exchange of gifts, collaborations and volunteer work. The pleasure is related to the action itself and there is no related reciprocity expected or demanded. Generalising, social norms are more right-brained and intuitive, while market norms are more left-brained and calculating. Humans have a great ability to slip from social to market norms as those have become the default or pre-established way our society works. Unfortunately, humans find it difficult to go back to social norms and getting stuck to the economic mode doesn't make them happy. To achieve happiness, they need the social reality (Orrell 2010).

Happiness is relational. Our happiness is completely and utterly intertwined with other people. It's a connecting tissue (Weiner 2008). We are living in a connected economy (Barabási 2002; Watts 2003; Orrell 2010). Happiness couldn't but spread between individuals. And that's what Fowler and Christakis showed in their research, that we are connected and so is our joy (Fowler and Christakis 2008). Happiness is a network phenomenon, extending to groups of people of three degrees of separation (i.e., your happiness depends on your friend's friend's friend's happiness). It can spread across a diverse set of social ties such as family, peers and neighbours. Network characteristics make also individual happiness predictable. Economist Richard Layard states that a society cannot prosper without any sensation of sharing objectives (Layard 2005). The actual quest for personal development will not fructify. It's just a trend. Everybody will have to feel that they exist for something more. We must search for a common benefit where every person counts, for equality with our neighbours. Of course, one cannot be happy without a wider objective than herself but neither without knowledge and acceptance of herself. Happiness comes both from the inside and the outside. The secret is compassion towards both us and others and the principle of greater happiness is essentially the expression of this ideal.

It's early to adopt rigid conclusions on happiness, the debate is just beginning. What is important is to open our minds on as many approaches as possible and to ask the right questions (Harari 2011).

6.1.2 ON SUSTAINABILITY

2015's Sustainable Development Goals (SDGs) form a *"universal call to action to end poverty, protect the planet and ensure that all people enjoy peace and prosperity by 2030"* (UNDP 2015a). They embrace the natural environment, the economy and social dimensions of living (Kagan and Burton 2018). Whereas the earlier Millennium Development Goals for 2015 (UNDP 2015b) referred to countries from the global south, SDGs refer to all countries including the global north. It is now our responsibility to achieve greater environmental, social and economic security for all (Kagan and Burton 2018).

Until recently, the main focus of sustainability science was on the biophysical and economic systems leaving the social dimension as the least developed. Consequently, and to reach SDGs, we will have to refocus our efforts towards sustainability through a social perspective both theoretically and empirically. The best way to do so is through multi- and transdisciplinary scientific collaboration. We are currently moving from the Brundtland paradigm that defined sustainable development as a process that meets today's needs without

compromising future generations (Brundtland 1987) to new paradigms that embrace both technological solutions and humanistic and ecological values (Brandi 2015).

We are in need for a “*Great Transformation*”, in the words of Karl Polanyi, to reorganize our knowledge, education and markets (Polanyi 1944). Starting from our education, we should lead ourselves towards the multi- and eventually transdisciplinary epistemology (Ramadier 2004; Max-Neef 2005) required for this paradigm shift. Universities of the future should be the places of *knowledge transfer, sharing* and behavioural change (Sonetti et al. 2019). They should teach the new generations values of empathy, openness, boldness, community engagement and accessibility. The emerging ‘integrative humanities’ science will be ready more suitable confront and understand the raising complexity of our contemporary society.

6.1.3 ON CITIES

United Nation’s Habitat III New Urban Agenda represents a shared vision for a better and more sustainable future – one in which all people have equal rights and access to the benefits and opportunities that cities can offer, and in which the international community reconsiders the urban systems and physical form of our urban spaces to achieve this (UN-Habitat 2017). As we mentioned in the previous section, putting the ‘social’ into sustainability is more urgent than ever (Kagan and Burton 2018).

From a sociological point of view, Richard Sennett believes the types of cities we want should be seen, perceived and treated as open systems (Sennett 2006). An open system would be one of unstable evolution while a closed one would be one of harmonious equilibrium. Until now, the closed system view has paralysed urbanism while the open one might free it. Originally, the idea of an open city comes from Jane Jacobs’ discourse against the urban vision of Le Corbusier (Jacobs 1961). Her ‘radical planner’ view of a city was a dense and diverse one with both public and private functions. This type of city would lead to the unexpected encounter, the chance discovery, the innovation. And it seems that what we need at this point to survive the pace of changes of growth of cities is innovation according to some scientific theories.

The view of complex systems scientists is similar. They also believe that cities and social systems in general should be thought of in terms other than equilibria (Batty 2017) following a rule of continuous adaptation (West 2017). We have come to a point where growth is unstable. It requires an unlimited, ever-increasing, and infinite supply of energy and resources at some finite time in the future to maintain it. Obviously, this is impossible and may trigger a transition to a phase that leads to inactivity and collapse. We won’t be able to keep up to the demand of this open-ended growth. A first solution would be to change the parameters of the growth equation, i.e. stop growing the way we did until now. Another solution would be to intervene in order to reach a new dynamic with a major innovation. This way the system’s conditions will change resetting the clock, allowing growth and avoiding collapse. It is considered a soft transition to a new phase. The thing is, if we maintain the pace of growth, the time between successive innovations should be shorter each time (see Figure 72), they should occur in an increasingly accelerating pace.

