‘Urban Design with Emotions: From Data Collection to Policy Guidelines’

for Research Dialogue with Research Group ‘Happiness by Design’, IIT Roorkee, India

2nd November 2022

UrBio

Making urban planning and 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

PRESENTATION OVERVIEW

UrBio

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Inês Boavida Portugal

Nuno Rodrigues

UrBio

THE OBJECTIVE OF THIS EXPLORATORY PROJECT (1 ½ years) 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

- Biosensing and its benefits
- The goals and research of project UrBio
- Our results so far

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

Four Advantages of Biosensing

Biosensors are considered more objective than self-reported assessments, which tend to be biased.

Wearables allow for continuous measurement at a high temporal resolution.

Wearables significantly reduce the burden on participants, who are not required to repeatedly complete surveys.

Ambulatory measurements facilitate the investigation of people's physiological signals during their daily routines in real-life situations, offering greater ecological validity than lab studies.

(Birenboim et al., 2019)

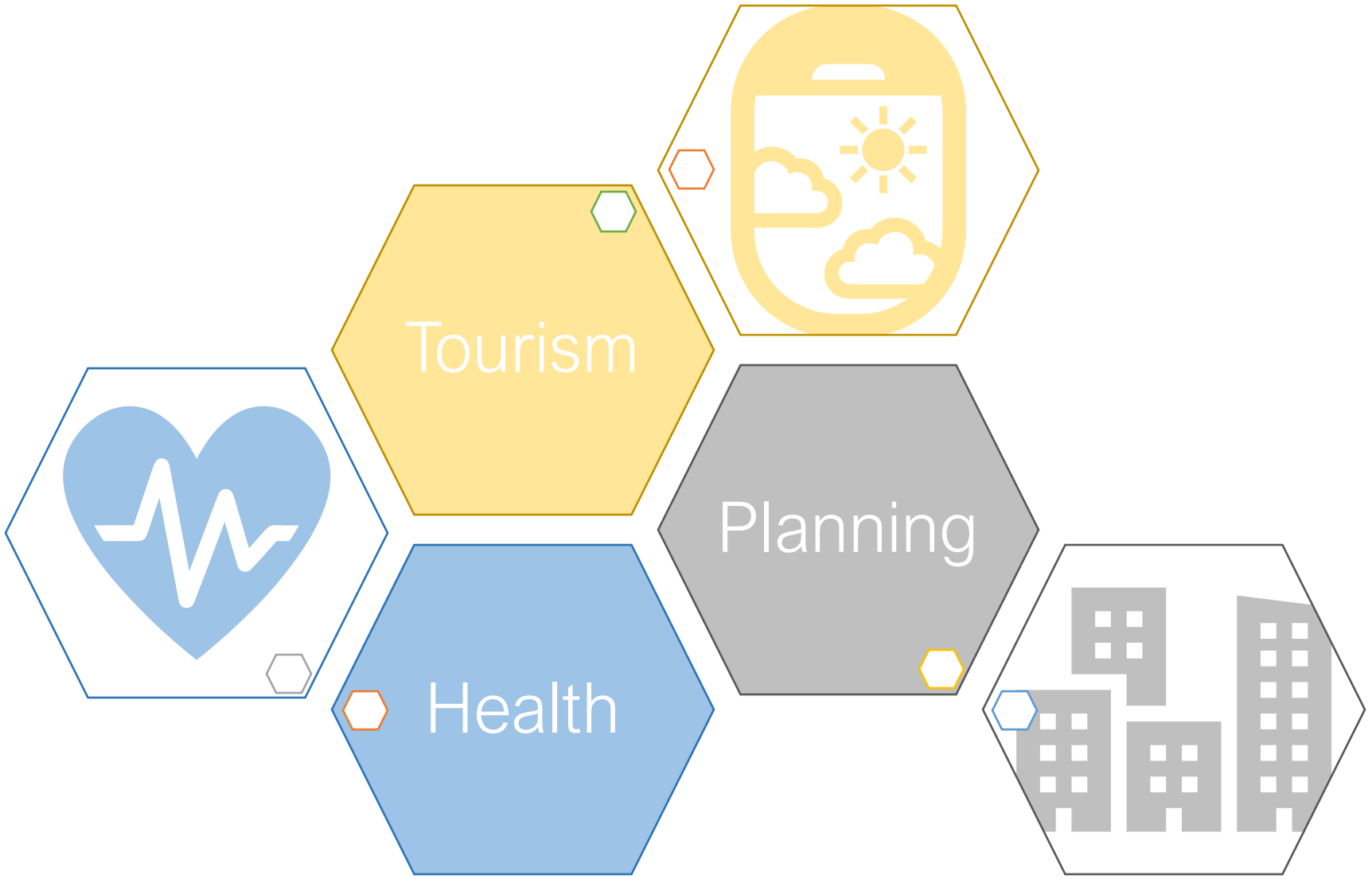
Limitations

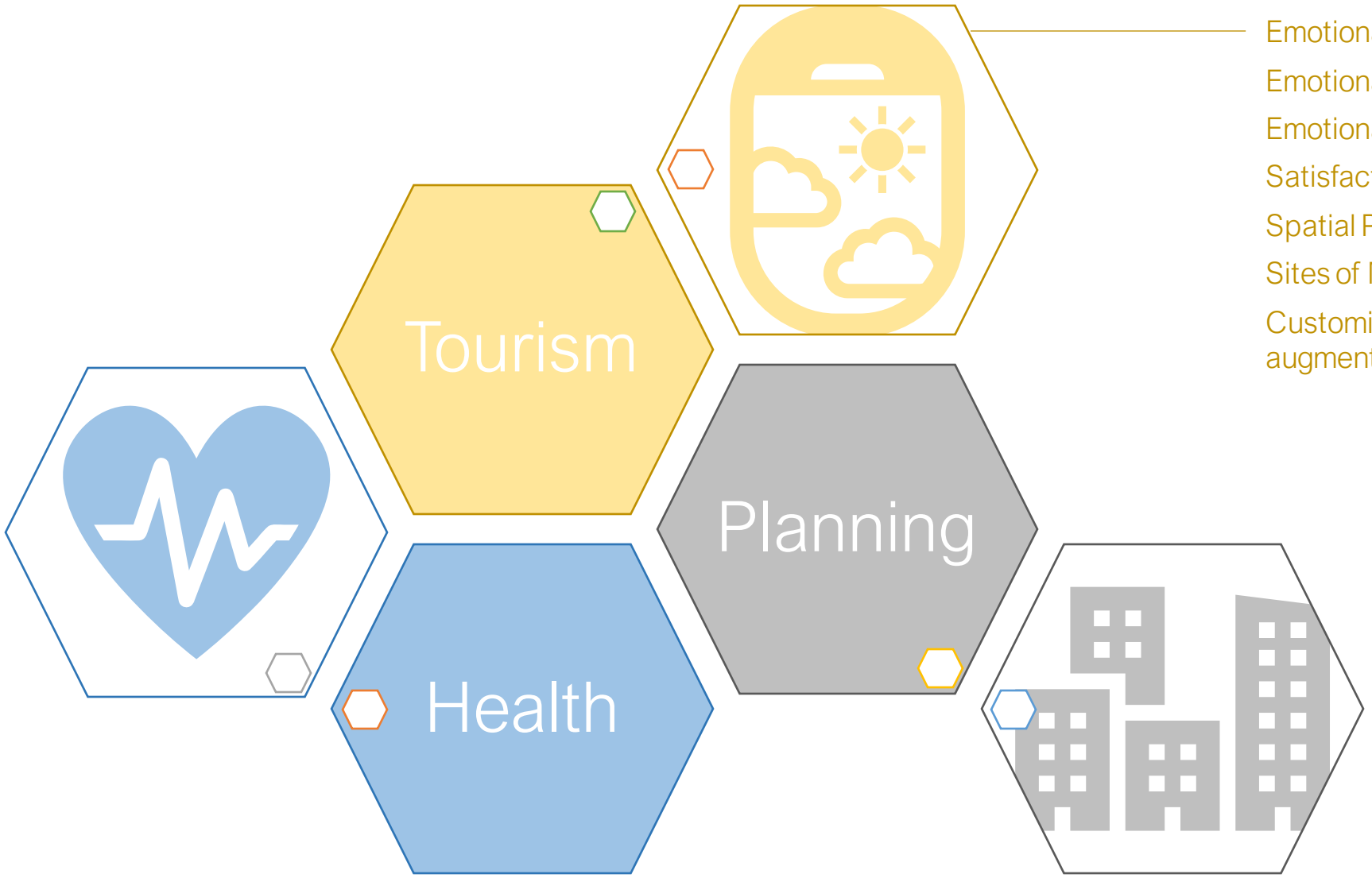
Objectivity

- 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

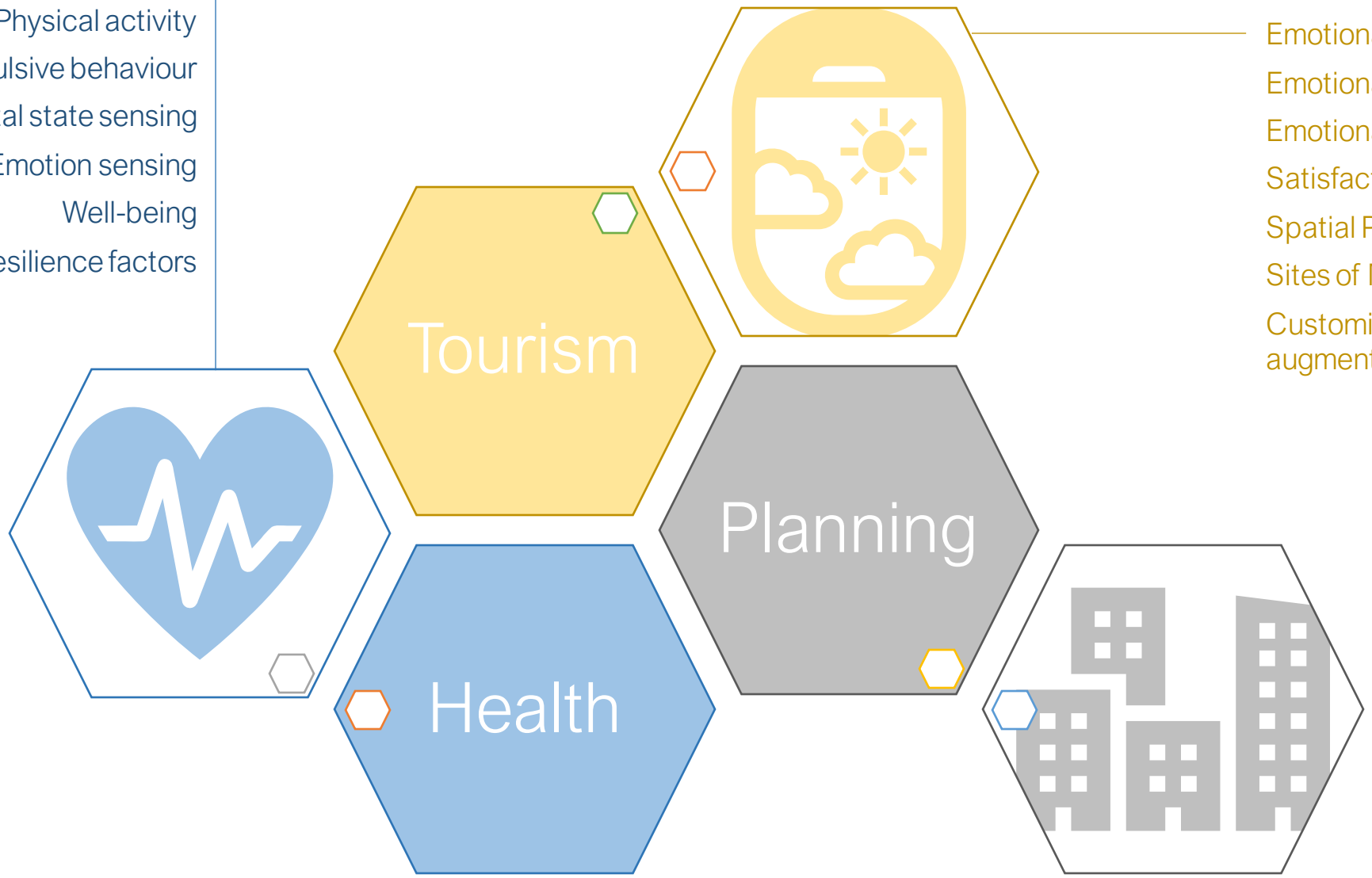
- The use of biosensor equipment can be understood as very invasive (Reif & Schmücker, 2021).


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
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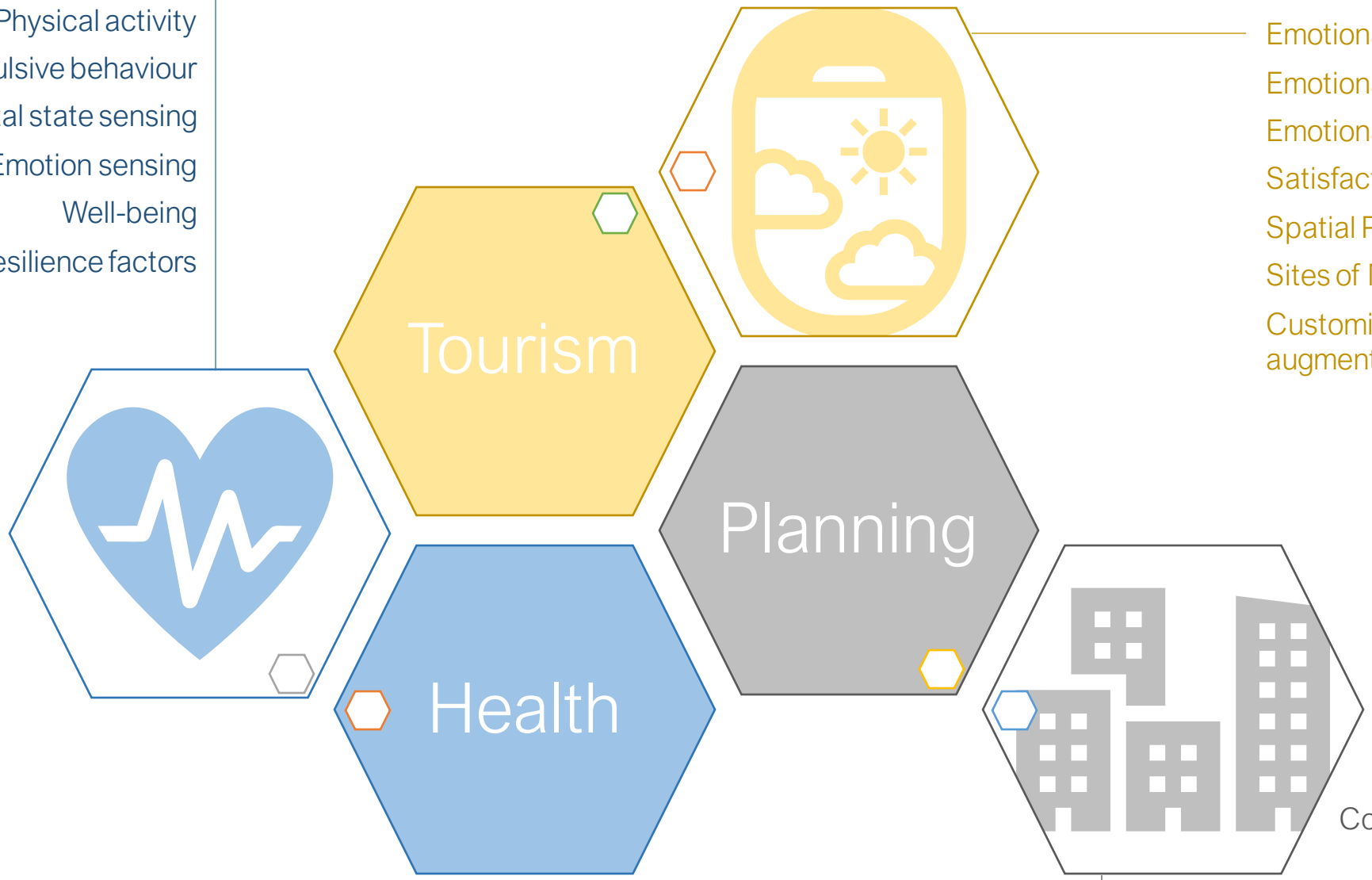
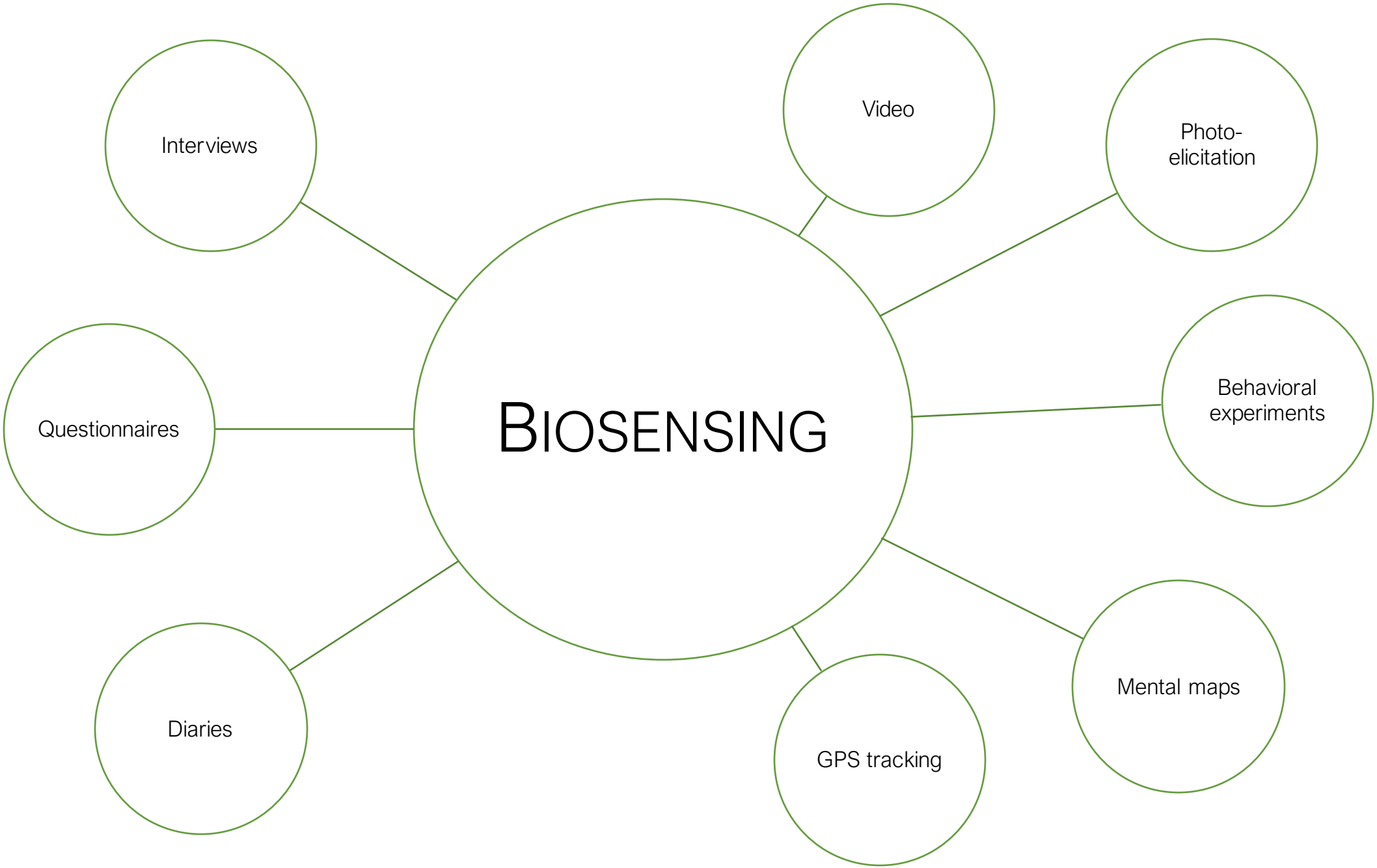


Emotional measurement
Emotional engagement
Emotional responses
Satisfaction
Spatial Points of Emotion
Sites of Memory
Customization and augmentation of experiences

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

“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

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)

UrBio

PEOPLE AND SENSORS

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.

