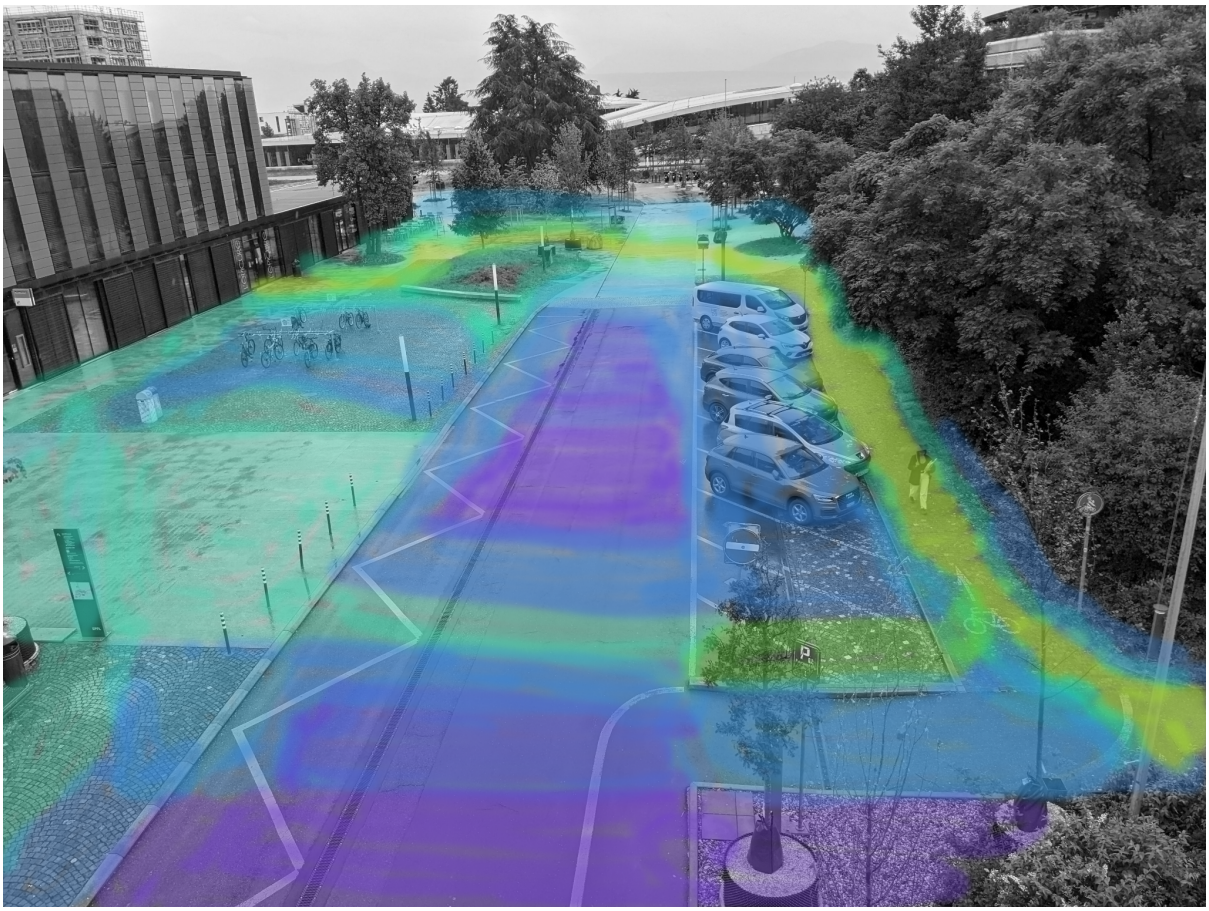
Social life of campus public spaces

Experimental study on the role of temporary interventions in fostering social activity



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Summary

With more than 17,000 users and inhabitants, the EPFL site constitutes a main urban piece of the West-Lausanne (Switzerland) agglomeration. The campus is currently going through a major renovation, including the pedestrianisation of roads to improve the quality and quantity of campus public space. “Avenue Piccard” is one of the cornerstones of the upcoming EPFL campus pedestrianisation, which will involve major changes to the infrastructure. Significant construction work is expected in order to reshape the Avenue into a high-quality public space. However, concerns about the climate impact of these interventions raise the question of whether it is possible to support social activity with minor, adaptable interventions such as temporary furniture. We therefore undertook an experimental study on Avenue Piccard in order to answer the question: *Do temporary interventions foster social activity?*

Our experimental study built on a tradition of quantitative urbanism, updating it to reflect recent developments in computer vision. We used cameras to track an area of Avenue Piccard in its current state, then intervened with temporary furniture such as outdoor tables, chairs, benches and reclining seats, and measured the outcome. The objective was to map the location and type of activities that take place at Avenue Piccard, and to determine if social activity (defined as talking, sitting and eating in groups instead of as individuals) changed due to the intervention with temporary furniture.

We found that Avenue Piccard is used in a multitude of ways, in addition to being a major thoroughfare. It facilitates group meetings, individual seated and standing people, lunch-spot and a quick-stop for tying shoelaces or fixing a bag. There is a cyclical rhythm to the activities, which can be observed in the peaks of each day and each week. The weather affects where activities take place, but does not affect the total number of people that visit or pass through the site. The interactions that users of Avenue Piccard have with the objects on location (i.e. the rocks, signs, cars, trees) change according to the group size and duration to stay. Furthermore, even before the intervention, large groups enact ownership of the paved and unpaved street: standing for long durations of time and moving only marginally for passing people, cars or bikes. After the intervention, there was an addition of large sitting groups as well: which was virtually impossible pre-intervention. The intervention furthermore brought a new type of activity to this area: working and studying. Our findings suggest that before the intervention, this area was not underutilised but it was underserviced. The addition of lightweight, movable furniture changed the size of groups, the duration of their stay and the type of activity that took place on site. This furniture did not substitute the existing activity at Avenue Piccard, it complemented it with an increase in options. We recommend the addition of furniture across campus in an effort to diversify the possibility of social activities to take place.

1. Introduction

1.1 Avenue Piccard, EPFL

With more than 17,000 users and inhabitants, the École Polytechnique Fédérale de Lausanne (EPFL) site constitutes an important piece of the West-Lausanne (Switzerland) agglomeration. Campus construction started in the 1970s, with new buildings added over time. Fifty years later, the EPFL campus is going through a major renovation, including the pedestrianisation of roads to create new public spaces. These changes to the built environment provide an opportunity for researchers to gain a better understanding of the relationship between the built and natural environment, and social life on campus.