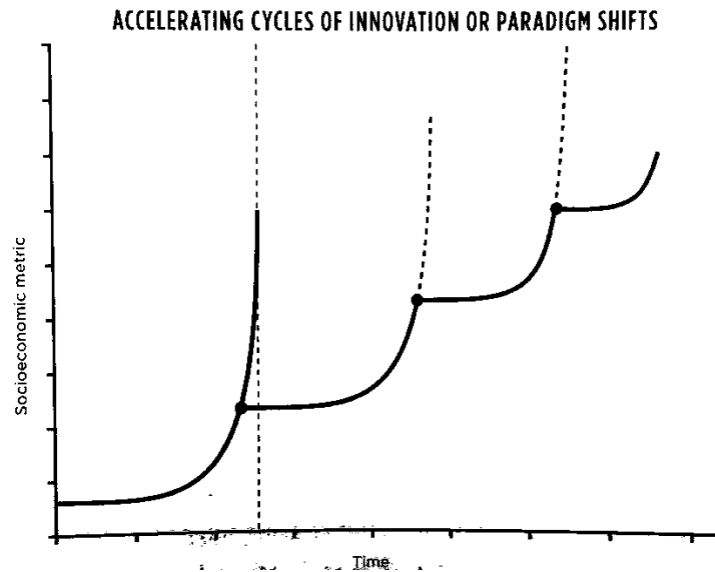


Figure 72: Accelerating cycles of innovation or paradigm shifts in socioeconomic systems.
Source: (West 2017).

Will human ingenuity follow this demand for innovation to prevent disastrous results? And until which point? There is already a lot of research going on in augmenting collective intelligence. But there is no prediction till the moment on the rate of biological innovations and even if there where, it would be hard to evaluate it scientifically. What is obvious is that we should continue to study cities as the originators of our current problems and possible triggers both of disaster and innovation. It is the only way to achieve a long-term sustainability in the planet (West 2017). The equation sounds impossible but we could probably start by finding a way to reconcile economic competitiveness, social cohesion, environmental sustainability, democratic governments and citizen participation (Belil et al. 2012)

6.2 ONGOING AND FUTURE RESEARCH

After all this analysis, applications and discussion it's time to express some of the ideas I am working or planning to work on in the future:

- A bibliometrics approach to the concept of happiness. We already applied co-word analysis to create the map of happiness keywords (see Section 2.1), but we had no significant results in terms of keyword clustering. We would like to add more complexity and analyse the co-author and co-citation networks of the happiness field as well.
- The next step will be to apply word embeddings as in (Tshitoyan et al. 2019) in the abstracts and titles of my article collection dataset. I will investigate if they can be efficiently encoded as information-dense word embeddings (vector representations of words) without human labelling or supervision and compare the results of close related concepts with the ones of the previous research.
- I would then like to apply sentiment analysis in geo-coded social media data (e.g. using Twitter API) for a specific urban public space and evaluate the results. I would combine those with data of existing spatial indicators. The results would allow to define more liveable urban spaces, adequate infrastructural systems and sustainable futures for the dweller.
- In parallel, I am currently specialising myself in Responsible AI and Data Ethics. I would like to continue my research in the field of computational linguistics and detect bias in datasets used to train models in natural learning processing as in (Zhao et al. 2017) but for no-English languages.
- Finally, I still have a long path towards it, but my dream idea of project would be to model agents in a virtual environment that would simulate the behaviour of people in extreme situations of natural disasters and terroristic attacks with the goal to design safer urban environments and settlements.

6.3 ON OUR FUTURE

“We already have - thanks to technology, development, skills, the efficiency of our work - enough resources to satisfy all human needs. But we don't have enough resources, and we are unlikely ever to have, to satisfy human greed.”

– Zygmunt Bauman

In Italo Calvino's *Ersilia* (Calvino 1972) the inhabitants stretch strings to establish all types of relationships that sustain the city's life: blood, trade, authority, agency, etc. When the strings become too many they leave in search for a new place, their houses are abandoned and dismantled and only the strings and their supports remain. When you travel in those territories you encounter yourself with abandoned cities without walls or bones but with only the spider webs that may still reveal a structure of relationships that no longer exist. In my understanding, today's societies are similar to *Ersilia*. We live in the network (Lazer et al. 2009), we use our emails, mobile phone, instant messaging and social media to connect to each other. We use our credit cards to make purchases and transit cards to use public transportation. Public cameras may capture our every move in the public space and our medical, tax and criminal records are stored online. We have minimum control on our 'cloud' information. Even if we leave or abandon the city our digital traces remain. We cannot start over. Our every action can be found in the digital sphere, catalogued and (mis)used.

Last summer I attended a summer school at the University of Alberta on Deep Learning and Reinforcement Learning. In a conversation with Richard Shotton, one of the most known Machine Learning researchers globally, he mentioned that he sees a 50-50 probability of having Artificial Intelligence in 2050. This raised many questions: Is 50% a lot? Is it not? What type of AI would that be? To me it seems both fascinating and scary. There is already a lot of research in prosthetics, especially with the boost of reinforcement learning. And there is also a lot of focus in training virtual agents to communicate but for the moment “*AI is not magic*”⁴⁰ as deep learning pioneer Yoshua Bengio assures. We are still very far from human-level AI in many ways. Humans use very few steps when they reason, and we need to address the gap that exists between our mind's two modes of thought: “System 1” (instinctive and emotional) and “system 2” (deliberative and logical)⁴¹ to approach human-level AI.

