The Potential of Tracking Technologies for Research in the Social Sciences

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Context

- The second geographical revolution
  - The first revolution in mapping and navigation led to the age of great discoveries (15th and 16th centuries).
  - Remote Sensing, Geographic Information Systems (GIS), Tracking Technologies (Smart Phones, GPS), Google Earth maps, etc. are changing our world, but also creating huge opportunities for research that will change the way we understand our world.

Traditional Methods for Data Collection on Human Spatial Activity

- Tracking / Following / Stalking
- Observation: high buildings, CCTV cameras, etc.
- Evidence provided by the research subject themselves (Questionnaires, Time-Space Diaries). This is especially challenging regarding Elderly and cognitive impaired people…

Where did you visit?

Available Tracking Technologies

- Land Based Tracking Systems
  - Long Range Radio Frequency (e.g. GSM)
    - Cell-Tower Identification
    - Cellular triangulation (e.g.) TDOA, AOA
  - Short Range Radio Frequency
    - RFID (Radio-Frequency Identification) Tags and Reader (6m-100m)
    - Bluetooth Beacons and Scanners (mobile phones for example)
    - UbiTags: Ultra Wide Band (UWB RFID), TDOA & AOA, Accuracy of 15cm in 3D
- GPS
  - NAVSTAR (Navigation System with Timing and Ranging)
  - Glonass
  - Beidou
  - Gallileo
- Hybrid Systems (= Smartphones)

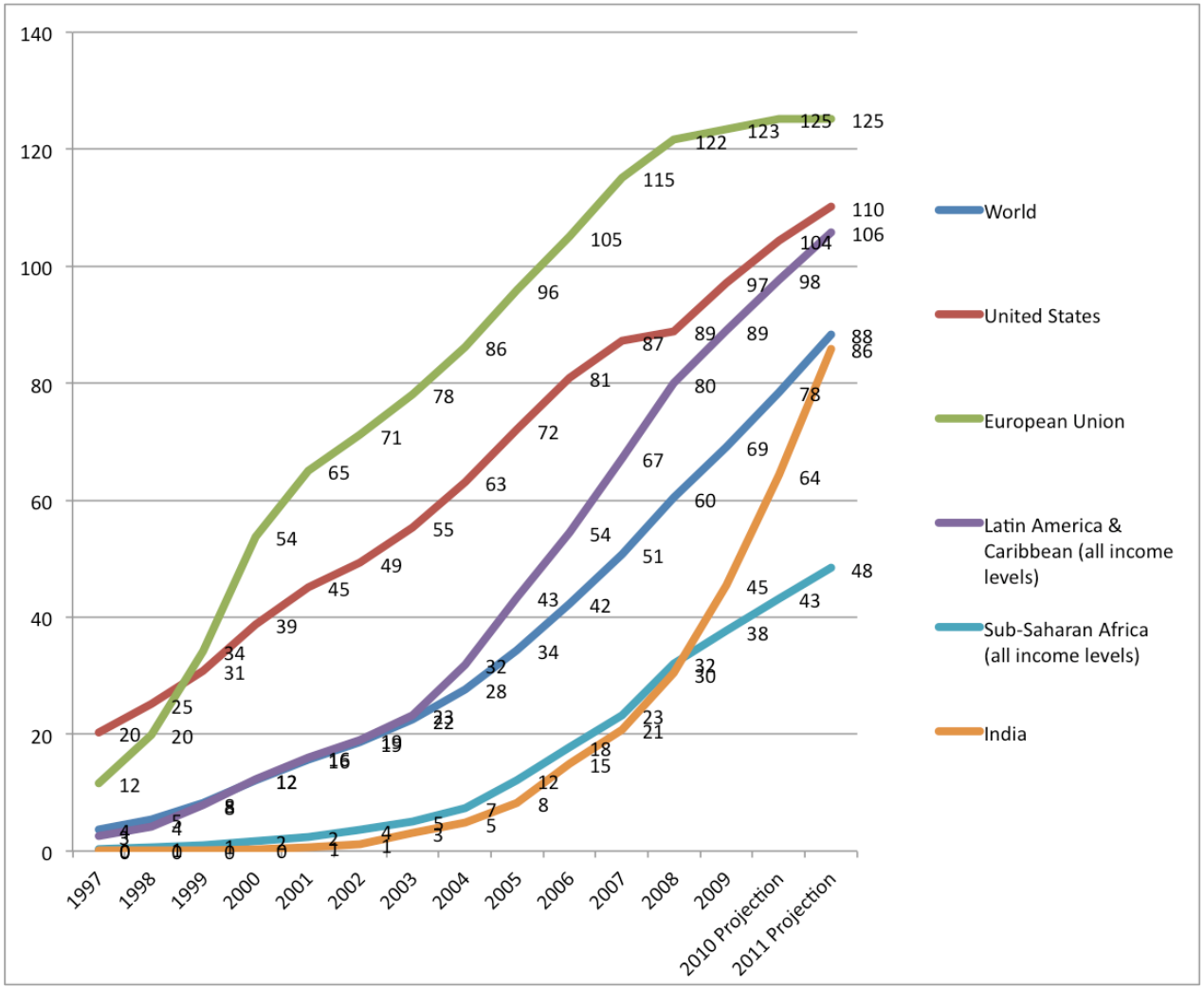
Introduction the Cellular Revolution

- 1983 – Motorola introduces the commercial use of cellular phones

Dr Martin Cooper

- A decade later… cellular phones are becoming widely available.

Mobile Phones Penetration

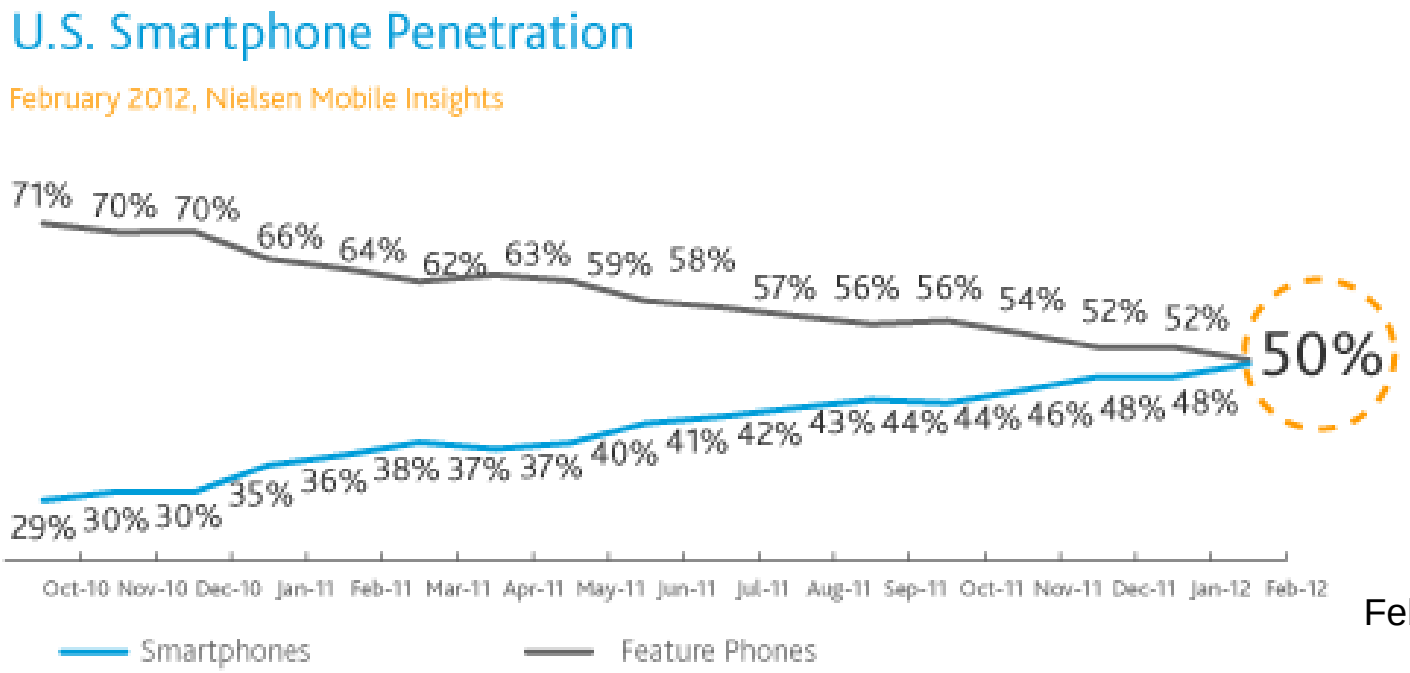


- Today it's more than a simple phone... It's an electronic diary, entertainment platform, a navigation aid, etc... some of us even take it with us anywhere...

Motorola's first commercial cell phone cost $3,995

- The technology have huge impacts on different aspects of life.

Smartphone Revolution



Oct 2010

Feb 2012

Read as: During February 2012, 50 percent of US mobile subscribers owned a smartphone

Source: Nielsen

nielsen

Smartphones - Main Features

- 3rd generation (and above) mobile telecommunication
- A touch-screen and/or a physical keyboard
- Operation System (Android, iOS, Symbian, Windows Phone, Blackberry OS)
- Media Player
- Browser, email, calendar (PDA)
- Camera
- Bluetooth technology
- GPS
- Wi-Fi
- Mobile internet (3G)

Location Technologies

Telecommunication - allows sending / receiving questionnaires and location

Inside Is A New Indoor-Location Platform That Uses Your Phone's Camera To Figure Where In The Mall You Are

Posted Feb 4, 2014 by Natasha Lomas (@riptari)

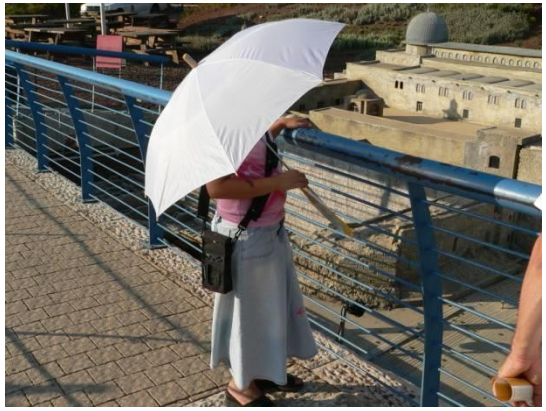
Inside is a new indoor positioning technology, being launched today in beta by Israeli startup Shopcloud, that claims to be able to locate a smartphone user to within a meter (or less) of where they're wandering under cover.

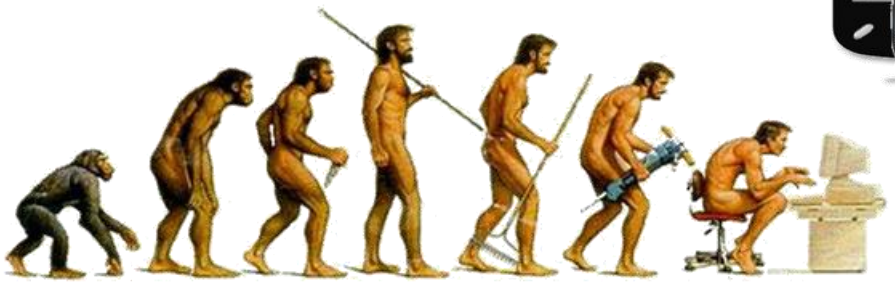
CrunchBase

ShopCloud

FOUNDED	TOTAL FUNDING
December 2012	Not available

Progress of Tracking Hardware





Types of Analysis

- Descriptive Cartography
- Descriptive Statistics
- Statistical Models
- Agent Based Models
- Sequence Alignment

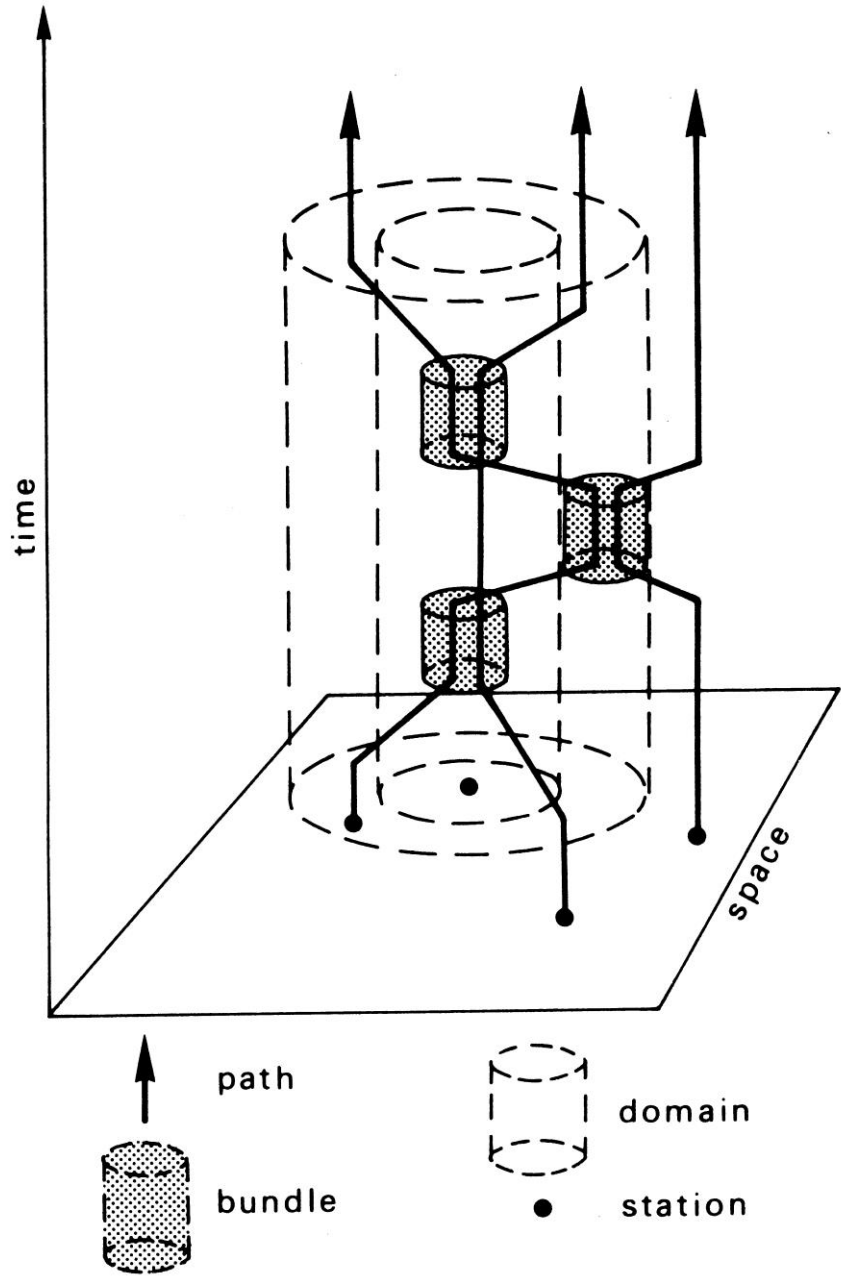
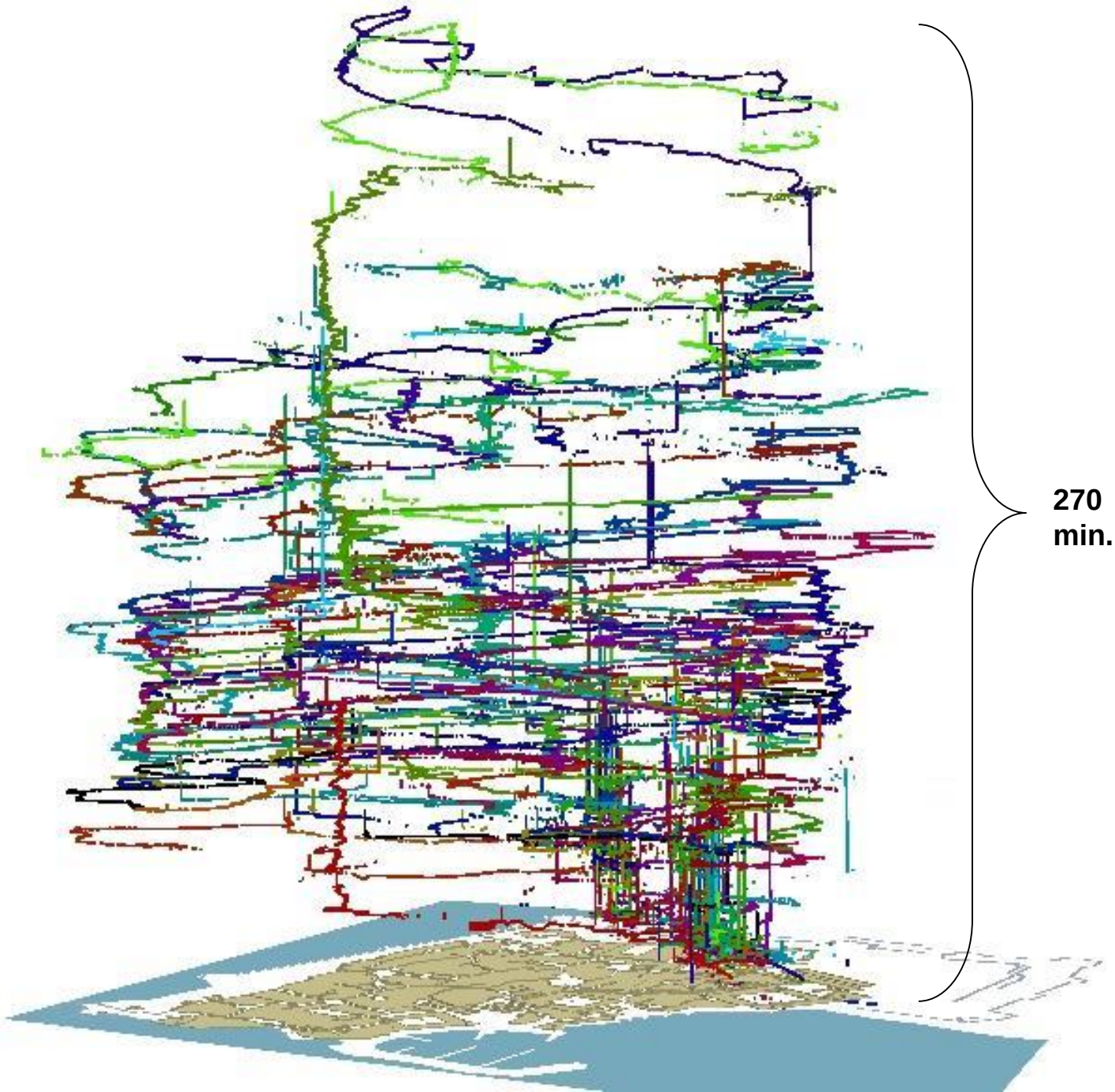


FIGURE 1.4.4 *The notation of time–geography (after Hägerstrand)*


270
min.

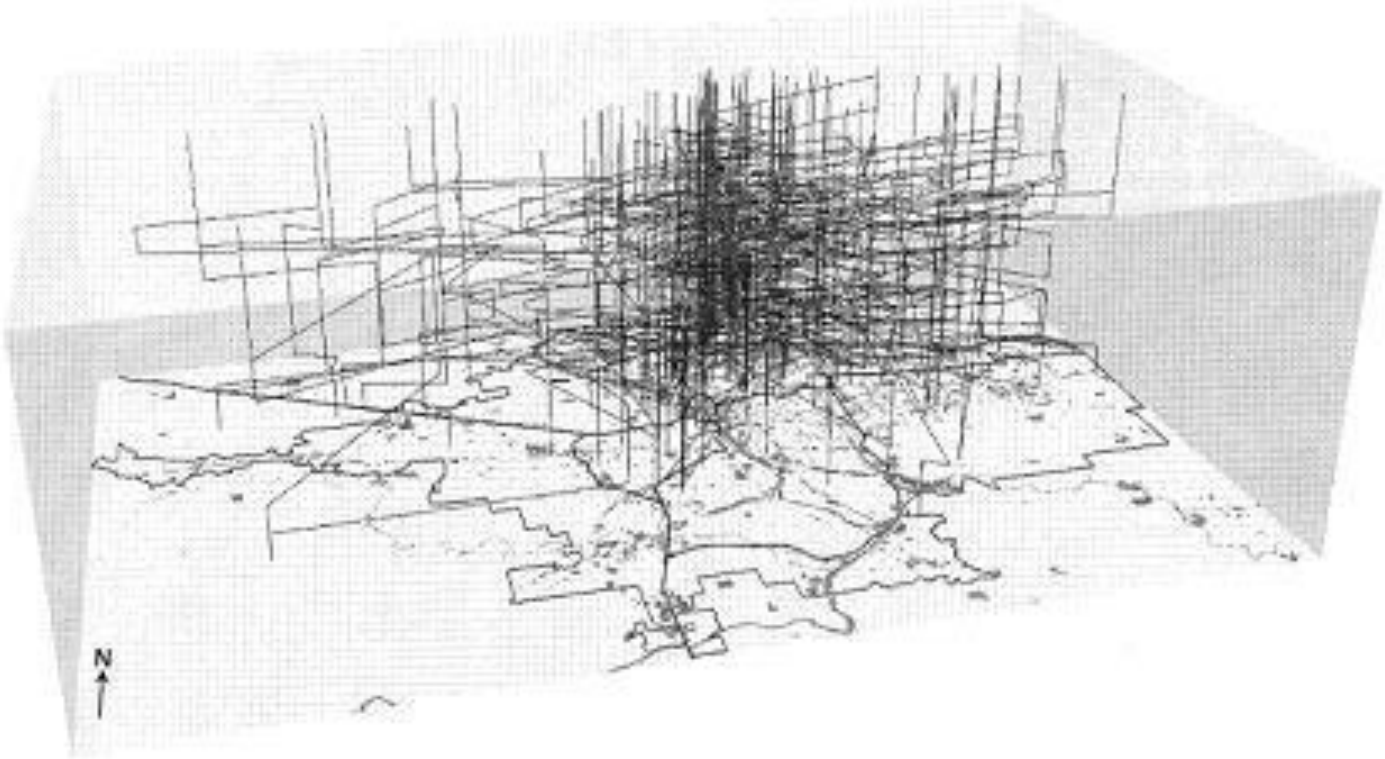


Fig. 6. Space-time aquarium with the space-time paths of African Americans, Hispanics and Asian American in the subsample.

- There is a need for aggregation.
- But in the existing statistical methods, there is a problem of aggregation of the time-space data without losing the sequential element.

ClustalG - Sequence Alignment

- In this research we have decided to implement ‘ClustalG’, a 'general' version of the ClustalX multiple sequence alignment program used for analysis of protein and nucleotide molecules. The ideas behind the main algorithm used were developed by Sankoff and Kruskal (1983).
- Was adapted to social science research in the end of the 1990’s (Abbott 1995; Wilson 1998).
- Its main contribution for geographic research is the ability to analyze SEQUENCES and thus the creation of typologies of spatial activity as one example [See: Shoval and Isaacson 2007 @ Annals of the Assoc. of American Geographers].