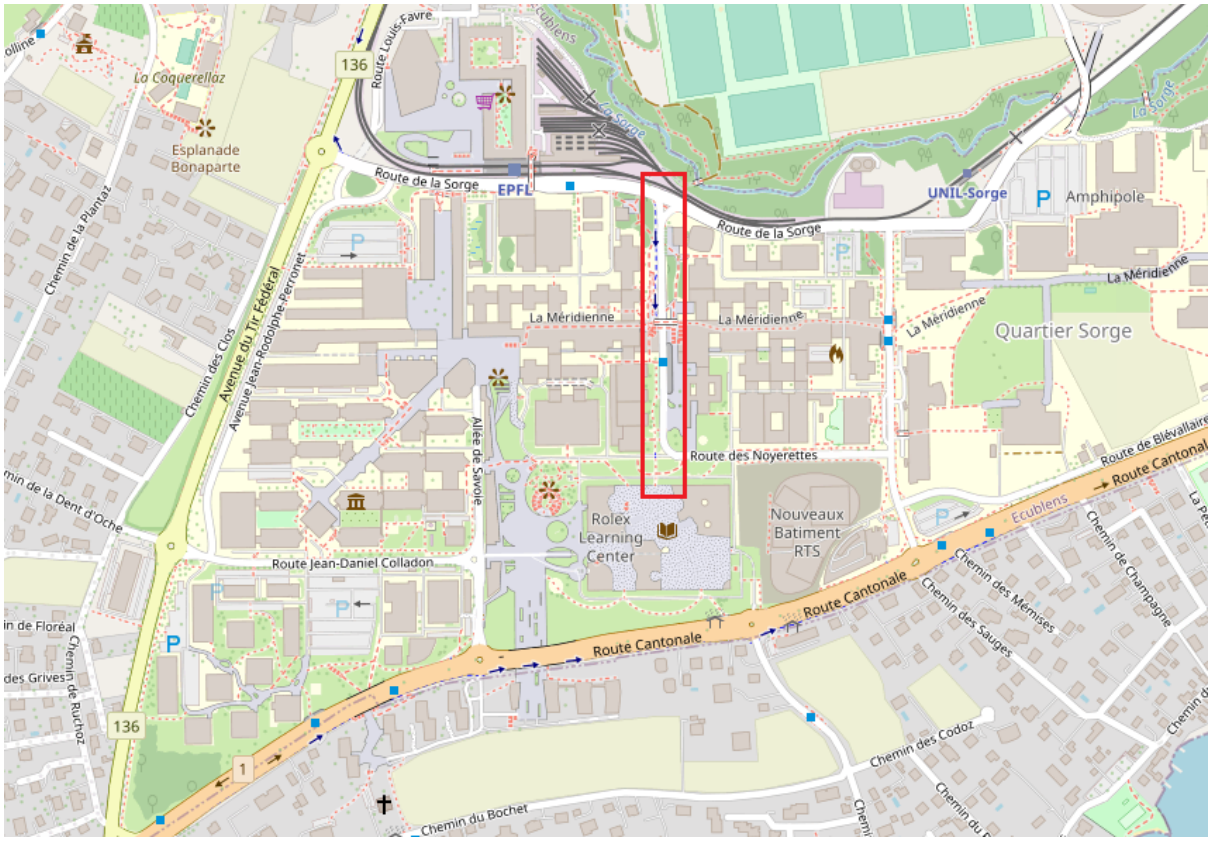

Figure 1: Campus map with Avenue Piccard highlighted

The “Avenue Piccard” (highlighted in Figure 1) currently serves as a major thoroughfare, predominantly used by vehicles. It stretches approximately 0.3km, from the university library (the Rolex Centre) to an intersection near the university metro station (EPFL metro stop). The avenue consists of a pedestrian path, and a paved one-way road used by cars, trucks, buses and bikes. It hosts multiple formal and informal parking places. Avenue Piccard is one of the cornerstones of the upcoming pedestrianisation, which will involve major changes to the infrastructure. Significant construction work is expected in order to reshape the Avenue into a high-quality public space. Concerns about the climate impact of these interventions raise the question of whether it is possible to support social activity with minor, adaptable interventions such as temporary furniture. We undertook an experimental study on Avenue Piccard in order to answer the question: *Do temporary interventions foster social activity?*

1.2 Social activity

On campus grounds, social activity is encouraged to enable knowledge exchange, support creativity, and ultimately enhance well-being by creating a sense of place and community. In our study, we focus on social activity on campus public spaces. Freely interpreted, social activity takes place every time two people are together in the same place: to see and hear each other, to meet, is a form of contact. More specifically, it can be defined as the activities that depend on the presence of others: eating together, playing, conversing, or even simply observing others together (Gehl, 1971). The physical environment may not have a direct influence on the content or intensity of social contacts, but it does affect the possibilities for meeting, seeing and hearing people (Gehl, 1971).

1.3 Temporary interventions

Architects and urbanists have long studied the relationship between public space and social activity, in search of better understanding the factors that make a designed space attractive, engaging and useful to its users. William Whyte's "The Social Life of Small Urban Spaces" used observation, film, counting and mapping techniques to document people's use of public spaces in cities across the United States (Whyte, 1980). They documented how people move and spend time around urban artefacts such as benches, steps, sculptures in order to determine what public space features make people comfortable, or make strangers engage with each other (Argota Sánchez-Vaquerizo & Cardoso Llach, 2019). They found that the best-used plazas are sociable places: those with people in groups, people meeting people or exchanging goodbyes. They found a high proportion of people in groups as an index of selectivity, because it indicates that people *chose* to go to it together (Whyte, 1980). Whyte's work proposed a seemingly obvious, yet often overlooked fact: that people spend time where there is space to sit. This includes ledges, steps, edges, chairs. The most important is that people have choice in dimensions, location, backrest and supports, and movability of furniture (Whyte, 1980).

Figure 2: Temporary interventions

We therefore intervene at Avenue Piccard by adding places to sit: temporary furniture such as outdoor tables, chairs, benches and reclining seats. In parallel, new plants were added to the area. The use of temporary furniture was based on the principles of tactical urbanism. Tactical

urbanism is an approach to neighbourhood building and activation that uses short-term, low-cost, scalable interventions (Lydon & Garcia, 2015). Tactical interventions in urban space are bottom-up, small local and sometimes incidental - they are different to the traditional planning process, and also qualitatively different to subversive or reactionary interventions such as graffiti or political demonstrations (Rossini, 2019). Tactical urbanism can be used to re-activate existing public spaces or help to create new ones by establishing new places for social activities (Rossini, 2019). We added standard EPFL outdoor furniture to our site (Figure 2), specifically: four tables and twelve chairs. They were chosen over custom designed solutions, because they are simple to procure, cost-effective, lightweight, weatherproof, and eventually reusable on other sites on campus - in line with principles of tactical urbanism.

2. Method

2.1 Experimental study in public space

Observational studies have made key contributions to urban studies, planning and policy. We expand on Gehl and Whyte's observational work by designing an experiment to examine the relationship between temporary furniture and social activity. An experiment is a systematic intervention in the world to measure an outcome, enabling researchers to move beyond correlations (Salganik, 2018). This study can be considered quasi-experimental, as it lacks random assignment. Studies in public space lack random assignment because it is unethical to randomly assign treatments to human participants, and difficult to pragmatically achieve when the treatment is a change in the environment.

Urban living labs provide a framework for experimentation that takes place in real-life contexts (Steen & van Bueren, 2017). Urban living labs are an approach to participatory local experiments where the goal is formal learning, facilitated by sharing decision power over a location, and cycling through feedback sessions and multiple iterations (Steen & van Bueren, 2017). The objective of this living lab was to 1) map the location and type of activities that take place at Avenue Piccard, and 2) to determine if social activity (defined as talking, sitting and eating in groups instead of as individuals) changed due to the intervention with temporary furniture.

2.2 Data collection

Our living lab took place on Avenue Piccard over three months (11 October 2022 - 13 December 2022). We observed the area for two weeks in its current state (11 - 25 October 2022), then intervened in a section of the Avenue with temporary furniture and observed the area for the following seven weeks (25 October - 13 December 2022). The observed area is divided into the treated area and control area (Figure 3). Observation took place with the use of an IP-camera, which sends images over a local area network directly to a secure cloud server. The camera was set up in a nearby office building, and set to record 30 images/minute from 8:00-18:00 over the course of three months. They were stored as JPEGS. Furthermore, sensors were set up to collect hourly data on local temperature, humidity, and wind speed. National API data was accessed for weather conditions, cloud cover and precipitation. This environmental data was to control for changes in social activity caused by weather rather than the temporary intervention.

