

People as planners: Stakeholder participation in the street experimentation process using a virtual urban living lab

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ABSTRACT

The creation and design of intervention for street experimentation is in itself a key challenge in sustainable urban mobility to effectively encourage a modal shift from high car dependence to more active, non-polluting modes of transport. Understanding the needs of the community, including the diverse stakeholders at play, is crucial in implementing successful street experiments that can ultimately manifest into more permanent and systemic change. This study aims to address a current gap between stakeholders and the community in the street experimentation process within the context of the principal urban area of Malta, a car-dependent Euro-Mediterranean island. By collecting initial input from the community and several key stakeholders, a virtual platform to engage the local community is created; a virtual urban living lab (VULL). The VULL is tested in a workshop setting as a method for the collection and visualisation of data in the process of street experimentation. The VULL offers an interactive space for participants to identify barriers that discourage walking and explore and evaluate ideas of street experimentation for the local urban environment. A discussion of preliminary findings from the community's direct input and feedback sheds light on the benefits and challenges of using virtual platforms for stakeholder and community participation in the street experimentation process. The paper concludes by proposing VULLs as a valuable tool for city leaders, urban planners and designers to effectively engage with stakeholders and test new solutions to the complex and pressing issues of urban mobility and public space.

Introduction

Urban transport planners hold a pivotal role in designing transport infrastructure and shaping the urban environment, which in turn shapes us and how we move around. This role is further complicated by ever-growing city populations which continue to evolve and bring new challenges to urban mobility. In recent years, there has been a growing interest by practitioners in this field to explore collaborative and experimental ways to innovate and promote active urban mobility (Keseru et al., 2016; Morar & Bertolini, 2013; Puerari et al., 2018). Conducting local, multi-actor experiments has revealed a number of challenges in terms of participation, organisation and resources (Cooney, 2021). This was underscored by the onset of the COVID-19 pandemic, which provided a unique opportunity to test out street experiments, but impacted the possibility of collaborative participation of stakeholders because of the risks associated with in-person meetings and activities. As a result, this study seeks to test out an online participatory platform that brings together key stakeholders and their street experiment ideas to collect crucial feedback from the community.

The implementation of pedestrian-focused interventions requires an initial understanding of the barriers the community currently faces, to create people-orientated spaces that meet their needs and ultimately increase the general acceptability of the proposed designs (Gonzalez-urango et al., 2020). The literature within the field of street experimentation has grown significantly, including both temporary and permanent interventions in the urban sphere, with varying degrees of complexity, ranging from simply re-marking the street and re-purposing parking spaces, to re-configuring street sections and entire streets (Bertolini, 2020). Although research in this field has provided ample examples of city streets experiments and their impacts, the involvement of decision-makers and the community in the planning process of pedestrian transport infrastructure remain lacking in both theory and practice (Gonzalez-urango et al., 2020).

In this field, the term Living Labs is often used to describe a multi-stakeholder platform that brings together different interested parties to decide on the best strategy for action to solve an issue (Molinari, 2011). Although public participation is acknowledged as an important consideration in implementing interventions, Living Labs move a step

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further in making citizens active and direct contributors, often entitling them co-creators in the innovation process (Puerari et al., 2018). Under the umbrella term of Living Labs, Urban Living Labs (ULLs) predominates the literature on public participation in urban interventions, referring also to the multi-stakeholder approach but focusing specifically on educating and solving urban challenges through engaging experimentation (Bulkeley et al., 2016; Oldbury et al., 2022). ULLs merge participatory and user-centred design (Dell'Era & Landoni, 2014) and have emerged as a valuable approach to effectively implementing sustainable urban solutions at a local scale (Nesti, 2020).

The concept of in-person participatory design is particularly prevalent in urban planning, however, the challenges that come with it, particularly in terms of time, money and attracting a variety of participants, have motivated researchers to seek alternative, technological tools to aid citizens to re-imagine urban spaces (Cooney, 2021). Although traditional Living Labs are geographically embedded in a specific location through in-person, on-site activities (Steen & Bueren, 2017), the use of a virtual platform allows people to participate from anywhere, at any time (Prendinger et al., 2013), which could be particularly advantageous to reach more people in the community and at varying stages of the street experimentation process. Apart from the challenges associated with implementing participatory approaches in general, within urban transport research, ULLs face a number of challenges due to the nature of transport systems which oftentimes extend beyond the small contexts of experimentation (Oldbury et al., 2022). Thus, more research on open and engaging street experimentation for mobility shifts can aid in better understanding not only the barriers to implementation but also how these interventions can be scaled-up and contribute to systemic change.