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

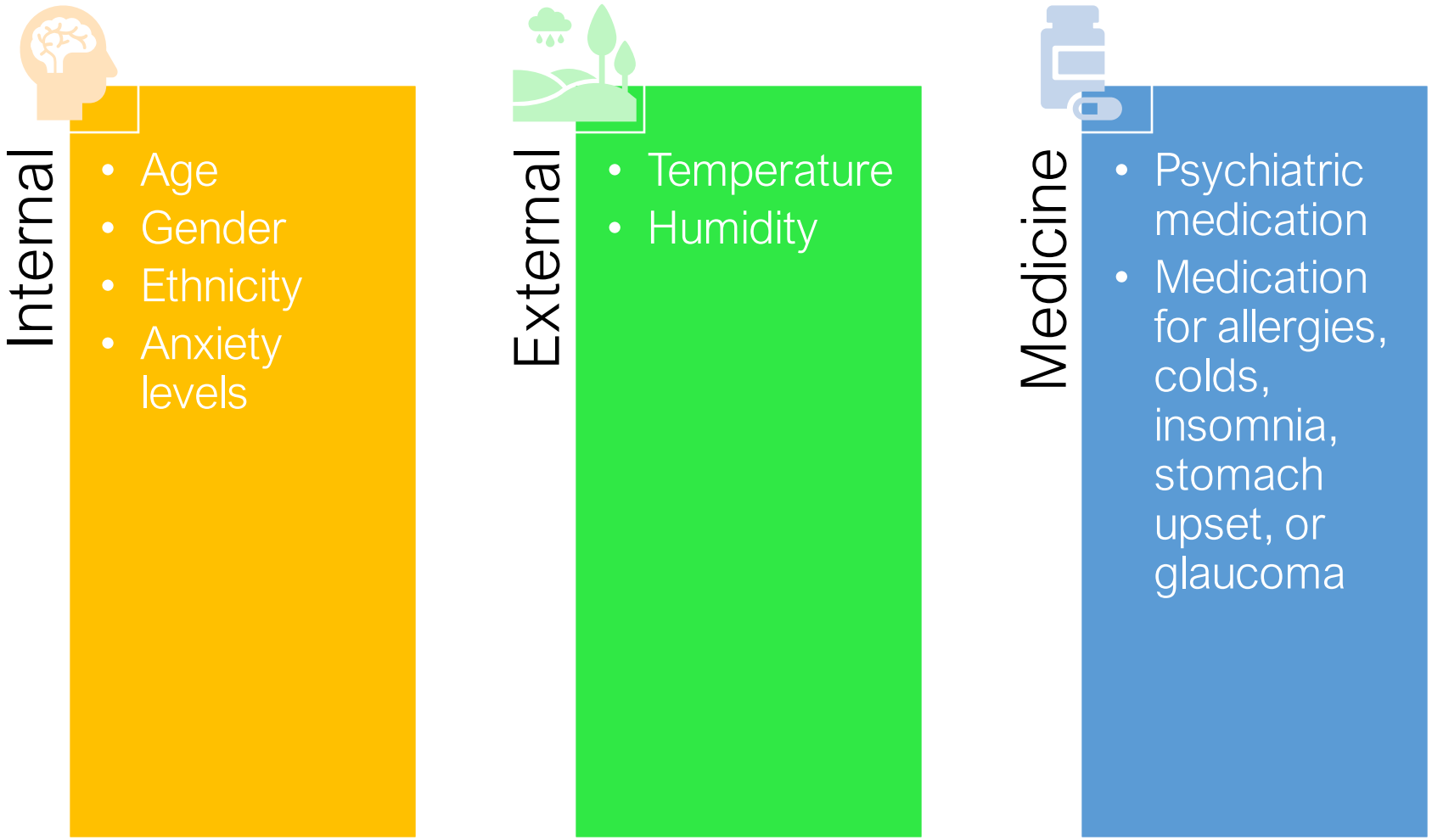
5. Planning application: Pilot study

Equipment

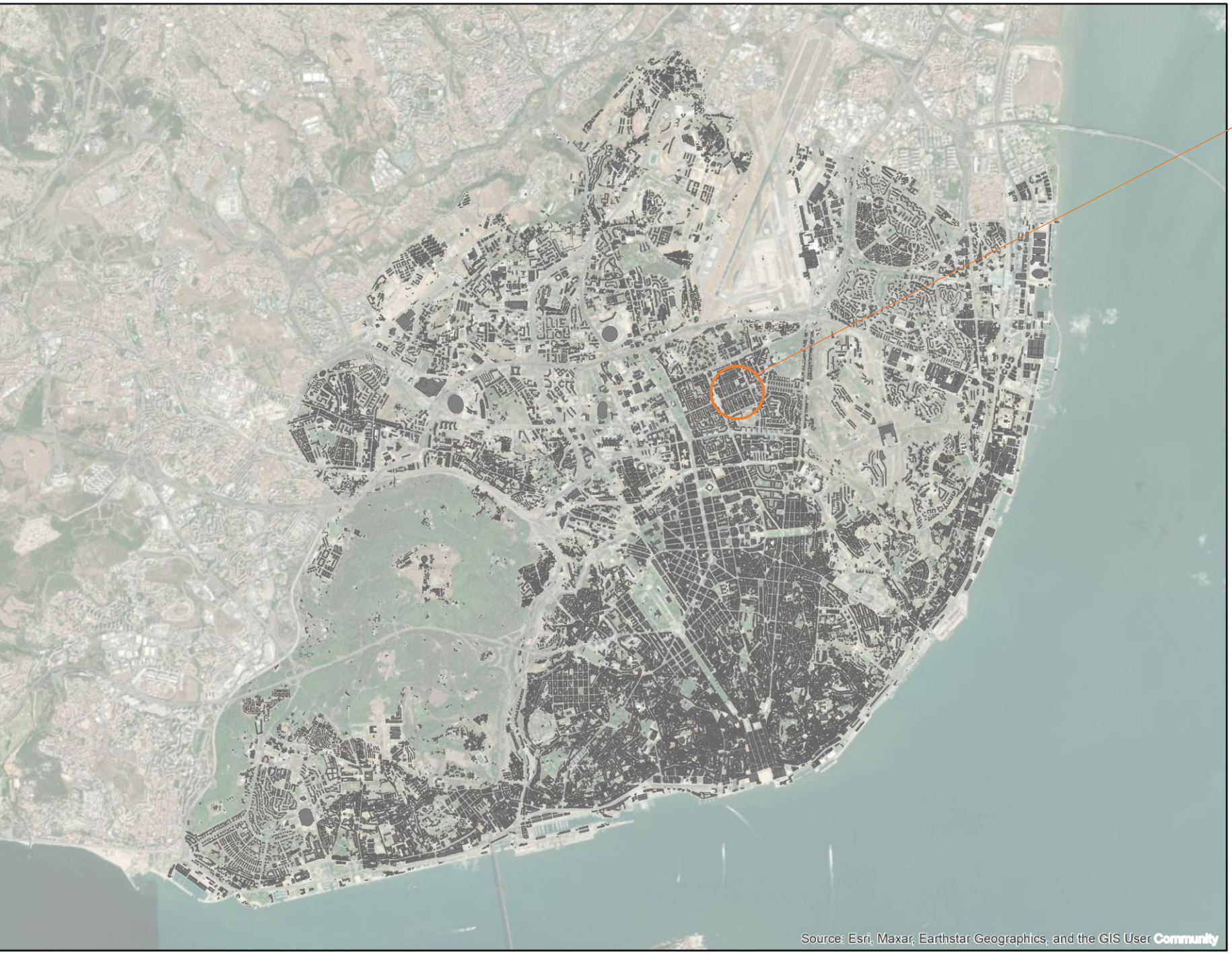
Empatica E4 Wristband

EDA (Electrodermal Activity) 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

