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Mapping the In-Motion Emotional Urban Experiences: An Evidence-Based Method

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Abstract: Urban settings affect the experience of people in places and the measurement of such urban experiences is the focus of this article. The 'experiential Environmental Impact Assessment—exp-EIA©' method and its application to the Città Studi area in Milan are presented. The method couples urban studies with environmental psychology and ICT for educational purposes with a sample of architecture students divided in two groups (N = 18). Experiential data are collected via a dedicated app installed on the participants' mobile devices, and an automatic data processing and analysis produces spatialized results creating maps of the overall urban experience. In particular, the emotional reaction of participants through a ten-minute walking path is assessed. A group activity focused on the link between urban features and subjective evaluation of places by participants is combined with the results obtained via the application of the circumplex model of affect. Results show that the path is characterized by two main emotional experiences, passing from a pleasant to an unpleasant experience within the short walk in both groups, offering some insights on the urban design of the area. The results are part of the teaching process to increase students' awareness about experiential design, yet the process is conceived also as a tool for professionals.

Keywords: emotions; behavioral effect; experiential walk; design education; affect; ICT; participatory app; atmosphere; environmental characteristics; urban design

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1. Introduction

Since the 1960s, sociology and environmental psychology have been recognized as valuable sources of information in the fields of urban design and planning providing insight to inform design decisions [1] and the debate about the relationship between design and social sciences is still lively [2,3]. Indeed, social sciences have positioned themselves next to design and engineering sciences, leading to a new set of variables and methods considered for the analysis of environmental settings [4]. Understanding how places and their layout affect people is crucial since the dynamic human-environment relationship contributes to the quality of place experience and people's behavior [5]. Even if the urban design incorporates some theories and practices from various research fields and professional domains [2,6] and is recognized as "an interdisciplinary approach to designing our built environment" [1] (p. 236), specific subjective measures to validate the design outcomes are not traditionally included in the formal process of urban transformations approval by Public Administrations. The same can be said for courses in architectural studies, even though environment-behavior studies should be a pivotal knowledge of urban design [7–9] since such an interdisciplinary approach can favor a deeper understanding of social, psychological, and environmental implications of urban transformations for both educational activities and the professional practice.

This debate emphasizes designers' need to read the relationship occurring among environmental, sensory and social factors, and has given origin to interdisciplinary concepts that might serve as a nexus for different perspectives. A prominent role is played by the notion of *atmosphere*, also known in French literature as *ambiance*, a concept including the subject experiencing the environment and the environment itself [10,11]. According to such a conceptualization "an atmosphere is never exclusively a psychological phenomenon, as state-of-mind, nor solely an objective thing 'out there', as an environment or milieu; atmospheres are always located in between experiences and environments" [9] (p. 32). Although the focus on both subjective and objective characteristics of the relationship has given origin to a vague notion that is hard to define and assess, it contributed to shifting the field of urban studies also towards two main subjective domains: the sensory aspects of urban spaces (e.g., temperature, wind, sound, smell, light) and the affective qualities associated with the environment [4]. Combining those aspects with environmental features is crucial for delivering a holistic approach that addresses the complexity of the urban environment and its inhabitants as a dynamic system evolving in time and space, favoring a design perspective focused on place experience. In this view, a helpful concept is the "ambiance empathy" [12]; indeed, this idea focuses on the role of designers' sensitivity in understanding and envisioning the social and environmental context and how this perspective, in return, shapes the design process and outcomes. Such a perspective that focuses on the human-environment relationship contributes to defining a design solution that is attentive to both expressed and unexpressed needs. Even if some authors argue about the importance of an interdisciplinary or holistic perspective for informing urban design [7,13], in the actual design practice it is still lacking a recognized and scientific-based procedure for measuring and assessing the design outcomes from an experiential perspective. An attempt to find practical methods fostering a design approach consistent with such principles is represented by experiential walks [14,15] grounded on the direct experience in place. This experiential approach contributes to fostering designers' "ambiance empathy", conducive to understanding the existing condition while envisioning places' design potentials in a comprehensive perspective. Yet, despite their contribution to education and design purposes, such practices do not deal with the issue of a sound and replicable assessment. In this respect, a contribution to frame and assess the subjective components of the notion of atmosphere can derive from the field of evidence-based design (EBD), an approach developed in the last three decades to exploit the available scientific theories and methods to properly inform the design process and to make decisions that improve the final outcome both in terms of environmental impact and reduced stress for the final users [16,17]. This perspective has developed on the basis of evidence-based medicine, which aims to inform clinical choices through research, and this strong linkage favored the spread of EBD for designing healthcare facilities [18,19]. Over the years EBD has been applied to additional environmental settings including workplaces [20,21], schools [22,23], university campuses [24,25], retail and public spaces [17,26]. Those principles have also been considered as the basis for evidence-based landscape architecture, defined as "the deliberate and explicit use of scholarly evidence in making decisions about the use and shaping of land" [22] (p. 328). A key aspect for properly implementing EBD into professional practice is to conceive the empirical observations and reliable analysis of individual and social responses to current conditions or future transformations as guidelines for the design process. The main goal is to inform and support designers' hypotheses and decisions without dictating the final solutions but rather fostering the creative process in a non-prescriptive manner [17,27,28]. Different data types are considered for investigating the people-environment relationship, spanning from behavioral to physiological aspects [19]. Among them, the application of psychology-based frameworks and methodologies in support of urban design have been applied over time to various settings highlighting the positive or negative role of specific urban elements [29]. The crucial contribution of such studies lies in the connection with precise theoretical frameworks, which opens the way to go beyond the mere description of subjective perceptions providing instead a significant explanation of the observed effects [30,31]. Such an approach to urban context assessment is generally grounded in various psychological constructs that explain the subjective spatial experience, among which those relating to affective aspects found significant applications (e.g., [32–35]). The circumplex model of emotions [36], in particular, was initially tested as a tool for urban environment evaluations [37], to be then extensively used as a theoretical or methodological reference above all in interior design (e.g., [38,39]) and in applied research in the field of tourism (e.g., [40–43]). According to this model, the main human emotions can be positioned along a circular continuum organized around two complementary axes: valence (pleasure: negative/positive) and activation (arousal: maximum activation/maximum deactivation). For instance, relaxation will be characterized by a positively valenced state of deactivation, conversely, alertness will be characterized by high negatively valenced arousal. This model also offers the projection of a physical place in an emotional space, and the comparison between different places about their emotional positioning according to people's evaluation. Furthermore, the circumplex model and its related measurement tools are characterized by a high heuristic simplicity and comprehensibility, also allowing easy integration with participatory methodologies focused on the immediate experience of urban places.

Notwithstanding the abundant literature produced by environmental psychologists as a potential basis for the design process, a fruitful integration between the two fields and an actual impact on the professional practice are still missing [44]. In this perspective, it is interesting to notice that even though there are currently no established conventional procedures in the professional practice of urban design that consider measurements of the human-environment relationship, there has been a recent trend towards Information and Communication Technologies (ICT) solutions for onsite data collection from citizens about intangible aspects of their urban experiences, such as feelings of safety and emotional reactions. Among the others, for instance, Li and colleagues [45] correlate emotional and visual data, collected via body sensors and GPS devices, to assess citizens' response to urban spaces and support the optimization of design solutions. Instead, the EmotionSense app [46] matches psychological questions and mobile sensors data to track users' activities and feelings and describe their experience in the urban environment. In this perspective, technology can be seen as an enabler to better focus the attention on the complexity of people's experiences in the actual and designed urban spaces, a perspective that is sometimes underestimated in design theories [47]. The aim of this paper is to present a case study in an urban campus in Milan for the application of a methodology for urban exploration whose general structure is consistent with the principles of experiential design, integrated with a digital tool for the momentary assessment of the emotional state. The phases of the methodology, applied to this case study with architecture students for teaching purposes, include an experiential walk followed by activities meant to increase awareness about the atmosphere of the place, according to the design perspective. Among the instruments used for developing such ambiance empathy, we included measures of the emotional reaction of participants coupled with the related environmental factors both in the forms of pictures and cartographic representation. Our attempt is to combine the representation of environmental and personal factors of a place exploiting the instruments developed in the psychological and ICT field. The present case study is designed as a pedagogical initiative, yet it is conceived as an approach transferable also to professionals.

2. Method

2.1. Case Study

The case study concerns an experiential walk passing in and out the Politecnico di Milano University (POLIMI) in the "Città Studi" district of Milan, Italy. This district is well-connected to the rest of Milan via public transportation, including several metro and tram lines, the Lambrate railway station, and major roads. The historic university buildings of POLIMI and Università degli Studi di Milano (UNIMI) are located in this area since the beginning of the XX century. This urban sector is still characterized by a significant presence of university functions that are only partially integrated with the surrounding neighborhood. As a consequence, the area experiences phases of intensive use during working days by researchers, professors, and students, and periods of tranquility outside of these times. In addition to universities, the district hosts two hospitals, the National Cancer Foundation IRCCS and the Carlo Besta Neurological Institute (Figure 1). Over the decades, the district has evolved from a peripherical to a semi-central area of the compact city characterized by a twentieth-century urban tissue with a mixed-used function, i.e., residential and commercial functions, private and public services, local and supra-local public functions [48]. The entire area has recently undergone, and is still experiencing, a phase of urban renewal which began in 2011 with the "Città Studi Campus Sostenibile" (http://www.campus-sostenibile.polimi.it/ (last accessed on 11 March 2023)) [Città Studi Sustainable Campus] inter-university project with the goal of improving the sustainability and livability of the area [48–50]. Within this framework, the experiential walk aims at focusing the attention on some issues related to the campus experience in motion (in continuity with the former "Città Studi Campus Sostenibile" (CSCS) project, the experiential walk is part one of the actions of the NextGenerationEU-funded "Multilayered Urban Sustainability Action (MUSA)-Spoke 1—Urban Regeneration—Cities of the Future" project, which focuses on the Città Studi, Bicocca, and MIND university districts of Milan. As for the CSCS, this project aims to promote sustainable urban regeneration processes by applying research innovations to university campuses, which serve as relevant demonstrators for urban contexts. The experiential walk's outcomes are one of the actions aimed at measuring the existing conditions as a baseline to evaluate the benefits of the urban renewals to be achieved by the end of the project. https://www.musascarl.it/ (last accessed on 11 March 2023)).