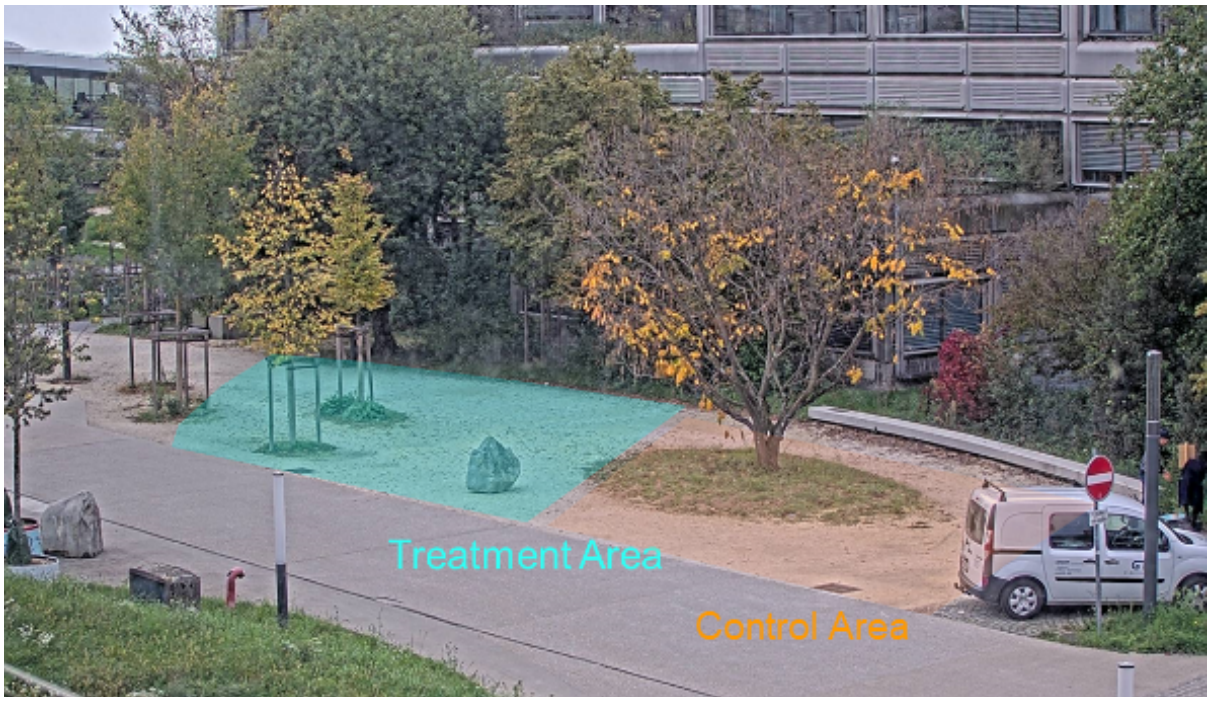

Figure 3: Treated and non-treated area of experimental study on Avenue Piccard, EPFL.

2.3 Image analysis

The raw image data was processed with "Openpifpaf" (Kreiss et al., 2019). The Openpifpaf algorithm detects and constructs a spatio-temporal pose whose nodes are semantic key points (e.g., a person's body joints) in multiple frames (Kreiss et al., 2021). In other words, the algorithm facilitates human body pose estimation and tracking (Figure 4). Once the key points are extracted, there are three characteristics of interest for understanding social activity on Avenue Piccard: what activities people are undertaking on the site, the amount of time they spend doing them, and whether they are done as individuals or groups.

Figure 4: Keypoint detection with Openpifpaf algorithm.

The activities are identified according to a pre-trained algorithm that categorises the Openpifpaf key points into different poses: sitting, walking, standing. The amount of time an individual spends in frame is calculated with the Tracking ID linked to the key points. Each person that enters the frame is identified with an ID that remains assigned to them through the frames. The number of people in the frame, duration of their stay, and their movement tracks are identified with this Tracking ID. Finally, the group size is calculated using "Monoloco" (Bertoni et al., 2022). Originally, this algorithm was developed to identify social distancing by calculating the distance between individuals in a frame. We invert its use, labelling multiple people who are within 1,5m to each other for a significant length of time as a social group. The number of groups in frame can therefore be computed.

The image analysis led to the final data structure of social activity per hour. Its features are: date and time, social activity (number of people, duration of stay, group size, number of groups, number of sitting) and environmental factors (temperature, wind speed, humidity, weather conditions, precipitation) (Table 1).

Table 1: Social activity per hour, data structure

frame	action	id	time	seconds	time2	date	groupN	groupID	treatArea	temp	windspeed	humidity
1	sitting	1	2022-10-07T08:00:00Z	1s	2022-10-07T08:00:01Z	2022-10-07	7	1, 2, 3, 4, 5, 6, 7	TRUE	13.4	0	90.1
1	sitting	2	2022-10-07T08:00:00Z	1s	2022-10-07T08:00:01Z	2022-10-07	7	1, 2, 3, 4, 5, 6, 7	TRUE	13.4	0	90.1
1	sitting	3	2022-10-07T08:00:00Z	1s	2022-10-07T08:00:01Z	2022-10-07	7	1, 2, 3, 4, 5, 6, 7	TRUE	13.4	0	90.1
1	sitting	4	2022-10-07T08:00:00Z	1s	2022-10-07T08:00:01Z	2022-10-07	7	1, 2, 3, 4, 5, 6, 7	TRUE	13.4	0	90.1
1	sitting	5	2022-10-07T08:00:00Z	1s	2022-10-07T08:00:01Z	2022-10-07	7	1, 2, 3, 4, 5, 6, 7	TRUE	13.4	0	90.1
1	biking	6	2022-10-07T08:00:00Z	1s	2022-10-07T08:00:01Z	2022-10-07	7	1, 2, 3, 4, 5, 6, 7	TRUE	13.4	0	90.1
1	bending	7	2022-10-07T08:00:00Z	1s	2022-10-07T08:00:01Z	2022-10-07	7	1, 2, 3, 4, 5, 6, 7	TRUE	13.4	0	90.1
2	bending	4	2022-10-07T08:00:00Z	2s	2022-10-07T08:00:02Z	2022-10-07	NA	NA	TRUE	13.4	0	90.1
3	sitting	8	2022-10-07T08:00:00Z	3s	2022-10-07T08:00:03Z	2022-10-07	NA	NA	TRUE	13.4	0	90.1
4	walking	9	2022-10-07T08:00:00Z	4s	2022-10-07T08:00:04Z	2022-10-07	NA	NA	TRUE	13.4	0	90.1
9	walking	10	2022-10-07T08:00:00Z	9s	2022-10-07T08:00:09Z	2022-10-07	NA	NA	FALSE	13.4	0	90.1

3. Results

Do temporary interventions in public space foster social activity?
The objective of this living lab was to map the location and type of activities that take place at Avenue Piccard, and to determine if social activity of this campus public space (defined as talking, sitting and eating in groups instead of as individuals) changed due to the intervention with temporary furniture.

3.1 Multifunctional Avenue Piccard

An initial mapping based on viewing the key point images shows that Avenue Piccard is used in a multitude of ways (Figure 5). Primarily, it is used by walkers crossing from one side to another. They use the unpaved pedestrian path along the edge, or the larger paved path. The unpaved path attracts individuals or small groups, and is used often in the daytime, whereas the paved path is used by larger groups, moving at a faster pace. People cross from one path to another very often. The concrete bench along the edge is used by individuals and duos (rarely by larger groups) throughout the day, sitting alongside each other to eat, chat, read or use the phone, and observe those passing by. Sometimes, it is used for a quick stop – to tie a shoelace, take off a jacket or rearrange a bag. The intervention furniture is used for multiple functions: eating, chatting, working or studying. It is used by individuals, duos and larger groups, for varying amounts of time, sometimes stretching into hours. The rocks and new trees are rarely interacted with.

