UrBio

Making urban planning an design smarter with participatory mobile biosensing

U LISBOA | UNIVERSIDADE DE LISBOA
IGOT Instituto de Geografia e Ordenamento do Território UNIVERSIDADE DE LISBOA
CEG Centro de Estudos Geográficos
FCT Fundação para a Ciência e a Tecnologia
EXPL/GES-URB/0273/2021

UrBio

Daniel Paiva (PI)

Herculano Cachinho (co-PI)

Ana Estevens

Ana Gonçalves

Daniela Ferreira

Eduardo Brito Henriques

Inês Boavida Portugal

Nuno Rodrigues

UrBio

THE OBJECTIVE OF THIS PROJECT is to develop and test inclusive and participatory mixed methodologies that use biosensor data to plan and design healthy, convivial, and sustainable tourism, consumption and leisure areas.

UrBio

- What is biosensing and what is it good for?
- The goals and research of project UrBio
- Our results so far
- A small experiment

Types of Biosensing

Electrodermal Activity (EDA)

- Electrical phenomena in skin, including all active and passive electrical properties which can be traced back to the skin and its appendages. (Boucsein, 2012, p. 2).
- It has been used as an indicator of emotional arousal.

Electroencephalogram (EEG)

- Records the electrical signals produced by the various regions of the brain.
- It has been used to identify emotions in real time (Aspinall et al., 2015).

Cortisol Level

- Cortisol is a hormone which is produced by the body in response to stress. It can be found in the saliva.
- Salivary cortisol is used as a biomarker for variation in stress levels (Thompson et al., 2012).

Eye-Tracking

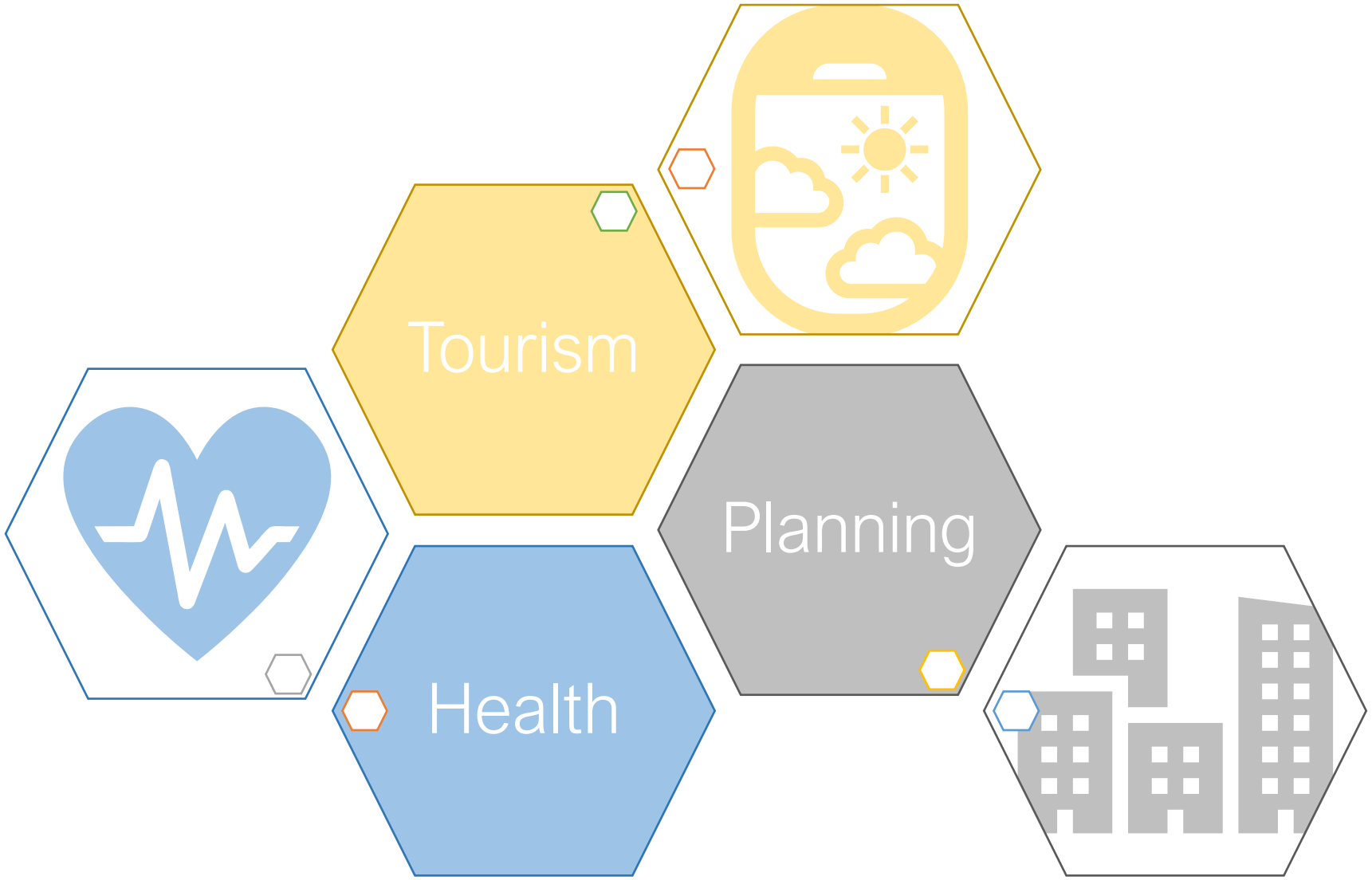
- Eye-tracking records the gaze of an individual in a given environment.
- Eye-tracking has been used to understand which spatial features capture the attention of individuals (Hollander et al., 2019).

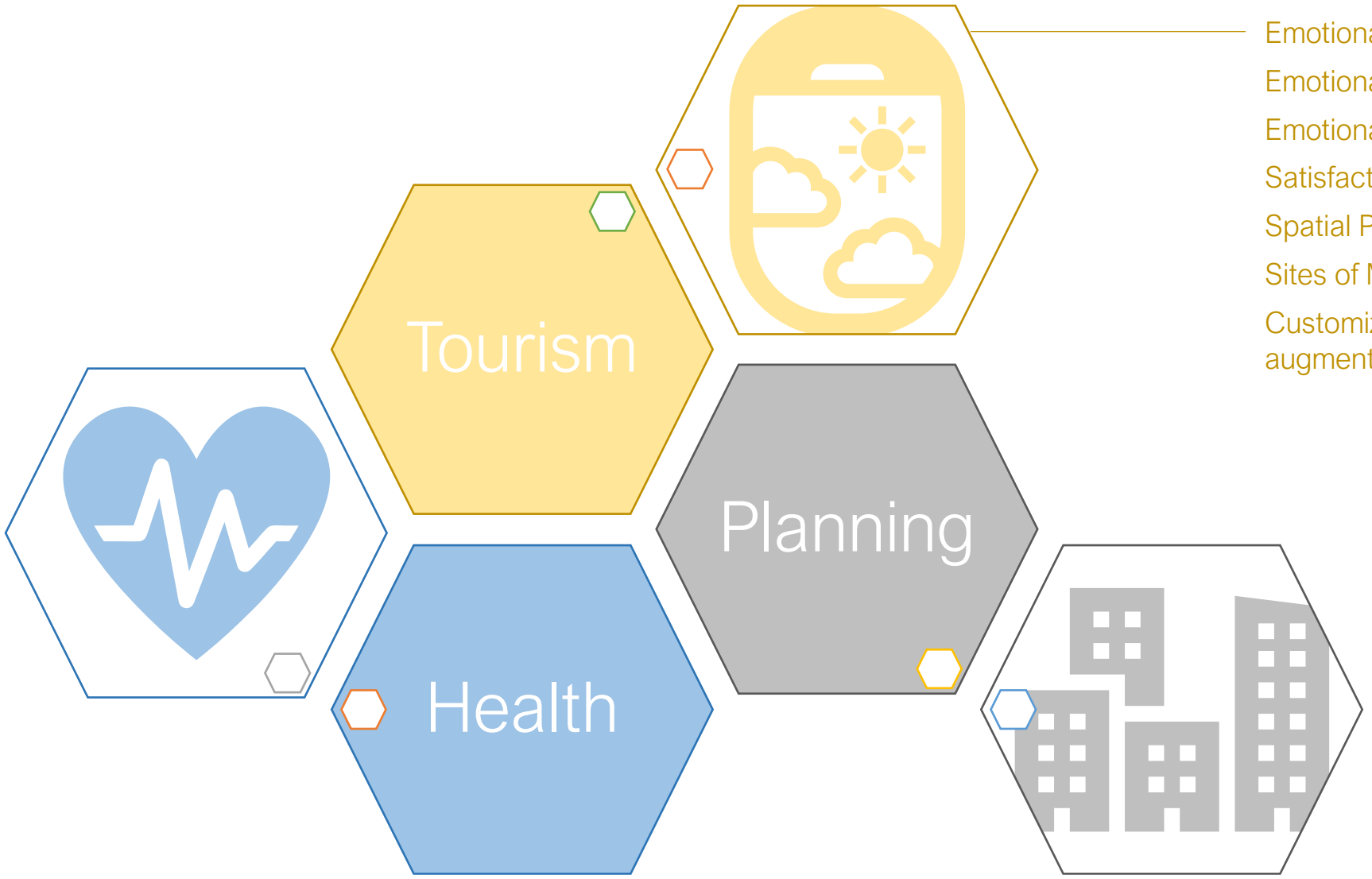
functional Magnetic Resonance Imaging (fMRI)

- Measures brain activity by detecting bloodflow.
- It has been used to study environmental imagery, virtual reality , or in post-hoc studies (Reichert et al., 2018).