I Sequences of Time-Space Activity

Sequence one - AAABBBCCDEEEFF

Sequence two - AAAABCDDDEEF

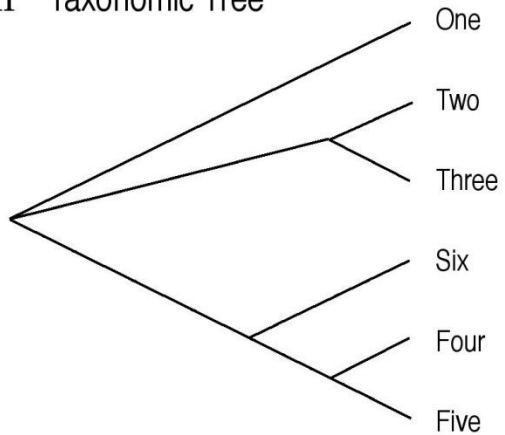
Sequence three - AABCCCDDDEEEFF

Sequence four - FFFEEEDDCCBBA

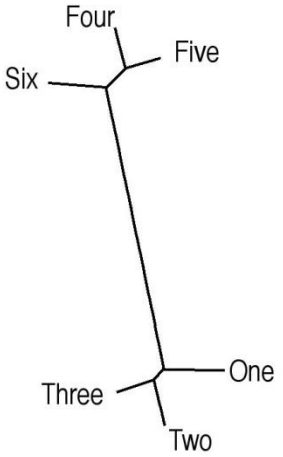
Sequence five - FFEEDDDDCCBBAA

Sequence six - FEEEDDCCBBBAAA

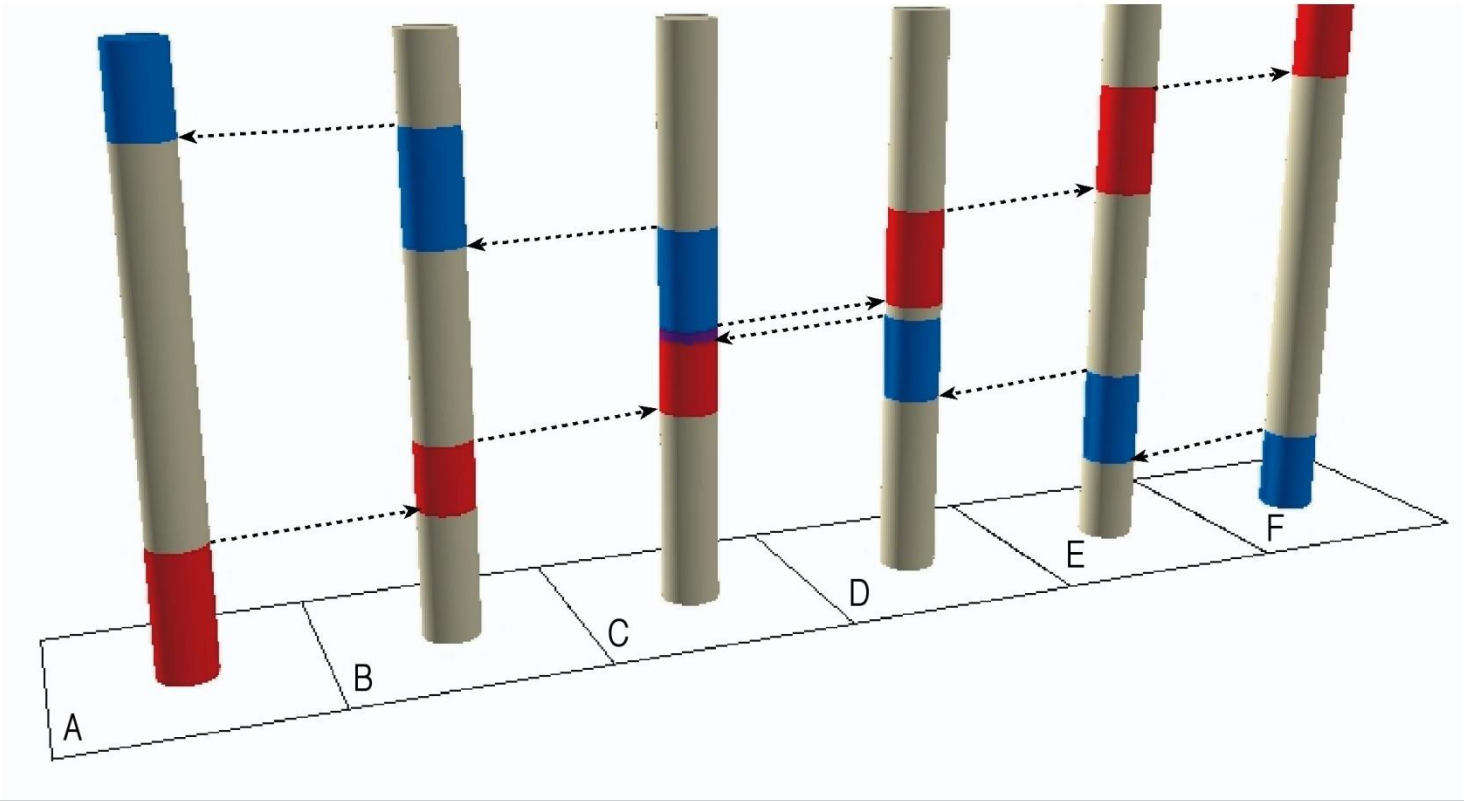
II Taxonomic Tree

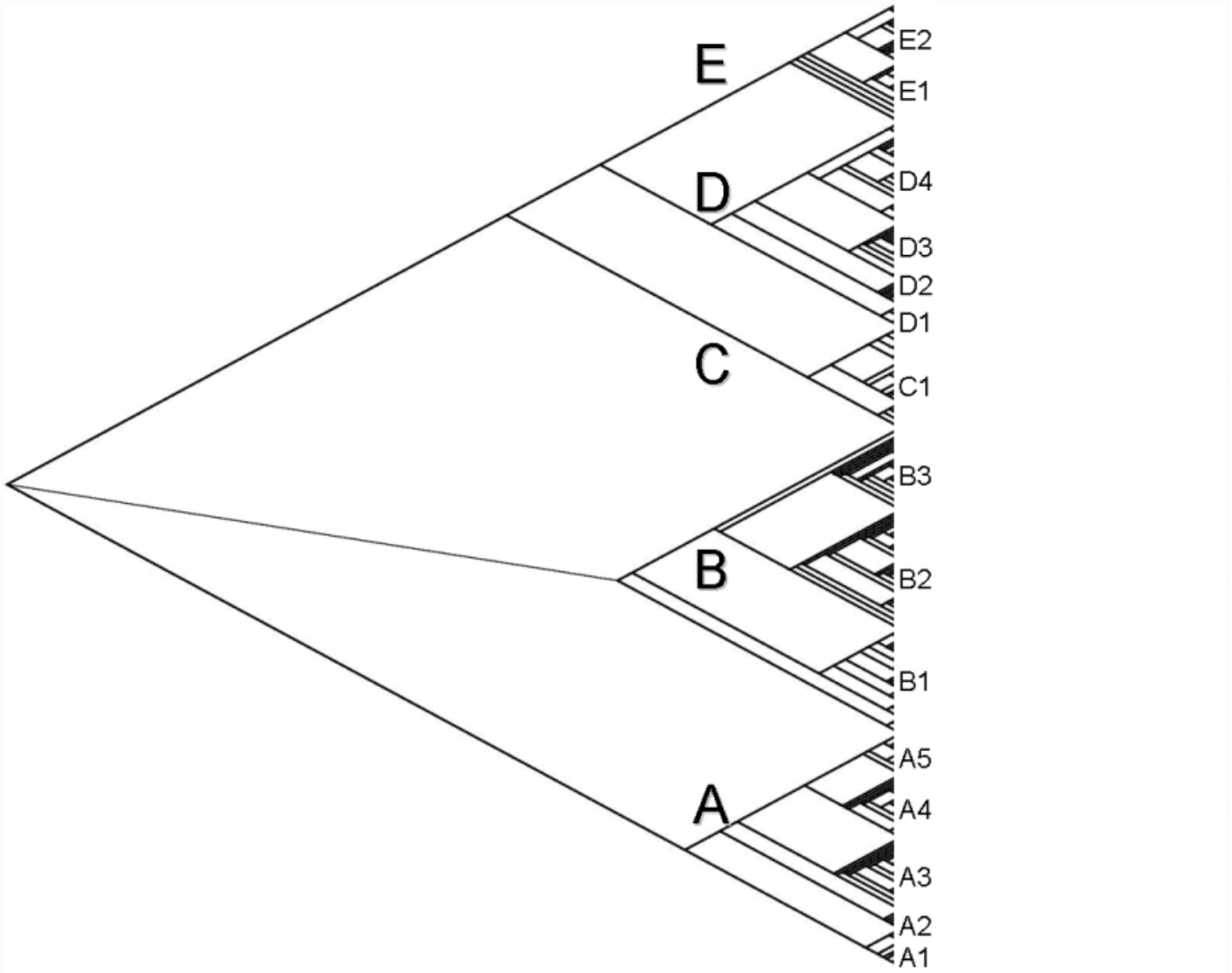


Unrooted Taxonomic Tree



III Graphic Display of the Sequence Alignment Results




E
D
C
B
A
E2
E1
D4
D3
D2
D1
C1
B3
B2
B1
A5
A4
A3
A2
A1

Progress in Software – Big Data Analysis

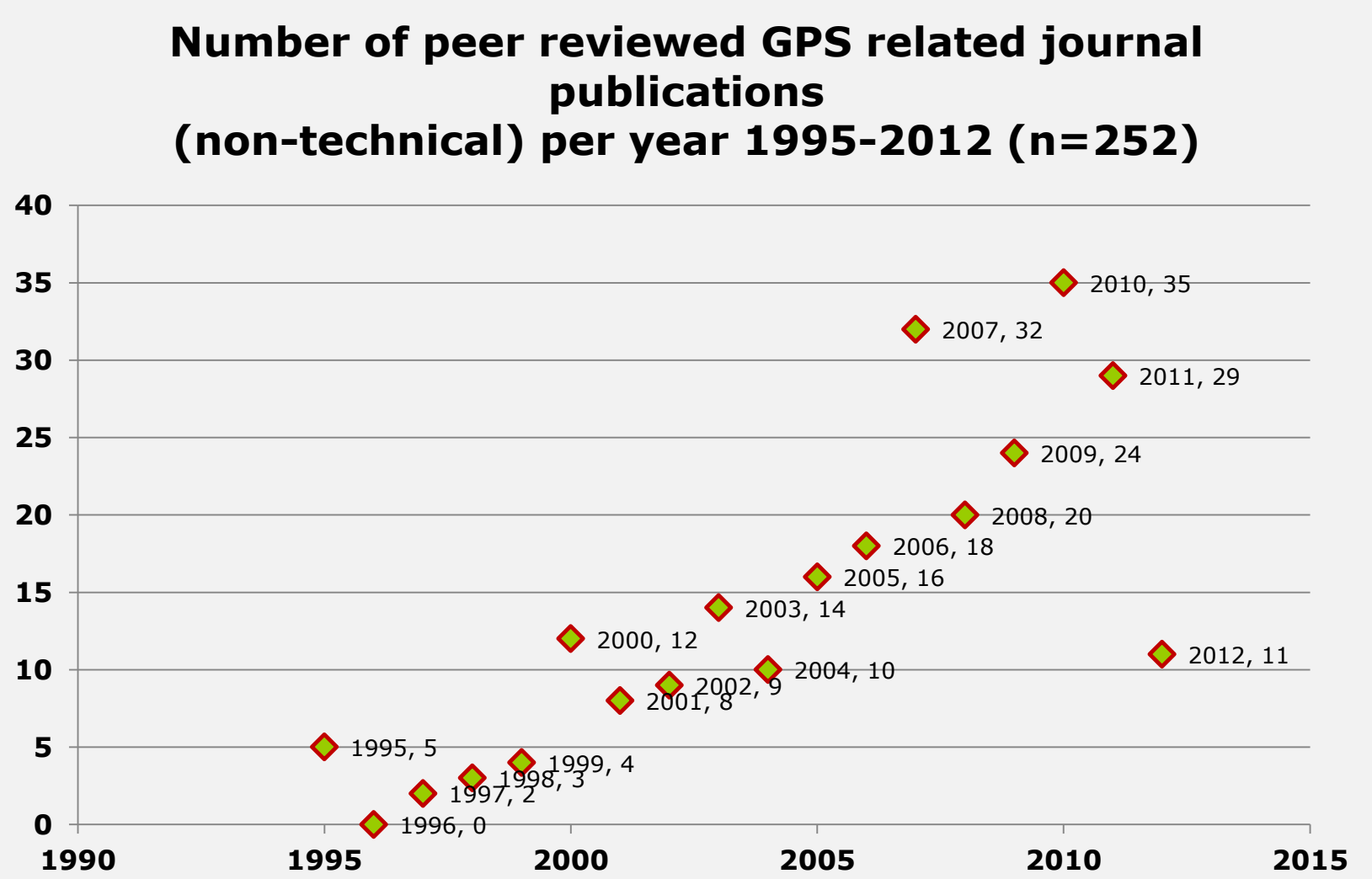
- Tracking a person every 1 second means collecting, storing and analyzing 3,600 points an hour, 86,400 points a day and 2,592,000 points a month.

That is a lot of data!

The figure below shows the morning walks during 28 days of tracking of the same participant that appeared in example 1. There are a total of 52,090 points presented in this map, this emphasize the importance of the analysis we provide to the raw collected data. Each point presents a location that was obtained by the GPS while the participant was located within the map's extent. The table below demonstrates the information that we are able to conclude from these GPS samples. Other parameters describing the walk can be calculated, such as the slope of the terrain the degree of variation in the walking speed and others.

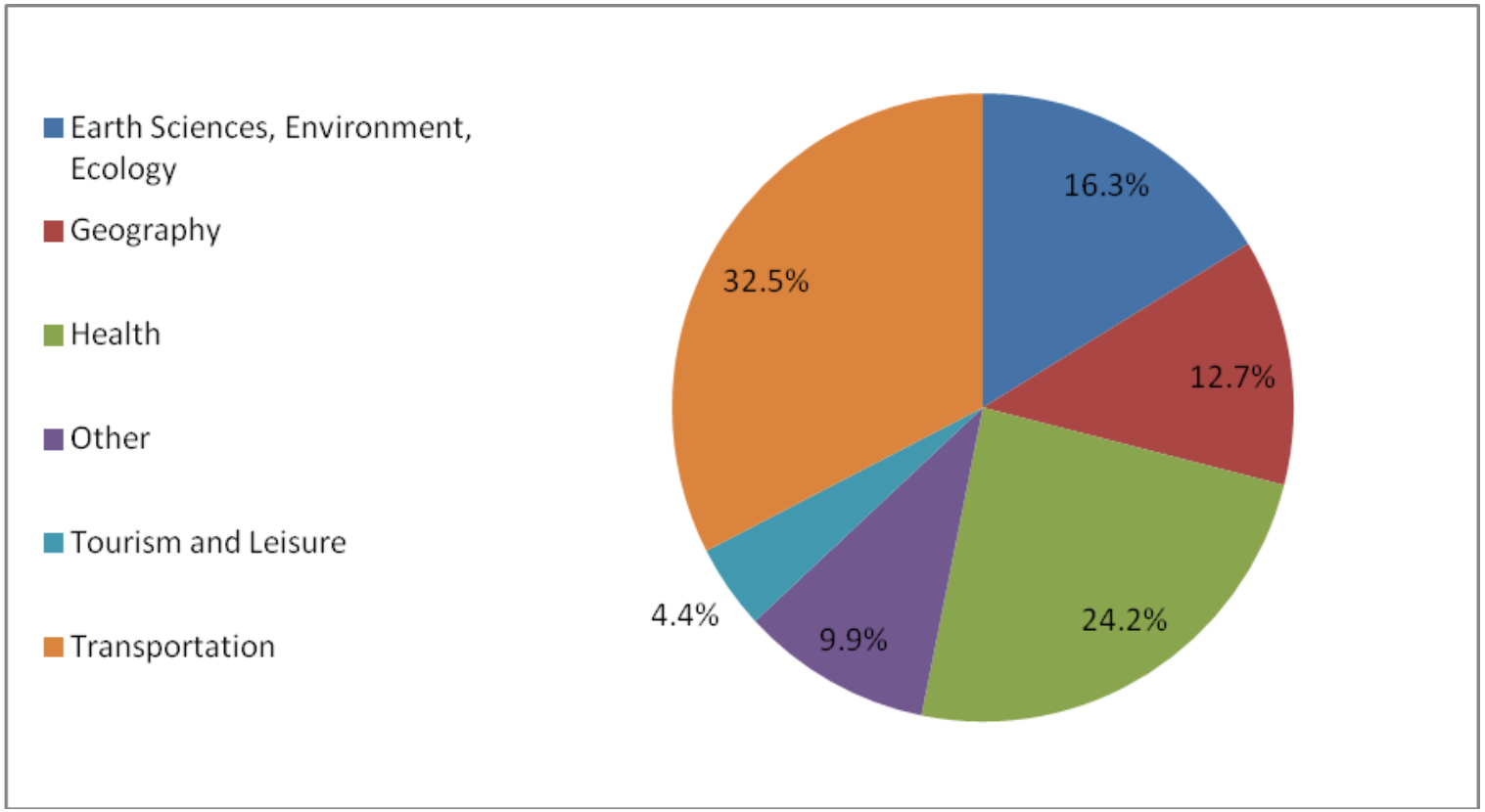
Track ID	Duration (min)	Length (km)	Speed (kmph)	Time	weekday
1005	12.07	1.04	5.16	30/04/2009 17:20	5
1006	46.40	4.73	6.11	01/05/2009 06:14	6
1013	51.23	4.89	5.72	02/05/2009 06:12	7
1014	45.13	4.86	6.46	03/05/2009 05:23	1
1024	54.45	5.55	6.12	04/05/2009 05:49	2
1025	43.13	4.69	6.53	05/05/2009 06:14	3
1033	44.67	4.65	6.25	06/05/2009 05:28	4
1036	45.62	4.75	6.24	07/05/2009 06:47	5
1037	50.53	5.11	6.07	08/05/2009 06:02	6
1038	23.22	2.33	6.02	09/05/2009 06:15	7
1043	42.53	4.67	6.59	10/05/2009 05:26	1
1050	47.53	5.30	6.69	11/05/2009 05:51	2
1053	47.43	4.95	6.27	12/05/2009 06:27	3
1061	43.98	4.55	6.21	14/05/2009 06:04	5
1062	52.12	5.13	5.90	15/05/2009 05:53	6
1063	48.07	5.00	6.25	16/05/2009 06:18	7
1064	47.40	4.86	6.16	17/05/2009 05:18	1
1068	46.93	4.93	6.30	18/05/2009 05:25	2
1073	48.15	4.98	6.21	19/05/2009 05:23	3
1081	47.78	5.01	6.29	20/05/2009 05:25	4
1089	49.65	5.04	6.09	21/05/2009 05:37	5
1098	48.47	5.00	6.19	22/05/2009 06:18	6
1104	42.28	4.37	6.20	23/05/2009 05:59	7
1107	43.07	4.57	6.36	24/05/2009 05:27	1
1110	42.35	4.38	6.20	25/05/2009 05:54	2
1111	42.20	4.62	6.56	26/05/2009 06:06	3
1114	47.70	4.98	6.26	27/05/2009 05:19	4
1123	51.00	5.19	6.11	28/05/2009 05:57	5
Average	**44.83**	**4.78**	**6.24**		

…Progress in Publications



Only first three months of 2012 were included

Breakdown of peer reviewed publications by main (thematic fields (n=252



Contents lists available at ScienceDirect

Geoforum

journal homepage: www.elsevier.com/locate/geoforum

Critical review

The shoemaker's son always goes barefoot: Implementations of GPS and other tracking technologies for geographic research ☆

Noam Shoval [a,*], Mei-Po Kwan [b], Kristian H. Reinau [c], Henrik Harder [c]

[a] Department of Geography, Hebrew University of Jerusalem, Israel
[b] Department of Geography and Geographic Information Science, University of Illinois at Urbana-Champaign, USA
[c] Department of Architecture, Design and Media Technology, University of Aalborg, Denmark

Implementation of Tracking Technologies in Tourism and Urban Research

- Enclosed environments: Theme Parks (Mini-Israel, PortAventura)
- Historic Cities (Acre, Heidelberg, Palermo)
- Complex and Multi-functional environments: World Cities (Hong Kong, Jerusalem).
- National Scale (Israel and Palestine):
  - Provides data on the regional and city level as well.

Routledge Advances in Tourism

EDITED BY STEPHEN PAGE, *University of Stirling, Scotland*

Tourism and Political Boundaries
Dallen J Timothy

Leisure and Tourism Landscapes
Social and Cultural Geographies
Cara Aitchison, Nicola E MacLeod and Stephen J Shaw

Tourism in the Age of Globalisation
Edited by Salah Wahab and Chris Cooper

Tourism and Gastronomy
Edited by Anne-Mette Hjalager and Greg Richards

New Perspectives in Caribbean Tourism
Edited by Marcella Daye, Donna Chambers and Sharma Roberts

The Advanced Econometrics of Tourism Demand
Haiyan Song, Stephen F. Witt and Gang Li

Tourism in China
Destination, Cultures and Communities
Edited by Chris Ryan and Gu Huimin

Sustainable Tourism Futures
Perspectives on Systems, Restructuring and Innovations
Edited by Stefan Gössling, C. Michael Hall, and David B. Weaver

Handbook of Tourist Behavior
Theory & Practice
Edited by Metin Kozak and Alain Decrop

Advances in Tourism Research
Edited by Metin Kozak, Luisa Andreu and Juergen Gnoth

Tourism Enterprises and Sustainable Development
International Perspectives on Responses to the Sustainability Agenda
Edited by David Leslie

Tourist Mobility and Advanced Tracking Technologies
Noam Shoval and Michal Isaacson

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Michal Isaacson

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Implementation of Tracking Technologies in Medical Research

- Cognitive decline ("Alzheimer's") and spatial activity of elderly people - SenTra (With University of Heidelberg).

- Objective functional measures of orthopedic procedures (with Hadassah University Hospital in Jerusalem).
- Estimation of Cumulative Walking Distance of Soldiers using GPS Devices – Research Related to Stress Fractures

- Neurology: Impact of Botulinum toxin (BOTOX) injections on outdoor activity of children with cerebral palsy (CP). (with Shaarei Tzedek & Hadassah University Hospitals in Jerusalem).

MEDICINE

Spatial Turn in Health Research

Douglas B. Richardson,[1] Nora D. Volkow,[2] Mei-Po Kwan,[3] Robert M. Kaplan,[4] Michael F. Goodchild,[5] Robert T. Croyle[6]

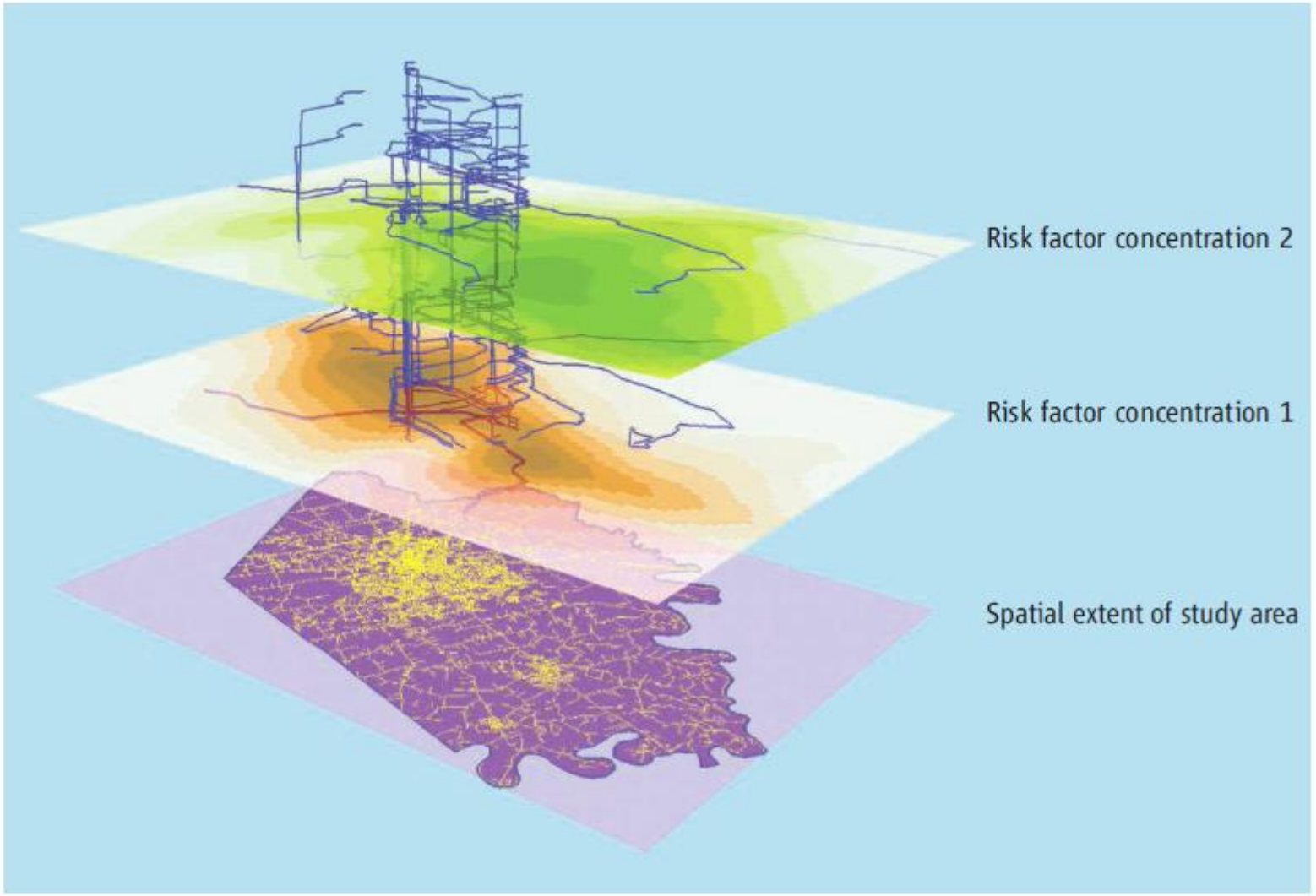
Developments in geographic science and technology can increase our understanding of disease prevalence, etiology, transmission, and treatment.

Spatial analysis using maps to associate geographic information with disease can be traced as far back as the 17th century. Today, recent developments and the widespread diffusion of geospatial data acquisition technologies are enabling creation of highly accurate spatial (and temporal) data relevant to health research. This has the potential to increase our understanding of the prevalence, etiology, transmission, and treatment of many diseases.

New approaches in geography and related fields, capitalizing on advances in technologies such as geographic information systems (GIS), the Global Positioning System (GPS), satellite remote sensing, and computer cartography, are often referred to

Science
AAAS

Spatial Turn in Health Research
Douglas B. Richardson *et al.*
Science **339**, 1390 (2013);
DOI: 10.1126/science.1232257



Exposure assessment with GPS/GIS data of individuals. Life paths of individuals collected with GPS/GIS methods can provide more accurate assessment of exposures to environmental or social risk factors when integrated with detailed GIS data about the spatial and temporal variations of these risk factors (*20*). Life paths of individuals are shown as trajectories that unfold along the vertical axis, which represents time; the bottom horizontal plane represents the spatial extent and transportation network of the study area. The green and orange horizontal planes illustrate the spatial distribution of risk factor concentrations (e.g., traffic-related air pollution, carcinogenic substances, liquor stores) for two time points.

Examples for sensors we can connect to smartphones

- Oxygen in Blood, Pulse and Strength of Pulse (in finger)

- Sugar Level in Blood

Examples for sensors we can connect to smartphones

- Blood Pressure

- Heart Monitor

The Use of Advanced Tracking Technologies for the Analysis of Mobility in Alzheimer's Disease and Related Cognitive Disorders - SenTra

Hebrew University

Noam Shoval
(Geography)

Gail Auslander
(Social Work: Gerontology)

Ruth Landau
(Social Work: Ethics)

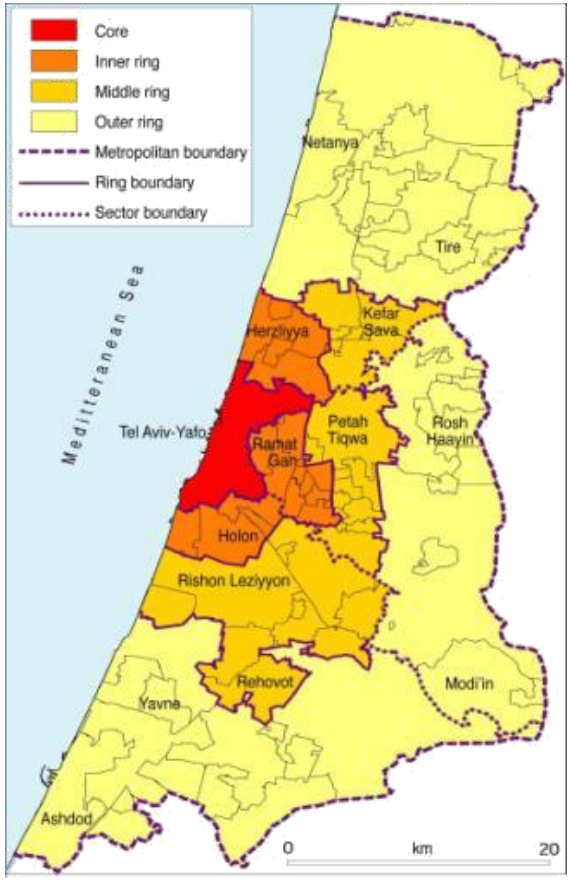
Jeremia Heinik – TAU
(Psychogeriatrics)

Univ. of Heidelberg

Hans-Werner Wahl
(Psychology: Gerontology)

Frank Oswald
(Environmental Psychology)

Tim Freytag
(Geography)



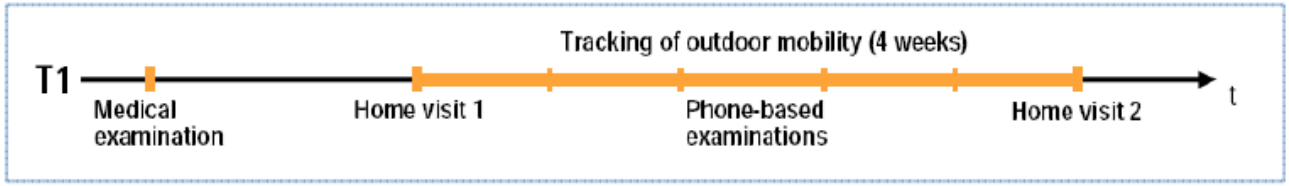
Tel-Aviv Metropolitan Region

Rhine-Neckar Metropolitan Region

Study Goals (Selected)

- **Determine whether mobility patterns of older adults vary according to their cognitive state. If so, what specific patterns in time and space occur?**
- Assess the relationship between mobility and quality of life among elders and their families
- Assess the potential of advanced tracking technologies to reduce stress and burden of families of elders with dementia
- Assess the potential of the technology in the diagnosis of dementia
- Examine the ethical implications of advanced tracking technologies

- Recruitment of participants from three groups in each country (Israel and Germany):
  - Healthy elders, Elders with Mild Cognitive Impairment (MCI), Elders with Mild Dementia (MD)



- Medical examination (first contact at memory clinic):
  - MCI and Dementia assessment
- Psycho-Social assessment (two home visits before / after tracking) :
  - e.g., demographics, housing, social network, perceived health, home/neighborhood attachment, mobility habits, psychological well being, depression, anxiety, technology evaluation, daily outdoor activity diary (see WP3).
- Examination of caregiver / partner (during home visits):
  - e.g., technology evaluation, autonomy allowance, perceive burden (see WP3).
- Tracking (4 weeks):
  - Digital assessment of outdoor mobility patterns with location kit.
- Phone-based examination (once a week during tracking period):
  - Daily activities, trouble shooting, and (in Germany) mood and technology evaluation.