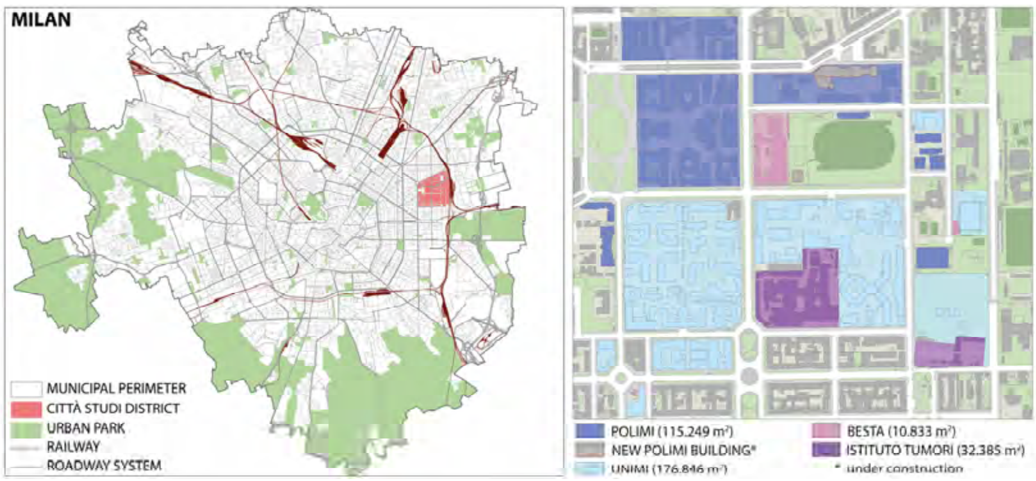

Figure 1. The image presents: (**left**) map of the city of Milan where the Città Studi district is located (east side in light red); (**right**) the area of the "Politecnico di Milano" and "Università degli Studi di Milano" campuses in the Città Studi neighborhood, and the hospitals "Besta" and "Istituto dei Tumori" in the same area (credits: B. Piga, C. Chiarini).

2.2. The Experiential Walk: Materials & Measures

Materials and measures were established for both indoor and outdoor activities. Three presentations were prepared to: (1) introduce the workshop; (2) frame the overall approach and the environmental psychology constructs applied in the activities; (3) present the outcomes of the analysis of the data collected via the City Sense app that employs the experiential—Environmental Impact Assessment (exp-EIA©) method during the onsite experiential walk [14,51].

The City Sense mobile app (later APP) was used during the walk to collect users' feedback about the urban experience. This APP is based on the exp-EIA© methodology, designed by the authors, to enable data collection, data analysis, and data representation for measuring and communicating the experience of people in existing or designed environments. The APP can display actual or designed scenarios from a subjective perspective and with a naturalistic interaction through Augmented (onsite) and Virtual Reality (onsite and remotely); this enables researchers, policymakers and local stakeholders to anticipate future conditions in a realistic-enough manner to guarantee the ecological validity of the simulation. As a matter of fact, the APP and the exp-EIA© method were developed to specifically foster collaborative and human-centered urban design processes with an evidence-based approach. Indeed, this tool allows users to collect, analyze, and spatialize subjective reactions to specific environments, i.e., describing the intangible features of spaces through the perspective of its users; the outcomes are presented in various forms, including geolocated psychological data [52–54]. When applying the exp-EIA© method via City Sense, participants have to: (1) register to the app and input their socio-demographic information, for statistical and data filtering purposes; (2) fill in a brief questionnaire related to the chosen neighborhood, including a question on how familiar they are with the area on a 5-points Likert scale and a multiple choice question with multiple select answers option concerning the main reasons for frequentation (e.g., work, shopping, social relations). Also, items based on environmental psychology constructs such as emotional appraisal (see Section 3.1) are included; (3) explore (in a free or guided manner) the surroundings: if participants are exploring a designed environment they use the app in AR or VR mode to navigate the environment; when assessing the existing condition onsite in AR participants do not need to use the app until they identify a relevant perspective to assess, otherwise, they can navigate the area remotely via VR; (4) in any case, when a scene attracts users' attention, they take a picture of the most relevant view using the app (Figure 2); this action starts the questionnaire which includes the items previously selected by the researchers (Depending on the psychological constructs and items included the length of the questionnaire varies.). Indeed, in the current version, the questionnaire enables data collection related to different psychological constructs about emotional or cognitive factors. Even though the exp-EIA© method is able to collect several psychological reactions to an environment (e.g., place attachment, sense of community, flow, environmental preference, restoration), emotions are the core of the present case study. Data are collected using an original native digital scale, which adapts the "Self-Assessment Manikin (SAM)" [55] to digital devices following the approach suggested by Betella and Verschure [56] when developing the "affective slider". Likewise, this pictorial tool represents the continuum of pleasure and arousal: participants rate their state by shifting the cursor on the slider and at each end of the two sliders' bars an icon symbolizes the minimum and maximum of pleasure/arousal. The cursor position is transformed into specific values recorded by the app.

A printed map of the "Città Studi" area including the path to follow, the points of view (POV) and the target points to assess (Figure 3) served as an aid for facilitators guiding the experiential walk. The path encompasses six stops for data collection of participants' psychological state; the first three are recently renovated areas that passed from car-oriented spaces to people-oriented places highly used; the last three stops, instead, are still barely functional areas with low urban quality despite high potential for transformation, as already highlighted in 2011 by the strategic vision (Strategic Vision of the Campus Sostenibile Project by Politecnico di Mialano and Università degli Studi di Milano: https://youtu.be/-Z9VhOoFJxQ (last accessed on 7 March 2023)) of the "Città Studi Campus Sostenibile" project.

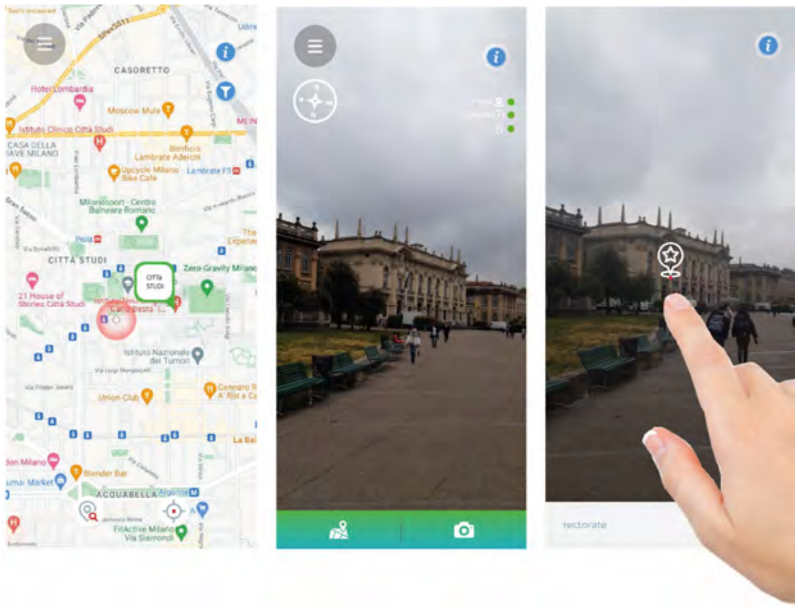

Figure 2. City Sense app screenshots. From left to right: initial map showing the user location (the red dot) and the flag of the Città Studi survey (the green flag); tapping on the flag the users have to answer some sociodemographic questions and a brief questionnaire related to their relationship with the chosen neighborhood; then they enter in the subjective exploration modality; main interface of the subjective perspective showing the compass on top left, the map button on bottom left, the screen capturing button on bottom right; after selecting a relevant view the users tap the camera icon and the survey starts; example of interaction with the app, to answer some questions the users can drag and drop a marker (the white pin including a star) onto the screen and label it; the marker three dimensional position is computed by the system via a ray casting process on the georeferenced 2.5D virtual model representing the area.