Mobile Ecological Context

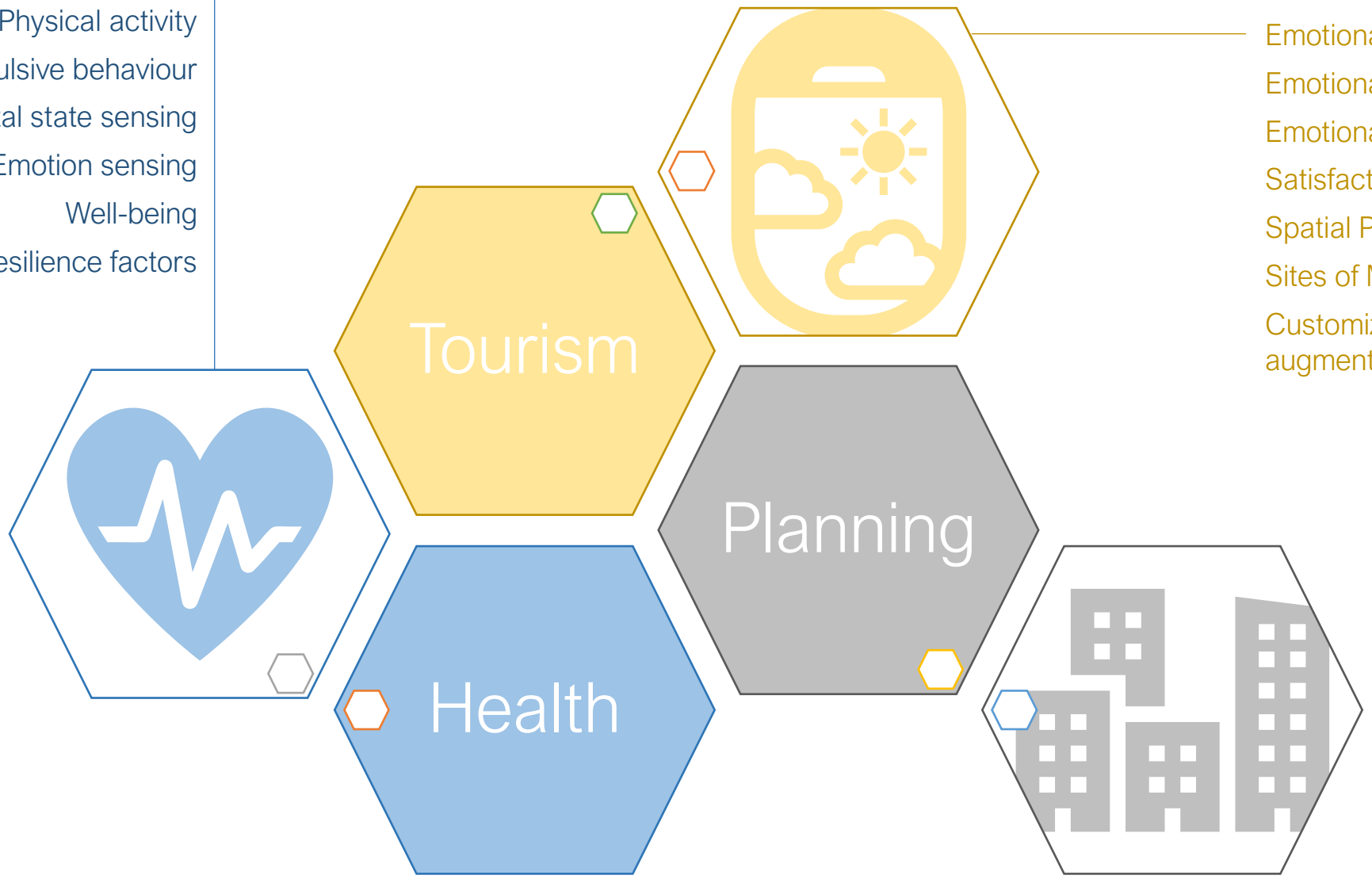
Static Laboratory Context


Tourism
Planning
Health



- Emotional measurement
- Emotional engagement
- Emotional responses
- Satisfaction
- Spatial Points of Emotion
- Sites of Memory
- Customization and augmentation of experiences

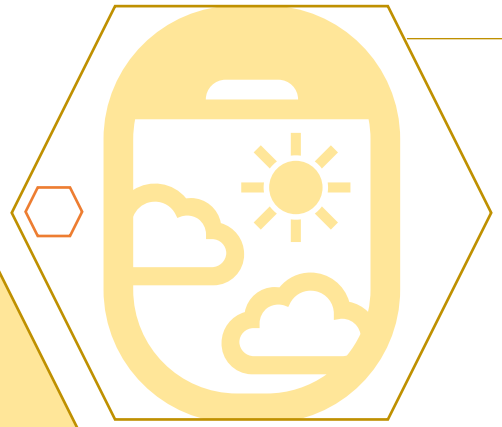
Stress
Physical activity
Compulsive behaviour
Mental state sensing
Emotion sensing
Well-being
Risk and resilience factors



Emotional measurement
Emotional engagement
Emotional responses
Satisfaction
Spatial Points of Emotion
Sites of Memory
Customization and augmentation of experiences

Stress
Physical activity
Compulsive behaviour
Mental state sensing
Emotion sensing
Well-being
Risk and resilience factors

Tourism



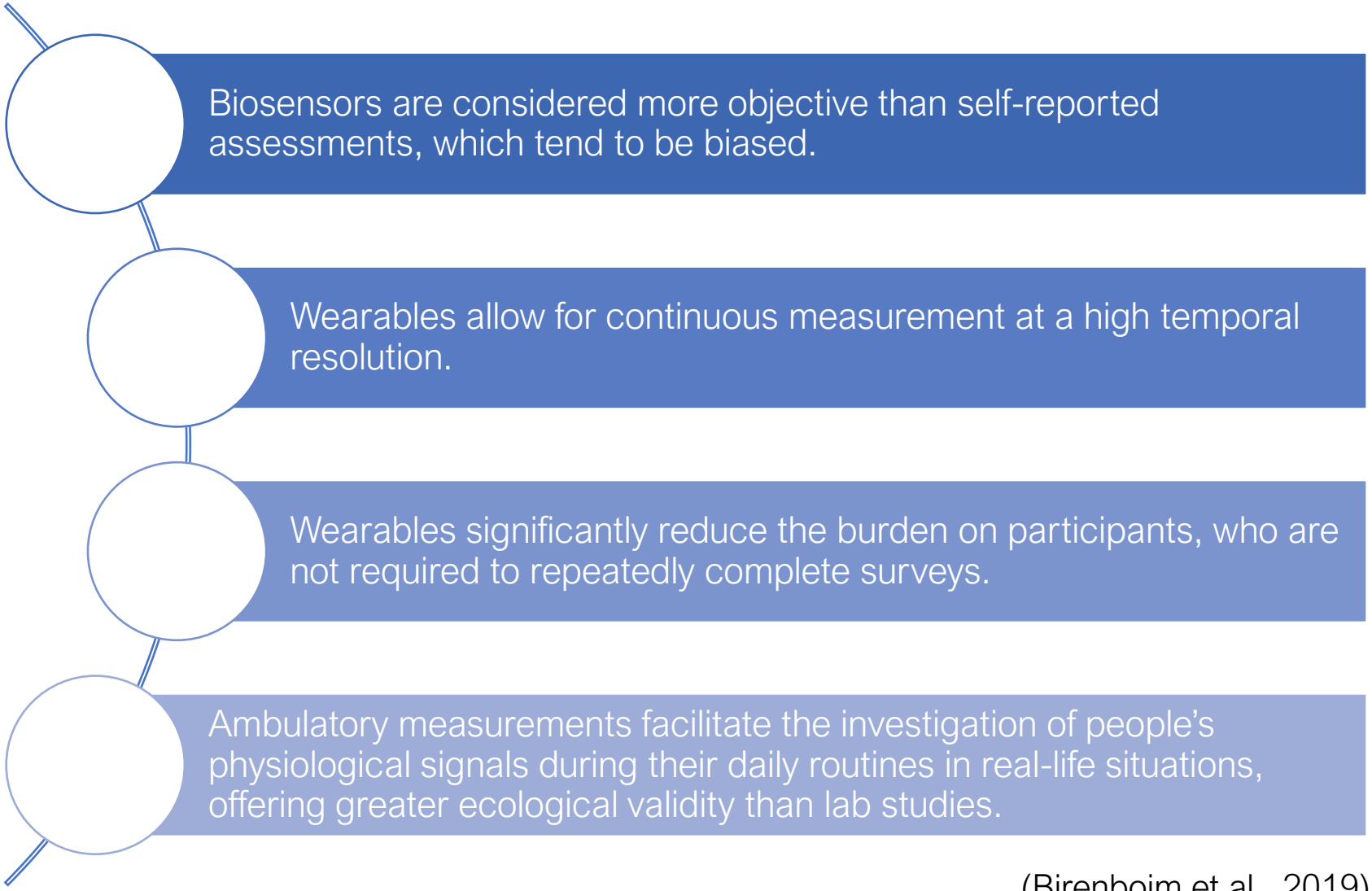
Emotional measurement
Emotional engagement
Emotional responses
Satisfaction
Spatial Points of Emotion
Sites of Memory
Customization and augmentation of experiences

Health

Planning

Urban analysis
Urban emotions
Cognitive responses
Communicating experience
City well-being
Urban Design

Four Advantages of Biosensing



(Birenboim et al., 2019)