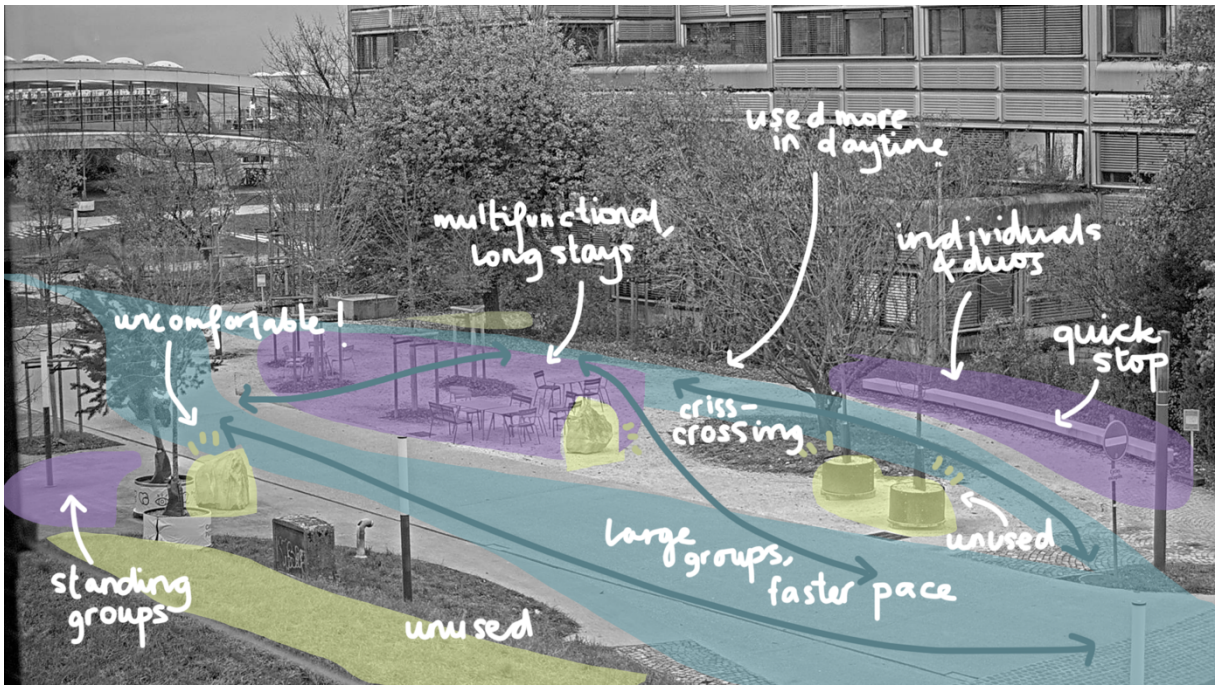

Figure 5: Zones within Avenue Piccard

3.2 Large groups enact ownership over street

A few times over the course of the observed months, a large group congregates and stays for an extended period of time in frame (Figure 6). A group of around six people meet in the centre of the road and stay for about 20 minutes. When a bus drives by, they step to the side, and then come back to the middle. As they are chatting, they enact ownership over the road, and treat the bus as a guest. For a passing car, they do not move from their place at all.

Another day, a large group of around twelve comes together and spends 45 minutes on the grass to take group photos. Afterwards a few people from the group stay standing and talking for a long while, with the last three separating about an hour later. The formal activity gives way to an informal social activity. The grass area on which they spend time is otherwise rarely traversed. Similarly, a large group of twenty-five people congregates for an activity for which they stand in a large circle, without much movement between people. They stay for about 30 minutes, and then people leave in small groups, leaving behind an informal group that lingers for another 20 minutes and then breaks apart. These large groups show a preference for the paved roads to congregate, and they show a preference for standing instead of sitting.

Figure 6: Large groups spend more time on the paved road

3.3 Cyclical rhythm across days and weeks

Considering a single day in detail, Figure 7 shows the count of people per hour, from 8:00 to 18:00, with the lighter colours indicating a higher density. It becomes clear that the movement of people shifts throughout the day: in the morning, people are evenly distributed across the frame. Around 10:00, users are concentrated along the centre and edge, which gives way to the outer edge at 11:00. From noon to 13:00, generally used as lunch time, there is an increase in the number of people, concentrated in the centre and on the concrete bench. In the evening, between 15:00-18:00, the number of people increases, and their concentration shifts towards the unpaved road.

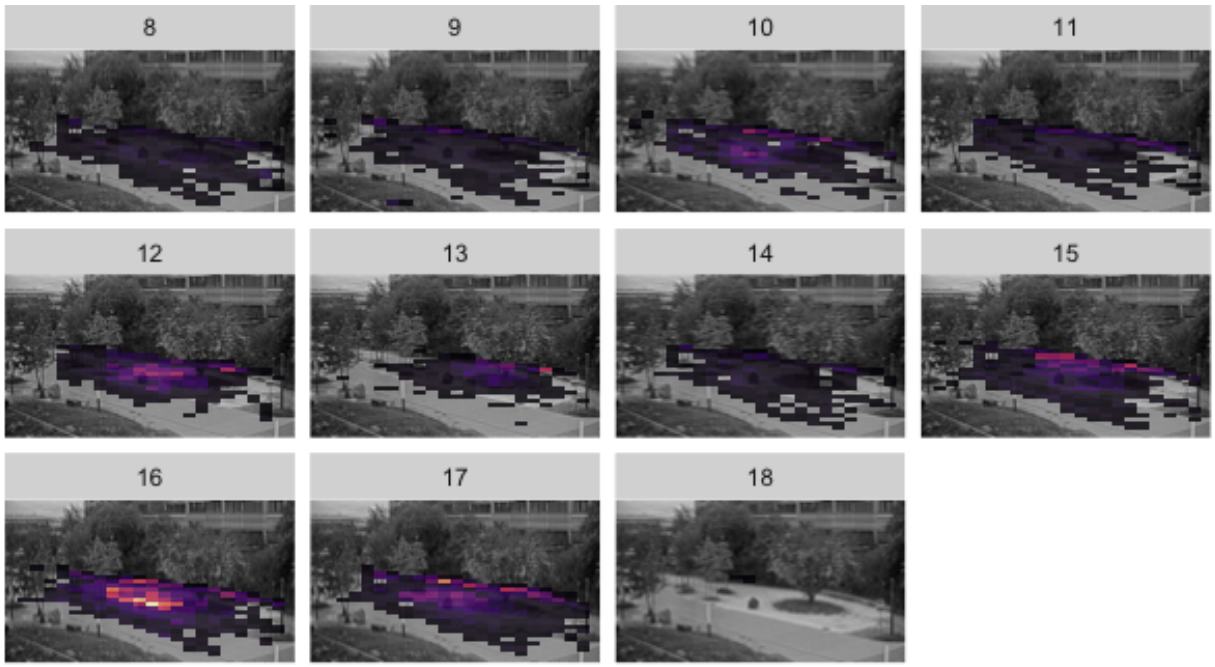

Figure 7: Heatmap of October 24th 2022, divided by hour of the day from 8:00 – 18:00

A reoccurring evening rush occurs in the middle of many weeks from the Rolex centre towards the north of Avenue Piccard, in which many large groups make their way across Avenue Piccard at the same time (Figure 8). The groups walk predominantly on the paved streets, perhaps following one another as they exit from the same place. They briefly make space for the bus, but do not adjust their paths for bicycles. They walk at a fast pace. A few individuals take the unpaved side path, or stop to chat along that side.

Figure 8: Mid-week evening rush

This mid-week rush is visible when the data is considered in more detail. Figure 9 illustrates the changes in group sizes per weekday and per hour, divided into the pre- and post-treatment. It shows that the middle of the week attracts the largest groups (defined here as individuals within 1,5m of each other). Furthermore, in the morning hours on each day, the area is largely traversed by individuals and small groups. Towards noon, the number of larger groups picks up, which is most prominently observed on Wednesdays and Thursdays. In the evenings, the rush of people on the paved roads is particularly visible on Wednesdays, around 17:00, when the high density of people on the road at the same time triggers the algorithm to group them as a single group of over 50 people.