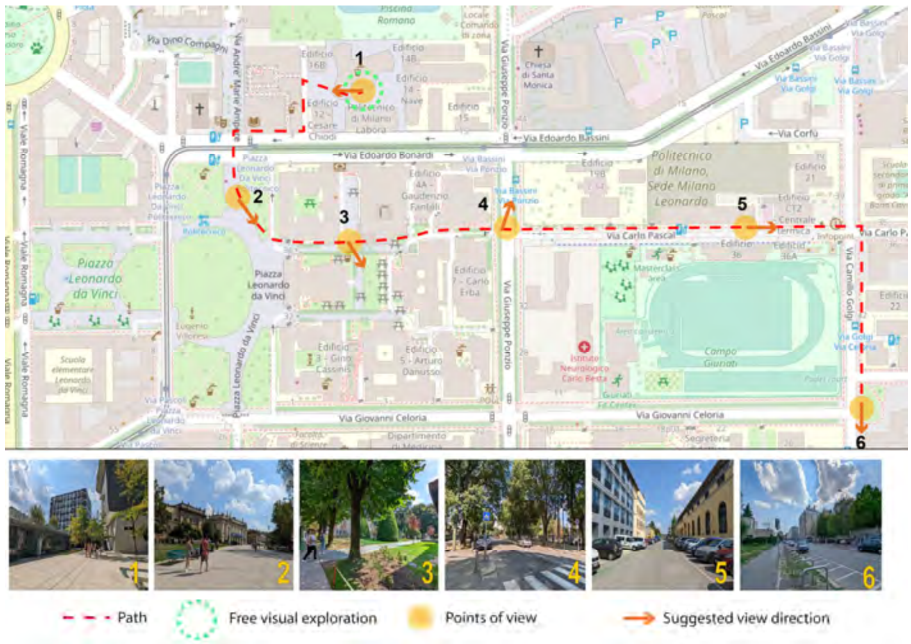

Figure 3. The experiential walk map (from Trifoglio to Golgi Street). It shows the path (red dashed line), the points of view (POV) (orange dots), and the target points to assess (orange arrows). The base map is taken from OpenStreetMap. The sequence of numbered images shows the targets that students looked at from the six points of view. In point 1 students were firstly asked to autonomously select and assess a free target (green dashed circle), then to assess the target selected by the researchers. Source: photos and map by the authors.

More in detail, the six stops show the following aspects:

1. The "Trifoglio area" is an open university space below the street level recently renovated (https://www2.polimi.it/il-politecnico/progetti-di-ateneo/nuovo-campus-architettura.html (last accessed on 11 March 2023)) (2021) based on the design concept of Renzo Piano and developed by the ODB-OTTAVIO DI BLASI & Partners architecture office. Today, it has a hard pavement and sits with some trees, and is encompassed by the university buildings; it is used by students to rest and meet during the day; the sight is directed east toward (from the right side) the buildings of the School of Architecture "Building 13—Trifoglio" by Gio Ponti in 1963, "Building 11—Architecture" by Vittoriano Viganò in 1985, the Department of Architecture and Urban Studies "Building 12—Cesare Chiodi" of 1962 (Figure 4).
2. Leonardo Da Vinci square was one of the relevant outcomes of the CSCS project (https://www.labsimurb.polimi.it/piazza-leonardo-da-vinci-renewal/ (last accessed on 11 March 2023)). It was renovated in 2016 based on the design project by Sara Protasoni and in collaboration with the Municipality of Milan passing from a parking area to a people-centered place (Figure 5); today it is mainly a pedestrian area characterized by a large path with benches and big green zones where students stay to rest and socialize; the view is oriented to spot the historic main building (1927) of the Rectorate ("Building 1—the Rectorate");

Figure 4. The panoramic photographs represent the "Trifoglio" area of Politecnico di Milano (campus Leonardo) as it was in winter 2011 (**bottom**) and in spring 2023 (**top**) after the renovation based on the Renzo Piano project.

Figure 5. The panoramic photographs represent piazza Leonardo da Vinci in the Città Studi district in Milan as it was in winter 2011 (**bottom**) and in spring 2023 (**top**) after the renovation within the "Città Studi Campus Sostenibile" inter-university (POLIMI—UNIMI) project.

3. The "Rectorate area" is the core area of the historical university block built in 1927; this area was recently renovated (2019) based on the design project "Giardini di Leonardo" [Leonardo's gardens] under the direction of Emilio Faroldi and within the framework of the VIVIPOLIMI project, aiming at improving the campus livability by increasing green and public areas and reducing parking slots. The area is characterized by a central garden and several fixed benches and tables; it is always full of students chatting or studying. Standing on the north-west corner of the garden, participants looked south-east in the direction of the green area; it is important to notice that on the day of the walk there was a functioning building site impacting the functionalities and atmosphere of the place, in particular the green area surrounded by a white and red stripe to block people access (Figure 6).
4. The stop is in Ponzio Street that is right outside the gates of the historical POLIMI block and connects two parts of the POLIMI campus. During working days the road is usually highly trafficked. Despite the structure of a boulevard, with a large section, two-directions carriages and large trees on both sides, pedestrians mainly use it to reach rapidly the POLIMI entrance, and it is otherwise used as a parking area, both on the street and under the trees. The stop was before crossing the street, on the sidewalk where the zebra crossing starts; the crossing is not regulated by a traffic light and the view is oriented North towards the approaching cars (Figure 7).

Figure 6. The panoramic photographs represent the "Rectorate area" of Politecnico di Milano (campus Leonardo) as it was in winter 2011 (**bottom**) and in spring 2023 (**top**) after the renovation within the VIVIPOLIMI project framework.

Figure 7. The panoramic photographs represent via Ponzio in the Città Studi district in Milan as it was in winter 2011 (**bottom**) and in spring 2023 (**top**) after the creation of the zebra crossing by the Municipality of Milan for connecting the two parts of Politecnico di Milano.

5. The stop is located in the middle of Pascal Street, a private POLIMI road that is mainly used as a parking area by the staff working at POLIMI. Some buildings are on both sides of the road, mainly POLIMI Departments, the Besta hospital, and the "Mario Giuriati" sport camp; the stop is in front of the entrance of the Giuriati building and the recently renovated (2018) "Building 20" hosting the Department of Electronics, Information and Bioengineering; the view is aligned to the street axis and looks East (Figure 8).

Figure 8. The panoramic photographs represent the Carlo Pascal Street of Politecnico di Milano (campus Leonardo) as it was in winter 2011 (**bottom**) and in spring 2023 (**top**) after the renovation of the Department of Electronics, Information and Bioengineering (building on the right side in both pictures).

6. Last stop is on Golgi Street, leading to the eastern and last blocks of both POLIMI and UNIMI universities. This is a two-way urban street highly trafficked in working hours. It has large sidewalks without trees and is mainly surrounded by universities and schools; on the West side a long blind wall runs along the sport camp. There are no dedicated spaces for socialization, no benches and no commercial activities in the portion of the street explored with the participants and there are no green areas except for a spot area with grass, not well maintained, on the left side of the stop (Figure 9).

Each of those urban segments is characterized by specific urban and architectural features and overall atmosphere; each of those was indeed defined by the authors organizing the experience in motion as a recognizable urban pattern. The viewpoints were selected by the authors as representative of those patterns considering the in-motion experience along the pre-determined route in that specific direction.

A black and white slide showing the labels of Rusell's circumplex model of emotions was prepared and projected during the activities in the class (Figure 10). This slide was used by students as a reference during the classroom activities described below.

Figure 9. The panoramic photographs represent via Golgi in the Città Studi district in Milan as it was in winter 2011 (**bottom**) and in spring 2023 (**top**). The area didn't undergo any transformation process.

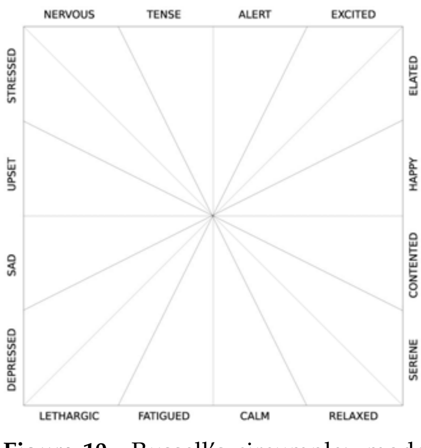

Figure 10. Russell's circumplex model of emotions labeled with emotions' name and their related sectors on the Russell cartesian representation, projected during the activities in the class. Source: the authors.

2.3. Participants

The workshop activity with students was held in the context of the POLIMI "Energy, Climate and Urban Planning" Master of Science course (Professors Eugenio Morello & Barbara E. A. Piga), involving 18 students who voluntarily took part in the activity.

2.4. Procedure

The procedure encompassed three days of collective activities organized in nine main phases, as follows:

- Day one (1) short introduction to the activity; (2) APP installation and registration (3) preliminary groups and teams' organization; (4) experiential walk and data collection via the APP through preselected stops; (5) class workshop (debriefing); (6) sharing and first discussion of the debriefing outcomes.
- Day two (7) theoretical lecture on environmental psychology for urban design; (8) presentation and discussion of the data analysis outcomes.
- Day three (9) students' presentation of the experiential walk interpretation.