The thing at this evolution point we encounter ourselves is we praise the data. And we are greedy. “Dataism” is for many the 'new religion' that will unify all scientific disciplines under one single theory (Ball 2004; Harari 2016). If we follow this path, everything, from individual organisms to economy will be viewed as independent data processing systems. The trust will pass from humans to Big Data and computer algorithms. Intelligence will decouple from consciousness. Highly intelligent algorithms will know us better than we know ourselves. So what will happen to society, politics and daily life in the near future? I commented in a previous section that a solution to our ever growing social systems could be innovation. Is increasing collective intelligence where we should focus? The future we envision? And how could we control it? What will even define a human or a person at that point? Will we live harmonically? Or will we be living under a terrible *Blade Runner* dystopia (Scott 1992)?

⁴⁰ *Towards Human-level AI: Scientific and Social Challenges*, speech in EmTech MIT conference 2019 as described in Forbes magazine (Press 2019).

⁴¹ On the distinction between System 1 and 2 see (Kahneman 2011).

I have just started taking my baby steps in the field of AI but I believe that there are many changes coming that will affect our economy, laws, ethics, values, social order, politics and daily life to name just a few. Of course, I have no direct answer to all the above questions, and if someone did, those would be just speculations. Where we are putting the limits depends on us. Cathy O’Neil in her book *Weapons of Math Destruction* (O’Neil 2016) presents a number of cases where algorithms ‘went wrong’. Are we to blame the models? Of course not. Statistician George Box wrote the famous line “All models are wrong, some are useful” (Box and Draper 1987). All models are a simplification of reality. Especially in the social sciences and our understanding of social systems our ignorance is still much higher than in ‘hard’ sciences. Yes, predictive modelling will be the tool that we will be relying on to run our institutions, deploy our resources, and manage our lives. But these models are not just constructed from data. They depend from the choices we make about which data to include and which to exclude. Those choices are fundamentally moral (O’Neil 2016). It’s up to us to maintain our future generations. While working with data we will always have to ask ourselves: *How does it fit with my values? How is this technology going to be used? Who will benefit or suffer from it? How much and what impact?* We should also put our limits on what we would like to work for: *military applications, especially lethal autonomous weapons, ML to beat the stock market, increasing the efficiency of advertising, increasing the efficiency of oil & gas industry, meat industry, etc*⁴². And of course, we all need to rethink issues of privacy and identity (Harari 2011) as there is a need for ethics and regulation (O’Neil 2016) and preserve the protection of personal privacy and freedom is critical to our future as a society (Pentland 2014). Let’s hope that this global rapid factory of data scientists designed and cut for the huge demand of the market for such positions will give its turn to a conscious and well-prepared education that would include disciplines such as psychology, ethics and sociology along with mathematics, computer science, neuroscience and biology.

Technology is a tool, it depends on how we use it. Diamantidis and Kotler (2012) in their theory of *Abundance*, explain how technology could serve human needs without costing much more than an Internet connection. According to Daniel Kahneman’s calculation, the point where well-being and money diverge on the chart is roughly \$10,000 across the whole globe (Kahneman 2006). That’s the average of what one needs to earn to fulfil her basic needs and have access to greater possibility. We can create the future ourselves. We know which technologies need further development to achieve the targets of abundance and we don’t need to wait anymore for big corporations to get interested, we can take matters on our hands. Today’s DIY innovators are perfectly capable of getting the job done. The ¼ of the humanity that we were neglecting until now can finally get into the game.

We cannot predict the future with accuracy, but what we can do is continue seeing the planet as a living system and stop damaging it (Orrell 2007). We already mentioned that massive increase in human power did not necessarily improve our happiness although it did cause disastrous impacts to the ecosystems that surround us. Nobody knows or can assure us where we are going. All this power we created and we don’t know yet what to do with it. “*Is there anything more dangerous than dissatisfied and irresponsible gods who don’t know what they want?*” (Harari 2011). I hope we will find a way to preserve our planet and its life in this race for growth we engaged ourselves.

⁴² Notes from Yoshua’s Bengio lecture on *ML4AI: What’s next* in CIFAR, Deep Learning & Reinforcement Learning Summer School, Edmonton, Canada, July 27th 2019.

6.4 ONE LAST THOUGHT

“When someone seeks,” said Siddhartha, “then it easily happens that his eyes see only the thing that he seeks, and he is able to find nothing, to take in nothing because he always thinks only about the thing he is seeking, because he has one goal, because he is obsessed with his goal. Seeking means: having a goal. But finding means: being free, being open, having no goal.”

— Herman Hesse, Siddhartha

I am on my way from Terrassa to Barcelona. It was my last correction with Martí today. I think I managed finishing many of the remaining pending tasks for my submission. On my way to the train I decide to walk (wasn't 'Walking' the title of that book I wanted to buy the other day?). I choose the path through the park that Oriol showed me one day some years ago. My steps are quick. I am still stressed, anxious, thinking about what's left to do. Will I manage to finish some more things later at home? Two days left, only two days left! And I accelerate.

I arrive at the first bridge. I breath. Trees, birds, nature, I slow down. How was my thesis journey I am asking myself? I cross the old city. Was it good? Was it bad? There are some children playing at the square. Would I do it again? I don't know. There were good and bad moments I suppose. I see a man sitting at a bench contemplating the view. Last bridge. I cross it. I think I envy him. How strange! I want to be him. Why can't I? I go back to the bridge. I stop. I look around. I can't decide. How beautiful all those colours around me! That's what I want to do now I am thinking. I want to just sit here like this man and write my epilogue.

And then it hit me! That's how I see my thesis: as a colourful sunset. I am deciding to keep the experience. We have to stop running, stop multi-thinking, stop stressing ourselves on the future. We have to close our eyes, breath, open them again and feel the now, feel the moment, contemplate the nature, the environment and see us in it. That's happiness.