- Procedure repeated for three years.

Table 1. Sample Description, sociodemographic measures

Variable	Total	HC	MCI	AD	Statistical Test
N	257	146	76	35	
Age (M, SD, Range)	72.9, 6.4, 59-91	72.5,6.1,61-91	72.9, 6.5,59-88	74.1,7.1,59-86	ns
Gender (n, %)					ns
Male	131 (51.0%)	73 (50%)	37 (48.7%)	21 (60%)	
Female	126 (49.0%)	73 (50%)	39 (51.3%)	14 (40%)	
Education (years)	(n=256)	(n=146)	(n=75)		*** (HC-MCI, HC-AD)
(M, SD, Range)	13.6,4.2,2-26	14.5,4.2,2-26	12.3,4.2,4-23	12.5,3.2,5-21	
No of persons in household (M, SD, Range)	1.8, 0.7,1-5	1.7,0.6,1-5	1.9,0.7,1-5	1.9,0.6,1-3	*
Car available (n, %)					Ns
Yes	188 (73.2%)	110 (75.3%)	55 (72.4%)	23 (65.7%)	
no	69 (26.9%)	36 (24.7%)	21 (27.6%)	12 (34.3%)	

Note. Statistical test for differences: F-test (means) and Chi-square-test (frequencies) with not significant: n.s., (*) $p < .10$; * $p < .05$; ** $p < .01$; *** $p < .001$.

Table 2. Sample Description, sociodemographic measures

Variable	Total	Germany	Israel	Statistical Test
N	257	157	100	
Age (M, SD, Range)	72.9, 6.4, 59-91	70.7, 4.9,59-84	76.3,6.8,62-91	***
Gender (n, %)				
Male	131 (51.0%)	90 (57.3%)	41 (41%)	*
Female	126 (49.0%)	67 (42.7%)	59 (59%)	
Education (years)	(n=256)		12.5,3.9,4-21	Ns
(M, SD, Range)	13.6,4.2,2-26	14.2, 4.2,2-26		
No of persons in household (M, SD, Range)	1.8, 0.7,1-5	1.8, 0.6,1-5	1.7,0.7,1-4	*
Car available (n, %)				***
yes	188 (73.2%)	136 (86.6%)	52 (52%)	
no	69 (26.9%)	21 (13.4%)	48 (48%)	

Note. Statistical test for differences: F-test (means) and Chi-square-test (frequencies) with not significant: n.s., (*) $p < .10$; * $p < .05$; ** $p < .01$; *** $p < .001$.

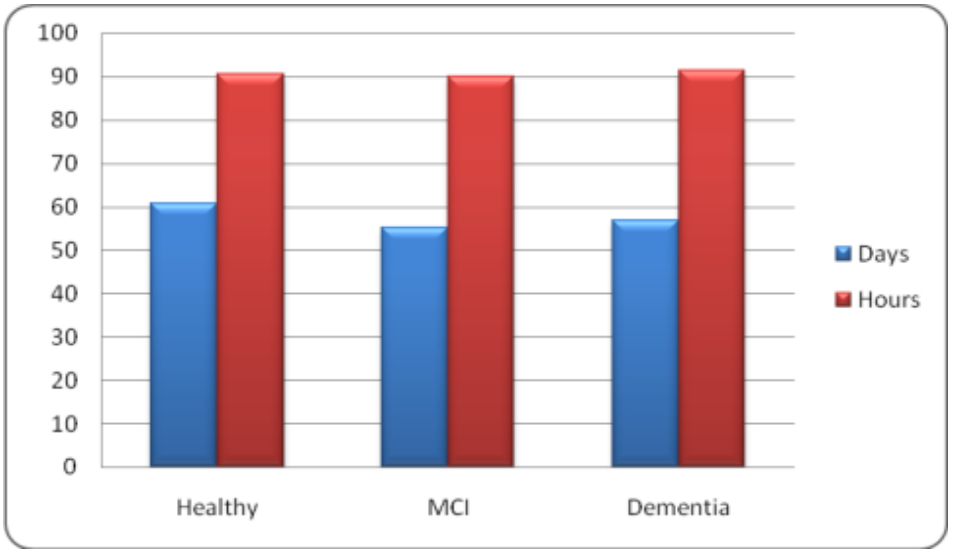
Data Collection

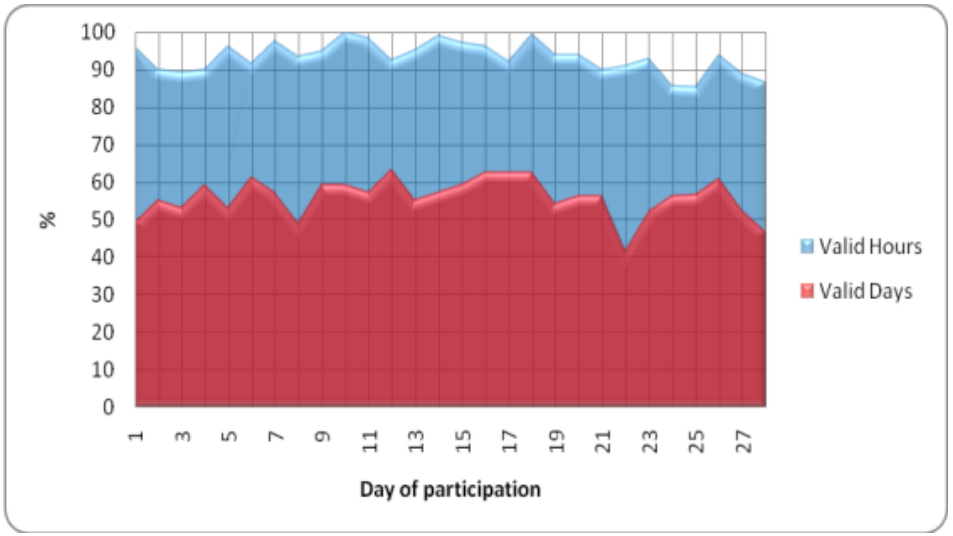
Personal Watcher
RF component

STaR Monitoring Unit
GPS Receiver
GSM modem
RF component

Home monitoring Unit
RF component

Quality control of data

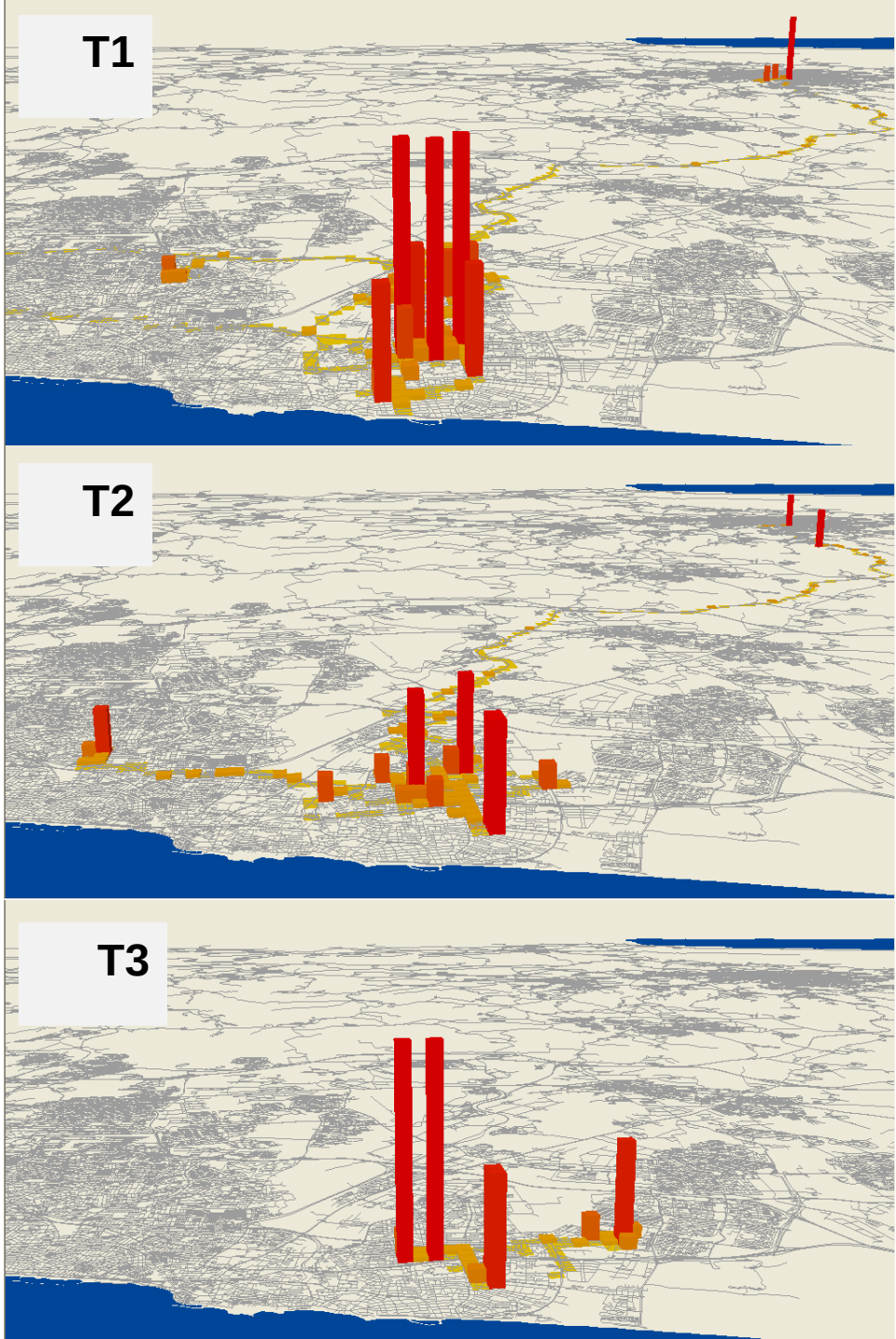




Perspective I:

Aggregative Consumption of Space

P5- Israel



P5- background data

	Round I	Round 2	Round 3
Gender	Man		
Family status	married	married	married
Age	76	77	78
Work (1=yes)	0	0	0
education	12	12	12
Car ownership (1=yes)	1	1	1
Who drives (1=me)	2	2	2
Help (1=yes)	2	1 (55 h)	1 (8 h)

	Round I	Round 2	Round 3
Cognitive Category	Dementia	Dementia	Dementia
MMSE	26	22	23
CAMCOG	79	82	79
CDT	23	27	
GDS	2	4	6

Round	Year	Days of participation	Valid Days	Partially Valid Days	Not Valid Days
1	2007	24	13	7	4
2	2008	29	20	0	8
3	2010	28	23	2	3

Intensity of activity – Mannheim area Residents (Healthy)

Activity inside home is not included

Cell size = 25X25 m
Height represents average duration per participant, divided by 10

n = 31

Intensity of activity – Mannheim area Residents (MCI)

Activity inside home is not included

Cell size = 25X25 m

Height represents average duration per participant, divided by 10

n = 14

Intensity of activity – Tel Aviv Yafo Residents (ages 61-75)

Activity inside home is not included, Sheltered housing participants are not included

Cell size = 25X25 m

Height represents average duration per participant, divided by 10

n = 12

Intensity of activity – Tel Aviv Yafo Residents (ages 76-87)

Activity inside home is not included, Sheltered housing participants are not included

Cell size = 25X25 m

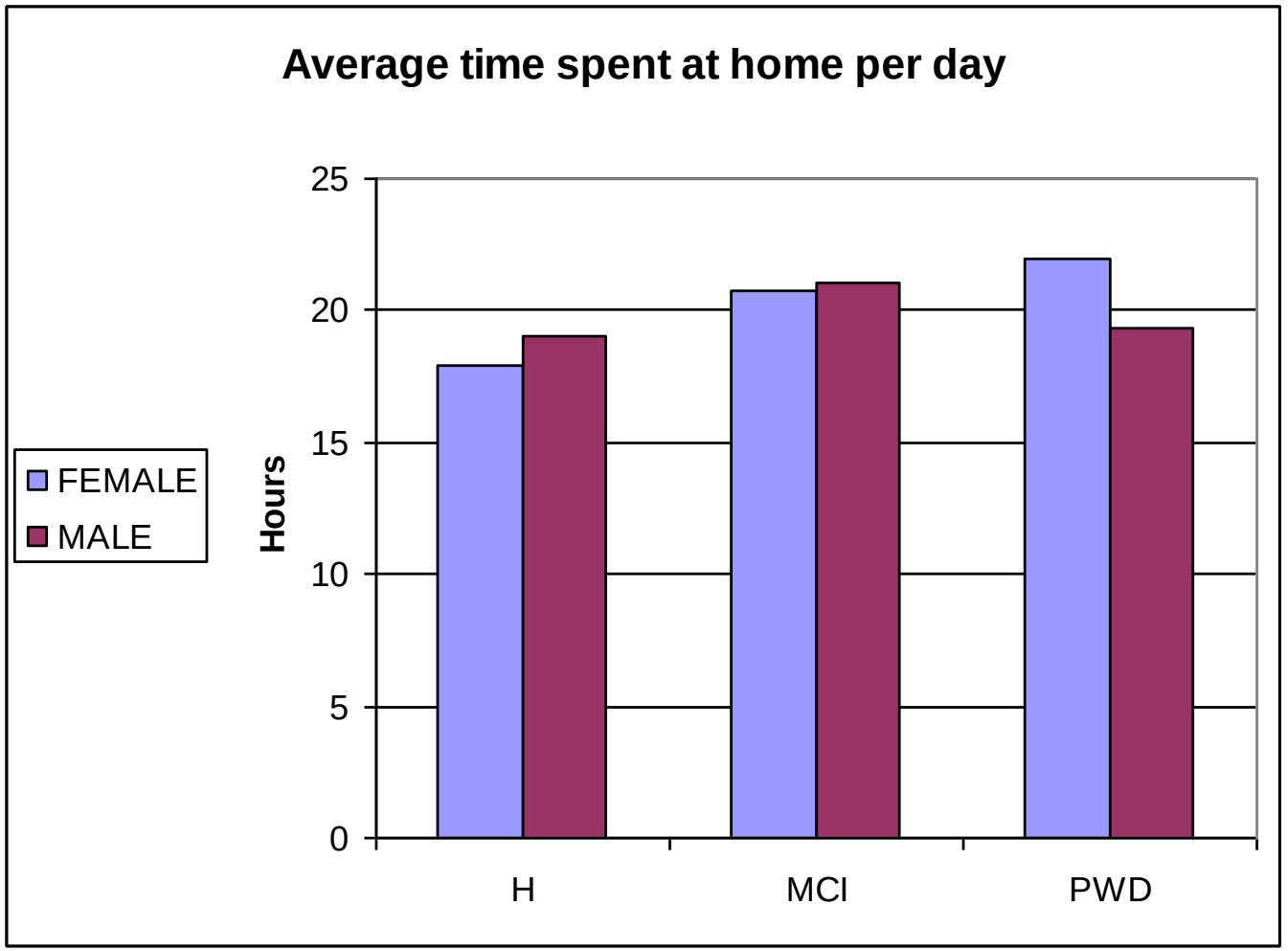
Height represents average duration per participant, divided by 10

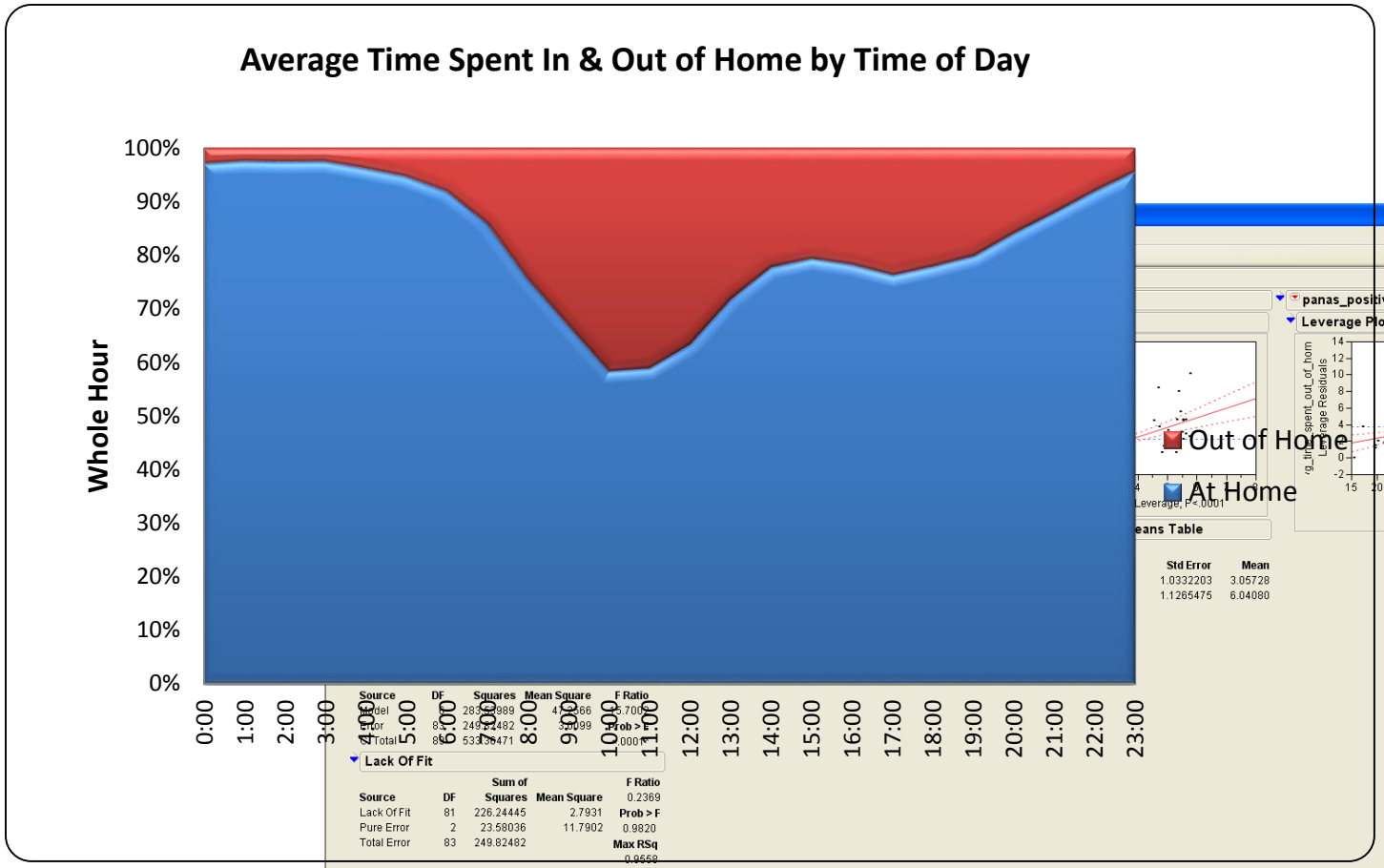
n = 21

Perspective II:

When the research unit is an individual

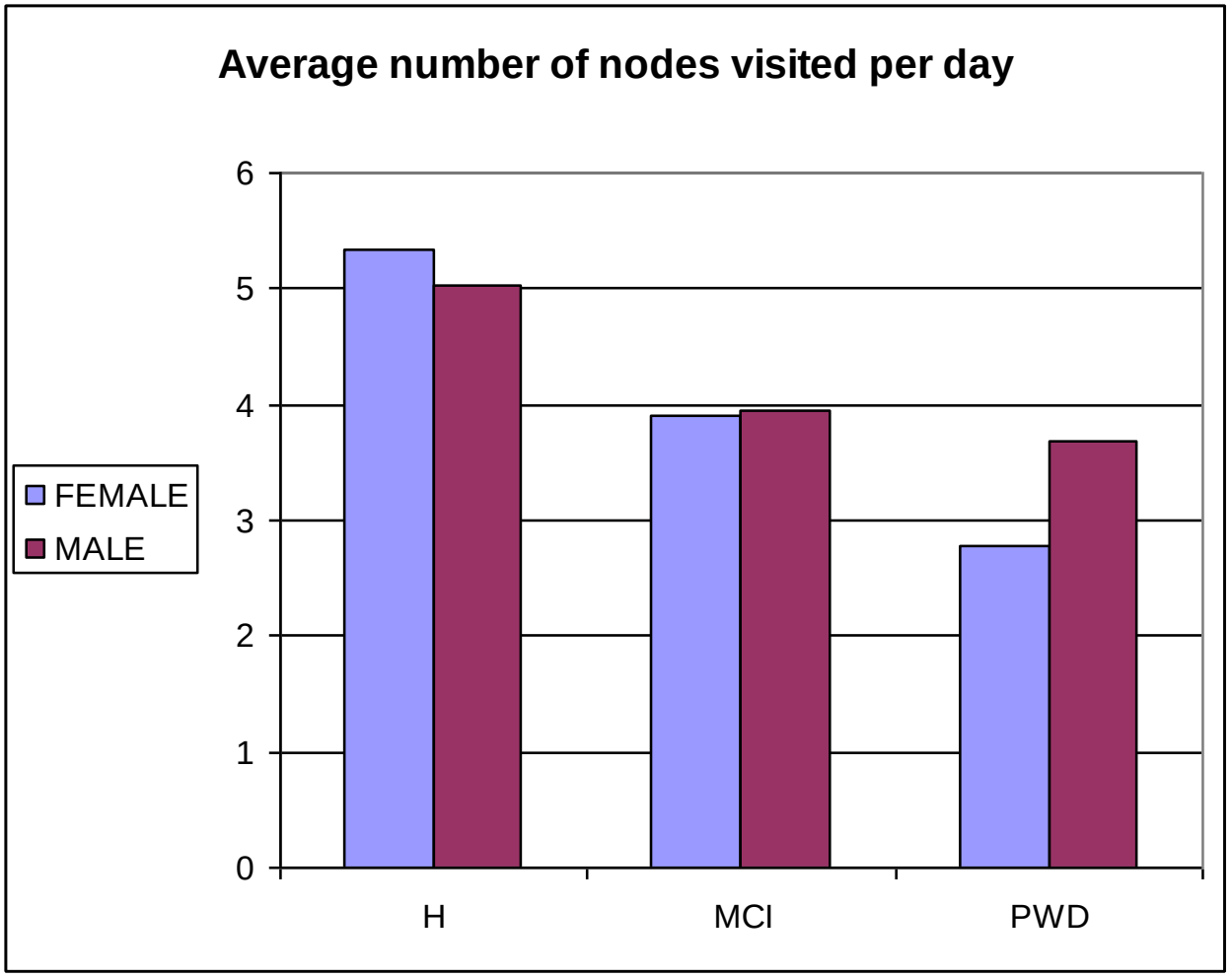
- How do Elderly people move through space?
- What types of transportation do they use?
- Where do elderly people spend their time?
- How much of their time is spent at home?