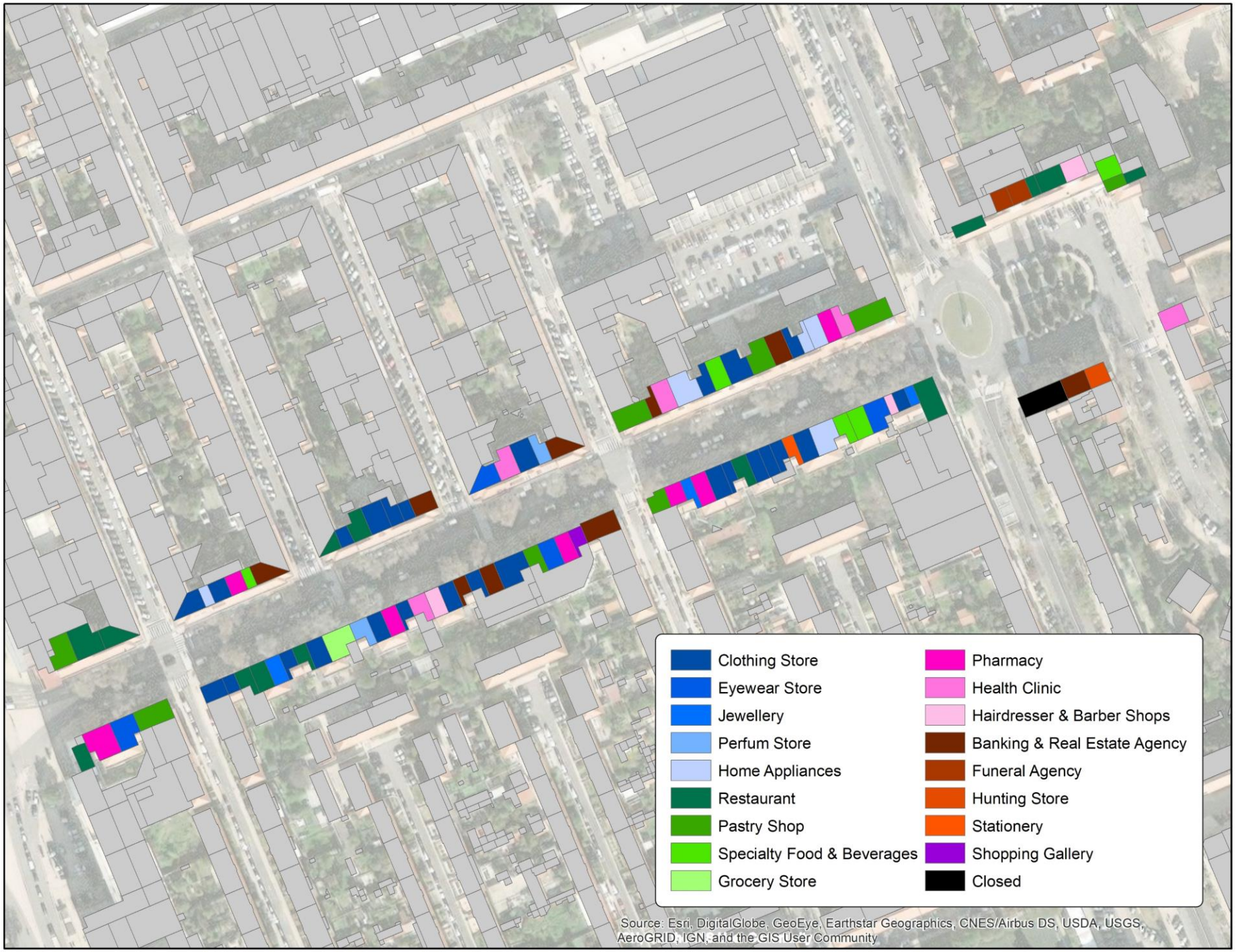


Research Contexts

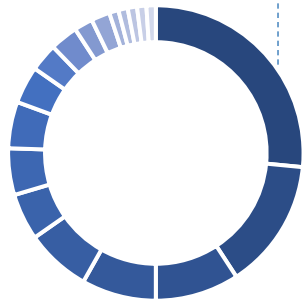


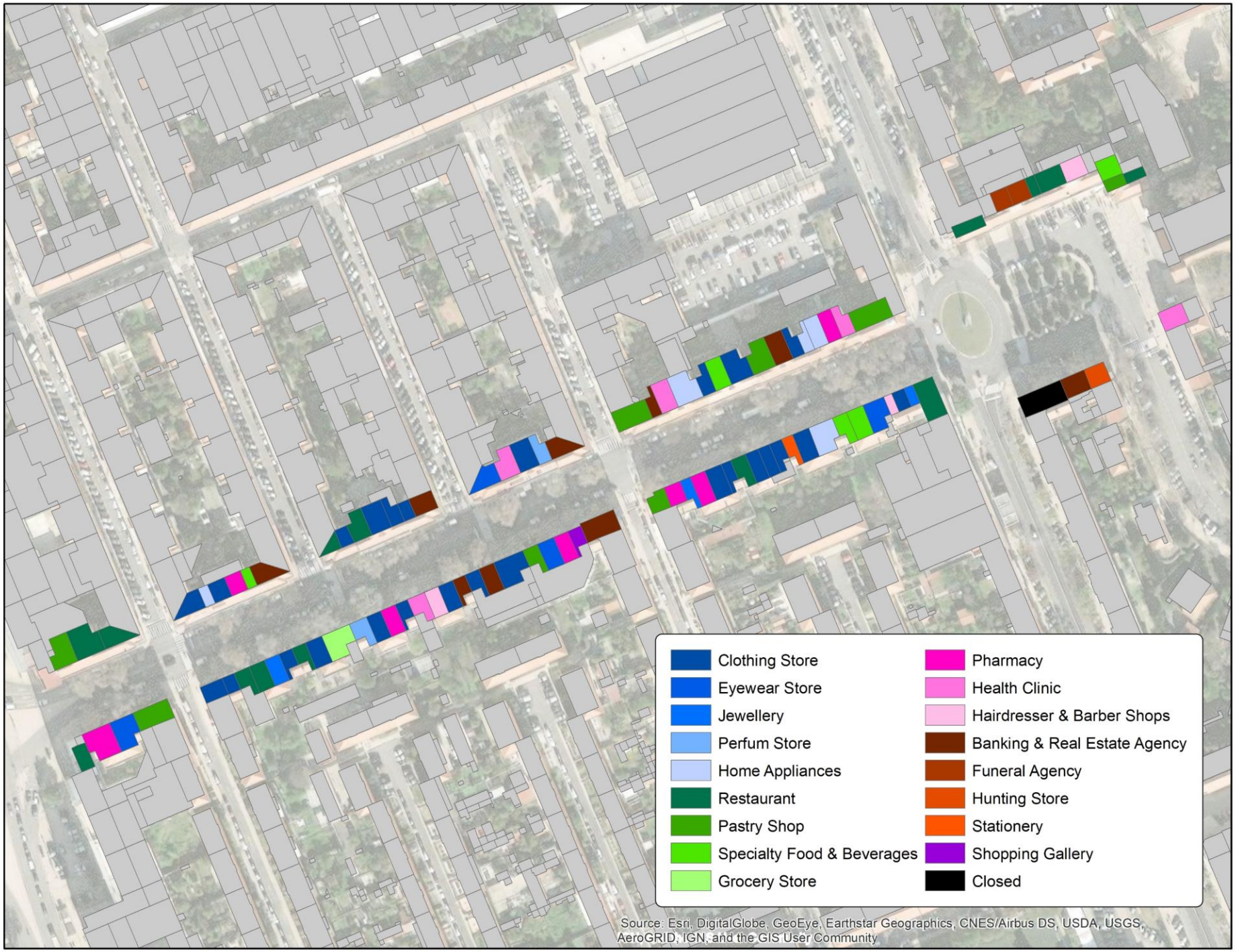
Alvalade, Lisbon (Portugal)

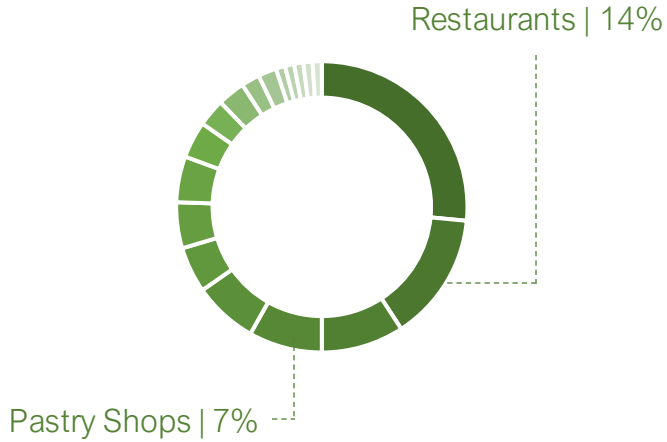
- Best example of modernist urban planning in Lisbon
- Organized by the concept of ‘neighbourhood unit’
- 8 units with about 5000 inhabitants each
- Built between 1945 and 1970
- Became a parish in 1959

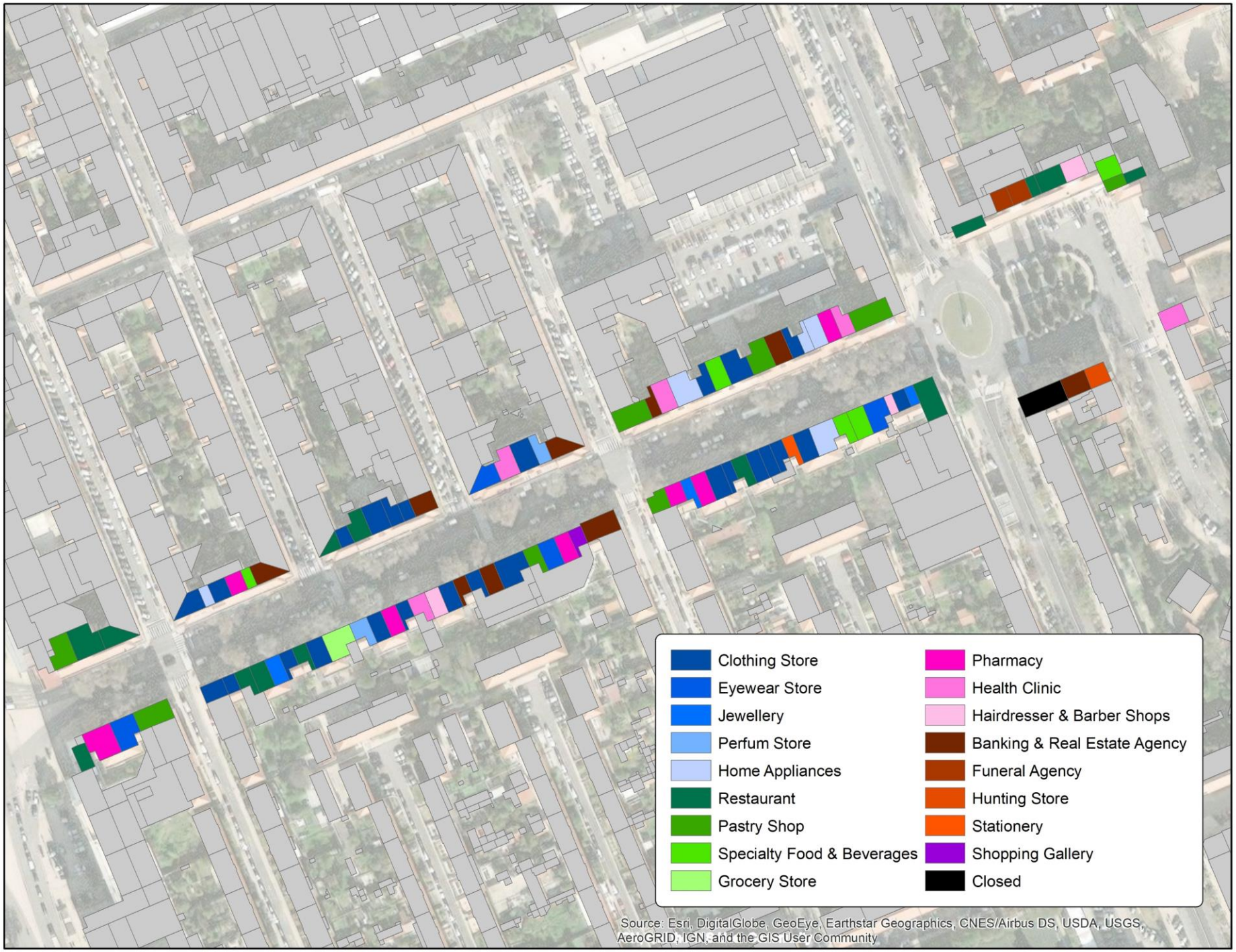


Clothing Stores | 27%




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

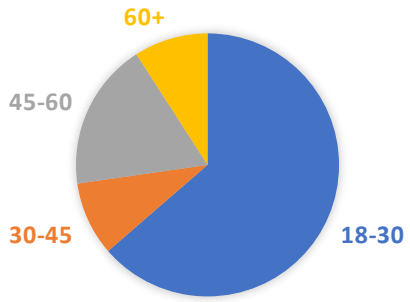
Part I _ The Walk

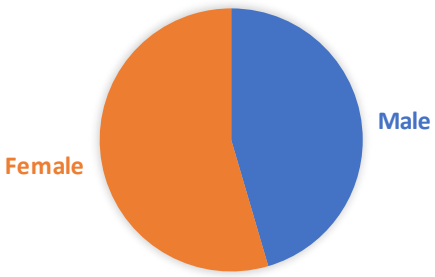
1. Can you describe your walk, the trajectory you did, and any stop you made?
2. What were the things that caught your ***attention***?
3. Was anything especially ***positive***? What kind of positive sensations or emotions did you feel?
4. Was anything especially ***negative***? What kind of negative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

