UNIVERSIDADE FEDERAL DO PARANÁ

GABRIELE SILVEIRA CAMARA

EMOTIONAL CARTOGRAPHY: DATA COLLECTION AND VISUALISATION IN THE CONTEXT OF URBAN MOBILITY

CURITIBA

2021

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EMOTIONAL CARTOGRAPHY: DATA COLLECTION AND VISUALISATION IN THE CONTEXT OF URBAN MOBILITY

Dissertação apresentada ao Curso de Pós-Graduação em Ciências Geodésicas, Setor de Ciências da Terra, da Universidade Federal do Paraná, como requisito parcial à obtenção do título de Mestre em Ciências Geodésicas.

Orientadora: Profa. Dra. Silvana Philippi Camboim.

Coorientador: Prof. Dr. João Vitor Meza Bravo.

CURITIBA

2021

Catalogação na Fonte: Sistema de Bibliotecas, UFPR
Biblioteca de Ciência e Tecnologia

C172e Camara, Gabriele Silveira

Emotional cartography: data collection and visualisation in the context of urban mobility [recurso eletrônico] / Gabriele Silveira Camara - Curitiba, 2021.

Dissertação (mestrado) - Programa de Pós-Graduação em Ciências Geodésicas, Setor de Ciências da Terra, Universidade Federal do Paraná.

Orientadora: Profa. Dra. Silvana Philippi Camboim
Coorientador: Prof. Dr. João Vitor Meza Bravo

1. Cartografia – Processamento de dados. 2. Mapeamento digital. 3. Mobilidade urbana – Curitiba (PR). I. Universidade Federal do Paraná. II. Camboim, Silvana Philippi. III. Bravo, João Vitor Meza. IV. Título.

CDD 526.8

Bibliotecário: Nilson Carlos Vieira Junior CRB9/1797

MINISTÉRIO DA EDUCAÇÃO
SETOR DE CIENCIAS DA TERRA
UNIVERSIDADE FEDERAL DO PARANÁ
PRÓ-REITORIA DE PESQUISA E PÓS-GRADUAÇÃO
PROGRAMA DE PÓS-GRADUAÇÃO CIÊNCIAS
GEODÉSICAS - 40001016002P6

TERMO DE APROVAÇÃO

Os membros da Banca Examinadora designada pelo Colegiado do Programa de Pós-Graduação CIÊNCIAS GEODÉSICAS da Universidade Federal do Paraná foram convocados para realizar a arguição da dissertação de Mestrado de **GABRIELE SILVEIRA CAMARA** intitulada: **EMOTIONAL CARTOGRAPHY: DATA COLLECTION AND VISUALISATION IN THE CONTEXT OF URBAN MOBILITY**, sob orientação da Profa. Dra. SILVANA PHILIPPI CAMBOIM, que após terem inquirido a aluna e realizada a avaliação do trabalho, são de parecer pela sua APROVAÇÃO no rito de defesa.
A outorga do título de mestra está sujeita à homologação pelo colegiado, ao atendimento de todas as indicações e correções solicitadas pela banca e ao pleno atendimento das demandas regimentais do Programa de Pós-Graduação.

CURITIBA, 20 de Dezembro de 2021.

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21/12/2021 10:57:01.0
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Presidente da Banca Examinadora

Assinatura Eletrônica
21/12/2021 10:48:11.0
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Assinatura Eletrônica
29/12/2021 13:08:40.0
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Avaliador Interno (UNIVERSIDADE FEDERAL DE UBERLÂNDIA)

In memoriam

Albari Silveira Prestes

ACKNOWLEDGMENT

I am immensely grateful to my advisors, PhD Silvana Philippi Camboim and PhD João Vitor Meza Bravo, for their dedication, wisdom, teachings, contributions, corrections, support and understanding.

I thank my mother, Andrea Silveira Prestes, for all her love and support.

My grandparents for believing and being proud of me.

Thiago Higuchi, for his daily companionship, love and zeal.

My sisters and friends for their support and encouragement.

The colleagues of the Graduate Program in Geodetic Sciences and Labgeolivre Laboratory.

The Foundation of the Federal University of Parana for fomenting my scholarship and MAPFOR for the opportunity to participate in the project.

I would like to thank PhD André de Mendonça (UFAM) and PhD Marcio Schmidt (UFPR) for their contributions to the qualification.

I thank all the professors who contributed to my academic education and to all researchers who make Science resist.

RESUMO

O mapa, enquanto representação simbolizada da realidade geográfica, pode incluir não apenas elementos observáveis ou tangíveis, mas também englobando elementos intangíveis, como as experiências humanas. Deste modo a Cartografia Emocional investiga os vínculos emocionais dos indivíduos com relação ao espaço geográfico, também estudados pela Topofilia de Tuan. Os mapas que representam a relação entre as emoções e o ambiente são gerados para diferentes finalidades, como por exemplo para o planejamento urbano, voltado à mobilidade urbana. Além disso, os dados podem ser coletados de diversas fontes, como por biossensores, entrevistas, crowdsourcing, redes sociais e dados abertos. Apesar da diversidade de fontes de dados e finalidades dos mapeamentos emocionais, não é conhecido um método alinhado ao conceito de Open Science para coleta, tratamento e representação de dados referente às emoções derivadas do espaço geográfico utilizando uma linguagem não verbal, como por exemplo, os emojis. Logo, esta pesquisa explora métodos para criação e representação de dados geográficos emocionais, por meio de emojis, no contexto da mobilidade urbana da cidade de Curitiba - Brasil, e está dividida em três experimentos. O primeiro experimento apresenta um framework para coleta das emoções dos indivíduos através dos emojis, em diferentes meios de transportes em um desafio intermodal. Além disso, foi desenvolvido um caderno Jupyter para consulta e visualização dos mapas emocionais. O segundo experimento teve como objetivo analisar semanticamente os emojis utilizados no experimento um, visto que, o significado de cada emoji pode variar de acordo com o perfil individual de cada pessoa, fatores culturais e devido a diferentes plataformas. Assim, o resultado do experimento dois foi uma lista de vinte emojis adequados semanticamente ao contexto pesquisado. Por fim, o terceiro experimento apresenta um framework para coleta de dados geográficos emocionais utilizando plataformas digitais de forma remota. Ao fim, foi desenvolvido um dashboard para a visualização e consulta dos mapas emocionais. O conjunto dos três experimentos com usuários resultou em uma solução completa para proporcionar à sociedade uma forma para considerar a distribuição espacial das emoções dos cidadãos na pesquisa, planejamento e gestão da mobilidade urbana nas cidades.

Palavras-chave: Mapas emocionais. Mobilidade Urbana. Emojis. Ciência Aberta.

ABSTRACT

As a symbolized representation of geographical reality, the map may include not only observable or tangible elements but also encompassing intangible elements, such as human experiences. In this way, Emotional Cartography investigates the emotional bonds of individuals concerning geographic space, also studied by Tuan's Topophilia. The maps representing the relationship between emotions and the environment are generated for different purposes, such as urban planning, focused on urban mobility. Moreover, data can be collected from different sources, such as biosensors, interviews, crowdsourcing, social networks, and open data. However, despite the diversity of data sources and purposes of emotion mappings, there is no known method aligned with the concept of the Open Science method for collecting, processing and representing data regarding emotions derived from geographic space using a non-verbal language, such as emojis. Therefore, this research explores methods for creating and representing emotional geographic data, through emojis, in the context of urban mobility in the city of Curitiba - Brazil and is divided into three experiments. The first experiment presents a framework for collecting the emotions of individuals through emojis in different transport modes in an intermodal challenge. Besides, a Jupyter notebook was developed to query and visualize the emotion maps. The second experiment aimed to semantically analyze the emojis used in experiment one since the meaning of each emoji may vary according to the individual profile of each person, cultural factors and different platforms. Thus, the result of experiment two was a list of twenty emojis semantically suitable to the researched context. Finally, the third experiment presents a framework for remotely collecting geographic emotional data using digital platforms. Finally, a dashboard was developed to visualise and consult the emotional maps. The set of the three experiments with users resulted in a complete solution to provide society with a way to consider the spatial distribution of citizens' emotions in research, planning and management of urban mobility in cities.

Keywords: Emotional Maps. Urban Mobility. Emojis. Open Science.

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1 INTRODUCTION

Conceptualizations about “maps” traditionally emphasize that this product represents the tangible - observable - elements of the geographic space (ROBINSON et al., 1995; DENT et al., 2008; SLOCUM et al., 2009). Kraak and Fabrikant (2017) amplify this concept as they propose the definition of a map as a “visual representation of an environment”, and this environment encompasses geographic and non-geographic, tangible and intangible, permanent or ephemeral, mobile or static dimensions. Thus, here we argue that the map is a more complex product than the traditional literature has suggested before, where the human component increase in importance (MACEACHREN, 1995; GRIFFIN, ROBINSON AND ROTH, 2017).

In this sense, the humanistic perspective gained visibility within the Cartographic scientific community in 1995, incorporating human experiences into the mapping process (GRIFFIN AND MCQUOID, 2012). These human experiences characterize the intangible emotional bonds of individuals concerning geographic space, studied in parts by Tuan's Topophilia (1974). According to Kwan (2007), when emotions are discussed as variables related to geographic space, the link between emotion and space become more relevant to the reality of both the researcher and the researched. This relevance of research in Emotional Cartography is because individuals and their environment are constructed and experienced through emotions (ANDERSON AND SMITH, 2001).

Much of the research in Emotional Cartography is applied in the urban environment, focusing on different applications such as tourism (MODY, WILLIS AND KERSTEIN, 2009), quality of life (MACKERRON AND MOURATO, 2020), urban mobility (ZEILE et al., 2015; HUANG et al., 2014) and urban planning (PÁNEK, 2018). According to Pánek (2018), collaborative emotional mapping has its main contribution to the urban planning process the engagement of citizens in cities’ policies production, providing more tangible, legitimate and acceptable results to municipal representatives, as well as creating urban structures that offer a greater quality of life (PÁNEK, 2018).

As an Emotional Cartography application to the Brazilian scenario, collaborative emotional mapping could be used to raise demands in the Master Plan review process, for example, as there is an incentive for the population to participate in the decision-making process (BRASIL, 2001). The first mention about the municipal Master Plans was in Brazil's constitution of 1988, aiming to guarantee the social function of the city and the development of citizens in the urban development process (BRASIL, 1988). In 2001, the City Statute made Master Plans mandatory for all Brazilian municipalities with more than twenty thousand inhabitants, an essential instrument for the development and urban expansion policy. Additionally, the Statute determines the citizens' and representative associations' contribution in the formulation, execution and monitoring of plans (BRASIL, 2001).

In Curitiba, the city elected as the study area in this dissertation, the Master Plan revision occurred in 2014 (CESTARO AND CESTARO, 2021). Therefore, citizens were invited to participate in workshops to raise demands through ludic activities that proposed portraying their neighbourhoods within the "The city we want" theme. The inhabitants who participated in the workshops and hearings for the diagnosis process, presentation of proposals and suggestions for the revision of the Plan, totalled only 0.2% of the city's population (CESTARO AND CESTARO, 2021).

Based on this example, we believe that collaborative emotional mapping can be an activity that enriches citizens' perception of the city, contributing to the diagnosis of problems and solutions and contributing to the population's engagement in the participation of urban planning policies.

Fundamentally, the research in Emotional Cartography (NOLD, 2009; GARTNER, 2012; CAQUARD AND GRIFFIN, 2018) investigates the emotional responses to human experiences about geographic space in two distinct ways: through (1) affective responses or (2) of emotions (KLETTER et al., 2013). Affective responses are constantly perceived subjectively by individuals and are classified as neutral, moderate or extreme. In moderate and extreme cases, the perception becomes conscious and can be experienced as pleasant or unpleasant, forming the basis of emotion (RUSSELL, 2003). On the other hand, emotions are categorizations or labels applied to our current affective state or caused by a context, wherein the space is a primordial component of this scenario (BARRETT, 2006). Some emotions are universally expressed and recognized, thus being considered basic (PANKSEPP, 2005; BARRETT et al., 2006), for example, the six proposals by Ekman (1994): fear, anger, surprise, disgust, sadness and joy.

Therefore, the theme of Emotional Cartography has been investigated from different points of view (GRIFFIN AND MCQUOID, 2012; CAQUARD AND GRIFFIN, 2018). The first point of view, the map is a source of data collection to elicit information, together with interviews or focus groups, as well as the results of this survey are processed again and assigned to an emotional map (GRIFFIN AND MCQUOID, 2012). An example of the application of this methodology is the mapping of places and emotions carried out in Hamburg, Germany, and Ames, United States (POPLIN, 2017). On these occasions, through paper maps, a questionnaire and a list of emotions, the participants - from each city - mapped their “power places”, which trigger relaxation in the individuals (POPLIN, 2017). The location of the power places was represented on the maps, and the emotions associated with these places were plotted in the core affect model proposed by Russell (1980, 2003). In this case, Russell's model (1980, 2003) classifies affective responses into pleasant and unpleasant axes and excitement and drowsiness.

In the second type of Emotional Cartography research, the emotions are experienced in response to handling or producing maps, such as experiencing feelings similar to anger in the process of reading a thematic map that represents social injustices (CAQUARD AND GRIFFIN, 2018). In this context, Pirani et al. (2019) compared the influence of emotional responses to three different types of thematic maps: choropleth, cartograms and Tilemap with repeated icons. These cartographic products represented one of the indicators of the United Nations Sustainable Development "Goal 5", which aims at gender equity and the empowerment of women and girls, as well as eliminating harmful practices such as early and forced child marriage and female genital mutilation (PIRANI, RICKER AND KRAAK, 2019). The variable represented in these maps was the proportion of girls and women between 15 and 49 years old who suffered female genital mutilation or cutting in countries on the African continent.

The third point of view from which the Emotional Cartography research is developed is emotion maps, products wherein emotions are usually located and represented to understand the emotional connection between places and individuals (WHITE, 2007; GARTNER, 2012; BENAYOUN, 2005; PANEK, 2018; CAQUARD

AND GRIFFIN, 2018). Within this research strand, emotional data can be collected by different methods. The first method used to measure emotional data utilizes technical sensors, also named biosensors, such as electrocardiograms (ECG) or galvanic skin response (GSR) (NOLD, 2009; RESCH et al., 2015; FATHULLAH AND WILLIS, 2018).

Using the two biosensors previously mentioned and a smartphone, Zeile et al. (2015) developed a survey to map the emotions of cyclists in Cambridge, United Kingdom. The research aims to identify unsafe places for cycling, with the premise that places associated with negative emotions are related to problems in urban planning in these locals (ZEILE et al., 2015). Among the results presented by the authors, there are maps of emotional peaks physically measured by biosensors and maps with specific emotions collected by the participants during the execution of the experiment. However, the authors do not show the spatial association between physical and emotional responses measured in the research made by Zeile et al (2015), evidencing a lack of modelling and conceptualization of the data collected. Furthermore, the maps produced in this work were presented through static images, disabling the readers of the research to visualise and analyze the results from a different perspective than those recorded by the authors.

The second method of collecting spatial data related to emotions employs investigation techniques as self-reports, usually done through questionnaires or interviews, wherein the “sensors” are considered the individuals (GOODCHILD, 2007) as they provide a subjective observation of the mapped experience. Pánek (2018) collected emotional spatial data from Olomouc, Czech Republic, applying the self-report method using paper questionnaires and a web map platform. Participants were asked which places they found pleasant, where they felt insecure, which areas should be improved concerning public transport and which areas were more suitable for walking (walkability) (PÁNEK, 2018). The locations were mapped by collecting punctual, linear and area features and were grouped according to question. The final result of this research was a map for each researched question, and the spatial features were aggregated in a hexagonal grid (PÁNEK, 2018). Data were collected digitally by a web platform - or digitized in the case of paper questionnaires - and stored in a geographic database, providing the technological conditions for developing a platform with an interactive map as a technological result of the research. Despite this, the final maps were presented in a single Portable Document Format file (PDF), making it difficult to read and analyze. Further, the author discusses the possibility of replicating the research approach in other scenarios. However, he does not present the system architecture or alternatives for sharing the proposed method and the products generated by the mapping.

Crowdsourcing is the third method for collecting emotional data. For example, Klettner et al. (2013) collected, analyzed and modelled emotional data gathered by crowdsourcing through the EmoMap application (KLETTNER et al., 2013; GARTNER, 2012) to create a subjective layer aimed at improving Location Based Services (LBS), with a focus on pedestrian navigation and routing (HUANG et al., 2014). These authors investigated phenomena such as comfort, safety, relaxation, diversity and attractiveness related to the urban environment, representing these variables in a continuous surface map. Klettner et al. (2013) developed the conceptual model for collecting these emotional phenomena is called the "Affect-Space-Model". Unfortunately, although the model was made available on the project's website at the time of the research, the published website is currently not available anymore, harming the proposed method's reproducibility. Therefore, the availability and reproducibility of proposed methods to conceptualize and acquire emotional spatial data, such as Klettner et al. (2013) research, but also from other authors (PÁNEK E BENEDIKTSSON, 2016; MODY, WILLIS AND KERSTEIN, 2009) is an identified gap in the realm of Emotional Cartography.

Finally, the fourth method collects data from social media such as Twitter, Instagram and Facebook (ZEILE et al., 2015; HAUTHAL E BURGHARDT, 2016). The project “Pulse of the Nation” (MISLOVE et al., 2010) mapped the spatiotemporal dimensions of the feeling of happiness of citizens in the United States. The data and its daily temporal variations were obtained from Twitter and classified according to a scale from “Less happy” to “Happier”. The phenomenon was represented by a choropleth map combined with a cartogram, which depicts the number of tweets analyzed according to the size of administrative units in the United States (MISLOVE et al., 2010). An interesting aspect of Mislove's research is visualising the relationship of emotions with space and their variation over time. A video was developed to show the temporal and spatial variations of the emotions raised. On the other hand, Mislove et al. (2010) does not share the methods of data collection and processing, hinder the reproducibility of the research, as well as other studies that research on emotions extracted from social media (CARAGEA et al., 2014; FELMLEE et al., 2020).

Considering the literature discussed above, contextualizing types of emotional maps and the methods to collect emotional spatial data, some discussions were identified as points of improvement and guided the development of this dissertation. First, the studies cited to elucidate emotional data collection methods (ZEILE et al., 2015; PÁNEK, 2018; KLETTNER et al. 2013; MISLOVE et al. 2010) do not present a detailed conceptual model for data collection and storage. Furthermore, in none of these researches, a cartographic visualization platform was developed, so the readers of this work can interact with the elaborated maps, performing spatial queries for data analysis. Another aspect identified in the theoretical study conducted to develop this dissertation is the absence of research in Emotional Cartography with open source initiatives. The last aspect to consider regarding the literature is the ways of representing emotions on maps that were restricted within conventional methods of cartographic symbolization, such as with lines, heat maps, choropleth maps and continuous surfaces, attributing subjective representations to emotions.

As a consequence of the previous discussion, the main question that guides this research is: How to develop methods for collecting, processing and representing spatial data related to emotions in the urban environment through emojis, allowing the method's reproducibility in different contexts?

Therefore, the hypothesis that arises is that the technological moment enables the engagement of individuals in the use of information technologies in such a way that it is common for people to register their opinions and feelings on web platforms, especially the ones of web 2.0. Such records are spatially referenced, which allows the creation of tools for collecting, processing and representing these data. These representations benefit the recognition of emotional responses to human experiences about geographic space. On this wise, the technological solutions proposed in this dissertation evolve: conceptualizing emotions through the graphic language of emojis; structuring and storing emotional data using open source software; developing an interactive geospatial solution to representation and visualization of emotional maps; and sharing the proposed methods openly, contributing to their reproducibility within the open science. Thus, to test the proposed method, three experiments were developed in which the map locates and represents emotions to represent the relationship of the emotional connection between places and individuals. The experiments discuss cases of study associated with urban planning in the context of urban mobility.

1.1 OBJETIVE

Develop geoinformation solutions to collect, process and represent spatial data associated with emotions related to the context of urban mobility using emojis.

1.1.1 Specific objectives

1. Propose a method to conceptualize and record spatial data referring to the emotional bond of the individual related to geographic space;
2. Structure and store geographic data mapped related to emotions and develop a preliminary tool that enables interactive spatial queries and the cartographic visualization of emotional maps;
3. Evaluate the semantics of the emojis and develop a refined set of emotions and emojis in this context;
4. Propose a method to collect spatial data related to emotions;
5. Structure and store the collected data and implement an interactive tool enable spatial queries to visualize the spatial distribution of emotional geographic data;

2 DISSERTATION STRUCTURE

This dissertation was developed through three experiments, and the flowchart below (FIGURE 1) presents the steps to develop each experiment and the relationship between them.

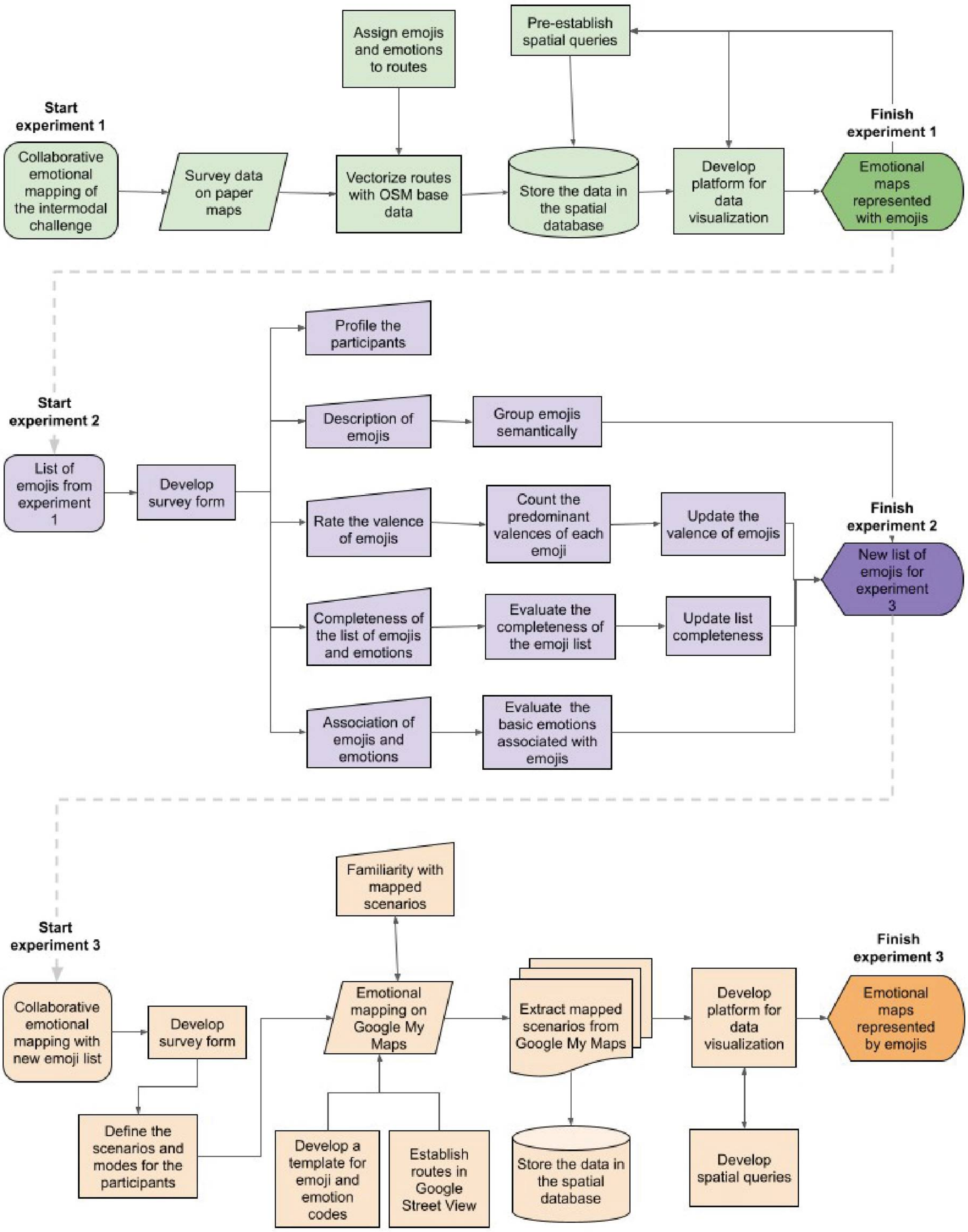
Chapter three presents the article “Collaborative Emotional Mapping as a tool for Urban Mobility Planning”, which presents a method for collecting, treating, and representing emotions through an intermodal challenge in the context of urban mobility in the city of Curitiba. The emotions selected for the experiment were represented using emojis and categorized according to the valences “positive” and “negative/neutral”; thus, the data were collected through these symbols, generating self-reports. For visualization and sharing results and reproducibility of the method, a geoinformation solution was developed through Jupyter notebooks on the Google Colab platform to provide the interface to interact with participants’ emotional spatial data related to the environment. The geospatial solution was developed in Python programming language and allowed spatial queries preestablished in the database, such as the emotions attributed to a particular street. Furthermore, the cartographic representation of the emotional reactions raised by the research participants is through emojis. Additionally, Appendix A contains the article “USING JUPYTER NOTEBOOKS FOR VIEWING AND ANALYZING GEOSPATIAL DATA: TWO EXAMPLES FOR EMOTIONAL MAOS AND EDUCATION DATA”, presented at the FOSS4G 2021 Buenos Aires (Online) and published in ISPRS Archives FOSS4G Academic Track. This article describes the technologies used to develop the Jupyter notebooks of experiment one.

Experiment one aroused a need to evaluate the semantics of the emojis used in data collection and representation. Thus a second experiment was developed (APPENDIX B). Emojis are graphic symbols that emerged at the end of the twentieth century to facilitate digital communication, representing facial expressions, concepts and ideas, as well as expressing emotions and feelings (NOVAK et al., 2015), giving additional emotional and contextual meaning to the communication (BAI et al., 2019). However, the meaning of emojis is understood differently by each person, differing due to demographic and psychological characteristics of each individual, cultural factors and the platforms of use (BAI et al., 2019). Hence, the second experiment was reported in the abstract “Semantic correlation between emojis and feelings' descriptions for Mapping Emotions into the Urban Mobility context,” and it is presented in chapter four of this dissertation. The abstract was presented at the International Cartography Conference 2021 and published in ICA Proceedings. In this second experiment, the set of emojis used in experiment one was evaluated semantically, ranked according to valence, and analyzed the completeness of the list within the context of urban mobility. The result obtained (APPENDIX C) was a list of twenty emojis semantically more aligned to the context of emotional mapping in urban mobility.

Applying the list of emojis defined in experiment two, a new collection of emotional spatial data similar to the first experiment was expected. However, due to the context of the COVID-19 pandemic, it was not possible to perform this survey. Consequently, we elaborated a third experiment, described in chapter five, that presents the article “Designing A Geoinformation Dashboard For Collecting And Representing Emotional Maps For Urban Mobility Planning”. Experiment three proposed a method for collecting and representing emotional geographic data remotely through digital platforms such as Google My Maps and Google Street View. For visualising emotional maps, an interactive dashboard was developed, with pre-established spatial queries that determine the maps that can be seen on the platform. In order to guarantee the method's reproducibility, the solution was also elaborated in python. Nevertheless, the Streamlit framework was used in this geoinformation solution to develop a more interactive interface with better usability. Finally, the representation of emotional geographic data was made using the emojis established in experiment two.

Finally, chapter 6 discusses the general conclusion of the dissertation, considering the results achieved through the three experiments, to synthesize what was proposed and developed in this research.

FIGURE 1 - FLOWCHART'S DISSERTATION



Paper 1	Published in the Geodetic Science Bulletin
Abstract	Abstract submitted to ICC 2021
Paper 2	Paper will be published after the defence

SOURCE: The author (2021).

3 COLLABORATIVE EMOTIONAL MAPPING AS A TOOL FOR URBAN MOBILITY PLANNING

Paper published in the Geodesic Sciences Bulletin - Special Edition XI Brazilian Colloquium of Geodesic Sciences. Bol. Ciênc. Geod. 27 (spe) • 2021 • https://doi.org/10.1590/s1982-21702021000s00011

3.1 ABSTRACT

In this article, we present a framework to collect and represent people's emotions, considering the urban mobility context of Curitiba. As a procedure, we have interviewed individuals during an intermodal challenge. The participants have described their experiences of urban mobility while using different transport modes. We have we used emojis as graphic symbols representing emotional data, once it is a modern language widely incorporated in everyday life as well as evokes a natural emotional association with the data we collected. We built an online geoinformation solution for visualising the emotional phenomenon. As a result, we found that the proposed methodology captures environmental factors as well as specific urban features triggering positive and negative/neutral emotions. Therefore, we validated the methodology of collaborative emotional mapping through volunteered geographic information, collecting and representing emotions on maps through emojis. Thus, here we argue this is a valid way to represent emotions and incorporate a modern language to maps. Based on the results and broader literature, we affirm this is a valuable alternative to increase knowledge about cities, once mapping emotions could assist urban planners in identifying variables, generating positive and negative feelings over the city space, which drives urban planning within a citizen-centred perspective.

Keywords: Emotional Maps. Urban Mobility. Emojis. VGI. Collaborative Mapping.

3.2 INTRODUCTION

Large cities are complex urban spaces where hundreds of thousands of people live and build their socioeconomic relations (RODRIGUE, COMTOIS AND SLACK 2016). These complex spaces have been on the focus of researchers because they produce such huge impacts on the Earth System dynamics (SEITZINGER et al 2012). In fact, the rise of large cities is a phenomenon associated with population growth, observed since the middle of the 20th century (GAKENHEIMER 1999; COHEN 2006; MONTGOMERY 2008; WANG et al 2012). In the literature, both phenomena are connected to subjects such as climate change, food security issues, deforestation, and decreased quality of life (GODFRAY et al, 2010; HIGGINS AND CAMPANERA 2011; DE JONG 2014).

During the last decades, medium and large cities in developing countries have experienced a fast mode of urban growth (COHEN 2006; ECKERT AND KOHLER 2014). Particularly in these countries, it is noticeable that rapid growth was not accompanied by well-established policies, which led to adverse urban land management outcomes (ESTES AND MOONEYHAN 1994; BIANCHINI 2006; BANISTER 2008; HICKMAN, HALL AND BANISTER 2013; DEVYLDER et al 2018; MOHAN, TIWARI AND SIVARAMAKRISHNA 2019). Consequently, the large cities in developing countries have been in such a chaotic scenario, notably in terms of public health management, environmental protection, quality of life, and urban mobility (COHEN 2006; MONTGOMERY 2008; ECKERT AND KOHLER 2014).

Given that context, people living in large cities in developing countries are experiencing slow traffic flows, due to the lack of public transport investments as well as the preference for using vehicles powered by fossil fuels (GÖSSLING 2016; RODRIGUE, COMTOIS AND SLACK 2016). Therefore, urban mobility is a subject matter of several research works, particularly in large cities in developing countries (GAKENHEIMER 1999; COHEN 2006; ECKERT AND KOHLER 2014; RODRIGUE, COMTOIS AND SLACK 2016). Urban mobility describes people's movements within the city space and is "linked to specific urban activities and their land use" (RODRIGUE, COMTOIS AND SLACK 2016). Population growth has made large cities slow in terms of mobility. That scenario could change people's feelings about the urban space, mostly encouraging negative emotions (VAN DEN BERG, HARTIG AND STAATS 2007; MCKENZIE, MURRAY AND BOOTH 2013; SHOVAL,

SCHVIMER AND TAMIR 2018; FETT, LEMMERS-JANSEN AND KRABBENDAM 2019).

The rise of earth observation technologies (EOs) has enabled scientists to carefully watch the dynamics of large cities (CALABRESE et al2013; FERSTER AND COOPS 2013). In the realm of geospatial science, that sort of observation had become closer to the citizen point of view when the web 2.0 technologies enabled individuals without education in Cartography and Geographic Information System (GIS) to collect data, the so-called neogeography made by “citizens as sensors” (GOODCHILD 2007). The fast development of technologies serving the purpose of mapping the world favoured populated geographic regions. The more people living at someplace, the greater are the possibilities of having individuals engaged in mapping it (HAKLAY, SINGLETON AND PARKER 2008; HEIPKE 2010; HAKLAY 2013; CAMBOIM, BRAVO AND SLUTER 2015; FRITZ, FONTE AND SEE 2017).

Within that new context, people have rapidly mapped dozens of places around the world, within Volunteered Geographic Information platforms such as OpenStreetMap. Therefore, the volunteered geographic information (VGI) enabled the growth of citizen’s engagement in urban development planning, within the Citizen-Centered Perspective (FATHULLAH AND WILLIS 2018; PÁNEK 2019). Notably, VGI has changed the way the researchers observe the world, especially urban systems, because they now could see places through the eyes of citizens (GOODCHILD 2007; RAHMATIZADEH, RAJABIFARD AND KALANTARI 2016; SEE et al2016; BECHTEL et al2017). Since then, scientists have been interested in mapping people’s emotions throughout the space with VGI applications, considering an extensive range of purposes (FATHULLAH AND WILLIS 2018; SHOVAL, SCHVIMER AND TAMIR 2018; CAQUARD AND GRIFFIN 2019).