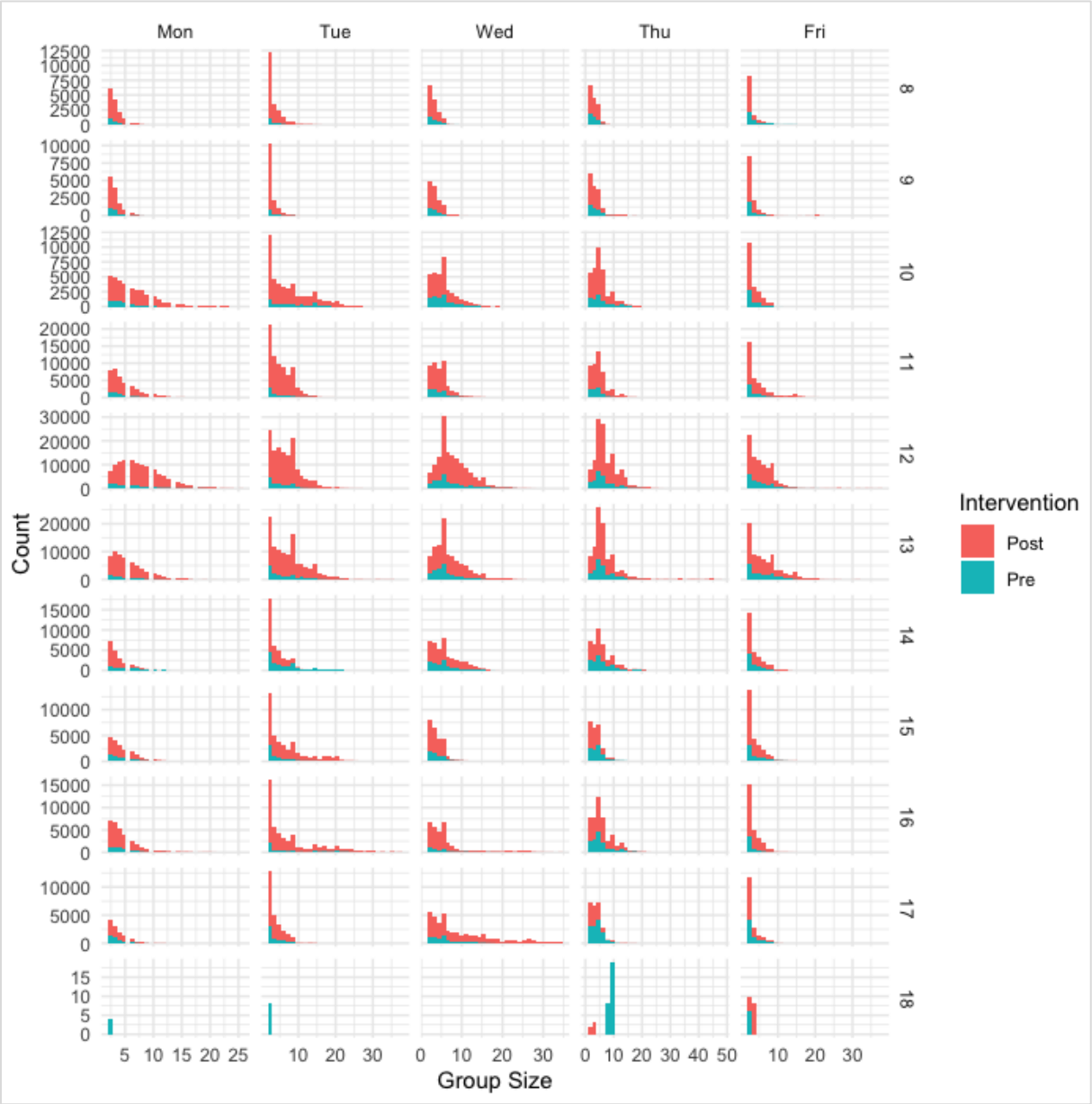

Figure 9. Group sizes by day of the week and hour, colour separated by pre/post intervention

3.4 Location of activity depends on weather

The weather has an effect on the use of Avenue Piccard. Dividing the days of the living lab into three categories: cold (below 5 °C), mild (5-15 °C) and warm (above 15 °C), shows that the expected inclination to spend time outdoors on warmer days. It also shows the differences in preferences of where people linger on warmer days. As Figure 10 shows, on cold days the hotspots are along the edge: where people can walk somewhat sheltered to their destination. On milder days, a new hotspot appears outwards to include the treated area, in addition to the edge along which people walk and sit. On warm days, this becomes more pronounced, with the hotspot in the intervention area increasing.

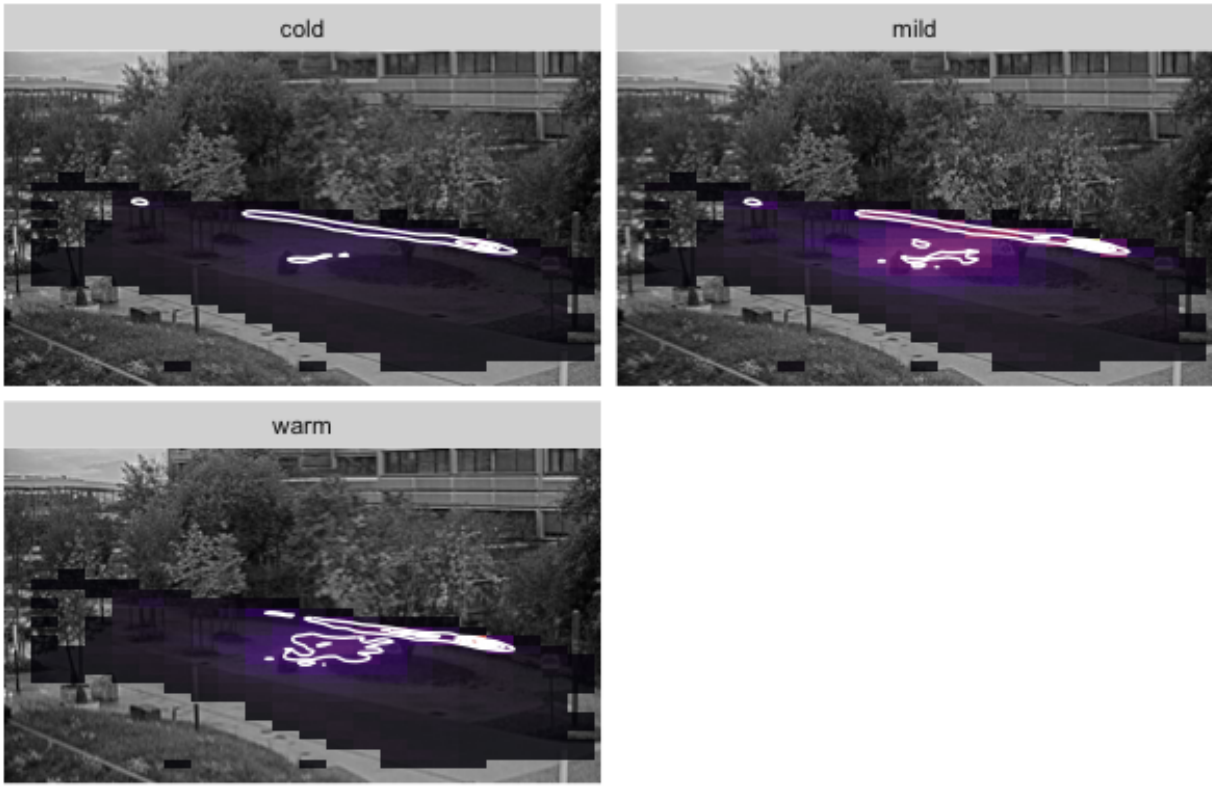

Figure 10: Heatmap of key points categorised by temperature conditions

Interestingly, even with decreasing temperatures in December, the median duration that a person spends in frame remains comparable to the warmer temperatures in October. Figure 11 shows the sharp increase in the median duration after the intervention takes place, which is higher in the treated area. This can be attributed to the new addition of people that spend a long time in seated on the temporary furniture and the mild autumn. After an initial peak, the median duration in the treated and control area stabilise similar to pre-treatment. It shows that although the weather impacts *where* people spend time at Avenue Piccard, it does not impact how long they spend time there.