Limitations

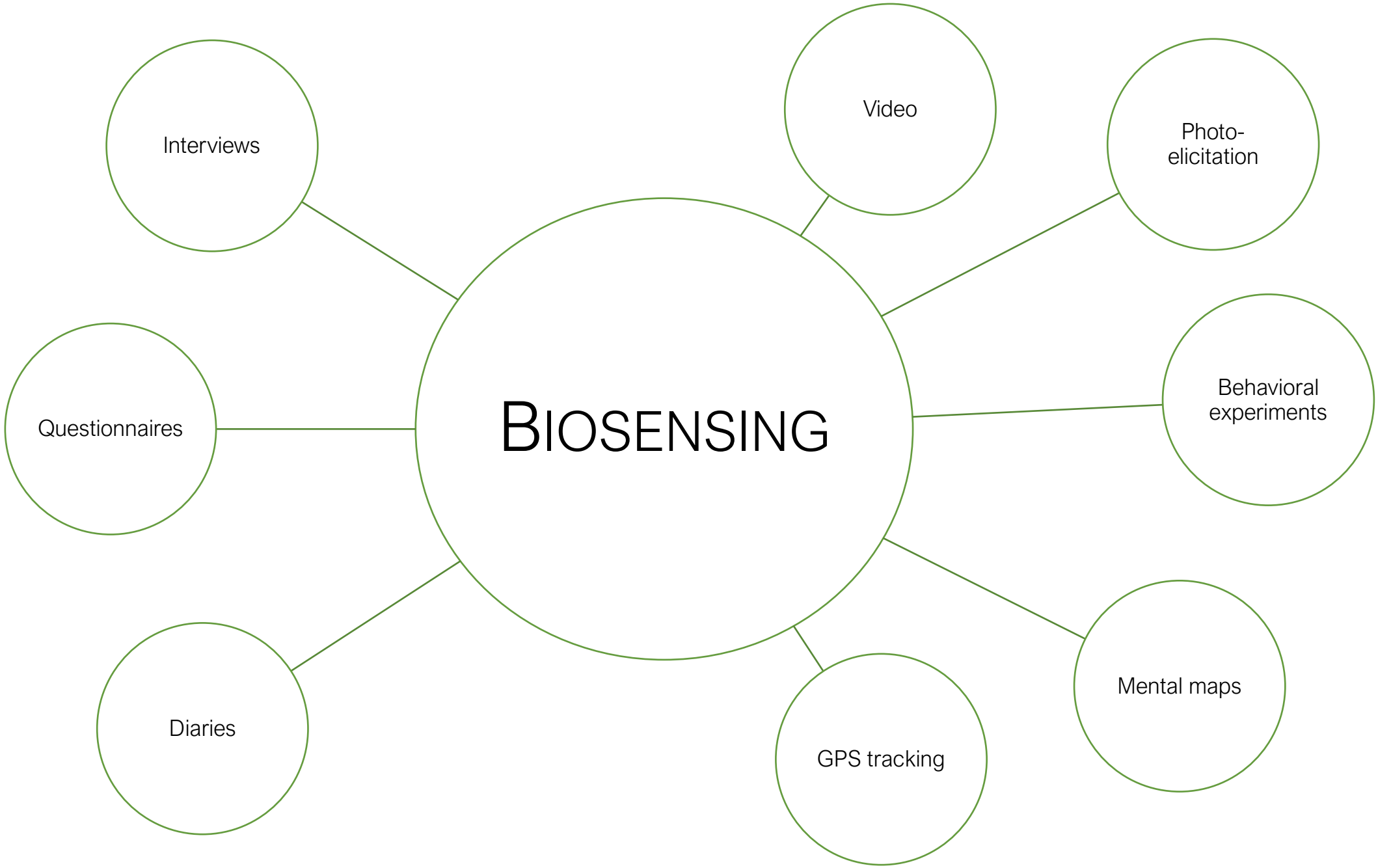
Objetivity

- Biosensing data cannot be assigned to a certain event unambiguously (Shoval et al., 2017; Reif & Schmücker, 2021)
- Biosensors might not detect low-intensity changes or be sensitive to differing cultural understandings of emotions (Pykett et al., 2020)
- Biosensing can capture the ‘what’ but not the ‘why’ (Osborne & Jones, 2017)
- Physical activity influences biosensor data (Pykett et al., 2020; Reif & Schmücker, 2021)
- Difficulties in standardization (Shoval et al., 2017)

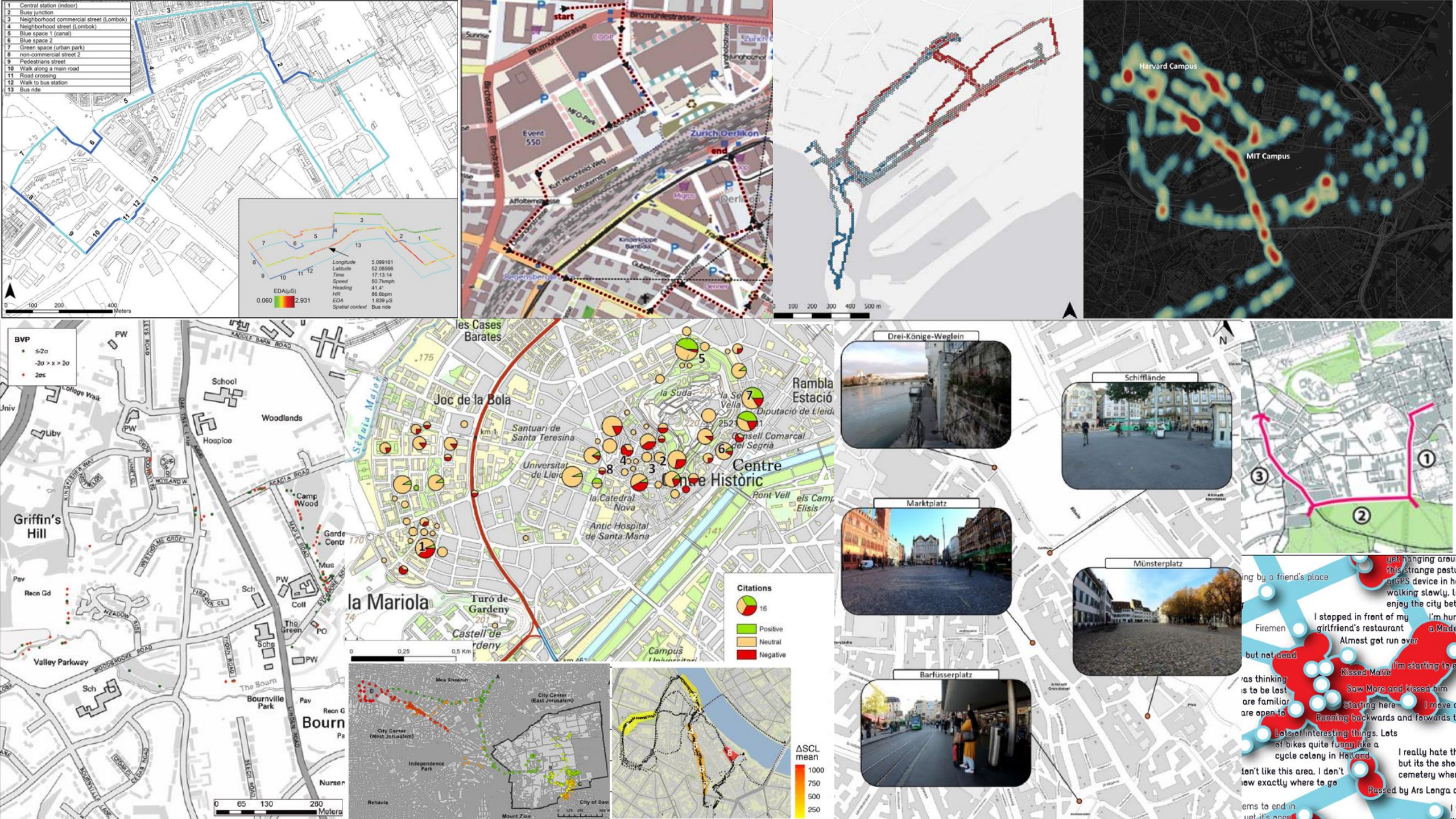
Non-interference

- The use of biosensor equipment can be understood as very invasive (Reif & Schmücker, 2021).

“A key takeaway from this is that using additional data sources and combined qualitative methods is fundamentally important for an in-depth understanding of the valence of the tourist emotions measured using biosensing” (Reif & Schmücker, 2021, p. 282)