On day one, the first three phases consist of some indoor preliminary activities. Phase 1 comprises fifteen minutes presentation of the main goals and overall procedure of the workshop; Phase 2 concerns the APP installation on students' smartphones and tablets, the creation of a personal account, and the completion of the questionnaire (socio-demographic information and the assessment of the neighborhood as a whole). Phase 3 regards students' organization into two main groups (9 people each) for the direct experience in the field, and smaller teams for the following class activity. Phase 4 consists of an outdoor "experiential walk" for each group. Two facilitators per group managed the activity. One guided the students along the defined route, stopped the group at each pre-determined point of view, and asked them to assess a specific target via the APP. Indeed, all viewpoints and target points were pre-defined, except for the first stop that also encompassed a free target point: the facilitator firstly asked to look around from a predefined standing point and freely select and assess a salient visual target, secondly, he asked to assess the pre-determined perspective from the same standing point. The other facilitator provided technical support, if needed, and looked over participants' safety while moving in the urban space. The first walking session started at 12:30 pm, while the second session started half an hour later. Weather conditions were measured on-site using a Pasco Wireless Weather Sensor with GPS model PS-3209 (temperature 28.8–32 °C; relative humidity 44.2–58.6%; wind speed 0–11.4 m/s). Phase 5 consists of a threefold activity held once back in the classroom. Firstly students individually elaborated on the in-field experience producing a shareable outcome for describing it (e.g., sketches, text, photo-collage); participants presented their individual experiences within their teams; then, each team internally discussed the overall experience of the path and the stops identifying a shared team vision; according to this, they labeled each path-stop with the emotions that better described the place experience referring to the black-and-white version of the circumplex model (projected on a screen); the goal for each team was to select up to three emotion per each stop defining, through a hierarchical order, their relevance in describing the experience. Phase 6 consists of a class activity where each team presented and explained the labeling identified per each stop. The researchers collected the feedback in a shared map projected on the screen, to enable a fast comparison of the outcomes. This process enabled a first understanding of the various perspectives that led to emotionally defining a place and supported the following assignment for the next lesson, which consisted in elaborating a representation of the shared team vision of the experience.

Day two of the workshop took place after a couple of weeks, during which the students collected some environmental data on the area and prepared a short representation to communicate their onsite experience. Phase 7 started with a theoretical lecture on the environmental psychology constructs applied in the previous phases and their relation to design thinking; this lecture aimed at supporting students' awareness about the process done and the potential consequences of this approach in urban design, i.e., human-centered and evidence-based "experiential urban design". Indeed, this theoretical lecture supports the following activities by acting as a reference framework. Phase 8 is devoted to presenting and discussing the psychological outcomes including the emotional assessment carried out during the experiential walks. The results emerging from the data collection via the APP were firstly presented by the researchers and later compared with those identified by the different teams and collect on the shared map (see Phase 6); the last part of the discussion with and among students was focused on their rational interpretation of personal place experience and the influence of the urban environment and its components (e.g., morphology, materials, landmarks, soundscape, livability, sense of community). On day three, coincident with Phase 9, students shared the representation of the team experience in a ten-minute presentation commented by the researchers and the other students. The freedom to choose the preferred techniques and modality of presentation led to very different results, from more conventional and technical to more artistic and creative. The overall workshop aimed to foster an experiential design approach to be integrated in the following part of the academic course and applied to the case study area. It is indeed intended as an integrated process of the urban design conception phase.

2.5. Analyses

The analyses conducted in this study involve a mixed-methods approach; indeed, it applies the exp-EIA© method within the City Sense app and more traditional workshop activities to assess and share students' emotional experiences in the area.

Descriptive analyses are performed with the data collected through the mobile app. According to the exp-EIA© method, the visual exploration behavioral analyses consider both the location of the person, i.e., the viewpoint, and the observed scene, i.e., the target view. Indeed, the GPS and gyroscope data are recorded along the route and enable to correctly locate participants' behaviors on a map, e.g., the direction of motion and the direction of sight. Those spatial data are paired with psychological data acquired through the onsite questionnaire via the APP. Spatial data are used to identify clusters of people sharing similar behavioral patterns, grouping together those in a similar position (point of view—POV) and looking in a similar direction: each resulting cluster is coupled with the site map and the average Field of View (FoV) related to the visual experience. To organize and analyze data, we coded a custom Python script to: (1) automatically recognize the different sessions; (2) cluster GPS locations of stops using the HDBSCAN algorithm with haversine metric [57–59]; (3) organize clusters according to the timeline; (4) generate subclusters based on normalized visual angles using KMEANS algorithm. In our analysis we produce three overlapped FoVs (i.e., considering the direction of the sight) of the same clustered view representing: (1) the 180° view field, thus including the peripheral view, (2) the 60° view field, corresponding to the central view [60], (3) the angle of the devices' mean field of view [57–59]. Once the clusters are created on the basis of the spatial behavior, we calculate the mean values of the clustered psychological data collected through the questionnaire to find the average emotion experienced by participants in a certain place while looking in a specific direction. The resulting clustered emotions enable the positioning of places on the circumplex model of emotions (colored version), while the clustered FoVs on the cartographic map inherits the color from their location on the emotional cartesian plane. The emotional intensity corresponds to the distance of the cluster point from the center of the plane: it is calculated as the ratio between the cluster point distance from the plane origin and the length of the straight line going from the plane origin to the plane perimeter, in the vectorial direction described by the straight line passing through the center and the cluster point. These analyses enable us to produce an interactive spatialized representation of the emotional experiences of places.

Inferential analyses are conducted to evaluate the between and within group differences (ANOVA), to verify if significant differences occur according to the two different paths or the peculiar characteristics of the two involved groups, and to compare the experience lived in the different stops (see Section 3.2).

A final set of frequency analyses is based on the students' feedback collected in phase 5. To emphasize the importance of the labels' selection order by the students, we applied the following weights: 20 for the first selection, 5 for the second, and 1 for the third. Each label could be selected up to five times at a hierarchical level. To obtain the raw score, we multiplied the number of times a label was chosen at each hierarchical level (primary, secondary, tertiary) by the corresponding weight. The maximum score for a label could be attained when five groups selected it as the primary emotional label. We computed the weighted selection recurrences of each label by dividing the raw score by the maximum score. We then established four weighted recurrency thresholds: frequently selected (over 30%), averagely selected (15% $\leq$ f < 30%), scarcely selected (5% $\leq$ f < 15%), and no selection or rarely selected (f < 5%).

3. Results

3.1. Descriptive Analysis

3.1.1. Sample

The participants were 18 students from Politecnico di Milano, 66.67% women, 33.33% man; age 23–37 (M = 26.61; SD = 3.29); from 9 different nations (China 33.33%, Colombia 16.67%, Brazil 11.11%, France 11.11%, Germany 5.56%, India 5.56%, Italy 5.56%, Turkey 5.56%, United Kingdom 5.56%).

3.1.2. Città Studi Neighborhood: Emotional Appraisal and Familiarity

Regarding the evaluation of the neighborhood as a whole, the outcomes show that the familiarity with the neighborhood is over the average (M = 3.25, SD = 0.80) 64.44%, and that the participants' emotional appraisal (Figure 11) is generally oriented in a positive and slightly activating way ("happy" segment, intensity 39%).

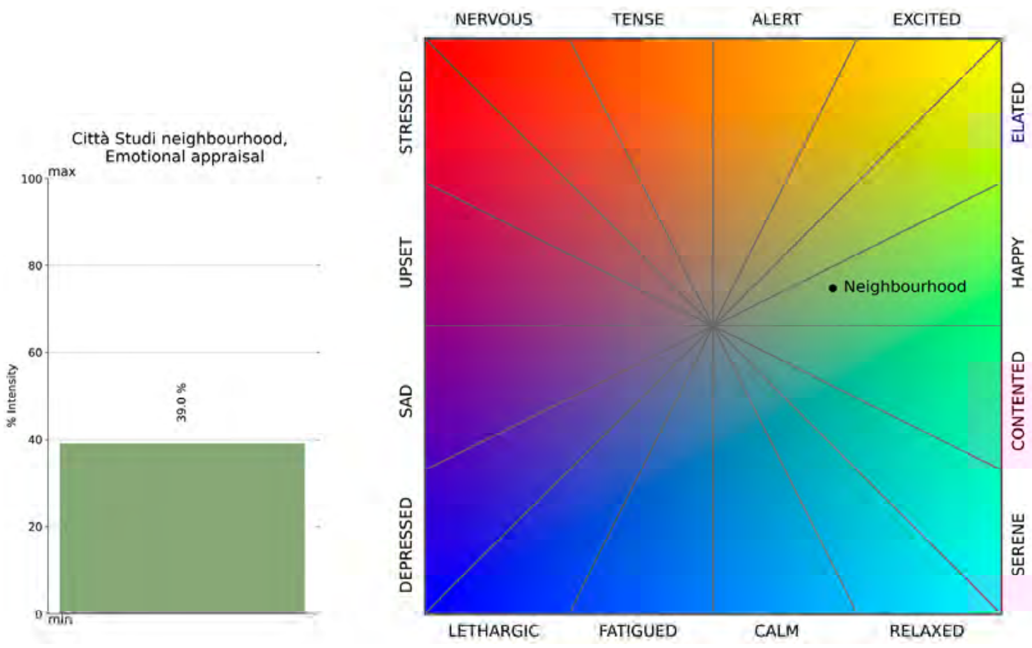

Figure 11. Città Studi emotional appraisal. (**Left**): the chart represents the emotion intensity felt for the neighborhood. (**Right**): emotion represented on the circumplex model. Source: the authors.

3.1.3. Clustered Emotional Appraisal: Analysis of the Data Collected via the Mobile App

Participants were divided into two groups which were analyzed separately since they walked through the same places and evaluated the same target points from the same viewpoints in two moments around midday. In general, both groups showed an emotional shift from "contented/elated" to "sad/depressed" during one's journey from the Trifoglio area to Golgi Street (Figures 12–15). In both cases the path is indeed clearly divided between Points of View (POVs) deemed as positively (POVs 1–4) and negatively (POVs 5–7) valenced. Furthermore, POVs 1–4 generally resulted as being activating, as opposed to POVs 5–7.