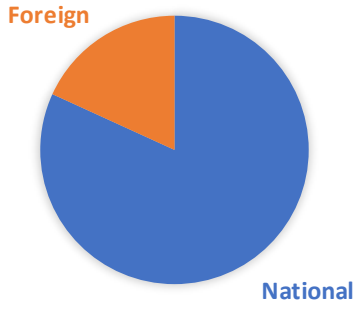
Part II _ The Data

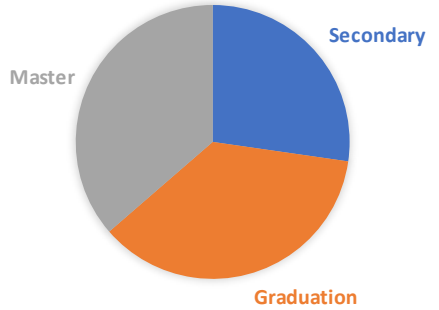
1. Can you identify the phases of your walk in this graphic?
2. Can you identify the ***positive*** moments of your walk in this graphic?
3. Can you identify the ***negative*** moments of your walk in this graphic?
4. Can you identify the affective ***memories*** that came up during your walk in this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

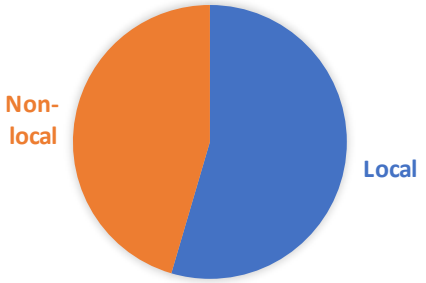
id	SOCIAL					ENVIRONMENTAL		HEALTH
	AGE	GENDER	NATION	EDUCATION	LOCAL	TEMPERATURE	HUMIDITY	MEDICATION
TW5	20	Female	Portuguese	Secondary	No	29.3	29	Yes
TW4	21	Male	Portuguese	Secondary	Yes	29.3	29	No
TW9	21	Female	Portuguese	Graduation	Yes	22	62	No
TW8	22	Female	Portuguese	Graduation	Yes	22	62	No
TW1	25	Female	Portuguese	Master	No	25.3	47	Yes
TW7	25	Male	Brazilian	Secondary	No	37.2	LO	Yes
TW2	26	Male	Portuguese	Master	No	23.6	50	Yes
TW11	41	Female	Brazilian	Master	No	22	62	Yes
TW3	47	Female	Portuguese	Master	Yes	23.8	36	No
TW10	59	Male	Portuguese	Graduation	Yes	22	62	Yes
TW6	66	Male	Portuguese	Graduation	Yes	37.2	LO	No