“Y ahora me despido, para pensar en otras cosas”

— Maxfred Max-Neef, La dimensión perdida

6.5 REFERENCES

- Alkire S (2002) *Valuing Freedoms: Sen's Capability Approach and Poverty Reduction*. Oxford University Press, Oxford
- Ariely D (2009) *Predictably Irrational: The Hidden Forces That Shape Our Decisions*. HarperCollins
- Aristotle (2002) *Nicomachean Ethics*. Focus Publishing, Indianapolis
- Ball P (2004) *Critical mass: How one thing leads to another*. William Heinemann, London
- Barabási A-L (2002) *Linked: The New Science of Networks*. Perseus Publishing, Cambridge, Massachusetts
- Batty M (2017) Cities in disequilibrium. In: Johnson J, Nowak A, Ormerod P, et al. (eds) *Non-Equilibrium social science and policy: Introduction and Essays on New and Changing Paradigms in Socio-Economic Thinking*. Springer Open, Cham, Switzerland, pp 81–96
- Belil M, Borja J, Corti M (2012) Sobre el título. In: Belil M, Borja J, Corti M (eds) *Ciudades, una ecuación imposible*. Icaria editorial, s.a., Barcelona
- Box GEP, Draper NR (1987) *Empirical Model-Building and Response Surfaces*. Wiley, New York
- Brandi C (2015) Safeguarding the earth system as a priority for sustainable development and global ethics: the need for an earth system SDG. *J Glob Ethics* 11:32–36. doi: 10.1080/17449626.2015.1006791
- Brundtland GH (1987) *Our common future*. Report of the World Commission on Environment and Development. Oxford University Press, Oxford
- Burns JH (1989) Bentham and Blackstone: A Lifetime's Dialectic. *Utilitas* 1:22–40. doi: 10.1017/S0953820800000042
- Calvino I (1972) *Le città invisibili*. Giulio Einaudi Editore, Turin
- Diamantidis PH, Kotler S (2012) *Abundance: The future is better than you think*. Free Press, New York
- Diamond J (2005) *Collapse*. Viking, Penguin Group, New York
- Fowler JH, Christakis NA (2008) Dynamic spread of happiness in a large social network: longitudinal analysis over 20 years in the Framingham Heart Study. *BMJ* 337:a2338–a2338. doi: 10.1136/bmj.a2338
- Harari YN (2011) *Sapiens: A Brief History of Humankind*. Vintage, London
- Harari YN (2016) *Homo Deus: A Brief History of Tomorrow*. Harvill Secker, London
- Huxley A (1932) *Brave New World*. Chatto & Windus, London
- Jacobs J (1961) *The death and life of great American cities*. Vintage Books, Toronto
- Kagan C, Burton MH (2018) Putting the 'Social' into Sustainability Science. In: W. LF (ed) *Handbook of Sustainability Science and Research*. Springer, Cham, pp 285–298
- Kahneman D (2006) Would You Be Happier If You Were Richer? A Focusing Illusion. *Science* (80-) 312:1908–1910. doi: 10.1126/science.1129688
- Kahneman D (2011) *Thinking fast and Slow*. Farrar, Straus and Giroux, New York
- Layard R (2005) *La felicidad. Lecciones de una nueva ciencia*. Tauros, Madrid
- Lazer D, Pentland A, Adamic LA, et al (2009) Social science. Computational social science. *Science* (80-) 323:721–3. doi: 10.1126/science.1167742
- Lyman Tower S (2005) The Necessity of Utopian Thinking: A cross-national perspective. In: Rusen J, Fehr M, Rieger TW (eds) *Thinking Utopia: Steps into other worlds*. Berghahn Books, New York, pp 1–14
- Max-Neef MA (2005) Foundations of transdisciplinarity. *Ecol Econ* 53:5–16. doi: 10.1016/j.ecolecon.2005.01.014
- Nietzsche F (1966) *Thus spoke Zarathustra*. Viking Press, New York

- Nussbaum MC (2000) *Women and human development: The capabilities approach*. Cambridge University Press, Cambridge
- O'Neil C (2016) *Weapons of Math Destruction*. Crown, New York
- Orrell D (2010) *Economyths: How the science of complex systems is transforming economic thought*. Icon Books Ltd, London
- Orrell D (2007) *The Future of Everything: The Science of Prediction*. Thunder's Mouth Press, New York
- Orwell G (1949) 1984. Secker & Warburg, London
- Papachristou IA, Rosas-Casals M (2019) Cities and quality of life. Quantitative modeling of the emergence of the happiness field in urban studies. *Cities* 88:191–208. doi: 10.1016/j.cities.2018.10.012
- Pentland A (2014) *Social Physics*. Penguin Books, New York
- Polanyi K (1944) *The Great Transformation*. Farrar & Rinehart, New York
- Press G (2019) Deep Learning Pioneer Yoshua Bengio Says AI Is Not Magic And Intel AI Experts Explain Why And How. In: *Forbes*. <https://www.forbes.com/sites/gilpress/2019/09/20/deep-learning-pioneer-yoshua-bengio-says-ai-is-not-magic-and-intel-ai-experts-explain-why-and-how/>. Accessed 23 Sep 2019
- Ramadier T (2004) Transdisciplinarity and its challenges: the case of urban studies. *Futures* 36:423–439. doi: 10.1016/j.futures.2003.10.009
- Robeyns I (2005) The Capability Approach: a theoretical survey. *J Hum Dev* 6:93–117. doi: 10.1080/146498805200034266
- Scott R (1992) *Blade Runner*. Warner Bros., USA
- Sen A (1999) *Development as Freedom*. Oxford University Press, Oxford
- Sennett R (2006) The Open City. *Urban Age* 1–5
- Shaw B (1903) *Man and superman. A comedy and a philosophy*. The University Press, Cambridge, MA
- Sonetti G, Brown M, Naboni E (2019) About the Triggering of UN Sustainable Development Goals and Regenerative Sustainability in Higher Education. *Sustainability* 11:254. doi: 10.3390/su11010254
- Thatcher M (1993) *The Downing Street Years*. HarperCollins, London
- Tshitoyan V, Dagdelen J, Weston L, et al (2019) Unsupervised word embeddings capture latent knowledge from materials science literature. *Nature* 571:95–98. doi: 10.1038/s41586-019-1335-8
- UN-Habitat (2017) *Habitat III: New Urban Agenda*. Quito, Ecuador
- UNDP (2015a) *Sustainable development goals*. New York
- UNDP (2015b) *The Millennium Development Goals Report*. New York
- Veenhoven R (1984) *Conditions of Happiness*. Springer Netherlands, Dordrecht
- Wachowski A, Wachowski L (1999) *The Matrix*. Warner Bros., Village Roadshow Pictures, United States / Australia
- Watts DJ (2003) *Six Degrees*. Vintage Books, London
- Weiner E (2008) *The geography of Bliss*. Black Swan, London
- West GB (2017) *Scale: The universal laws of life and death in organisms, cities and companies*. Weidenfeld & Nicolson, London
- Zhao J, Wang T, Yatskar M, et al (2017) Men Also Like Shopping: Reducing Gender Bias Amplification using Corpus-level Constraints. In: *EMNLP 2017*