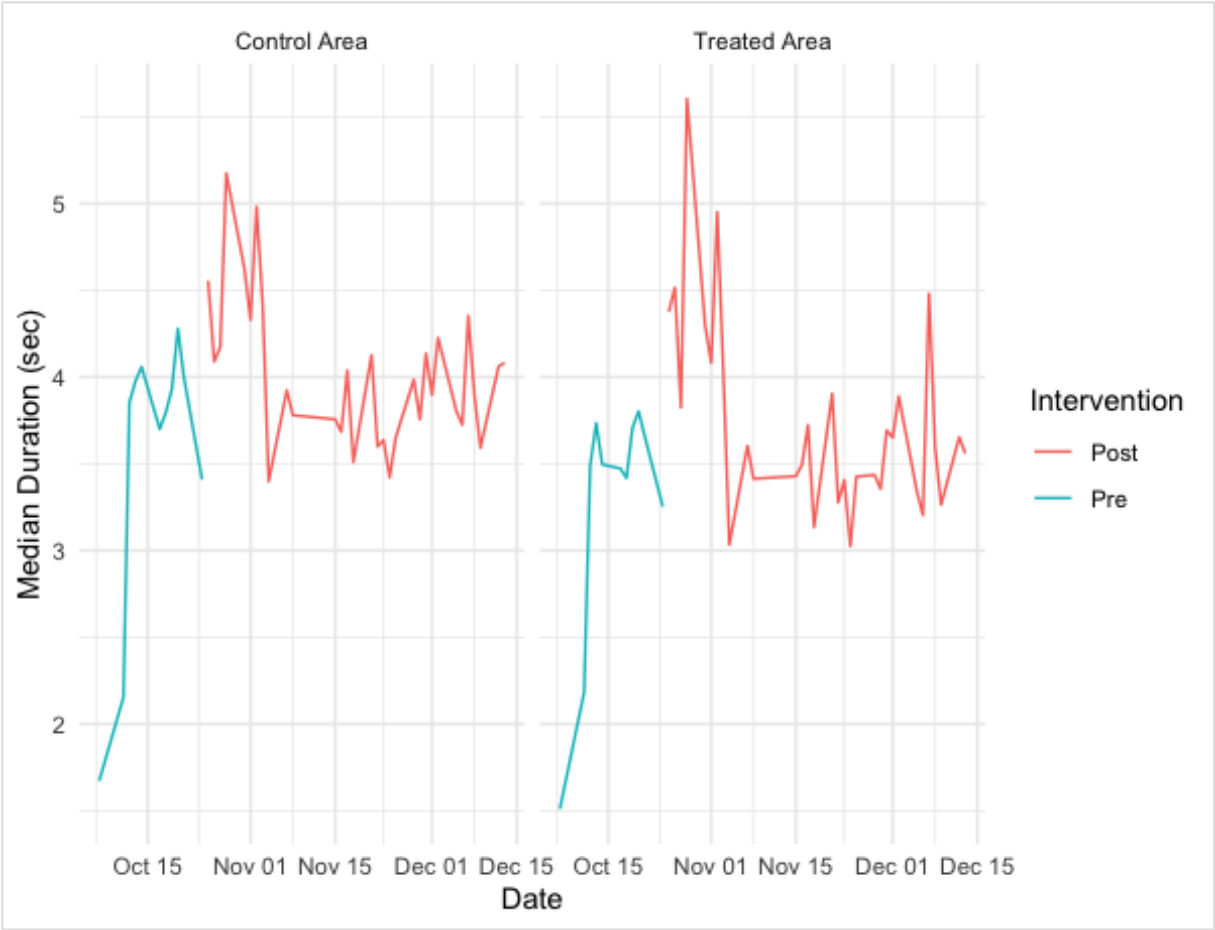

Figure 11: Median duration in seconds separated by treatment/control areas over days and colour separated by pre/post intervention.

3.5 Introduction of a new activity: working

Within the first days after the furniture is placed on Avenue Piccard, a group joins two tables together and moves them further out toward the paved street. Pulling the table out towards the street shifts the centre of sitting activity towards the middle of the street, which remains the case for the following two months. All through the day, individuals and small groups sit, work, talk or eat on the table. The social activity around the tables peaks at noon, with groups having lunch on the tables, sometimes staying for hours after with a few people coming and going. People walking on the path break away to join for a short talk next to the table before continuing. Before the intervention, there were not many people studying/working on this section of Avenue Piccard (i.e. using laptop, reading), however the intervention with the furniture adds this activity to the range occurring on the street (Figure 12).

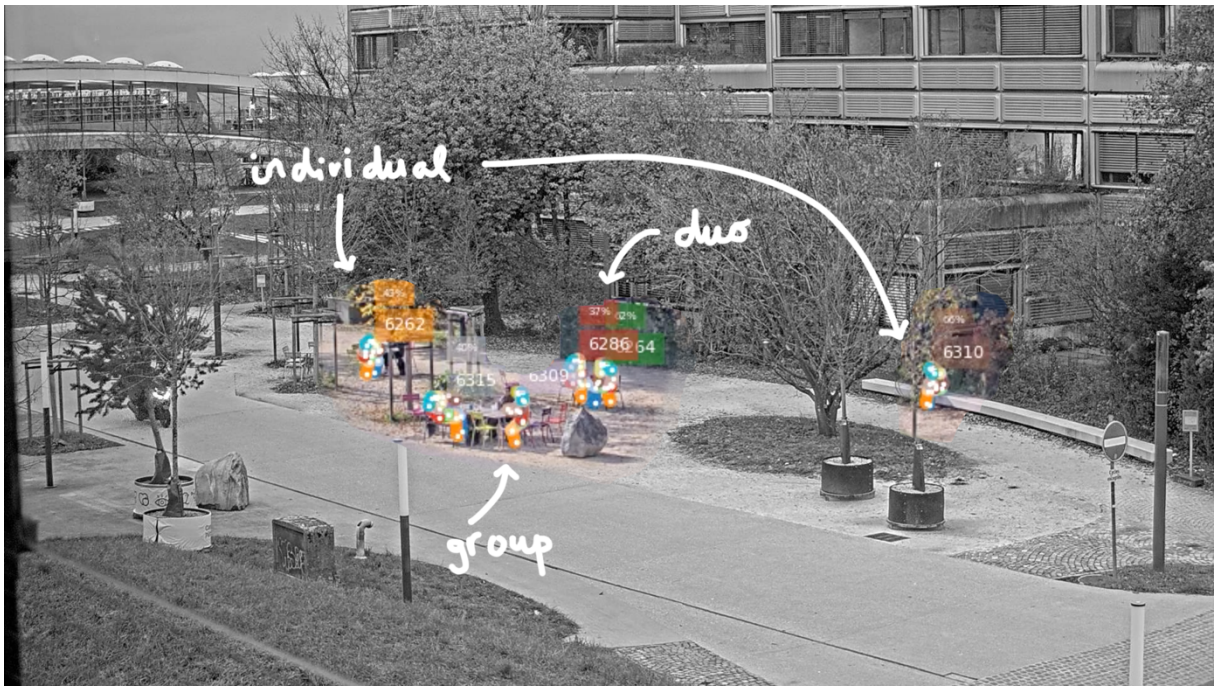

Figure 12: Diversity of groups that stay after lunch to study of work

The emergence of space for studying/working relates to the introduction of the temporary furniture. Figure 13 shows a sharp increase in the median group size in the week following the intervention with furniture, which can be seen in the large (5+ people) groups that congregate at the tables to work on their laptop, read, or discuss work.

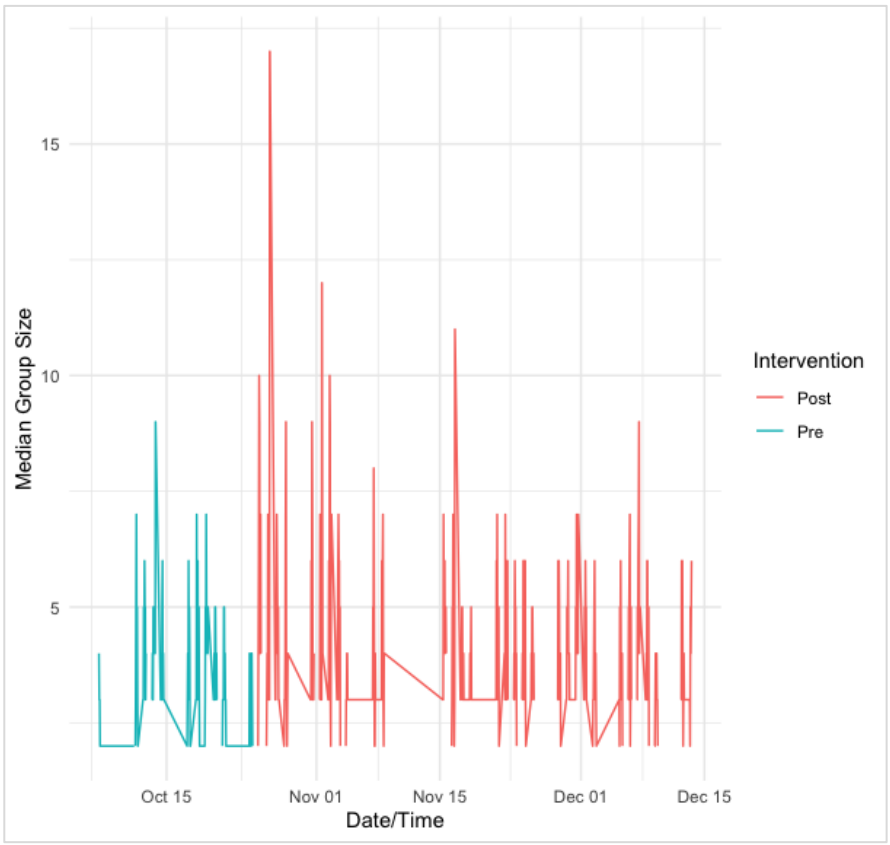

Figure 13: Median group size by hour and pre/post intervention

3.6 Human-object interactions change according to several factors

The flow of people through the space (before and after intervention) criss-crosses between the paved and unpaved paths: users on foot and on bicycles cross from one side to another along the rock and trees. The main objects that temporarily redefine these flows are when cars park in between the trees and rock (Figure 14).