In this study, the inclusion of stakeholders and the community in the process of experimentation, primarily the planning and design phase, is explored through the use of a virtual urban living lab (VULL). The use of virtual interfaces in experimentation for sustainable mobility continues to evolve to develop new tools that enable different stakeholders and the community to experience possible future scenarios through the use of virtual reality, for example, as a means of demonstration (Oldbury et al., 2022). The involvement of stakeholders can include the collection of data on their mobility requirements, issues and needs and providing a medium through which their own ideas can be proposed (Tellioglu et al., 2019). Digital platforms in transport-related pilot projects set out to obtain ideas and innovations from different actors by getting everyone in the same room and are predominantly used for Mobility as a Service projects, but it has also been used as a tool to re-shape mobility systems and support a shift from car dependence (Oldbury et al., 2022). Apart from the use of digital tools to merely support ULLs conducted in real-life settings, VULLs aim to create the experimental and participatory space online in a virtual environment (Prendinger et al., 2013).

This preliminary study seeks to test the possibility of conducting a VULL by initially testing it in a workshop setting to identify its applicability as a method for the collection and visualisation of stakeholder input in the process of street experimentation. Research focusing on platformisation projects has revealed the need for such platform-based mobility projects to integrate better the public's response by testing its use in a more coordinated approach in several experimental activities (Oldbury et al., 2022). Considering this research gap, the aim of this study is to test the VULL as a method for collecting, exploring and evaluating ideas of street experimentation in Malta using an interactive space for the community. By gaining a better understanding of the current barriers to active travel and the perceptions of the Maltese community about proposed intervention ideas, this research explores the viability of a VULL as a qualitative approach to gather policy-relevant feedback from the community.

Methods

This study uses three qualitative data collection methods, all set

within the case study of Malta's principal urban area (PUA). The overall process of the study is illustrated in Fig. 1. The stages in the process and the activities implemented were based on previous research in the field of street experimentation (Bulkeley et al., 2019; Keserü et al., 2019; Oldbury et al., 2022; Pappers et al., 2020; Rollin et al., 2021; Tellioglu et al., 2019; Villani & Talamini, 2021), but adapting them to the specific context of the study, considering also the limitations associated with COVID-19 regulations at the time.

First, semi-structured interviews were conducted with key actors within the local transport context coming from governmental and private entities, NGOs, and academic institutions. Each interviewee was able to propose a contribution to the VULL; an idea for a real-life street experiment in Malta's PUA to encourage walking or cycling as modes of transport. In addition to the ideas proposed by these stakeholders, citizens were also able to propose and sketch their own idea for a real-life street experiment during an in-person workshop (Workshop I). These proposed ideas were then digitally sketched and visualised on the VULL. The VULL online platform was then tested in another workshop (Workshop II) with members of the PUA community, in which all of the stakeholders' ideas were presented to the participants to get their feedback, understand the main barriers and challenges they are currently facing, and get their direct input and ideas for improvement.

Case study

The VULL, although a virtual platform, is geographically embedded within Malta's PUA, as both the workshop and the ideas proposed by the stakeholders were focused within the same area. The PUA encompasses the island's major employment, service and residential sites (Planning Authority, 2015) and is currently home to almost 60 % the country's population (NSO, 2022a). The local transport scenario is heavily dependent on motorised vehicles, with 424,904 licensed motor vehicles (NSO, 2022b) compared to its population of 516,100 (NSO, 2021). This dependence is very much linked to the increased supply of road infrastructure that stems from governmental pressure to provide for the car (Attard & Ison, 2010) and a strong cultural effect that glorifies car ownership (Warren & Enoch, 2010). Private vehicles are the primary mode of transport in Malta, with over 84 % of trips being done by car, starkly contrasting with just 0.5 % and 7 % of cycling and walking trips respectively (NSO, 2022c). The reliance on motorised vehicles is evidently strong, especially when considering that cars are the most used mode of transport even for short-distance trips, i.e. trips which take 10 min or less and occur within the same locality (Transport Malta, 2010) and the average journey length is 5.5 km (Transport Malta, 2016). Considering the islands' mobility situation, the promotion of sustainable urban mobility and a shift to more active, non-polluting transport modes is faced with several challenges. The introduction of street experimentation and intervention projects as a potential key player in encouraging a modal shift in Malta has slowly started to gain traction, with increased interest from local authorities to implement such interventions during the COVID-19 pandemic (Zammit, 2022). However, the inclusion of stakeholders and in particular the community is still lacking throughout the process of street experimentation in Malta, especially in the initial stages of planning and design.