Average time spent at home per day
FEMALE
MALE
Hours
25
20
15
10
5
0
H
MCI
PWD

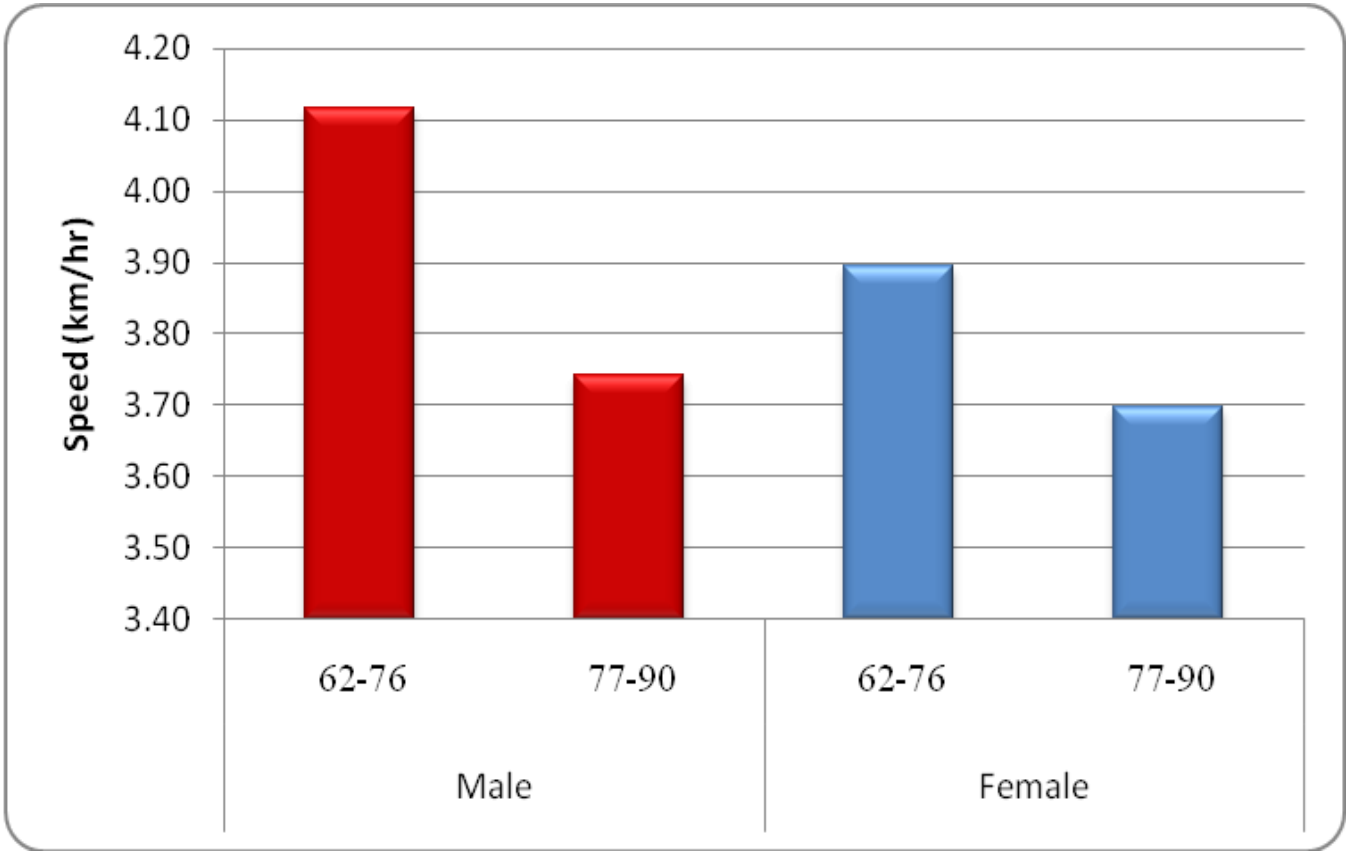


Parameter Estimates

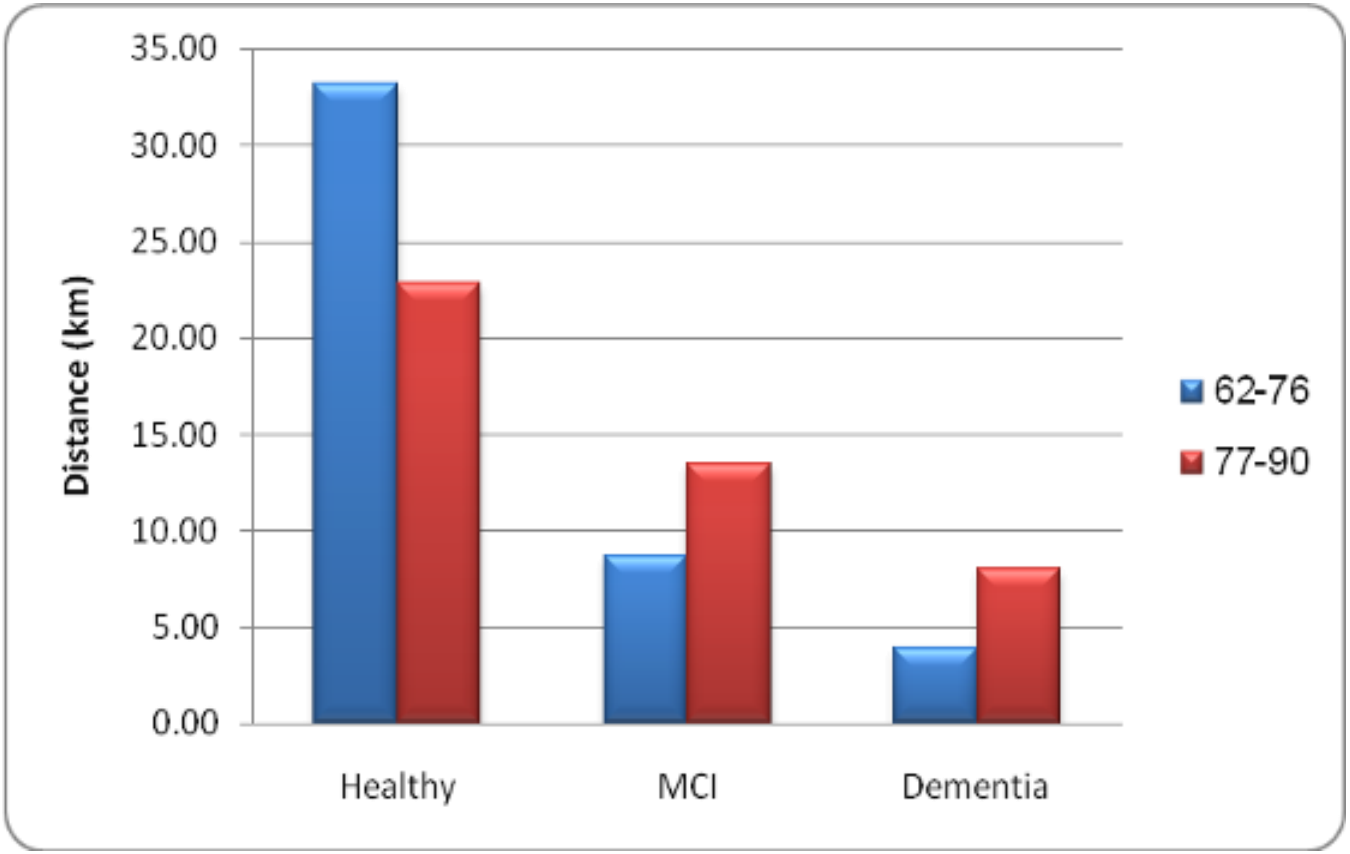
Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	9.5580774	2.744804	3.48	0.0008*
elevator[yes-no]	-0.893578	0.374765	-2.38	0.0194*
work[1-2]	2.2749095	0.468187	4.86	<.0001*
panas_positive	0.1136247	0.02766	4.11	<.0001*
age	-0.099576	0.029518	-3.37	0.0011*
(age-77.6444)*(age-77.6444)	0.0077451	0.003436	2.25	0.0268*
safe_day3[2-1]	-2.154548	1.029963	-2.09	0.0395*


Average number of nodes visited per day
6
5
4
3
2
1
0
FEMALE
MALE
H
MCI
PWD

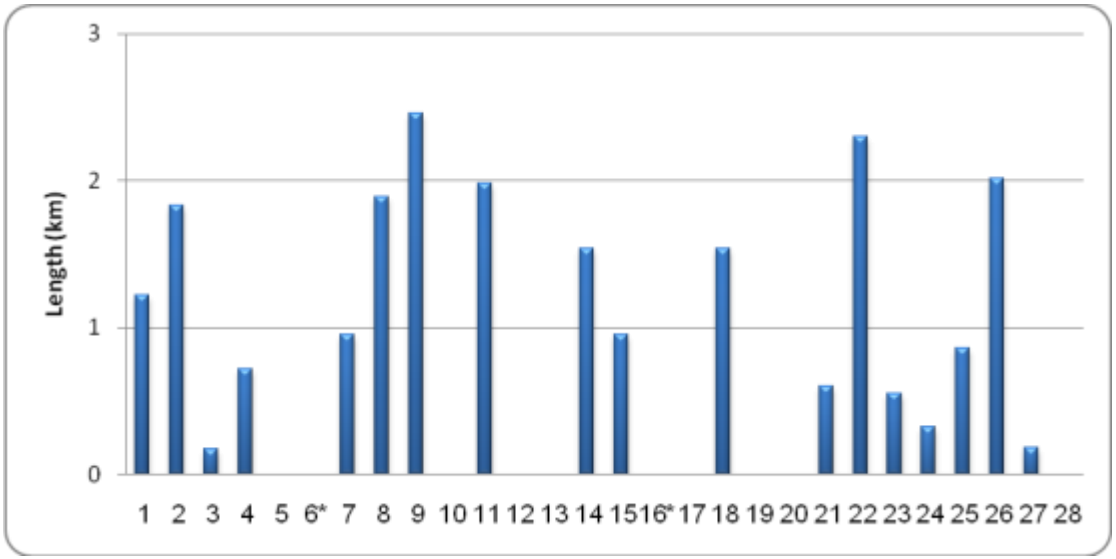
Average of Average walking speed by gender and Age group

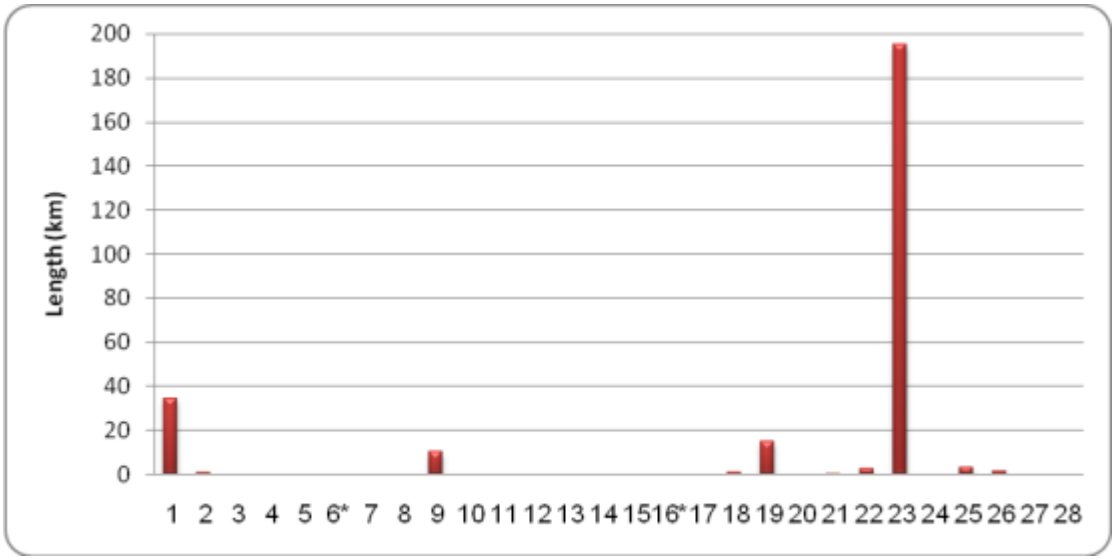


Average daily distance travelled per age group and cognitive status

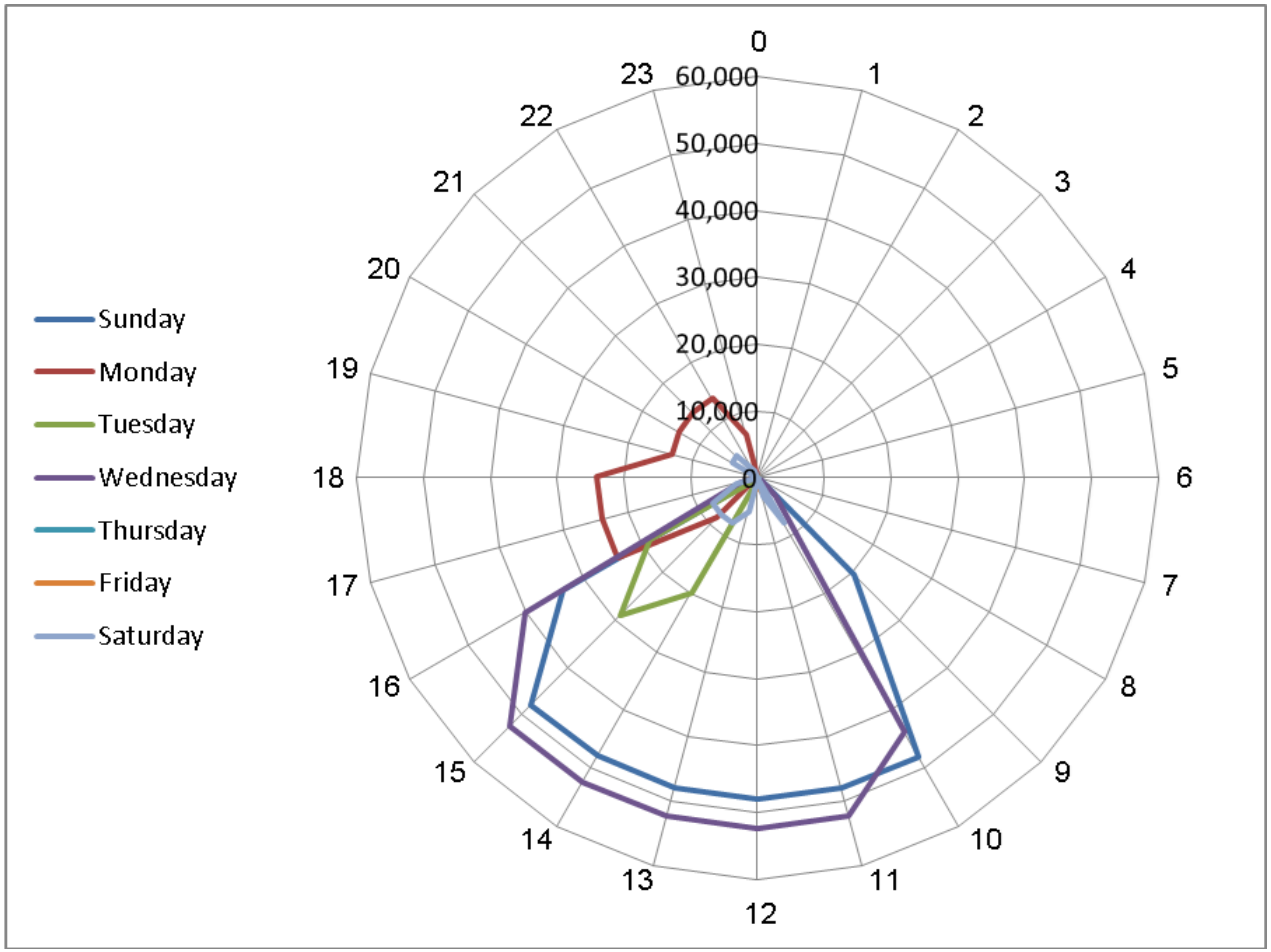


Aggregative data of daily walking **distance** of one participant over one month (MCI)



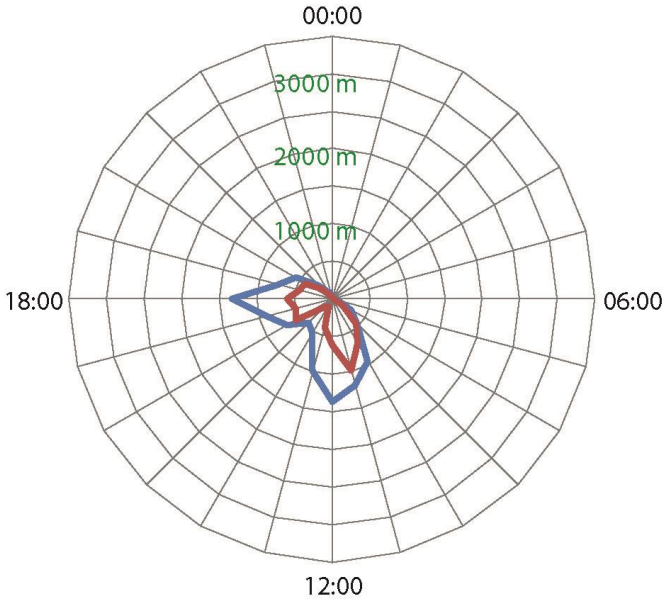


Distances from home of one participant during one week

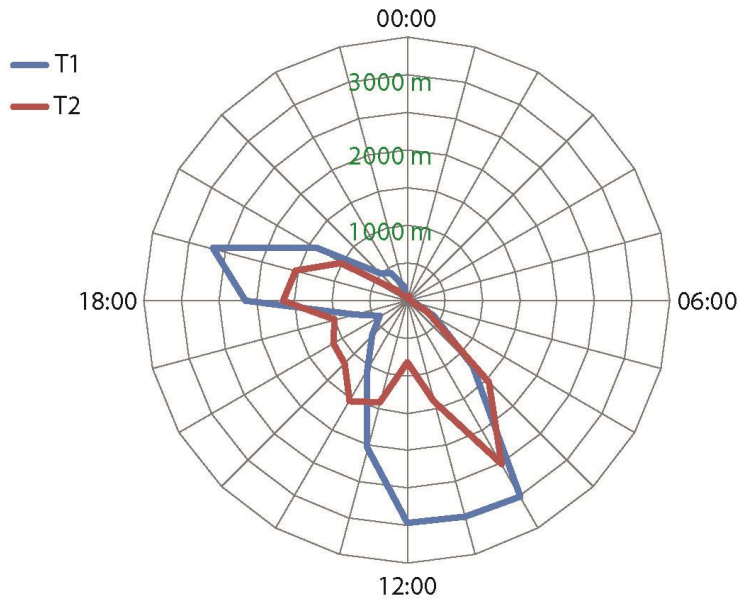


T1 – T2:

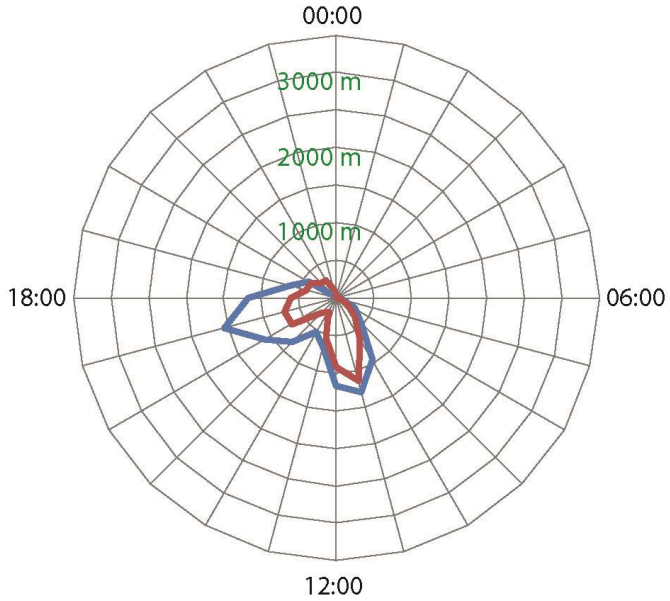
The impact of one year of aging



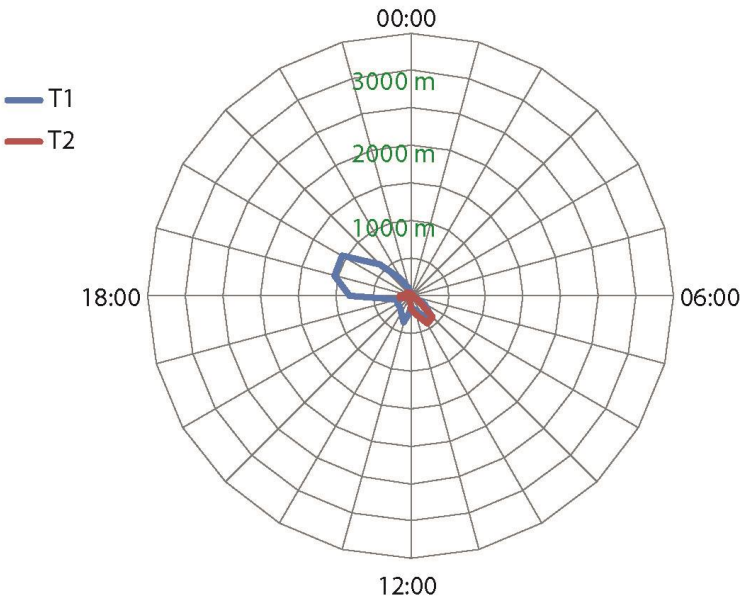
All Israeli participants



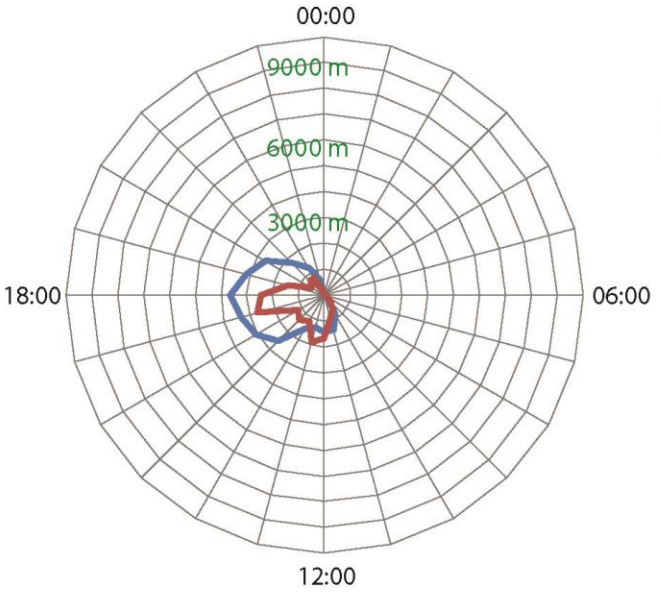
Israeli healthy participants



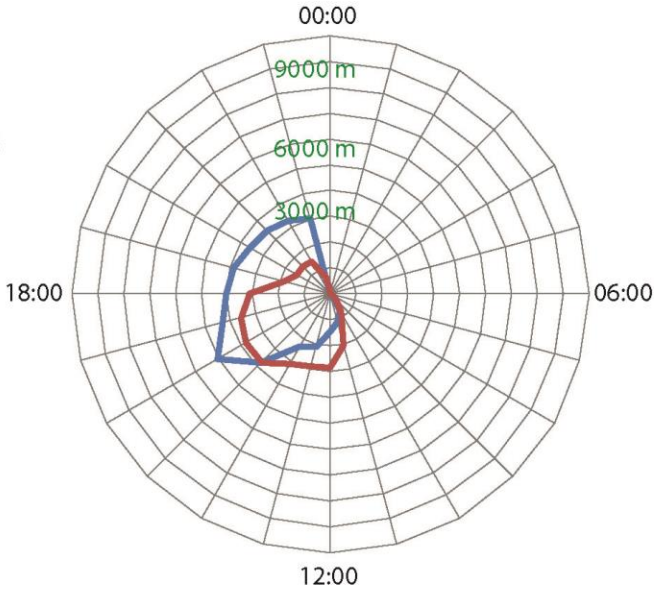
Israeli MCI participants



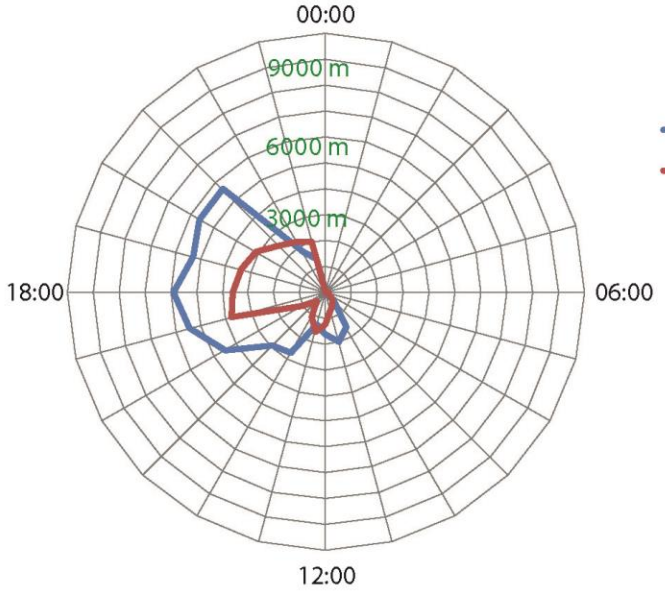
Israeli PWD participants



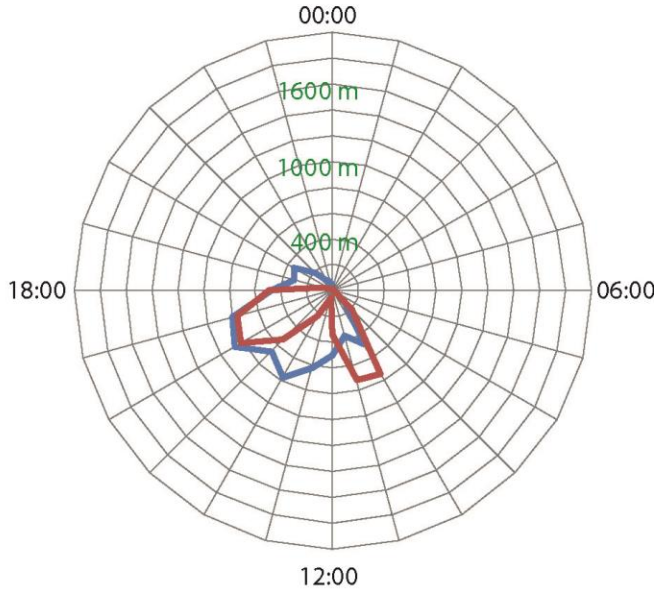
All German participants



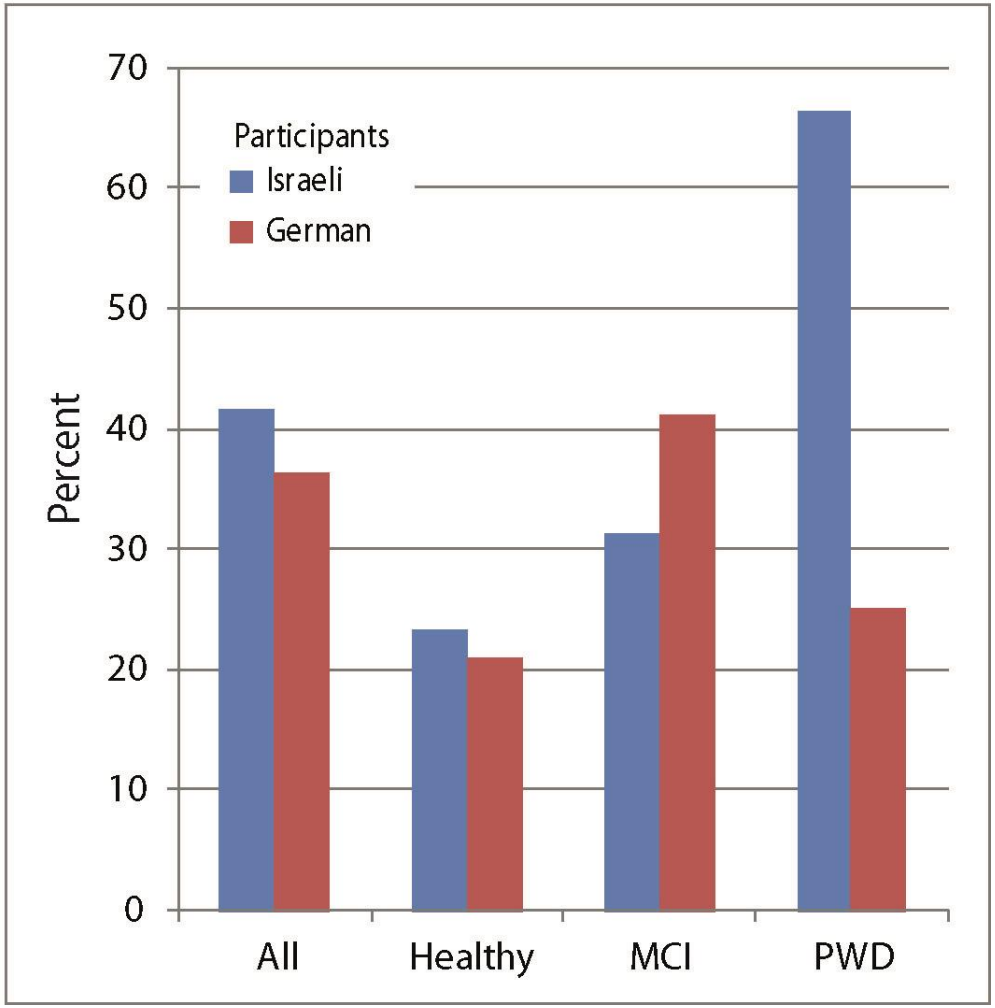
German healthy participants



German MCI participants

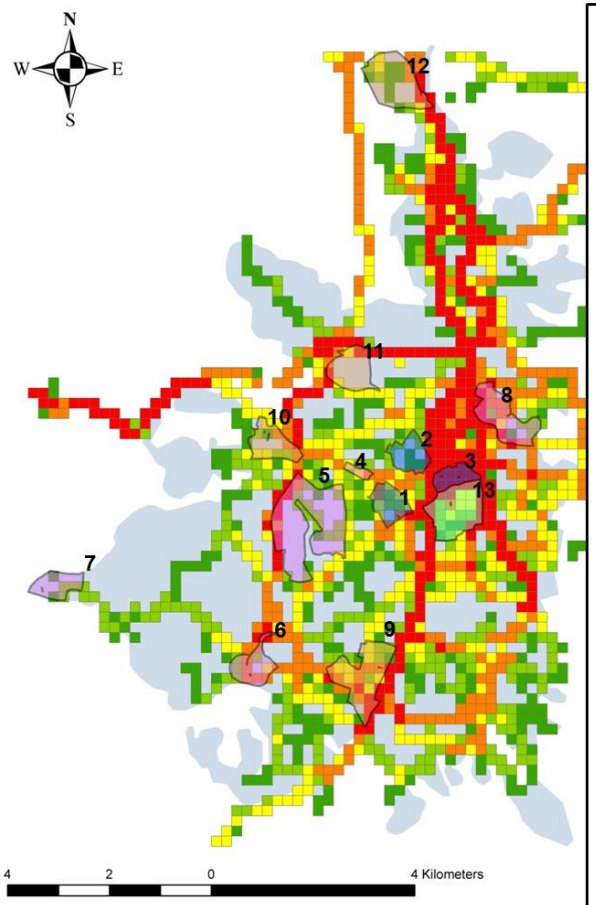


German PWD participants


70
60
50
40
30
20
10
0
Percent
Participants
Israeli
German
All
Healthy
MCI
PWD

Implementation of Tracking Technologies in Urban Geography Research

- Data collected as a part of the new transportation plan of Jerusalem
- About 16,000 respondents were tracked for 24 hours each (10,000 days fit for analysis)