It is not new that emotions have been the focus of researchers from fields like Psychology, Geography and Cartography (CAQUARD AND GRIFFIN 2019). For psychologists, determining how people feel in specific contexts could be more interesting than the purely geographic focus given by geographers and cartographers, whose interest lies in observing the emotional phenomenon distribution over space and time (CAQUARD AND GRIFFIN 2019). Also, to think about emotions over space is not a new issue in geographic studies. Tuan (1974) explained that the process of mapping emotions occurs according to the emotional bond of the individual generating information about the explored environment. In this sense, the integration of emotions with the participation of citizens in the field of urban planning, allows public managers to improve their understanding of the relationship between the population and urban spaces (SHOVAL, SCHVIMER AND TAMIR 2018). Therefore, the emotions experienced in certain portions of the geographic space could be a valuable input for creating urban planning policies, represented through the “emotional maps” (MODY, WILLIS AND KERSTEIN 2009; GRIFFIN AND MCQUOID 2012).

Nowadays, it is noticeable there are several interesting applications in the realm of emotional cartography. As we stated before, collecting geographic data about the emotional response of individuals in cities could benefit the development of urban planning policies in agreement with the people’s needs. These emotional data could be collected or measured using technical sensors (bio-sensing), self-reports who provide people’ subjective observations or crowdsourcing, and social media information (ZEILE et al2015; KLETTNER et al2013).

For example, the project “Bio-Mapping” measured the Galvanic Skin Response associated with a Global Positioning System (GPS) to produce an Emotional Mapping based in the participant’s arousal in the paths taken. In that project, the emotion was mapped according to the participant’s interpretation of what has triggered the emotion response (NOLD 2009). The “Mappiness” is another example of research work that uses crowdsourcing methods for mapping citizens’ emotions. That project is settled in the United Kingdom and is based on a smartphone application that allows people to collect and disseminate data related to the happiness felt by passersby in British cities (MACKERRON AND MOURATO 2020). Similarly, the “EmoMap” project gathers the people’s affective response to model and develops pedestrian routes, called “AffectRoutes, providing data to smart location-based services (LBS) (HUANG et al2014). Other using data from social media (Twitter, Facebook, Instagram) to produce emotional maps are from Mislove et al. (2010), who mapped the variation mood throughout the day in US at a scale of “Less Happy” and “More Happy”, and Oliveira and Painho (2015), which aims to map the geo-tagged data related with people’s perception and feelings regarding Lisbon (Portugal).

Additionally, it is noticeable that there are several ways to represent emotions on maps, applying different graphic variables for different contexts. For example, there are solutions with lines (PÁNEK AND BENEDIKTSSON 2016; MEENAR et al2019), heat maps (ZEILE et al2016), dot maps, choropleth maps, cartograms (MISLOVE et al2010) or continuous surface (KLETTER et al2013). However, these solutions keep the emotions variations subjective because they are based on conventional cartographic methods of symbolisation.

Cartographic representation through graphic symbols that evokes an emotional association with the data is not a new approach. In 1977 Eugene Turner brought to the Thematic Cartography realm the concept of Chernoff faces in the famous map “Life in Los Angeles” (TURNER 1977). The Chernoff’s faces were created by Hermann Chernoff to produce a multivariate symbol that uses the human face to represent different variables (NUNEZ 2009). In this context the emojis are a modern language that emerged as a graphic alternative to incorporate within thematic cartography (ESCOFFIER 2018), whereas visually translate subjective concepts, ideas and emotions, enabling sentiment interpretation (NOVAK et al 2015). Gamio (2017) merged the Chernoff faces and emojis, creating the Chernoff Emojis applied in a USA map that combines variables like uninsured rate, unemployment rate, poverty, obesity, among others. Another example is the Emoji Map of the reactions to unfolding events, like Donald Trump’s inauguration (DT 2017). Furthermore, connected to our research work, the emojis are also studied in urban planning applications (ÖZYILDIRIM 2019). However, the use of emojis on thematic maps need to be assisted, once they are complex symbols, composed of different forms and colours, which could impact on the cognitive load during the map-reading (PETCHENIK 1983). Additionally, these symbols don’t follow traditional cartography guidelines once they mix several visual variables.

Therefore, we understand that it is possible to create maps with emojis from data collected by collaborative mapping, in order to understand the dynamics of urban mobility and its impact on the emotional response of people living in chaotic cities, such as those in developing countries (FATHULLAH AND WILLIS 2018; PÁNEK 2019). Here we argue that collaborative mapping combined with emotional mapping is an exciting tool to understand the gaps in urban planning policies-especially in an urban mobility context, once it allows us to understand the people's emotional response to different urban environments.

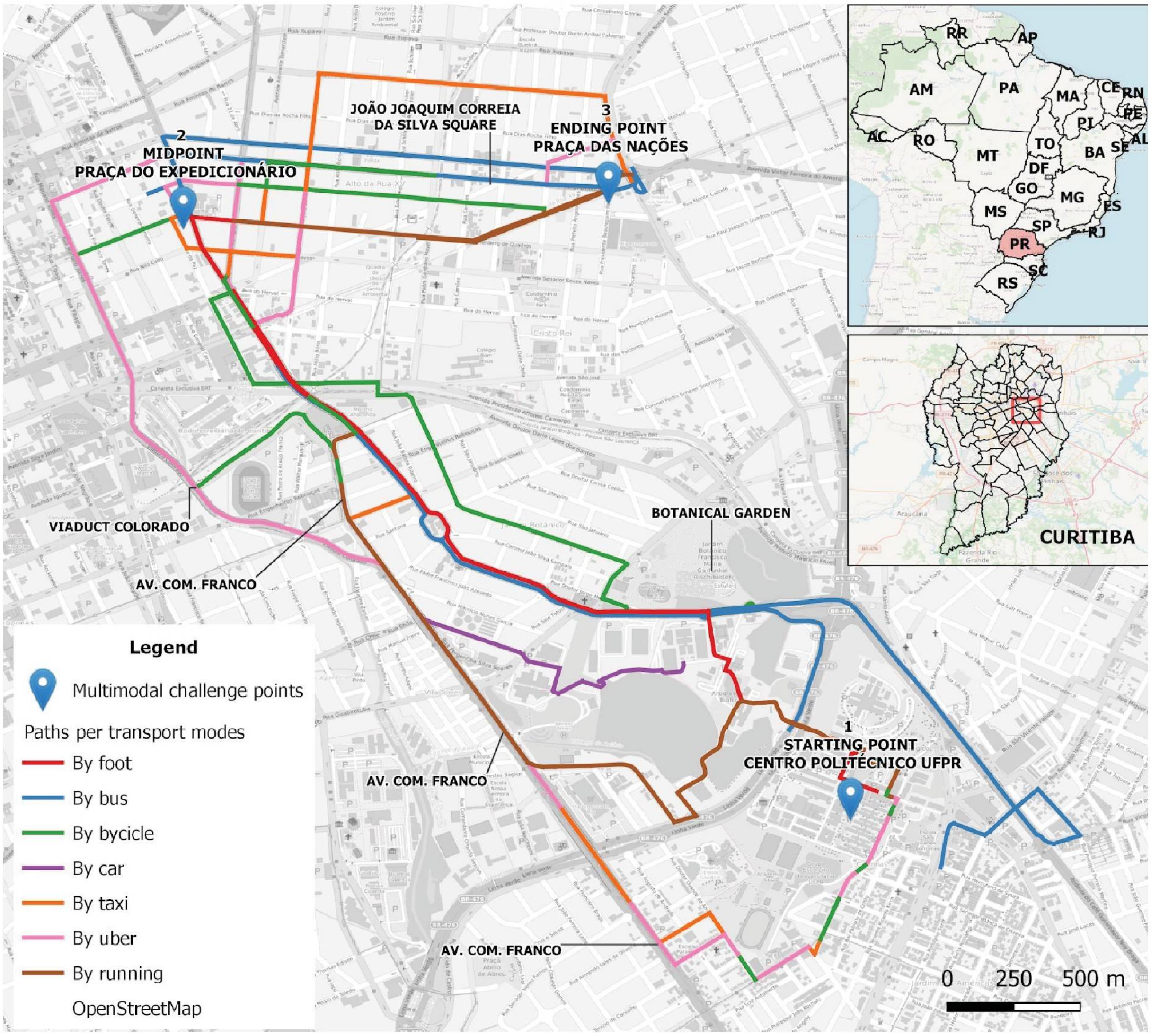
Therefore, in this article, we present a framework to collect and to represent people's emotions, considering the urban mobility context of Curitiba, one of the largest cities in Brazil. We have interviewed individuals during an intermodal challenge in the city of Curitiba, where they have described their experiences of urban mobility while using different types of transport. While interviewing the individuals, we have encouraged them to indicate the emojis representing "what they felt" along the paths, considering the different types of transport (NOVAK et al, 2015). As a result, we have collected and represented the participant's feelings all over the routes, considering the different "points-of-view" given by the specific type of transport selected. In the next topics, we present the way we have built this research work, as well as the platform to visualise the interactive emotional maps regarding urban mobility at Curitiba.

3.3 THE CASE STUDY

We selected Curitiba as the case study, which is one of the large Brazilian cities, located in the southern part of the country. Curitiba has 1.9 million inhabitants; however, the whole metropolitan area achieves 3.5 million citizens, according to the Brazilian Institute of Geography and Statistics – IBGE – estimation (IBGE 2017). In Brazil, Curitiba is recognised for its valuable planning policies related to urban mobility, sometimes associated with pioneer projects in Latin America, such as the implementation of a Bus Rapid Transit (BRT) system. Despite those efforts, according to Duarte (2006), Curitiba is still one of the Brazilian cities with the highest number of private cars per inhabitant. These mobility issues led the researchers at the Federal University of Paraná to create the "Ciclovida" Project, aiming to stimulate sustainable urban mobility within that city (NAKAMORI et al 2015). Since 2007, the main activity linked to the "Ciclovida Project" is the Intermodal Challenge, which is an activity designed to assess the efficiency of different transport modes (on foot, by car, by bicycle and using public transport), considering its impacts on the time en route, costs, and on the city environment (MARTINS 2018). Each participant departs and arrives from the same point with a different transport mode, and they necessarily should pass to an intermediate point, however, the path they have taken is their own choice.

Therefore, for accomplishing this research, we have used the intermodal challenge edition of 2018 as the context for collecting the citizens' emotions about urban mobility in some parts of Curitiba. The challenge is an instrument for reflection about urban mobility, as the participants were encouraged to observe the paths with a critical view, including emotions. Most of them travelled the paths alone, except for those of the transport mode car, who was accompanied by a person to assist in filling out the information raised. The routes under evaluation, the area we have used as the case study and reference places cited in this work are illustrated in the map (FIGURE 1). Thus, in the next topics, we describe the methods we have used to collect, represent, and to analyse the participants' feelings during urban mobility, while they travelled by different transport modes.

FIGURE 1 - MAP OF THE STUDY AREA



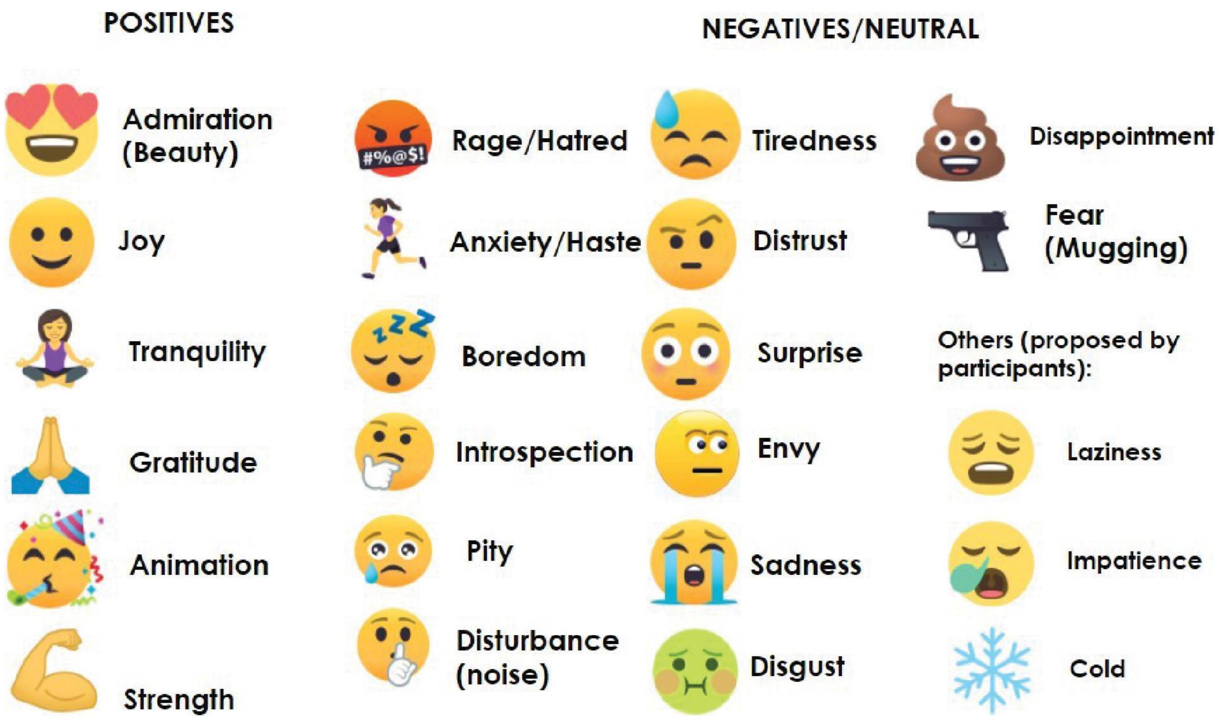
SOURCE: The author (2019).

3.4 METHODS

First, we have selected 32 (17 males, 15 females) students from the Federal University of Parana, who have participated in the intermodal challenge – edition 2018. The range in age was from 20 to 30 years old. We have invited these students to register their feelings during the route, following the steps we explain below.

Before the activity, we have presented to the participants a list of emojis associated with positive, negative, and neutral emotions. However, during the instructions, we have not shown these categories (positive, negative, and neutral) to keep the participants free for choosing a specific emoji for each one of his/her feelings. Therefore, we selected 20 emojis (FIGURE 2), each one identified by a single word or expression explaining the meaning we were adopting.

FIGURE 2 - EMOJIS REPRESENTING EMOTIONS, CLASSIFIED ACCORDING TO POSITIVES AND NEGATIVES



SOURCE: Emojitwo (https://emojitwo.github.io/) (2019).

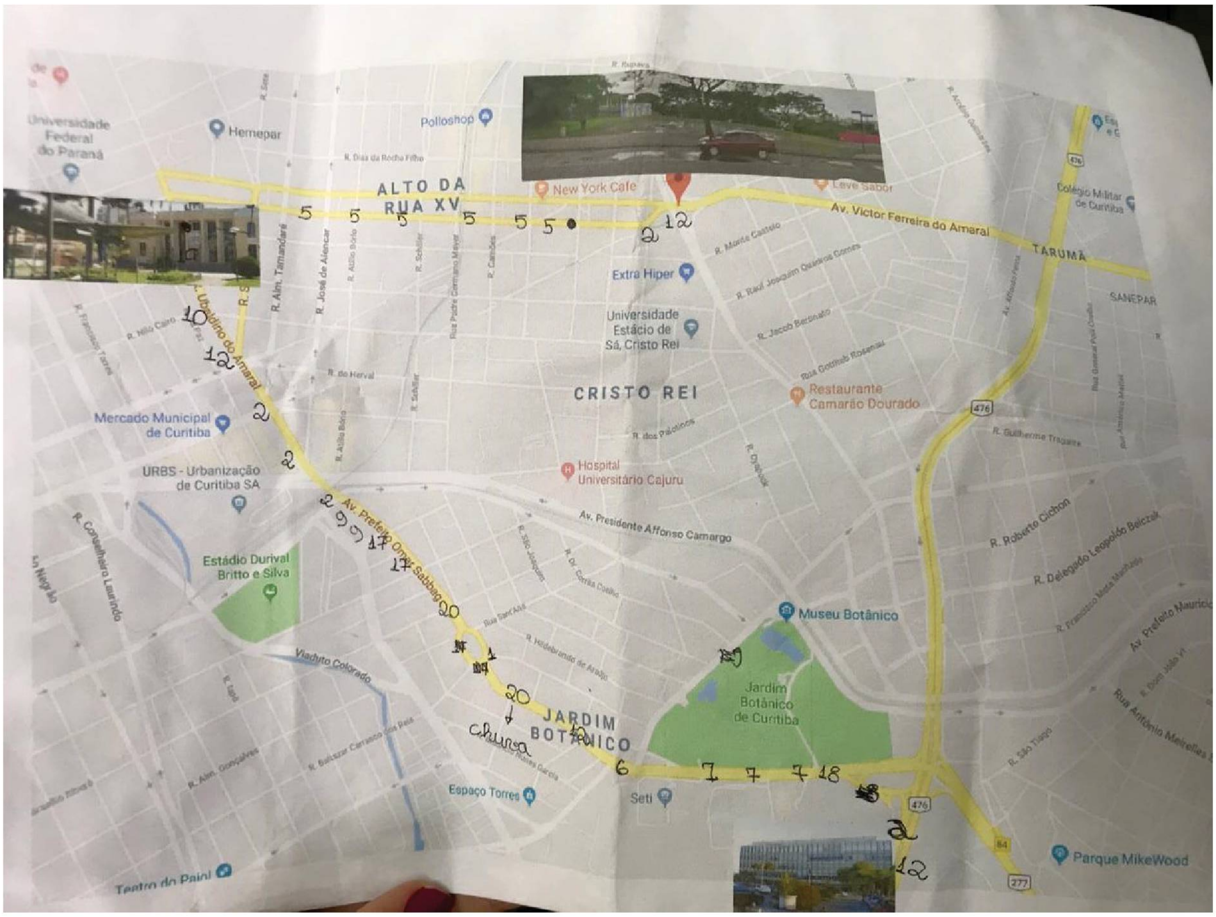
After the initial instructions, each participant received a paper map representing the area where they were about to navigate. The paper maps were chosen to maintain the data collection strategy consistent since the participants already had to fill out other Intermodal Challenge forms that were related to transportation variables and studies. On the other hand, the choice was also reinforced based on security reasons, avoiding the participants having their cell phones exposed.

We have asked the participants to take notes on what emotions they were feeling during their trip, also observing what phenomenon is supposed to trigger that feeling. They have registered their emotions by choosing an emoji and plotting it on the paper map. These emojis are part of a collection (Emojitwo) that was chosen because it is collaborative and free licensed under CC-BY 4.0. After that, they took pictures of their maps (FIGURE 3) and submitted them on an online platform (Google

Forms). Within that online platform, the participants have also registered their names and surnames and the transport modes they used.

Subsequently, we received the data and organised it in a tabular form to count and to classify the emotions collected per mode, participant, and route. Then, we have represented the routes in QGIS, associating the lines with the points/emotions mapped by the participants. We have selected as base map the OpenStreetMap vector data. Finally, we modeled and implemented a geographic database in PostgreSQL, with the spatial extension PostGIS.

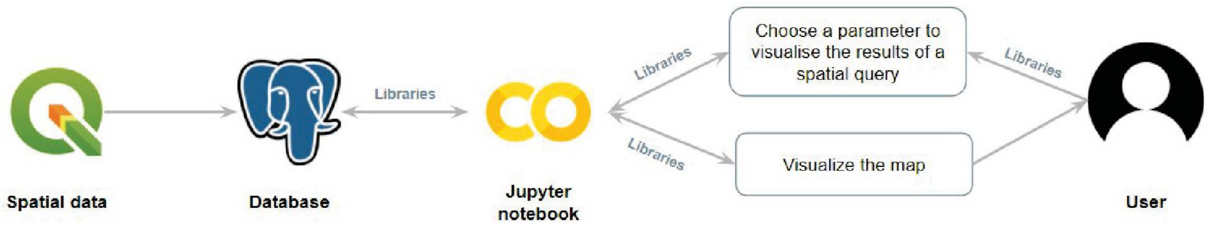
FIGURE 3 - PAPER MAP OF A PARTICIPANT WITH THE CODE OF THE EMOJIS THAT CORRESPONDS TO AN EMOTION



SOURCE: Participant from the activity (2019).

Later, we have developed a tool, by using the Google Colab Platform, characterised as “Jupyter notebooks”: these “notebooks” enable the data documentation and analysis, employing visual solutions. That tool was designed to allow the data visualisation of what we have collected during the interviews. We have selected these technological solutions to encourage the use of open-source software, as well as to increase the method reproducibility. Therefore, it is needed to mention we have used Python libraries (folium, psycopg2, ipywidgets, json, nominatim and openrouteservice) to handle the data and program the maps. This graphic (FIGURE 4) representation allows for a better understanding of the system so that it can be replicated. The system design allows the user to choose parameters that will determine pre-established spatial queries. This process will filter what is represented on the online map. Specifically, it will query the database, that will return the corresponding spatial data, which is then shown as an interactive map.

FIGURE 4 - SYSTEM ARCHITECTURE



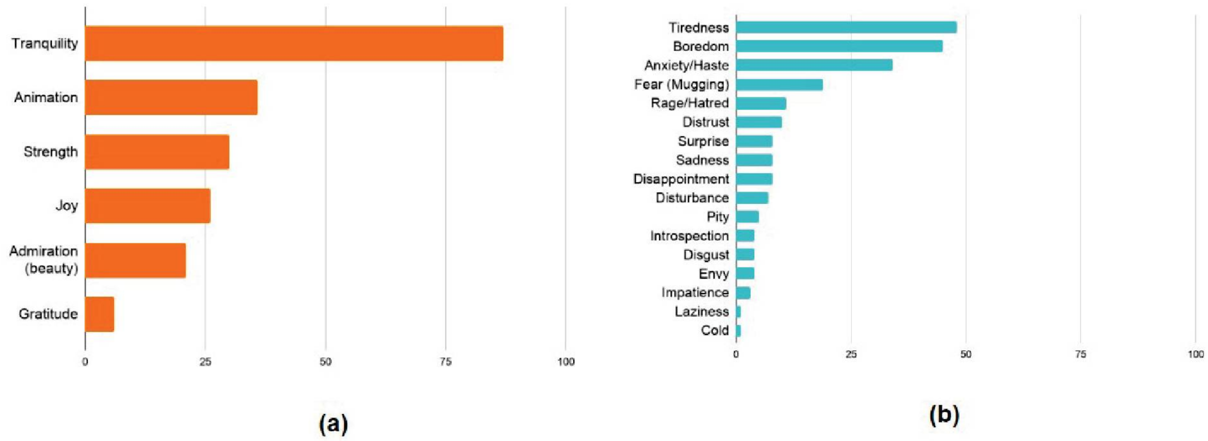
SOURCE: The author (2020).

Finally, we analysed the data collected and represented, aiming to visualise patterns in the participants' environmental perceptions. Therefore, we have observed the participants' responses in terms of the factors triggering the emotions in specific places (environmental and urban factors), considering transport mode groups as well as similar feelings mapped.

3.5 RESULTS AND DISCUSSIONS

Firstly, we have registered 426 points associated with positive (52%) and negative/neutral (48%) emotions. Figures 5 ("a" and "b") illustrate the frequency distribution of emotions we registered, over the spectra of positive and negative/neutral feelings, respectively.

FIGURE 5 - A) NUMBER OF POSITIVE EMOTIONS ATTRIBUTED DURING THE INTERMODAL CHALLENGE. (B) THE NUMBER OF NEGATIVE OR NEUTRAL EMOTIONS ATTRIBUTED DURING THE INTERMODAL CHALLENGE



SOURCE: The author (2020).

When observing Figure 5, it is noticeable that the emotions “tranquillity” – on the positive side – and “tiredness”/“boredom” – on the negative/neutral side – were on the top of the participants’ preference. We could associate these preferences with general motivations. Therefore, “boredom” and “tranquillity” might be explained by the passive attitude offered by the transport mode selected. For example, while crossing the urban environment by bus, taxi, or uber, people are passive in terms of “paying attention” to the traffic. That “tranquillity” could also trigger the feeling of “boredom” while, en route, people usually stay quiet and motionless. Then, here we explain the higher frequency for “tranquillity”, “tiredness”, and “boredom” because we have received more responses about the transport modes correlated with traveler’s passive attitude (Table 1). On the other hand, feelings such as “gratitude”, “envy”, “impatience”, “laziness”, might be associated with more specific situations, depending on the individual’s internal condition. That means, “gratitude” and “envy”, for example, are particular feelings, generally triggered by personal experiences that might not have a connection with the “human-urban environment” interaction.

TABLE 1 - COMPARISON OF THE NUMBER OF EMOTION DESCRIBED IN ACTIVE AND PASSIVE TRANSPORT MODES

		Boredom	**Tranquillity**	**Tiredness**
Active transport modes	Bicycle	4	6	8
	Car	0	9	1
	By foot	12	13	13
	Running	0	0	1

		Boredom	Tranquillity	Tiredness
	SUM	**16**	**28**	**23**
Passive transport modes	Uber	2	7	0
	Bus	26	49	24
	Taxi	1	3	1
	SUM	**29**	**59**	**25**

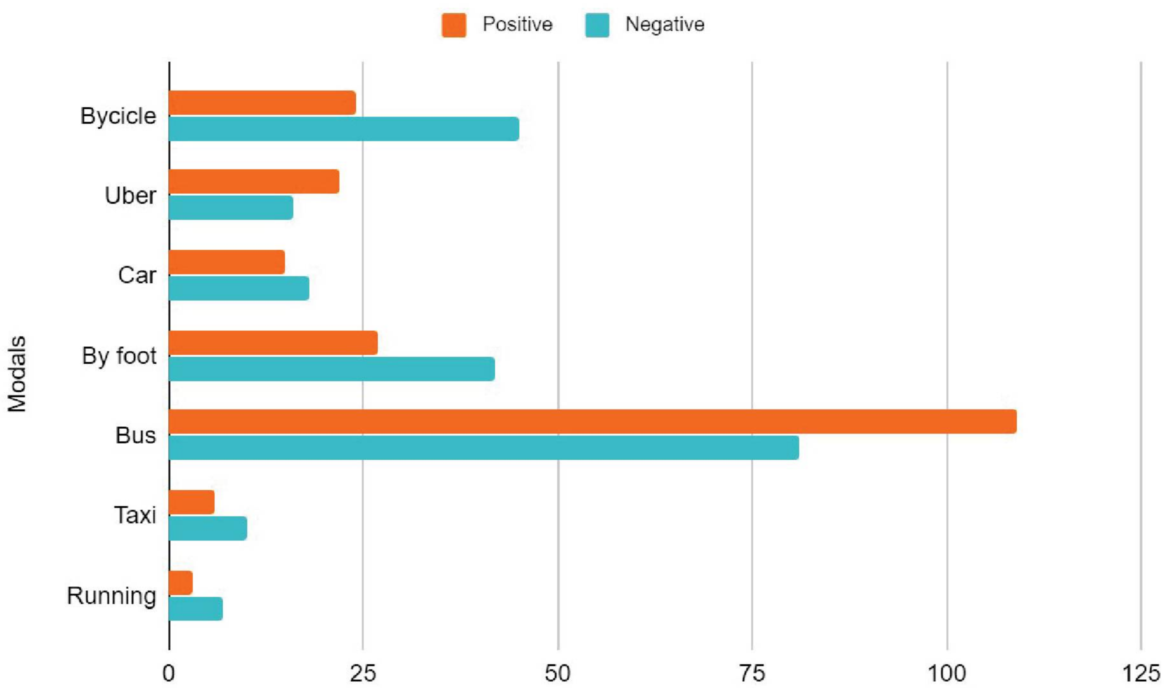
SOURCE: The author (2020).

Interestingly, “Anxiety/Haste” is almost at the top of the preferences for negative emotions. This is a general condition of modern society, mostly linked with urban life (MCKENZIE, MURRAY AND BOOTH 2013; FETT, LEMMERS- JANSEN AND KRABBENDAM 2019). That means people living in urban spaces have been experiencing more anxiety than people living in rural areas (VAN DEN BERG, HARTIG AND STAATS 2007; MCKENZIE, MURRAY AND BOOTH 2013). Plenty of urban (social, economic and environmental) variables generally are cited as factors triggering psychological disorders (FETT, LEMMERS-JANSEN AND KRABBENDAM 2019). Moreover, these psychological disorders are significantly correlated with urban life in developing countries, a condition explained by the socioeconomic disparities and all discrimination spectra (DEVYLDER et al2018). These statements give support to the results we found.

Subsequently, we have computed the percentage of positive and negative/neutral emotions per mode (FIGURE 6). There was a prevalence of positive emotions associated with the “Uber” and “Bus”, and negative to the other transport modes. Accordingly, Uber was the transport mode with a higher percentage of positive emotions 57.89%, followed by the bus with 57.39%. Proportionally, the Uber has achieved higher levels of positive emotions compared to the bus mode, once we have counted 190 and 38 responses, respectively. That might be explained because Uber is a private company that creates favourable conditions to provide customer satisfaction. Additionally, people using Uber as a transport mode usually interact with the driver, which could benefit positive experience during the travels in most cases.

In contrast, the higher level of negative emotions was marked at the transport mode “bicycle”. It is noticeable that 70% of the emotions associated with the transport mode “running” are negative; however, proportionally, there were more negative responses linked to the “bicycle” mode. Interestingly, people using a bike as a transport mode have experienced “tiredness” and “fear (mugging)”. Basically, here we connect the “tiredness” with the physical effort naturally made by the participants using this type of transport mode. The “fear (mugging)” emotion might be associated with the lack of the citizens’ security policies, a common experience in developing countries (COHEN 2006; BANISTER 2008; HICKMAN, HALL AND BANISTER 2013; ECKERT AND KOHLER 2014). Those negative feelings are, somehow, consequences of the social and economic disparities, and a consequence of infrastructure problems (ESTES AND MOONEYHAN 1994; COHEN 2006; CAMBOIM, BRAVO AND SLUTER 2015). For example, only 13 kilometres (from 45 kilometres) of the route travelled by bicycle had a cycle path on the streets. Thus, it is typical for bikers to feel uncomfortable and to register negative emotions (PÁNEK AND BENEDIKTSSON 2016).

FIGURE 6 - COMPARISON OF THE NUMBER OF POSITIVE AND NEGATIVE/NEUTRAL EMOTION ATTRIBUTED PER TRANSPORT MODES.

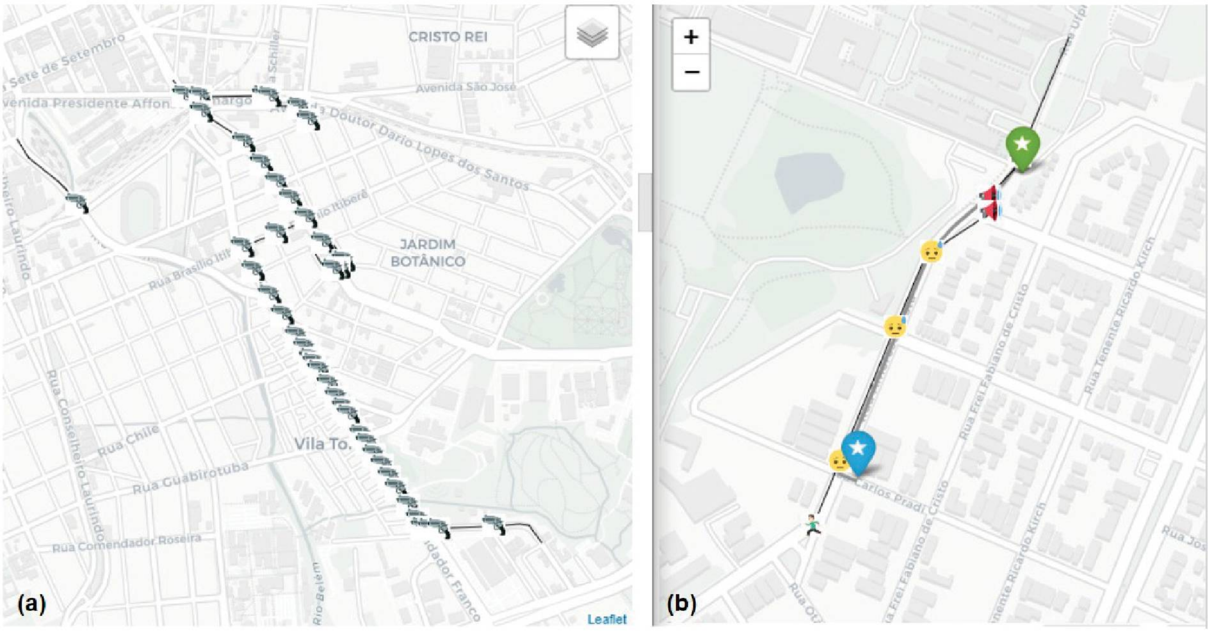


SOURCE: The author (2020).