Figure 12. Screenshots related to the clustered views corresponding to each Point of View (POV). Each picture was automatically captured by the mobile app when the user started a questionnaire. Screenshots 1 and 2 show two different sides of the Trifoglio area: picture 1 emerges from free exploration while the direction of the view of picture 2 was suggested by the facilitators. The other screenshots show: (3) Leonardo Da Vinci Square; (4) Rectorate area; (5) Ponzio Street; (6) Carlo Pascal Street at the entrance of the Mario Giuriati sport camp; (7) Golgi street. Source: screen captures collected by the City Sense app.

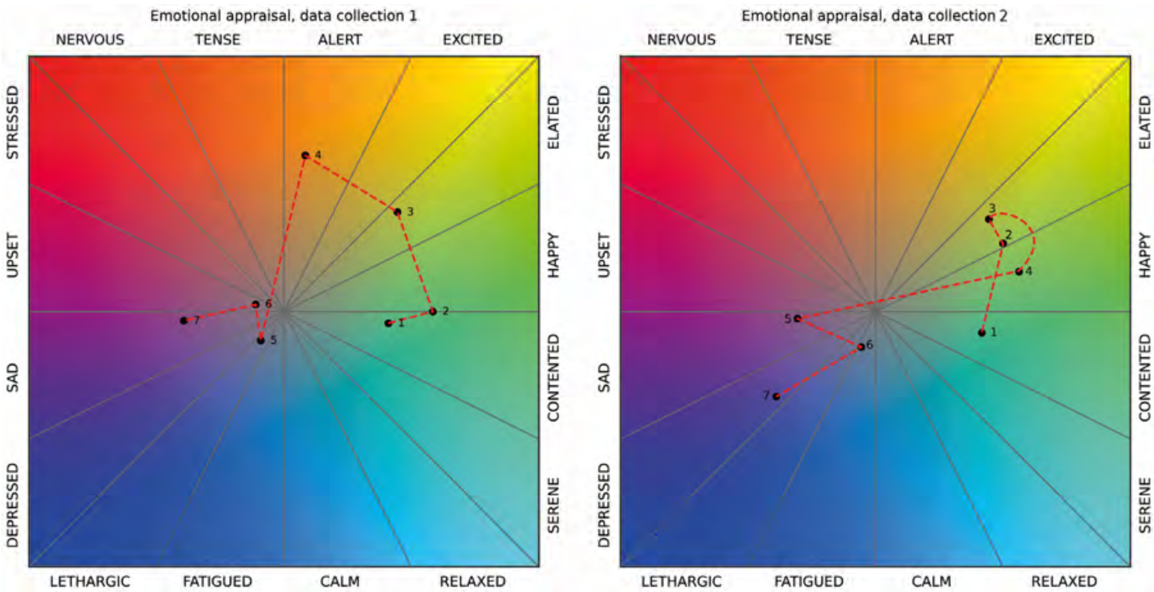

Figure 13. Emotional Appraisal on circumplex model for both data collections, each point is a cluster, red dashed polyline links the stops along the route. Source: the authors.

More in detail, the members of group 1 experienced contentedness evaluating both (opposite gaze directions) POVs related to the Trifoglio area (clusters 1 and 2, with respective intensities 40% and 57.5%), while in the second group the first clustered view was perceived as contented (intensity 41.5%), and the opposite one induced elatedness as prevalent emotion (intensity 51.1%). Cluster 3 (Leonardo da Vinci square) was identified in the "elated" segment in both data collection sessions (45.3%, 44,2%). The first group highlighted a condition of alert (intensity 62.5%) in the central area of the Campus (cluster 4). The same emotional state was not experienced by the second group, in which a happy condition (intensity 54.8%) prevailed. Cluster 5 was mainly identified as lethargic (intensity 11.8%) by the first group and sad (30.0%) by the second, cluster 6 as upsetting (12.2%) by the first group and fatigued (14%) by the second, and cluster 7 was perceived as sad (group one, intensity 40%) and depressed (group two, 37.7%).

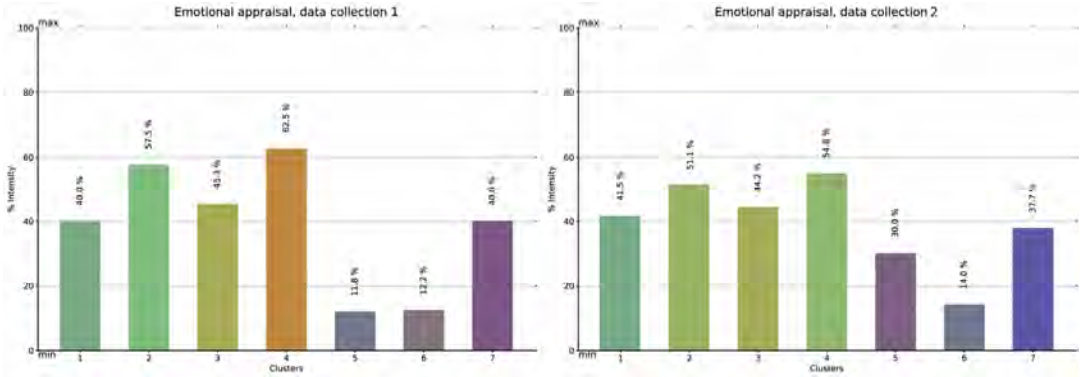

Figure 14. Emotional Appraisal intensity per each cluster in the two data collections, the bar color is inherited from the location of the point with the same number (corresponding to a cluster) on the circumplex model. Source: the authors.

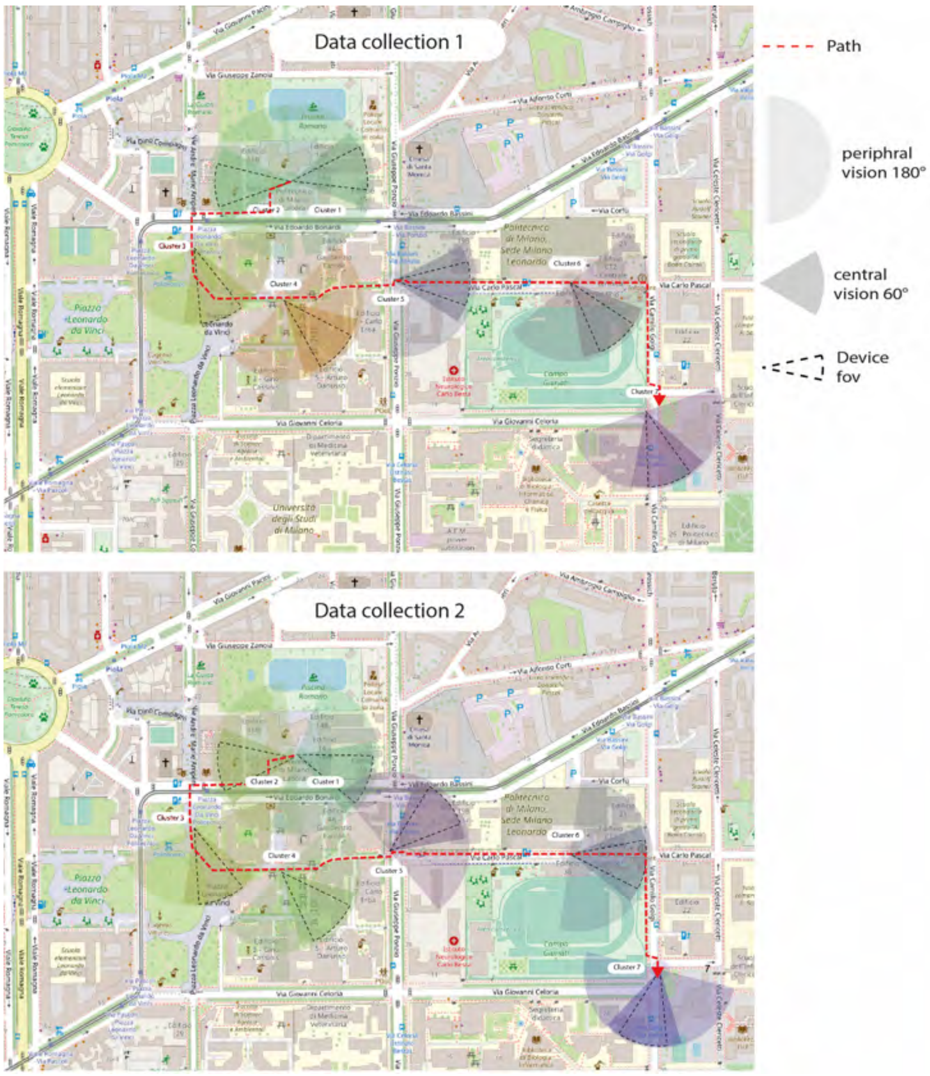

Figure 15. Visual Cones colored on the base of Russell's circumplex model. The wider cone, represented with higher transparency, is the 180° peripheral vision; lower transparency represents the 60° central view; the black dotted dashed perimeter is the mean device FoV; the red dashed polyline is the path followed by the students from Trifoglio area to Golgi Street. The Visual Cones color is inherited from the location of the point with the same number (corresponding to a cluster) on the circumplex model. Source: the authors.