Initial data collection for the VULL platform

To ensure the VULL considers the relevant stakeholders, an initial mapping of the stakeholders was undertaken, in line with the quadruple helix approach. This approach includes both public and private actors, Non-Governmental Organisations (NGOs), academia and citizens (Nesti, 2020). One representative for each of the stakeholder types was chosen to participate in this collaborative research, as outlined in Table 1. Whereas the input from government, private entity, academic and NGO stakeholders was collected through semi-structured interviews ($n = 4$), the input from citizens was acquired through a workshop ($n = 7$)

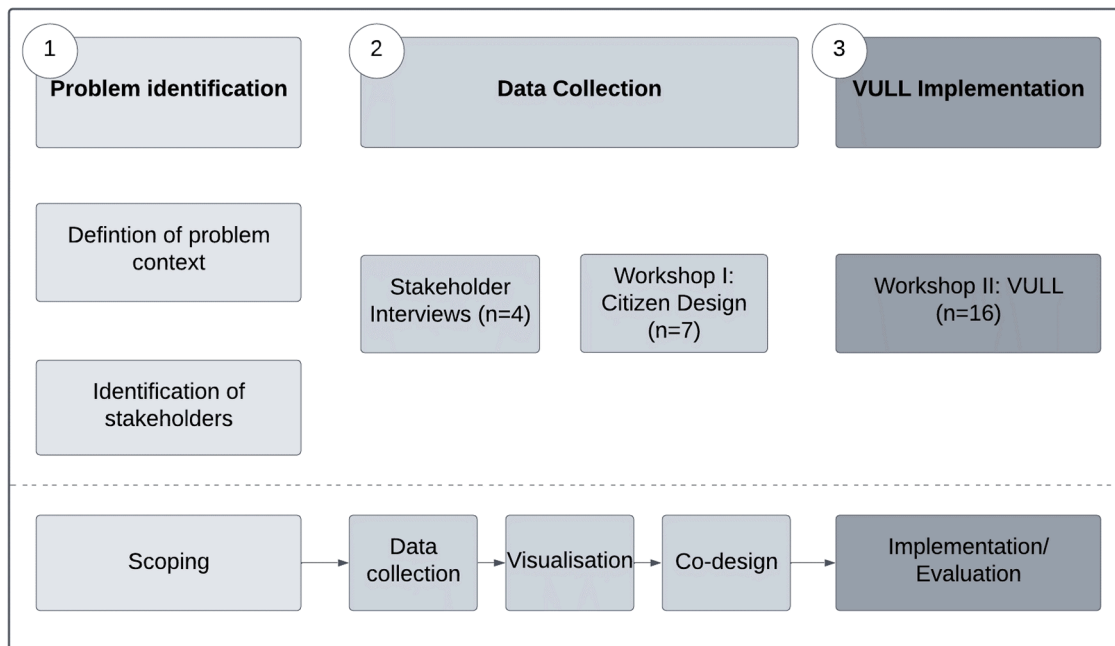


Fig. 1. Framework design and the research process.

Table 1 Stakeholder list.

Stakeholder type	Stakeholder reference	Description of representative
Government Entities	S#1	Coordinating association for collaborative projects across local councils
NGO	S#2	Network of professionals creating alternative urban visions
Academia	S#3	Urban design academic
Private Entities	S#4	Architectural and urban design consultancy
Citizens	S#5	Group of citizens from the PUA interested in active travel

with residents of the PUA interested in active travel. The interviews were held physically in-person in March of 2022 and a snowballing technique was used to recruit further participants, whereby stakeholders could nominate other potential interviewees (Gonzalez-urango et al., 2020). The interviewees could propose any street experiment idea they had for any location within the PUA.

The initial workshop was held at the University of Malta on the 28th of October 2022 where a co-design activity was organised, focusing on the importance engaging non-designers in the design and exploration of future vision (Oldbury et al., 2022). The participants (n = 7) were recruited through social media and were able to brainstorm, discuss and illustrate a specific idea for a street experiment that would encourage more people to travel actively. Following a brief introduction on the research context and street elements to consider, the participants visited