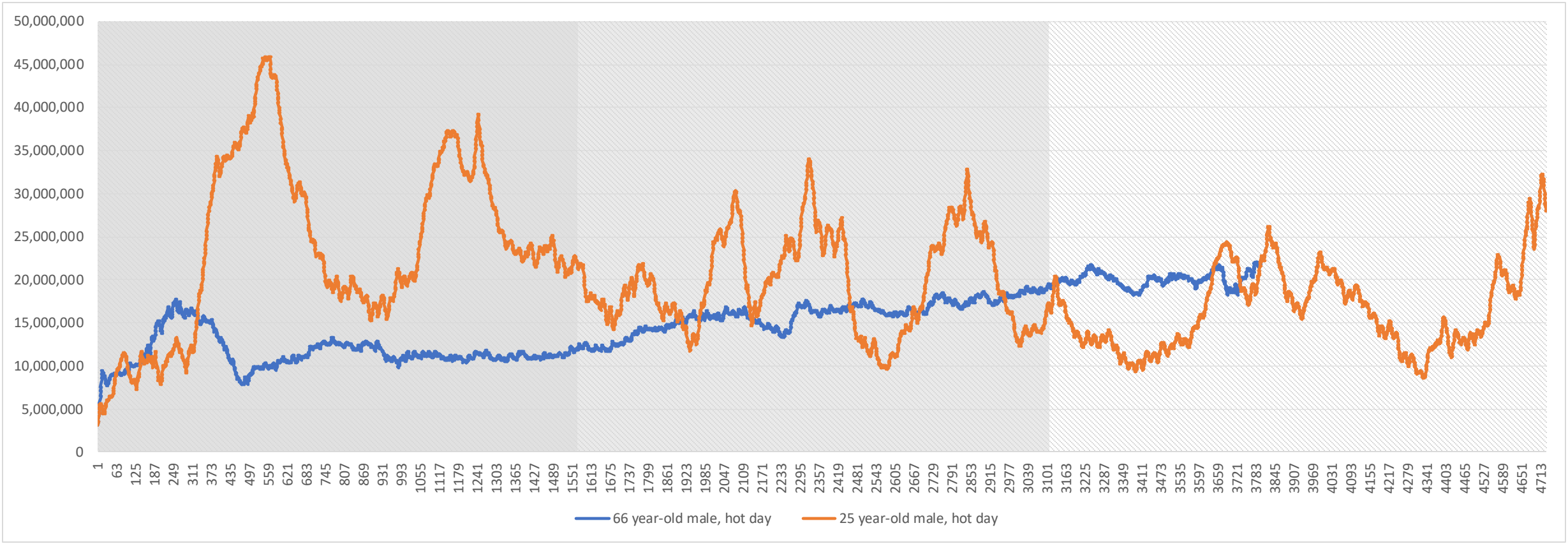








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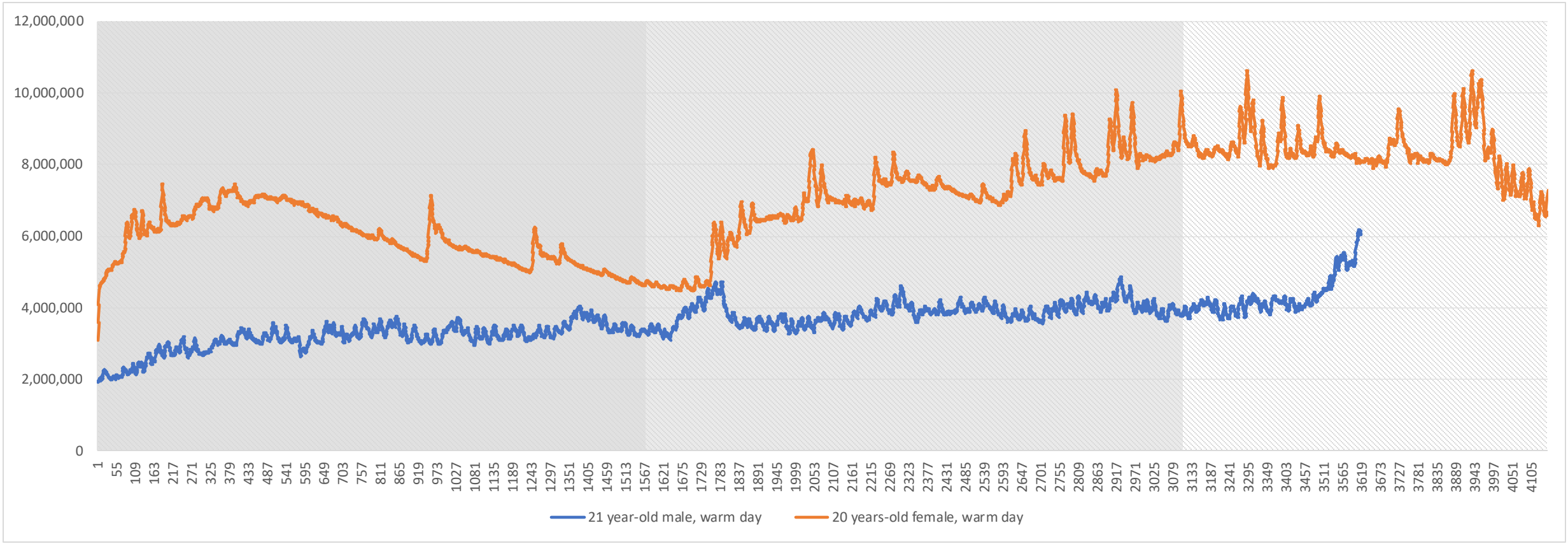
66 year-old male, hot day
25 year-old male, hot day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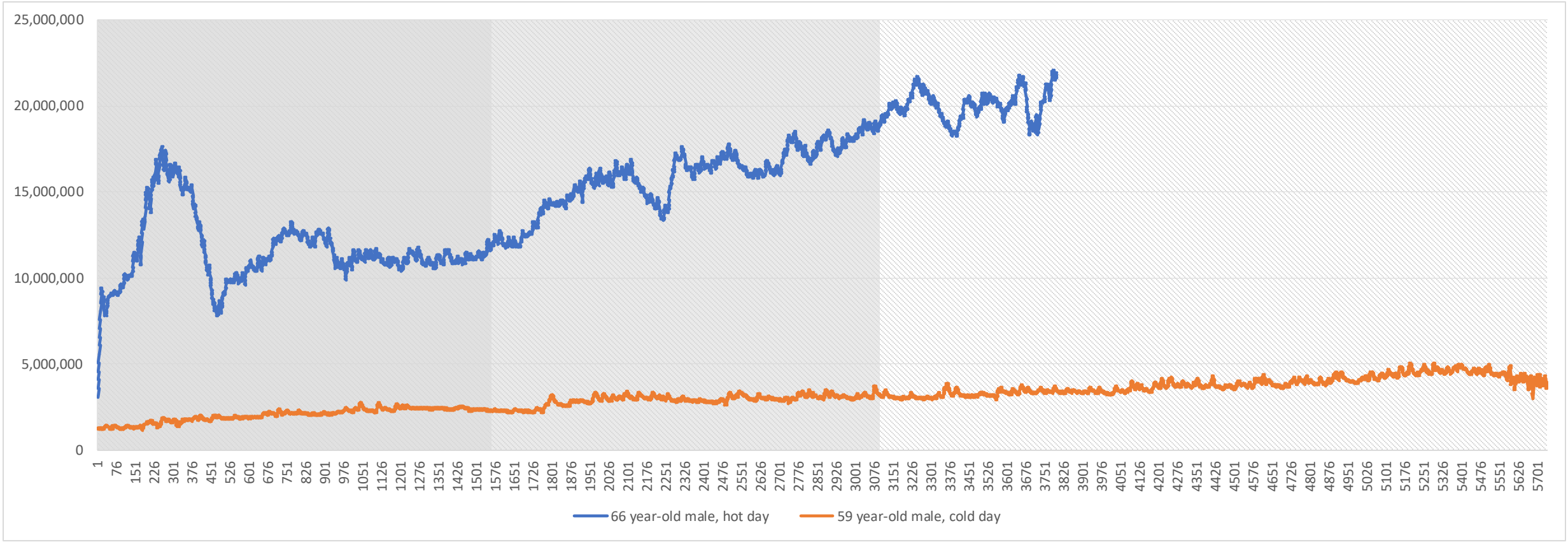
21 year-old male, warm day
20 years-old female, warm day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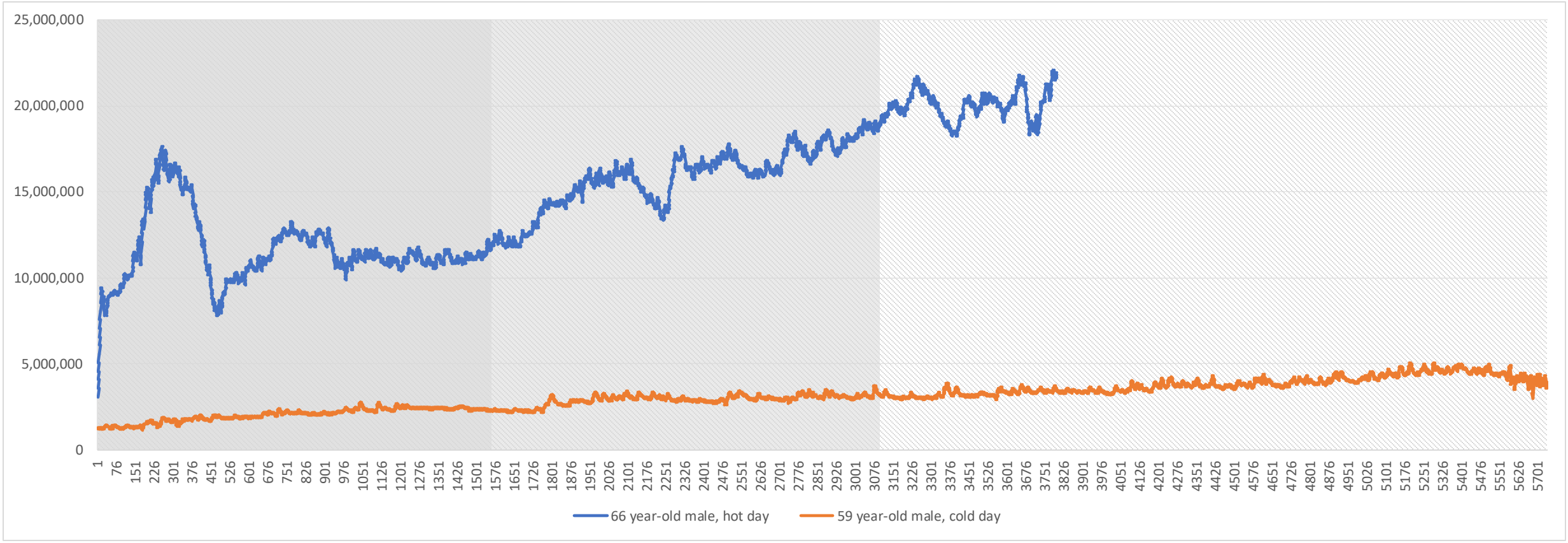
66 year-old male, hot day
59 year-old male, cold day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66 year-old male, hot day
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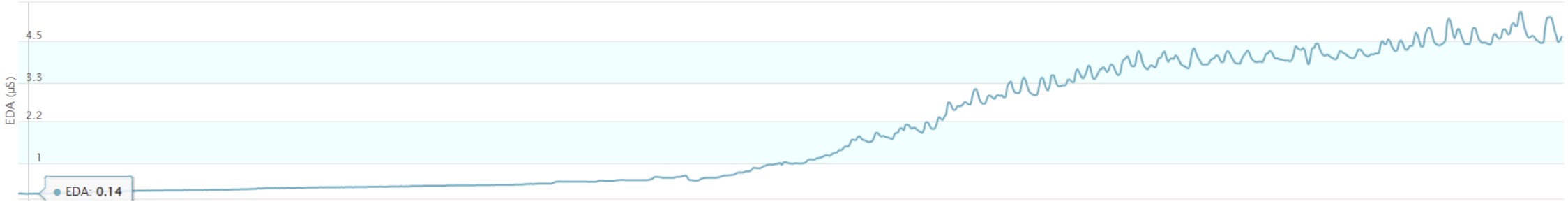
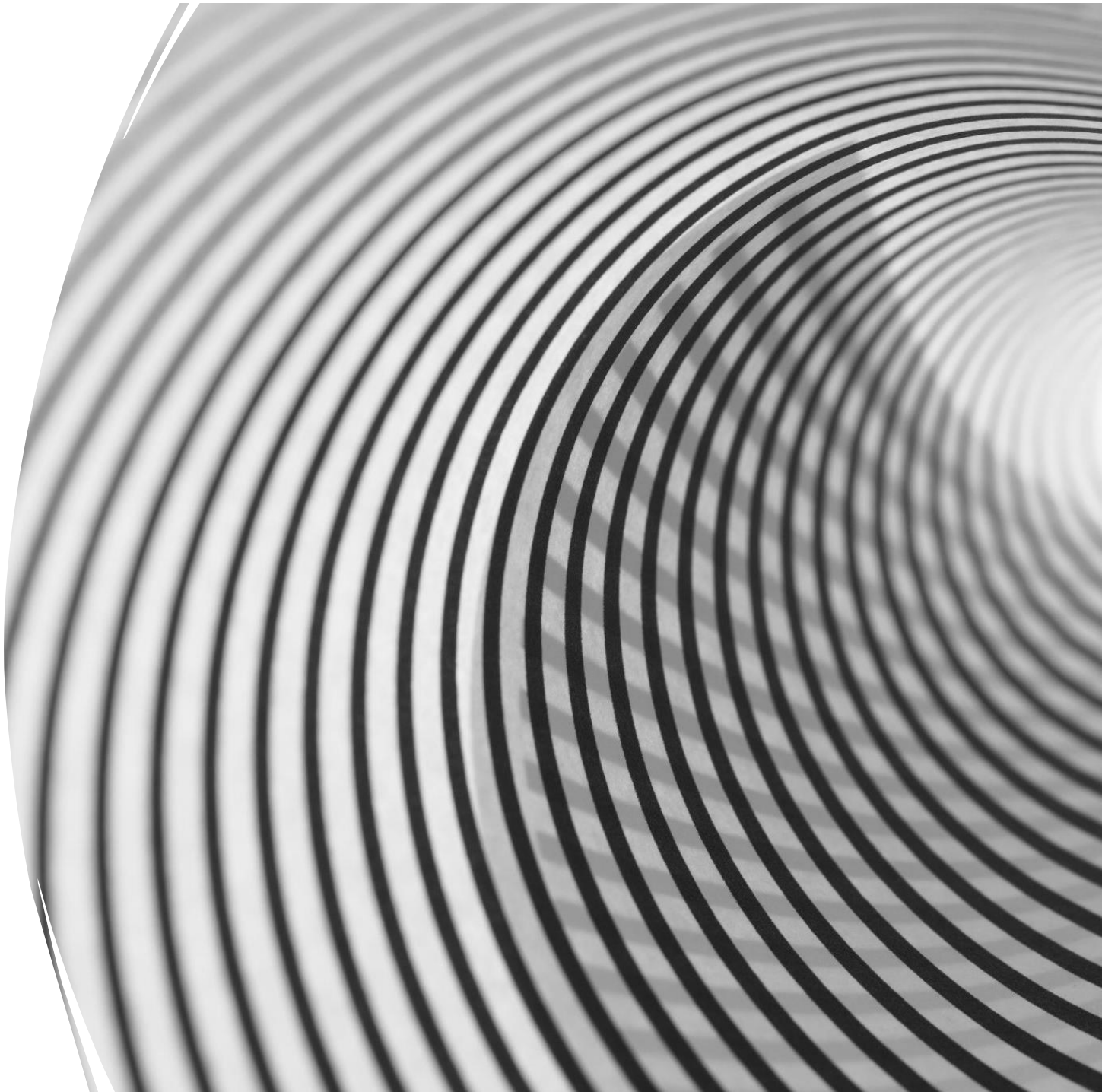

EDA (µS)
4.5
3.3
2.2
1
EDA: 0.14

Bounded Interference?

The phenomenological relationship between humans and machine interfaces in which interfaces can persuade humans to rethink about their own experiences, but humans retain an ‘agential super-position’ over the meanings of such interfaces (Fazio 2022).

Allowing subjects to interpret such data creates moments of bounded interference in which biosensing data can persuade humans to rethink their own experiences

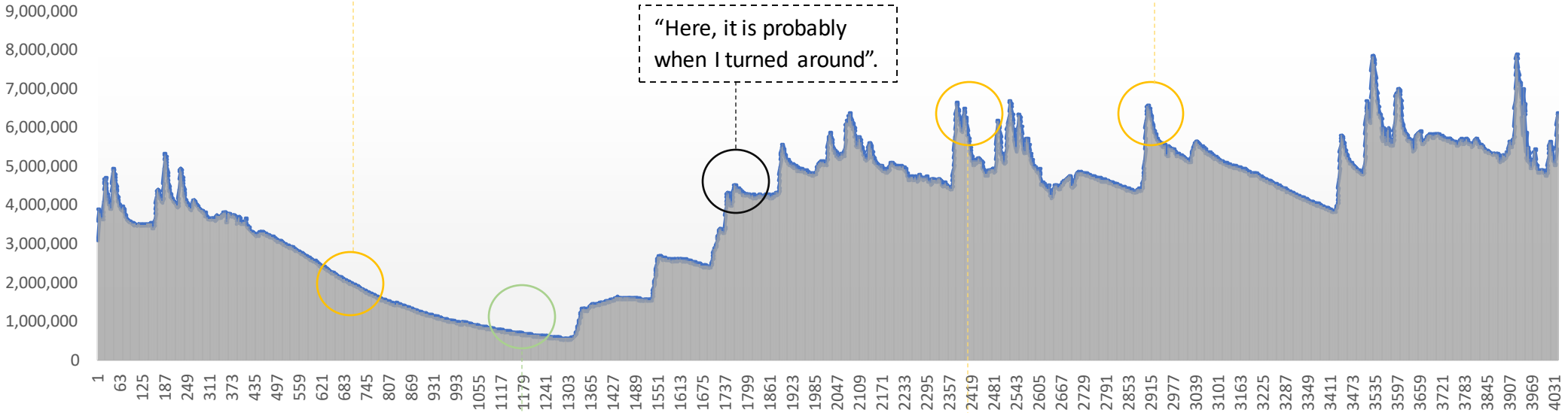


TW3

"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".