Legend:

Urban Centers:
1 CBD
2 Orthodox Center
3 Palestinian Center

Commerce, Services and Employment:
4 Mahne Yehuda Market
5 Givaat Ram Campus and the Governmental Offices
6 Malha Shopping Mall
7 Hadasa Ein Karem Hospital
8 Mount Scopus Campus

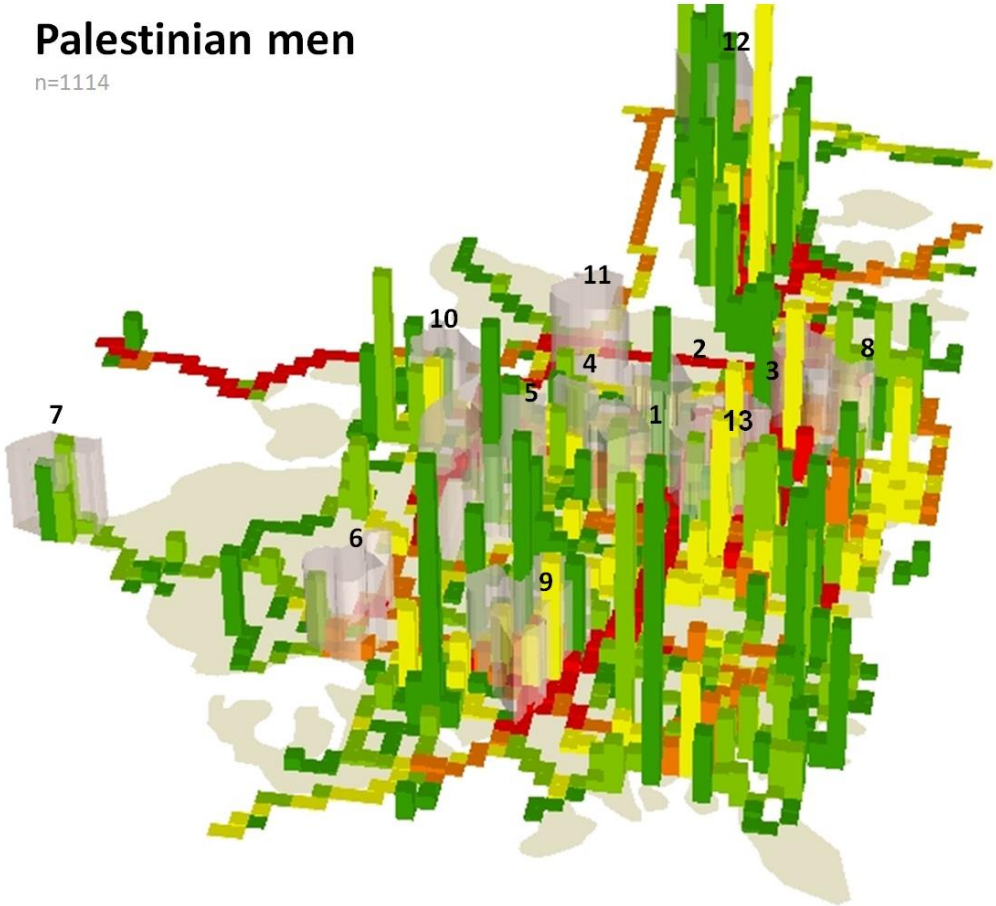
Light Industry
9 Talpiot
10 Givat Shaul
11 Har Hotzvim
12 Atarot

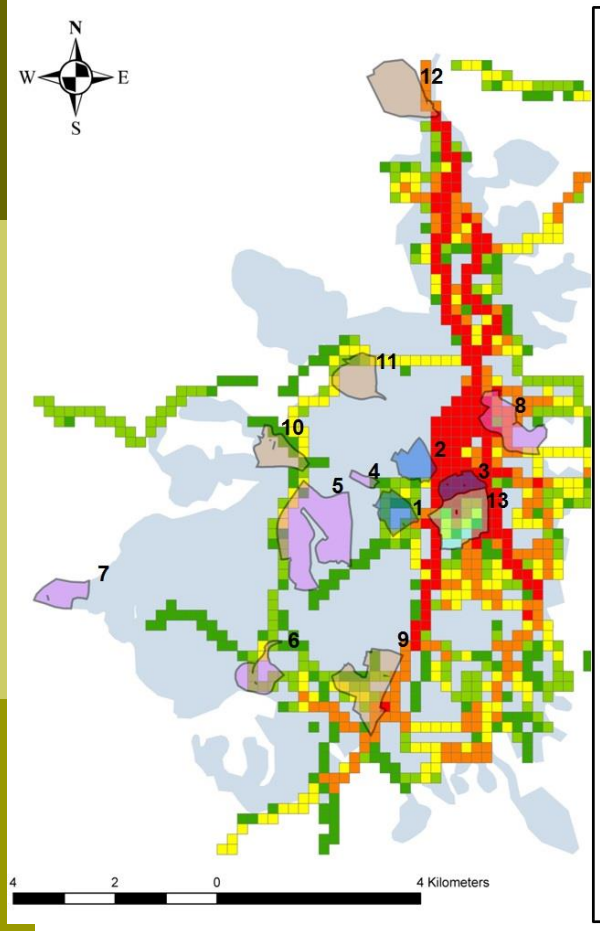
Other:
13 Old City

Only cells with more than 1% of n are displayed.
Color represents number of participants, by quantiles.
Height represents average duration per participant, divided by 2.

Palestinian men

n=1114





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Light Industry
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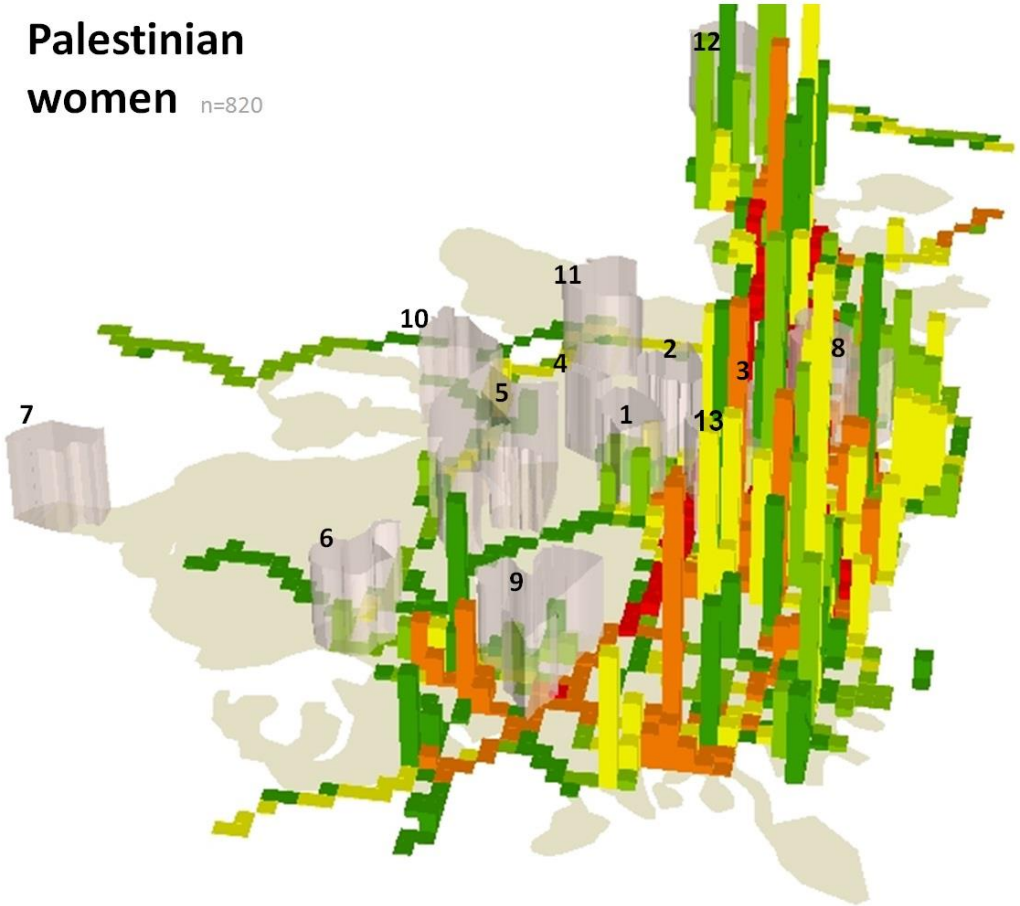
11 Har Hotzvim
12 Atarot

Other:
13 Old City

Only cells with more than 1% of n are displayed.
Color represents number of participants, by quantiles.
Height represents average duration per participant, divided by 2.

Palestinian women n=820

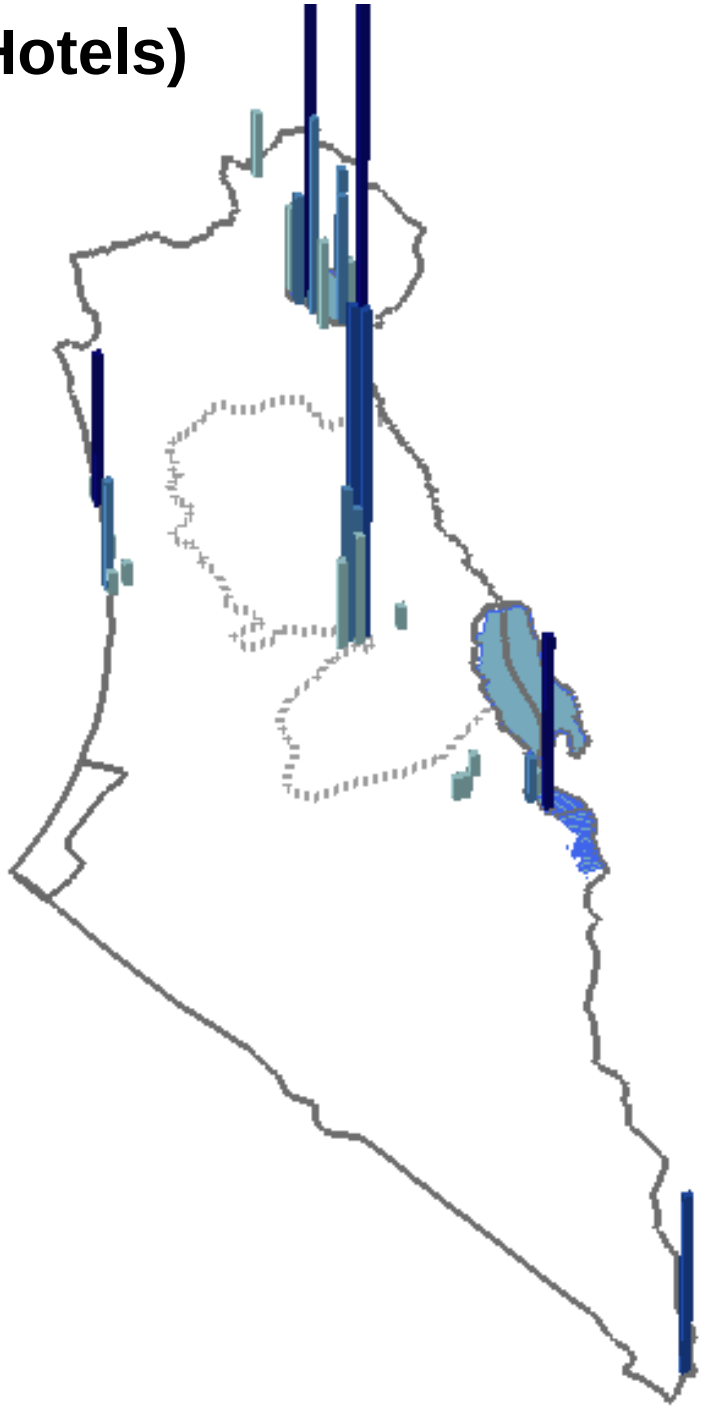


National Tourism Flows in Israel and Palestine:

- Individual Tourists Survey at Ben-Gurion Airport (Hertz)
- Organized Jewish Tourism Survey (Taglit-Birthright)
- Organized Christian Pilgrimage

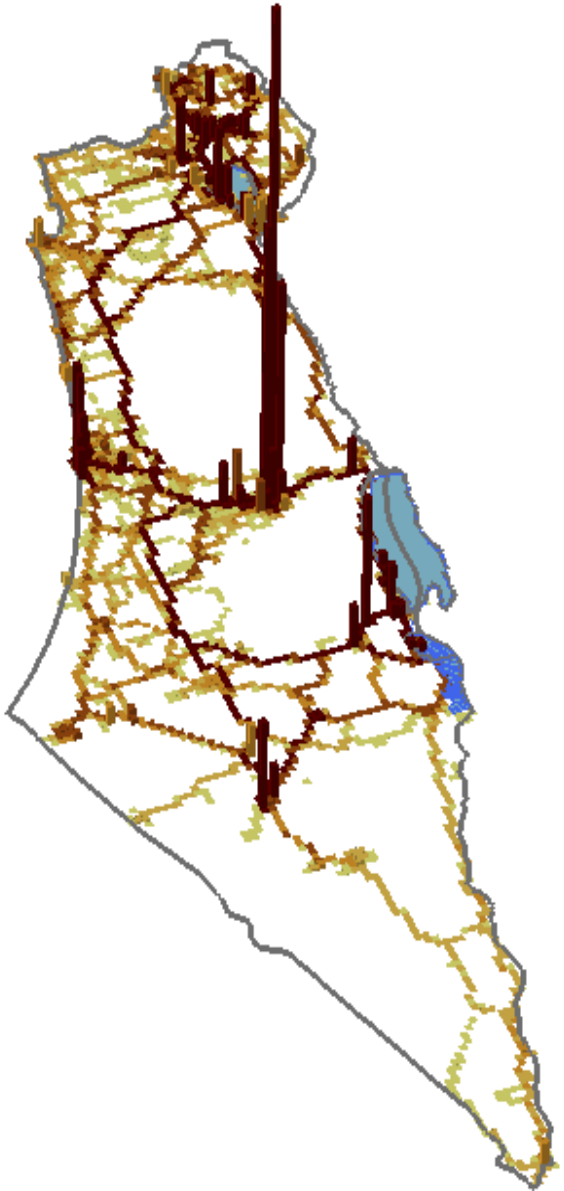
Day (Nodes activity)

Night (Hotels)