Although the labels may differ for specific stops, the differences of the underlying values of pleasure and arousal are not statistically significant when analyzed with a *t*-test ($p > 0.05$).

3.1.4. Clustered Emotional Appraisal (Direct Participants' Feedback)

As mentioned above, at the end of the walk the students were asked to discuss in groups and collectively express which emotions were predominantly associated with the different places they evaluated through the app, prior to receiving feedback about the outcomes of the app assessment (Figure 16, created during the class activity; Figures 17 and 18, represented at a later time by the authors). As already suggested for data collected via the app, the overall trend showed a shift from the pleasant side toward the unpleasant one also in this case.

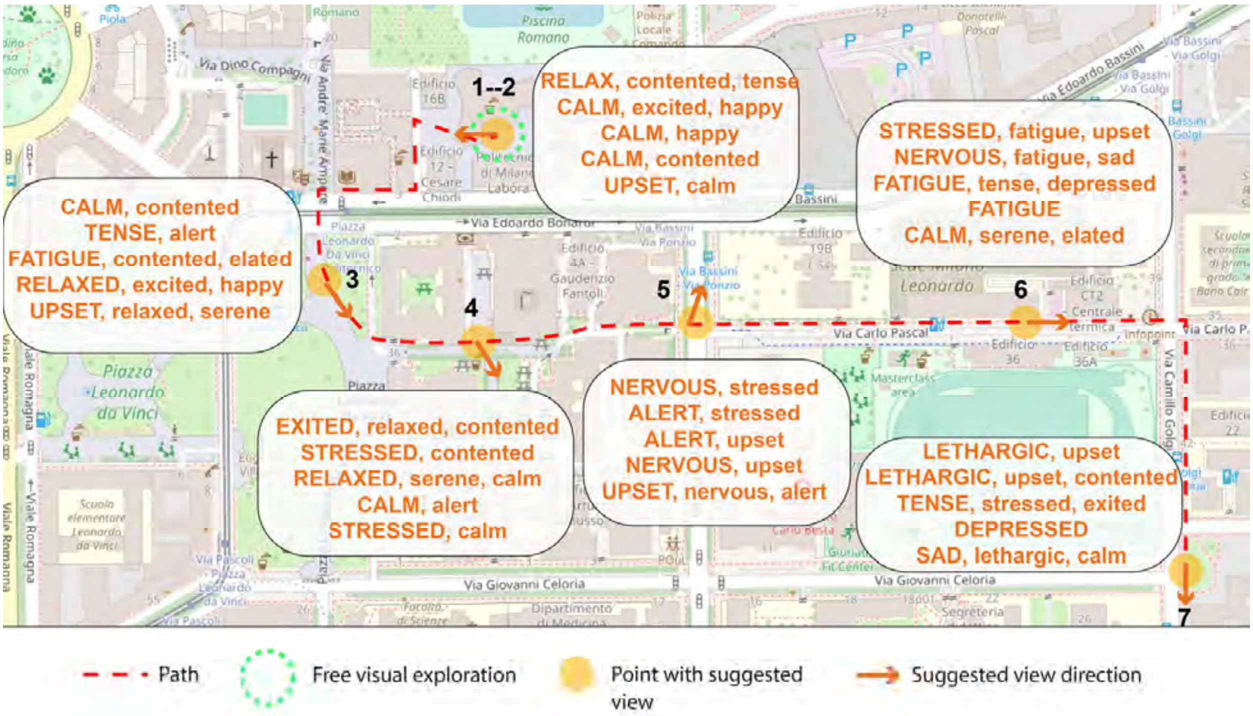

Figure 16. Emotional Labels selected by groups of students per each place along the path on the base map from OpenStreetMap. All labels are selected from the circumplex model shown during the workshop. Source: the authors.

Trifoglio building area (clusters 1 and 2) was labeled as mainly relaxing and calming, while "content" and "happy" are considered secondary emotions in its description. This area is primarily perceived as pleasantly deactivating, and the bottom-left quadrant in the circumplex model was left blank. Leonardo da Vinci Square (cluster 3) was described by students as a mix of different emotions such as calm, tension, fatigue, relax, and even being upset. Leonardo Campus's central area (cluster 4) resulted at the same time exciting-stressing and calming-relaxing depending on groups' interpretation. Anyhow, primary keywords are focused mainly on the activation side of the Russell model, mostly stressing. The bottom-left quadrant of the model remained blank also in this case. Giuseppe Ponzio street (cluster 5) was mainly described with words indicating a negatively valanced activation ("nervous", "alert", "upset"). Also, all labels are positioned on the "activating" side of the model, mainly on the "unpleasantness" segment. Addressing the Giuriati sport camp (cluster 6), it was described by students as "stressed", "nervous", "fatigued", or "calm". The mainly selected label is "fatigued", as the "pleasantness-activation" quadrant of the model is entirely blank. Lastly, Golgi Street (cluster 7) was labeled by students as "lethargic", "depressed", "sad", and "tense". This street is mainly located on the "unpleasantness-deactivation" quadrant of the Russell model; the "pleasantness" side is entirely blank.

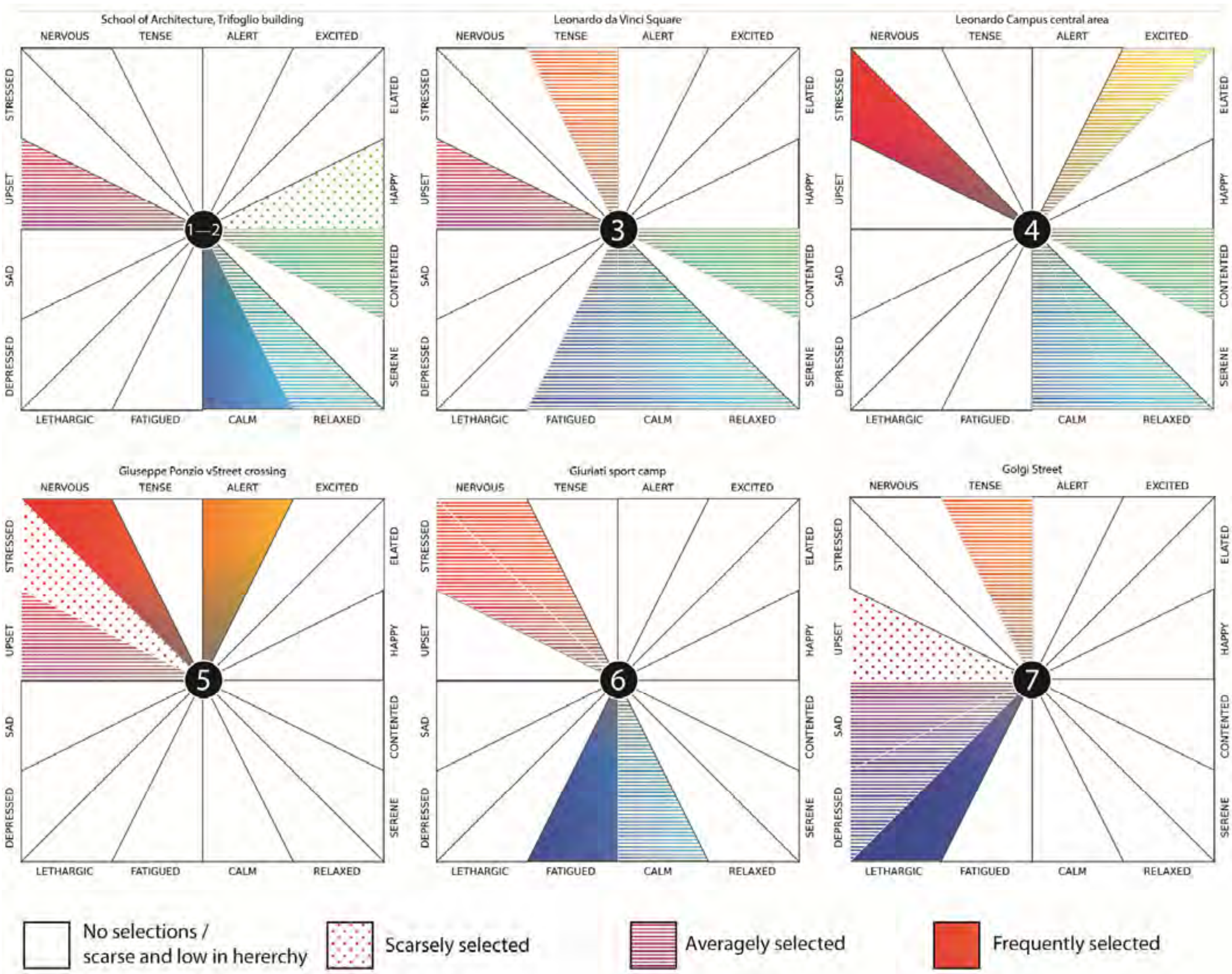

Figure 17. Representation of students' label selection frequency represented on the circumplex model; the full saturation color of a sector represents a frequently selected label; white lines texture represents an averagely selected label; stippled white background represents a scarcely selected label; a full white background represents no selection for a specific label. Weighted recurrency thresholds: frequently selected (over 30%), averagely selected (15% = f < 30%), scarcely selected (5% = f < 15%), and no selection or rarely selected (f < 5%). Source: the authors.