Furthermore, while observing the spatial distribution of people’s emotions on the online platform we built, we could see patterns easily associated with the existence of urban infrastructure and beautiful features (parks, green areas, monuments). As an example, Figure 7 illustrates maps of the streets where the participants assigned the emojis, corresponding to negative/neutral emotions. Figure

7 also shows the interface of the geoinformation solution we have developed in this research. Indeed, within Figure 7a we have consulted places where people felt “fear (mugging)”; in Figure 7b we identified the emotions placed into a route, established between 2 points. These capabilities were implemented for facilitating the visualisation task, as we mentioned before.

FIGURE 7 - (A) STREETS ASSIGNED WITH THE EMOTION OF FEAR (MUGGING). (B) NEGATIVE EMOTIONS OF A ROUTE BETWEEN TWO ADDRESSES



SOURCE: The author (2019).

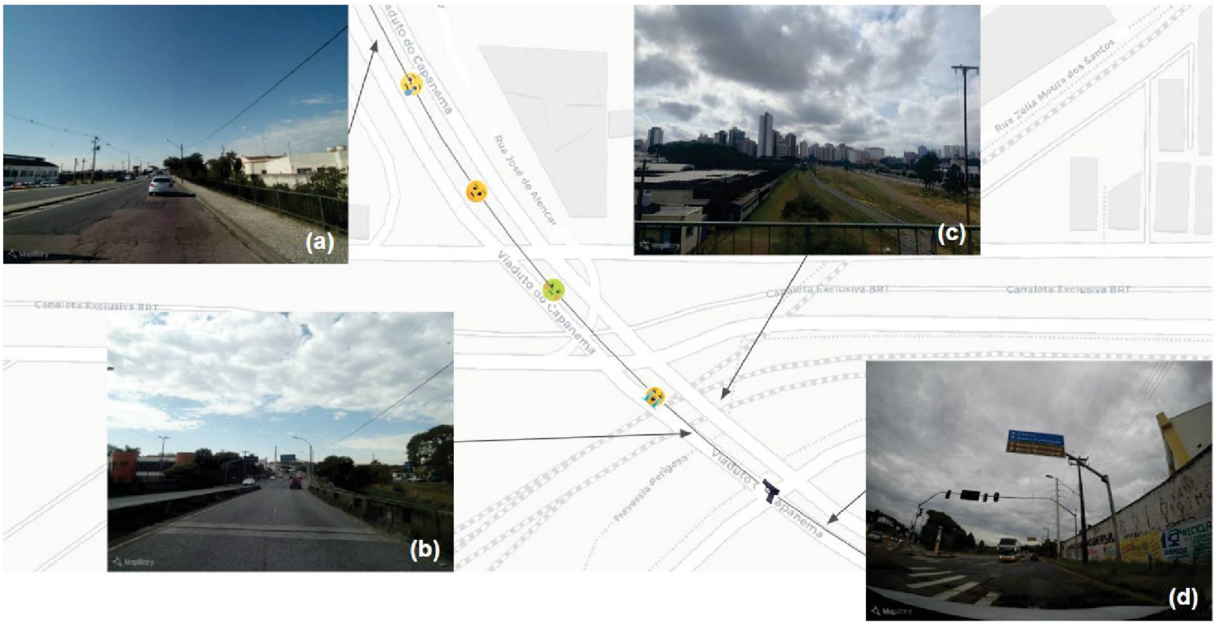
While observing Figure 7a, it is noticeable that the participants attributed the fear of being mugged along the Comendador Franco Avenue, near the Vila Torres neighbourhood. This location is the first informal settlement (“favela”) in Curitiba, where residents live in a fragile social-economic condition. That condition was triggered by the massive migration process seen in the 1970s when Curitiba has expanded its industrial capabilities without planning its geographic occupation (BIANCHINI 2006). Since then, this region has been in the same poor condition, and, consequently, is the focus of adverse social disorders of Curitiba (BIANCHINI 2006). This background might explain the results we found here. In parallel, these negative impressions might also be associated with traffic conditions. Comendador Franco Avenue is a route of fast traffic and, at some times of the day, has slow traffic and a high level of air pollution, noises, and other unfriendly environmental variables.

Depending on the hour when participants have transited through this avenue, they could be in touch with that adverse scenario, which might be connected to the feelings we registered.

Similarly, the viaduct Colorado – at the endpoint of the Comendador Franco Avenue, near to Vila Torres – has counted several negative emotions, such as pity, distrust, sadness, fear (mugging) and disgust (FIGURE 8). Here we link the emotions “sadness”, “pity” and “distrust” to the social conflicts as those previously described. It is needed to mention that some of these negative social-related FEELINGS must be attributed to the existence of homeless people begging for money in that region. Therefore, people who selected individual transport modes were more exposed to that negative scenario.

The viaduct Colorado is also an excellent example of negative environmental-related feeling because it crosses the Belem river. Belem river is an urban watercourse which vertically crosses Curitiba. As a consequence of the environmental disrespect, the Belem river is polluted, especially near Vila Torres (Figura 9a). That is a shred of incontestable evidence that might explain the association with the “disgust” emotion, we found in the interviews. Here we argue that the “disgust” emotion could also be associated with the unpleasant odor coming from the river at that point (IAP 2009).

FIGURE 8 - MAP OF THE STREET THAT REGISTERED A GREATER NUMBER OF NEGATIVE/NEUTRAL EMOTIONS



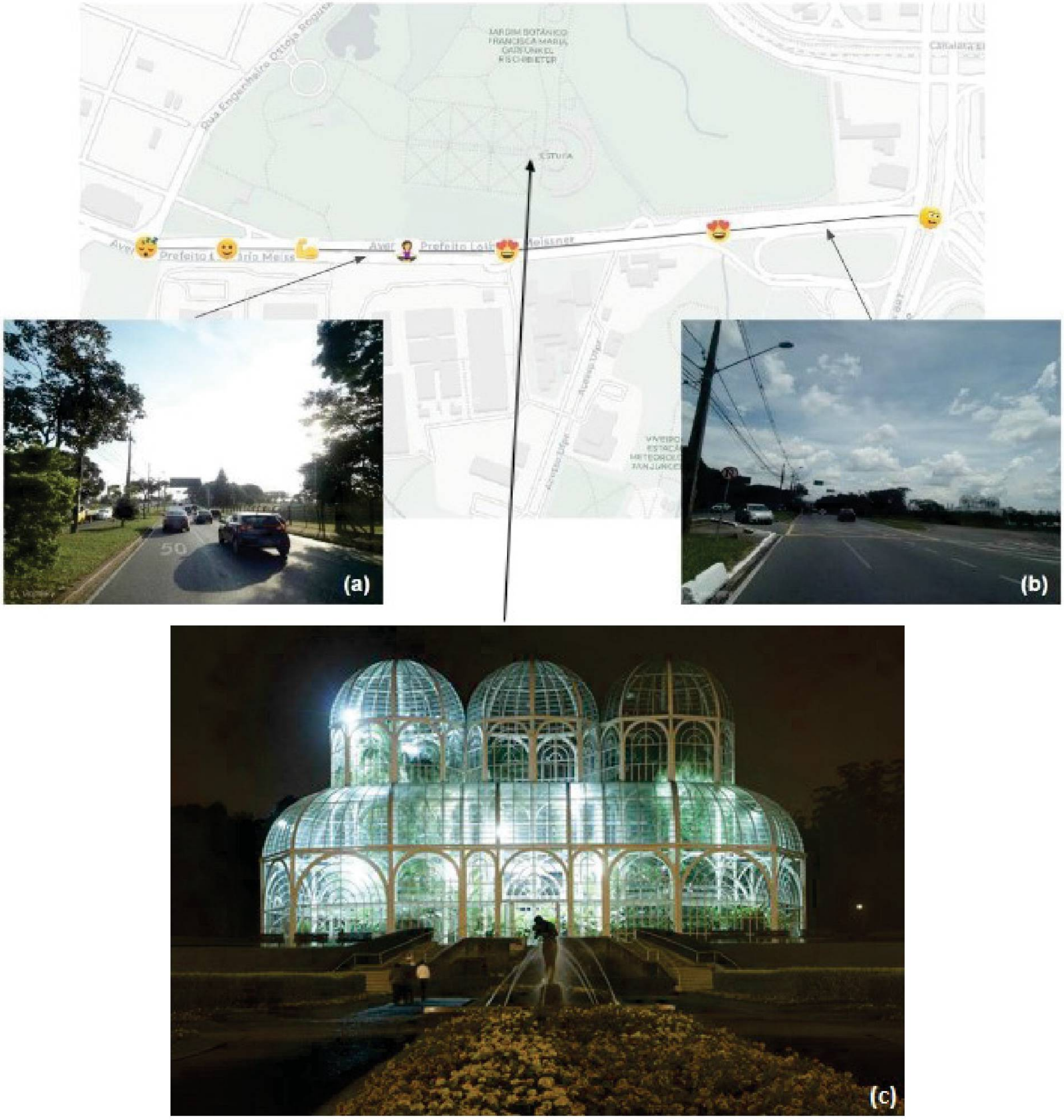
SOURCE: Author (2019) and Mapillary (2020).

FIGURE 9 - A) VIEW OF BELEM RIVER AT VILA TORRES. (B) VIEW OF THE JOÃO JOAQUIM CORREIA DA SILVA SQUARE

SOURCE: a) Maristela Mitsuko Ono (2011-2020) - Portal Cuide dos Rios (http://www.cuidedosrios.eco.br/). (b) Mapillary (2020).

Beyond the negative emotions, Curitiba has locations where the participants felt positive feelings. For example, the Prefeito Lothário Meissner avenue is a route that was frequently annotated with the “admiration (beauty)” emotion. This specific type of feeling has occurred near to the Botanical Garden of Curitiba (FIGURES 10a, 10b). The park is one of the most important tourist points of Curitiba, settled as a green spot inside the urban landscape. The Botanical Garden has its greenhouse, which is a distinctive building inside the park (FIGURE 10c).

FIGURE 10 - GEOGRAPHICAL REGION WITH POSITIVE EMOTIONS.



SOURCE: Authors (2019); Mapillary (2020) and Prefeitura Municipal de Curitiba (2020).

The results we found demonstrate the connection between positive emotions en route with the presence of green spaces and beautiful monuments (GASCON et al2015; FETT, LEMMERS-JANSEN AND KRABBENDAM 2019). For example, the participants had a tendency of recording positive emotions (40 positives vs 22 negatives) along the trajectory Prefeito Lothário Meissner avenue, even though this road also has characteristics like fast traffic, air pollution, noise, that are usually associated with negative emotions. Thus the tendency of positive emotions in this avenue could be explained by the greenness and the presence of the Botanical Garden (GASCON et al2015). This result was also found in another geographic region with similar characteristics: the Marechal Deodoro Street, near the João Joaquim Correia da Silva square (FIGURE 9b) presented a high number of positive emotions (86 positives vs 45 negatives). Additionally, it is essential to mention that 23% of positive emotions were attributed to roads located at least within 50 meters of green areas (squares, gardens and parks). These findings support the argument that adequate urban planning policies can create geographic landscapes that cause positive emotions in citizens.

3.6 CONCLUSIONS

Within this article, we propose and validate a methodology for collecting emotional data and represent it in interactive queriable maps using emojis. This approach can contribute to urban planning policies through the perspective of urban mobility, also contributing to the literature about the relationship between VGI and the engagement of citizens in mapping cities. Here we have collected spatial information that fulfils the lack of knowledge about how the citizens see Curitiba, our case study. Likewise, based on the results and the broader literature, we understand that emotional mapping improves the understanding of the city under a citizen-centred perspective, empowering public participation in the urban planning process. For example, mapping emotions such as fear (mugging), might be used in public security policymaking. Besides, mapping emotions could also assist urban planners in identifying variables generating feelings like anxiety, impatience, disturbance (noise), and those linked to decreasing levels of quality of life.

The innovative framework we have developed for collecting and representing emotions over the city of Curitiba has been successful, once we visualised – through emojis and its positions on the map – the emotional content linked to the urban mobility context. Despite the homogeneity of the group of participants in the challenge, with the same age group and level of education, it was possible to validate the methodology and analysis of emotions associated with the urban environment and the geographic features of Curitiba. A recommendation to future works is to increase the number and the heterogeneity of participants.

Specifically, we have found a relationship between positive and negative emotions with urban space. As a result, here we understood that transport modes with a higher proportion of negative emotions might be associated with the participant's exposure to environmental dangers, the path infrastructure, the greenness, and the urban infrastructure along the route.

Within this work, we also adapted – with an innovative approach – the process of creating emotional maps. Here the emotions have been categorised by the emojis they should represent, which facilitated the interpretation of the responses we have received. Another innovation point is to portray emotions on maps through emojis, which is a modern language insert in people's daily lives. However, this is an approach that needs to be studied more in future works, since the symbols are complex, composed of different forms and colours and merge diverse visual variables, which could cause a cognitive load, interfering in the map interpretation. Also, the technological advancement promoted by the proposed tool lies upon the fact that it is an open, reproducible, and accessible technology, for collecting, representing, visualising, and analysing people's emotions over the city space. Differently to the commonly used routing systems, within our geoinformation solution individuals could establish routes based on the emotions they prefer to feel, similarly with the AffectRoutes as cited before. There are also other options, where the paths are classified according to the transport modes and their emotional content, contributing to evaluating the quality associated with the transport mode. For decision-making purposes, that could be developed in future research.

Finally, it is needed to cite that collaborative emotional mapping, also using paper maps such as in this research, for example, provides a surveyed method that could be accessible to most of the population. That is a valuable input that should be considered for urban planners to understand the city under a citizen-centred perspective.

3.7 ACKNOWLEDGEMENT

The authors would like to thank Marcia De Andrade Pereira Bernardinis, professor of the Transport Engineering course in Civil Engineering undergraduate degree where the intermodal challenge was held, as well as the students of the discipline for having participated in the data collection. We also thank the undergraduate student of Cartographic and Surveying Engineering Thiago Padilha, who organised the data in tabular form and digitised the routes, as supervised internship work.

4 SEMANTIC CORRELATION BETWEEN EMOJIS AND FEELINGS' DESCRIPTIONS FOR MAPPING EMOTIONS INTO THE URBAN MOBILITY CONTEXT

Abstract presented at the 30th International Cartographic Conference 2021. Gabriele Silveira Camara, Silvana Philippi Camboim, and João Vitor Meza Bravo. Abstr. Int. Cartogr. Assoc., 3, 40, https://doi.org/10.5194/ica-abs-3-40-2021, 2021

Keywords: Emotional Maps. Emojis. Urban Mobility.

In this research, we characterised and validated a set of emojis for collecting and representing on maps the people's emotional response into the urban mobility context. This study is part of research in progress that aims to create a framework that allows mapping people's feelings about urban environments while moving through different transport modes (CAMARA, CAMBOIM AND BRAVO, 2021). Here we assume that emojis are graphic symbols that evoke a natural emotional association with data-space, such as the Chernoff Faces from Eugine Turner in 1977 (TURNER, 1977). Thus, here we argued that emojis are modern language tools that become alternatives to represent people's emotional response on maps (CHURCHES et al, 2014).

Several pieces of research on the field of Emotional Cartography have been developed to collect and represent the individuals' intangible emotional bonds with the geographic space (NOLD, 2009; GARTNER, 2012; GRIFFIN AND MCQUOID, 2012). Applications in this area of Cartography have been widely explored in several urban planning contexts, especially on developing policies based on the citizens' needs, including those on urban mobility. Here we underline researches on the improvements of pedestrians' experiences (KLETTNER et al, 2013), the walkability (PANEK, 2018), the improvements of cyclists' experience (ZEILE et al, 2015), and quality of life and well-being in cities (MACKERRON AND MOURATO, 2013).

Thus, in the first study of our research project, we have developed a framework to collect and represent emotional data during an intermodal challenge in the city of Curitiba, Brazil (CAMARA, CAMBOIM, AND BRAVO, 2021). Participants were encouraged to record which emoji represented their emotions about the city while travelling on different routes, using different transport modes. The method we developed has enabled us to visualise the individuals' emotional responses to the urban environment through the emojis and their geographic positions on the map (CAMARA, CAMBOIM, AND BRAVO, 2021). Although the results also enabled us to establish a relationship between positive and negative emotions with the urban space. However, we have identified the need to comprehend the semantics of the emojis used in this experiment, considering the context of urban mobility and individuals' different and heterogeneous realities. Then, we have designed an experiment to fill this gap, which is the focus of what we report here. The emojis used are from Emojitwo open source set, available under a CC-BY 4.0 license (https://emojitwo.github.io/).

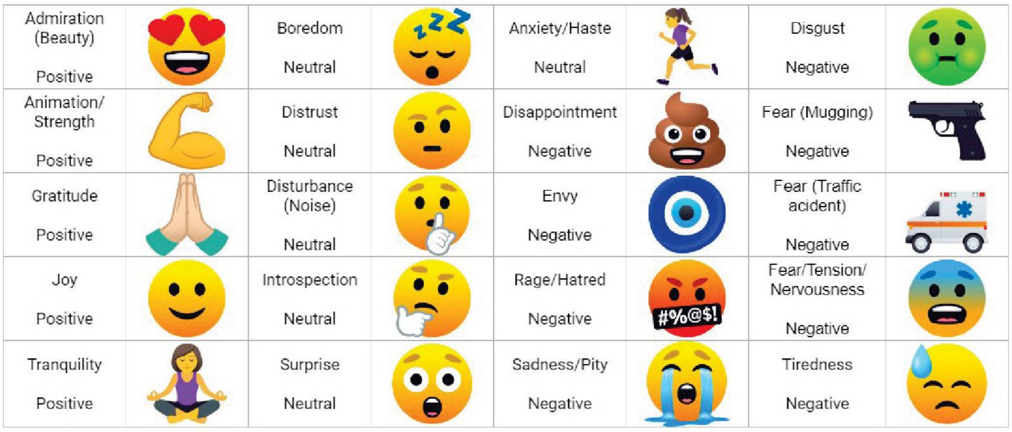
The experiment was carried online, where we interviewed 219 individuals, in Portuguese. The main goal was to research the completeness of the list of emotions proposed in the first study and analyse the correlation emojis/emotions with participants' profiles regarding gender, type of transport, and age. Therefore, in the first part of the interview, we have collected information about the individuals' profiles. Then, in the second part, we have asked participants to describe a set of emojis, each with a word that expresses the emotion within the urban mobility context. The evaluation of the individuals' understanding of the emojis meaning was made by summing the percentages of answers considered correct or correct associative. The total number obtained was then validated using two methods of determining the acceptance threshold. The first method we have chosen was proposed by Clarke (1989), which considers as effective symbols those who achieve 50% (or more) of correct answers. The second method was proposed by Formiga (2012), who believes that adequate symbols achieve at least 66% correct answers. In the third moment, we have asked the individuals to classify emojis' valencies according to positive, neutral, and negative categories of feelings (NOVAK el al, 2015). After that, we have called the participants to associate the emojis with five emotions universally expressed and recognized, considered as basic (EKMAN, 1994; PANKSEPP, 2005; BARRETT et al, 2007), despite the basic emotions are still being discussed (LEDOUX, 2012). In the last stage of the interview, we measured the frequency of emotions related to the urban mobility context to establish the most representative emojis for that purpose.

Participants belonged to different age groups, from the age of 18 to over 60. The age group with the most participation was 25 to 29 years old, comprising 22.8%. Regarding gender responses, 67.5% identified as "female", 31.5% as "male", and 1% as other gender identities. The participants were geographically distributed all over the Brazilian territory, mainly in the south, southeast, and northeast regions. One of the participants was born in German, and also there were participants from Portugal and Chile. Finally, more than half of the participants (56.6%) said that they always use emojis to communicate on social media, and only 1.8% reported that they have never used emojis for communication purposes. Participants were also asked to tell us which transport modes they generally use in their daily lives. As a result, the transport mode car has been chosen more times than the other options, and the motorcycle was ranked as the last one.

Here, we have found that the participants did not comprehend emojis referring to "envy 🤨 " and "impatience 😫 " because both have not been validated at the thresholds. In contrast, the emojis-emotions association of "pity 😢 ", "tranquillity 🧘‍♀️ ", "anxiety/haste 🏃‍♀️ ", "boredom 😴 ", "disappointment 💩 " was validated with a minimum of 69% effectiveness and a maximum of 98%. Concerning the classification of emotions represented by the emojis - positive, negative, and neutral - all emojis initially considered positive continued with this classification. On the other hand, there was a change in the emojis classified as negative and neutral since the first mapping test considered these two extracts together. Regarding the emojis that represented basic emotions such as "joy 🙂 ", "sadness 😭 ", "anger 🤬 ", and "disgust 🤢 ", all were related to emotions by most participants. The emotion with the highest number of correct answers was "anger 🤬 ", with 96.3% correct answers, and the next one was "joy 🙂 ", with 61.2%. Finally, we have defined a list with 20 associations emojis-emotions, which were validated by the thresholds. The symbols we defined differ only in two classes compared to those from the first research we have made (CAMARA, CAMBOIM AND BRAVO, 2021). Specifically, the first symbol 😨 was added to characterise "fear", "worry", "tension", and "nervousness". The second one was 🚑 related to the fear of traffic accidents.

Additionally, the emotions of "sadness" and "pity" were represented by a unique emoji 😭. Furthermore, we grouped the emotions of "animation" and "strength" with symbol 💪 because they present many similarities in interpretation. An emoji tested with more correct answers replaced the original “envy” one . Figure 1 presents the final list of emojis obtained through this research and their respective valences.

FIGURE 1 - LIST OF EMOJIS SEMANTICALLY ANALYSED FOR EMOTIONAL MAPPING



Admiration (Beauty) Positive	Boredom Neutral	Anxiety/Haste Neutral	Disgust Negative
Animation/ Strength Positive	Distrust Neutral	Disappointment Negative	Fear (Mugging) Negative
Gratitude Positive	Disturbance (Noise) Neutral	Envy Negative	Fear (Traffic acident) Negative
Joy Positive	Introspection Neutral	Rage/Hatred Negative	Fear/Tension/ Nervousness Negative
Tranquility Positive	Surprise Neutral	Sadness/Pity Negative	Tiredness Negative

SOURCE: Authors (2021)

Therefore, based on the results, we may conclude that most of the proposed emojis align with the semantics attributed to them within the urban mobility context. Also, it was possible to understand how people interpreted emotions and their synonyms, allowing the creation of a group of emotions associated with a unique emoji. In addition, we concluded that it is essential to differentiate categories of fear, such as an emoji that describes a general fear and others for more specific situations. Finally, considering this research is in progress, we are still analysing the relationship between emotions and the groups surveyed, like gender and transport modes. The list of emojis and associated emotions produced in this phase of the project will be used to develop a collaborative tool for emotional data collection and representation in urban mobility scenarios.

5 DESIGNING A GEOINFORMATION DASHBOARD FOR COLLECTING AND REPRESENTING EMOTIONAL MAPS FOR URBAN MOBILITY PLANNING

5.1 ABSTRACT

This article presents a framework for collecting and representing emotional geographic data obtained through web platforms. Five scenarios were developed in the study area of the city of Curitiba to evaluate the participants' emotional response related to the city through urban mobility. The participants had to simulate the route of the scenarios considering different transport modes, using platforms like Google My Maps and Google Street View. We used a list of emojis semantically analysed for data collection and representation of the emotional spatial data. Thus, we developed an interactive geoinformation solution to visualise the produced maps. Although the necessity to consider the participants' experience related to the environmental conditions registered at a particular time in the Google Street View images, it was possible to capture the environmental factors that trigger positive, negative or neutral emotions. Thus, we argue that the method presented is also an opportunity for collaborative emotional mapping to identify demands contributing to urban planning and mobility.

5.2 INTRODUCTION

The urbanisation process was accentuated in the 20th century and is associated with population growth, occurring unequally worldwide (IOANNIDES AND ROSSI-HANSBERG, 2005; WANG et al., 2012). In developing countries, this rapid and disorderly growth of cities has triggered social, economic and environmental problems (UDEGA, 2018), negatively impacting issues of public safety, health and education infrastructure, quality of life, and urban mobility (WHO, 2004; ECKERT AND KOHLER, 2014). These impacts also directly affect individuals, causing negative emotions associated with the urban environment (MCKENZIE, MURRAY AND BOOTH 2013).

Emotional Cartography is a research field in Cartography in which methods are created to map human experiences, characterising the emotional bonds of individuals regarding geographic space (NOLD, 2009; GARTNER, 2012; CAQUARD AND GRIFFIN, 2018). In this case, Emotional Cartography products are generated for different "map use contexts", including urban planning and mobility (FATHULLAH AND WILLIS 2018; PÁNEK 2019). This aspect of cartography, combined with volunteered geographic information, increases citizens' engagement in urban development planning (PÁNEK, 2018).

Thus, Camara, Camboim and Bravo (2021a) proposed a framework for collecting, manipulating, and representing emotional spatial data through emojis in the context of urban mobility in Curitiba. The authors argue that collaborative emotional mapping can be a tool to understand the failures of urban planning policies and the emotional bond of people in different environments in the urban space (CAMARA, CAMBOIM AND BRAVO, 2021a). Furthermore, collecting and representing emotions by emojis, a modern language of graphic symbols, enables the representation of emotions less subjectively than other symbolisation methods in conventional cartography. However, emojis must be evaluated concerning cartographic language, mainly semantics. Therefore, Camara, Camboim and Bravo (2021b) developed a semantic study of the list of emojis used in those mentioned above collaborative emotional mapping, resulting in a new set of emojis that will be used in a new data collection.

In December 2019, an epidemic began in Wuhan, China, and rapidly became the global COVID-19 pandemic, which unfortunately made millions of victims across the planet, unleashing economic and social impacts (AL-ROHAIMI E OTAIBI, 2020; WHO, 2020). The main precautions to prevent transmission of this virus infection are: social distancing, wearing masks, washing hands and keeping environments ventilated (WHO, 2020), and adopting such prophylactic measures, especially social isolation, caused behavioural changes (LADES et al., 2020). The impact of pandemic also affects scientific research, making it necessary to expand and adapt data collection strategies, with digital media becoming an alternative (SCHMIDT, PALAZZI E PICCININI, 2020). The collection of volunteer geographic data through digital platforms has been a reality since web 2.0 (GOODCHILD, 2007), in which the internet technologies, including those involving cartographic components, has created groups of people characterised as "users-producers" or "users-creators" (KRÓL, 2020). Additionally, based on the technological and ideological fundamentals of Web 2.0, social media emerged, enabling the creation and exchange of content (KAPLAN AND HAENLEIN, 2010), that includes verbal expressions of emotional manifestations that are geotagged and consequently could be mapped (HU AND WANG, 2020; RESCH et al., 2015; RESCH et al., 2016; ASHKEZARI-TOUSSI el al, 2018; OLIVEIRA AND PAINHO, 2015). Thus, the mapping of individuals' emotions linked to geographic space is within the domain of Emotional Cartography (NOLD, 2009). In the realm of Emotional Cartography, the methods for surveying emotional geographic data can also be by digital platforms, such as mobile applications (ZEILE et al., 2015), web platforms (PANEK, 2018) and through social networks (MISLOVE et al., 2010).

According to Kraak (2015), the World Wide Web (WWW) provides the opportunity to increase the production of maps regarding the collection of spatial data and related to the visualisation of maps, which has become more dynamic and interactive for users. The most common way of using maps is through digital solutions (MENDONÇA, 2013). However, there are still challenges in developing tools for geovisualization, as the efficient transmission and visualisation of spatial data for users (BELUSSI et al., 2007).

Therefore, considering the context of the COVID-19 pandemic, this article aims to develop a method for collecting and representing emotional geographic data remotely through web platforms. Thus, it was developed to collect emotional geographic data through digital platforms such as Google My Maps and Google Street View. The advantage of using these platforms is that the company has more than 1.5 billion users of the active Gmail email service globally (GOOGLE, 2018). Thus, most individuals probably experience Google tools daily or have experienced them once. However, the disadvantage of this choice is that the services used are from a proprietary platform, which is free and public but not open source. Moreover, the solution developed is restricted to the company's terms of use.

An interactive geoinformation solution was developed for visualising emotional maps, with pre-established spatial queries to enable the users' interaction with the map. The solution was also elaborated in Python, but instead of Jupyter, it was hosted at Github to assure the method's reproducibility. Furthermore, the Streamlit framework was used in this geoinformation dashboard to develop a more interactive interface with better usability. The representation of emotional geographic data was made using the emojis established in Camara, Camboim and Bravo (2021a).

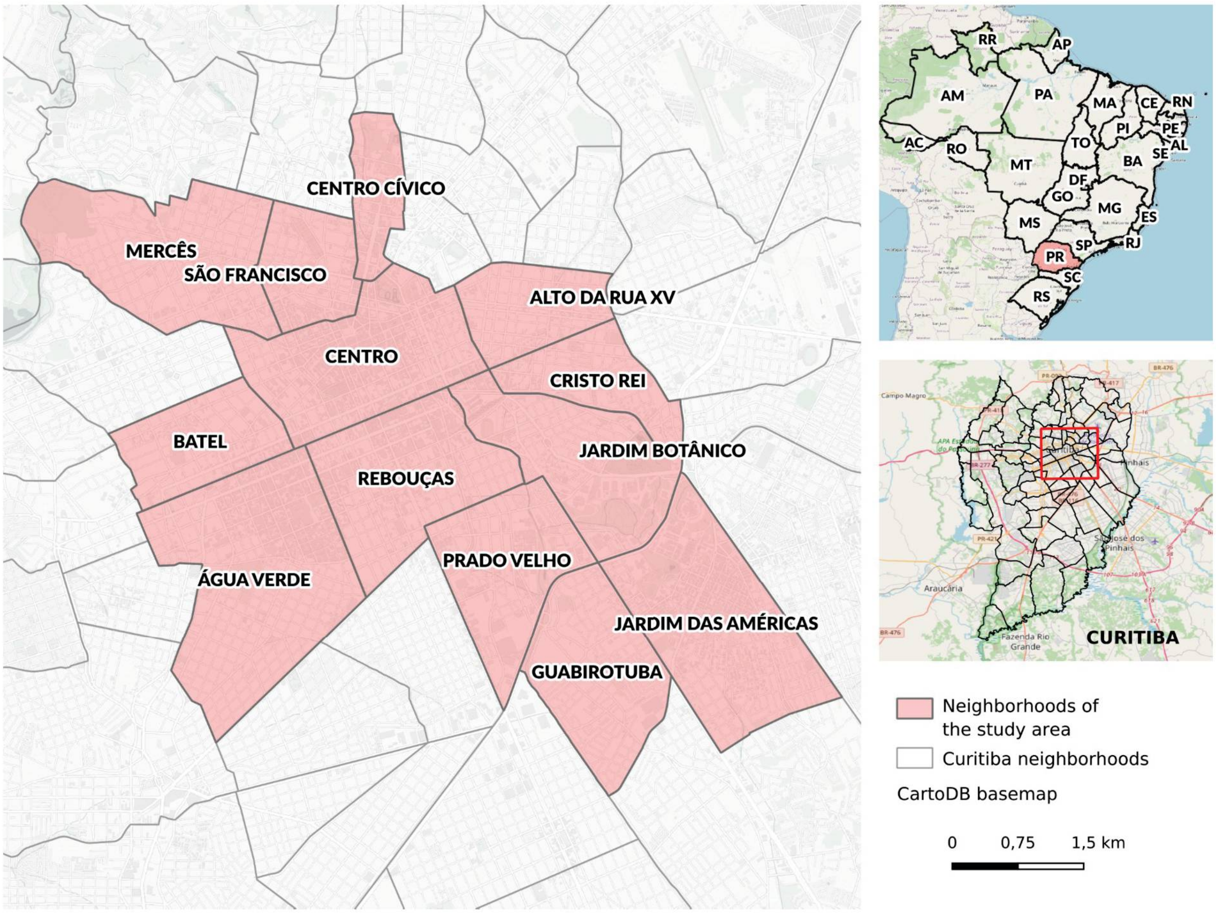
The challenge in data acquisition is formulating a method that can reproduce the conditions of the urban environment and the transport modes to enable emotional mapping. Regarding data visualisation, the challenge is developing an interactive dashboard applying the set of semantically tested emojis (CAMARA, CAMBOIM AND BRAVO, 2021b).

We argue that despite the impossibility of data collection through the city because of the security measures related to the pandemic context, it is possible to map spatial data associated with the emotional bond of the individuals with the environment through web platforms. The following topics present the steps to develop the mapping process and visualisation of maps concerning urban mobility in Curitiba.

5.3 THE STUDY AREA

Curitiba is located in southern Brazil and has a prominent role in the country, being the fifth municipality with the highest nominal municipal GDP (IBGE, 2019). Therefore, the city was chosen as a case study, and figure 1 shows Curitiba's neighbourhoods where we define the scenarios to realise the emotional mapping. According to the city's zoning (IPPUC, 2021), the neighbourhoods of the study area have different soil uses, which could trigger different emotions in the individuals. For example, the Centro Cívico' has almost 100% of the area designated for government use, such as the building of the state of Paraná government seat. On the other hand, the Jardim Botânico and Jardim das Américas are areas with a specific use, respectively 29% and 20% of the area concerned with educational use since there are two campuses Federal University Parana in these neighbourhoods. Finally, Batel, Bigorrilho, Água Verde and Alto da Rua XV have more residential uses.