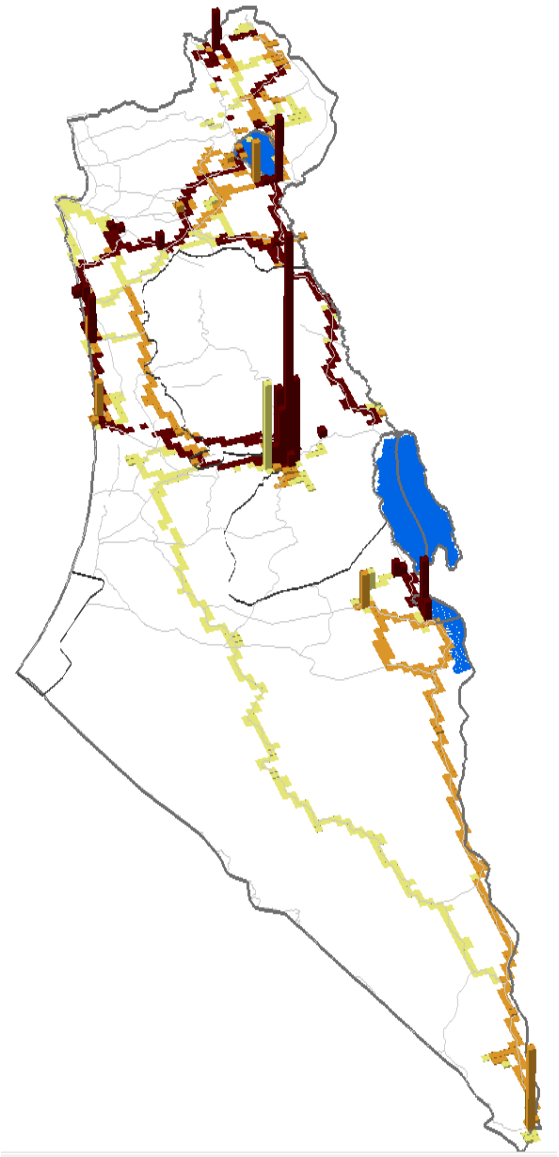


Organized Evangelists

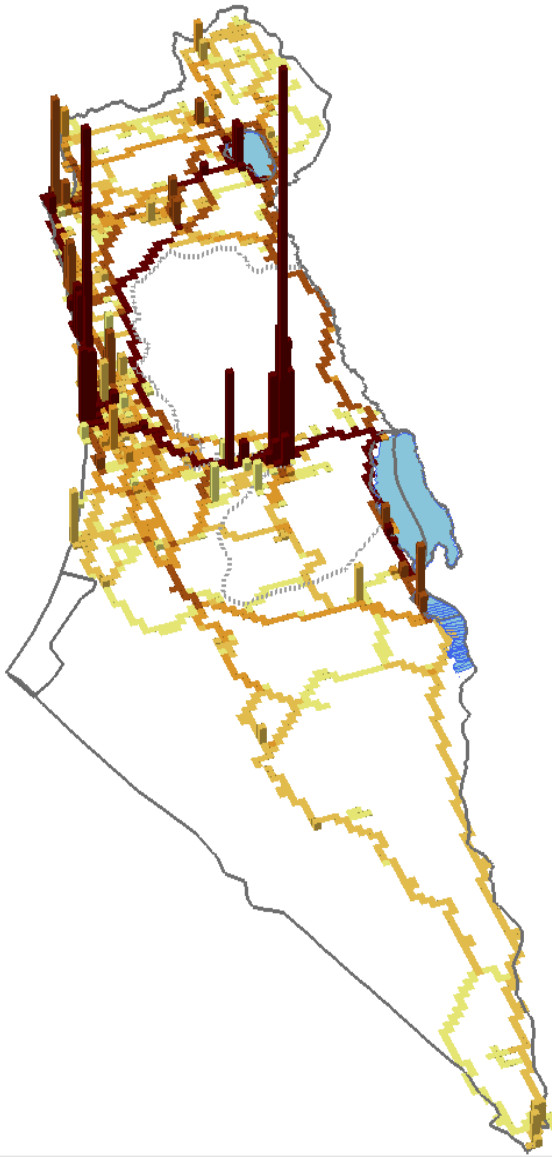
Taglit-Birthright



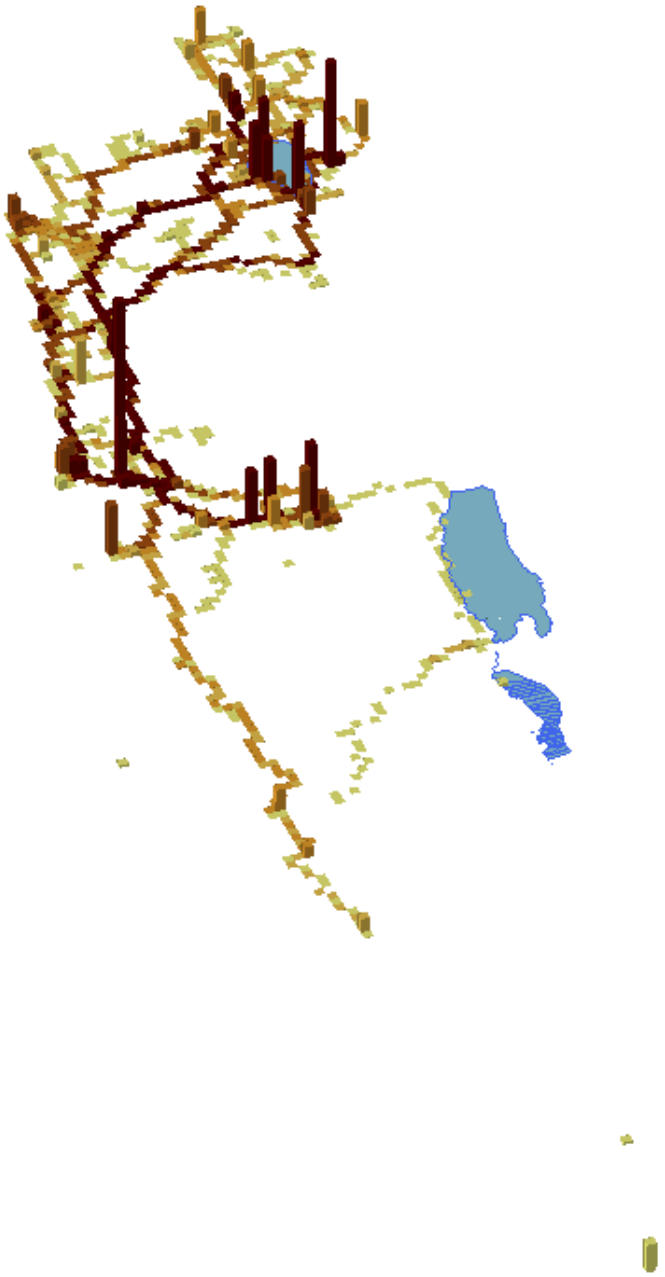
Organized Evangelists



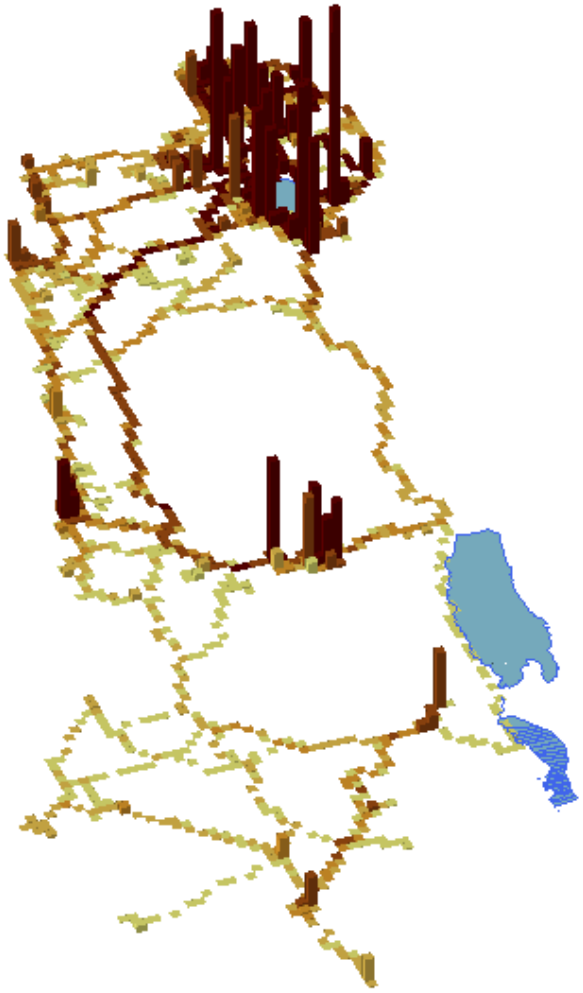
Individual Tourists



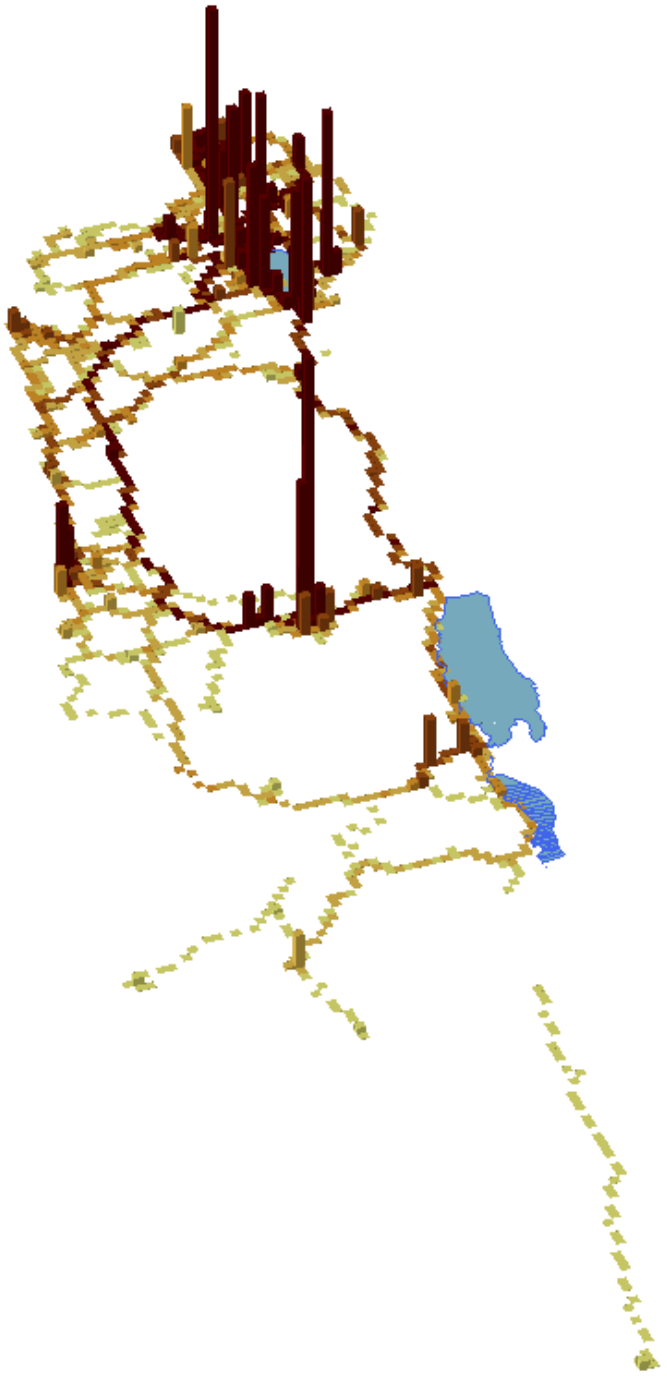
Day 1



Day 2

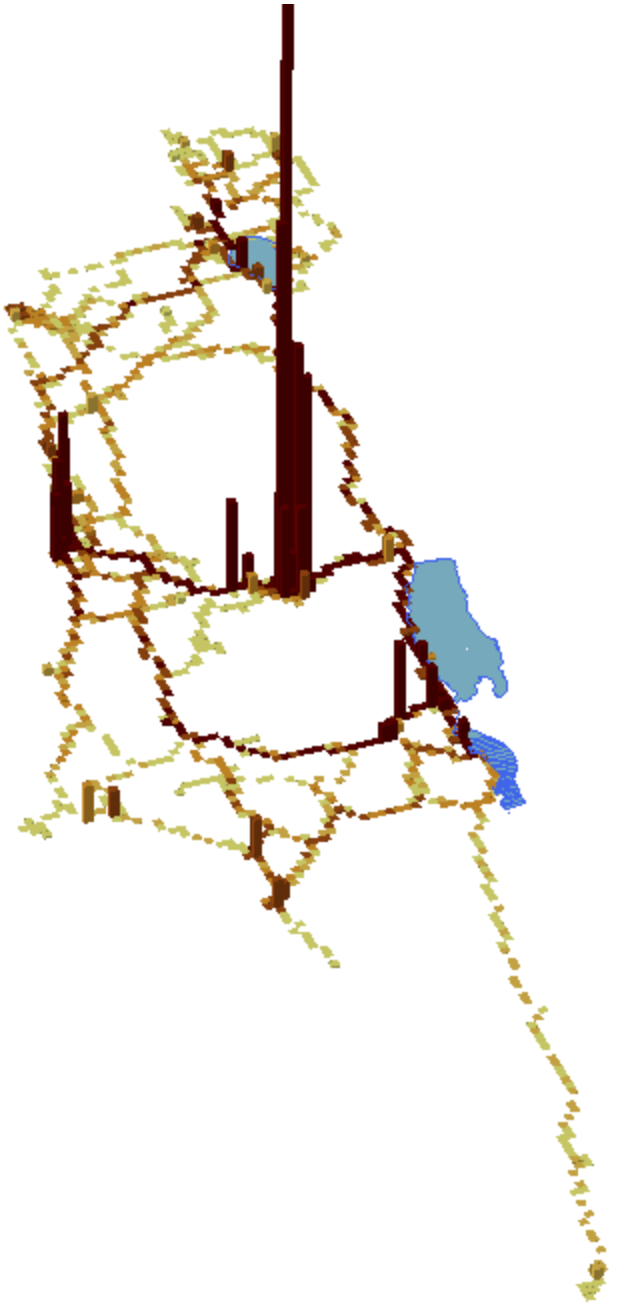


Day 3

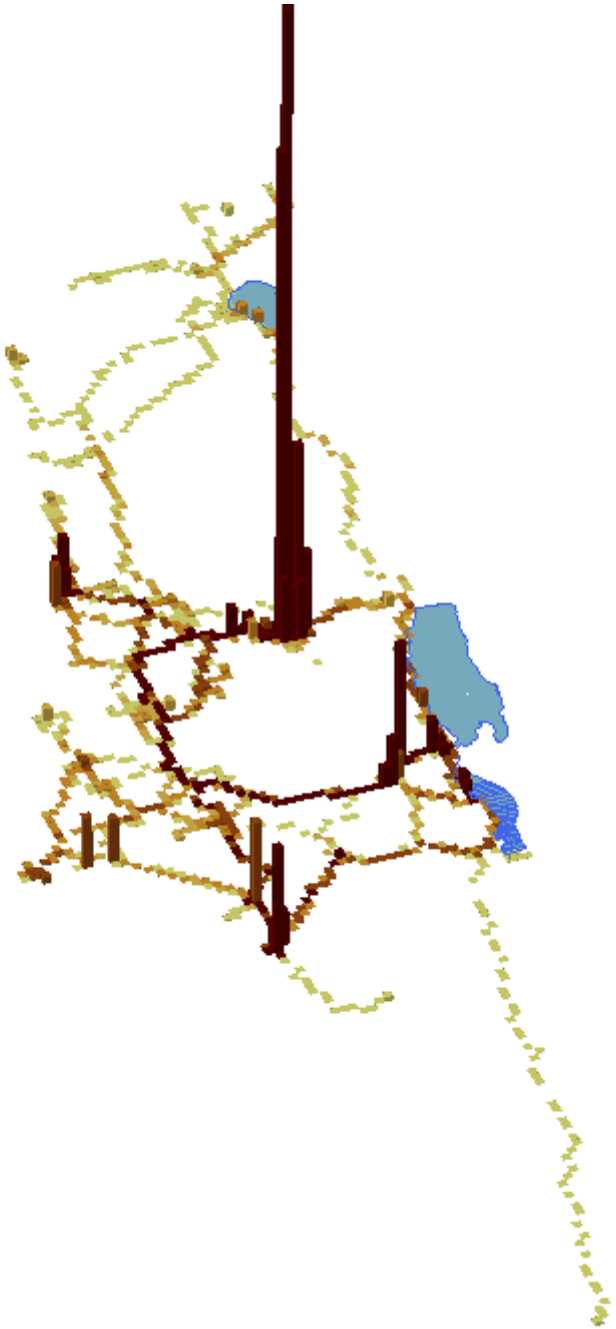


Day 4

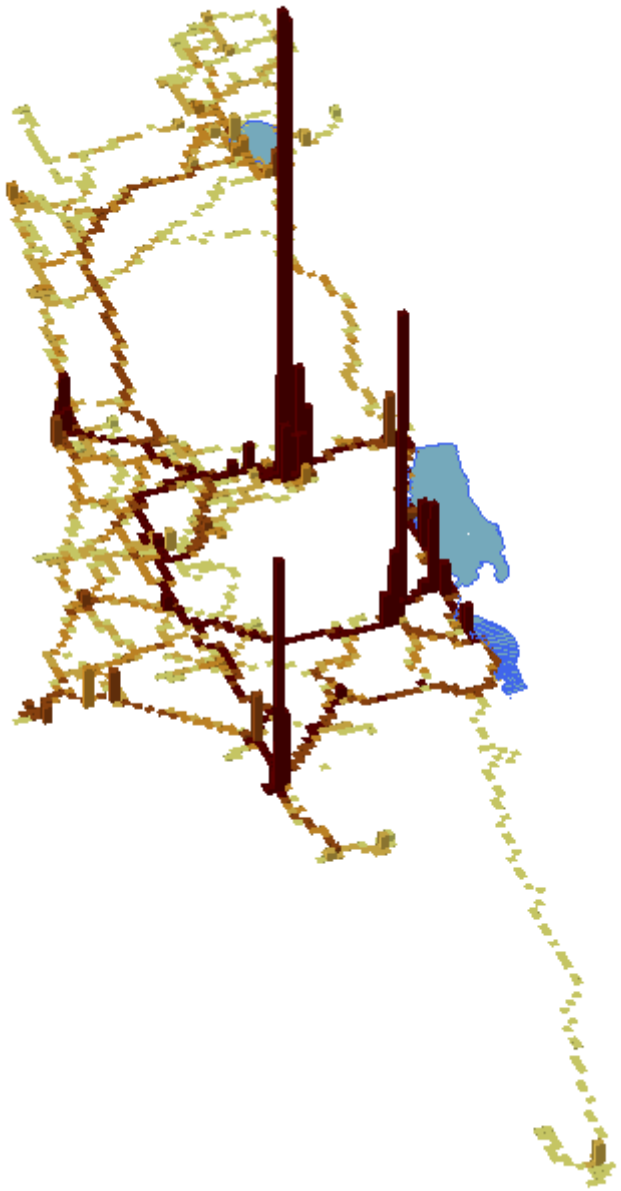
Day 5



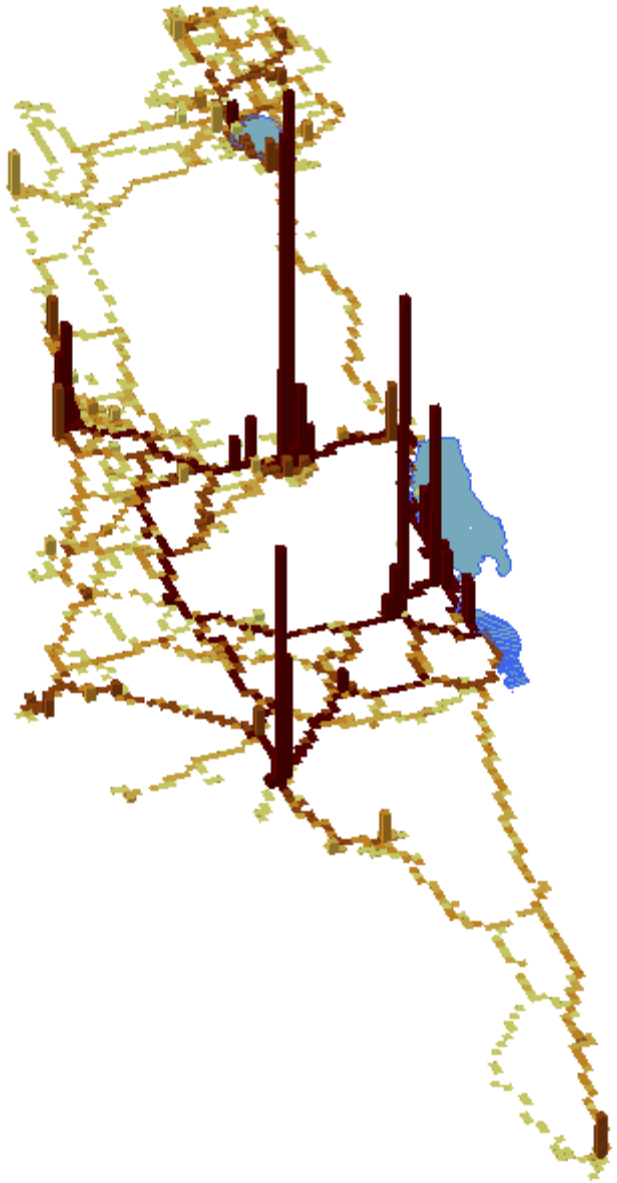
Day 6



Day 7

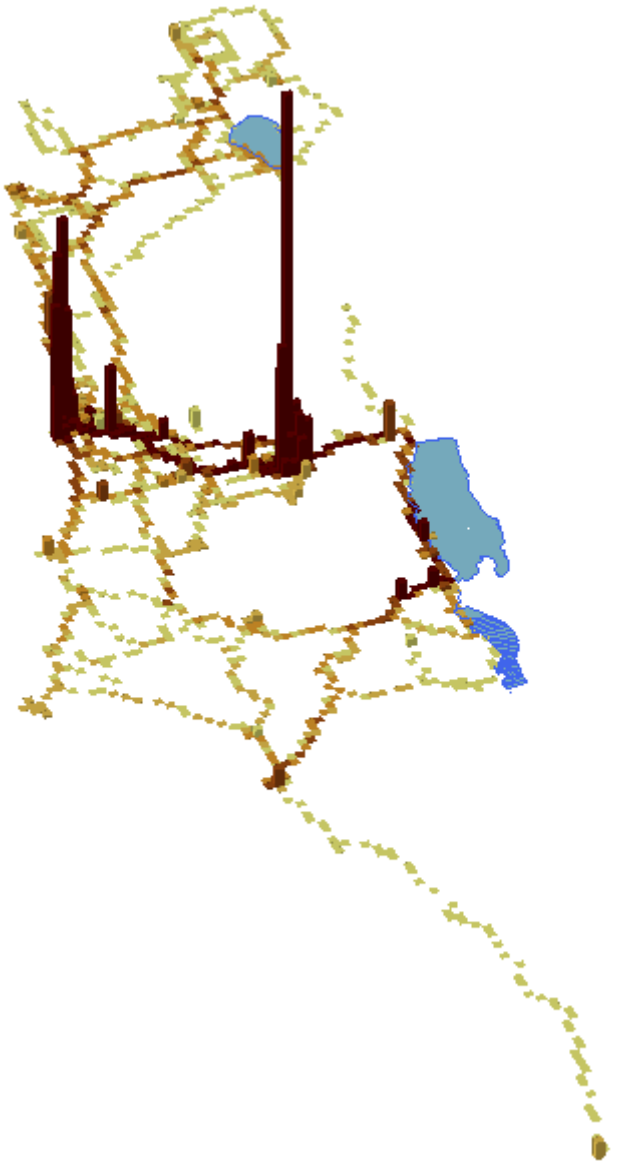


Day 8

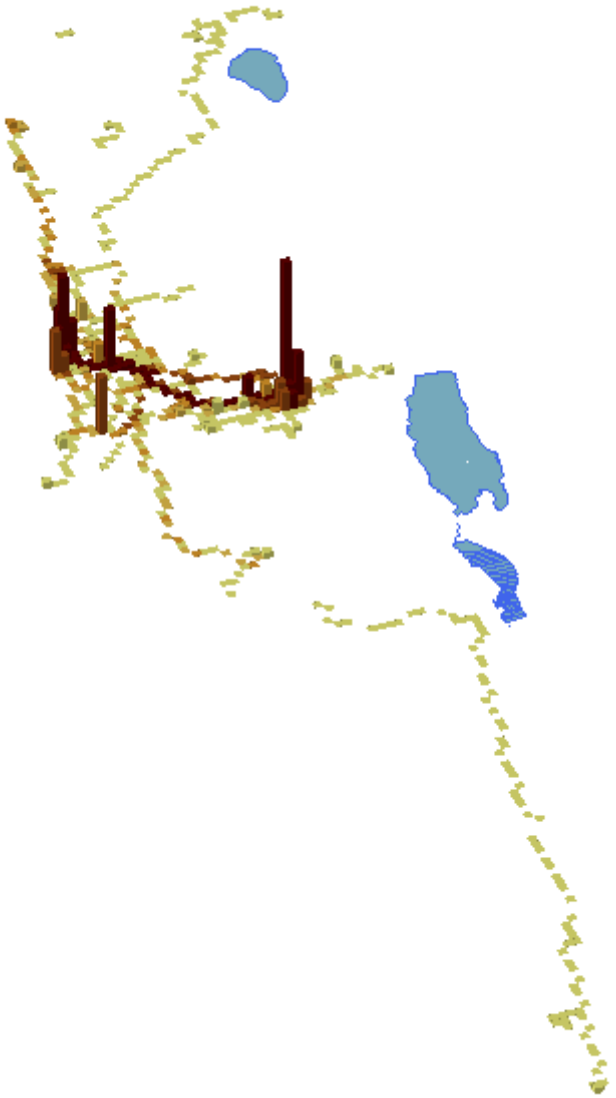


Day 9

Day 10



Day 11




NORWEGIAN JADE


IBIS HOTEL
our desk
Cruises arrives here
tour vendors; taxi, etc..)
closed space for safekeeping (e.g. desk)
Via Francesco Crispi
Via Piano dell'Ucciardone
Molo Santa Lucia
Molo Piave
Molo Vittorio Veneto al Porto
Palermo
Piazza Ucciardone
Piazza Don Luigi Sturzo
Via Emerico Amari
Via Benedetto Gravina
Via Ammiraglio Gravina
Corso D. Scina
Via Archimede
Via Dalia
Via Conte Ruggero
Via Enrico Albanese
Via Ucciardone
Banchina Crispi
SS113
Mappa
Traffico
100 m
200 ft
Immagini ©2014 DigitalGlobe, Map data ©2014 Google
Modifica in Google Map Maker
Segnala un problema


MSC MUSIC
MSC

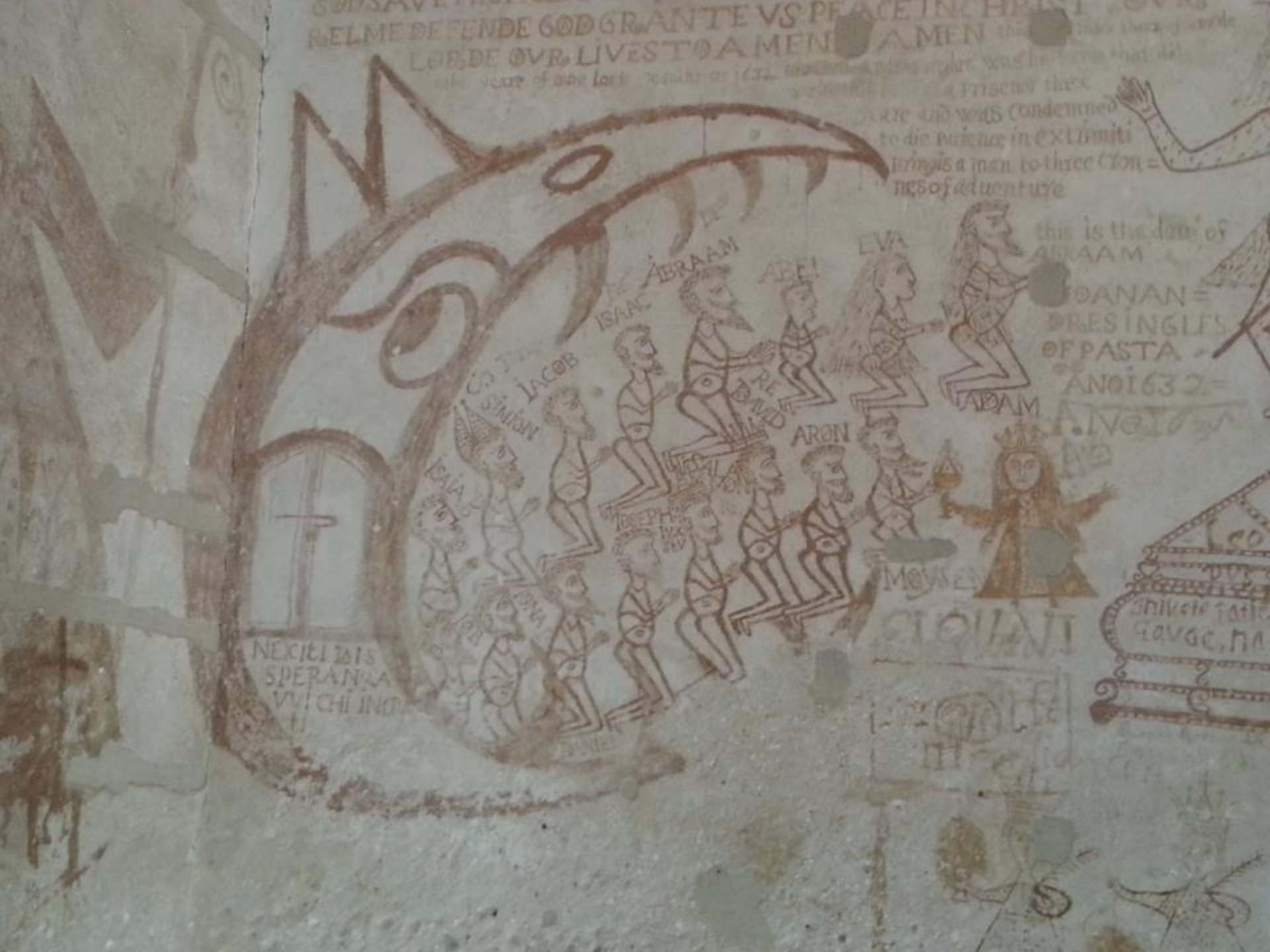

SCORPIONBAY

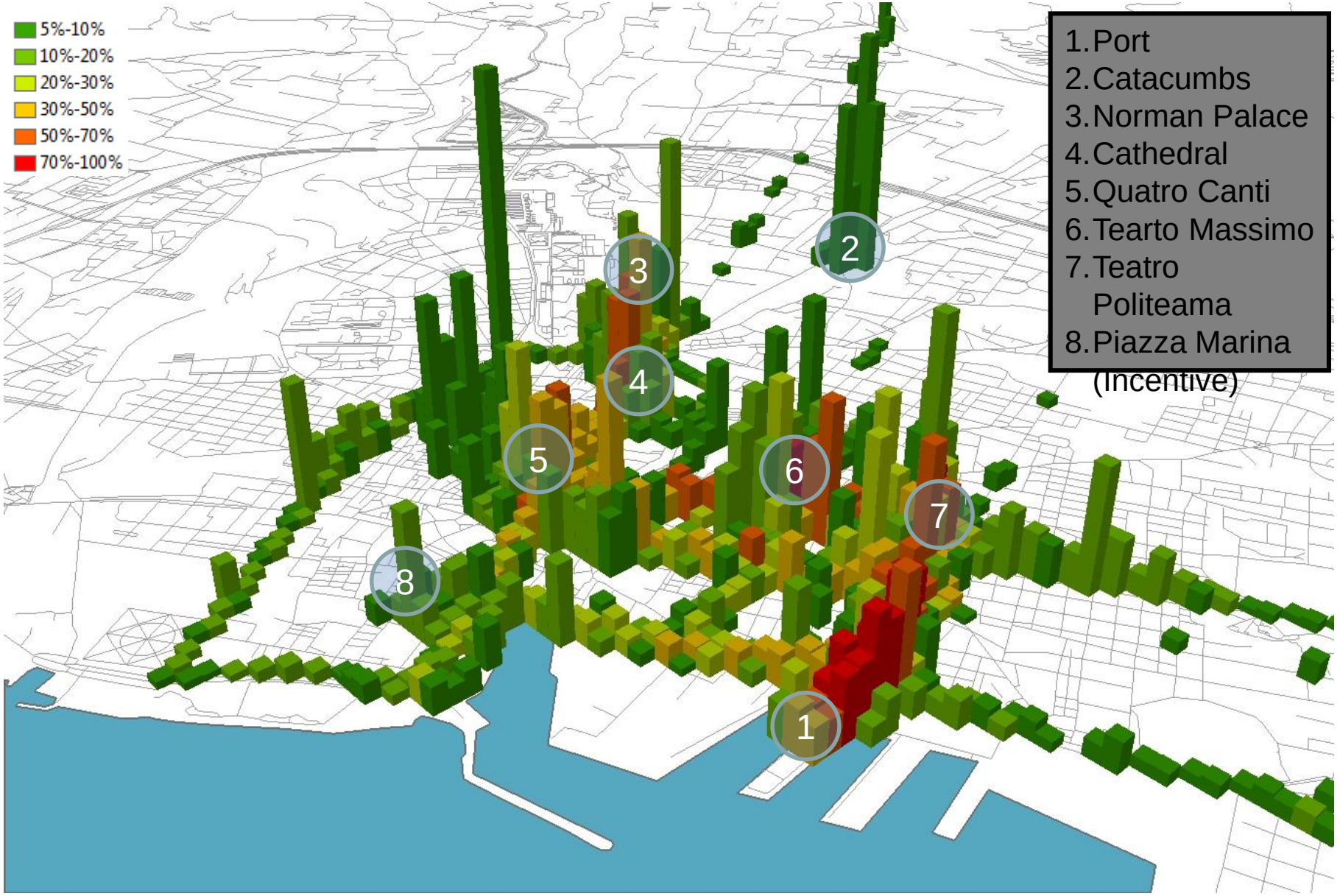

MSC MUSICA
MSC


MSC
MSC

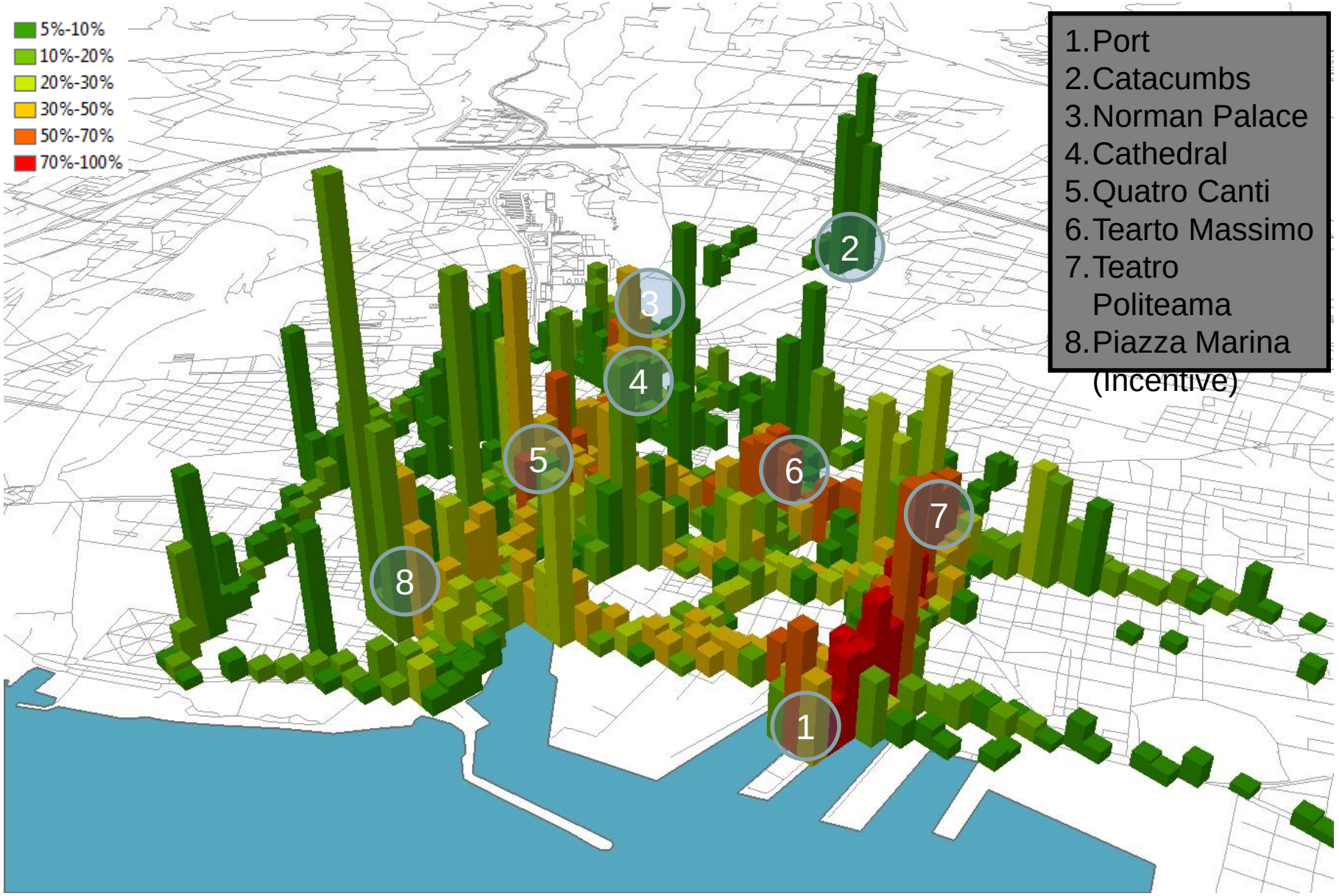

Tour Mob
Tour Mob
Analysis of cruisers' mobility through GPS technologies
Tour Mob
Tour Mob
Analysis of cruisers' mobility through GPS technologies