Appendix

A. URBAN STUDIES JOURNALS

Table A1: Journals in Urban Studies category according to 2015 classification.

Journal ID	Journal	First publication
1	Cities	1983
2	City and community	2002
3	Economic development quarterly	1987
4	Education and urban society	1968
5	Environment and urbanization	1989
6	EURE	1960
7	European planning studies	1993
8	European urban and regional studies	1994
9	Habitat international	1976
10	Housing policy debate	1990
11	Housing studies	1986
12	Housing theory and society	1984
13	International journal of urban and regional research	1977
14	International regional science review	1975
15	Journal of architectural and planning research	1984
16	Journal of contemporary ethnography	1972
17	Journal of housing and the built environment	1986
18	Journal of housing economics	1991
19	Journal of planning education and research	1981
20	Journal of planning literature	1985
21	Journal of real estate finance and economics	1988
22	Journal of the American planning association	1935
23	Journal of urban affairs	1979
24	Journal of urban economics	1974
25	Journal of urban history	1974
26	Journal of urban planning and development	1956
27	Journal of urban technology	1992
28	Landscape and urban planning	1974
29	Open house international	1976
30	Real estate economics	1973
31	Regional science and urban economics	1971
32	Urban affairs review	1965
33	Urban design international	1996
34	Urban education	1965
35	Urban forestry and urban greening	2002
36	Urban geography	1980
37	Urban lawyer	1969
38	Urban policy and research	1982
39	Urban studies	1964

B. SURVEYS

B.1 QUESTIONS AND SATISFIERS

TABLE B1: Example of questions (and groups of questions) associated to satisfiers before being weighted into needs.

Satisfiers	Groups of questions	Questions	Response range
Food, shelter, vital ecological services, healthcare, rest	Caloric intake, access to clean air, water, facilities	Are you satisfied with the quality of water in your area?	1 (no) - 5 (a lot)
		Are you satisfied with the quality of air in your area?	1 (no) - 5 (a lot)
		How satisfied are you of the sanitation facilities in your area?	1 (no) - 5 (a lot)
		How satisfied are you of the green spaces in your area?	1 (no) - 5 (a lot)
		How satisfied are you of the pedestrian areas in your area?	1 (no) - 5 (a lot)
		How satisfied are of the noise in your area?	1 (no) - 5 (a lot)
	Access to health care	How satisfied are you of the traffic in your area?	1 (no) - 5 (a lot)
		How satisfied are you with your health?	1 (no) - 5 (a lot)
		Do you have any long-term disabilities, health/mental problems?	Yes/No
		If yes does the long-term disability restrict your activities?	Yes/No
Nurturing of children, pregnant women	Maternity leave/child care	Do you have access to public or private health care?	Yes/No
		If yes, how satisfied are you of your health care?	1 (no) - 5 (a lot)
Transmission of the culture	Family provision for care	Do you have in charge children from 0 to 14 years old?	Yes/No
		Time dedicated to the education of children	1 (no) - 5 (a lot)
Homemaking	Household and child care allocation within the household	Do you think that the time you dedicate to your children's education is adequate?	Yes/No
		Do you own your home?	Yes/No
		Do you believe that your living environment (house / apartment) favours the feeling of home?	Yes/No
Enforced predictable rules of conduct		Do you feel "at home" when you go home?	Yes/No
		Do you thing that the existent rules and leys for your safety are sufficient? / Do you feel safe at your area?	1 (no) - 5 (a lot)
Safety from violence at home and in public	Interpersonal violence experiences	Have you ever experienced violence in you familiar environment?	Yes/ No
Security of subsistence into the future		Do you think you can make plans for the future?	Yes/ No
Maintain safe distance from crossing critical ecological thresholds	Environmental practices	Do you: recycle, save energy, don't spare water, share your car, share your apartment, use the bicycle, prefer walking to the destinations or use the public transportation?	Yes/ No
Stewardship of nature to ensure subsistence into the future			Yes/ No
Care for the sick and elderly	Who provides care for aged parents etc. / in case of acute, chronic illness	Do you provide care for aged parents/ family or to somebody with a chronic illness?	Yes/ No
Being able to have attachments to things and persons outside ourselves	Level of attachment to significant others	Do you have or planning to form a family?	Yes/ No
		How much do you depend on your family?	1(no) - 5 (a lot)
		Do you have friends?	Yes/ No