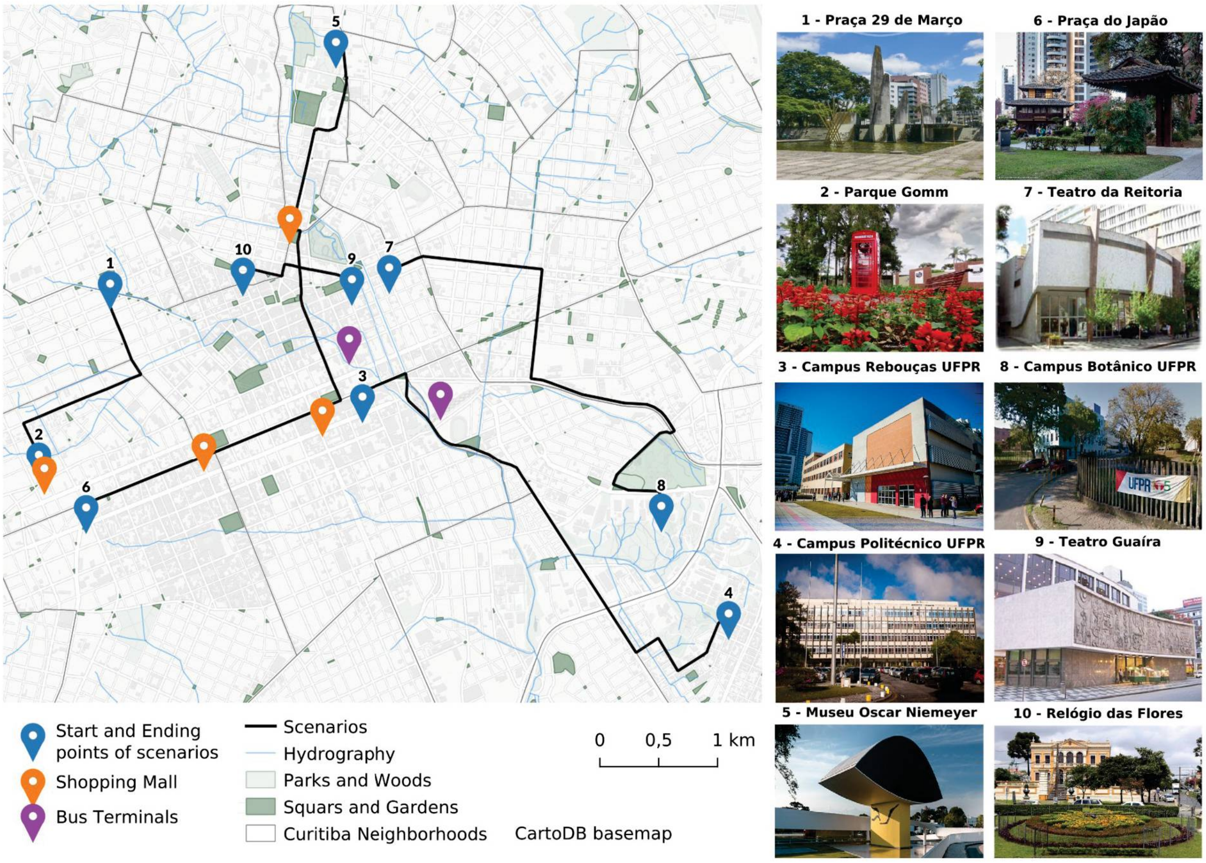
FIGURE 1 - STUDY AREA



SOURCE: Authors (2021)

The scenarios mapped by the participants of this research (FIGURE 2) were designed to be diverse, enabling assess the emotional bond of individuals concerning different aspects of the city. One of the aspects that will be evaluated is the green areas, as the city has already been considered the fifth greenest in Brazil, with 76.1% of arborised roads (IBGE, 2010). Currently, it has more than 13 million square meters of green area distributed throughout the city, reaching 70 square meters of vegetation per inhabitant, much more than the ideal predicted by the World Health Organization of 12 m²/inhabitant (CURITIBA, 2021).

FIGURE 2 - SCENARIOS' POINTS OF REFERENCE



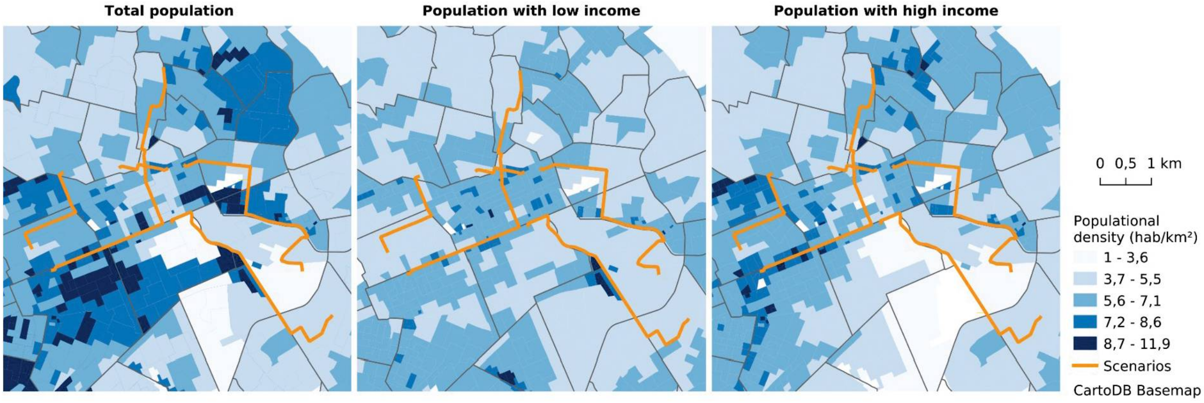
SOURCE: Authors (2021)

In addition, another aspect that was taken into account when defining the scenarios was the distribution of income. Curitiba is one of the cities with the worst income distribution in Latin America (ONU-HABITAT, 2012). This inequality is reflected in the urban space through the spatial segregation of social classes, which is a common segregation type of several Brazilian metropolises (VILLAÇA, 2001). Socioeconomic spatial segregation is when individuals from different social classes tend to concentrate in specific regions of the city (VILLAÇA, 2001). Consequently, based on these relations of inequality, these regions are unequally supported in terms of public investments, urban characteristics, infrastructure, public facilities and conservation of spaces, wherein these improvements tend to be concentrated in the most valued areas of the city (SABOYA, 2009). Thus, spatial segregation generates several consequences, such as the non-use of public space equally by the entire population, reinforcing the disparity of access, usufruct and right to the city (AMANAJÁS AND KLUG, 2018), resulting in conditions of social vulnerability concerning education, mobility, health and public safety (AMANAJÁS AND KLUG, 2018).

As a palliative action to social inequality, hygienist measures are applied in the cities, creating differentiated circulation spaces in regions of urban space based on capitalist social criteria (MACHADO, 2012). Brazilian cities have a history of hygienist policies (MACHADO, 2012), which replace social policies with control policies, such as surveillance, policing, heritage protection and social control techniques (FARIA, 2020). The city of Curitiba has a vast history of hygienist policies, such as the closing of luggage storage and the largest shelter in the city centre for homeless people (RESENDE, 2017; GALINDO, 2020), the restriction and criminalization of food distribution for homeless people (DARTORA, 2021) and the constructions and installations aiming to exclude undesirable groups from the space, mainly public spaces, a practice called hostile architecture (FARIA, 2020). Another example of the hygienist policy of Curitiba is the detour that the tourist bus line makes when passing through Vila Torres. This tourist route passes through the main tourist attractions of the city, including the neighbourhoods Jardim Botânico and Jardim das Américas, both neighbouring Vila Torres, however, in the section where the bus should pass next to this place, a detour is made, avoiding that tourists see social inequalities, further reinforcing exclusion (BIANCHINI, 2006).

Thus, the scenarios were designed to intersect neighbourhoods with different incomes (FIGURE 3). The income data used are from the 2010 census, with the low-income population earning up to one minimum wage while the high-income population was earning ten or more times the minimum wage.

FIGURE 3 - INCOME MAP OF STUDY AREA



SOURCE: Authors (2021)

5.4 METHODS

The proposed experiment aims at remote emotional geographic data collection since the pandemic context restrained the presential data acquisition, using tools such as Google Forms, Google My Maps and Google Street View. We also developed a dashboard for visualising emotional maps that allows the interaction with the map data through an interactive interface. Furthermore, through widgets, it is possible to choose filters that determine parameters for spatial queries in the database, returning spatial data filtered by emotions, transport modes, scenario, age and gender of the participant.

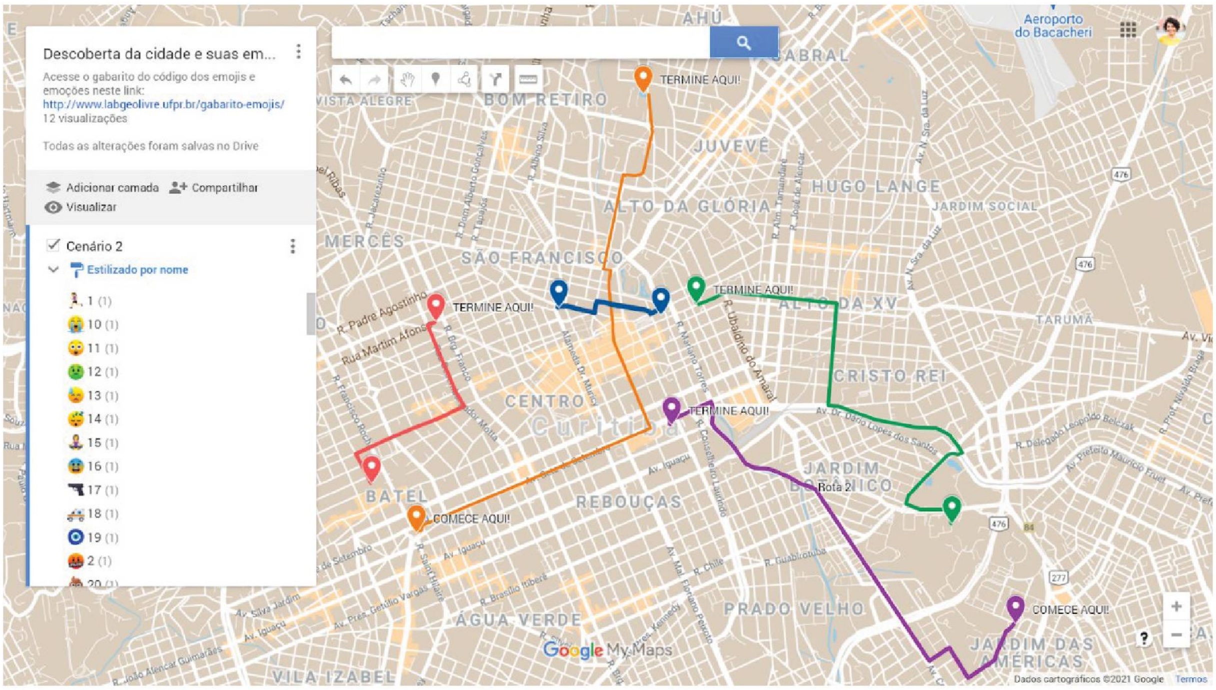
The data collection was structured through an online form, which allowed organising the collection stages by sessions, delimiting users' profiles, the circumstances of mapping such as transport mode, and directing participants to other platforms to the mapping process (APPENDIX D). The developed method has as innovations the mapping of emotions through emojis on an online platform and the exploration of the urban environment through street-level images through Google Street View.

The online survey was performed in Portuguese, and the participants' quotes described here were translated from the original by the authors. This survey was conducted with 35 participants (11 females and 24 males) between 18 and 44 years. Data collection was obtained through 2 distinct groups. Group 1, representing 34.3% of the sample, comprises a general public that came to the survey due to disclosure of the research on social media. On the other hand, group 2, representing 65.7% of the participants, comprises undergraduate students in the Transport Engineering discipline from the Civil Engineering course at the Federal University of Paraná. In this group, emotional mapping was included as an activity in the course.

Firstly, the first step of the online form outlines the profile of the participants regarding age, gender, use of emoji on social media and whether they know, live or have lived in the city in the study area. Then, step two provides mapping instructions with a video and a PDF tutorial (APPENDIX E). Finally, participants were asked which of the instructional methods they used.

Five scenarios were developed where the participants were encouraged to map according to a weekday and time to simulate the actual mapping conditions (FIGURE 4). Initially, it was thought that all participants would do the five developed scenarios. However, it was a very long time of data collection. Thus, it was decided that each participant would do two scenarios, that from our point of view, the same person could experience the mapping process considering a short path by walking and a more extensive path considering a transport mode.

FIGURE 4 - THE FIVE SCENARIOS



SOURCE: Authors (2021)

The context of spatial segregation of the city leads to certain types of emotions, which the environmental perception is dependent on the personal characteristics and interests of each individual, changing over time and due to the different types of contact between the person and the place (SANTOS, 2011 APUD ELALI, 2003). Therefore, the five scenarios were built in different regions of the city, based on distinct income distributions, as we know that income bias is the predominant factor for determining spatial segregation in Brazil and directly impacts the emotional bond of the individuals with the environment. However, the definition of the scenarios also intends to incorporate the diversity of the urban space, integrating touristic points, parks, points of commerce, shopping malls, bus stations, among others (FIGURE 2).

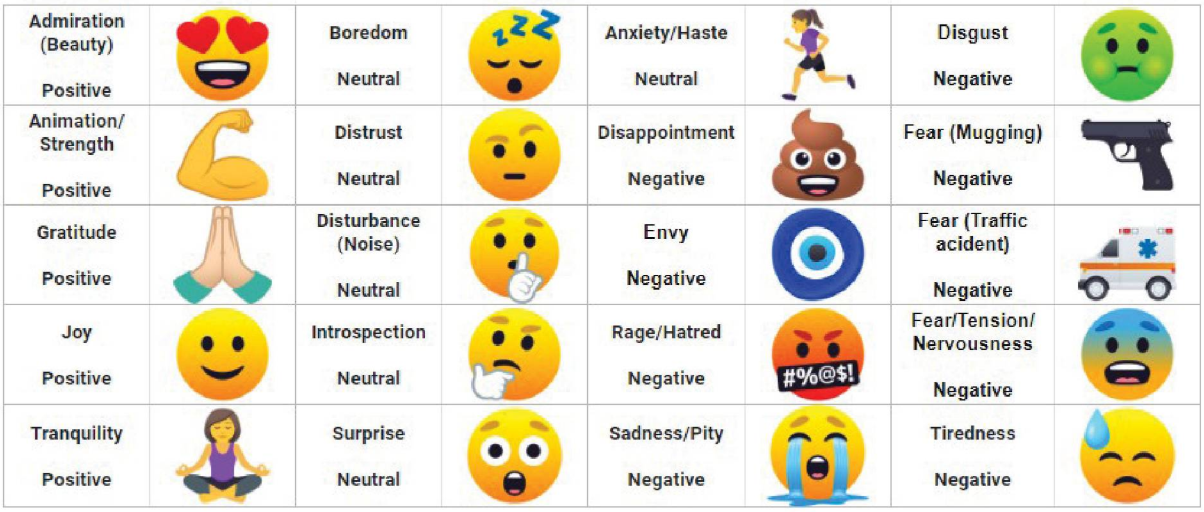
Scenarios 1 and 2 were located in neighbourhoods with contrast income rages, the first is located in the Batel and Bigorrilho districts of the city (FIGURE 1), with a high concentration of people with an income of 10 wages or more (FIGURE 3), the second is located in the Rebouças and Prado Velho districts are neighbourhoods with high population density with low income (FIGURE 3). Thus, we aim to understand the dissimilarities of emotional bonds between these two scenarios. Furthermore, scenario 3 was placed close to green areas, such as Botanical Garden and tree-lined streets to evaluate if green areas are linked with positive emotions. On the other hand, scenario 4 embraces other city characteristics such as the city centre and one of the city's structural axes, characterised as one of the BRT lines, that could be associated with negative emotions. However, this scenario has an end and start point in touristic and wooded spots, such as Japan Square and Oscar Niemeyer, that may be associated with positive emotions. Finally, scenario 5 was established in the surroundings of the city's historic centre, which concentrates on tourist attractions and bars. However, it faces problems related to public safety, poor lighting and depredation of cultural heritage. Furthermore, in this scenario, the time indicated for participants to simulate the routes was the night period. Thus, considering the ambient characteristics of the place and the suggested time, it is expected that there will be more negative emotions.

Additionally, at each starting point in Google My Maps, a context for mapping is presented, referencing a day of the week and a time to simulate routes on days and times with different conditions. The initial instructions also include the link to the Google Street View of the route and a suggested minimum amount of emojis. Finally, the endpoints of the paths give new instructions for the next route or the end of the mapping.

Therefore, in step 3 of the online form, the scenarios were assigned to the groups of participants. For group 1, the scenarios were destined according to raffles based on their birth month. Each group participant could choose the transport mode they would like to consider to map the emotions in one of the scenarios, based on their daily urban mobility experience. On the other hand, the participants of group 2 were divided into six teams, arranged according to the transport mode they most used, and the scenarios were assigned randomly for each team.

In step 4 of the online form, the link of Google My Map was provided for the mapping emotion process and auxiliary links that the participant must access during data collection, such as Google Street View routes and the template of emojis (http://www.labgeolivre.ufpr.br/gabarito-emojis/). The list of emojis (FIGURE 5) used in this experiment results from research on the semantics of emojis in the context of urban mobility (CAMARA, CAMBOIM AND BRAVO, 2021b).

FIGURE 5 - LIST OF SELECTED EMOJIS (CC-BY 4.0 LICENSE)

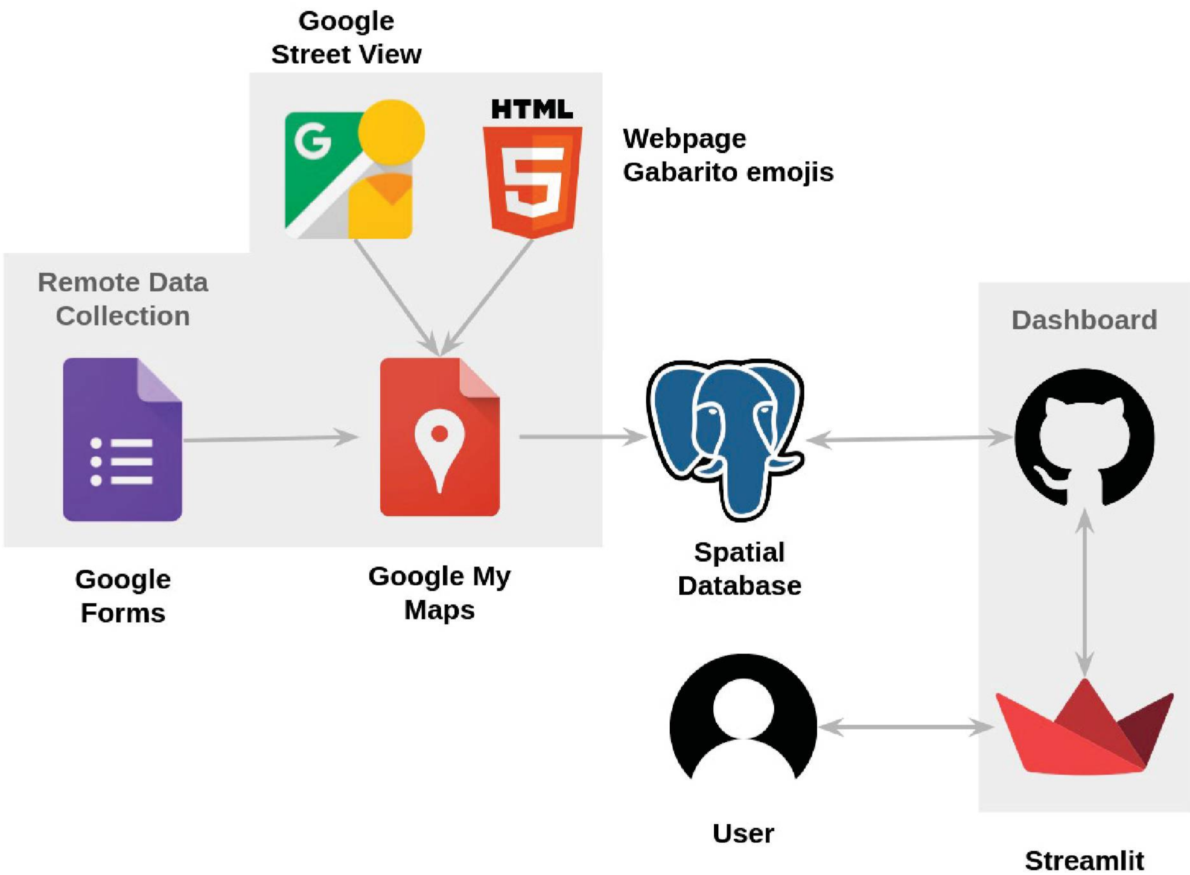


SOURCE: Authors (2021)

In mapping emotions, participants were encouraged to walk the paths of the scenarios in Google Street View, following the context provided in the instructions. For example, the participant would place a marker on Google My Maps at homologous to the Google Street View location to map an emotion. At each point, these markers should be named with the emoji code equivalent to the emotion identified, according to the template provided. After completing both scenarios, the participant was instructed to return to step 4 of the online form to answer questions about the level of familiarity with the mapped scenarios. Finally, in the last step of the form, the participant should share the map produced on Google My Maps through a link generated on the platform, as instructed previously. There was reserved space for comments, suggestions, or praise in this last session.

It was possible to download the data collected in KML (Keyhole Markup Language), accessing the links of each map, making it possible to open them in the QGIS software and then store them in the spatial database. Later, we developed a python script to build a dashboard enabling data query and visualisation through the framework Streamlit. Finally, we store the code in a Github repository, aiming for the sharability and the publication of the web app developed using the Streamlit Cloud. Figure 6 allows a better understanding of the system architecture aiming at the reproducibility of the methodology. The user can choose parameters to pre-establish spatial queries in the database in the dashboard. This query process filters the spatial information presented in the online map, shown interactively.

FIGURE 6 - SYSTEM ARCHITECTURE



SOURCE: Authors (2021)

The cartographic project was designed (TABLE 1) according to the methodology proposed by Sluter et al. (2014) to represent the emotional maps elaborated using the collected data. The cartographic language of the emotion map, which in the project is exemplified with the emotion "joy", also characterises the cartographic language of the individual emotion maps with the other emojis. Likewise, the cartographic language of the thematic map of transport modes can also be applied to maps such as emotions associated with the scenarios, emotions according to the age group of participants and gender.

TABLE 1 - CARTOGRAPHIC PROJECT OF THE DEVELOPED MAPS

Cartographic Project Elements	Cartographic Project Details		
Basemap	Carto DB Positron		
Thematic Data	Map of emotions	Stretches of street by the valence of emotions	Map of transport modes
Classes	Individuals emotions	Positive, Neutral, Negative	Positive, Neutral, Negative
Scale (Zoom Level)	14	14	14
Cartographic Languages			
Data	Collected emotions	Collected emotions	Collected emotions
Spatial dimension	Point	Point	Points
Graphic Primitive	Pontual	Linear	Pontual
Theme	Joy	Emotional valences	
Levels of measurement	Nominal	Ordinal	Nominal
Visual Variables	Form	Color Hue	Form
Symbology		Positive Neutral Negative	Emojis from figure 4

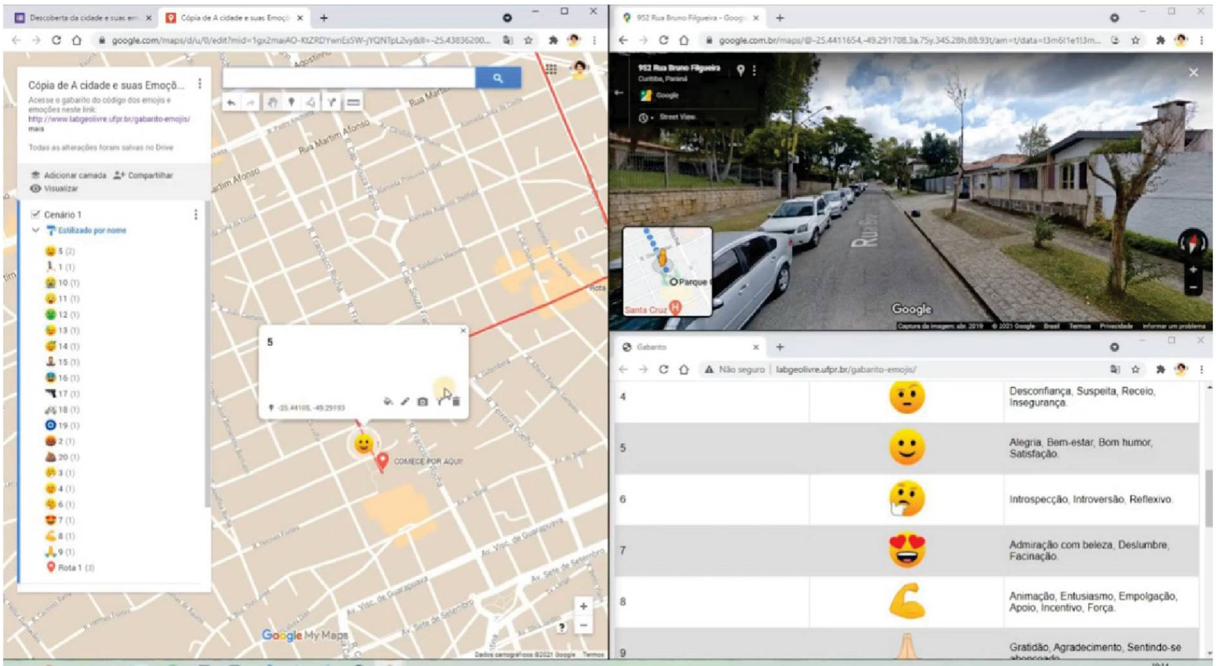
SOURCE: Authors (2021)

5.5 RESULTS AND DISCUSSIONS

The first result achieved in the development of this research was the method for remote emotional geographic data collection. The combination of Google My Maps and Google Street View tools enabled a virtual mapping experience (FIGURE 7) that was well accepted by the participants, as described by one of the participants "Even virtually, the experience brought many emotions to light, mainly nostalgia for remembering when I used to transit more frequently in the city before the pandemic. I believe it was the most immersive experience of all I have done during remote learning" (free translation from Portuguese in the original). However, some participants described the methodology as complicated, difficult and complex, mainly regarding the mapping tools and the duration.

In addition, when using the Google Street View service to explore the city, it should be considered that the participants' emotions attributed to the places are also related to the conditions recorded in the image and may be associated with transient and non-permanent environments conditions. This aspect can be illustrated by one of the research participants "I considered the situations that Street View brought me (for example, dumpsters, movements, traffic" (free translation from Portuguese to English).

FIGURE 7 - MAPPING PROCESS IN GOOGLE MY MAPS WITH GOOGLE STREET VIEW



SOURCE: Authors (2021)

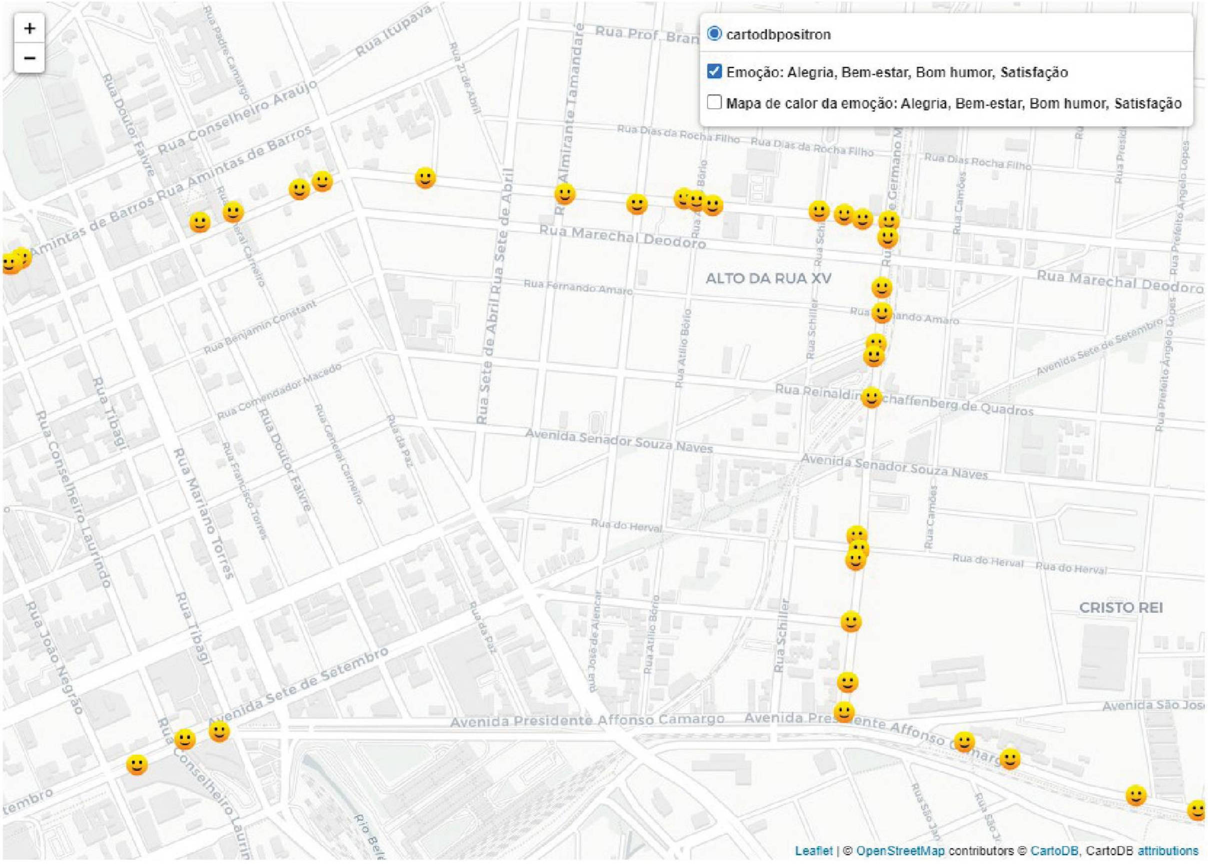
After collecting and manipulating the data, a geoinformation dashboard (FIGURE 8) was developed using the python framework Streamlit (https://share.streamlit.io/gabrielecamara/streamlit_emotional/main/streamlit-app.py). The panel has a sidebar with widgets to choose the parameters for the spatial queries in the database that will be then loaded on the map. For example, the emotions represented by emojis can be visualised through their point location. Alternatively, the user could see the line geometry corresponding to the streets and run queries using the sidebar widgets grouped according to each of these graphical primitives (Box 1 from Figure 8). In addition, it is also possible to filter the data regarding the valence of emotions (Box 2 from Figure 8), enabling visualisations such as all the positive emotions of a specific age group or only the neutral emotions attributed to a specific scenario.

FIGURE 8 - DEVELOPED GEOINFORMATION DASHBOARD

SOURCE: Authors (2021)

The method, developed successfully, enables the mapping and visualisation of 1147 emotions, where 530 of them were associated with the positive valence (46.2%), 287 with negative valence (25.0%) and 330 of the neutral valence (28.8%). The most mapped emotion was "Joy, well-being, good mood, satisfaction", with a frequency of 276 times (FIGURE 9). On the other hand, the least mapped emotion was "envy", with only one occurrence.

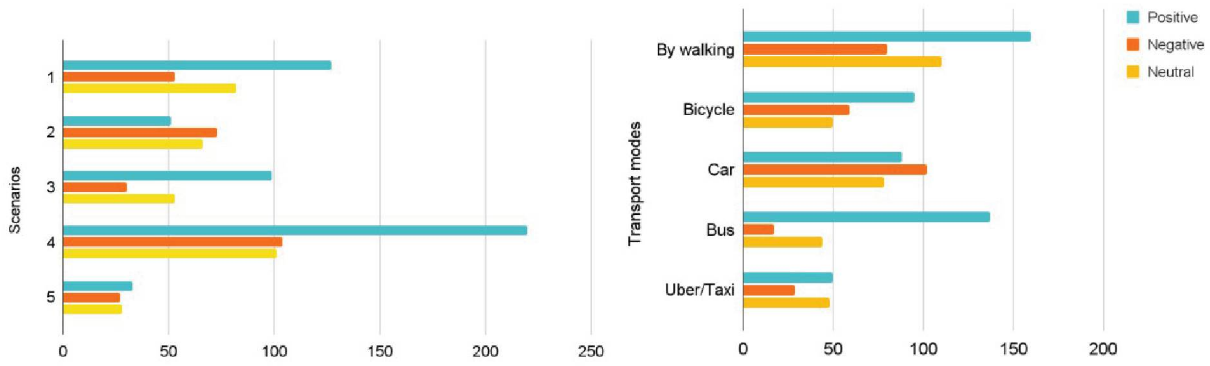
FIGURE 9 - MAP OF EMOTION "JOY, WELL-BEING, GOOD MOOD, SATISFACTION"



SOURCE: Authors (2021)

With collected data, it was possible to analyse the emotional bonds of individuals regarding the geographic space and environment of the city. Concerning scenario 1, it has more positive emotions associated. On the other hand, scenario 2 presented the opposite response, with more negative emotions associated, as shown in figure 10a of the valences of emotions in each scenario. One of the participants made a comment that describes their feelings about each of the routes in these two scenarios "The first route, there in the Batel region, is actually much more pleasant than the route leaving the Polytechnic, especially there in the region of Chile and the Viaduto Colorado that brings a lot of insecurity" (free translation from Portuguese in the original). The Colorado Viaduct is among the eight streets with the highest number of associated negative emotions and was also identified as one of the places with the most negative emotions in the previous collaborative emotional mapping (CAMARA, CAMBOIM AND BRAVO, 2021a). Despite this concentration of negative emotions in scenario 2, it is essential to point out that the environmental perception of individuals changes depending on the type of contact between the person and the place. According to Santos (2011), most residents of Vila Torres, a region belonging to scenario 2 that suffers from social vulnerability and spatial segregation, have a solid affective bond with the place, perceiving the community as a great place to live, being that only a tiny portion of the population has an image of Vila Torres associated with drugs, fear, violence and dirt. Thus, it is important to point out that we did not register where the research participants lived in this research. However, it is assumed that most of them live in regions with different realities from Vila Torres, causing their perception of this place to be influenced by the bias and stereotypes resulting from spatial segregation.