Green – Start
Red - End
Massimo
Cathedral
N
1
2
0 125250 500 750 1,000
Meters


ABRAAM
ISAAC
JACOB
EVA
ADAM
ARON
MOYSES
IOSEPH



No Incentive, N=141



Incentive, N=110

		Piazza Marina		
		Yes	No	Total
Incentive	Yes	43%	57%	100%
	No	21%	79%	100%

Total time spent in Palazzo Steri's Area

	Total time	Average (mins)
No incentive	150.56	4.71
Incentive	684.92	26.34

GPS Loggers Advantages

- High resolution of spatial and temporal information
- Digital information that can be easily analyzed
- Relatively high compliance rate
- Do not rely on participants spatial memory

However… Typical Field Work

Opening Questionnaire

GPS Delivery

Departure Questionnaire

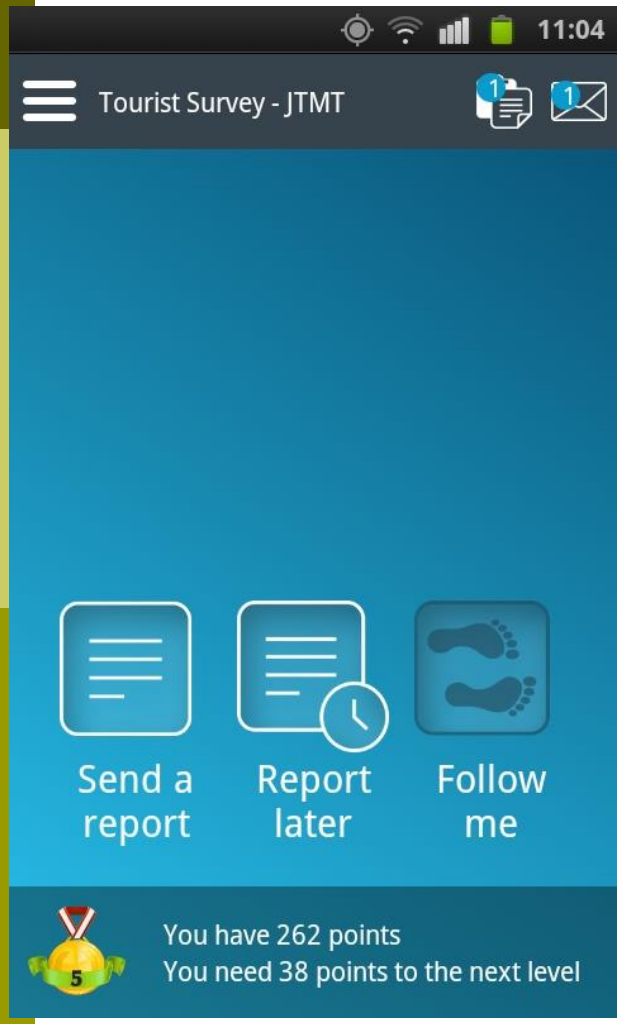
GPS Loggers Disadvantages

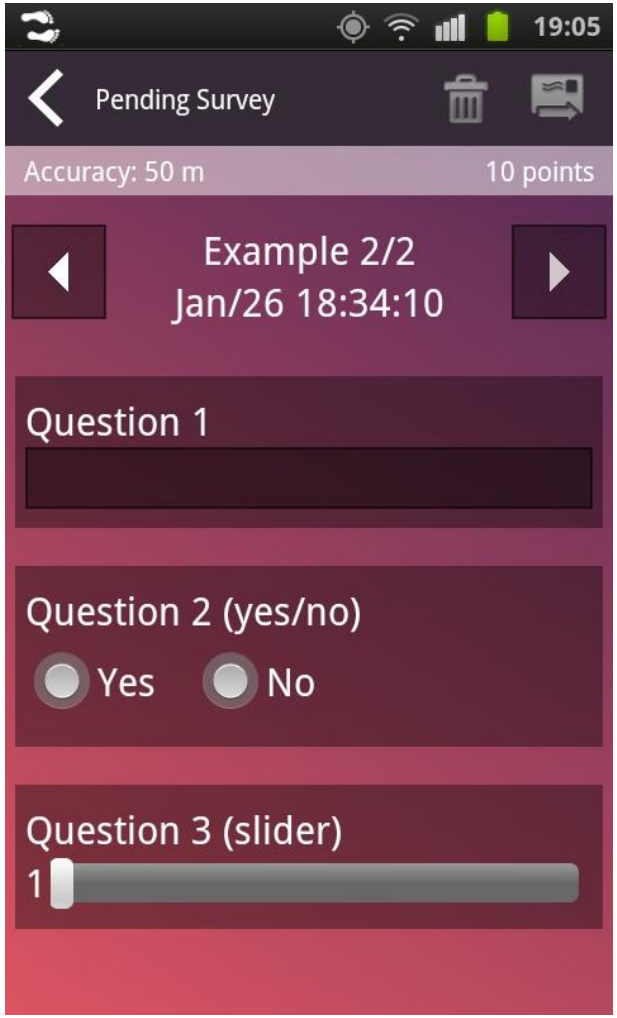
- Does not function indoor (no GPS reception)
- Requires additional devices (GPS) which participants need to carry
- Additional questionnaires are required to gather more information about the participants

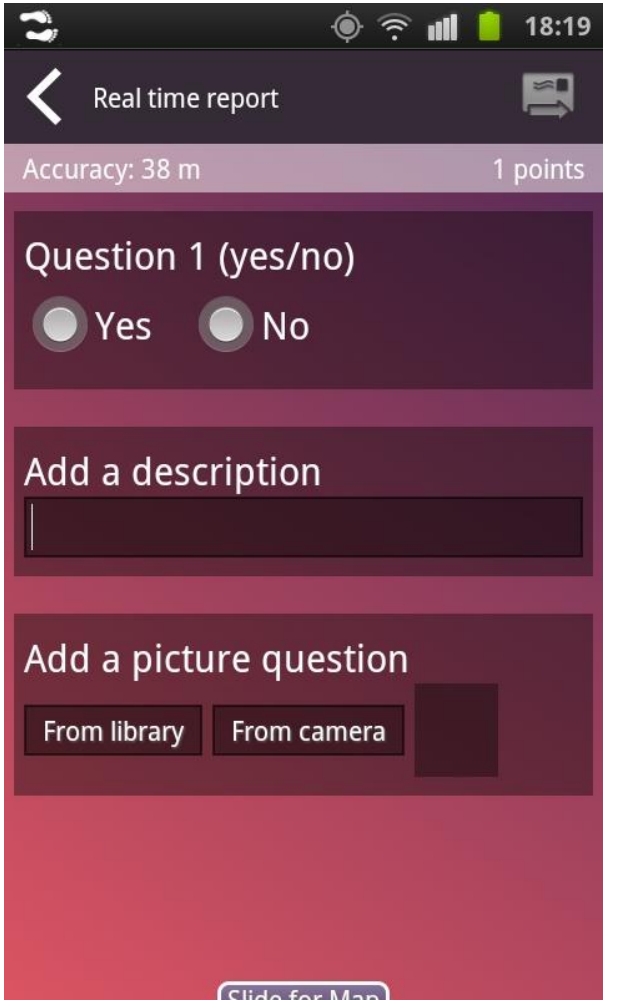
SensoMeter - Smartphone Application for Geo-based Research

- Sensometer (EU FP7 DESURBS Project)
- Generic application for location aware surveys and reports

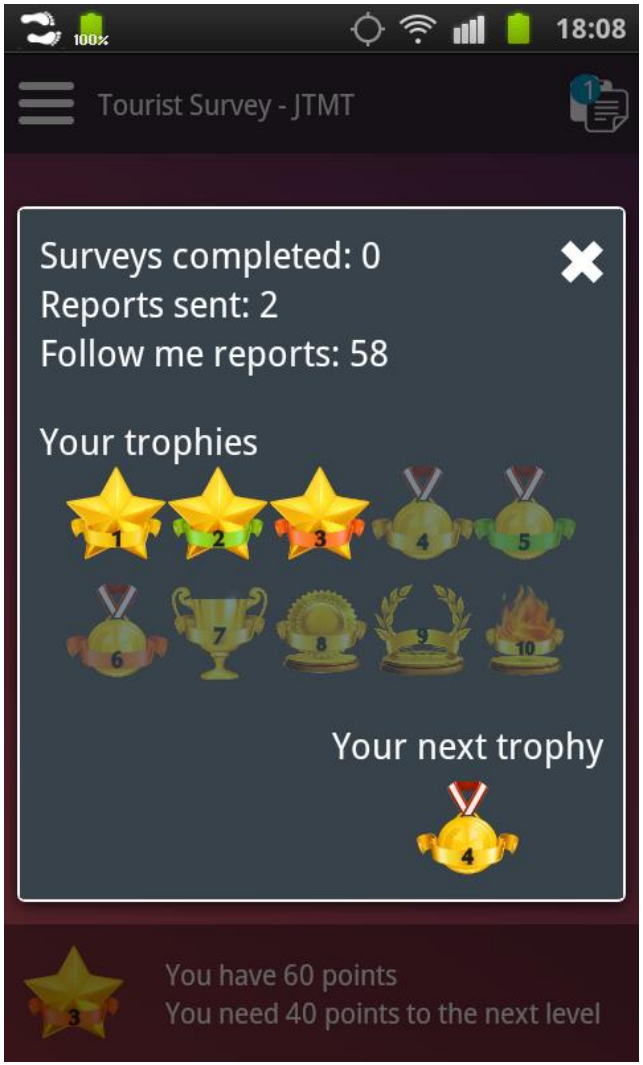
Senso-Meter 3.0





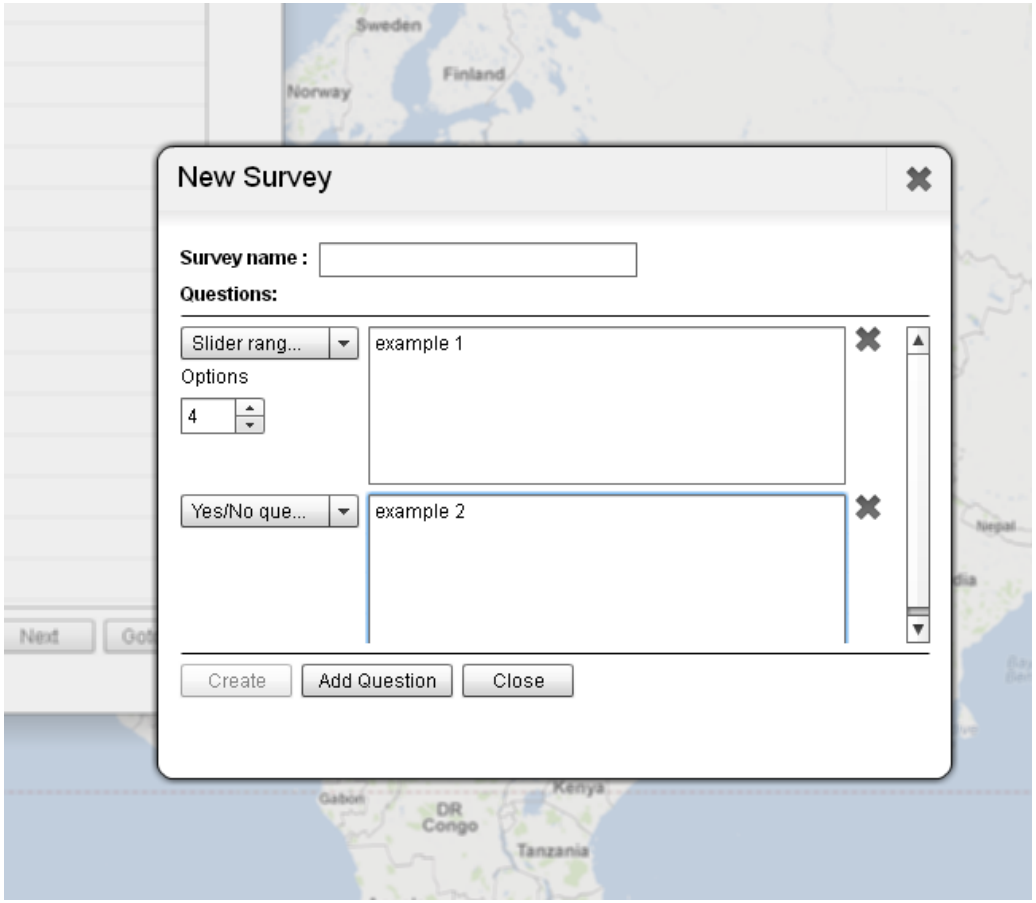


Senso-Meter 3.0



SensoMeter 2.0 – Web Interface

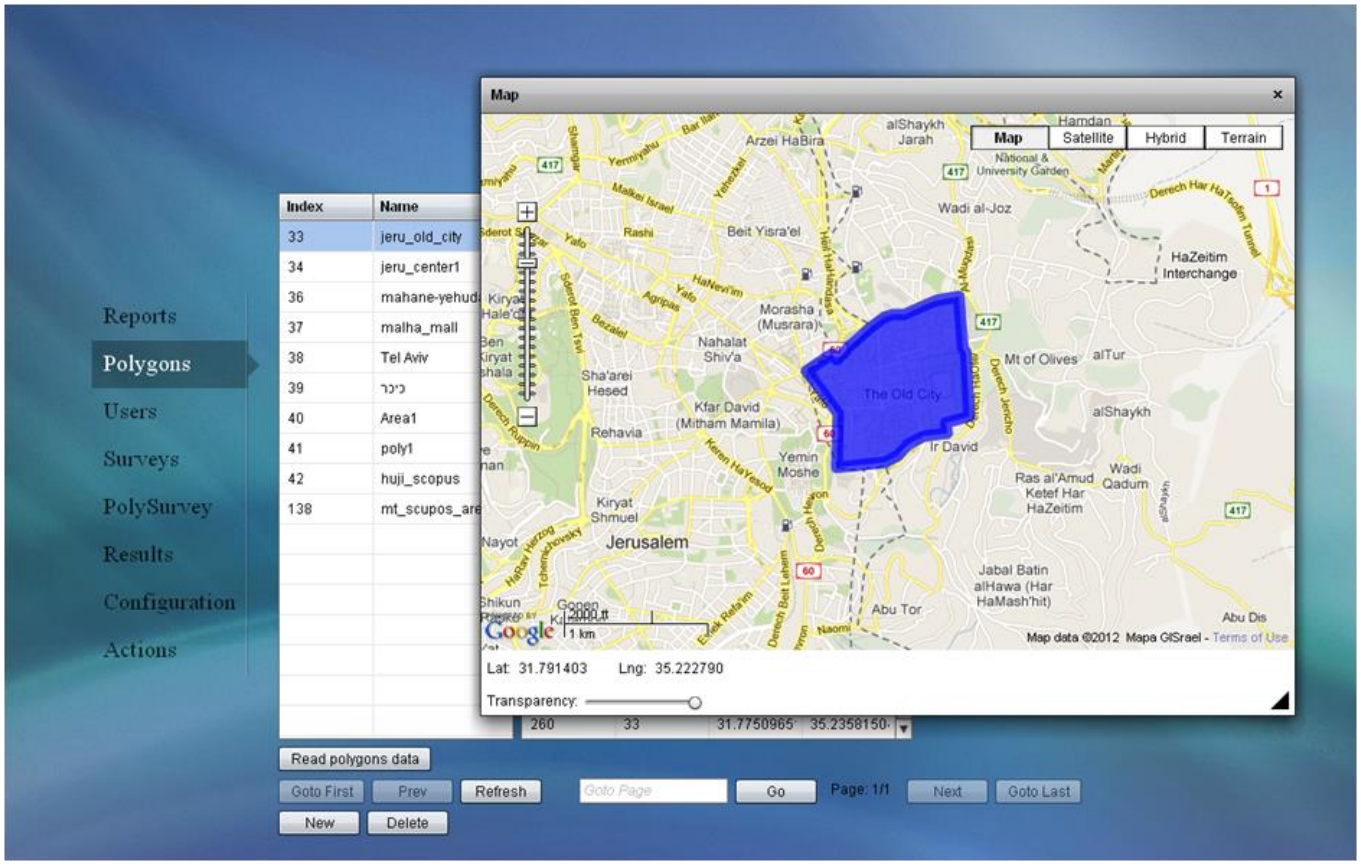
Author questionnaires



SensoMeter 2.0 – Web Interface

Define polygons

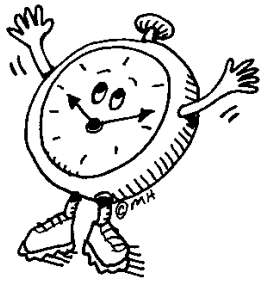
(in which surveys will be triggered)



The system allows to configure surveys' triggers based on:

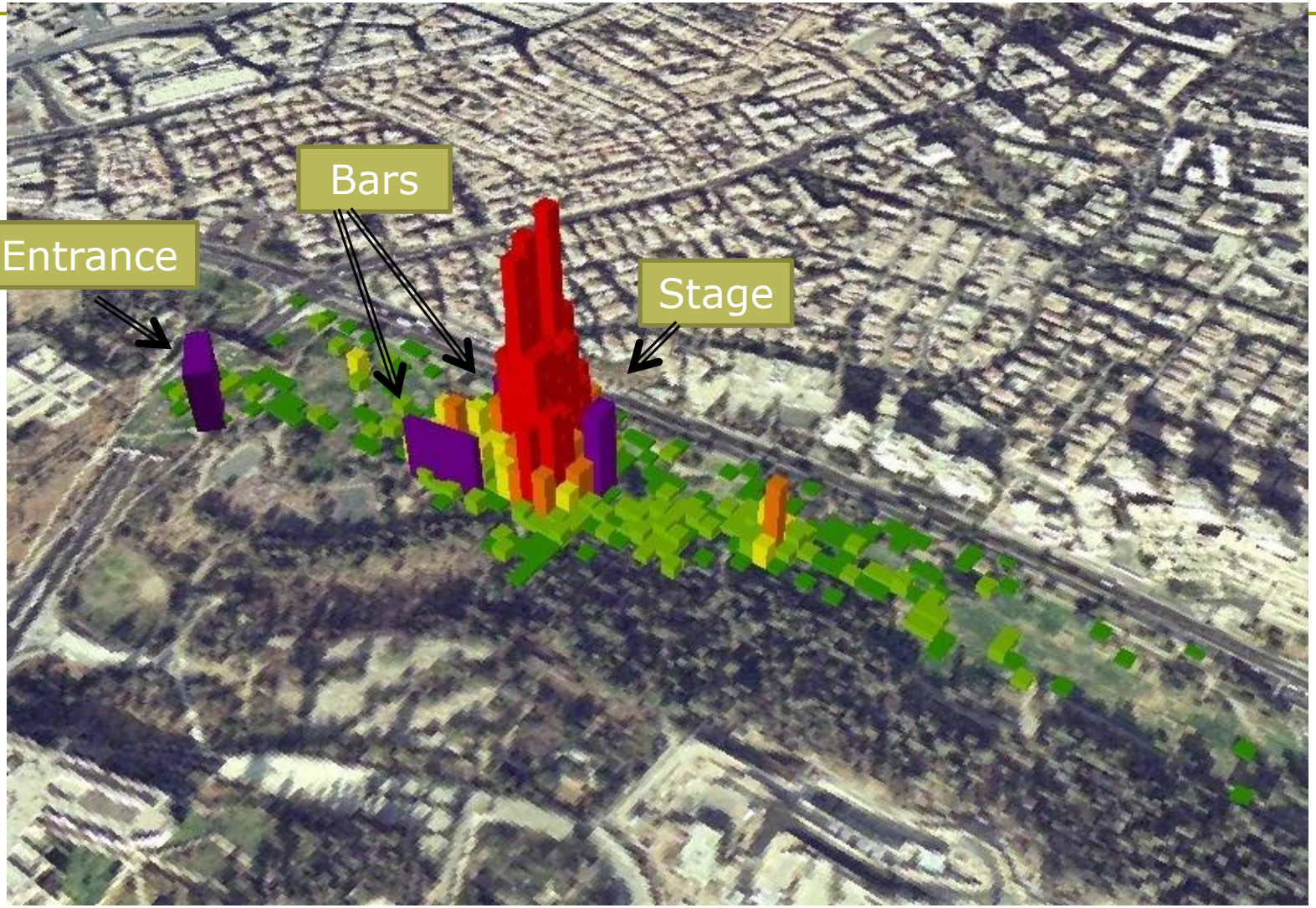
- Location

- Time (specific time, interval)

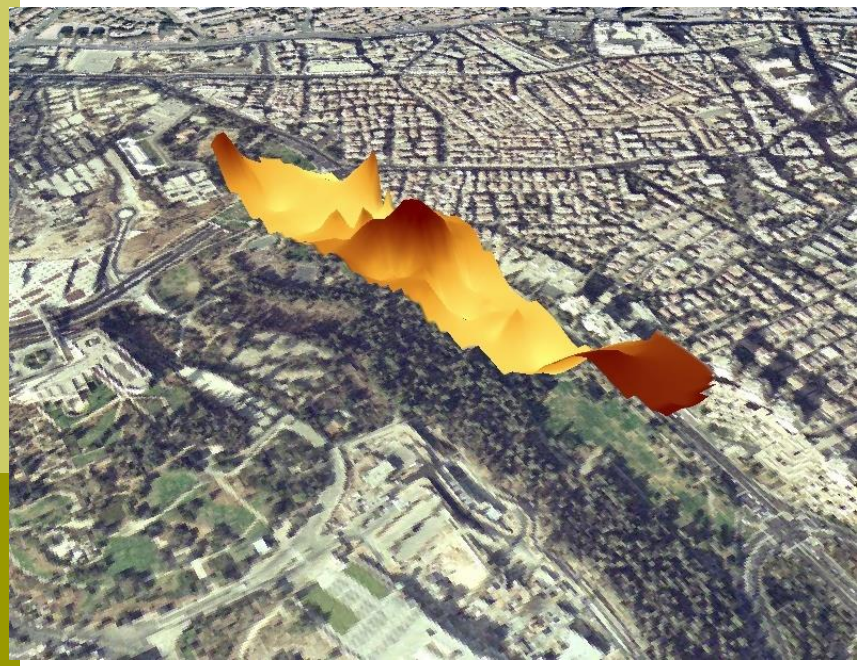


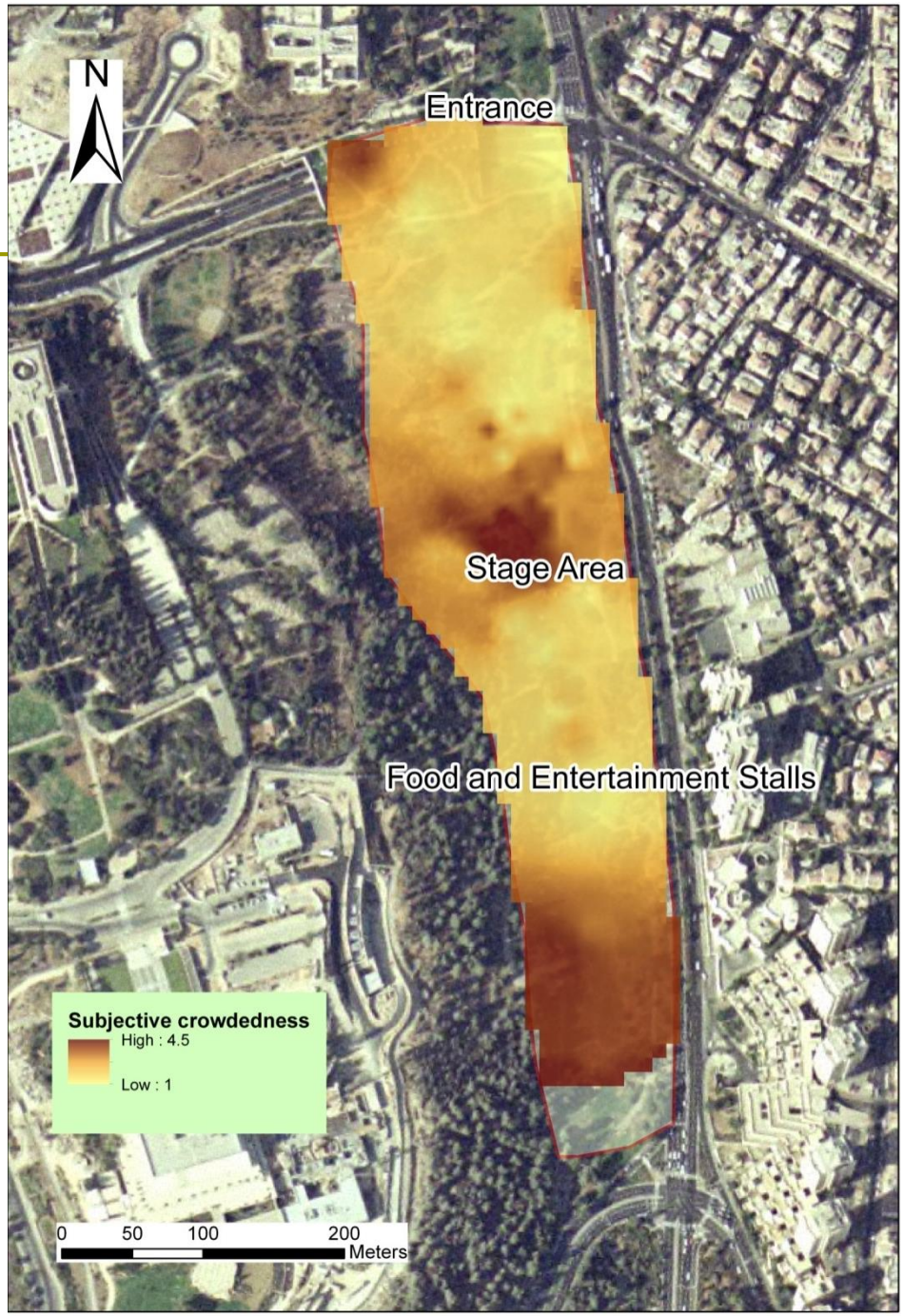
The Hebrew University in Jerusalem
Student's Day