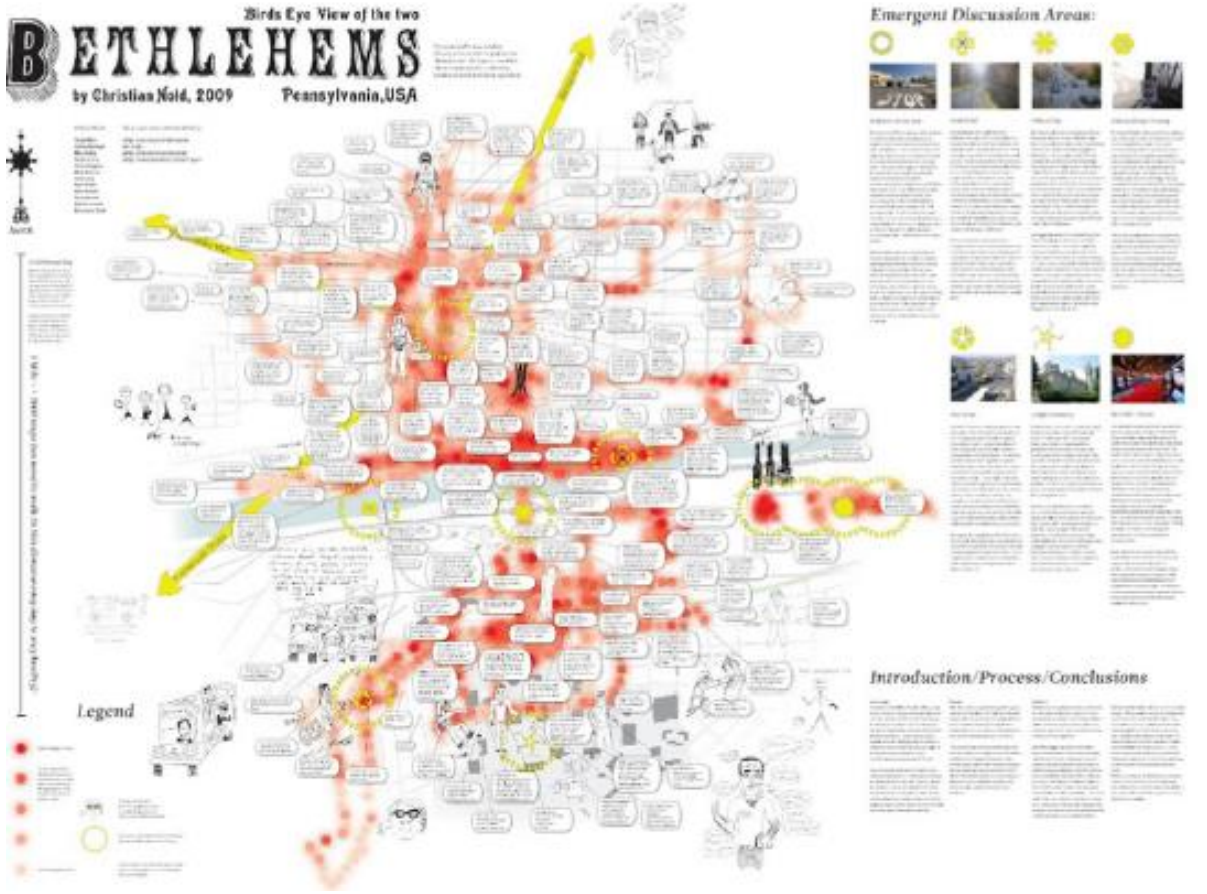

Interviews
Video
Photo-
elicitation
Questionnaires
BIOSENSING
Behavioral
experiments
Diaries
GPS tracking
Mental maps

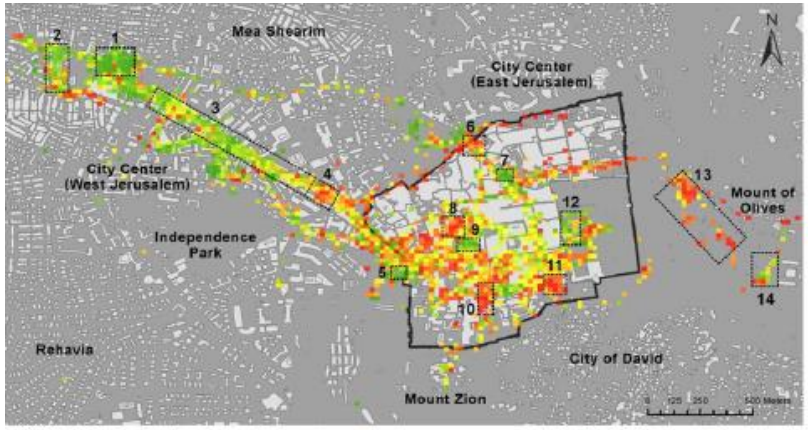
“…even understanding the “what” seems to be a challenging task.” (Reif & Schmücker, 2021, p. 290)



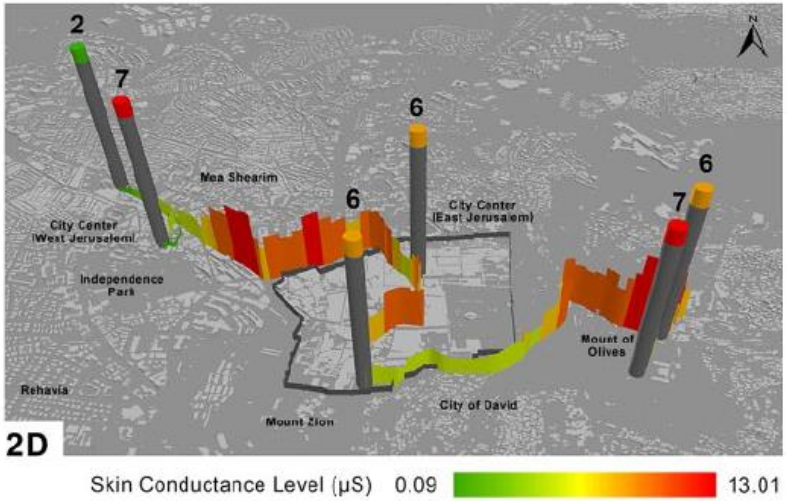
1 Central station (indoor)
2 Busy junction
3 Neighborhood commercial street (Lombok)
4 Neighborhood street (Lombok)
5 Blue space 1 (canal)
6 Blue space 2
7 Green space (urban park)
8 non-commercial street 2
9 Pedestrians street
10 Walk along a main road
11 Road crossing
12 Walk to bus station
13 Bus ride
Longitude 5.099161
Latitude 52.08566
Time 17:13:14
Speed 50.7kmph
Heading 41.4°
HR 86.6bpm
EDA 1.839 µS
Spatial context Bus ride
EDA(µS)
0.060
2.931
Meters
start
end
Binzmühlestrasse
Zurich Oerlikon
Event 550
Harvard Campus
MIT Campus
BVP
Joc de la Bola
Santuari de Santa Teresina
Universitat de Lleida
Centre Històric
Rambla Estació
la Catedral Nova
Antic Hospital de Santa Maria
la Mariola
Turó de Gardeny
Citations
16
Positive
Neutral
Negative
Drei-Könige-Weglein
Schifflände
Marktplatz
Münsterplatz
Barfüsserplatz
Woodlands
Hospice
Griffin's Hill
Valley Parkway
Bournville Park
Firemen
I stopped in front of my girlfriend's restaurant
Almost got run over
Kissed Marie
Saw Marc and kissed him
Starting here
Running backwards and forwards
Lots of interesting things. Lots of bikes quite funny like a cycle colony in Holland
ΔSCL mean
1000
750
500
250

Here the gate was closed at the old people's home
Church
Just happy to walk here
Low arc
Small corner point
There is a little street that I liked and I just walked down it
stresse car les sans -papiers la regardent avec la machine
Someone was walking behind me and was loc
I never saw this place before of worker's house - dead end street
©2005 Google


Birds Eye View of the two
BETHLEHEMS
by Christian Nold, 2009
Pennsylvania, USA
Emergent Discussion Areas:
Introduction/Process/Conclusions
Legend


Mea Shearim
City Center (East Jerusalem)
City Center (West Jerusalem)
Independence Park
Mount of Olives
Rehavia
City of David
Mount Zion
1. Abraham Hostel
2. Machne Yehuda
8. Church of the Holy Sepulchre
9. Muristan Rooftop
-5.68
7.66
SCL Z-Score

Mea Shearim
City Center (West Jerusalem)
City Center (East Jerusalem)
Independence Park
Mount of Olives
Rehavia
City of David
Mount Zion
2A


Mea Shearim
City Center (West Jerusalem)
City Center (East Jerusalem)
Independence Park
Mount of Olives
Rehavia
City of David
Mount Zion
2D
Skin Conductance Level (µS) 0.09 13.01

UrBio

Making urban planning an design smarter with participatory mobile biosensing

UrBio

Thus far, biosensors have been mostly used in urban studies to achieve better accuracy on the emotions that public space elicit on urban dwellers. In our research, we want to include citizens in the research process, and use biosensor data to allow them to reflect and express the impact of the urban environment on their everyday experiences.

There needs to be a consideration of…

1) multi-dimensional emotion data

2) an active participant role

3) extended participation within the planning process

4), and empowerment within urban governance

(Willis & Nold, 2022)

Our research questions

1. How are biosensing technologies currently being used by citizens, and what will be the impact of the new generation of wearable biosensors in everyday life?
jan. – mar. 2022

2. How can wearable biosensor's data be used to enhance qualitative research on the experience of urban affective atmospheres?
abr. – dez. 2022

3. How can biosensor data be used to make urban planning and design more participatory?
jan. – jun. 2023

Our tasks

1. Exploratory research on biosensors in everyday urban life
   - Training workshop with postgraduate students
   - Biosensor tests
2. Biosensing the city: Transect walks
3. Biosensing the city: Participatory mapping
4. Biosensing the city: Scenario-elicitation
5. Planning application: Pilot study

Our research questions

1. How are biosensing technologies currently being used by citizens, and what will be the impact of the new generation of wearable biosensors in everyday life?
jan. – mar. 2022

2. How can wearable biosensor's data be used to enhance qualitative research on the experience of urban affective atmospheres?
abr. – dez. 2022

3. How can biosensor data be used to make urban planning and design more participatory?
jan. – jun. 2023

Our tasks

1. Exploratory research on biosensors in everyday urban life
   - Training workshop with postgraduate students
   - Biosensor tests