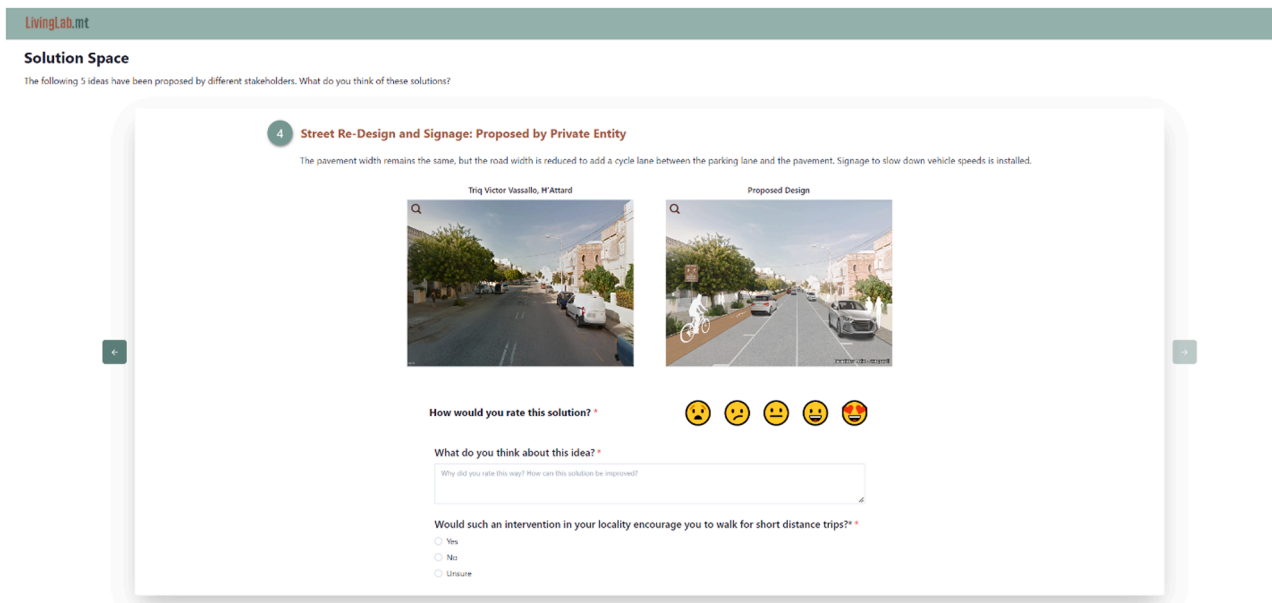


Fig. 2. Proposed street experiment idea example as displayed on the VULL.

a nearby street adjacent to the University of Malta campus, and as a group were asked to complete the following task on a worksheet; *How would you re-design this street to encourage more people to walk and cycle? Sketch and write down your ideas of how you would re-design it.* This street experiment sketch was then digitally drawn and visualised so that it could be added to the VULL, along with the intervention ideas proposed by the other stakeholders, as shown in Fig. 2.

Virtual urban living lab

The second workshop was then held with a different group of participants who reside within Malta's PUA and test out the VULL. For this workshop, the participants were instructed to join the VULL through a website link. The workshop was conducted in Naxxar on the 30th of January 2023 and participants ($n = 16$) were recruited through online adverts distributed on social media. After a short 20-minute walk around the village of Naxxar, participants returned to the venue and accessed the VULL through a website link on their smartphones. The VULL consisted of an initial set of socio-demographic questions followed by three interactive activities, similar to activities held during real-life Living Labs (Tellioğlu et al., 2019). The first activity was a problem-identifying activity in which participants were asked to identify the barriers they experienced during their most recent walk in the surrounding urban environment. The barriers listed on the VULL consisted of ten factors which impact active travel, particularly, walking as a mode of transport. These include the cleanliness of streets and pavements, the visual appeal of architecture, the presence of trees and greenery, safety from crime, safety from traffic, the quality of road infrastructure, including the pavements, cycle lanes and street crossings, the street furniture such as benches, the land use variety and density, and the noise and air pollution (Curl & Mason, 2019; Saadi et al., 2021; Ton et al., 2019). Participants could indicate to what extent each of these factors posed an issue during their walk; red (major issue), orange (somewhat of an issue) and green (not an issue). Additionally, participants could also add other barriers they encountered and comment further on their responses. Following this, the second activity consisted of the intervention ideas within Malta's PUA (Fig. 3) as proposed by the stakeholders from the interviews and the citizens from the initial workshop. As depicted in Fig. 2, the

intervention ideas were presented as digital illustrations of the street with a short description of the intervention (Table 2). The participants could then rate the idea and give feedback on why they rated it in that way. The third and final activity of the VULL consisted of a virtual sticky note board, which gave participants the chance to submit their own ideas and recommendations to improve the urban walking environment. The sticky note board also displayed other participants' ideas so one could upvote ideas they concurred with. The initial testing of the VULL within a workshop setting rather than a fully virtual lab was also useful to better assess its potential limitations related to inclusivity. Similar to obstacles faces by digital tools used within the field of mobility, the issues of digital skills, internet connection and the availability of an adequate digital device are all potential factors that may lead to segments of the population, particular vulnerable social groups to be excluded (Martinez & Keseru, 2023). Despite the overall increased trends of internet usage in Malta, with 91.5 % of persons aged between 16 and 74 years using the internet in 2022 (NSO, 2023) and over 60 % having at least basic overall digital skills (Eurostat, 2022), this methodological limitation should still be acknowledged when interpreting the paper's findings.