FIGURE 10 - (A) NUMBER OF EMOTIONS DIVIDED IN VALENCIES ATTRIBUTED PER SCENARIO. (B) NUMBER OF EMOTIONS DIVIDED IN VALENCIES ATTRIBUTED PER TRANSPORT MODE.



SOURCE: Authors (2021)

As expected, scenario 3 had a more significant number of positive emotions, with many occurrences of emotions such as "beauty admiration", "tranquillity" and "joy" near tree-lined streets, such as Padre Germano Mayer Street, as well as the Botanical Garden, point reference cited by one of the participants referring to the place with a positive aspect "I know the region close to the botanical garden a lot, as I do an internship nearby and I really enjoy running in that region. On the other hand, in the other scenario, I am a little afraid of Treze de Maio Street, as I consider it a little dangerous" (free translation from Portuguese in the original). Scenario 4 also had its hypothesis confirmed, with more positive emotions and negative emotions surrounding the city centre, mainly near the same region of scenario 5, once these two paths cross each other. It is interesting to note that scenario 4 was proposed on a different weekday and time of scenario 5, and still the occurrence of negative emotions in this region. One of the participants quoted a comparison between these two paths "I would definitely do route 04 on a Sunday morning, and not route 05 on a Saturday night (unaccompanied). I realised that despite often finding the places to be beautiful, I felt insecure about going through them, especially on Route 05" (free translation from Portuguese in the original). This quote is also very illustrative for scenario 5, as well as the cited quote "On the other hand, in the other scenario, I am a little afraid of Treze de Maio Street, as I consider it a little dangerous" (free translation from Portuguese in the original), because although the hypothesis of this scenario has not been confirmed (a greater number of negative emotions) the amount of positive and negative emotions were very close to the negative ones. The positive emotions in this region are linked to the historical sights, with a concentration of the emotion "Admiration of beauty" in Largo da Ordem. On the other hand, several mentions about insecurity and a concentration of the emotion "Fear of mugging" (FIGURE 11).

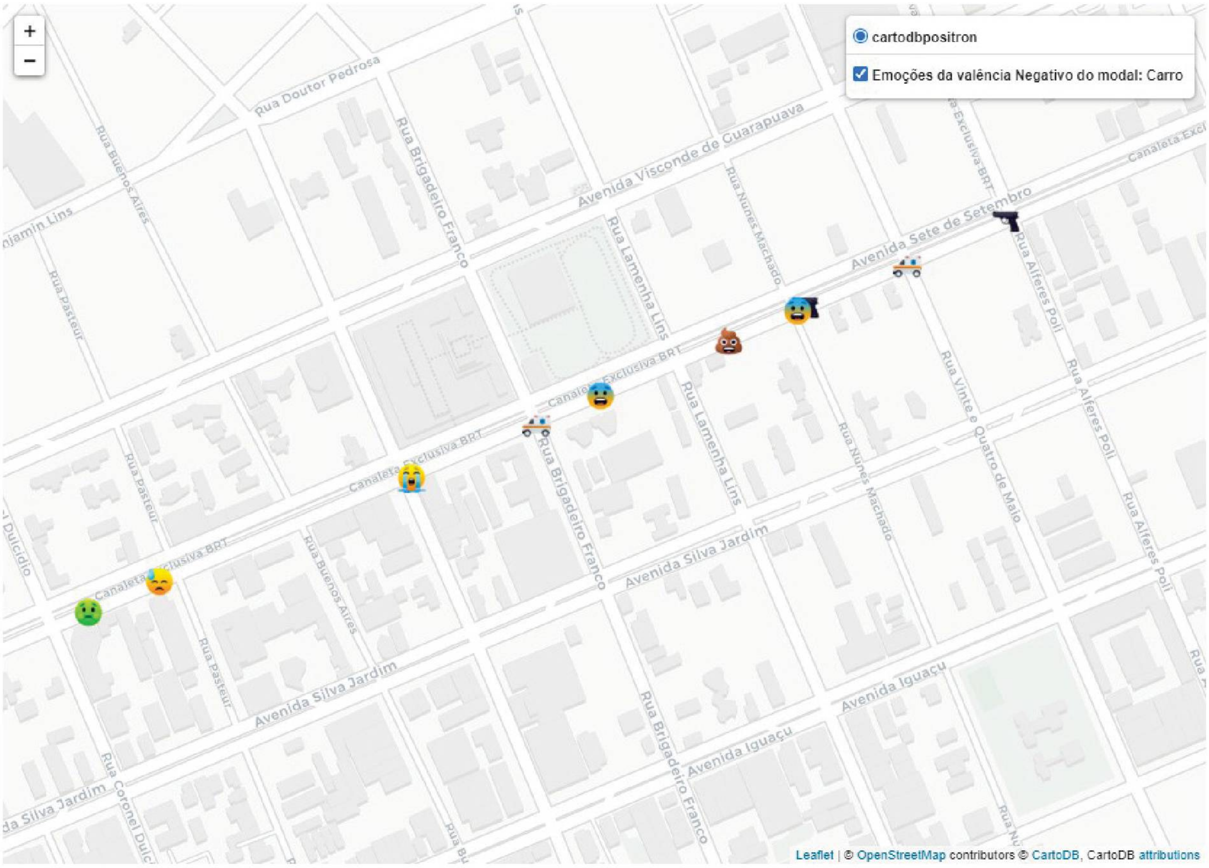
FIGURE 11 - NEGATIVE EMOTIONS LOCATED IN LARGO DA ORDEM

SOURCE: Authors (2021)

Regarding the transport modes, more negative emotions were expected in the modes "On foot" and "Bicycle" due to greater exposure of individuals. However, grouping the valences of the data collected by transport modes (FIGURE 10b), the highest number of positive emotions were to "On foot", "Bike", "Bus" and "Uber", with

"Joy" being the emotion most attributed to these modes. In addition, the neutral emotion most associated with these same cited transport modes was "distrust", except to "Uber", that the neutral emotion most attributed were "Introspection" followed by "Boredom", a fact that may be associated with these emotions is the passive attitude of the passenger towards this type of transport. Finally, the transport mode with the prevalence of negative valence compared to other valences was "Car" with the "Fear of mugging" as the most attributed emotion with 32 occurrences, followed by "Fear, Tension, Worry, Nervousness" with 31 occurrences and "Fear of car crash, being run over" with 22 occurrences (FIGURE 12).

FIGURE 12 - NEGATIVE EMOTIONS OF TRANSPORT MODE "CAR"



SOURCE: Authors (2021)

The negative emotions registered in the other transport modes were also within the fear spectrum, as exemplified by the following participant's quote (free translation from Portuguese in the original) "The research is very interesting, especially when noticing the differences between what is observed in a car and walking tour. As a pedestrian on busy streets, insecurity is a very relevant factor associated with fear. By car, the fear is often greater in terms of collisions and in some moments of robbery, depending on the stretch. Furthermore, the sensations are more unstable as a pedestrian".

5.6 CONCLUSIONS

In this article, we proposed a method for emotional data collection over space through online platforms. It was also possible to evaluate the list of emojis semantically aligned with the context of urban mobility proposed by Camara, Camboim and Bravo (2021b). Five scenarios were elaborated with initial hypotheses related to which valences would prevail in each one of them, based on the environmental conditions of each scenario. The hypotheses of four of the five scenarios were validated. In addition, some emotions in the city coincide with the collaborative emotional mapping done by Camara, Camboim and Bravo (2021a).

The developed method can contribute to the literature collecting emotional spatial data simulating the experience of exploring the city through street-level images. However, this experiment has an ecological validity restricted to mapping emotions remotely, according to the people's interpretations of the geographical space through the street-level images, also considering their past experiences and remembrance of the places. Thus, when using imaging services to explore the city, such as Google Street View, it is necessary to consider that the images capture the spatial reference but not the dynamic conditions of the place. Additionally, it should be noted that some conditions shown in the images do not correspond to the actual characteristics of the environment, such as imaged good lighting places that will not necessarily have the same lighting conditions in the real world, interfering with the people's perceptions of the place. Another critical point to be considered is the impossibility of experiencing the real conditions of travelling through cities with different transport modes. In this case, the participants had to use their previous experience regarding the transport modes and their relationship with the city to simulate how it would be to go through the scenarios. Therefore, they need to adapt their memories to the proposed situation and then choose the emotions associated with that location, considering the transport mode.

Remarkably, the possibility of exploring the city remotely for collecting emotional spatial data through digital platforms allows people who know the study area but no longer reside there to contribute to the mapping. This condition brings to the discussion a new research perspective related to emotions, as some ex-residents of Curitiba reported that they would like to map emotions referring to nostalgia, homesickness and feelings linked to their memories. Thus, from this discussion comes the need for further research on the relationship of spatial cognition with collaborative emotional mapping.

Here we made advances in technology used to collect emotional spatial data. That means we developed a geoinformation solution in Python and stored it at Github to keep the code open, enabling the method's reproducibility and accessibility of the research. Despite prioritising open source tools, in the case of this research, it was necessary to use services provided by the company Google, which are free and for public use. However, they are not open source. Consequently, we indicate the dependence of Google tools as a point of improvement, and as a recommendation for the research advancement, we recommend developing emotional spatial data acquisition applications using open-source solutions. Regarding the results obtained for data visualisation, it is possible to visualise emotions through emojis and identify the emotional triggers linked to the urban environment. However, some challenges were identified from the cartographic point of view.

The symbolisation with emoji represents emotions graphically in order to facilitate communication. However, we detected limitations to implementing these symbols in the maps of the proposed geoinformation solution. The limitations are related to the impossibility of establishing scaling levels, which consequently cause the emoji coalition problem when represented using the point graphic primitive. This limitation is related to the tools available for developing maps through the folium library. Furthermore, another difficulty was the representation of emotions by the graphic primitive of the line related to the streets, as emojis are punctual symbols, generating difficulty in representing the streets with the proposed emojis. Therefore, we recommended further research to appraise the cartographic generalisation associated with the emojis and better understand the use of these graphic symbols as cartographic symbols, searching for solutions to problems such as coalescence. Another relevant challenge regarding these symbology, mainly in the context of urban mobility, is emojis to represent features with primitive graphic lines, such as streets, for example.

In the last experiment, we also evaluated the previous semantical study of these symbols used in this research (Camara, Camboim and Bravo, 2021b). As a result, we validated some changes in the set of emojis to collect represent emotional spatial data in the context of urban mobility. One of the changes was the addition of emojis that represent different emotions within the fear spectrum, such as "Fear, Tension, Worry, Nervousness" and "Fear of accidents, being run over", besides the emotion "Fear of a mugging, robbery or theft". In the data acquisition of this research, these three fear emotions were the most used negative emotions in the mapping process: "Fear of a mugging, robbery or theft" was mapped 73 times, followed by "Fear of accidents, being run over" appearing 68 times, and finally, "Fear, Tension, Worry, Nervousness" with 65 times.

Considering the presented results, we understand that the proposed method captured the emotional geographic data of the individuals, despite the challenges raised in the development of the research. Additionally, through the geospatial dashboard developed, it was possible to visualise the created maps and recognise the environmental triggers related to mapped emotions, very similar to what was found in the study Camara, Camboim, Bravo (2021a). Finally, the work has recommended expanding emotional data collection for use and application in urban planning. Thus, with a greater volume of spatial data, the proposed geoinformation dashboard would need to be refined, especially concerning visualisation and cartographic generalisation issues, considering the challenges encountered in symbolisation with emojis.

6 GENERAL CONCLUSIONS

In the first experiment of this master thesis, the main scope was the development of a framework for the collection and visualisation of emotional geographic data in the context of urban mobility. The method developed aims to contribute to the Emotional Cartography literature through an innovative approach to collect the individuals' emotional bond related to experiences lived in displacements in the city through different transport modes using emojis. In addition, these graphic symbols were also used to represent emotions in the final maps of the proposed solution. In this experiment, it was possible to locate the participants' emotions in different places in the city of Curitiba, as well as identify which environmental or causal factors triggered such emotions, for example, positive emotions in places with green areas, such as parks, or negative emotions in modals which participants are more exposed to the environment, such as walking and cycling.

We can cite as positive points of the first experiment the proposition of a method that prioritises principles of open science since it was used tools such as Jupyter notebooks and the platform Google Colab, that enables to keep the code accessible, findable and reproducible. Finally, we concluded that the collaborative emotional mapping developed by the proposed method contributes to understanding the city from a citizen-centred perspective, encouraging the population's participation in the urban planning process. Furthermore, the method supplies new possibilities for the collection and representation of emotions, using a graphical language not common in conventional cartography, as in the case of emojis. Based on the experiences of this process, we perceived the importance of increasing the heterogeneity of the participants. Furthermore, it became clear the need to discuss the semantics of the emojis used since the literature points out that the interpretation of these symbols may vary due to several factors

Encouraged by the previous recommendations, we developed the second experiment of this master thesis to assess the emojis' semantics. The participants were asked to describe the emojis with words that represented the emotions associated with them, considering the context of urban mobility. As a result, it was possible to evaluate whether the interpretation of the emotion associated with the emoji was similar to the meaning attributed to it in the research context. We also appraise emojis described with synonyms, enabling the representation of similar emotions with a single emojis, such as emotion "sadness" and "pity", which were two separate emojis and could be merged into only one. The participants were also stimulated to point out which emojis related to the context of urban mobility they would like to add to the list of emotions. Therefore, the need to differentiate emotions within the fear spectrum was reported, whereas there was only "Fear of mugging" on the set of emotions. Thus, emotions that portray "Fear, tension, nervousness" and "Fear of traffic accidents" were added to the set of emojis.

The second experiment demonstrated the relevance of assessing the semantics of emojis in the collaborative emotional mapping to ensure that these graphic symbols have the most remarkable adherence to the meaning of the emotion they represent. Based on the results of this experiment, we concluded that although some participants do not describe precisely the emoji with the emotion that it was assigned to portray in the context, participants use synonyms of the designated emotion to label the symbols, demonstrating that the emotion's core was understood. It is important to emphasize that this experiment is strongly linked with a Brazilian cultural aspect. People appropriate the symbols to correspond to their reality, impacting the perception of the emoji meanings and the interpretation of the emotions represented with these symbols. Thus the semantic understanding of emojis is strongly linked to the context of the participants and the reality where data will be collected using these symbols. Besides, the temporality of the emojis may influence their interpretation, so it became another factor to consider when considering the reproducibility of the methods. Therefore, when using the proposed method in other locations, it would be interesting to perform a new semantic analysis since new emotions may arise in conjunction with the context of the participants and the study area. Finally, this experiment does not evaluate differences of emojis between different social media or devices once they are UNICODE.

The third and last experiment of this master thesis created a new emotional spatial data collection using the list of emojis resulting from experiment two. In this experiment, we propose a method for remote emotional mapping through digital platforms due to the restrictions imposed by the COVID-19 pandemic, based on the exploration of the urban environment through street-level images. According to the results achieved, we concluded that the images managed to capture the environmental conditions of the created scenarios, enabling the map of the emotions through digital platforms befitting the environmental conditions and emotional triggers. However, it is important to mention that this result has an ecological validity limited to the conditions of mapping emotions remotely, influenced by the people's perceptions of the geographical space through the street-level images, also considering their past experiences and remembrance of the places. Based on this experience of using street-level images, we identified the opportunity for future studies related to the relationship between spatial memory and emotional mapping. In the third experiment, future research has also emerged to enlarge the exploration related to spatial segregation in emotional mapping, as we identified a connection between the spatial distribution of income and emotions. This discussion also evidences the need for data collection in different places, especially in more peripheral regions.

Finally, in experiment 3, we developed a geoinformation dashboard to interact and visualise the maps resulting from the data collected. The dashboard was programmed in Python using the Streamlit framework to build a more interactive web page where the end-user can make spatial queries by choosing the parameters in the widgets instead of executing the code, as in Jupyter Notebooks. The proposed solution also uses open-source tools, contributing to the literature in developing research in emotional cartography aligned with the open science concept.

Considering the three experiments conducted, we concluded that it was possible to develop different solutions to collect, process and represent emotional spatial data associated with the context of urban mobility. The obtained results corroborate with the literature, showing the potential that emotional mapping using emojis has, contributing to raising demands for urban planning and encouraging participants in this contribution to the city. This context of urban mobility was widely addressed in the experiments, from the mapping process, the conceptualization of symbols, and the cartographic representation. Thus, it is crucial to explicit this context once it influences cartographic communication. If this context isn’t highlighted, the map's construction and reading open to multiple interpretations, which the location of the emoji on the map may misrepresent the meaning initially assigned to the emoji.

Additionally, as part of the cartographic communication, it is also important to mention that the results achieved were based on the experiment participant's profile.

In general, they are in the age group between 20 and 30 years, do not necessarily know cartography, but use cartographic products daily, such as routing services. In addition, they are close to modern languages that use emojis to communicate. However, one of the characteristics of the people’s profile that we did not register in this research, but it is necessary to, is the user's familiarity with the area. If the region they are mapping is where they live and know in-depth, or it is a region that they know but it is just passing through because this difference is significant in terms of people's perception of space and socioeconomic and cultural aspects. Thus, when applying the proposed methods for data collection, it is necessary to take into account the diverse cultural backgrounds linguistic differences and observe the reality of the study area, since the proposed method of this research is strongly linked with a Brazilian cultural aspect and these factors influence the context of emotions' interpretation. An interesting analysis would include other transport modes in the study, such as the subway. Lastly, the cartographic visualization proposed in the experiments was developed for desktop devices. Thus, it is necessary to evaluate the feasibility of visualizing the maps developed in other devices, such as smartphones and tablets.

Considering that one of the contributions of this research is the use of emojis to represent the emotions in the maps, it is necessary to highlight that this discussion is a starting point about the use of these symbols in cartographic use. Hence, it is fundamental to evaluate subjects such as generalization, semiotic issues, the suitability of the symbol in a cartographic project, and mainly, how to use the emojis as a cartographic symbol, ensuring Cartographic Communication.

We can cite the primary recommendation is collecting emotional spatial data in a broader way, such as through a mobile app. A large dataset will contribute to collecting data under diverse urban environment conditions. On the other hand, with a greater volume of data, it will be necessary to improve the geoinformation dashboard to visualise emotional maps, including generalisation aspects. Another important recommendation is using non-verbal languages such as emoji in maps regarding cartographic language and cognition issues. It would be valuable to investigate and compare emotional maps that use conventional methods to represent emotions versus maps that use emojis to assess cartographic comprehension and communication.

It is also vital to discuss semiotic aspects of emojis and their use in maps. The last recommendation is to expand this research by exploring cultural and generational aspects, such as applying the same method and set of emojis to a group of people born and raised in another country. This cross-culture expansion could enable the exploration of similarities and differences related to the interpretation of emojis in the context of emotional maps and urban mobility.

The final aspect is the possibility of using open tools and a widely adopted graphic language to map people's relationships with cities, thus enabling a ground-breaking input to plan and management processes, considering the well-being of individuals as a fundamental part of this challenge.

REFERENCES

AL-ROHAIMI A. H.; AL OTAIBI F. Novel SARS-CoV-2 outbreak and COVID19 disease; a systemic review on the global pandemic, **Genes & Diseases**, 2020. DOI. 10.1016/j.gendis.2020.06.004

AMANAJÁS, R.; KLUG, L. Direito À Cidade, Cidades Para Todos E Estrutura Sociocultural Urbana. In: COSTA, M. A.; MAGALHÃES, M. T. Q.; FAVARÃO, C. B. **A Nova Agenda Urbana e o Brasil: insumos para sua construção e desafios a sua implementação.** Brasília, 2018. p. 29 - 44.

ANDERSON, K.; SMITH, S. Editorial: Emotional geographies. **Transactions of the Institute of British Geographers,** v. 26, n. 7, pp. 7-10, 2001.

ASHKEZARI-TOUSSI, S.; KAMEL, M.; SADOGHI-YAZDI, H. Emotional maps based on social networks data to analyze cities emotional structure and measure their emotional similarity. **Cities,** v. 86, pp. 113-124, 2019. DOI 10.1016/j.cities.2018.09.009

BAI, Q.; DAN, Q.; MU, Z.; Y, M. A Systematic Review of Emoji: Current Research and Future Perspectives. **Frontiers in Psychology,** v. 10, 2019. DOI 10.3389/fpsyg.2019.02221

BANISTER, D. The sustainable mobility paradigm. **Transport Policy**, v. 15, n. 2, pp. 73-80, 2008.

BARRETT, L.F. Solving the emotion paradox: Categorization and the experience of emotion. **Personality and social psychology review,** v. 10, n. 1, pp. 20-46, 2006.

BECHTEL, B. *et al.* Quality of Crowdsourced Data on Urban Morphology —The Human Influence Experiment (HUMINEX). **Urban Science***,* v. 1, n. 2, 2017. DOI. 10.3390/urbansci1020015.

BENAYOUN, M. World Emotional Mapping (e-maps), 2005, Disponível em: http://www.moben.net/ projet.php?id=28.

BELUSSI, A.; CATANIA, B.; CLEMENTINI, E.; FERRARI, E. Spatial Data on the Web: Issues and Challenges. **Spatial Data on Web.** Springer-Verlag, 2007. DOI: 10.1007/978-3-540-69878-4_1

BLENDON, R.; BENSON, J.; DESROCHES, C.; WELDON, K. Using opinion surveys to track the public's response to a bioterrorist attack. **Journal of Health Communication,** v. 8, pp. 83-92, 2003.

BRASIL. **CONSTITUIÇÃO DA REPÚBLICA FEDERATIVA DO BRASIL DE 1988.** Brasília DF: Senado Federal, 1988. Disponível em: http://www.planalto.gov.br/ccivil_03/constituicao/constituicao.htm

BRASIL. **Estatuto das Cidades.** Lei no 10.257, de 10 de julho de 2001. Disponível em: http://www.planalto.gov.br/ccivil_03/leis/LEIS_2001/L10257.htm. Brasília DF: Senado Federal, 2001.

BRASIL. **Lei de Acesso à Informação - LAI.** Lei n° 12.527, 18 de Novembro de

2011. Brasília DF: Senado Federal, 2011.

BRASIL. **Lei Geral de Proteção de Dados Pessoais - LGPD.** Lei n° 13.709, de 14 de Agosto de 2018. Brasília DF: Senado Federal, 2018.

BRASIL. **Portal Brasileiro de Dados Abertos.** 2020. Disponível em: https://dados.gov.br/pagina/dados-abertos. Acesso em: 11/11/20.

BRASIL io. Disponível em: https://brasil.io/home/. Acesso em: 25/10/2020.

BIANCHINI, F. A. **Vila Torres - Curitiba/PR: Os espaços de representação e as relações de poder.** 141 f. Dissertação (Mestrado em Geografia) - Setor de Ciências da Terra, Universidade Federal do Paraná, Curitiba, 2006.

CALABRESE, F. *et al.* Understanding individual mobility patterns from urban sensing data: A mobile phone trace example. **Transportation Research Part C: Emerging Technologies***,* v. 26, pp. 301-313, 2013. DOI. 10.1016/j.trc.2012.09.009.

CAMARA, G. S.; CAMBOIM, S. P.; BRAVO, J. V. M. Collaborative emotional mapping as a tool for urban mobility planning. **Bulletin of Geodetic Sciences,** v. 27(spe): e2021011, 2021.

CAMARA, G. S.; CAMBOIM, S. P.; BRAVO, J. V. M. Semantic correlation between emojis and feelings' descriptions for mapping emotions into the urban mobility context. **Abstr. Int. Cartogr. Assoc.**, v. 3, n. 40, 2021. DOI: 10.5194/ica-abs-3-40-2021.

CAMBOIM, S. P.; BRAVO, J. V. M; SLUTER, C. R. An investigation into the completeness of, and the updates to, OpenStreetMap data in a heterogeneous area in Brazil. **ISPRS International Journal of Geo-Information**, v. 4, n. 3, pp. 1366–1388, 2015.

CAQUARD, S.; GRIFFIN, A. L. Mapping emotional cartography. **Cartographic Perspectives***,* v. 4, pp. 4-16, 2018.

CARAGEA et al. Mapping Moods: Geo-Mapped Sentiment Analysis During Hurricane Sandy. **Proceedings of the 11th International ISCRAM Conference – University Park, Pennsylvania**, 2014.

CESARO, L. R.; CESARO, L. Ensaios para a Participação Popular em Curitiba - PR: a revisão do Plano Diretor em 2014. **Bitácora Urbano Territorial**, v. 31, n. 3, pp. 67-80, 2021. DOI: 10.15446/bitacora.v31n3.86850.

CLARKE, L. M. An experimental investigation of the communicative efficiency of point symbols on tourist maps. **The Cartographic Journal**, v. 26, n.2, pp. 105–110, 1989. DOI: 10.1179/caj.1989.26.2.105.

CHURCHES, O.; NICHOLLS, M.; THIESSEN, M.; KOHLER, M.; KEAGE, H. Emoticons in mind: An event-related potential study, **Social Neuroscience**, v. 9, n. 2, pp. 196-2020, 2014. DOI: 10.1080/17470919.2013.873737

COHEN, B. Urbanisation in developing countries: Current trends, future projections, and key challenges for sustainability. **Technology in Society**, v. 28, n. 1–2, pp. 63–80, 2006.

CURITIBA. **Os números da Curitiba Verde.** 2021. Não paginado. Disponível em: https://www.curitiba.pr.gov.br/conteudo/os-numeros-da-curitiba-verde/3319

DARTORA, C. A fome não tem hora nem lugar. Plural Curitiba. Curitiba, 2021. Available in: https://www.plural.jor.br/colunas/politicas/a-fome-nao-tem-hora-nem-lugar/

DEVYLDER, J. E. et al. Association of urbanicity with psychosis in low- and middle-income countries. **JAMA Psychiatry, American Medical Association**, v. 75, n. 7, pp. 678–686, 2018. DOI. 10.1001/jamapsychiatry.2018.0577.

DENT, B; TORGUSON, J. S.; HODLER, T. W. **Cartography: thematic design.** McGraw-Hill Higher Education, 2008.

DESJARDINS, M. R. HOHL, A. DELMELLE, E. M. Rapid surveillance of COVID19 in the United States using a prospective space-time scan statistic: Detecting and Evaluating emerging clusters. **Applied Geography**, v. 188, 2020.

DUARTE, F. Redes de mobilidade urbana – Curitiba. **Revista dos Transportes Públicos – ANTP**, pp. 31-46, 2006.

DT. 2017. **Mapping Emoji**. Não paginado. Disponível em: <https://rnd.dt.com.au/emojuration-e3acf031040b>. Acesso em: 12 out. 2020.

ECKERT, S.; KOHLER, S. Urbanisation and health in developing countries: a systematic review. **World health & population**, v.15, n. 1, pp. 7-20. 2014. DOI. 10.12927/whp.2014.23722

EKMAN, P. Strong evidence for universals in facial expressions: A reply to Russell's mistaken critique. **Psychological Bulletin,** v. 115, pp. 268-287, 1994.

ESCOFFIER, E. 2018. **Thematic Mapping with Emojis.** Não paginado. Disponível em: <https://2018.stateofthemap.org/slides/T044-Thematic_mapping_with_emojis.pdf>. Acesso em: 12 out 2020.

ESTES, J. E.; MOONEYHAN, D. W. Of maps and myths. **Photogrammetric Engineering & Remote Sensing**, v. 60, n. 5, pp. 517–524, 1994.

FARIA, D. R. **Sem Descanso Arquitetura Hostil e Controle Do Espaço Público no Centro de Curitiba.** 180 f. Dissertação (Mestrado em Planejamento Urbano) - Setor de Tecnologia, Universidade Federal do Paraná, Curitiba, 2020.

FATHULLAH, A.; WILLIS, K. Engaging the Senses: The Potential of Emotional Data for Participation in Urban Planning. **MDPI AG**, v. 2, n. 4, p. 98, 2018. DOI. 10.3390/urbansci2040098.

FELMLEE, D.H.; BLANFORD, J.I.; MATTHEWS, S.A.; MACEACHREN, A. M. The geography of sentiment towards the Women's March of 2017. **PLoS ONE,** v. 15, n. 6, 2020. DOI. 10.1371/journal.pone.0233994

FERSTER, C. J.; COOPS, N. C. A review of earth observation using mobile personal communication devices'. **Computers & Geosciences**, v. 51, pp. 339–349, 2013. DOI. 10.1016/J.CAGEO.2012.09.009.

FETT, A. K. J.; LEMMERS-JANSEN, I. L. J.; KRABBENDAM, L. Psychosis and urbanicity: A review of the recent literature from epidemiology to neurourbanism. **Current Opinion in Psychiatry Lippincott Williams and Wilkins**, v. 32, n. 3, pp. 232–241, 2019. DOI. 10.1097/YCO.0000000000000486.

FRITZ, S.; FONTE, C.; SEE, L. The Role of Citizen Science in Earth Observation. **Remote Sensing, Multidisciplinary Digital Publishing Institute**, v. 9, n. 4, p. 357, 2017. DOI. 10.3390/rs9040357.

GALINDO, R. Greca relaciona moradores de rua com crime e epidemia de coronavírus. Plural Curitiba. Curitiba, 2020. Disponível em: https://www.plural.jor.br/colunas/caixa-zero/greca-relaciona-moradores-de-rua-com-crime-e-epidemia-de-coronavirus/

GAMIO, L. **Chernoff emoji.** Não paginado. Disponível em: <https://flowingdata.com/2017/05/18/chernoff-emoji/>. Acesso em: 12 out 2020.

GASCON, M. et al. Mental Health Benefits of Long-Term Exposure to Residential Green and Blue Spaces: A Systematic Review. **International Journal of Environmental Research and Public Health**, MDPI AG, v. 12, n. 4, pp. 4354–4379, 2015. DOI. 10.3390/ijerph120404354.

GAKENHEIMER, R. Urban mobility in the developing world. **Transportation Research Part A: Policy and Practice,** Elsevier Science Ltd, v. 33, n. 7–8, pp. 671–689, 1999. DOI. 10.1016/S0965-8564(99)00005-1.

GARTNER, G. openemotionmap.org - Emotional response to space as an additional concept in cartography. **XXII ISPRS Congress**, Melbourne, Australia. pp. 473-476, 2012.

GODFRAY, H. C. J. *et al.* Food Security: The Challenge of Feeding 9 Billion People. **Science**, v. 327, n. 5967, pp. 812-818, 2010. DOI. 10.1126/science.1185383.

GOODCHILD, M. F. Citizens as sensors: the world of volunteered geography. **GeoJournal**, Springer Netherlands, v. 69, n. 4, pp. 211–221, 2007. DOI. 10.1007/s10708-007-9111-y.

GOOGLE. Twitter, 2018. Disponível em: https://twitter.com/gmail/status/1055806807174725633?ref_src=twsrc%5Etfw%7Ctwcamp%5Etweetembed%7Ctwterm%5E1055806807174725633%7Ctwgr%5E%7Ctwcon%5Es1_&ref_url=https%3A%2F%2Fwww.tudocelular.com%2Fgoogle%2Fnoticias%2Fn132472%2Fgmail-mais-de-1-5-bilhao-usuarios-ativos.html.

GÖSSLING, S. Urban transport justice. **Journal of Transport Geography**, v. 54, pp. 1-9, 2016. DOI. 10.1016/j.jtrangeo.2016.05.002.

GRIFFIN, A. L.; MCQUOID, J. At the Intersection of Maps and Emotion: The Challenge of Spatially Representing Experience. **Kartographische Nachrichten**, v. 6, pp. 291-299, 2012.

GRIFFIN, A. L.; ROBINSON, A. C.; ROTH, R. E. Envisioning the future of cartographic research. **International Journal of Cartography**, v. 3, n. S1, pp. 1-8, 2017. DOI. 10.1080/23729333.2017.1316466.