2. Biosensing the city: Transect walks

3. Biosensing the city: Participatory mapping

4. Biosensing the city: Scenario-elicitation

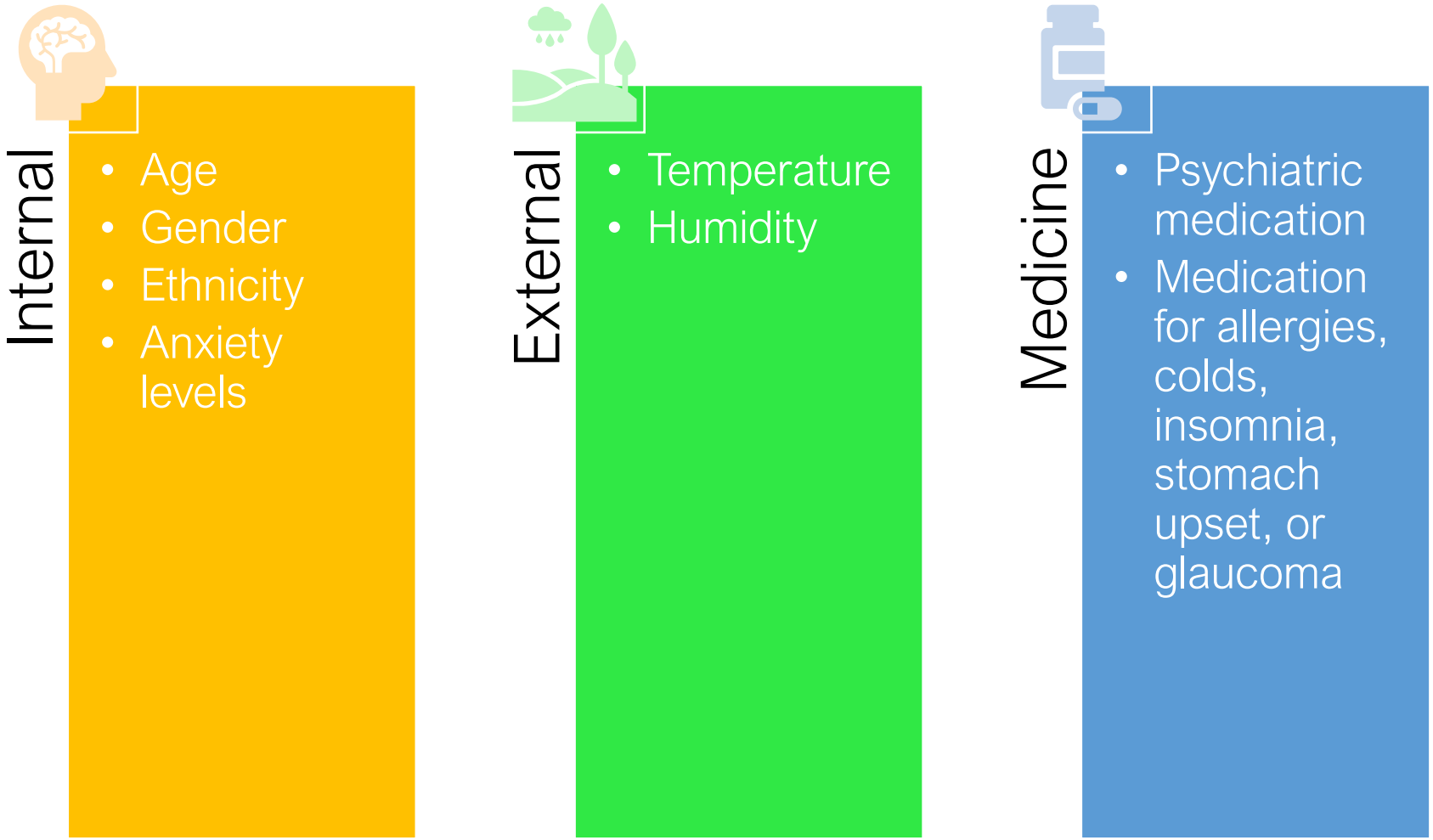
5. Planning application: Pilot study

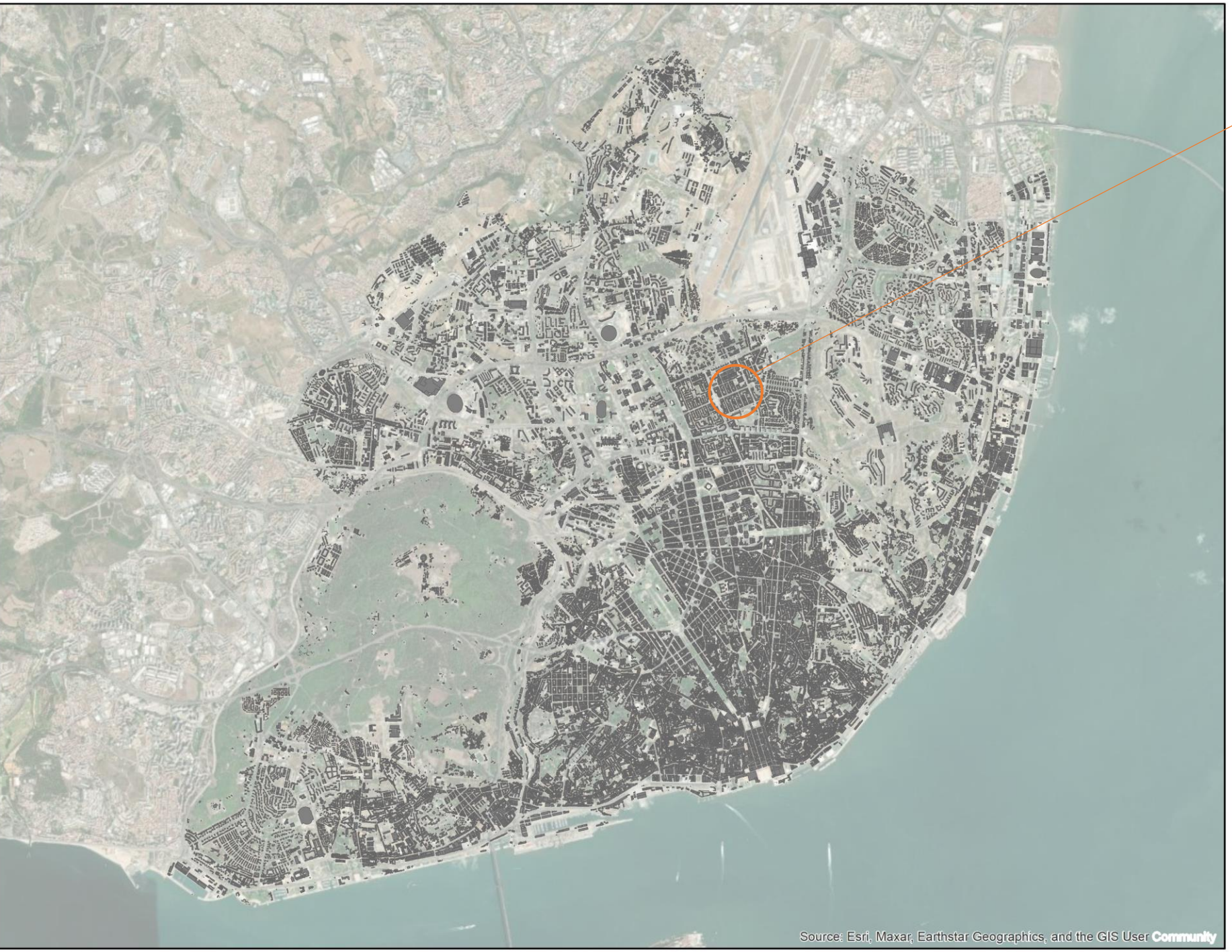
Equipment

Empatica E4 Wristband

EDA measures skin gland activity and can be used to measure the level of emotional arousal. To put it simply, EDA tells us how intensively we feel about places.