Figure 14: Pre-intervention, 3-4 cars could be parked in this area

The two rocks on the Avenue Piccard are occasionally used to lean, to gather around, or to take a quick stop to rearrange a backpack or tie shoelaces. Occasionally a person attempts to make themselves comfortable by sitting on them (Figure 15). This is generally unsuccessful and does not lead to long-term stays in the area. People sometimes make a little stop next to the trees as they wait for someone, or check something on their phone. Occasionally, a person stops to read our sign informing users of Avenue Piccard that the street is being observed for this experiment. It is not possible to assess how many people are deterred from using the street due to observation: these people are not captured by our camera.

Figure 15: Interactions with the rocks and trees are generally short

The concrete bench along the side invites small groups (2-3 people) and individuals. Individuals sit and eat, observe, drink a beverage or spend time on their phone. Some use the bench for a brief pitstop, to search for something in their bag to tie their shoelace. Small groups sit facing the street, marking a difference to the face-to-face compositions that occur in standing groups or groups on the temporary tables and chairs (Figure 16). The activities around the concrete bench do not change with the addition of the temporary tables – it is used in similar ways as before. It shows that the social activity that occurs with intervention of the temporary furniture is additive, not substituting previous activity.

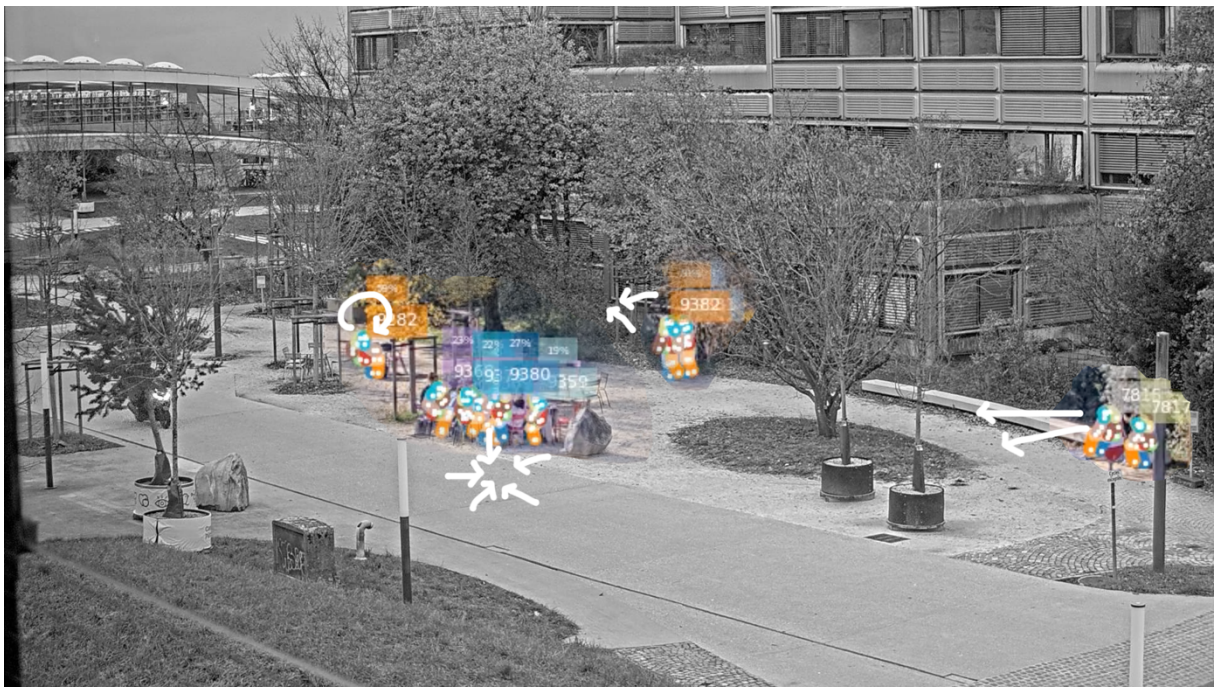

Figure 16: Sightlines and foci of attention depend on location and activity

4. Discussion and conclusions

Avenue Piccard is one of the cornerstones of the upcoming EPFL campus pedestrianisation, which will involve major changes to the infrastructure. We undertook an experimental study to understand if it is possible to improve the quality of campus public space with minor, adaptable interventions such as temporary furniture, and answer the question: *Do temporary interventions in public space foster social activity?*

Our experimental study built on a tradition of quantitative urbanism, updating it to reflect recent developments in computer vision. We used cameras to track an area of Avenue Piccard in its current state, then intervened with temporary furniture such as outdoor tables, chairs, benches and reclining seats, and measured the outcome. The objective was to map the location and type of activities that take place at Avenue Piccard, and to determine if social activity (defined as talking, sitting and eating in groups instead of as individuals) changed due to the intervention with temporary furniture.

We found that Avenue Piccard is used in a multitude of ways; a walk-way, place to meet a group, individual sitting area, lunch-spot, and quick-stop for tying shoelaces or fixing a bag. There is a cyclical rhythm of activities. In a single day, we see a peak in the use of the area at noon for lunch, and in the evening as people leave the campus. In a week, there is a more activity taking place in the middle of the week, and Mondays and Fridays are the quietest. The weather affects where activities take place: along the edge or in the centre, around the trees – however it does not affect the total amount of activity. The interactions that users of Avenue Piccard have with the objects on location (i.e. the rocks, signs, cars, trees) change according to the group size and duration to stay. Furthermore, even before the intervention, large groups enact ownership of the paved and unpaved street: standing for long durations of time and moving only marginally for passing people, cars or bikes. After the intervention, there was an addition of large sitting groups as well: which was virtually impossible pre-intervention. The intervention furthermore brought a new type of activity to this area: working and studying.

Our findings suggest that before the intervention, this area was not underutilised but it was underserviced. The addition of lightweight, movable furniture changed the size of groups, the duration of their stay and the type of activity that took place on site. This furniture did not substitute the existing activity at Avenue Piccard, it complemented it with an increase in options. We recommend the addition of furniture across Avenue Piccard, diversifying the location include covered and non-covered areas.

Nonetheless, there are some limitations to our study. The algorithm for capturing activities is less sensitive to sitting people, where many of the key points are obscured by a table. This had to be supplemented with observational studies of the key points. Furthermore, the recordings were done over three months, whereas they could have provided more interesting results on the rhythms of Avenue Piccard if an entire year was observed. Finally, it becomes clear that current algorithmic studies of urban space are not able to substitute observational, analogue and ethnographic studies of public space, they are merely complementary. They provide an ability to collet information for more hours and days then an individual would be able to do. However, they are limited in giving insights outside the frame of recording, and interpreting the collected data. This remains an important and necessary task of urban scholars.

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Co-creating public spaces: operationalizing urban living labs and digital twins

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Co-creation of public spaces

- Public spaces are fundamental to urban inhabitants' quality of life and can affect the larger societal wellbeing in return."It is difficult to design a space that will not attract people. What is remarkable is how often this has been accomplished." (William H. Whyte).

- Co-creation of public spaces promises to increase inclusivity into the planning process; it involves a multi-directional approach to problem solving.
- Urban living labs and digital twins are two promising avenues for studying the social, environmental and technological layers of public spaces.
- Currently, there is a lack of empirical research on how urban living labs and digital twins can be used for effective co-creation of public spaces.

Urban living labs

- Urban living labs are places for participatory local experiments promoting innovation and collaboration.
- The urban living lab should work towards developing solutions/ products through an iterative process of robust co-creation.
- Participants should include a wide range of stakeholders and have decision-making power.
- What differentiates an urban living lab is the real-life context in which the experimentation takes place. (Steen and van Bueren, 2017)

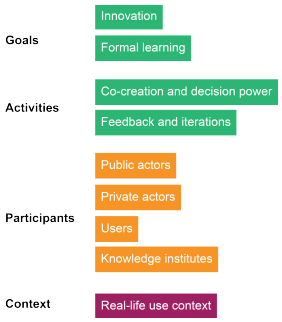


Fig. 1: Key characteristics of urban living labs, based on Steen and van Bueren.