		How much do you depend on your friends?	1(no) - 5 (a lot)
Solidarity, respect, tolerance, generosity, passion, receptiveness, ...		How often do you experience compassion, calmness, forgiveness, contentment, generosity, respect, passion, tolerance, solidarity, receptiveness?	1 (occasionally) - 5 (really often)
		How often do you experience selfishness, jealousy, fear, worry, loneliness, anger, stress?	1 (occasionally) - 5 (really often)
		Which of the above do you think that may change in a different urban environment?	
Access to information	Newspaper, radio, TV, internet, usage for news information	How often do you check the news on the newspaper, radio, television, and the internet?	1 (no access) - 5 (continuously)
Intuition and rationality	Education	What is your education level?	no studies - doctoral
To act meaningfully in the world	Volunteering, association memberships	Do you or have you ever worked as a volunteer?	Yes/ No
		Do you participate to any association?	Yes/ No
		Are you a member in any social group?	Yes/ No
Contribute to and have some control over political, community and social life		Do you contribute to and have some control over political, community and social life in your area?	Yes/ No
Being heard		Do you express your opinion or speak publically?	Yes/ No
Meaningful employment		Do you consider your job meaningful?	Yes/ No
Citizenship		Do you participate to the local assemblies of your neighbourhood?	Yes/ No
		Do you vote at the elections?	Yes/ No
Recreation, relaxation, tranquillity, access to nature, travel	Time use, activities pursued, money spent	How satisfied are you of your free time?	1(no) - 5 (a lot)
		How many hours do you work, spend with family/friends, dedicate to yourself and dedicate to commuting?	0 - >8h
		How happy are you with your time distribution?	1(no) - 5 (a lot)
Play, imagination, inventiveness, artistic expression	Free time use	With what frequency do you: go out, go to an excursion to the nature, go to spiritual or religious celebrations, watch TV, use internet/ computer at home, participate to an artistic activity, do sports, go to the cinema, see your friends, go to a museum, concert, play music, writing, drawing, sculpture?	1 (never) - 5 (every day)
	Sense of play in work, etc.	Do you consider your time spent to work as creative?	Yes/ No
Status, recognition, sense of belonging, differentiation, sense of place	Major statuses, sense of "place"	Specify you relationship with the area	Live there, lived there, live close, work there, visit, etc.
		Specify your gender, age, type of occupation, salary per month.	
		How satisfied are you of your life, work, money, the place you live, family life, social life, social status?	1 (no) - 5 (a lot)
		Do you feel like forming part of the place you live?	Yes/ No
		Do you think that with the money you earn you would live better in a different part of the city?	Yes/ No
Being able to live one's own life and nobody else's.	Personal freedoms in various social contexts (family, work, religion, etc.)	Do you feel free as a person?	Yes/ No
Mobility		Is the connection with work satisfying?	Yes/ No
Engaging in transcendent experiences		How spiritual do you consider yourself?	1 (no) - 5 (a lot)

	Spiritual/ transcendent experiences spiritual organization membership	How often do you meditate/ pray?	1 (no) - 5 (a lot)
Access to nature		Do you have access to the nature?	Yes/ No
		Do you feel the need once in a while to visit nature?	1 (no) - 5 (a lot)
Participation in a community of faith	Time spent on spiritual activities	How much time do you spend in spiritual activities?	1 (1-2 times per year) - 5 (everyday)

B.2 QUESTIONS, PRIORITIES AND AXES OF INTERVENTION

Table B2: Gn's highest-ranked unsatisfied questions classified per priority and intervention axes.

Q code	Question	Q priority	Q priority value	Axis Priority
<i>Eliminate fear</i>				1
Gn69	27. How often do you experience - fear	A	1	
Gn86	28. Which of the above do you think that may change in a different urban environment? - fear	A	1	
<i>Promote free-time activities and improve time distribution</i>				2.25
Gn112	34. Choose the activities you usually do during your free time - go to the cinema	B	2	
Gn114	34. Choose the activities you usually do during your free time - go to a museum/exposition	B	2	
Gn115	34. Choose the activities you usually do during your free time - go to a concert	B	2	
Gn116	34. Choose the activities you usually do during your free time - play music	B	2	
Gn117	34. Choose the activities you usually do during your free time - write	B	2	
Gn118	34. Choose the activities you usually do during your free time - draw/paint	B	2	
Gn119	34. Choose the activities you usually do during your free time - sculpture	B	2	
Gn110	33. In a scale from 1 to 5, how happy are you with your time distribution?	D	4	
<i>Increase caring feelings</i>				2.89
Gn82	28. Which of the above do you think that may change in a different urban environment? - solidarity	A	1	
Gn88	28. Which of the above do you think that may change in a different urban environment? - loneliness	B	2	
Gn81	28. Which of the above do you think that may change in a different urban environment? - tolerance	B	2	
Gn59	27. How often do you experience - forgiveness	C	3	
Gn74	28. Which of the above do you think that may change in a different urban environment? - compassion	C	3	
Gn76	28. Which of the above do you think that may change in a different urban environment? - forgiveness	C	3	
Gn77	28. Which of the above do you think that may change in a different urban environment? - contentment	D	4	