As a further step, students were also asked to give their own "symbolic" (visual) representation of the path they followed (Figure 19). They mainly described the environmental conditions during their walks as scarcely shadowed and hot; "crowdy" and "noisy" are the two preferred adjectives for the Trifoglio and Leonardo da Vinci square areas. Moreover, we can observe a biased representation of space depending on participants' experience, since the East-West axis (the longest one) was generally represented as compressed while the North-South axis (the shortest one) appears enlarged. Also, green areas and tree canopy are exalted in size, highlighting the importance of these elements for a path otherwise exposed to solar radiation. Several students' annotations stressed the lack of tree canopy.

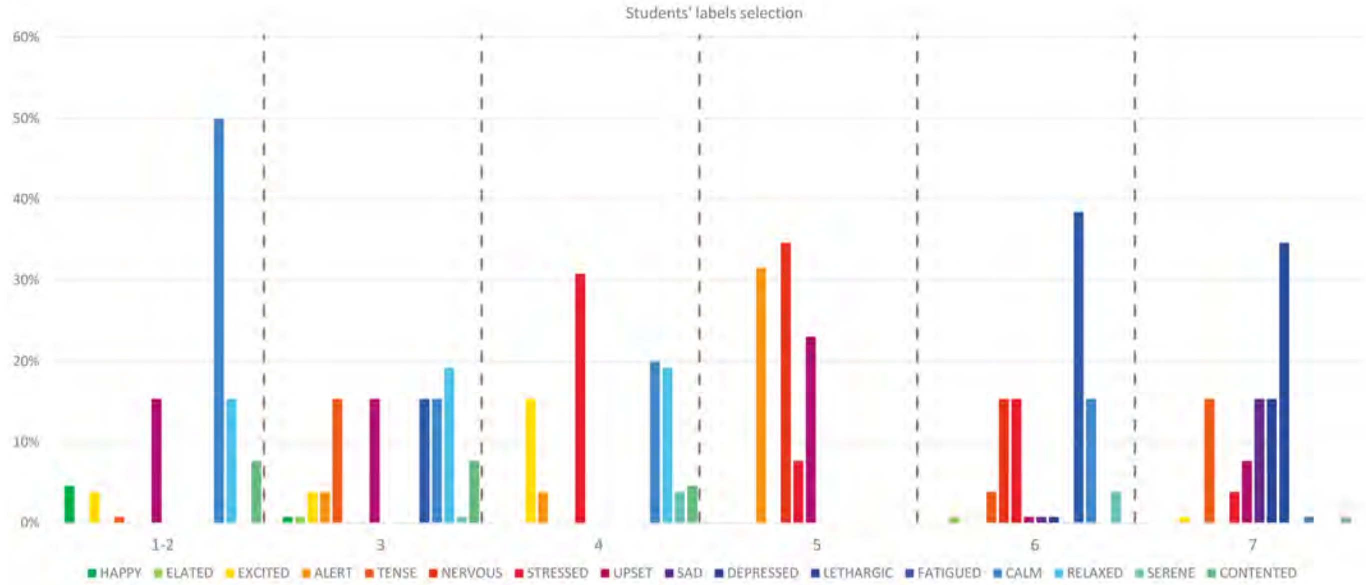

Figure 18. Representation of students' label selection on circumplex model; bar chart representing the frequency of selections of each label per point along the route.

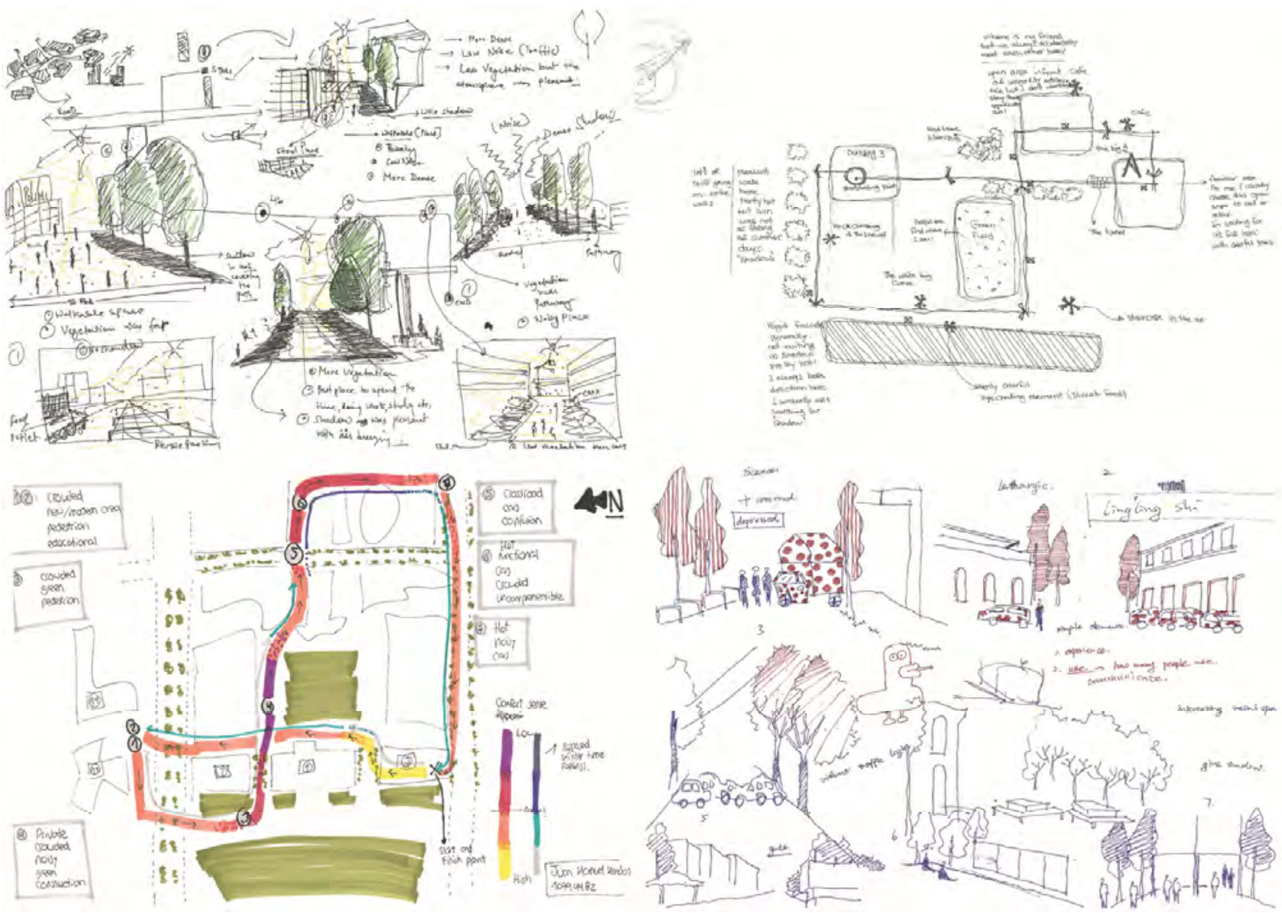

Figure 19. In each of the four pictures quadrant a personal representation of the route and related urban scenes drawn by a student during phase 5. Illustrations selected from four different groups.

3.2. Inferential Analysis

As a first step, an analysis of variance (*t*-test) was performed on data collected through the app to verify if the differences found in emotional appraisal between the two groups reached a statistical significance. Analysis showed that the results of both groups on each POV are not statistically different ($p > 0.05$) neither on the "Pleasure" nor on the "Arousal" axis. It implies that the members of the two groups similarly experienced any given POV and it is therefore possible to assume the two groups as a single group with equivalent statistical characteristics. As a second step, an analysis of variance within (repeated measures) was performed, aimed at verifying whether members of the reunited group experienced each given POV differently and whether these differences reached statistical significance. Unlike the previous one, which focused on a comparison between subjects, this analysis indeed focused on comparing the group experience comparing different POVs. To ensure methodological correctness and data reliability, data relating to POV 1 were conservatively excluded from this analysis, as it was the only POV on which subjects were not given formal indications on the target to choose before starting their assessment through the app. Regarding arousal, the assumption of sphericity is not violated, as assessed by Mauchly's Test of Sphericity, $p = 0.386$. In general, different POVs were found eliciting a statistically significant change in arousal intensity (F = 4.546, $p < 0.05$, η2 = 0.431). Coherently, post-hoc analysis with a Least Significant Difference (LSD) adjustment revealed that the level of arousal associated with the clustered view 2 (M = 0.929) is higher than the ones associated with the clustered views 6 (M = −0.286, $p = 0.024$) and 7 (M = −1.143, $p = 0.002$). Moreover, the same trend was highlighted for the clustered views 3 (M = 1.429) and 4 (M = 1.429) with respect to clustered view 7 ($p = 0.032$ and $p = 0.017$ respectively). Addressing pleasure intensity (Mauchly's Test of Sphericity $p = 0.152$), different POVs have been again found eliciting significant changes (F = 10.717, $p < 0.001$, η2 = 0.641). Post-hoc analysis (adjusted with LSD) showed that the level of pleasure associated with the clustered view 2 (M = 2.214) is significantly higher than the ones associated with the clustered views 5 (M = −0.857, $p = 0.003$) 6 (M = −0.429, $p = 0.021$) and 7 (M = −1.29, $p = 0.003$). The same trend emerged for the clustered view 4 (M = 2.71) with respect to clustered views 5 ($p < 0.001$), 6 ($p = 0.009$) and 7 ($p < 0.001$), and for clustered view 3 (M = 2.286) against the clustered views 5 ($p = 0.019$) and 7 ($p = 0.024$). Also, pleasure intensity associated with clustered view 6 (M = −0.429) is significantly higher than the one associated with clustered view 7 ($p = 0.045$).