Objective Crowdedness

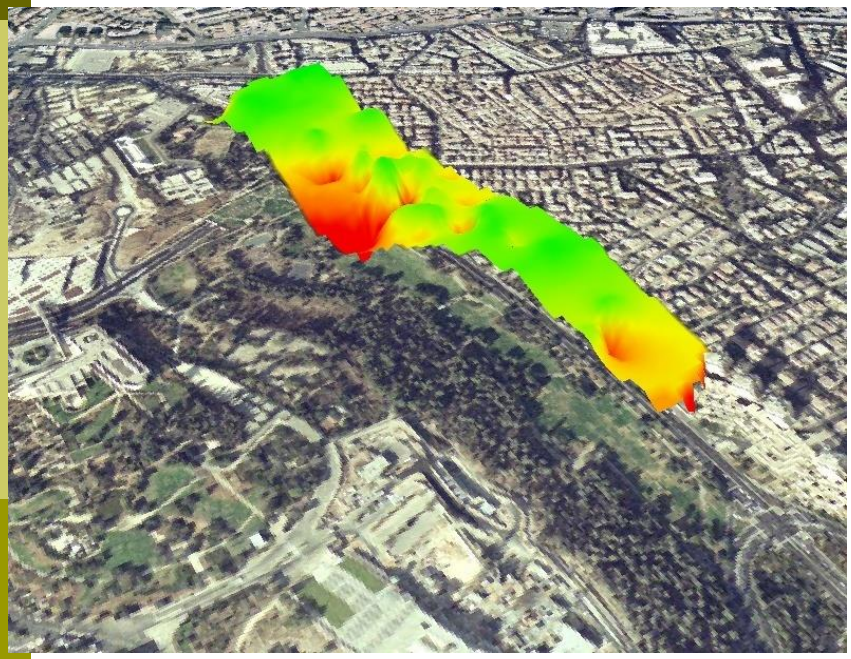


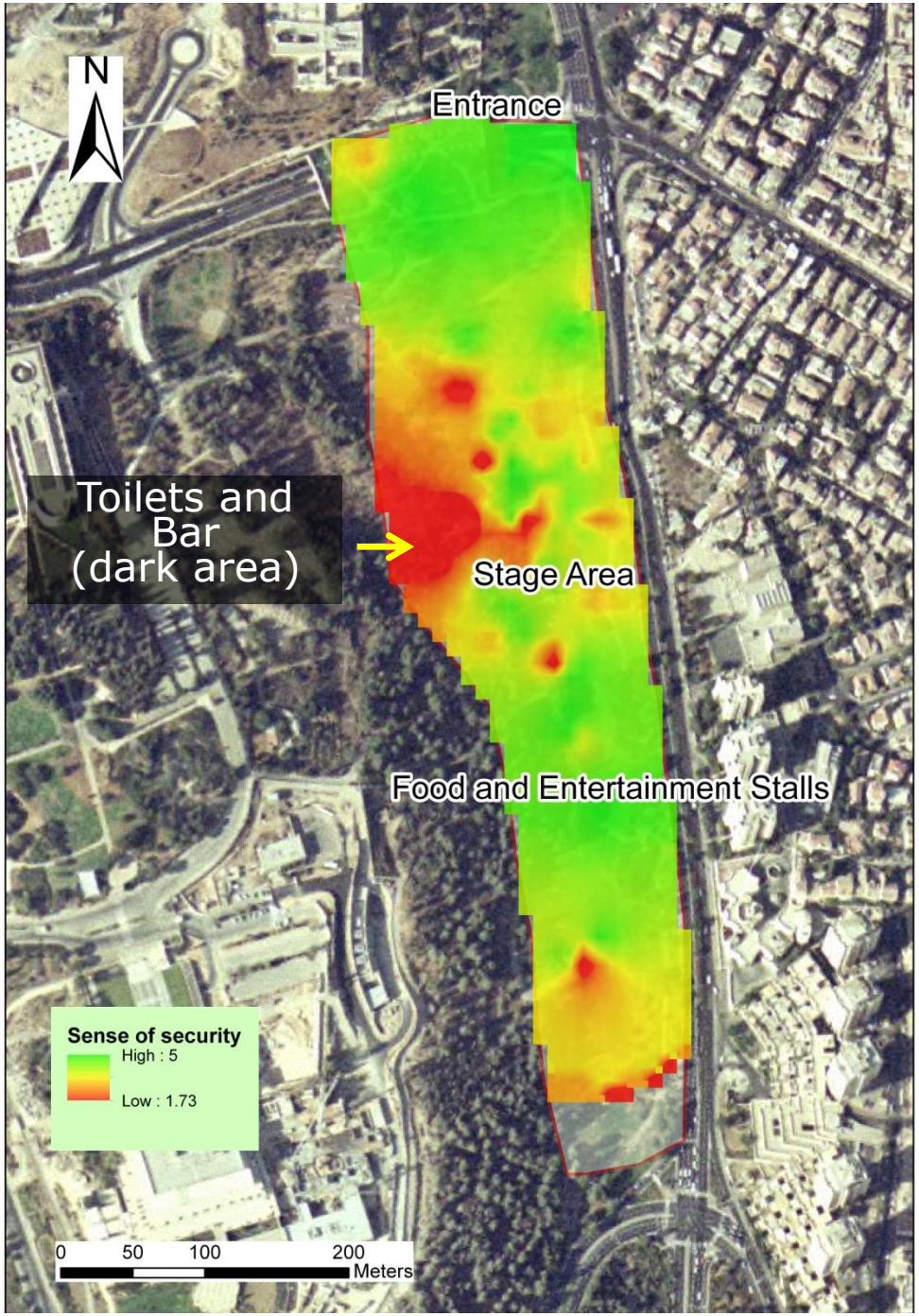
Subjective Crowdedness





Sense of Security





Text Messages

Queue at the Entrance to the Compound

time	description
20:15:21	not very crowded at the entrance to the student's day
21:13:08	crowded at the entrance
21:33:35	was not crowded at the entrance
21:34:05	smooth entrance to the compound
21:37:09	I entered, not crowded
21:55:54	Moderate crowding at the ticket office
21:57:10	crowded at the entrance
22:03:10	not very crowded at the entrance to the compound
22:03:13	not very crowded at the entrance
22:06:19	queue at the entrance
22:08:20	Everything went smooth at the entrance
22:09:57	Convenient at the entrance
22:33:17	I've arrived, relatively long queue
22:33:58	I've arrived, the queue is relatively long
22:39:54	Entrance, long queue
22:43:50	Great, not crowded at the entrance

not crowded
moderate
crowded

Visual Reports

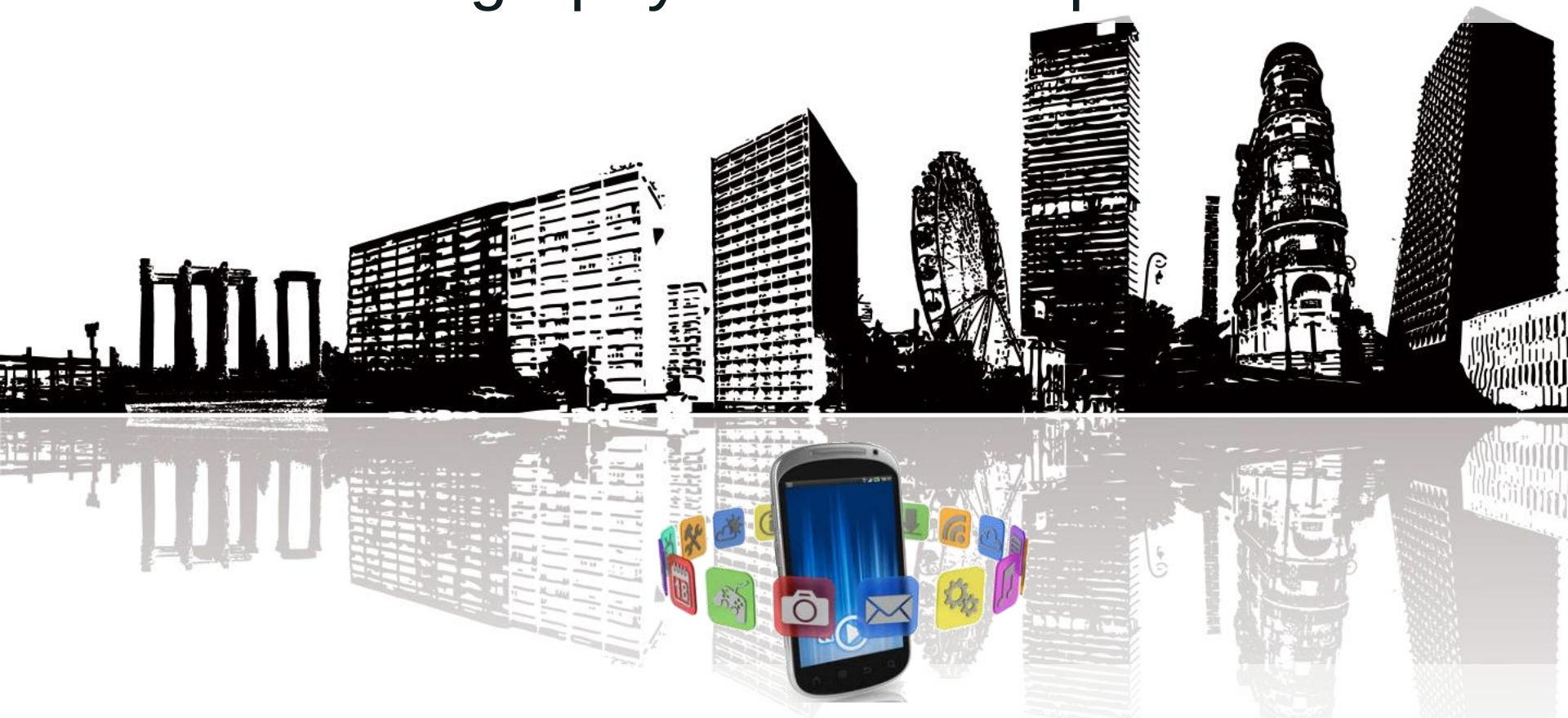
Participant 566, 02:43

The garbage around is annoying, but I guess it is normal for such events…

Participant 366, 00:48

Drunk girl

Sensing the City in the Smartphone Age:
The Geography of Urban Experiences



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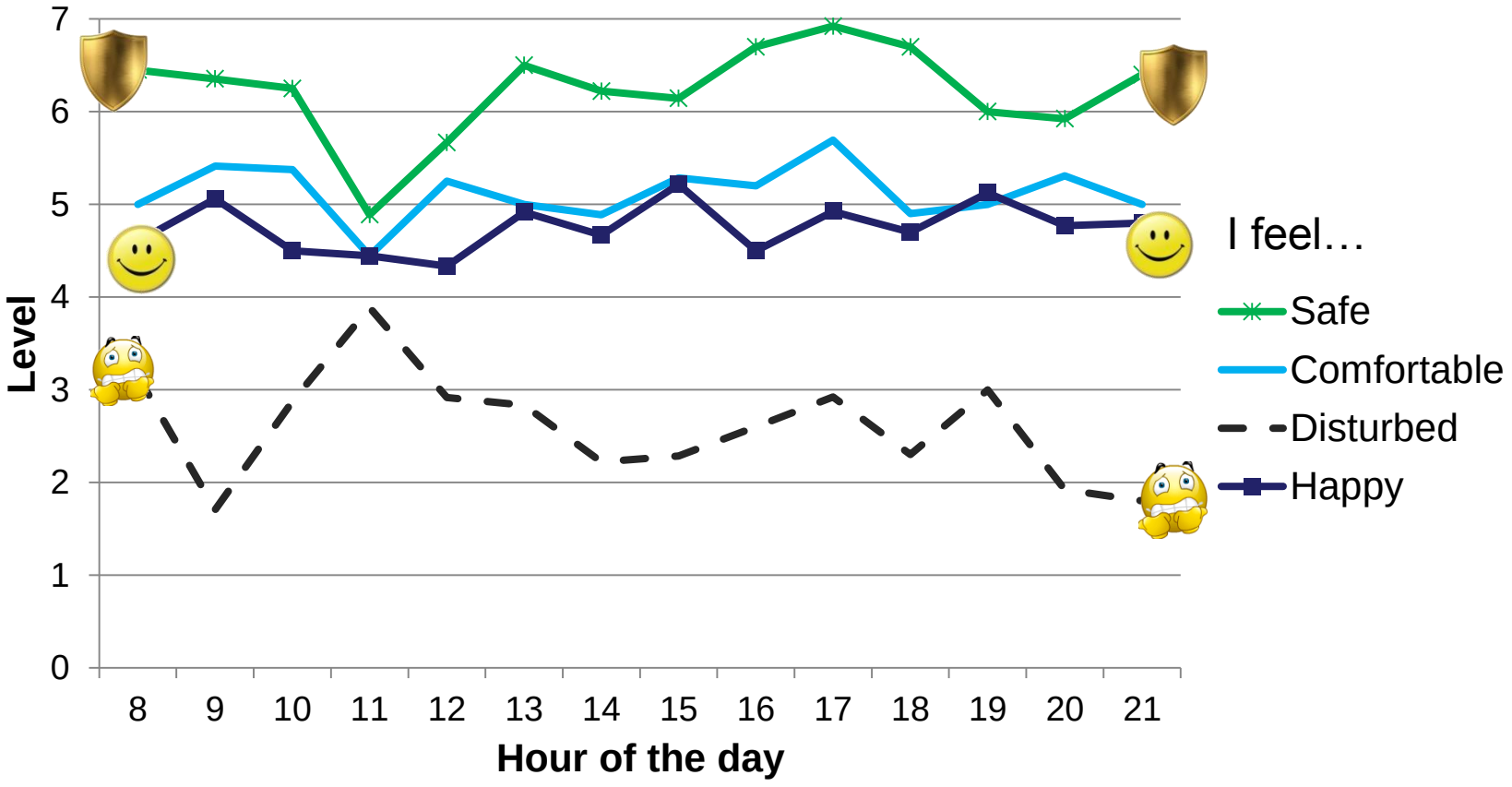
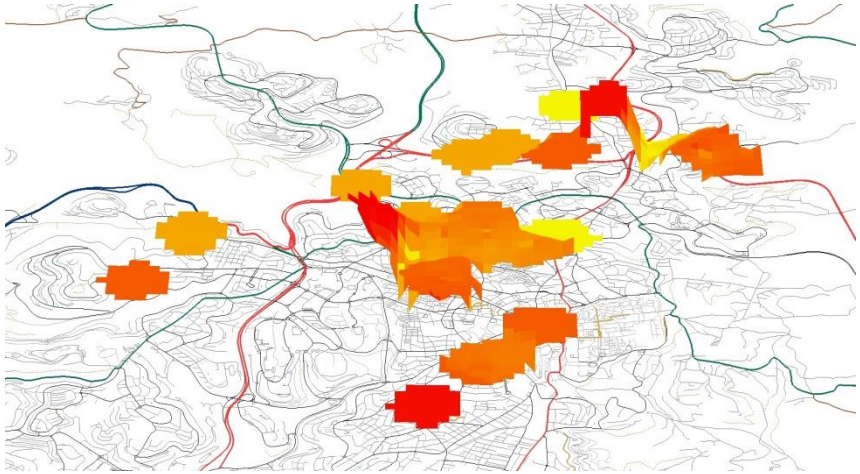
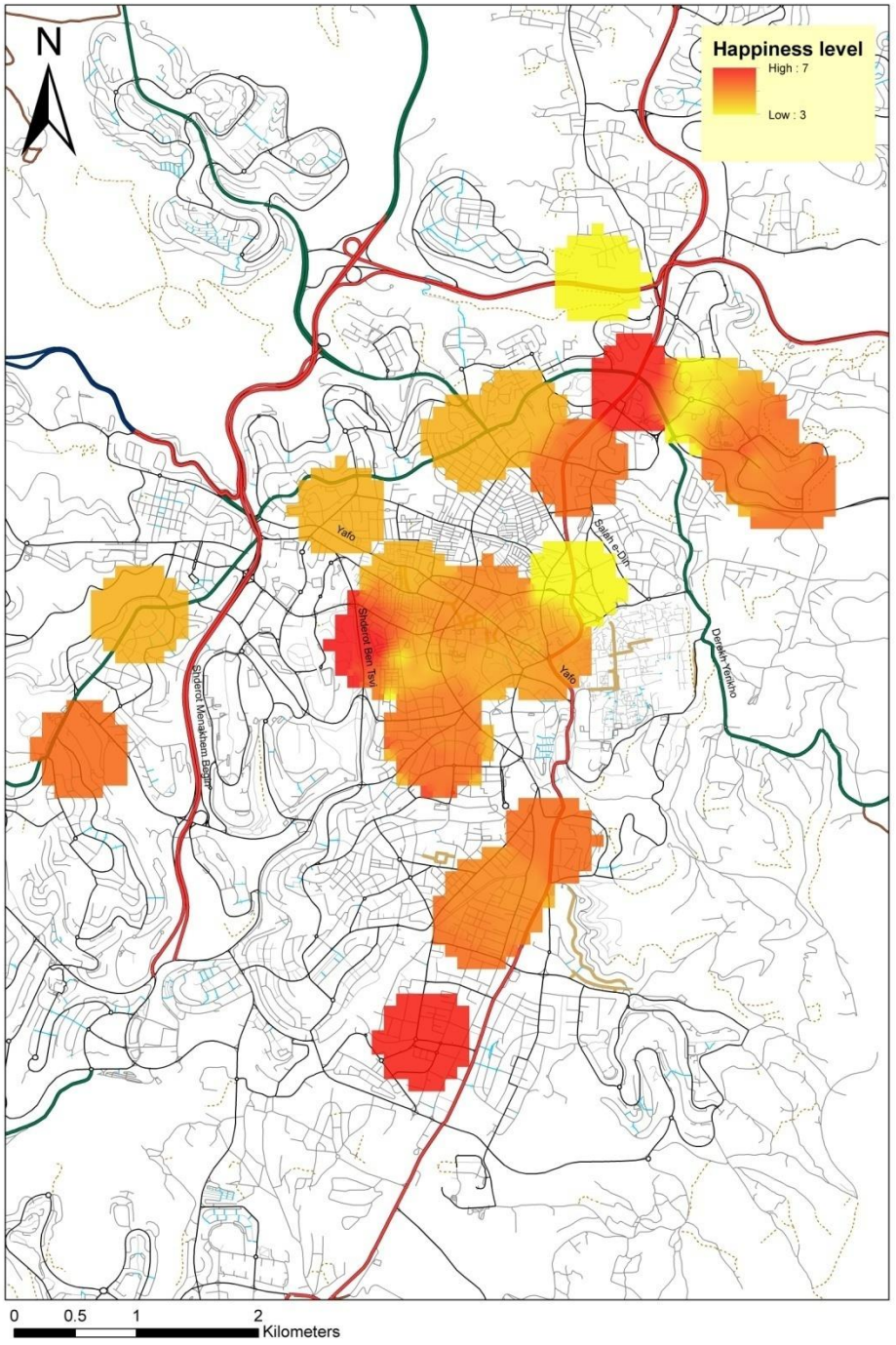
Does Time affect Our Experiences?



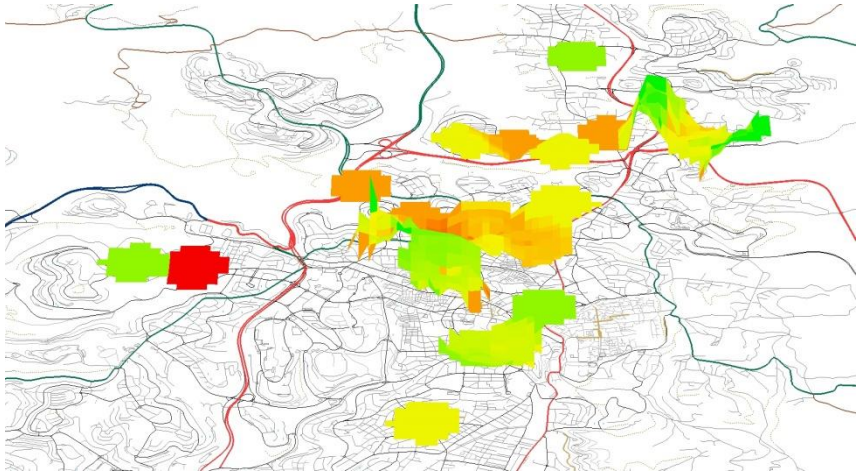
n	20	17	8	9	12	12	9	14	10	13	10	8	13	10

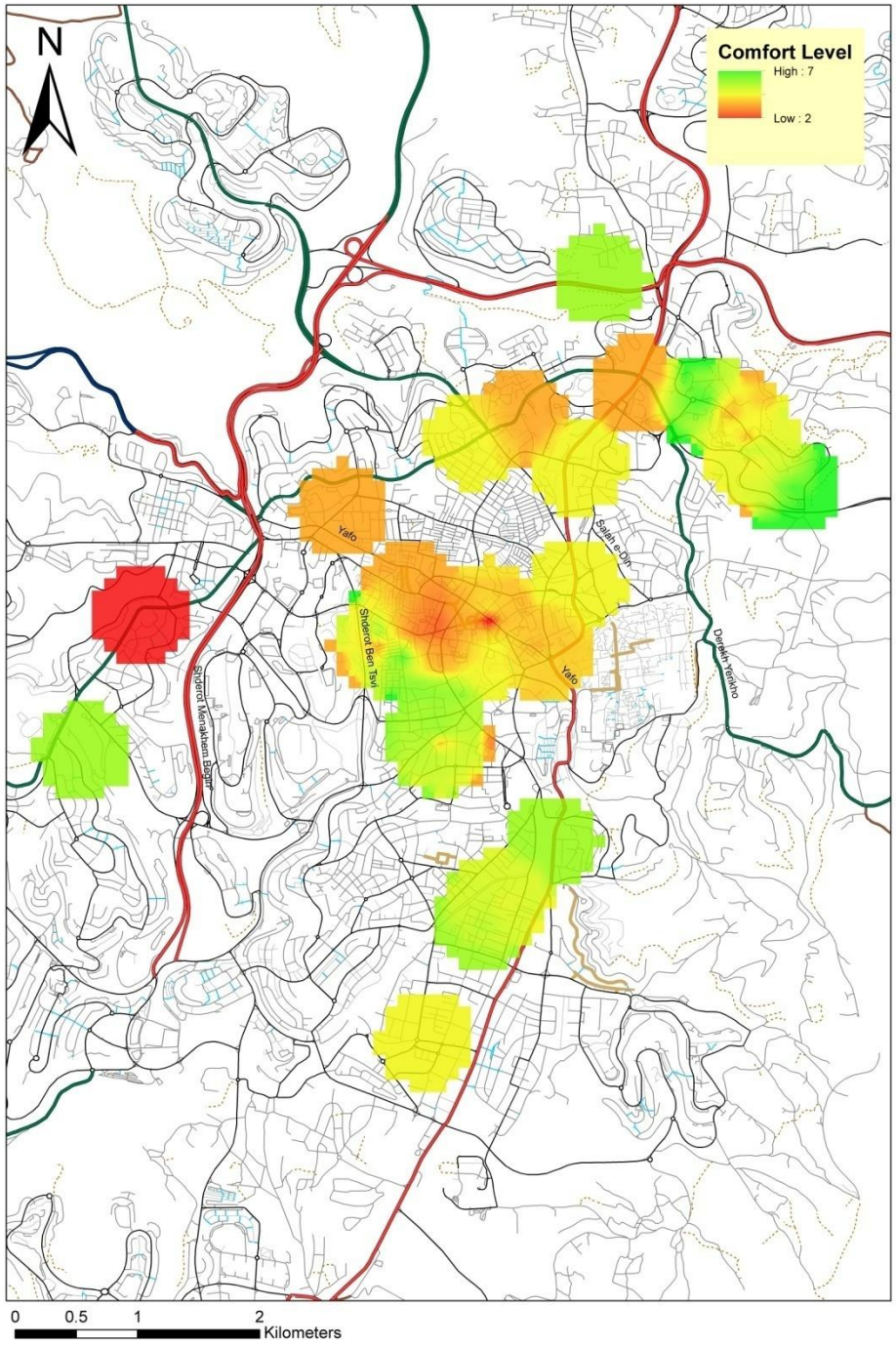
Happiness Level





Comfort Level





Smartphones - Advantages

- Easy to disseminate surveys (communication technology)
- Researchers do not need to buy hardware (phones)
- Has the potential to reduce surveys costs
- Questioning in real time – reduces recall bias
- People take them everywhere

Smartphones – Still Some Challenges

- Problem with the sample
  - Not everybody owns (yet) a smartphone (older adults, lower socio-economic status, developing countries)
- Technical issues:
  - Short battery life
  - GPS/Location is usually not as good as with designated devices
  - Adapting our applications to several platforms and OS
- Will people download the app? How will we draft people? (while keeping a representative sample)
- Researcher is still dependent on participants cooperation (to turn on Wi Fi and GPS, enable application)

Thank You Very Much!

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