HAKLAY, M. M. Neogeography and the delusion of democratisation. **Environment and Planning A**, v. 45, n. 1, pp. 55–69. 2013. DOI. 10.1068/a45184.

HAKLAY, M.; SINGLETON, A.; PARKER, C. Web Mapping 2.0: The Neogeography of the GeoWeb. **Geography Compass**, v. 2, n. 6, pp. 2011–2039, 2008. doi: 10.1111/j.1749-8198.2008.00167.

HAUTHAL, E.; BURGHARDT, D. Mapping Space-Related Emotions out of User-Generated Photo Metadata Considering Grammatical Issues. **The Cartographic Journal,** v. 53, n. 1, pp. 78-90, 2016

HU, Y.; WANG, R-Q. Understanding the removal of precise geotagging in tweets. **Nature Human Behaviour,** comment, 2020. DOI. https://doi.org/10.1038/s41562-020-00949-x

HU, Y.; WANG, R. Q. Geo-Text Data and Data-Driven Geospatial Semantics. **Geography Compass**, 2018.

HUANG, H.; KLETTNER, S.; SCHMIDT, M.; GARTNER, G.; LEITINGER, S.; WAGNER, A.; STEINMANN, R. AffectRoute–considering people's affective responses to environments for enhancing route-planning services. **International Journal of Geographical Information Science**, v. 28, n. 12, pp. 2456-2473, 2014.

HEIPKE, C. Crowdsourcing geospatial data. **ISPRS Journal of Photogrammetry and Remote Sensing**, Elsevier, v. 65, n. 6, pp. 550–557, 2010. DOI. 10.1016/J.ISPRSJPRS.2010.06.005.

HICKMAN, R.; HALL, P.; BANISTER, D. Planning more for sustainable mobility. **Journal of Transport Geography***,* v. 33, pp. 210-219, 2013. DOI. 10.1016/j.jtrangeo.2013.07.004.

HIGGINS, P.; CAMPANERA, J. M. (Sustainable) quality of life in English city locations. **Cities**, v. 28, n. 4, pp. 209-299, 2011. DOI. 10.1016/j.cities.2011.02.005.

INSTITUTO AMBIENTAL DO PARANÁ. **Monitoramento da qualidade das águas dos rios da Bacia do Alto Iguaçu, na Região Metropolitana de Curitiba, no período de 2005 a 2009.** p. 51, 2009.

INSTITUTO BRASILEIRO DE GEOGRAFIA E ESTATÍSTICA. 2019. **Portal Cidades@ IBGE.** Não paginado. Disponível em: <https://cidades.ibge.gov.br/brasil/pr/curitiba/panorama>

INSTITUTO BRASILEIRO DE GEOGRAFIA E ESTATÍSTICA. 2017. **Portal Cidades@ IBGE.** Não paginado. Disponível em: <https://cidades.ibge.gov.br/brasil/pr/curitiba/panorama>

INSTITUTO BRASILEIRO DE GEOGRAFIA E ESTATÍSTICA. **Censo Demográfico: Características urbanísticas do Entorno Domiciliar.** 2010. Disponível em: https://biblioteca.ibge.gov.br/visualizacao/periodicos/96/cd_2010_entorno_domicilios.pdf

IOANNIDES, Y. M.; ROSSI-HANSBERG, E. **Urban Growth.** Department of Economics Working Paper, Tufts University, 2005.

IPPUC. Zoneamento Consolidado. **Dados Geográficos.** 2021. Disponível em: https://ippuc.org.br/geodownloads/geo.htm

JONG, W de. Climate change and deforestation: The evolution of an intersecting policy domain. **Environmental Science & Policy**, Elsevier, v. 35, pp. 1–11, 2014. doi: 10.1016/J.ENVSCI.2013.06.001.

KAPLAN, A.; HAENLEIN, M. Users of the world, unite! The challenges and opportunities of Social Media. **Science Direct: Business Horizons,** n. 53, pp. 59-68, 2010. DOI 10.1016/j.bushor.2009.09.003.

KLETTNER, S.; HUANG, H.; SCHMIDT, M.;GARTNER, G. Crowdsourcing affective responses to space. **Kartographische Nachrichten**, v. 63, pp. 66-73, 2013.

KRAAK, M. J. **Mapping time.** University of Twente, Faculty of Geoinformation Science and Earth Observation, 2014.

KRAAK, M. J. FABRIKANT, S. I. Of maps, cartography and geography of the International Cartographic Association. **International Journal of Cartography,** v. 3, n. S1, pp. 9-31, 2017.

KRÓL, K. Evolution of Online Mapping: From Web 1.0 to Web 6.0. **Geomatics, Landmanagement and Landscape,** n. 1, pp. 33-51, 2020. DOI. 10.15576/GLL/2020.1.33

KWAN, M. P. Affecting Geospatial Technologies: Toward a Feminist Politics of Emotion*. **The Professional Geographer,** v. 59, n. 1, pp. 22-31, 2007.

LADES, L. K.; LAFFAN, K.; DALY, M.; DELANEY, L. Daily emotional well-being during the COVI-19 pandemic. **British Journal of Health Psychology**, 2020. DOI. 10.1111/bjhp.12450

LEDOUX, J. Rethinking the Emotional Brain. **Neuron Perspective**, v. 73, pp. 653-676, 2012.

MACEACHREN, A. M. **How maps work: representation, visualization, and design.** New York: The Guilford Press, 1995.

MACKERRON, G.; MOURATO, S. Mappiness: natural environments and in-the-moment happiness. In: **Handbook on Wellbeing, Happiness and the Environment**. Edward Elgar Publishing, pp. 266–282, Ch. 14, 2020. DOI. 10.4337/9781788119344.00022.

MACHADO, G. C. A. A difusão do pensamento higienista na cidade do Rio de Janeiro e suas conseqüências espaciais. **Anais do XXVI Simpósio Nacional de História – ANPUH**, São Paulo, 2011. Available in: https://www.snh2011.anpuh.org/resources/anais/14/1308340710_ARQUIVO_GiseleCardosodeAlmeidaMachado-ANPUH.pdf

MCKENZIE, K.; MURRAY, A.; BOOTH, T. Do urban environments increase the risk of anxiety, depression and psychosis? An epidemiological study. **Journal of Affective Disorders**, Elsevier B.V., v. 150, n. 3, pp. 1019–1024, 2013. DOI. 10.1016/j.jad.2013.05.032.

MARTINS, G. D. M. 2018. **Desafio Intermodal de Curitiba.** Não paginado. Disponível em: <http://www.ciclovida.ufpr.br/?s=desafio+intermodal&search=Search>

MEENAR, M.; FLAMM, B.; KEENAN, K. Mapping Emotional Experience of Travel to Understand Cycle-Transit User Behavior. **Sustainability***,* v. 11, n. 17, pp. 4743, 2019. DOI. 10.3390/su11174743

MENDONÇA, A. L. A. Avaliação de Interfaces Cartográficas para Dispositivos com Tela Sensível ao Multitoque. **Tese apresentada no curso de Pós-Graduação em Ciências Geodésicas - Universidade Federal do Paraná.** Curitiba. 2013.

MISLOVE, A.; LEHMANN, S.; AHN, Y.-Y.; ONNELA, J.-P.; ROSENQUIST, J.N. 2010. **Pulse of the nation: U.S. mood throughout the day, as inferred from Twitter.** Não paginado. Disponível em: <http://www.ccs.neu.edu/home/amislove/twittermood/>. Acesso em: 13 out 2020

MODY, R. N.; WILLIS, K. S.; KERSTEIN, R. **WiMo: Location-based emotion tagging.** In: Proceedings of the 8th International Conference on Mobile and Ubiquitous Multimedia, MUM 2009, pp. 22-25, 2009. DOI. 10.1145/1658550.1658564.

MOHAN, D.; TIWARI, G.; SIVARAMAKRISHNA, K. C. Urban mobility. ed. 2019. In: **Sustainable Approaches to Urban Transport. Boca Raton**: CRC Press. Ch. 7., 2019, DOI. 10.1201/9781351004862-7.

MONTGOMERY, M. R. The urban transformation of the developing world. **Science**, v. 319, n. 5864, pp. 761–764, 2008. DOI. 10.1126/science.1153012.

NAKAMORI, S.; BELOTTO, J. C. A.; JUNIOR, M. F. F.; OLIVEIRA, A. G. A Contribuição Da Academia Para Mobilidade Urbana Sustentável Por Meio Do Programa De Extensão Universitária Da Ufpr – Ciclovida. **Revista Políticas Públicas & Cidades**, v. 3, n. 2, pp. 145–163, 2015.

NOLD, C. 2009. **Introduction: Emotional Cartography, Technologies of the Self.** London: Softhook. Disponível em: <http://emotionalcartography.net/EmotionalCartographyLow.pdf>

NOVAK, P. K. *et al.* Sentiment of emojis. **PLoS ONE***,* v. 10, n. 12, pp.1-22, 2015. DOI. 10.1371/journal.pone.0144296.

NUNEZ, J. J. R. 2009. **Ideas for the Use of Chernoff Faces in School Cartography.** Não paginado. Disponível em: <https://www.researchgate.net/publication/228587294_IDEAS_FOR_THE_USE_OF_CHERNOFF_FACES_IN_SCHOOL_CARTOGRAPHY>. Acesso em: 12 out 2020.

OLIVEIRA, T. H. M.; PAINHO, M. **Emotion & stress mapping: Assembling an ambient geographic information-based methodology in order to understand smart cities.** In: 2015 10th Iberian Conference on Information Systems and Technologies (CISTI), 2015, pp.1-4, 2015.

OLIVEIRA, T. PAINHO, M. Open Geospatial Data Contribution Toward Sentiment Analysis Within the Human Dimension of Smart Cities. **In: Open Source Geospatial Science for Urban Studies**, 2020.

ONU-HABITAT. Estado das Cidades da América Latina e Caribe. **Programa das Nações Unidas para os Assentamentos Humanos,** 2012. Disponível em: https://brasil.un.org/pt-br/57045-onu-lanca-relatorio-sobre-cidades-latino-americanas

ÖZYILDIRIM, E. 2019. **Subjective Value Assessment Based on Emojis for Applications in Landscape and Urban Planning**. Dresden: Dresden University of Technology.Disponível em: <https://cartographymaster.eu/wp-content/theses/2019_Ozyildirim_Thesis.pdf>

PÁNEK, J. BENEDIKTSSON, K. Emotional mapping and its participatory potential: Opinions about cycling conditions in Reykjavík, Iceland. **Cities**, v. 61, pp. 65-73, 2016.

PÁNEK, J. Emotional maps: Participatory crowdsourcing of citizens' perceptions of their urban environment. **Cartographic Perspectives***,* v. 2018, n. 91, pp. 17-29, 2019. DOI. 10.14714/CP91.1419.

PANKSEPP, J. Affective consciousness: Core emotional feelings in animals and humans. **Science Direct, Consciousness and Cognition**, v. 14, pp. 30-80, 2005.

PETCHENIK, B. B. A map maker´s perspective on map design research 1950-1980. In: **Graphic Communication And Design Contemporary Cartography**, 1983.

PIRANI, N.; RICKER, B. A.; KRAAK, M. J. Feminist cartography and the United Nations Sustainable Development Goal on gender equality: Emotional responses to three thematic maps. **The Canadian Geographer,** pp.1-15, 2019. DOI. 10.1111/cag.12575

POPLIN, A. Cartographies of Fuzziness: Mapping Places and Emotions. **The Cartographic Journal**, 54(4), pp. 291-300, 2017.

RAHMATIZADEH, S.; RAJABIFARD, A.; KALANTARI, M. A conceptual framework for utilising VGI in land administration. **Land Use Policy**, Pergamon, v. 56, pp. 81–89, 2016. DOI. 10.1016/J.LANDUSEPOL.2016.04.027.

RESCH, B.; SUMMA, A.; SAGL, G.; ZEILE, P. EXNER, J. P. Urban Emotions: Geo-semantic emotion extraction from technical sensors, human sensors and crowdsourced data. **In Progress in Location-Based Services 2014: Lecture Notes in Geoinformation and Cartography, edited by Georg Gartner and Haosheng Huang,** pp. 199-212, 2015. DOI 10.1007/978-3-319-11879-6_14

RESCH, B.; SUMMA, A.; ZEILE, P.; STRUBE, M. Citizen-Centric Urban Planning through Extracting Emotion Information from Twitter in an Interdisciplinary Space-Time-Linguistics Algorithm. **Urban Planning,** v. 1, n.2, pp.114–127, 2016. DOI 10.17645/up.v1i2.617.

RESENDE, N. Greca fecha guarda-volume de moradores de rua. Paraná Portal. Curitiba, 2017. Available in: https://paranaportal.uol.com.br/cidades/sem-categoria/greca-fecha-guarda-volume-de-moradores-de-rua

ROBERT KOCH INSTITUTE. COVID-19 Dashboard. Disponível em: https://experience.arcgis.com/experience/478220a4c454480e823b17327b2bf1d4/

page/page_1/. Acesso em: 27/10/2020.

ROBINSON, A.H. et al. Elements of Cartography, 1995.

ROBINSON, et al. Geospatial big data and cartography: research challenges and opportunities for making maps that matter. **International Journal of Cartography,** v. 3, n. 1, pp. 32-60, 2017.

RODRIGUE, J. P.; COMTOIS, C.; SLACK, B. **The Geography of Transport Systems**. 3rd ed. New York: Routledge, 2016. DOI. 10.4324/9781315618159.

RUSSELL, J. A. Core Affect and the Psychological Construction of Emotion. **Psychological Review,** v. 110, n. 1, pp. 145-172, 2003.

RUSSELL, J.A.; PRATT, G. A. A description of the affective quality attributed to environments. **Journal of Personality and Social Psychology,** v. 38, pp. 311-322, 1980.

SABOYA, R. Segregação espacial urbana. Urbanidades, 2009. Available in: https://urbanidades.arq.br/2009/05/14/segregacao-espacial-urbana/.

SCHMIDT, B. PALAZZI, A. PICCININI, C. A. Entrevistas online: potencialidades e desafios para coleta de dados no contexto da pandemia de COVID-19. **Revista Familia Ciclos de Vida e Saúde no Contexto Social,** v. 8, n. 4, pp. 960-966, 2020. DOI: 10.18554/refacs.v8i4.4877

SEE, L. *et al.* Crowdsourcing, Citizen Science or Volunteered Geographic Information? The Current State of Crowdsourced Geographic Information. **ISPRS International Journal of Geo-Information. Multidisciplinary Digital Publishing Institute**, v. 5, n. 5, p. 55, 2016. DOI. 10.3390/ijgi5050055.

SEITZINGER, S. P. *et al.* Planetary stewardship in an urbanising world: Beyond city limits. **Ambio***,* v. 41, n. 8, pp. 787-794, 2012. DOI. 10.1007/s13280-012-0353-7.

SHOVAL, N.; SCHVIMER, Y.; TAMIR, M. Tracking technologies and urban analysis: Adding the emotional dimension. **Cities**, v. 72, pp. 34-42, 2018. DOI. 10.1016/j.cities.2017.08.005.

SLUTER, C. R. Uma abordagem sistêmica para o desenvolvimento de projeto cartográfico como parte do processo de comunicação cartográfica. **Portal da Cartografia.** Londrina, v.1, n.1, p.1-20, 2008. Disponível em: http://www.uel.br/revistas/uel/index.php/portalcartografia.

SLUTER, C. R.; VAN ELZAKKER, C. P. J. M.; IVÁNOVÁ, I. Requirements elicitation for geo-information solutions. **The Cartographic Journal**, v. 54, n. 1, pp. 77-90, 2014

SLOCUM, T. A.; MCMASTER, R. B.; KESSLER, F. C.; HOWARD, H. H. **Thematic Cartography and Geovisualization.** 3rd ed USA: Prentice Hall Series in Geographic Information Science, 2009.

TUAN, Y. F. **Topophilia: A Study of Environmental Perceptions, Attitudes, and Values.** Columbia University Press: New York, 1974.

TURNER, E. 1977. **Life in LA 1970.**Disponível em: <https://mapdesign.icaci.org/2014/12/mapcarte-353365-life-in-los-angeles-by-eugene-turner-1977/>. Acesso em: 12 out 2020.

UDEGA JUNIOR, J. C. **Urbanização Brasileira, Planejamento Urbano e Planejamento Da Paisagem.** Faculdade de Ciências e Tecnologia (FCT) Universidade Estadual Paulista, 2018. Disponível em: <http://www.ambiente-augm.ufscar.br/uploads/A2-151.pdf>

VAN DEN BERG, A. E.; HARTIG, T.; STAATS, H. Preference for nature in urbanised societies: Stress, restoration, and the pursuit of sustainability. **Journal of Social Issues**, v. 63, n. 1, pp. 79–96, 2007.

VILLAÇA, F. **Espaço intra-urbano no Brasil.** São Paulo: Studio Nobel: FAPESP: Lincoln Institute, 2001.

WANG, H. *et al.* Global urbanisation research from 1991 to 2009: A systematic research review. **Landscape and Urban Planning,** Elsevier, v. 104, n. 3-4, pp. 299–309, 2012. DOI. 10.1016/j.landurbplan.2011.11.006.

WHITE, A. A Global Projection of Subjective Wellbeing: A Challenge to Positive Psychology?. **Psychtalk,** v. 56, pp. 17–20, 2007.

WORLD HEALTH ORGANIZATION. Globalization and infectious diseases: A review of the linkages. Special Programme for Research e Training in Tropical Disease, n. 3. Geneva, 2004.

WORLD HEALTH ORGANIZATION. WHO Director-General's opening remarks at the media briefing on COVID-19 - 11 March 2020. Disponível em: https://www.who.int/dg/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-covid-19---11-march-2020.

ZEILE, P.; RESCH, B.; SUMMA, A.; SAGL, G.; EXNER, J. P. Urban emotions — Geo-semantic emotion extraction from technical sensors, human sensors and crowdsourced data. **In Progress in location-based services 2014**, Springer, Cham, pp. 199-212, 2015.

ZEILE, P.; RESCH, B.; LOIDL, M.; PETUTSCHNIG, A.; DÖRRZAPF, L. Urban Emotions and Cycling Experience–enriching traffic planning for cyclists with human sensor data. **GI_Forum**, v. 1, pp. 204-216, 2016.

APPENDIX A – ARTICLE PRESENTED IN FOSS4G 2021

Int. Arch. Photogramm. Remote Sens. Spatial Inf. Sci., XLVI-4/W2-2021, 17–24, 2021. DOI: https://doi.org/10.5194/isprs-archives-XLVI-4-W2-2021-17-2021

USING JUPYTER NOTEBOOKS FOR VIEWING AND ANALYSING GEOSPATIAL DATA: TWO EXAMPLES FOR EMOTIONAL MAPS AND EDUCATION DATA

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KEYWORDS: Open Science, Jupyter Notebooks, Google Colab, Education Data, Emotional Maps.

ABSTRACT:

This article presents two applications developed using Jupyter Notebook in the Google Colab, combining several Python libraries that enable an interactive environment to query, manipulate, analyse, and visualise spatial data. The first application is from an educational context within the MAPFOR project, aiming to elaborate an interactive map of the spatial distributions of teachers with higher education degrees or pedagogical complementation per vacancies in higher education courses. The Jupyter solutions were applied in MAPFOR to better communicate within the research team, mainly in the development area. The second application is a framework to analyse and visualise collaborative emotional mapping data in urban mobility, where the emotions were collected and represented through emojis. The computational notebook was applied in this emotional mapping to enable the interaction of users, without a SQL background, with spatial data stored in a database through widgets to analyse and visualise emotional spatial data. We developed these different contexts in a Jupyter Notebook to practice the FAIR principles, promote the Open Science movement, and Open Geospatial Resources. Finally, we aim to demonstrate the potential of using a mix of open geospatial technologies for generating solutions that disseminate geographic information.

1. INTRODUCTION

Scientific research is how modern society develops knowledge about the world and its phenomena, answering questions by testing hypotheses with valid methods. However, making impactful science is difficult once there is an increasing need for (super)budgets to collect data, buy equipment, and publish research results in relevant scientific vehicles (Cantrell and Collister, 2019; Tennant et al., 2016).

For instance, we are experiencing a challenging scenario promoted by the COVID-19 pandemic. The virus has reached populations worldwide in a few weeks, also due to the global interconnection of our society (Castells, 2009; Mas-Coma et al., 2020). The technology we developed during the last decades is responsible for that globalisation: and it is an outcome of scientific research of our society. However, despite all this intellectual development, it is noticeable that the virus spread has found a freeway into the people's misinformation (Apuke and Omar, 2021; van der Linden et al., 2020).

We understand that the lack of knowledge about Covid-19 could be filled by the large dataset of scientific research we – scientists – rapidly built in such a chaotic scenario. Meanwhile, this gap is being occupied by "fake news" (van der Linden et al., 2020), and it has happened because scientific research is made inaccessible for people outside academia and, sometimes, also restricted to researchers beyond the "paywalls" (Cantrell and Collister, 2019).

Moreover, here we accept that fake news is being spread once people cannot find reliable sources for refuting such absurd claims. Thus, the fake news phenomenon is considered one of those variables with negative impacts on the COVID-19 pandemic, promoting mistakes that lead people to take ineffective treatments and avoid vaccines or safety measures (van der Linden et al., 2020). So then, how could we – scientists - modify this scenario? Somehow, delivering scientific knowledge as fast as we could and accessible for general people. However, as we told before, the scientific knowledge is still untouchable, even for scientists behind the paywall (Papin-Ramcharan and Dawe, 2006; Poulin, 2004; Scheliga and Friesike, 2014).

Nevertheless, there is an increasing attempt to empower "the availability of scholarly works to read and reuse" (Cantrell and Collister, 2019), here called the open access or open science movement (Kathawalla et al., 2021). Open Science does not have a formal definition (Arabito & Pitrelli, 2015; Vicente-Saez and Martinez-Fuentes, 2018), but it is a term that has its core based on knowledge, with required characteristic, like transparency, accessibility, shareability, collaboratively-developed (Vicente-Saez and Martinez-Fuentes, 2018), credibility and reproducibility (Kathawalla et al., 2021). This knowledge comprises scientific research and outputs, code, data, results, publications, information, and ideas (Vicente-Saez and Martinez-Fuentes, 2018).

The open concept has assumed different meanings over time and depending on the context. There is a consensus that the "open" emerged from "free", but it crossed the boundaries of "free", meaning rights, access, use, transparency, participation, and openness (Pomerantz and Peek, 2016). Furthermore, to support open science, it is necessary to rethink the research landscape and practice the FAIR principles, which means ensuring research is findable, accessible, interoperable, and reusable (Bruce and Cordewener, 2018). The open concept into geospatial information science has increased in importance since the beginning of the 21st century (Sui, 2014). Also, several free and open geospatial solutions have emerged into the context of web 2.0 technologies, once more individuals were interested in disseminating geospatial information into the internet (Elwood et al., 2012; Griffin and Fabrikant, 2012).

These sorts of solutions have created opportunities for the open science development into geospatial science (Sui, 2014) and produced such a fertile environment for disseminating the use of geographic information in several contexts. For example, the open geospatial information played a key role in the context of the COVID-19 pandemic by enabling governments to create policies and adopt strategies for holding the virus dissemination into the territories (Franch-Pardo et al., 2020).

Further, the rise of open geospatial data - open and interoperable – has been accompanied by the emergence of open GIS software, standards, and methods (Sui, 2014). In this context, the Open Geospatial Consortium (OSGeo) promotes software and standards for disseminating open geospatial information. The combination of open and interoperable geospatial technologies/resources - encouraged by the agents involved with OSGeo - plays an essential role in geospatial data science. This rise has not only taken place in the fields of health sciences but also is consolidating itself in the research and practice of the most diverse themes, for the sustainable management of cities, the environment, education, and several other aspects where the territorial understating is fundamental for knowledge building.

Nowadays, widely used open-source software that allows disseminating, accessing, and creating geospatial information - such as QGIS - may have extensions and customisations made with the Python language. Remarkably, Python is the most popular coding language used since 2018, holding this position for five years (Carbonnelle, 2020). Tools and libraries for data analysis, including spatial applications, have been developed within an environment of a growing trend in adopting free software solutions through the decade. The Jupyter is an example of a non-profit and open-source project to data science and scientific computing (Project Jupyter, 2021), enabling the embodiment of the FAIR principles, being a tool for open science (Randles et al., 2017). Similarly, the Google Colaboratory (or Colab) is a Jupyter cloud environment maintained by Google that allows for a shared development environment with no client-side software installation required (Google, 2021a).

This article aims to present two different applications developed with Python in Google Colab to manipulate and visualise data in an Open Science environment. The projects are 1 - MAPFOR: an interactive geospatial query tool to visualise supply and demand of teacher training in Paraná State; and 2 - the Collaborative Emotional Mapping, a tool to explore maps of emotions in urban mobility and represent them using emojis. Therefore, here we demonstrate the potential of using a mix of open geospatial technologies for generating solutions that disseminate geographic information. For both study cases, the data is acquired from a spatial database through widgets interactions and allows the cartographic visualisation of phenomena we mapped. In the following sections, we present an overview of the used libraries, a context, the methods applied, and results achieved from both applications. Finally, in the conclusion section, we discuss the results, the notebook's approach, limitations, and future works.

2. GEOSPATIAL SOLUTIONS USING JUPYTER

Jupyter is a computational notebook browser-based tool that supports workflows, code, data, and visualisations (Randles et al., 2017; Perkel, 2018), combining user's input and output in the same client-side. Likewise, Google Corporation launched the Colab, a hosted Jupyter notebook provided by a cloud-based service with no client-side software installation required (Google, 2021b; Carneiro et al., 2016).

The Jupyter notebooks in Colab were chosen to develop these applications due to the interaction, open-source, and shareability, promoting an even more collaborative environment. Additionally, the notebook could be hosted in GitHub or shared as an online link, where it is possible to set the permissions of access, ensuring security issues if the projects handle database credentials, as the applications developed in this research.

Nowadays, there are several examples of geospatial applications using computational notebooks. For example, Kiran et al. (2018) use the Jupyter Notebook as a tool for remote access and processing the DataCube API to geoprocessing satellite images, such as NDVI generation and unsupervised classification. Another example is the open-source implementation of a protocol for identifying problems in continuous movement data (Graser, 2021). Moreover, these geospatial Jupyter notebooks could interact with other open source initiatives like the Open Street Map, as in Boeing's urban street network analysis (2019).

Consequently, new libraries are emerging to optimise geospatial applications, such as Leafmap (leafmap.org), a Python package for performing advanced geospatial analysis in Jupyter Notebooks. Leafmap is developed upon several data science frameworks and geospatial packages widely used, such as Folium, Ipyleaflet, Ipywidgets, and Geopandas.

The Python libraries have considerable importance in the development of applications in notebooks. Hence, these tools enable the connection with external elements, such as databases, visualisation of graphic and cartographic solutions, manipulation of datasets, among other functions. Several libraries are native to Jupyter notebooks in Colab since the environment is executed in a cloud-based runtime. However, some particular libraries need to be installed in the runtime environment. Table 1 presents the Python libraries used in the development of both applications of this research.

Libraries	Application	Source
psycopg	Both	https://www.psycopg.org/
ipywidgets	Both	https://pypi.org/project/ipywidgets/
folium	Both	https://python-visualization.github.io/folium/
configparser	Both	https://pypi.org/project/configparser/
json	Emotional maps	https://docs.python.org/3/library/json.html
openrouteservice	Emotional maps	https://github.com/GIScience/openrouteservice
matplotlib	Mapfor	https://matplotlib.org/
jenkspy	Mapfor	https://pypi.org/project/jenkspy/

Table 1. Libraries used in the development of the research and their sources.

The main libraries used were:

- Psycopg: A PostgreSQL adapter for the Python programming language;

- Ipywidgets: Interactive HTML widgets for Jupyter notebooks and the IPython kernel;
- Folium: Manipulates data in Python and visualises it on a Leaflet map;
- ConfigParser: Read data from files, strings, and dictionaries;
- Json: Package to manipulate JSON data, as encoding and decoding;
- Openrouteservice: API that provides services using free geographic data from OpenStreetMap;
- Matplotlib: Library to create graphs sinPython.
- Jenkspy: Compute the limits of classes using the natural breaks method.

Among the cited libraries, openrouteservice for the Collaborative Emotional Mapping and jenkspy of the MAPFOR are not native to Google Colab; thus, they were installed.

3. APPLICATION ONE: MAPFOR - INTERACTIVE MAP OF BASIC EDUCATION TEACHER TRAINING

The educational system in Brazil faced many challenges, such as illiteracy, dropout rates, grade repetition, and inefficiency in teaching training (Bomeny, 2003; Schwartzman, 2005). In addition, there is a significant gap in the availability of educational data, despite being essential for the development of public policies to tackle educational inequalities in Brazil (Gazeli, 2012).
Therefore, in 2018 the Brazilian Ministry of Education (MEC) developed the PARFOR project (in portuguese Programa Nacional de Formação de Professores da Educação Básica). This project aims to provide higher or complementary guidance for teachers who lecture without superior formal education or who already have higher education, but teach in different areas that diverge from their formation or even bachelor teachers without basic teacher training (Brasil, 2018).

Due to the national program, it was established by the Federal University of Paraná, the MAPFOR project (in Portuguese, Mapeamento da Formação dos Professores do Estado do Paraná), which aims to ensure the educational quality offered in all stages of primary education in the State of Paraná (Camara and Camboim, 2020). In this project, state universities, especially the Federal University of Paraná, seek to map the supply and demand for undergraduate courses for teacher training to meet the specific demands of each region.

Besides the geolocation of 9511 schools, divided between different administrative dependencies, such as primary school, high school, federal institutions, and private schools (Camara and Camboim, 2020), we developed a spatial visualisation to research spatial distributions of professors with higher education degrees or pedagogical complementation concerning other variables vacancies in higher education courses. Furthermore, considering the multidisciplinary team of MAPFOR project, as professors, designers, cartographers, and developers, we choose to develop a Jupyter notebook for thematic maps instead of a traditional Geographical Information System to establish better communication within the research team.

3.1 Methods

The spatial data of Paraná State municipal boundaries were from an open data source produced by IBGE (in Portuguese Instituto Brasileiro de Geografia e Estatística). Furthermore, the educational data used is also from another open data source provided by INEP (In Portuguese Instituto Nacional de Estudos e Pesquisas Educacionais Anísio Teixeira), an institution associated with the Brazilian Ministry of Education, which produces the Scholar Census since 1995. In this project, the educational data used were the percentage of graduate professors per municipal boundaries and the information about the institutes of higher education, such as vacancies in higher education courses, both were from the Census of 2018. Finally, we selected as base map the OpenStreetMap tile layer. As already mentioned, the platform chosen for the project's development was the Jupyter notebooks through the Google Colab platform.

The data was stored in a PostgreSQL database with PostGIS extension. In order to connect the database with the Jupyter notebook, we used the Python library Psycopg, enabling the query and manipulation of data through the notebook. Furthermore, using the Ipywidgets library, tools have been added to the interface to allow users to interact with data and maps and create interactive queries. Consequently, through a combo box, the user can choose which higher education course he wants to see the number of vacancies compared to the percentage of graduated teachers.

Considering that data queries are customised, developing a method to symbolise the map dynamically is necessary. For example, the number of vacancies in undergraduate courses in teacher training was represented in proportional symbol maps. Furthermore, as the classification of numeric data changes with each query, we use the Jenkspy library to redo the classification by Jenks' method based on the user's choice. Thus, it was possible to automatically classify and determine the ranges of the data classes for each course.

Finally, the maps were developed using the Folium library. It was determined that the better way to visualise the spatial data and their symbology was through the OGC standard WMS (Web Map Service). Thus, the data has been allocated from the database on the map server Geoserver, allowing storing the layer's symbology in SLD (Styled Layer Descriptor).

This graphic (Figure 1) represents how the elements that compose this application interact with each other, enabling the system's reproducibility.

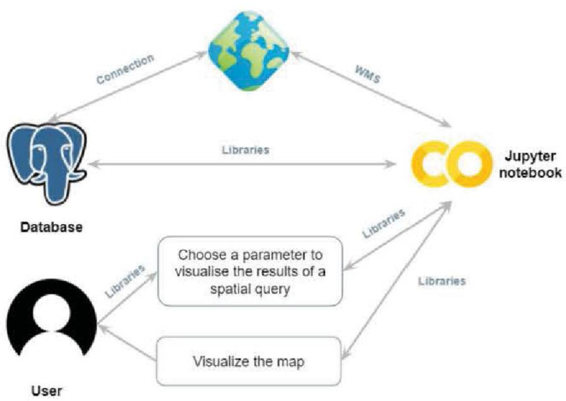

Figure 1. The system architecture of MAPFOR project.