4. Discussion and Conclusions

The objective of the overall research is to demonstrate the potential of combining urban studies, environmental psychology, and ICT via a mobile solution to enhance experiential urban design: we aim at integrating the affective assessment of a place from an evidenced-based perspective into a broader framework fostering a design process tailored to the concept of *ambiance*. This article focuses on the first stage of the design process, which involves analyzing the current condition of a place to inform the design conception and development. The procedure includes activities derived from the design tradition, such as an experiential walk followed by a representation task to share the experience lived by participants [15]. The emphasis on the emotional aspects is pursued with two different tools and activities. On the one hand, the circumplex model is provided to participants during the debriefing as a basis for discussing within the groups their experience, inviting them to use the labels to describe each stop along the path. In this case the main goal is to make them more aware of the affective state lived in specific areas, to make this aspect more relevant during the representation task consistently with an ambiance perspective [61–63]. The actual assessment is not the key aspect of this activity, whereas the tool has mainly a pedagogical goal. On the other hand, a proper evidence-based design assessment is carried out with the app including the scale for the values of pleasure and arousal on the circumplex model, which provides a sound assessment and is included in the pedagogical process at a later moment, when the representation task within the groups is completed but before sharing the final representation with the rest of the class. The emotional data are integrated with environmental information, including a spatial representation of the outcomes on a map and pairing the emotions with the pictures taken by the group when answering the questionnaire.

The outcomes of the experiential walk from Trifoglio to Golgi Street, which covers areas differently characterized from an architectural point of view (see Figure 12), reveal two main emotional experiences spanning from an activating and pleasant affect of the first part toward a less activating and unpleasant affect in the second one. That is to say that intense pleasantness such as happiness and elation in this campus is associated with recently renovated, well-maintained, and lived areas including freshly designed natural elements whereas a mild experience of unpleasantness corresponding to fatigue, boredom and sadness occurs in areas that are less architecturally and socially characterized. These results are consistent with previous studies on urban happiness [64–66] which identify the good maintenance conditions, the formal variety and the mix of natural elements and equipment among the main positive emotional factors in urban environments' evaluation. Furthermore, it can be argued that the most lived places are connected to a greater sense of belonging and place attachment eliciting more positive emotional states, as found elsewhere [67]. Significant differences are observed between the two areas both on the pleasure and arousal continuum, yet the direction of such a relationship is consistent with the literature for the former and counterintuitive for the latter, above all considering that the presence of greenery is associated with higher arousal. In this regard, one explanation focused on the psychological effect of environmental features may be related to higher levels of fascination (attraction of involuntary attention) experienced by our participants when interacting with the first area. High levels of fascination have indeed been found to lead to a state of "pleasurable arousal" [68]. In addition to this aspect one could consider also the social interaction with the environment, as the lively atmosphere observed in the renovated part of the campus, which was crowded during the lunch break when the walk took place, offers some elements to reflect on the role of architectural quality and sociability in defining the emotional reactions to places. As emerged from the description of the route (Section 2.2. The Experiential Walk: Materials & Measures), the areas and views that have been evaluated are differently characterized from an architectural point of view. The Trifoglio area is a planted square that significantly animates during class breaks and typically during lunchtime. It becomes a natural gathering place where students who attend the surrounding buildings converge. The fact that the square is underground creates a feeling of enclosure, almost like an outdoor room where one feels protected from the city and its rhythms. The area is typically frequented by young people between the ages of 18 and 26, who experience lunch breaks as a moment of exchange and pleasure of being together. This atmosphere, undoubtedly favored by the physical location, is obviously particularly linked to the type of frequentation and sociality of the area. Indeed, In Gehl's way of seeing the life between buildings [69], the Trifoglio area, like the Leonardo da Vinci square and the Rectorate area, is a familiar and informal place for students where ordinary activities, such as reaching classrooms, are mixed with optional activities, characterized by moments of relaxation and leisure among people who know each other, often close friends. Those actions are related to the space locations but also to the quality of the place and its intrinsically social nature. In such terms, the issue is whether the architectural quality of the area is sufficient to provoke a certain emotional reaction or whether the social life taking place there significantly modifies its features. According to previous studies, increased greenery is associated with improved emotional states [70–74]. Comparative studies have shown that students have a more positive affective reaction to university campuses integrating greenery into the design solutions [75]. Similarly, a comparison between residential buildings with and without greenery in urban contexts is associated with an increased preference and perceived beauty for the first condition, which also results in a more positive affective quality [33]. It is worth noting that such studies rely on stimuli where an environmental manipulation is conducted on the same visual simulation, adding or subtracting natural elements without other relevant features being modified. Consistently with such effects, one could expect that renovated areas with well-maintained greenery are more desirable for users, hence attracting more people in general and in particular to take a break seeking a restorative effect. As a result, such areas are more likely to be crowded, especially when the amount of green spaces is relatively small compared to the number of people present in that area. Hence, the affective effect observed in a laboratory setting holds true, even though in real contexts it implies a behavioral change. In an actual urban setting, the improvement of an area increases people's willingness to spend their time there, which in certain conditions can lead to a crowded environment. The literature on retail services and customers' experience offers several examples of the effect of the crowd on the affective reaction to environments, as increased density can reduce positive affect and increase negative affect in retail situations, even though other factors like cultural background can mediate such a relationship [76,77]. In light of such studies, we can argue that crowding played a major role in increasing the level of arousal in the current study, despite not diminishing the perceived pleasantness of the place. To our knowledge, no studies are available investigating the interaction of crowd and greenery on affective states, especially in settings other than retail. A more thorough investigation of such aspects would be useful to better understand the effects of natural elements in the urban context. Such reflections are consistent with a broader call to adopt a less "romantic" approach to natural settings, which implies considering natural elements integrated into an actual urban environment rather than focusing on utopic sceneries [78]. Indeed, taking into account site-specific affective experiences is crucial for implementing practical design solutions in the urban context [79].

From the educational perspective, the overall process acted as a learning tool for students that had the opportunity to include a scientifically based environmental psychology inquiry as part of the designer toolkit. As future urban designers, this occasion was useful to test firsthand how the environment affects people's emotions, thus stimulating thoughts about the civic role of professionals in the fields related to urban transformations. In this specific case, students were both a relevant sample, since they study in the Città Studi district and some of them live next to the Campus, and the designers of the proposal for urban regeneration projects of the area. Indeed, the second part of the academic course was devoted to the development of urban strategies and the delivery of a masterplan. As a matter of fact, this sample is not completely representative of the district, since important stakeholders such as residents of different ages were missing from the survey; on the other hand, the process was the goal from the educational perspective. Since the environment influences the quality of life of people, it is essential to study the dyad constituted by the individual and the environment beyond the mere sensory component. In this perspective, the exp-EIA© method and the app act as a facilitator of participatory paths where people are no longer simple users of spaces but are citizens with a personal and emotional relationship with places.

Equally, assessing current city conditions from the inhabitants' perspective and the reactions to the designed future scenario is also relevant from the professional perspective. Indeed, it can serve to inform the design brief starting from the spatialized analysis of people experiences in places or to pre-assess design solutions from the final users' perspective before the project implementation. Knowing citizens' reactions in advance is crucial to refining the project's developments and reducing potential conflicts between the actors involved in urban transformations and delivering a meaningful urban transformation.

Lastly, the overall learning process acted in an interdisciplinary perspective; in particular, the comparison of the process of rationalization by students after the experiential walk with the analysis based on the scientific psychological constructs of data collected onsite increased their awareness not only in the process of understanding the tangible and intangible features of the urban context, but also in demonstrating the potential role of an interdisciplinary investigation (and the importance of a scientific-based approach) in supporting urban design processes.

While promising, our results are not without limitations. First, as mentioned above, no targets other than students were included in the study. Future research should investigate other targets (i.e., residents, fragile social groups) to verify whether the outcomes may vary. Second, the study is not based on a large sample, so it is expected to expand into a larger student population over time. Third, all the variables present in the urban environment during the experiential walk cannot be controlled as well as in laboratory research. It cannot be excluded that some variables affecting the evaluation were not adequately considered in the analysis. This represents a general challenge for all studies conducted "in vivo", future research should be designed to include a wider range of environmental variables (e.g., temperature, noise) and integrate them into the emotional analysis.

5. Patents

Through an architectural\psychological integrated framework, the interaction with a real or simulated environment triggers an experience that can be reliably assessed using the exp-EIA©—Experiential Environmental Impact Assessment method (Copyright BOIP N. 123453—6 May 2020 and N. 130516—25 February 2021; Patent for Invention N. 102021000017168—30 June 2021, International Publication Number WO 2023/275679 A1—5 January 2023).

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Institutional Review Board Statement: The study was conducted according to the guidelines of the Declaration of Helsinki and approved by the Institutional Ethics Committee of POLITECNICO DI MILANO (protocol code 7/2019 on 18 March 2019, and 15/2020 on 15 July 2020).

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: Original data can be obtained by contacting the first author. Authorization for publication consent was obtained from all authors and involved partners.

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