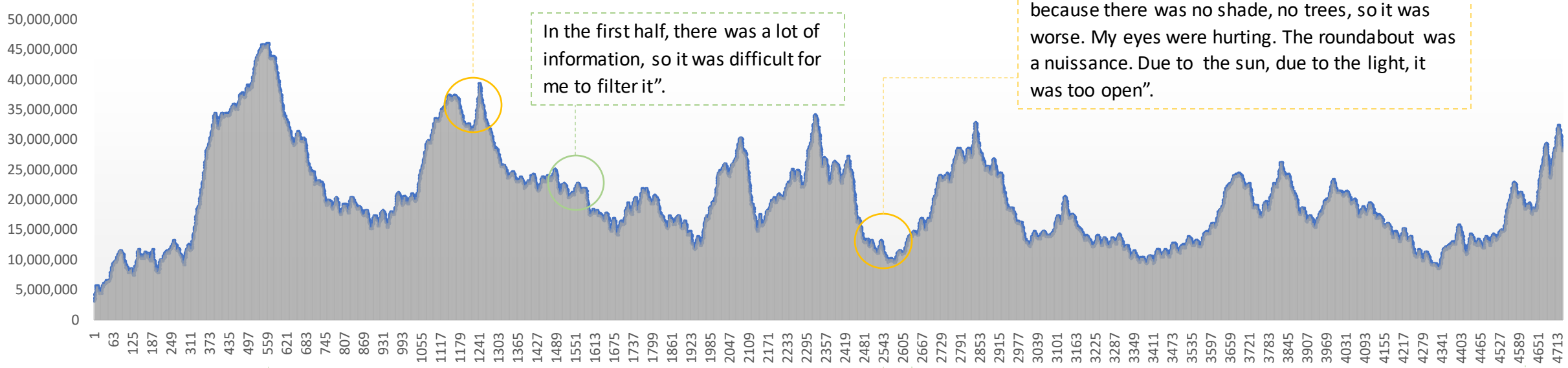
TW7

"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".

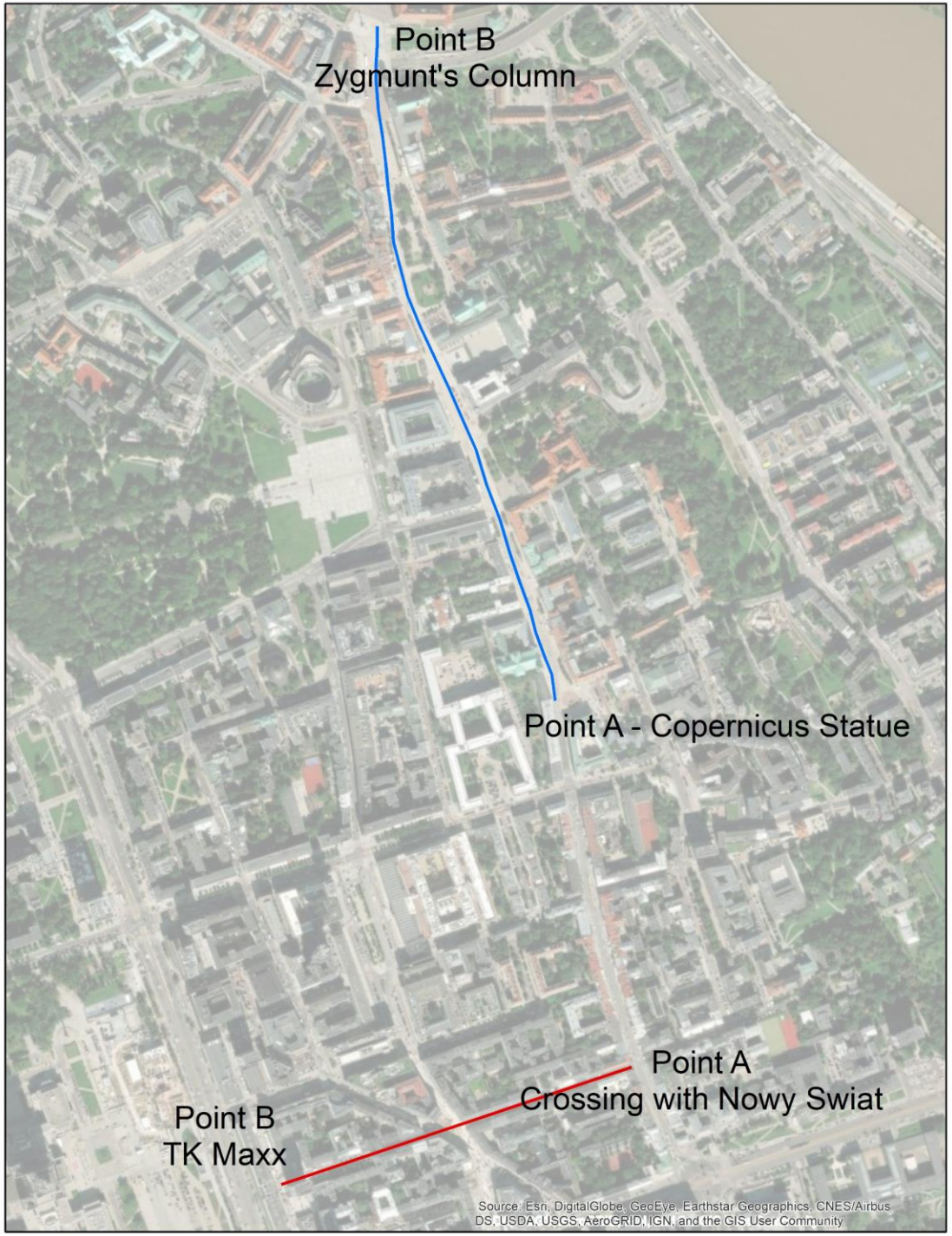


AGE	25
GENDER	MALE
TEMPERATURE (c)	37.2
HUMIDITY (%)	LO
MEDICATION	YES
LOCAL	NO

"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".


Białołęka
Bielany
TARGÓWEK
Żoliborz
Praga-Północ
REMBERTÓW
Bemowo
PRAGA POŁUDNIE
WOLA
WESOŁA
ŚRÓDMIEŚCIE
OCHOTA
URSUS
MOKOTÓW
WAWER
WŁOCHY
WILANÓW
URSYNÓW
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community


Point B
Zygmunt's Column
Point A - Copernicus Statue
Point A
Crossing with Nowy Swiat
Point B
TK Maxx
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community


MIKOŁAJOWI KOPERNIKOWI
RODACY


green CAFFÈ NERO
CAŁA NADZIEJA W KAWIE
81
GALERIA SZTUKI
Okręg Warszawski Związku Polskich Artystów Plastyków
frappe


green CAFFÈ NERO
CAŁA NADZIEJA W KAWIE
CAŁA NADZIEJA W KAWIE
Odkrywaj
KAROLIA
green CAFFÈ NERO
green CAFFÈ NERO

This sudden change in the EDA was caused by me seeing the observation tower. When I saw it, it reminded me of many holiday trips in elementary and middle school, when I used to visit many such places.

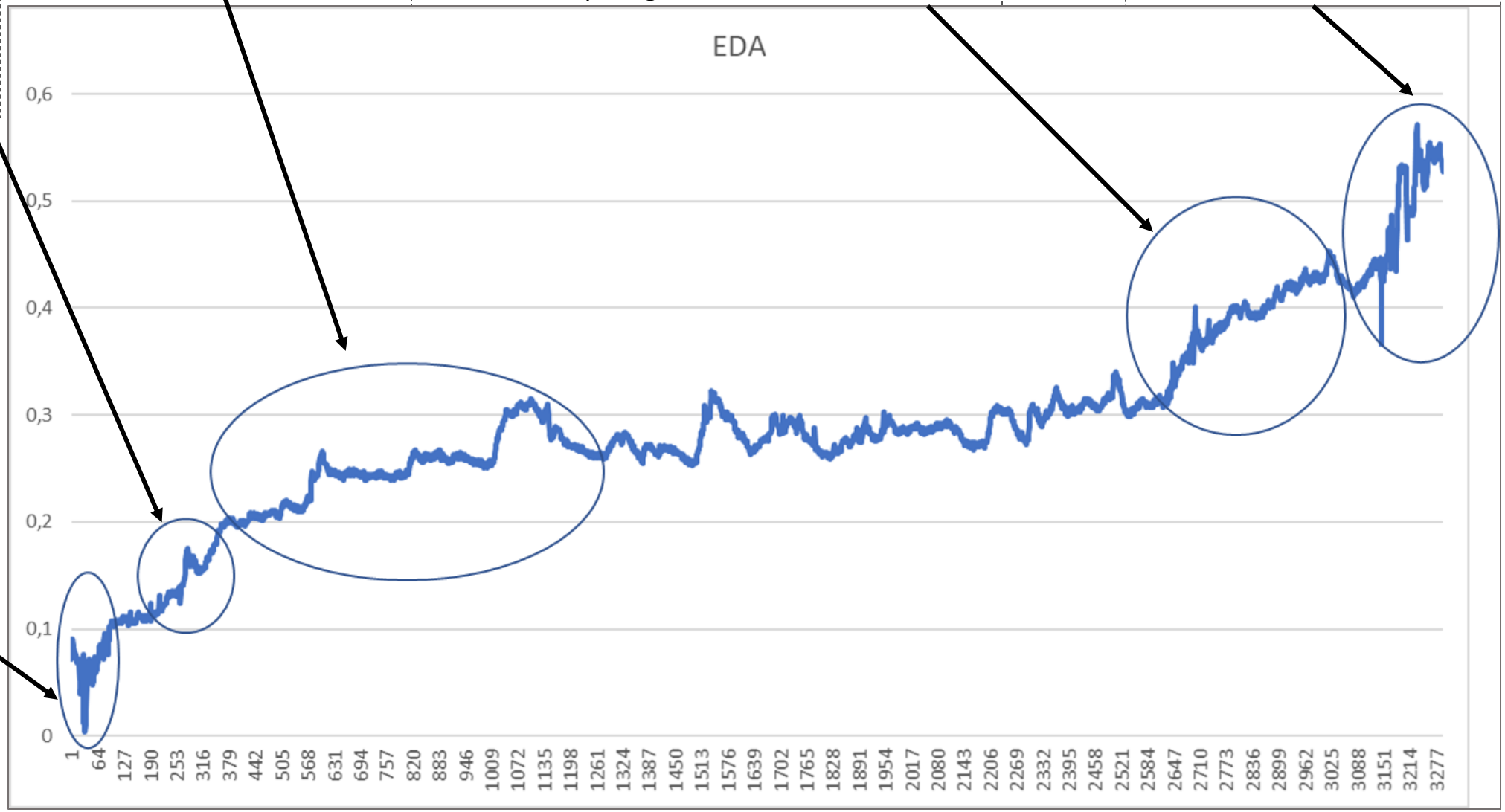
The EDA continued to rise, as I began to enter the more crowded areas with less space.