3.2 Results

The Google Colab developed for MAPFOR project is available in Github (https://github.com/GabrieleCamara/Mapfor/blob/main/maps_mapfor.ipynb).
After connecting with the database, the user can choose a higher education course (Figure 2a). The parameter is passed to the database and returns the number of vacancies of that course chosen. This data is classified using the natural breaks (Jenks) method. Figure 2b presents a graphic that illustrates the distribution of the data from a higher education course and the limit of classes determined by Jenkspy library.
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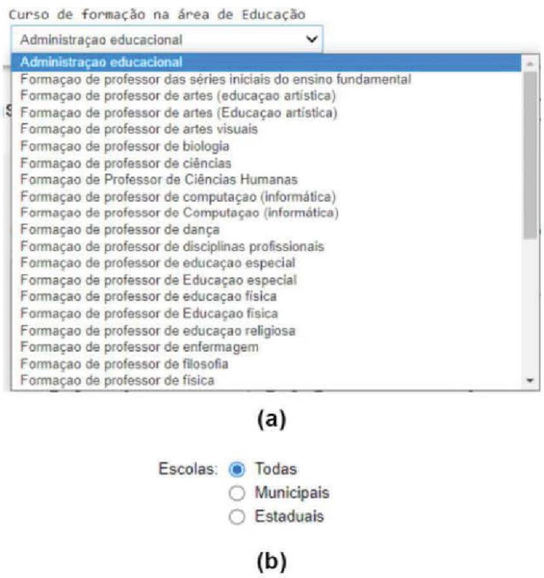

Figure 2. (a) Widget of higher education course. (b) Widget of options of aggregation of the percentage of graduate professors.

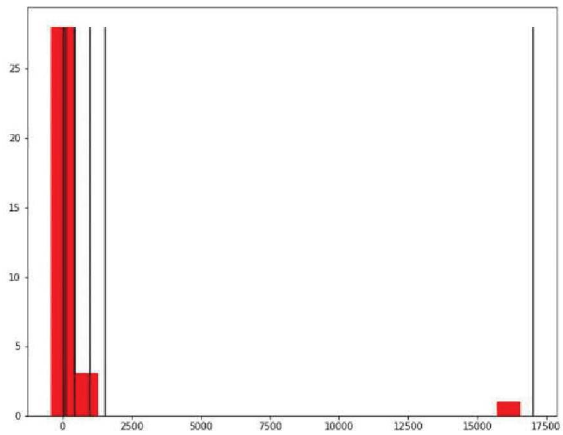

Figure 3. Graphic generated by Jenkspy with the data distribution and the limits of classes.

Then, the user chooses to normalise the percentage of graduate professors aggregated by the total number of primary schools in the municipal boundaries, the total number of primary schools, or the number of high schools (Figure 2b). Therefore, after executing cells that pass the parameter chosen to the database and Geoserver, the user visualises the map (Figure 4).

As it is an interactive map, the data can be presented in an aggregated form in a choropleth map with the 399 municipalities of Paraná, when the maximum level of distance is activated, until progressively closer to the individual school location. The choropleth map of municipal boundaries represents the percentage of graduate teachers, and the proportional punctual symbols represent the number of vacancies in the high educational course.

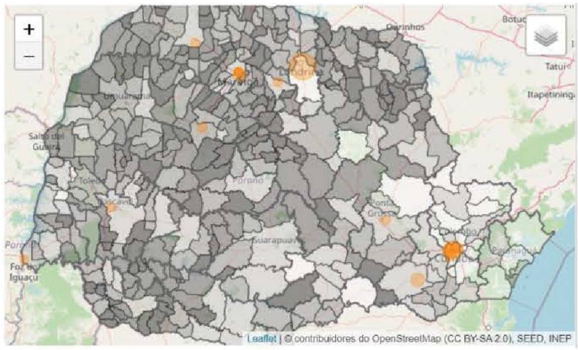

Figure 4. Percentage of graduate teachers aggregated with municipalities of Paraná, and the proportional punctual symbols represent the number of vacancies in the high educational course.

4. APPLICATION TWO: COLLABORATIVE MAP OF EMOTIONS IN THE CONTEXT OF URBAN MOBILITY

The Emotional Cartography collects and represents the emotions associated with an environment to understand their connection between individuals and places (White, 2007; Nold, 2009; Gartner, 2012). Thus, collaborative emotional mapping allows the representation of the emotions or sentiments experienced in a specific location of the space according to the individual's emotional bond, generating information with the environment's experience (Tuan, 1974; Camara, Camboim, and Bravo, 2021). This emotional information is being applied in the development of urban policies, including those on urban mobility, where the citizens contribute through their engagement in the Citizen-Centered Perspective, contributing as sensors (Fathullah and Willis, 2018; Goodchild, 2007). According to Camara, Camboim, and Bravo (2021), collaborative emotional mapping could be a tool to identify issues related to urban mobility.

Thus, a case study was developed with participants of an intermodal challenge in the city of Curitiba, the capital of Parana state Brazil, for emotional mapping in the context of urban mobility, through the collection and representation of data using emojis. The participants indicated the emojis that represented their emotions when traveling along the path taken in the different modes (Camara, Camboim, and Bravo, 2021).

4.1 Methods

It was registered 426 points associated with positive (52%) and negative/neutral (48%) emotions. The data was collected through a paper map and later were organised and vectorised in QGIS software using as reference the Open Street Map, where each emoji was attributed to a line corresponding with a street. We modelled and implemented a spatial database in PostgreSQL with the extension PostGIS.

As in the MAPFOR project, we used the psycopg library to connect the application and the database, and the ipywidgets enabled the user to interact with the system. The options of widgets are from Python functions that get information from the database.

Figure 5 illustrated the elements that compose the system and intent the reproducibility of the application.

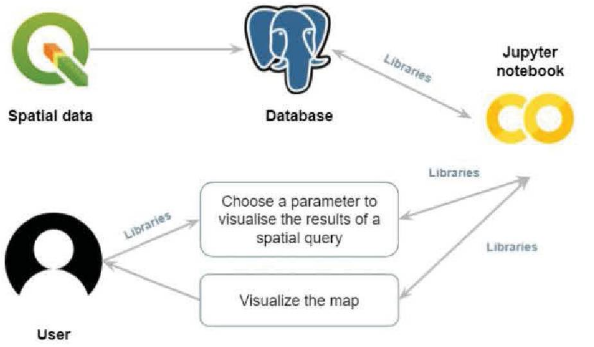

Figure 5. The system architecture of Collaborative Emotional Mapping Project.

To visualise the spatial data in the map, we used the tools of the Folium library instead of the WMS service, such as in application one. Consequently, the spatial information to be compatible with Folium tools must be in geojson format. Thus, it is necessary to develop a transformation between the PostGIS geometry WKT (Well-Known Text), returned in response to a query, and the Geojson format. This conversion was done using the row_to_json tool in a spatial query and the json library to decoding the data (Figure 6).

```
cursor.execute("""SELECT row_to_json(fc)
FROM ( SELECT 'FeatureCollection' As type, array_to_json(array_agg(f)) As features
FROM (SELECT 'Feature' As type, ST_AsGeoJSON(lg.geom_wgs)::json As geometry,
row_to_json((SELECT l FROM (SELECT gid) As l)) As properties
FROM emoc_selec As lg    ) As f )  As fc;""")
```

Figure 6. SQL query that transforms a selected spatial data in WKT geometry to Geojson format.

The symbology of emotions is made through emojis from Emojitwo open-source set, available under a CC-BY 4.0 license (emojitwo.github.io). Each point on the street axis was customised with URL icons, a property of Folium's markers. Therefore, the list of emojis was stored in a Github repository, enabling a URL from the image, together with the final result of Jupyter notebooks developed.

We developed three types of maps; each one is within a Jupyter section. As mentioned before, the user has to run the cells sequentially to run the application, send the parameter chosen to the database, and execute the database responses.

To establish routes based on emotions desired, customising the sensory experience with the urban space, we developed the third map of application that enables the user to determine a route and then retuned the streets within the emotionally mapped route. The directions are generated by Openroute Services (Table 1), as defined in Section 2.

4.2 Results

The Jupyter notebook developed for the collaborative emotional map is available in Github (https://github.com/GabrieleCamara/emotional_maps/blob/master/visualizer_emotional_maps.ipynb) in order to keep the project open-source. However, to interact with the application, it has to be opened in Google Colab.

The first map developed, the user chooses the emotion in the widget and sees the streets that emotion was assigned represented with the emoji (Figure 7). The user can activate and deactivate five layers, the emotions attributed into lines and points, all the paths taken in the collection of the data, and the streets classified with the gender of the participant who assigned that emotion.

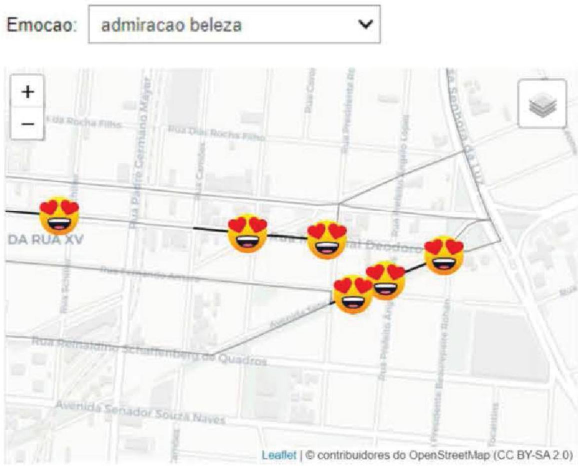

Figure 7. Streets assigned with the emotion Admiration (Beauty).

On the second map, it is possible to choose a street name and visualise which emojis were assigned to it to represent an emotion (Figure 8). The emojis are divided into three layers: emojis classified as positives extracts, emojis classified as negatives/neutral, and the street was chosen. Each emoji is also assigned in layers, thus the user can activate and deactivate the emojis individually.

Finally, in the third map, the user can type two addresses to define a route. Thus the application queries on the database if any street of the route was emotionally mapped, then return which emojis were associated with the street (Figure 9).

It is possible to activate and deactivate a group layer of negative/neutral emojis (Figure 9a) and positive emojis (Figure 9b). Besides, the blue marker represents the starting point and the green marker the ending point of the chosen route.

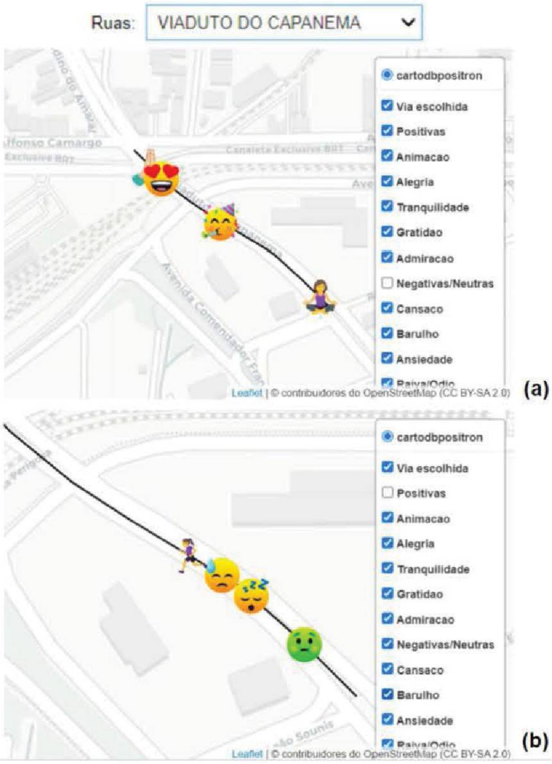

Figure 8. (a) Viaduto do Capanema assigned with positive emotions. (b) Viaduto do Capanema assigned with negative/neutral emotions.

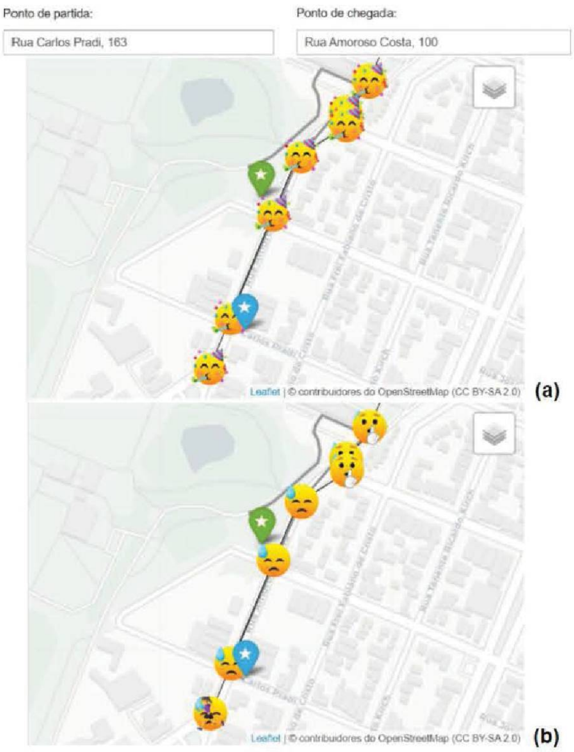

Figure 9. (a) Negative/neutral emotions of a route between two addresses. (b) Positive emotions of a route between two addresses.

5. CONCLUSION

This article presents two applications in different contexts using Jupyter Notebooks as the environment of interaction, analysis, and visualisation of spatial data and integrating the notebook with Python libraries made it possible to create an interface for spatial queries on a database through widgets, allowing users access, exploring, and analysing data without specific knowledge, like SQL. The geospatial libraries used were also essential to visualise the spatial data, enabling the map update according to the parameter chosen by users. Additionally, the possibility of install additional libraries, such as Jenkspy and Openrouteserives, enriches the power of data manipulation and analysis.

The use of Jupyter Notebooks in several contexts, including the ones presented in this research, shows how it is possible to apply this approach to perform spatial visualisation and analysis in a research environment in an open way, with the advantage of allowing the monitoring and improvement of the code simultaneously by the team involved. Furthermore, the notebooks reinforce the open science and the principles for digital objects: Findable, Accessible, Interoperable, Reusable (FAIR), always aiming the reproducibility and interoperability.

Other advantages of projects that follow this approach are the openness of development processes and better communication and collaboration among a multidisciplinary research team, the possibility of reproducibility of methods, and the popularisation of codes in data science.

On the other hand, Jupyter also has limitations. The notebooks are great for exposing and modifying code, working and teaching content through coding, developing prototypes, and publishing peer-reviewed articles, for example. However, this environment is orientated to data scientists, students, and researchers with minimal programming languages and notebooks background. Despite the possibilities of interaction of user/application, projects developed in Jupyter Notebooks are not aimed at the end-user, such as a teacher searching about the training course in the case of study of MAPFOR, or a person doing a daily route based on emotions, in the case of study of collaborative emotional mapping. Thus, for these cases where the interface must be intuitive to not specialists user, it has to be developed type of solution.

Although Google Colab is an excellent solution for building collaborative projects, as it does not need local computing resources and promotes sharing through Google's already disseminated tools, the cloud platform has the disadvantage of being inflexible in the options it offers to manipulate the server. For a project with a greater capacity to use different libraries and customisations, it would be advised to use its own Jupyter server.

Finally, Jupyter notebooks will continue to have great potential for the future, considering the increase of open resources in the last two decades. Thus, with the growth of the Open Science movement and FAIR principles incorporation into the landscape of research, more open research and libraries are created and derived from others, establishing a virtuous cycle and expanding the contexts of application. The possibility of interaction in a single environment between the code and its outputs makes the learning curve fast, and the creation of codes is incorporated into the routine of teachers, students and researchers from distinct fields.

REFERENCES

Apuke, O.D., Omar, B., 2021: Fake news and COVID-19: modelling the predictors of fake news sharing among social media users. *Telemat. Informatics,* 56(101475). doi.org/10.1016/j.tele.2020.101475.

Arabito, S., Pitrelli, N., 2015: Open Science training and education: Challenges and difficulties on the researchers' side and in public engagement. *Journal of Science Communication,* 14(4).

Boeing, G., 2019: Urban Street Network Analysis in a Computational Notebook. *The Journal of ERSA*, 6(3), 39-51. doi.org/10.18335/region.v6i3.278

Bomeny, H., 2003: Quando os números confirmam impressões: desafios da educação brasileira. *CPDOC,* 29f.

Bruce, R., Cordewener, B., 2018: Open Science is all very well but how do you make it FAIR in practice? *LSE.* blogs.lse.ac.uk/impactofsocialsciences/2018/07/26/open-science-is-all-very-well-but-how-do-you-make-it-fair-in-practice/ (12 June 2021)

Camara, G.S., Camboim, S.P., Bravo, J.V.M., 2021: Collaborative Emotional Mapping as a Tool for Urban Mobility Planning. *Boletim de Ciências Geodésicas*, 27(e2021011). doi.10.1590/s1982-21702021000s00011.

Camara, G.S., Camboim, S.P., 2020: A importância da disponibilização de dados educacionais na INDE: A experiência do MAPFOR - Mapeamento de Formação dos Professores no Estado do Paraná. *Anais 2° Simposio Brasileiro de Infraestrutura de Dados Espaciais,* 111-112.

Cantrell, M.H., Collister, L.B., 2019: The status quo bias and the uptake of open access. *First Monday*, 24(7). doi.org/10.5210/fm.v24i7.10089

Carbonnelle, P., 2020: PYPL PopularitY of Programming Language, CC BY 3.0. pypl.github.io/PYPL.html (12 June 2021)

Carneiro, T., Nóbrega, R.V.M., Nepomuceno, T., Bian, G.B., Albuquerque, V. H.C., Filho, P.P.R., 2016: Performance Analysis of Google Colaboratory as a Tool for Accelerating Deep Learning Applications. *IEEE,* 4. doi.org/10.1109/ACCESS.2018.2874767

Castells, M., 2009: *The Rise of the Network Society*. The Rise of the Network Society, 1. doi.org/10.1002/9781444319514

Elwood, S., Goodchild, M.F., Sui, D.Z., 2012: Researching Volunteered Geographic Information: Spatial Data, Geographic Research, and New Social Practice. *Ann. Assoc. Am. Geogr*, 102, 571–590.

Franch-Pardo, I., Napoletano, B.M., Rosete-Verges, F., Billa, L., 2020: Spatial analysis and GIS in the study of COVID-19. *A review. Sci. Total Environ.* 739(140033). doi.org/10.1016/j.scitotenv.2020.140033

Gazeli, P., 2012: Plano Nacional de Educação: Implicações para a Educação Infantil. *Revista Exitus,* 2(2).

Google, 2021a. O que é o Colaboratory? colab.research.google.com/notebooks/intro.ipynb (12 June 2021).

Google, 2021b. Colaboratory: Frequently asked Questions. research.google.com/colaboratory/faq.html (14 June 2021).

Graser, A., 2021. An exploratory data analysis protocol for identifying problems in continuous movement data. *Journal of Location Based Services,* 15(2), 89-117. doi.org/10.1080/17489725.2021.1900612.

Griffin, A.L., Fabrikant, S.I., 2012: More Maps, More Users, More Devices Means More Cartographic Challenges. *The Cartographic Journal,* 49, 298–301. doi.org/10.1179/0008704112z.00000000049

Vicente-Saez, R., Martinez-Fuentes, C., 2018: Open Science now: A systematic literature review for an integrated definition. *Journal of Business Research,* 88, 428-436. doi.org/10.1016/j.jbusres.2017.12.043

Kathawalla, U.K., Silverstein, P., Syed, M., 2021: Easing Into Open Science: A Guide for Graduate Students and Their Advisors. *Collabra Psychol,* 7(1). doi.org/10.1525/collabra.18684

Kiran, A., Gupta, P.K., Jha, A.K., Saran, S., 2018: Online Geoprocessing using Multi-Dimensional Gridded Data. *ISPRS Annals of the Photogrammetry, Remote Sensing and Spatial Information Science - ISPRS TC V Mid-term Symposium "Geospatial Technology - Pixel to People".* IV(5). doi.org/10.5194/isprs-annals-IV-5-29-2018

Mas-Coma, S., Jones, M.K., Marty, A.M., 2020: COVID-19 and globalisation. *One Heal, 9(100132)*. doi.org/10.1016/j.onehlt.2020.100132

Papin-Ramcharan, J.I., Dawe, R.A., 2006: Open access publishing: A developing country view. *First Monday*, 11(6). doi.org/10.5210/fm.v11i6.1332

Perkel, J.M., 2018: Why Jupyter is data scientists' computational notebook of choice. *Nature,* 563, 145-146. doi.org/10.1109/ACCESS.2018.2874767

Pomerantz, J., Peek, R., 2016: Fifty shades of open. *First Monday*, 21(5). doi.org/10.5210/fm.v21i5.6360

Poulin, D., 2004: Open access to law in developing countries. *First Monday*, 9(12). doi.org/10.5210/fm.v9i12.1193

Project Jupyter, 2021. jupyter.org (12 June 2021)

Randles, B.M., Pasquetto, I.V., Golshan, M.S., Borgman, C.L., 2017: Using the Jupyter Notebook as a Tool for Open Science: An Empirical Study. *IEEE/ACM Joint Conference on Digital Libraries (JCDL)*, 1-2. doi: 10.1109/JCDL.2017.7991618.

Robinson, A.C., Demšar, U., Moore, A.B., Buckley, A., Jiang, B., Field, K., Kraak, M.-J., Camboim, S.P., Sluter, C.R., 2017: Geospatial big data and cartography: research challenges and opportunities for making maps that matter. *International Journal of Cartography,* 3, 32–60. doi.org/10.1080/23729333.2016.1278151

Scheliga, K., Friesike, S., 2014: Putting open science into practice: A social dilemma? *First Monday*, 19(9). doi.org/10.5210/fm.v19i9.5381

Schwartzman, S., 2005: Os desafios da educação no Brasil. *Editora Nova Fronteira.*

Sui, D., 2014: Opportunities and Impediments for Open GIS. *Transactions in GIS,* 18, 1–24. doi.org/10.1111/tgis.12075

Tennant, J.P., Waldner, F., Jacques, D.C., Masuzzo, P., Collister, L.B., Hartgerink, C.H.J., 2016: The academic, economic and societal impacts of Open Access: an evidence-based review. *F1000Research,* 5(632). doi.org/10.12688/f1000research.8460.3

Touya, G., Brando-escobar, C., 2013: Detecting Level-of-Detail Inconsistencies in Volunteered Geographic Information Data Sets. *Cartographica: The International Journal for Geographic Information and Geovisualization,* 48(2), 134–143. doi.org/10.3138/carto.48.2.1836

van der Linden, S., Roozenbeek, J., Compton, J., 2020: Inoculating Against Fake News About COVID-19. *Frontiers Psychol*, 11, 2928. doi.org/10.3389/fpsyg.2020.566790

APPENDIX B – EXPERIMENT 2 DATA COLLECTION QUESTIONNAIRE

UFPR
UNIVERSIDADE FEDERAL DO PARANÁ

Questionário - Emoções e emojis no contexto da mobilidade urbana

TERMO DE CONSENTIMENTO

Olá, eu sou a Gabriele Silveira Camara, aluna de mestrado do Programa de Pós Graduação em Ciências Geodésicas da Universidade Federal do Paraná. Gostaria de te convidar a responder este questionário com relação ao uso de emojis na coleta e representação de emoções no contexto da mobilidade urbana.
- A aplicação deste questionário e o registro do seu consentimento em participar da pesquisa serão feitos de forma remota, por meio do formulário a seguir.
- O questionário leva em torno de 5 minutos para ser respondido e tem como objetivo estudar a relação dos emojis com as emoções vivenciadas no contexto da mobilidade urbana.
- Caso você participe da pesquisa será necessário acesso a internet por um computador ou aparelho mobile.
- A sua participação neste estudo é voluntária e anônima e se você não quiser mais fazer parte da pesquisa poderá desistir a qualquer momento.
- O material obtido por meio deste questionário será utilizado unicamente para fins de pesquisa.
- É possível a qualquer momento e sem nenhum prejuízo, a retirada do seu consentimento na utilização dos dados obtidos nesta pesquisa. Neste caso, você deverá entrar em contato com os pesquisadores solicitando a retirada do seu consentimento.
- Os pesquisadores responsáveis por este estudo estão a disposição para esclarecer eventuais dúvidas e fornecer as informações sobre a pesquisa, antes, durante ou depois de encerrado o estudo.

Contatos:
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Profº. Drº. João Vitor Meza Bravo - UFU: jvmbravo@ufu.br

camaragabriele@gmail.com (não compartilhado)
Alternar conta

*Obrigatório

Afirmo que li o Termo de Consentimento e compreendi a natureza e o objetivo do estudo do qual estou concordando em participar, voluntariamente *

☐ Sim, eu concordo em participar.

Perfil do Participante - Parte 1

Qual sua idade? *

Escolher

Com qual gênero você se identifica? *

- ○ Feminino
- ○ Masculino
- ○ Não binário
- ○ Prefere não identificar
- ○ Outro:

Em qual cidade e estado você nasceu? (Ex.: Curitiba/PR) *

Sua resposta

Em qual cidade e estado você mora atualmente? (Ex.: Curitiba/PR) *

Sua resposta

Qual o meio de transporte/modal você mais utiliza no seu dia-a-dia? *

	Nunca uso	Raramente uso	Uso às vezes	Uso muitas vezes	Sempre uso
A pé	○	○	○	○	○
Bicicleta	○	○	○	○	○
Carro	○	○	○	○	○
Motocicleta	○	○	○	○	○
Ônibus	○	○	○	○	○
Uber/Táxi e outros serviços similares	○	○	○	○	○

Indique na escala de 0 (nunca uso) a 5 (sempre uso) a frequência com a qual você utiliza emojis para se comunicar em redes sociais (WhatsApp, Instagram, Facebook, Twitter)? *

	1	2	3	4	5	
Nunca uso	○	○	○	○	○	Sempre uso

Descrição dos Emojis - Parte 2

Considerando as emoções que você sente no trânsito enquanto circula com o seu meio de transporte habitual,
descreva os emojis abaixo com uma palavra que exprima a emoção a eles associadas, no contexto mencionado.
Considere ideal responder com apenas 1 palavra ou 1 expressão curta, conforme o exemplo a seguir.

EXEMPLO - Resposta: Espanto

*

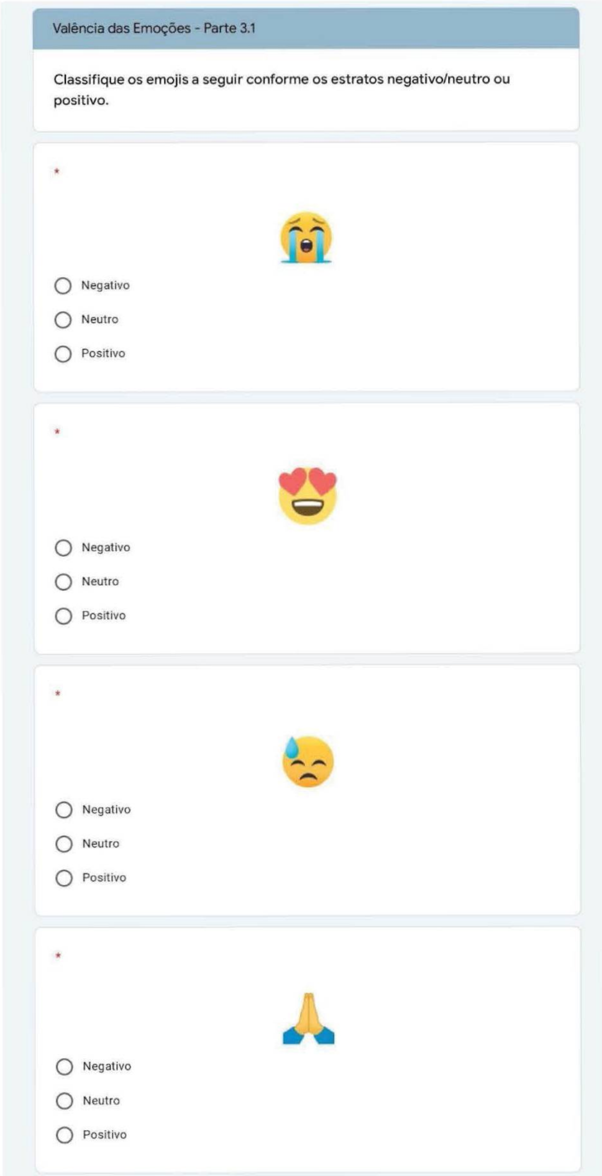
Sua resposta

*

Sua resposta

*

Sua resposta



Valência das Emoções - Parte 3.1

Classifique os emojis a seguir conforme os estratos negativo/neutro ou positivo.

*

- Negativo
- Neutro
- Positivo

*

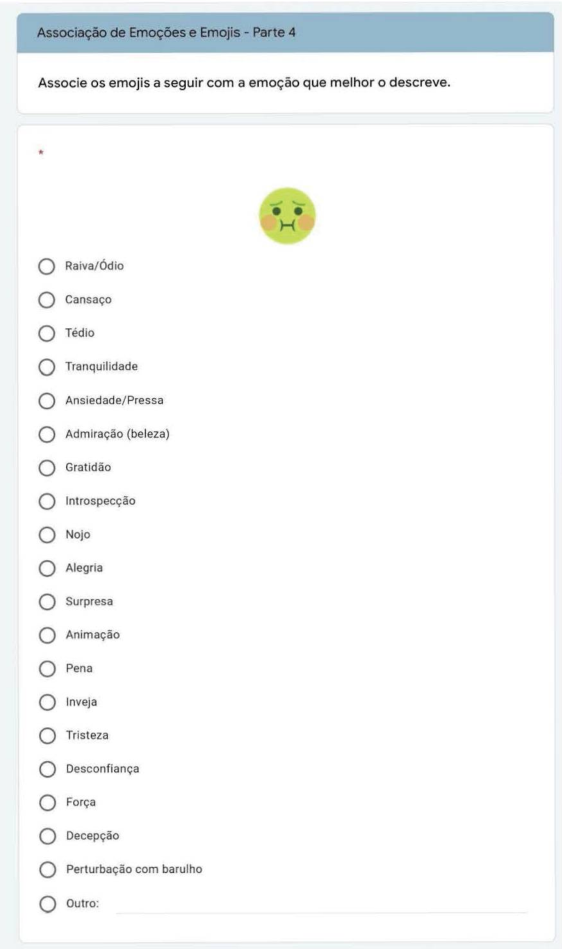
- Negativo
- Neutro
- Positivo

*

- Negativo
- Neutro
- Positivo

*

- Negativo
- Neutro
- Positivo



Associação de Emoções e Emojis - Parte 4

Associe os emojis a seguir com a emoção que melhor o descreve.

*

- Raiva/Ódio
- Cansaço
- Tédio
- Tranquilidade
- Ansiedade/Pressa
- Admiração (beleza)
- Gratidão
- Introspecção
- Nojo
- Alegria
- Surpresa
- Animação
- Pena
- Inveja
- Tristeza
- Desconfiança
- Força
- Decepção
- Perturbação com barulho
- Outro: ____

Emoções e a Mobilidade Urbana - Parte 5

Considerando o meio de transporte que você mais usa no seu dia-a-dia e a sua experiência no trânsito, quais são as emoções que você mais sente quando está se deslocando na cidade? *

- [ ] Raiva/Ódio
- [ ] Cansaço
- [ ] Tédio
- [ ] Tranquilidade
- [ ] Ansiedade/Pressa
- [ ] Admiração (beleza)
- [ ] Gratidão
- [ ] Introspecção
- [ ] Nojo
- [ ] Alegria
- [ ] Surpresa
- [ ] Animação
- [ ] Pena
- [ ] Inveja
- [ ] Tristeza
- [ ] Desconfiança
- [ ] Força
- [ ] Decepção
- [ ] Perturbação com barulho
- [ ] Outro:

Liste 3 principais situações que lhe causam medo no deslocamento pela cidade *

Sua resposta

Considerando o meio de transporte que você mais usa no seu dia-a-dia, imagine situações que você vive que envolvam a emoção de medo no trânsito. Visto isso, quais emojis você associaria a essas emoções? *

- [ ] 1

- [ ] 2

- [ ] 3

- [ ] 4

- [ ] 5
- [ ] Nenhuma das alternativas

APPENDIX C – ICC ABSTRACT RESULTS

The results presented in this appendix complement chapter 4 of this dissertation, which presents the abstract “Semantic correlation between emojis and feelings’ descriptions for mapping emotions into the urban mobility context”.

Thus, in the first step of the interview developed in the abstract, participants should attribute to eight different emojis a word that expresses the emotion represented by the symbol, considering the context of urban mobility. Table 1 shows the emojis and the summing of percentages of answers considered correct or correct associative. Six emojis were validated according to the acceptance threshold proposed by Clarke (1989) and Formiga (2012), 50% (or more) and 66%, respectively. One of the least correct associations was the emoji equivalent to the emotion "Impatience" that did not reach the minimum of 50%. In addition to this, with low results, was the emoji for the emotion 'Envy'. None of the answers attributed to it contained a description within the expected definition for this emotion. Thus, a new emoji to represent the emotion “Envy” was evaluated, reaching the acceptance threshold, replacing the first emoji referring to that emotion.