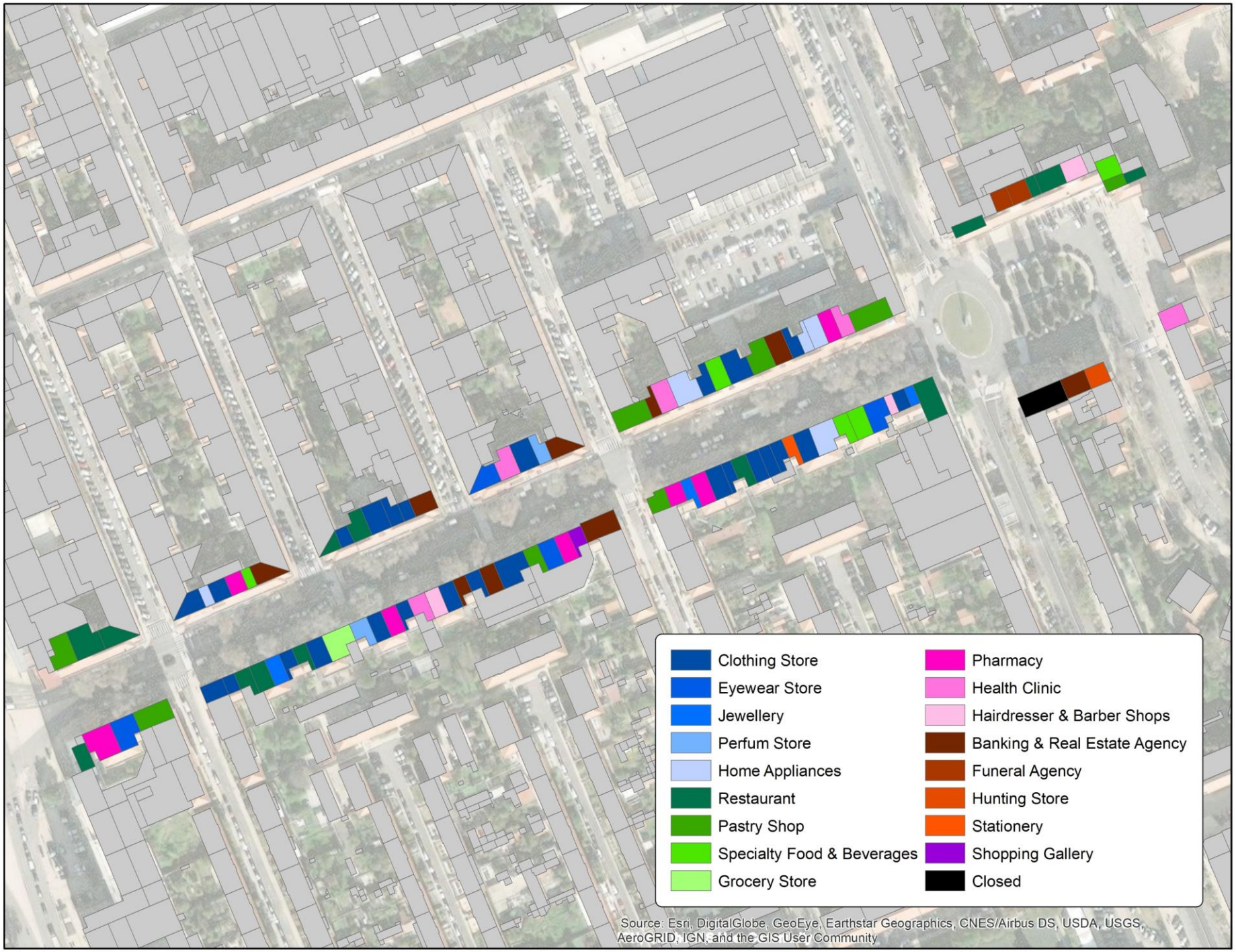
Factors that affect EDA



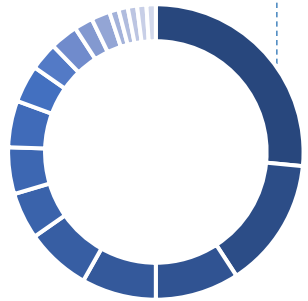


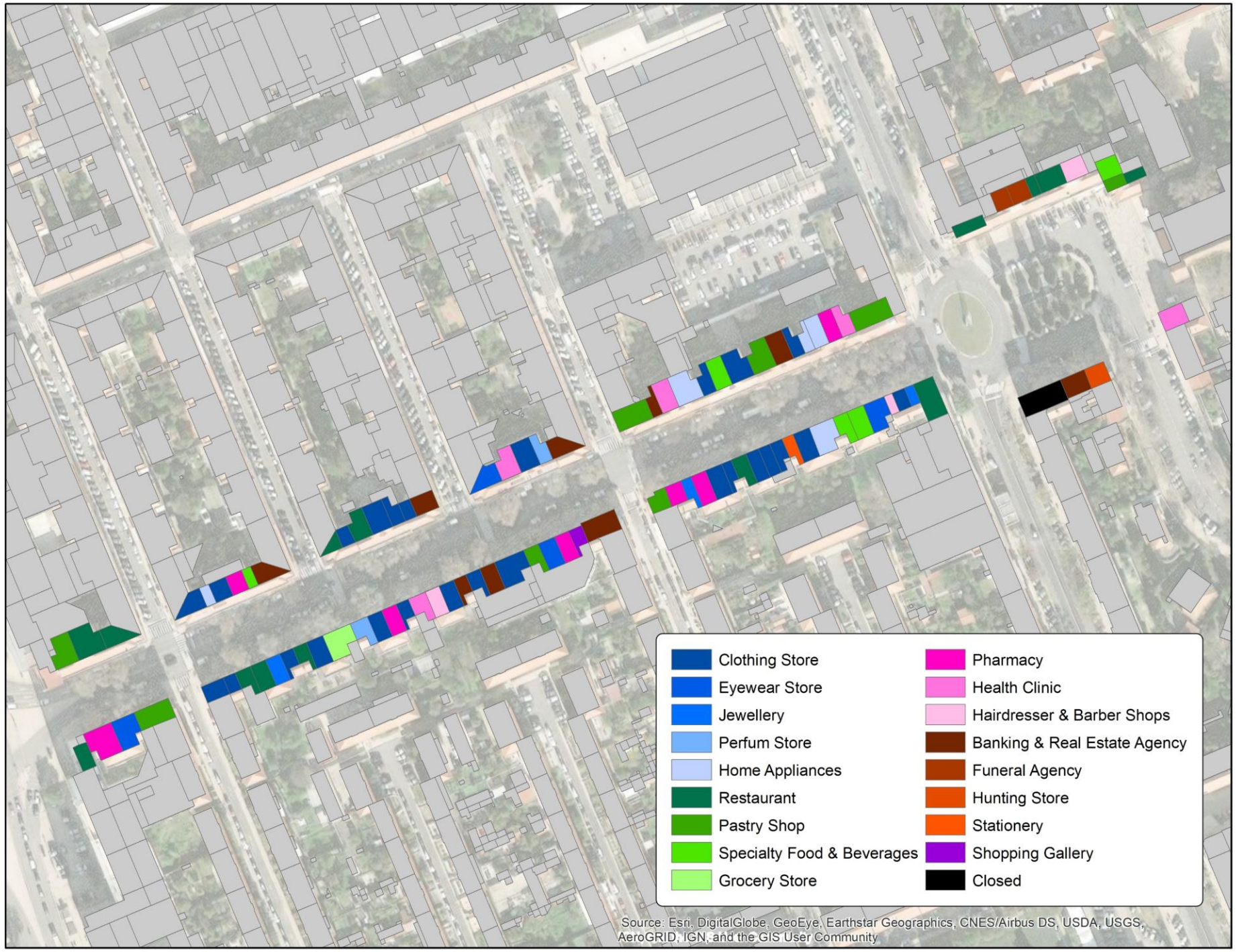
Alvalade

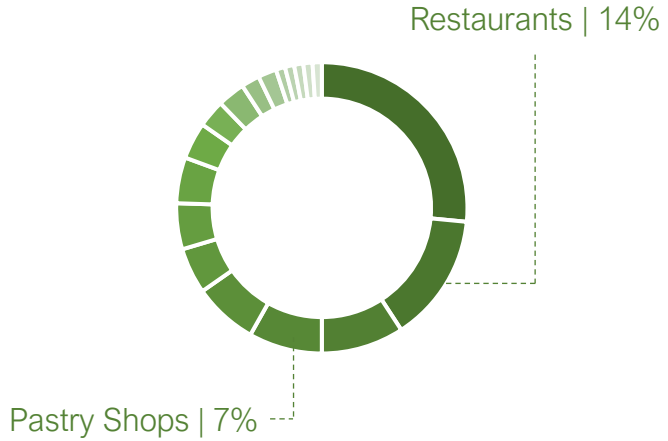
- Best example of modernist urban planning in Lisbon
- Organized by the concept of ‘neighbourhood unit’
- 8 units with about 5000 inhabitants each
- Built between 1945 and 1970
- Became a parish in 1959

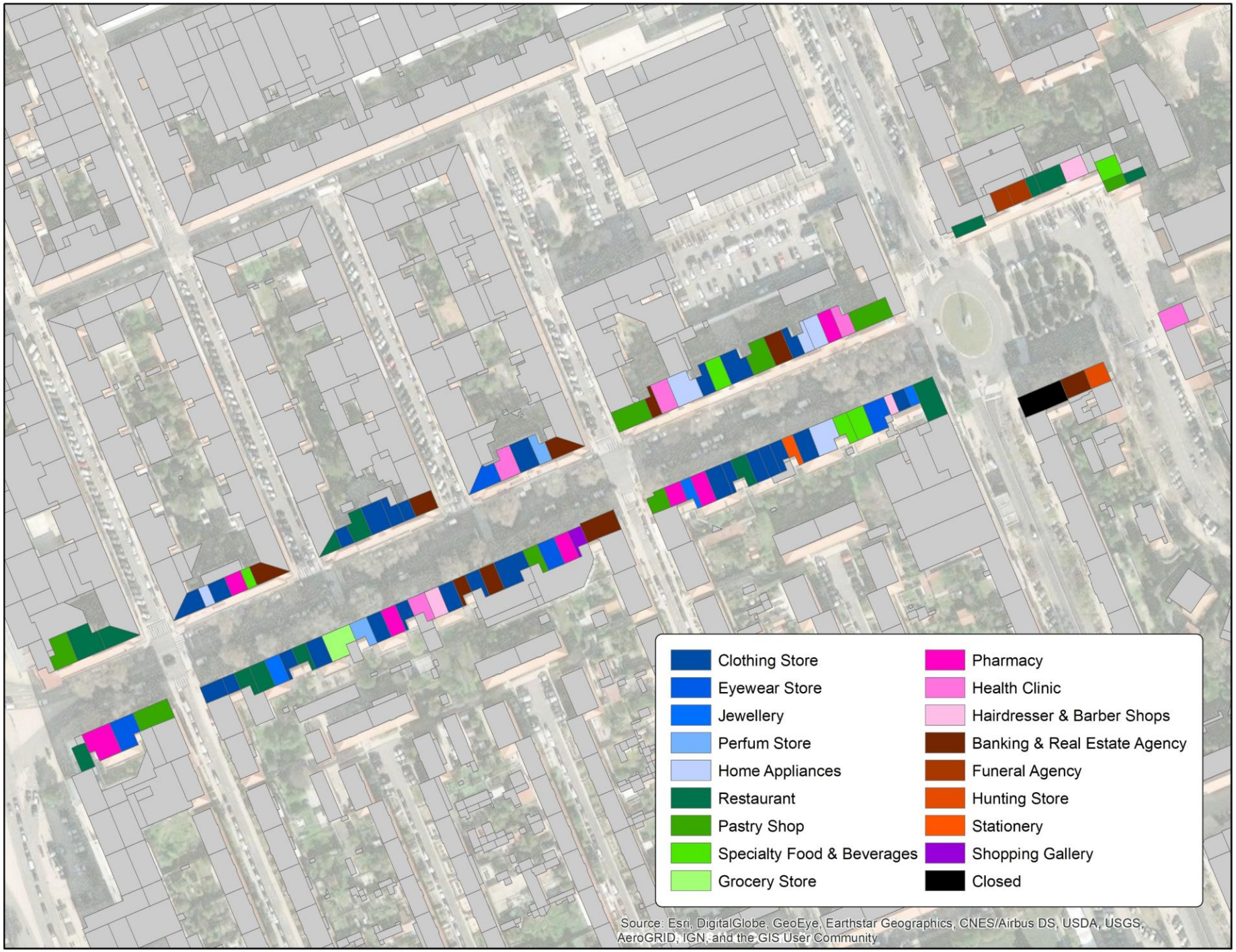


Clothing Stores | 27%




Clothing Store
Eyewear Store
Jewellery
Perfum Store
Home Appliances
Restaurant
Pastry Shop
Specialty Food & Beverages
Grocery Store
Pharmacy
Health Clinic
Hairdresser & Barber Shops
Banking & Real Estate Agency
Funeral Agency
Hunting Store
Stationery
Shopping Gallery
Closed
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community


Restaurants | 14%
Pastry Shops | 7%



Banking & Real Estate Agencies | 9%

Public Bench
Kiosk
Muppie
Phone Booth
Bus Stop
Bike Parking
Stores
Buildings
Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

1

The Walk

Conditions

- Participants wear the Empatica E4 Wristband, which records their EDA data.
- They take a tablet with them, which displays real time EDA data.
- They are invited to take a look at the data display during their walk.