After some time, the EDA started to rise again, which was caused by me thinking about the study and wondering what should I say in the interview when I'll finish the walk. Another factor of the greater EDA growth is probably the fact that I could be a little more tired at the second part of the walk, comparing to the start of it.

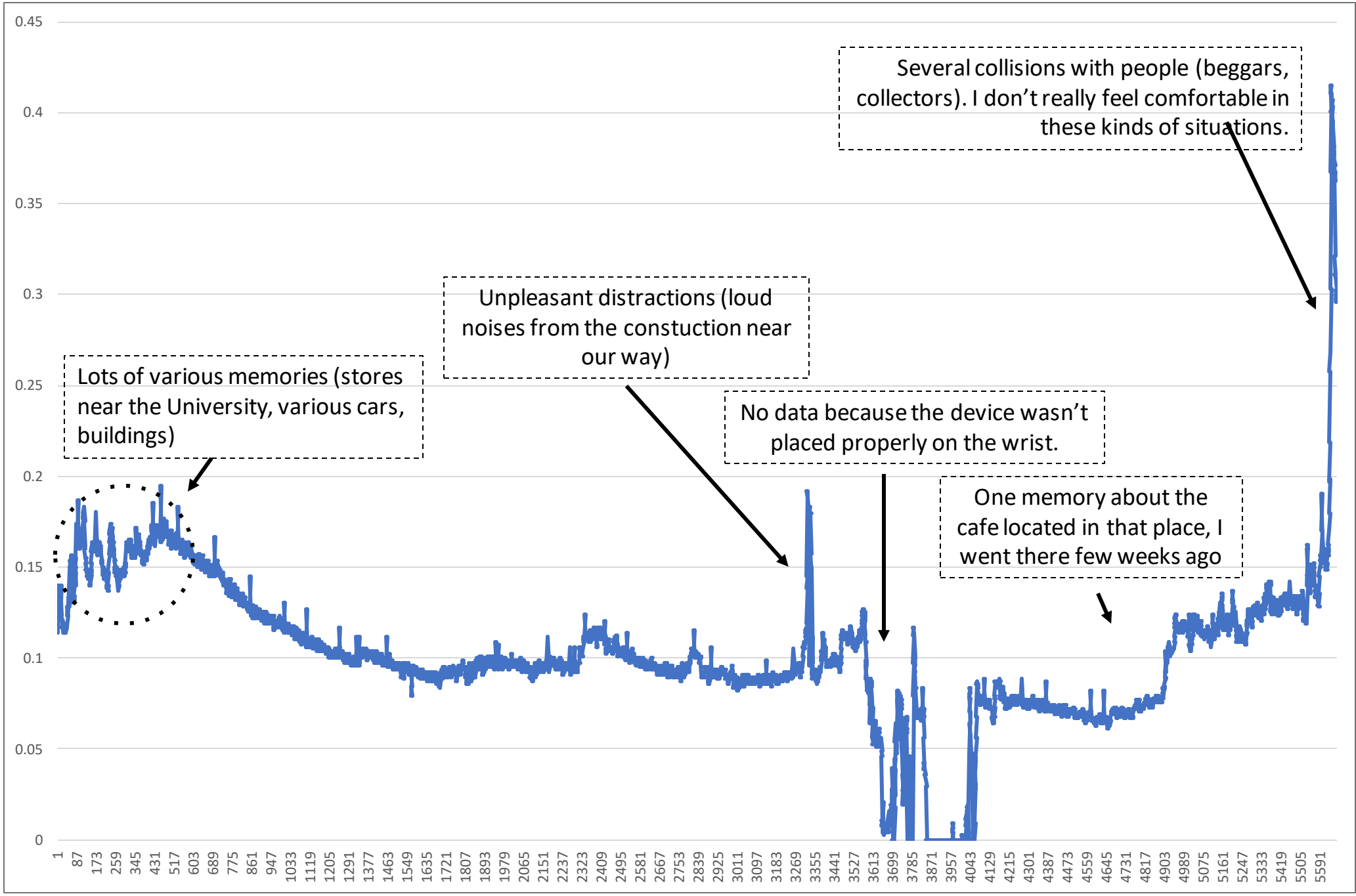
At the very end of the walk, the sudden raise of the EDA happened, probably because I stopped at the Copernicus Statue to take off the Empatica E4 device.

AGE	21
GENDER	MALE
TEMPERATURE	19˚C
HUMIDITY	2%
MEDICATION	NO

At the beginning of the walk, near the Royal Castle, I was watching a nice panorama of parks and National Stadium in the distance. It made me feel relaxed and it caused my EDA to lower.



AGE	19
GENDER	FEMALE
TEMPERATURE	23˚C
HUMIDITY	50%
MEDICATION	NO
LOCAL	NO

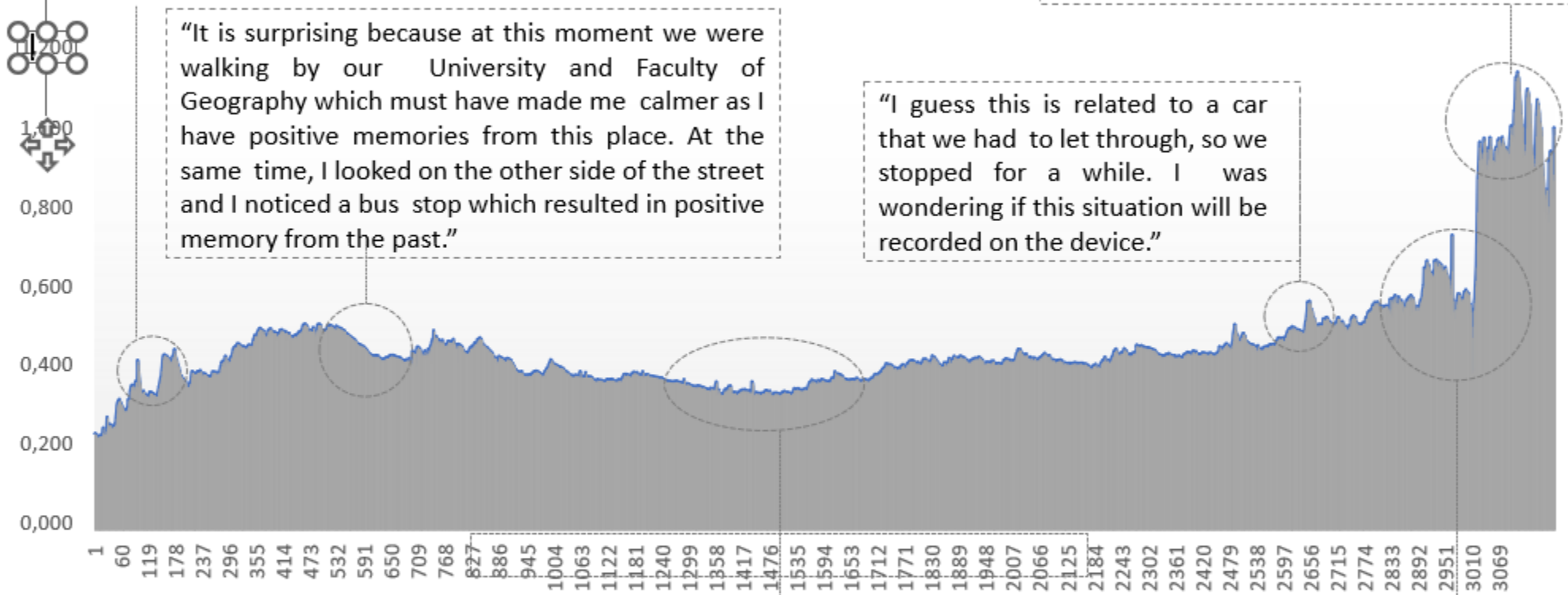


"It was a new situation for me, having this wristband on my hand. I felt overwhelmed at the beginning by all those things and noises around me. I tried to focus and remember as much as I could so I could interpret the data later and I think it caused me stress."

"It is surprising because at this moment we were walking by our University and Faculty of Geography which must have made me calmer as I have positive memories from this place. At the same time, I looked on the other side of the street and I noticed a bus stop which resulted in positive memory from the past."

"I guess this is related to a car that we had to let through, so we stopped for a while. I was wondering if this situation will be recorded on the device."

"Suddenly, the truck started to move, and we were on its way, so I grabbed my partner, who was walking beside me, and pulled him with me so that the truck wouldn't run us over. Everything happened very quickly. I felt an adrenaline rush, and after that, I felt stress as I imagined what could have happened if I hadn't done anything."



AGE	20
GENDER	FEMALE
TEMPERATURE (°C)	12
HUMIDITY (%)	96
MEDICATION	NO
LOCAL	YES

"At this point, I just enjoyed my walk and felt pretty calm. I noticed that there were not as many buses on the street, so it was quieter than at the beginning."

"In the end, I was becoming more stressed as we were getting close to the Zygmunt's Column, which was an ending point of this walk, and I started to think about the next steps of our task. At the same time there was a big truck on the street next to us, and it was very loud so it could cause higher values of the data."

Preliminary Conclusions

Events of bounded interference show that the ambiguities of biosensing data can be taken as generative drivers for deeper and more detailed discussions about spatial experiences.

The elicitation of biosensing data in post-walk interviews is fundamental for the contextualization and the analysis of such data (Stadler et al. 2018; Pykett et al. 2020a; Reif & Schmücker, 2021; Osborne, 2022).

Biosensing can be rethought as an elicitation technique that can be integrated into established qualitative and participatory methods in urban studies to generate more profound reflections and conversations.

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

UrBio

Thank you

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