Gn79	28. Which of the above do you think that may change in a different urban environment? - respect	D	4	
Gn89	28. Which of the above do you think that may change in a different urban environment? - anger	D	4	
Promote sharing/ Sustainable way of living				3
Gn47	22. Do you share your car (with your friends/ family, through car-sharing platforms, etc.)?	C	3	
Gn48	22. Do you share your apartment?	C	3	
Eliminate stress				3
Gn73	27. How often do you experience - stress	C	3	
Gn90	28. Which of the above do you think that may change in a different urban environment? - stress	C	3	
Eliminate worry				3
Gn70	27. How often do you experience - worry	C	3	
Gn87	28. Which of the above do you think that may change in a different urban environment? - worry	C	3	
Facilitate connection with nature and inner self				3.75
Gn19	8. With what frequency - go to religious or spiritual celebrations?	C	3	
Gn128	- How much time do you spend in spiritual activities?	C	3	
Gn57	27. How often do you experience - compassion	D	4	
Gn58	27. How often do you experience - calmness	D	4	
Gn75	28. Which of the above do you think that may change in a different urban environment? - calmness	D	4	
Gn124	39. In a scale from 1 to 5, - How spiritual do you consider yourself?	D	4	
Gn125	39. In a scale from 1 to 5, - How often do you meditate/ pray?	D	4	
Gn126	39. In a scale from 1 to 5, - Do you have access to the nature?	D	4	
Age				4
Gn4	4. Specify your age	D	4	
Improve urban life quality				4
Gn24	9. How satisfied are you of the bellow in Gracia? - water quality	D	4	
Gn25	9. How satisfied are you of the bellow in Gracia? - air quality	D	4	
Gn26	9. How satisfied are you of the bellow in Gracia? - sanitation facilities	D	4	
Gn27	9. How satisfied are you of the bellow in Gracia? - green spaces	D	4	
Gn29	9. How satisfied are you of the bellow in Gracia? - noise	D	4	
Gn30	9. How satisfied are you of the bellow in Gracia? - traffic	D	4	
Gn38	17. Home ownership	D	4	
Diminish dependence on others				4
Gn55	26. In a scale from 1 (little) to 5 (a lot), how much do you depend on your - family?	D	4	
Gn56	26. In a scale from 1 (little) to 5 (a lot), how much do you depend on your - friends?	D	4	
Responsibilities/ Having children				4
Gn35	14. Do you have in charge children from 0 to 14 years old?	D	4	
Improve civic commitment				4

Gn99	31. Which of the following are true about you? - Do you contribute to and have some control over political, community and social life in Gracia's neighborhood?	D	4	
Gn102	31. Which of the following are true about you? - Do you participate to the local assemblies of your neighborhood?	D	4	

Table B3: Vs's highest-ranked unsatisfied questions classified per priority and intervention axes.

Q code	Question	Q priority	Q priority values	Axis priority
Encourage perception of inclusiveness				1
Vs92	31. How would you describe citizen participation according to Arnstein ladder?	A	1	
Vs93	32. Which level of the previously mentioned do you consider ideal?	A	1	
Promote free-time activities and improve time distribution				2.6
Vs114	34. Choose the activities you usually do during your free time - go to the cinema	B	2	
Vs116	34. Choose the activities you usually do during your free time - go to a museum/exposition	B	2	
Vs117	34. Choose the activities you usually do during your free time - go to a concert	B	2	
Vs118	34. Choose the activities you usually do during your free time - play music	B	2	
Vs119	34. Choose the activities you usually do during your free time - write	B	2	
Vs120	34. Choose the activities you usually do during your free time - draw/paint	B	2	
Vs13	8. How satisfied are you of the following? - your free time	C	3	
Vs24	9. With what frequency do you participate to an artistic activity?	C	3	
Vs19	9. With what frequency do you go out (cinema, restaurants, bars, etc.)?	D	4	
Vs112	36. In a scale from 1 to 5, how happy are you with your time distribution?	D	4	
Promote sharing/ Sustainable way of living				3
Vs52	27. Do you share your car (with your friends/ family, through car-sharing platforms, etc.)?	C	3	
Vs53	27. Do you share your apartment?	C	3	
Vs54	27. Do you use the bicycle to transit?	C	3	
Eliminate worry				3
Vs72	29. How often do you experience – worry?	C	3	
Vs88	30. Which of the above do you think that may change in a different urban environment? - worry	C	3	
Eliminate stress				3
Vs75	29. How often do you experience – stress?	C	3	
Vs91	30. Which of the above do you think that may change in a different urban environment? - stress	C	3	
Be informed				3
Vs95	33. How often do you check the news on - the radio?	C	3	
Surviving				3
Vs123	40. Specify your monthly salary	C	3	
Improve civic commitment				3.25