Instructions

- Participants must walk up and down Avenida do Brasil.
- The starting and end point is the Church of São João de Brito.
- Walk length is c. 525m x2. Total walk time ranges from 15 to 30 minutes.

2

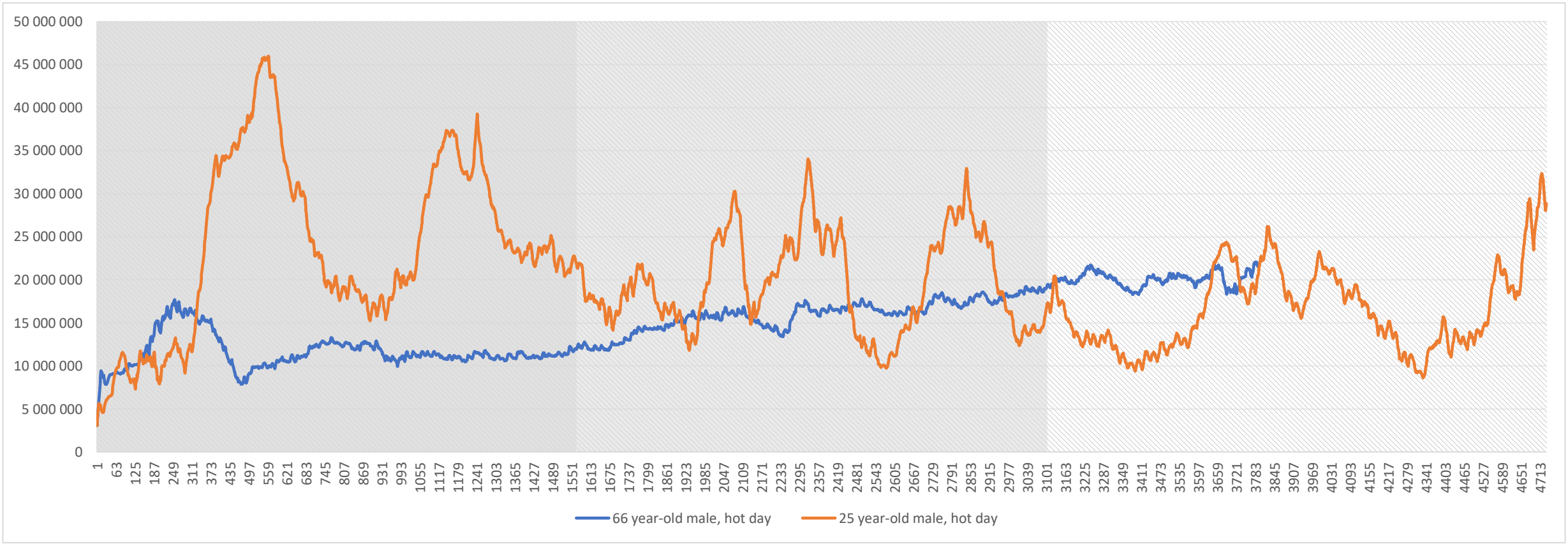
Interview Script

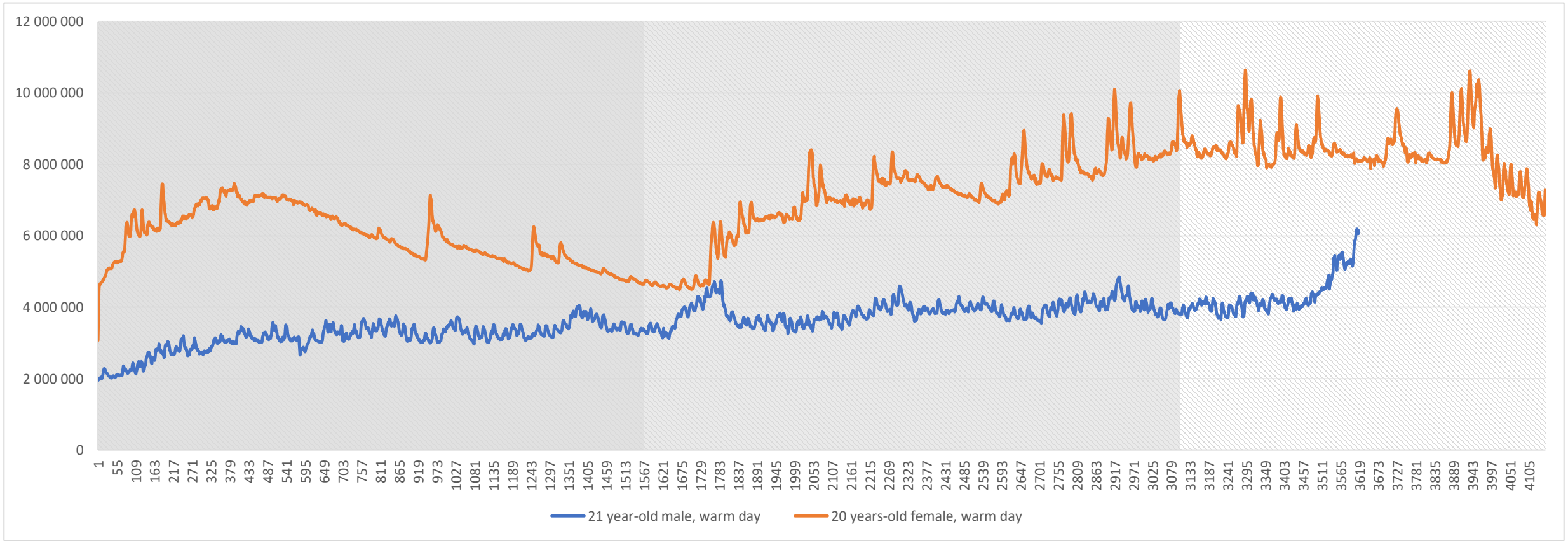
Part I _ The Walk

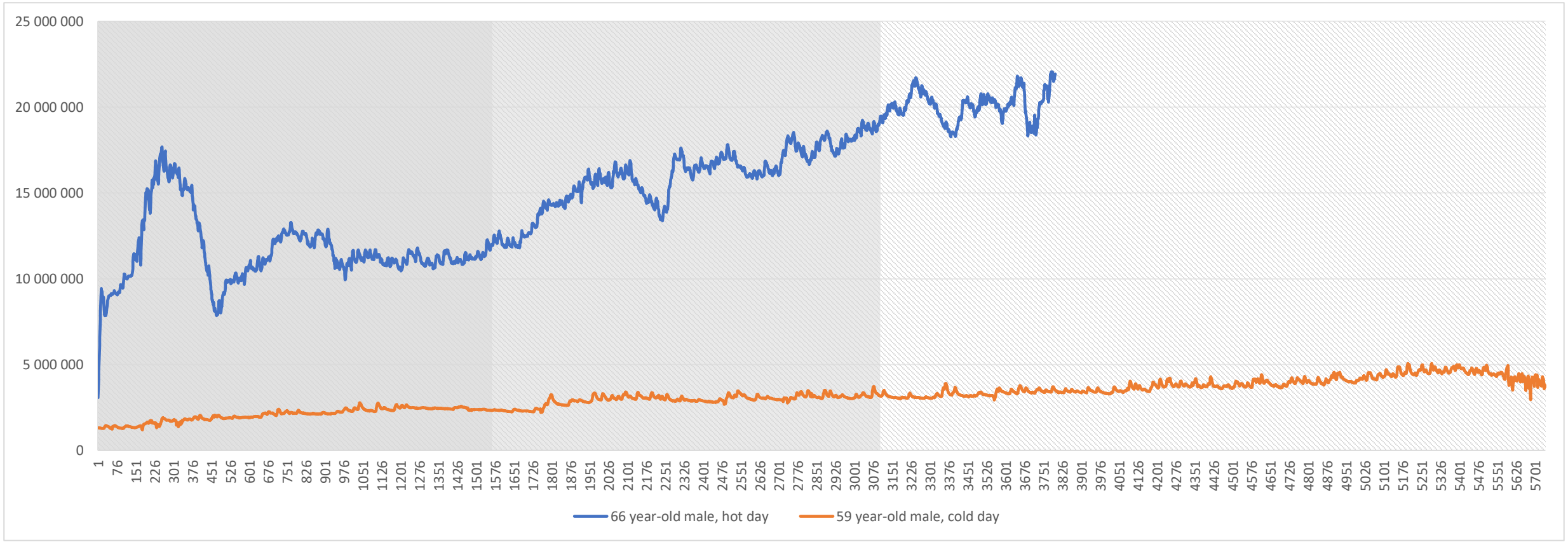
1. Can you describe your walk, the trajectory you did, and any stop you made?
2. What were the things that caught your ***attention***?
3. Was anything especially ***positive***? What kind of positive sensations or emotions did you feel?
4. Was anything especially ***negative***? What kind of negative sensations or emotions did you feel?
5. Did you see or hear anything that brought you any kind of affective ***memory***?