Digital twins

- Creating a digital twin is not a goal in itself, it exists to improve the monitoring, designing, decision-making of a system.
- Urban digital twins are relatively unexplored.
- The main components of a digital twin are: the physical components, the virtual models, and the data that connects them.
- Data from "the physical" comes in a raw format. After processing, it is transformed into actionable knowledge. This, in turn, transforms the physical. (Boje et al., 2020)

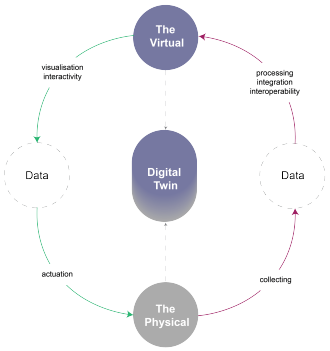


Fig. 2: The digital twin paradigm, expanded from Boje et al.

Campus living lab: challenges and opportunities

Formal learning

Communication: Otherwise inaccessible knowledge can be visualised to facilitate discussion between users, public and private actors, and knowledge institutes.

Multi-user: Interactive platforms can facilitate discussions through methods such as backcasting.

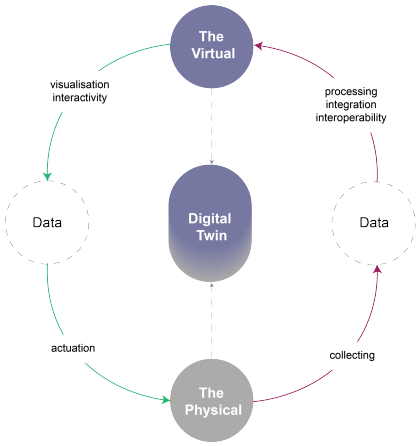
Decision power

Transparency: Every stage of decision-making can be explicit, and decision power is shared with users as well as other actors.

Innovation

False aspirations: Innovation should not happen for the sake of innovation or at the cost of people and environment: small-scale experiments allow beta testing.

Open data: Data and models should be open access so that anyone can access them.



Modelling

Context-specificity: Bringing the lab to the location allows for context specific feedback and interactions, but makes results irreproducible because it's not a controlled environment.

Sensors

Consent: Users must not only be informed, but give consent to the monitoring of spaces with sensors. In public space, there is a challenge to providing the right type and amount of information for users to retain agency.

Open data: Data and models should be open access so that anyone can access them.

Real-life use context

Context-specificity: Bringing the lab to the location allows for context specific feedback and interactions, but makes results irreproducible because it's not a controlled environment.

Feedback and iterations

Actuation: Neither living labs, nor digital twins, can decide what the best form of action is without an agreed upon normative criteria.

- The figure above showcases the integration of an urban living lab and digital twin for a campus living lab.
- We highlight the potential opportunities and challenges of co-creation that resulted from our analysis.

Case study

- Campuses serve as an important setting for social interactions where information exchanges take place. (K. E. Fisher)
- At the EPFL, a major renovation of the campus is taking place, with a focus on increasing pedestrianization and greenery.

Fig. 3: Site conditions for EPFL campus case study

Conclusions

- There is a gap in literature combining digital twin and urban living lab concepts.
- Within this conceptualization, there are opportunities and challenges of consent, communication, open data, transparency, actuation and false aspirations that need to be balanced for co-creation of quality public spaces.
- There are benefits for cities and their inhabitants to operationalize the concepts of urban living labs and digital twins to co-create more context-specific, participatory, and just public spaces.

Next steps

- We are deploying the findings from this analysis to co-create a campus living lab and digital twin.
- They will be used to empirically study the activation of public space with a quasi-experimental design.

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Figure 17: Urban Transitions conference poster

Social life of campus public spaces: Experimental study on the role of temporary interventions in fostering social activity

Ankita Singhvi, Kaz Sakamoto - Laboratory on Human-Environment Relations in Urban Systems (HERUS)

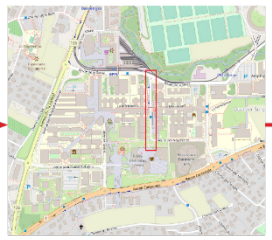
Campus living labs

- Public spaces are fundamental to urban inhabitants' quality of life and can affect the larger societal wellbeing in return."It is difficult to design a space that will not attract people. What is remarkable is how often this has been accomplished." (William H. Whyte).
- Living labs are an approach for participatory experiments, in order to promote innovation and collaboration. They aim to develop solutions/products through an iterative process of co-creation with participants.
- What differentiates an urban or campus living lab is the real-life context in which the experimentation takes place. (Steen and van Bueren, 2017)

Avenue Piccard, EPFL campus

- Campuses serve as an important setting for social interactions where information exchanges take place. (K. E. Fisher)
- At the EPFL, a major renovation of the campus ("Campus Pieton") is taking place with the objective to pedestrianise and improve the green infrastructure.
- Significant construction work is expected in order to reshape the Avenue Piccard into a high quality public space. However, there are concerns about the climate impacts of large-scale infrastructure change.
- We therefore ask: *Is possible to support social activity with minor, adaptable interventions such as temporary furniture?*

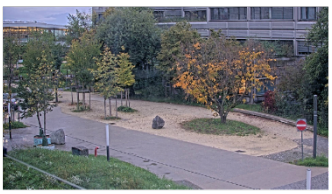
Tactical urbanism as an approach to urban activation that uses short-term, low-cost, scalable interventions such as temporary furniture (Lydon & Garcia, 2015)



Avenue Piccard served primarily as a thoroughfare for buses, bikes, cars and walkers

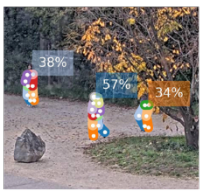
Social activities depend on the presence of others: eating together, playing, conversing, or even simply observing others together (Gehl, 1987; William Whyte, 1980)

Method: Experimental study



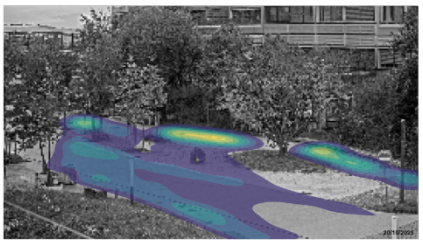
Data collection: 11 October - 25 October 2022: Pre-intervention

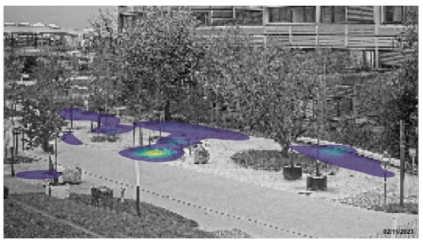
Data collection: 25 Oct - 13 December 2022: Post-intervention



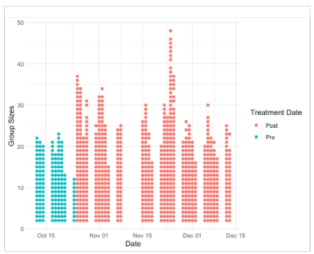
Data processing: Using algorithms from EPFL's VITA Lab - Openpifpaf, Action pose, Monoloco

Results: Do temporary interventions in public space foster social activity?

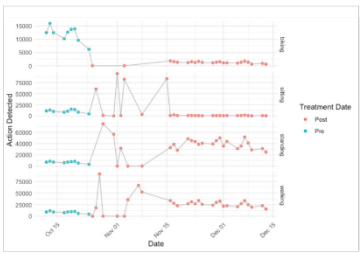




Campus users' movements have become less concentrated along the edges, shifting into the treated area



The instances of larger group sizes (multiple people within 1,5m of each other) increased post-intervention



The instances of people walking and standing increased post-intervention, whilst bicyclists passing the Avenue Piccard decreased

Implications and next steps

- Analysis of the images shows a quantitative change in the footfall, number of groups and type of activities at Avenue Piccard. However, further qualitative analysis is required to characterise these changes in the social activity, and to check the sensitivity of the algorithms to each action.
- Multiple changes (removal of parking, new seating areas, renovation of the street) occured at the same time as the experiment. How can the effect of these factors be incorporated into the results?
- In the heatwave of August 2023, campus users' showed agency over the temporary interventions: moving the furniture under trees. The experiment should run through the year to see changes in social activity through the seasons.

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Figure 18: ENAC Day, EPFL poster