Vs99	34. Which of the following are true about you? - Do you or have you ever worked as a volunteer?	B	2	
Vs100	34. Which of the following are true about you? - Do you participate to any association?	C	3	
Vs101	34. Which of the following are true about you? - Do you contribute to and have some control over political, community and social life in Vila de Gràcia neighbourhood?	D	4	
Vs104	34. Which of the following are true about you? - Do you participate to the local assemblies of your neighbourhood?	D	4	
Facilitate connection with nature and inner self				3.6
Vs20	9. With what frequency - do you go to an excursion in the nature?	C	3	
Vs21	9. With what frequency – do you assist to religious o spiritual celebrations?	C	3	
Vs127	43. In a scale from 1 to 5, - How spiritual do you consider yourself?	D	4	
Vs128	43. In a scale from 1 to 5, - How often do you meditate/ pray?	D	4	
Vs129	43. In a scale from 1 to 5, - Do you have access to the nature?	D	4	
???				4
Vs4	3. Specify your gender	D	4	
Vs5	4. Specify your year of birth	D	4	
Improve urban life quality				4
Vs26	10. How satisfied are you of the bellow in Virreina square - water quality (fount, tap water, drinking water quality, etc.)	D	4	
Vs29	10. How satisfied are you of the bellow in Virreina square – green spaces	D	4	
Vs31	10. How satisfied are you of the bellow in Virreina square – noise	D	4	
Vs44	22. Home ownership	D	4	
Eliminate selfishness				4
Vs69	29. How often do you experience - selfishness	D	4	
Vs85	30. Which of the above do you think that may change in a different urban environment? - selfishness	D	4	
Responsibilities/ Having children				4
Vs39	17. Do you have in charge children from 0 to 14 years old?	D	4	
Enhance sociability				4
Vs108	35. How many hours per day do you - spend with your friends?	D	4	

C. ARTICLES AND OTHER INDEXES OF QUALITY

C.1 ARTICLES

Published:

- Papachristou, I. A., Rosas Casals, M. (2019). Cities and quality of life. Quantitative modeling of the emergence of the happiness field in urban studies. *Cities*. 88:191 – 208 DOI: 10.1016/j.cities.2018.10.012
- Papachristou I. A., Rosas Casals M. (2019). Maximising the degree of user choice. A simple tool to measure current levels of quality of life in the urban environment. *Urban Planning*, 4(2):107-222 DOI: 10.17645/up.v4i2.2006
- Papachristou I.A. – Rosas-Casals M. (2016). Unveiling connectivity patterns of categories in complex systems: An application to human needs in urban places. *The Journal of Mathematical Sociology*. 40(4):219-238 DOI: 10.1080/0022250X.2016.1219855
- Papachristou I.A. – Rosas-Casals M. (2015). Making the neighbourhood a better place to live. A SWB approach implementing fundamental human needs. *On the W@terfront*, 40(2), pp. 31-50. <http://www.raco.cat/index.php/Waterfront/article/view/300217>

Under review:

- Papachristou I.A., Rosas-Casals M. (*under review*). From the neighbourhood to the square. Capturing (and comparing) perceptions on SWB from two different scales. <http://hdl.handle.net/2117/134898>
- Papachristou I.A., Katseniou E., Petropoulou C., Rosas-Casals M. (*under review*). Palabras sobre los refugiados: un análisis, mediante redes semánticas, de la construcción social de percepciones de los habitantes de Mitilene en función de los eco-paisajes vividos. <http://hdl.handle.net/2117/134897>

In preparation:

- Insights from the happiness studies field. Clustering options and concepts' dimensions.
- A way to activate the social grid: Experimenting with the public space of Barcelona.

C.2 BOOK CHAPTERS

- Papachristou I.A., Rosas-Casals M. (*accepted*). The many urban languages or why there is always a gap between bottom-up initiatives and top-down processes. *Resilient Cities Book Series* <https://www.springer.com/series/14171>

C.3 CONFERENCE PRESENTATIONS

- Papachristou I.-A., Katseniou E., Petropoulou C., Rosas-Casals M. (2015). Refugiados de ayer, refugiados de hoy: un análisis de percepciones desde la perspectiva de género en Mitilene utilizando redes complejas. Jornadas GRECS-GRACU: Género y producción del espacio. De la exclusión a la reivindicación del derecho a la ciudad, Barcelona, Nov. 25 - 27, 2015.
- Papachristou I.-A., Rosas-Casals M. (2015). The many urban languages or why there is always a gap between bottom-up initiatives and top-down processes. RESURBE 2 Conference, Bogotá, Sep. 17 - 20, 2015.

- Papachristou I.-A., Rosas-Casals M. (2015). Making the neighbourhood a better place to live. A SWB approach implementing fundamental human needs. Cities 2 Conference: Cities for XXIst century. Barcelona, Sep. 15 - 19, 2015.
- Papachristou I.-A., Rosas-Casals M. (2015). An integrative methodology for the quality of life measurement in urban places based on the accomplishment of human needs. UN-Habitat Future of Places III Conference, Stockholm, Jun. 29 – Jul. 1, 2015.
- Papachristou I.-A., Pich-Aguilera M. (2014). "El ciudadano importa", Barcelona City Sessions, World Sustainable Building Conference, Oct. 28 - 30, 2014.

C.4 OTHER INDEXES OF QUALITY

C.3.1 LECTURES

- Introduction to the Human Scale Development Paradigm, (17/06/2015). Sustainability Measurement and Modeling Lab., Escola d'Enginyeria de Terrassa (EET), Terrassa (Spain).
- Papachristou I.-A., (2015). Jornada de seguimiento. UPC Campus Nord, Barcelona (Spain).
- Introduction to Gephi and NodeXL, (21/07/2014). UNESCO Chair of Sustainability, UPC, Terrassa (Spain).
- Dynamic Networks in Gephi, (15/01/2014). Sustainability Measurement and Modeling Lab., Escola d'Enginyeria de Terrassa (EET), Terrassa (Spain).
- Quantification of the perception of happiness for the urban context. Analysis of the methodology, (08/10/2012). Escola Tècnica Superior d'Arquitectura del Vallès (ETSAV), Sant Cugat de Valles (Spain).

C.3.2 MEDIA

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

C.3.3 OTHER PUBLICATIONS

- Papachristou I.-A., (2013). The social media in the economy. 19th Economia Student Competition.