Part II _ The Data

1. Can you identify the phases of your walk in this graphic?
2. Can you identify the ***positive*** moments of your walk in this graphic?
3. Can you identify the ***negative*** moments of your walk in this graphic?
4. Can you identify the affective ***memories*** that came up during your walk in this graphic?
5. Do you feel that this data represents your physical and emotional state during the walk accurately?


50 000 000
45 000 000
40 000 000
35 000 000
30 000 000
25 000 000
20 000 000
15 000 000
10 000 000
5 000 000
0
1
63
125
187
249
311
373
435
497
559
621
683
745
807
869
931
993
1055
1117
1179
1241
1303
1365
1427
1489
1551
1613
1675
1737
1799
1861
1923
1985
2047
2109
2171
2233
2295
2357
2419
2481
2543
2605
2667
2729
2791
2853
2915
2977
3039
3101
3163
3225
3287
3349
3411
3473
3535
3597
3659
3721
3783
3845
3907
3969
4031
4093
4155
4217
4279
4341
4403
4465
4527
4589
4651
4713
66 year-old male, hot day
25 year-old male, hot day


12 000 000
10 000 000
8 000 000
6 000 000
4 000 000
2 000 000
0
1
55
109
163
217
271
325
379
433
487
541
595
649
703
757
811
865
919
973
1027
1081
1135
1189
1243
1297
1351
1405
1459
1513
1567
1621
1675
1729
1783
1837
1891
1945
1999
2053
2107
2161
2215
2269
2323
2377
2431
2485
2539
2593
2647
2701
2755
2809
2863
2917
2971
3025
3079
3133
3187
3241
3295
3349
3403
3457
3511
3565
3619
3673
3727
3781
3835
3889
3943
3997
4051
4105
21 year-old male, warm day
20 years-old female, warm day


25 000 000
20 000 000
15 000 000
10 000 000
5 000 000
0
1
76
151
226
301
376
451
526
601
676
751
826
901
976
1051
1126
1201
1276
1351
1426
1501
1576
1651
1726
1801
1876
1951
2026
2101
2176
2251
2326
2401
2476
2551
2626
2701
2776
2851
2926
3001
3076
3151
3226
3301
3376
3451
3526
3601
3676
3751
3826
3901
3976
4051
4126
4201
4276
4351
4426
4501
4576
4651
4726
4801
4876
4951
5026
5101
5176
5251
5326
5401
5476
5551
5626
5701
66 year-old male, hot day
59 year-old male, cold day

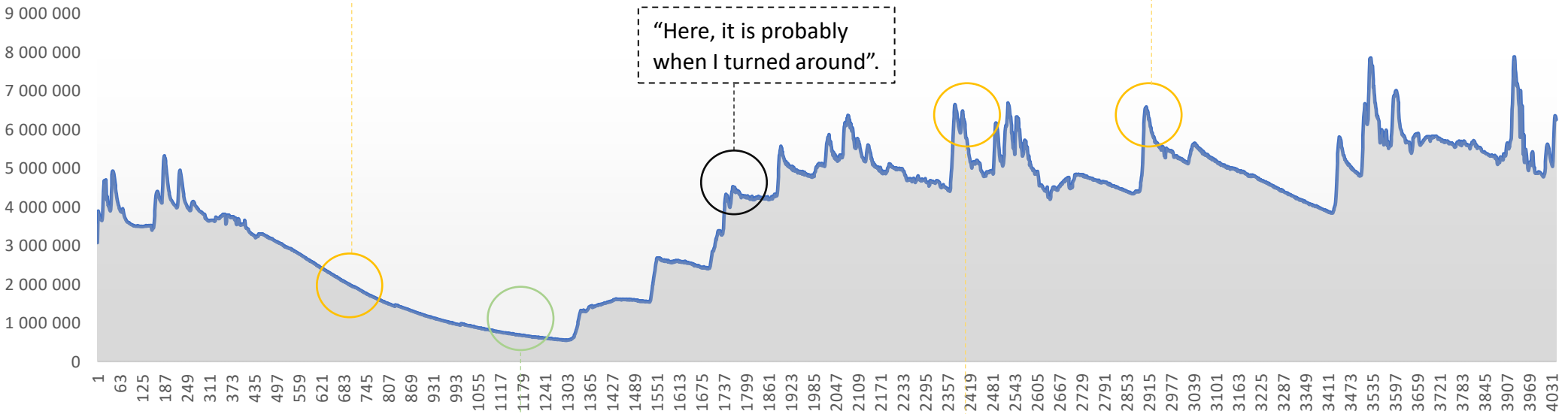
Bounded Interference?

TW3

"The shop windows. A pharmacy window got my attention, with a series of creams and products. The clothing store windows as well. A restaurant that I had never seen also got my attention. I know the area, but I had not come here, at least on foot, for a while".

"Perhaps it's a stretch to say that this is an affective memory, but I actually passed by a Churrasqueira [grilled chicken take away restaurant], which I think have the best chicken in Lisbon. And as I passed by, it reminded me of my friends with whom I ate those chicken that last time".

"Here, it is probably when I turned around".



AGE	47
GENDER	FEMALE
TEMPERATURE (c)	23.8
HUMIDITY (%)	36
MEDICATION	NO
LOCAL	YES

"It is curious that in this first half everything is more calm".

"It's not related to the street, I am not sure if this will make much sense for the study that you are doing. Because I am having some negative thoughts, nothing to do with the walk, it's my own stuff. And I felt that during the walk, because when a person winds down, it is easier to start thinking about stuff . I felt this in the second half. Because in the first half I was more distracted, with the shop windows and everything. In the second half, I was ruminating".

"This makes sense because when I went the first time, I was super-distracted with what I was seeing, and I was super calm, and then when I got back I was more involved in my own thoughts".

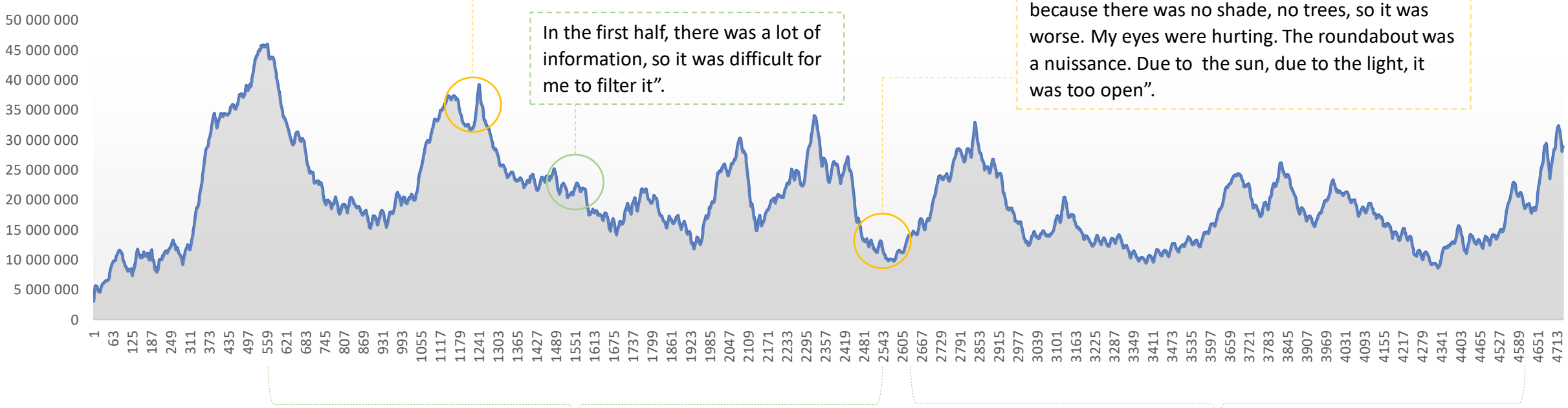
TW7

"The streets that intersect with the avenue… Each time I stopped to cross the street I enjoyed taking a moment to appreciate the buildings and the street as it is, because I found it pretty and organized. (…) When I walked by, I felt good. I think the model of the houses reminded me a lot of some houses in Brazil. So I could see myself, my childhood somehow on those streets. And while the avenue is not too packed, not too confusing, those streets were like a calmer funnel, with not too many cars. I was like: 'wow, how beautiful'".

"But it was very funny because even here when I felt unconfortable. I was crossing the street and a gentleman came to talk to me. He wasn't talking to me because I was waiting for the traffic light and he made a sign like ' come quickly, you have time to cross'. And I thought that interaction was funny".

"Walking thought the roundabout was annoying because there was no shade, no trees, so it was worse. My eyes were hurting. The roundabout was a nuissance. Due to the sun, due to the light, it was too open".

In the first half, there was a lot of information, so it was difficult for me to filter it".



AGE	25
GENDER	MALE
TEMPERATURE (c)	37.2
HUMIDITY (%)	LO
MEDICATION	YES
LOCAL	NO

"Here is me going away, this is me going back. First I went by the right side of the street, then I went by the left side of the street.".

"The values are higher in the first half because it was new to me then. It was the first time I was looking at the street".

Our research questions

1. How are biosensing technologies currently being used by citizens, and what will be the impact of the new generation of wearable biosensors in everyday life?
jan. – mar. 2022

2. How can wearable biosensor's data be used to enhance qualitative research on the experience of urban affective atmospheres?
abr. – dez. 2022

3. How can biosensor data be used to make urban planning and design more participatory?
jan. – jun. 2023

Our tasks

1. Exploratory research on biosensors in everyday urban life
   - Training workshop with postgraduate students
   - Biosensor tests
2. Biosensing the city: Transect walks
3. Biosensing the city: Participatory mapping
4. Biosensing the city: Scenario-elicitation
5. Planning application: Pilot study