TABLE 1 - PERCENTAGES OF ANSWERS CONSIDERED CORRECT OR CORRECT ASSOCIATIVE TO EVALUATED EMOJIS

Emotion	Emoji	Described with Synonyms	Described literally	Described with expressions associated with the context	Total
Pity		77.98%	5.96%	-	83.94%
Tranquility		54.37%	43.77%	-	98.14%
Anxiety/Haste		35.78%	52.29%	-	88.07%

Boredom		6.88%	85.31%	-	92.19%
Disappointment		16.05%	46.78%	16.97%	79.80%
Impatience		13.76%	35.32%	-	49.08%
Envy		-	-	-	-
Envy (test)		8.75%	60.36%	-	69.11%

SOURCE: Authors (2021).

In the second stage of the interview, participants were encouraged to assess the valence of emotions represented by emojis (TABLE 2). Thus, the six emotions classified as positive in the first version of the emoji list kept this valence after the evaluation. On the other hand, negative and neutral emotions that were being considered as only one classification were divided after this analysis, giving rise to nine emotions classified as negative valence and eight as neutral. Finally, due to the context of the COVID-19 pandemic that the world is facing at the time of dissertation development, we placed the emoji “Face with mask” among those evaluated just for experimentation, and this emoji was considered neutral.

TABLE 2 - CLASSIFICATION OF VALENCES ACCORDING TO THE PARTICIPANTS

Emotion	**Valence before analysis**	**Valence after analysis**	**Classification of the emotions according to valence (%)**
Sadness	Negative/Neutral	Negative	90.0
Admiration (Beauty)	Positive	Positive	98.2
Tiredness	Negative/Neutral	Negative	74.4
Gratitude	Positive	Positive	85.8

Tranquility	Positive	Positive	67.6
Disgust	Negative/Neutral	Negative	90.9
Boredom	Negative/Neutral	Neutral	73.5
Introspection	Negative/Neutral	Neutral	80.4
Joy	Positive	Positive	89.0
Rage/Hatred	Negative/Neutral	Negative	98.2
Disturbance (noise)	Negative/Neutral	Neutral	82.2
Strength	Positive	Positive	64.8
Distrust	Negative/Neutral	Neutral	64.8
Animation	Positive	Positive	97.3
Laziness	Negative/Neutral	Negative	92.7
Envy	Negative/Neutral	Neutral	74.0
Disappointment	Negative/Neutral	Negative	75.3
Pity	Negative/Neutral	Negative	91.8
Fear (mugging)	Negative/Neutral	Negative	90.4
Anxiety/Haste	Negative/Neutral	Neutral	48.9
Surprise	Negative/Neutral	Neutral	71.2
Impatience	Negative/Neutral	Negative	53.9
Cold	Negative/Neutral	Neutral	78.1
Face with mask	-	Neutral	42.9
		Negative	36.5
		Positive	20.5

SOURCE: Authors (2021).

We also have called the participants to associate the emojis with five emotions universally expressed and recognized, considered as basic (TABLE 3). The five emotions evaluated were considered symbols suitable for representing emotions according to minimum thresholds of 50% according to Clarke (1989) and 66% according to Formiga (2012). However, the emotions "Joy" and "Surprise" only suited the minimum threshold of 50%, while the other emotions were higher than 66%.

TABLE 3 - PERCENTAGE OF ASSOCIATION OF THE EMOJI WITH THE CORRESPONDENT BASIC EMOTION

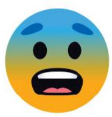
Basic Emotion	**Association of the emoji with the correspondent**

	emotion (%)
Disgust	78.5
Joy	61.2
Surprise	62.1
Sadness	82.2
Rage/Hatred	96.3

SOURCE: Authors (2021).

Finally, in the last stage of the interview, we measured the frequency of emotions related to the urban mobility context to establish the most representative emojis for that purpose. Participants were requested to indicate which emojis they associated with situations they experience in urban mobility that involve emotions of fear, considering the transport modes they use in their daily lives. The three most voted emojis were: “Fear of mugging”, which was already on the first version of the emoji list, and the emojis that represent “Fear, Tension, Worry, Nervousness” and “Fear of accidents, being run over”, which have been added to the final list (TABLE 4).

TABLE 4 - PERCENTAGE OF PARTICIPANTS WHO ASSOCIATED THE PRESENTED EMOJI WITH A FEARFUL SITUATION

Emoji	**Emojis associated with fear in the context of urban mobility (%)**
	59.8
	54.8
	50.2
	13.7
	6.8

None	7.8

SOURCE: Authors (2021).

Finally, we have defined a list with 20 associations emojis-emotions, which were validated by these experiments. Table 5 shows the main changes in the list of emojis. The emotions of “sadness” and “pity” were represented by a unique emoji, as well as the emotions of “animation” and “strength” that were grouped since they present many similarities in interpretation. Lastly, the emoji corresponding to the emotion “Envy” was replaced as mentioned in the first step of the interview.

TABLE 5 - EMOJI CHANGES MADE TO THE FINAL LIST

	Before	After
Animation/ Strength Positive		
Envy Negative		
Sadness/Pity Negative		

SOURCE: Authors (2021).

After evaluating the completeness of the list of emotions, we analyze the correlation between emojis/emotions with participants’ profiles regarding gender, type of transport, and age. Considering that the analyzed variables are nominal and categorical, and the group of analysis is unpareid, an adequate statistical test to assess the association of these variables with the valences of emotions is the Chi-square.

The null hypothesis (H0) for the chi-square test determines causality or independent relationship between the variables. On the contrary, the alternative hypothesis (H1), determines the dependence between the variables. Thus, if the calculated chi-square value is greater or equal than the tabulated chi-square value, the null hypothesis is rejected, accepting the alternative hypothesis and confirming the dependence between the variables. If the calculated chi-square value is smaller than the tabulated one, the null hypothesis is accepted, proving the independence between the variables.

The tabulated chi-square is determined based on the degrees of freedom and the level of significance, or probability P. The degrees of freedom are calculated by the difference between the number of interest classes (gender, transport modes, age group) and the number of observable variables (positive, negative and neutral valencies). Table 6 presents the calculated degrees of freedom for each class of interest, as well as the frequencies of these samples of interest in each observable variable.

TABLE 6 - FREQUENCY TABLE OF THE ANALYZED VARIABLES AND THEIR DEGREES OF FREEDOM

	Positive	Neutral	Negative	Degrees of Freedom
GENDER				
Male	60	91	56	4
Female	135	196	121	
Non Binary	4	2	0	
TRANSPORT MODE				
By walking	154	234	145	10
Bicycle	60	59	30	
Car	160	244	151	
Motorcycle	21	27	15	
Bus	52	121	87	
Uber/Taxi	105	170	104	
AGE GROUP				
18 to 24 years	27	48	33	14
25 to 29 years	59	93	68	
30 to 34 years	45	60	31	
35 to 39 years	18	31	17	
40 to 44 years	19	22	11	
45 to 49 years	16	20	10	
50 to 59 years	18	15	7	
60 years or more	3	7	6	

SOURCE: Authors (2021).

Thus, table 7 presents the chi-square test results applied to the variables of interest. The significance level for this analysis was 5% (P = 0.05). Based on the results, we can state that gender and age groups present independence concerning the valences of emotions. On the other hand, the transport mode group showed dependence on the valences of emotions since the null hypothesis was rejected in this case.

TABLE 7 - RESULTS OF CHI-SQUARE TEST

	X^2 calculated	X^2 tabulated	p-value	Hypothesis
GENDER	4.538	9.488	0.338	Accepted H0
TRANSPORT MODE	22.271	18.307	0.013	Reject H0
AGE GROUP	13.486	23.685	0.4887	Accepted H0

SOURCE: Authors (2021).

APPENDIX D – EXPERIMENT 3 DATA COLLECTION QUESTIONNAIRE

PÓS-GRADUAÇÃO EM CIÊNCIAS GEODÉSICAS

UFPR

Descoberta da cidade e suas emoções: Mapeamento Emocional por Emojis no Contexto da Mobilidade Urbana em Curitiba

TERMO DE CONSENTIMENTO

Olá, eu sou a Gabriele Silveira Camara, aluna de mestrado do Programa de Pós Graduação em Ciências Geodésicas da Universidade Federal do Paraná. Gostaria de te convidar para fazer um passeio pela cidade de Curitiba, com o objetivo de mapear emoções por meio de emojis, no contexto da mobilidade urbana da cidade.

- A aplicação deste mapeamento e o registro do seu consentimento em participar da pesquisa serão feitos de forma remota, por meio do formulário a seguir.

- O teste leva em torno de 30 minutos para ser feito e tem como objetivo a coleta de dados emocionais por meio de emojis na cidade de Curitiba para estudar a relação das emoções vivenciadas na mobilidade urbana.

- **IMPORTANTE:** Faça esse teste usando um COMPUTADOR DESKTOP OU NOTEBOOK.

- Caso você participe da pesquisa será necessário acesso a internet e um computador.

- A sua participação neste estudo é voluntária e se você não quiser mais fazer parte da pesquisa poderá desistir a qualquer momento.

- Para participar da pesquisa, além do questionário, você também precisará acessar o Google My Maps e links de apoio.

- Ao final do deste questionário terá um campo onde você deverá enviar o link do mapa que você irá produzir durante o teste. Esse envio fará com que os pesquisadores saibam sua identidade por meio do seu email. Mas suas informações pessoas NÃO serão utilizadas e NÃO serão divulgadas, preservando o seu anonimato.

- O material obtido por meio deste questionário e do teste serão utilizados unicamente para fins de pesquisa.

- É possível a qualquer momento e sem nenhum prejuízo, a retirada do seu consentimento na utilização dos dados obtidos nesta pesquisa. Neste caso, você deverá entrar em contato com os pesquisadores solicitando a retirada do seu consentimento.

- Os pesquisadores responsáveis por este estudo estão a disposição para esclarecer eventuais dúvidas e fornecer as informações sobre a pesquisa, antes, durante ou depois de encerrado o estudo.

Contatos:
Gabriele Silveira Camara - UFPR: gabrielecamara@ufpr.br
Profª. Drª. Silvana Camboim - UFPR: silvanacamboim@ufpr.br
Profº. Drº. João Vitor Meza Bravo - UFU: jvmbravo@ufu.br

camaragabriele@gmail.com Alternar conta

*Obrigatório

E-mail *

Seu e-mail

Afirmo que li o Termo de Consentimento e compreendi a natureza e o objetivo do estudo do qual estou concordando em participar, voluntariamente *

☐ Sim, eu concordo em participar.

Próxima | Limpar formulário

Nunca envie senhas pelo Formulários Google.

Este conteúdo não foi criado nem aprovado pelo Google. Denunciar abuso - Termos de Serviço - Política de Privacidade

Google Formulários

Perfil do Participante - Parte 1

Qual sua faixa etária? *

Escolher

Com qual gênero você se identifica? *

- ○ Feminino
- ○ Masculino
- ○ Não binário
- ○ Prefere não identificar

Indique na escala de 1 (nunca uso) a 5 (sempre uso) a frequência com a qual você utiliza emojis para se comunicar em redes sociais (WhatsApp, Instagram, Facebook, Twitter)? *

	1	2	3	4	5	
Nunca uso	○	○	○	○	○	Sempre uso

Você conhece/já veio para a cidade de Curitiba? *

- ○ Sim, moro ou morei
- ○ Sim, já visitei
- ○ Não

Voltar | Próxima | Limpar formulário

Instruções de como mapear suas emoções enquanto conhece alguns lugares de Curitiba - Parte 2

Para a realização do mapeamento de suas emoções você poderá usar dois materiais de apoio. Um vídeo e/ou um tutorial em PDF, ambos apresentados a seguir.

Este vídeo apresenta as instruções de como mapear suas emoções no decorrer do passeio em Curitiba. Recomendamos que você abra o vídeo em uma nova aba e coloque em tela cheia para visualizar melhor todas as instruções. Para acessar o vídeo pelo YouTube, clique no link: https://youtu.be/2O9hgG5z2qw

O tutorial em PDF sintetiza algumas ferramentas explicadas no vídeo para o mapeamento das emoções nos cenários que serão apresentados.
https://drive.google.com/file/d/1ZYzgETytXfV6nhhn34SzeBrduDWT3w3a/view?usp=sharing

Qual ferramenta você preferiu utilizar durante o teste? *

- ○ Apenas o vídeo
- ○ Apenas o PDF
- ○ O vídeo e o PDF

Voltar | Próxima | Limpar formulário

Quase lá! Aqui vão alguns pontos importantes - Parte 3

Na próxima sessão você será direcionado ao link do Google My Maps para mapear suas emoções em Curitiba.
Antes disso, temos alguns pontos importantes:

1 - Faça esse teste usando um COMPUTADOR DESKTOP OU NOTEBOOK.

2 - Você deverá acessar os links indicados CONECTADO a sua conta do Google Gmail.

3 - NÃO FECHE ESTE FORMULÁRIO. Após o mapeamento você deverá voltar a esta página para responder algumas perguntas referentes a sua experiência na execução das tarefas.

No mapa você irá mapear suas emoções em 2 cenários: Primeiro fazendo o trajeto a pé, e Segundo fazendo o trajeto utilizando algum meio de transporte. Baseado nas suas experiências se deslocando pela cidade, qual meio de transporte você gostaria de considerar para mapear suas emoções? *

Note que você deverá lembrar do meio de transporte escolhido aqui para realizar uma das rotas no mapa. IMPORTANTE: Se você tem experiência com mais de um meio de transporte, como carro e bicicleta, ou carro e ônibus, dê preferencia para fazer o teste considerando bicicleta ou ônibus.

Escolher ▾

Para sortear o qual dos cenários você irá fazer o seu passeio, precisamos saber em qual o mês do seu aniversário? *

Escolher ▾

Voltar | Próxima | Limpar formulário

Vamos juntos nesse passeio? Acesso ao mapa - Parte 4

1- Para começar seu passeio clique neste link: https://www.google.com/maps/d/u/0/edit?mid=1SBBr9J0L5fdgn85fP5e-Vgoi3smE72PD&usp=sharing

2 - Para visualizar o caminho que irá percorrer, você deverá acessar o Google Street View nos links indicados a seguir (Esses links também estarão no mapa, no ponto COMECE AQUI em cada um dos cenários!):
Cenário 1 - https://goo.gl/maps/WZxjEQGVdCeRydLM9
Cenário 2 - https://goo.gl/maps/AokHdo5N9qnHHVro7

3 - Mapeie as emoções conforme as instruções do vídeo (https://youtu.be/2O9hgG5z2qw) e do tutorial (https://drive.google.com/file/d/1ZYzgETytXfV6nhhn34SzeBrduDWT3w3a/view?usp=sharing).
Relembrando, no link do mapa (item 1):
3.1 - Clique nos três pontinhos no menu vermelho do lado esquerdo da tela. Depois clique em COPIAR MAPA.
3.2 - Abra em uma nova aba o gabarito dos emojis: http://www.labgeolivre.ufpr.br/gabarito-emojis/
3.3 - Clique no marcador "COMECE AQUI" para iniciar o primeiro cenário.

4 - IMPORTANTE: Ao finalizar o mapeamento dos trajetos VOLTE A ESTE FORMULÁRIO para responder as perguntas a seguir.

Responda as perguntas a seguir após finalizar o mapeamento dos trajetos no Google My Maps

CENÁRIO 1: Parque Gomm até a Praça 29 de Março - Indique na escala de 1 (Nenhuma familiaridade) a 5 (Total familiaridade) qual sua familiaridade com a rota identificada no mapa como cenário 1? *

	1	2	3	4	5	
Nenhuma familiaridade	○	○	○	○	○	Total familiaridade

CENÁRIO 2: Campus Politécnico da UFPR até o Campus Rebouças da UFPR - Indique na escala de 1 (Nenhuma familiaridade) a 5 (Total familiaridade) qual sua familiaridade com a rota identificada no mapa como cenário 2? *

	1	2	3	4	5	
Nenhuma familiaridade	○	○	○	○	○	Total familiaridade

Submissão do mapa - Parte 5

E aí? Como foi seu passeio por alguns lugares de Curitiba? Como você se sentiu?
Agora falta pouco para acabamos essa viagem.

Agora, copie abaixo o link do mapa que você produziu durante o passeio, de acordo com a imagem a seguir. LEMBRE DE ALTERAR A PERMISSÃO DE ACESSO DO SEU MAPA PARA "Qualquer pessoa com o link"!!! *

Sua resposta

O que você achou dessa experiência? Sinta-se a vontade para dar um feedback, sugestões, críticas e elogios.

Sua resposta

Voltar | Enviar | Limpar formulário

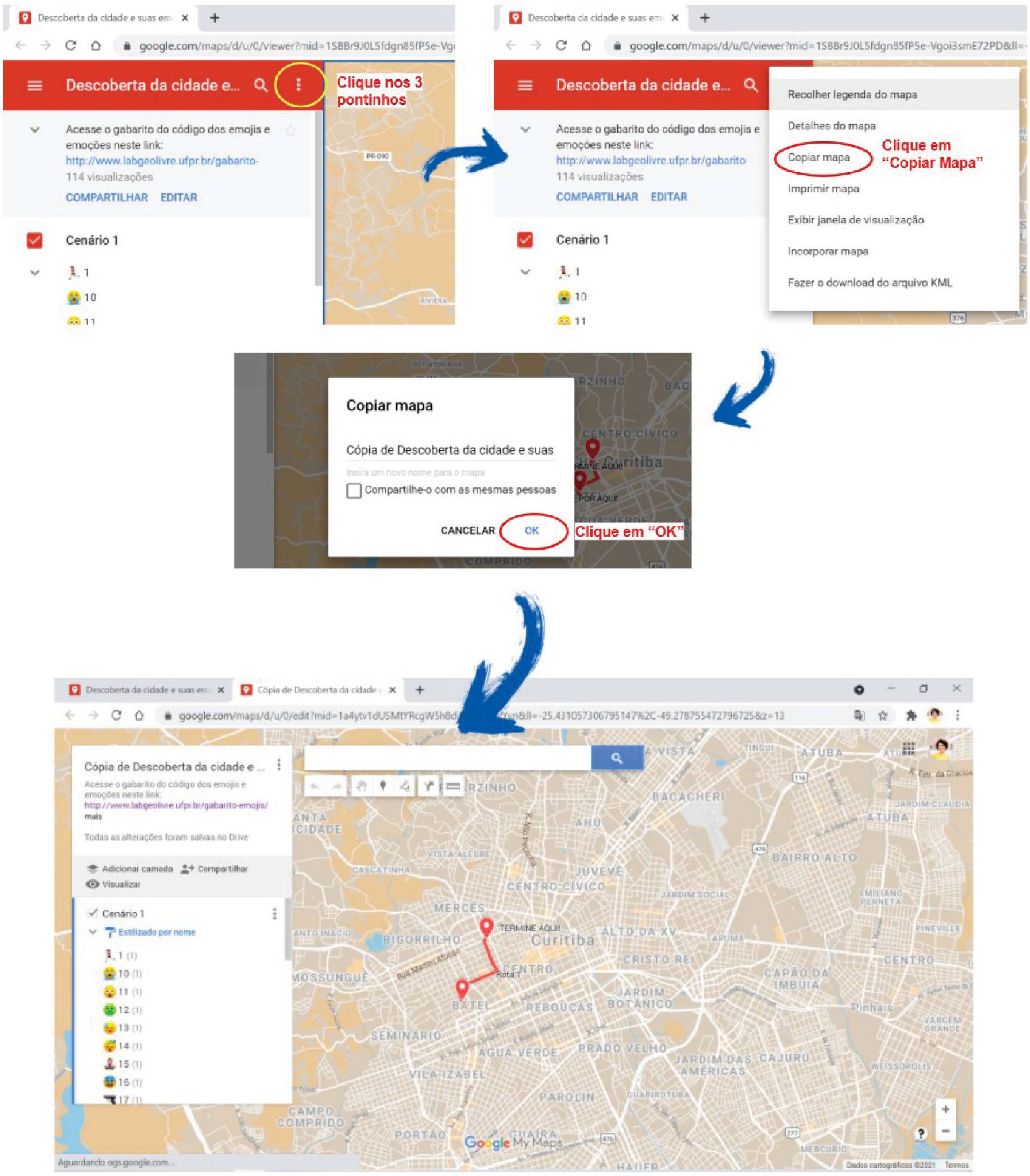
APPENDIX E – TUTORIAL TO HELP THE PARTICIPANTS TO MAP THE EMOTIONS IN CURITIBA ON GOOGLE MY MAPS

Este é um arquivo auxiliar ao vídeo explicativo, que te ajudará a mapear suas emoções na cidade de Curitiba no contexto da mobilidade urbana.

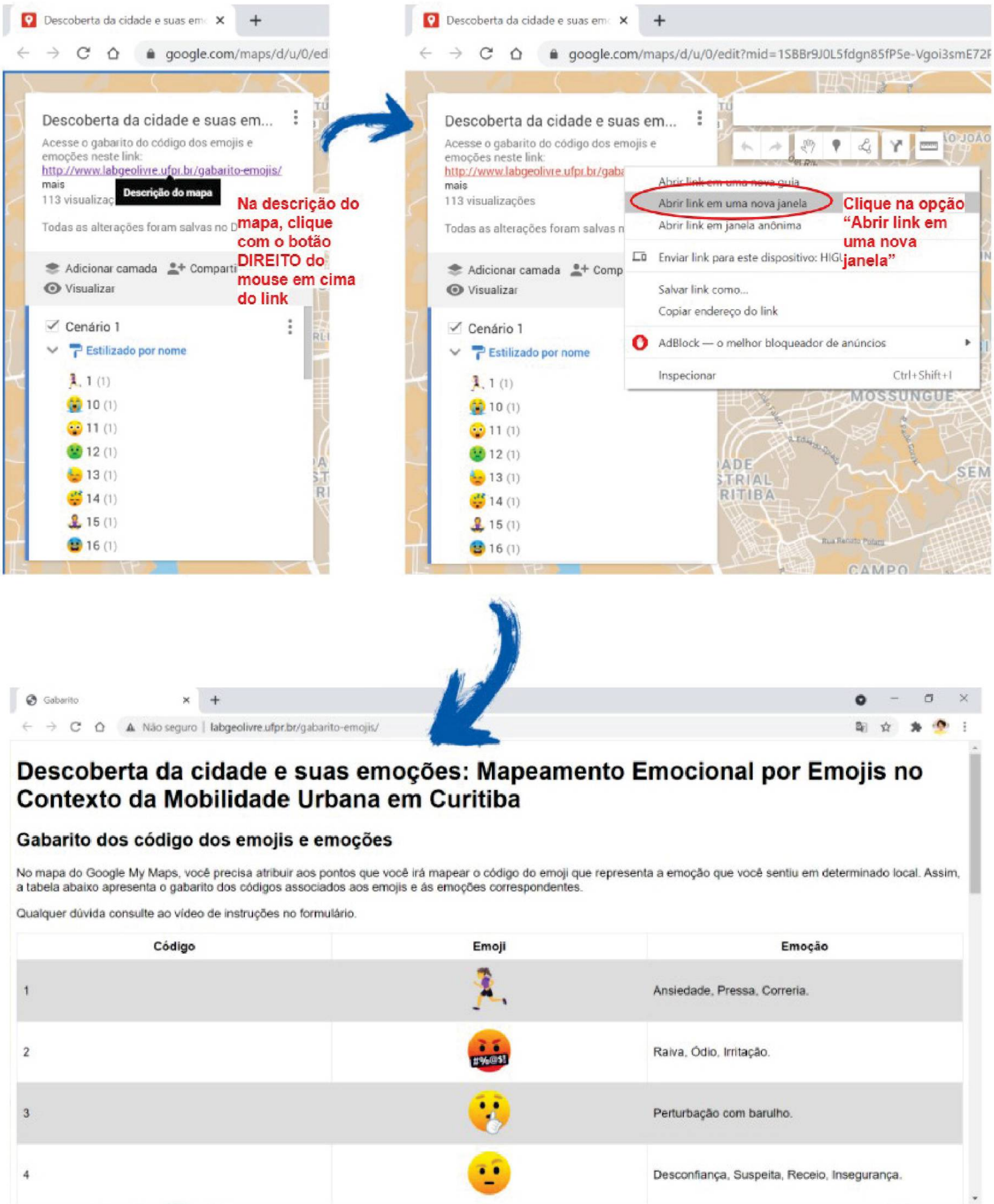
SUMÁRIO

1 COMO COPIAR O MAPA?

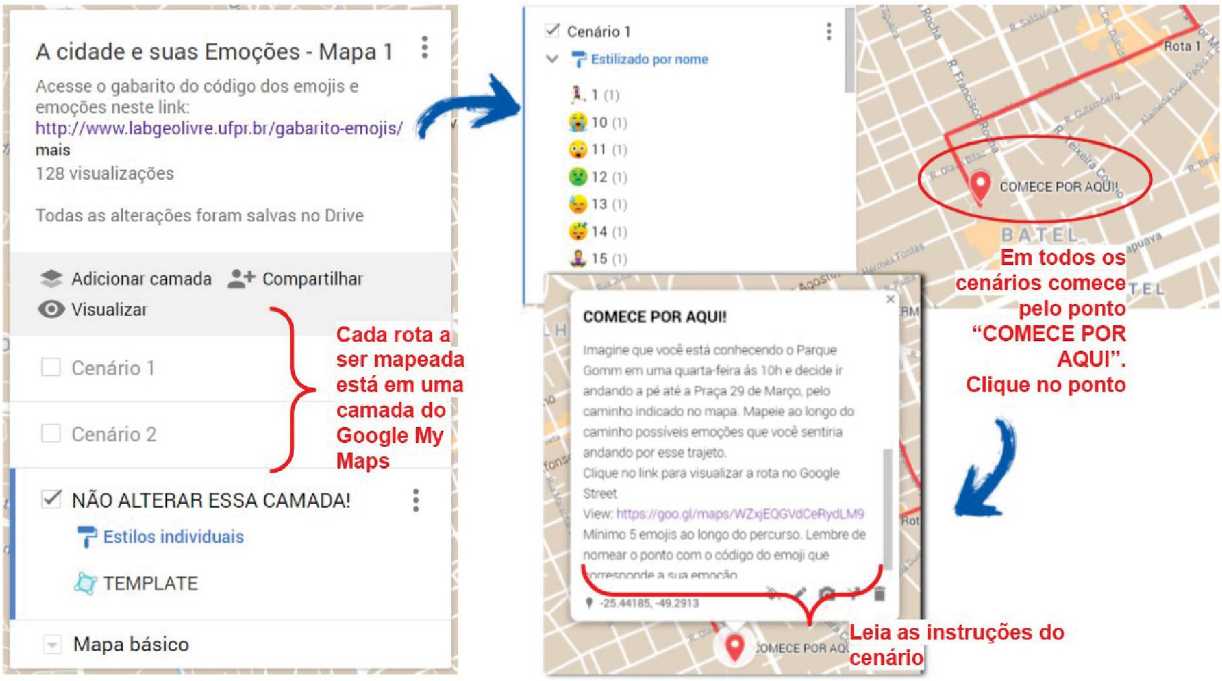
IMPORTANTE: Para copiar o mapa você deverá ter uma conta no gmail e **estar logado com seu login e senha**. Caso contrário, a opção "copiar mapa" não estará habilitada.



2 COMO ABRIR O GABARITO DOS EMOJIS E EMOÇÕES?



3 POR ONDE COMEÇAR?



4 COMO ACESSAR O GOOGLE STREET VIEW PARA VISUALIZAR AS ROTAS?

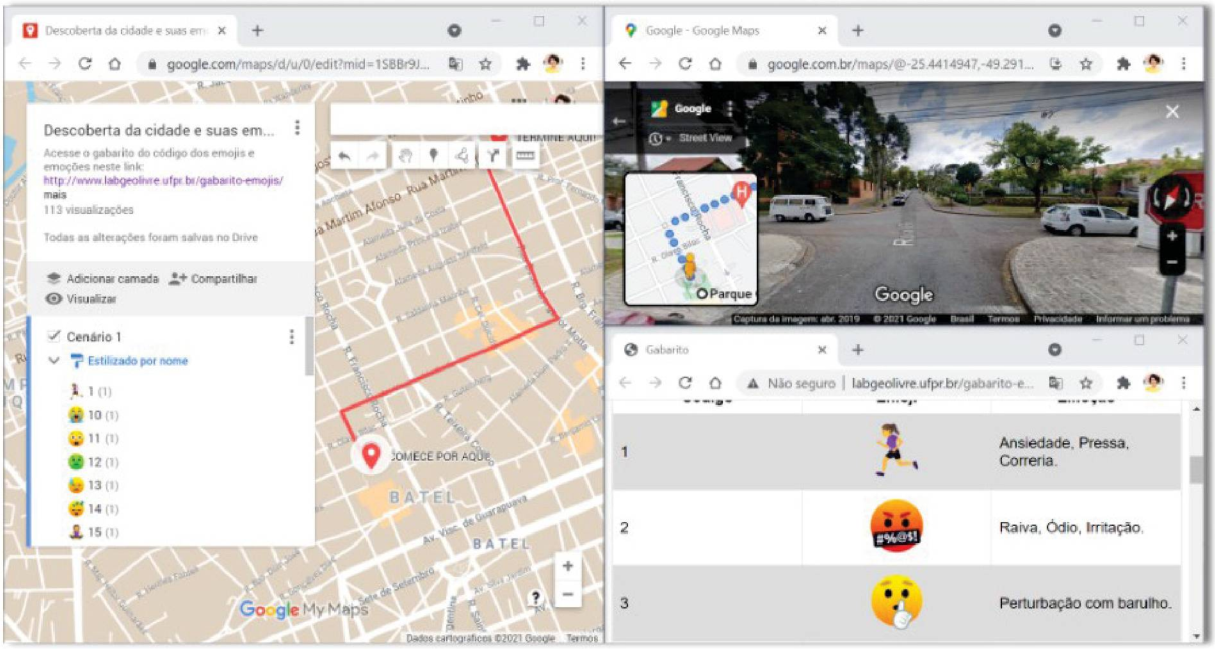
5 TENHO TODAS AS FERRAMENTAS PARA MAPEAR MINHAS EMOÇÕES?

Para mapear suas emoções nos cenários, você deverá abrir uma nova janela para o Google Street View de cada cenário.

Mantenha o gabarito sempre aberto caso precise conferir o código dos emojis e a qual emoção ele se refere.

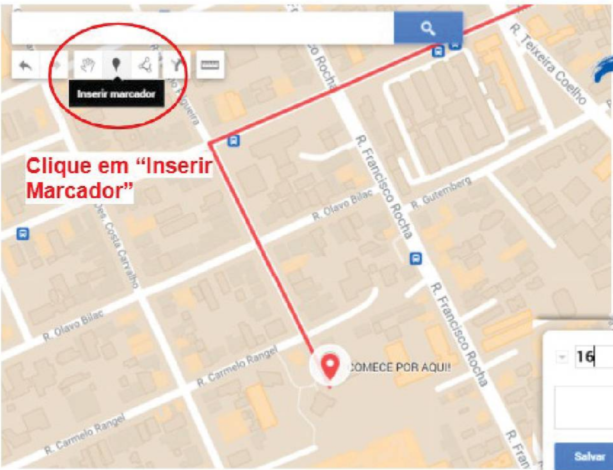
Google My Maps

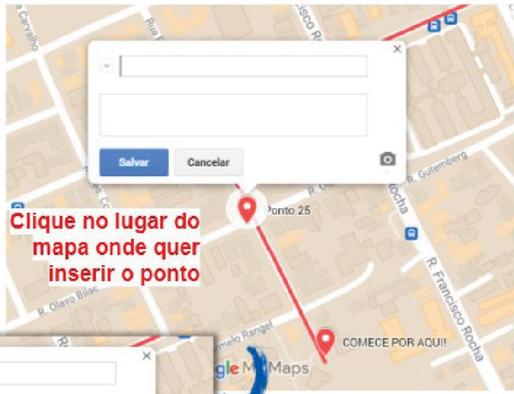
Google Street View

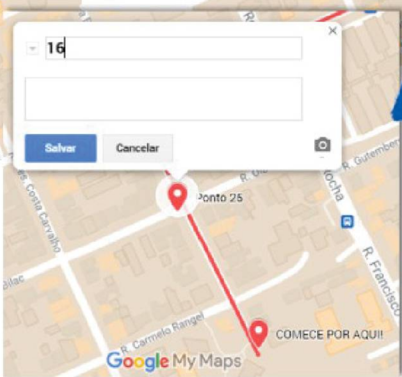


Gabarito das emoções

6 COMO INSERIR UM PONTO NO MAPA?

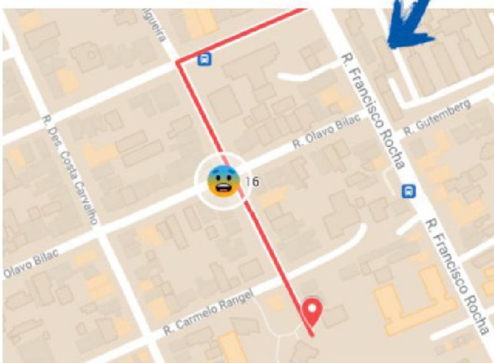






Nomeie o ponto mapeado com o código do emoji/emoção que você deseja inserir naquele local do mapa

16		Medo, Tensão, Preocupação, Nervosismo.



7 COMO ENVIAR O MAPA QUE PRODUZI?