Data analysis

In this paper, the initial stakeholder interviews and workshop were primarily used to gather the street experiment ideas to then be visualised on the VULL. The main data analysis was centred around the data collected from the VULL. The quantitative data collected from the VULL was analysed using SPSS to compute basic descriptive statistics of the sample. However, the main mode of data analysis was the qualitative data analysis for the open-ended answers posted by the VULL users. Thematic analysis was used to structure the understanding of the data by extracting a set of codes and themes (Braun & Clarke, 2006; Ferrer et al., 2015). These themes then formed the major lines of discussion and interpretation in the study but were also reinforced with qualitative content analysis. Content analysis was conducted by quantifying the number of times a particular theme was mentioned (Simons et al., 2013). As employed by other researchers in similar qualitative research (Ferrer et al., 2015; Simons et al., 2013), the following criteria were used

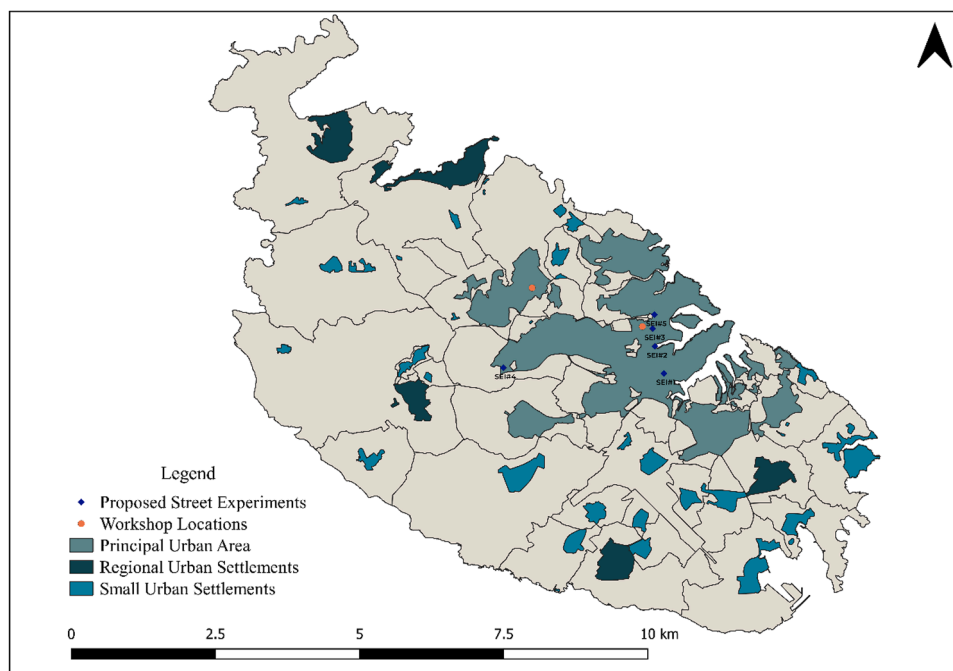


Fig. 3. Location of proposed street experiment ideas within the Principal Urban Area of Malta (Planning Authority, 2015).

Table 2
Description of street experiment ideas proposed by stakeholders as displayed on the VULL.

Stakeholder type	Street experiment Ideas	Location of street experiment	Description
Government Entity	(SEI#1)	Hamrun, Malta	The road width is reduced but both traffic lanes and parking lanes are kept. A green strip is added on one side of the street and the pedestrian area on the other side is extended with a coloured walking lane at street level. Motorised vehicles, public transport and cyclists must share the road and additional signage is installed to slow down cars (20 km/h zone) and give priority to cyclists.
NGO	(SEI#2)	Msidra, Malta	By re-routing traffic and restructuring roads, one continuous open space that connects destinations can be created, providing a church square, garden and promenade. The space allows people to walk and cycle within a green space, including also a bicycle path.
Academia	(SEI#3)	Gżira, Malta	By reducing the traffic lane width and removing one side of on-street parking, more space is available for street greenery on both sides of the street and a wider pavement with benches. On-street parking is restricted to one side of the street, in between pockets of greenery. Complementing this, alternative centralised parking facilities in the locality, such as underground or built car parks are provided to relocate the on-street parking.
Private Entity	(SEI#4)	H'Attard, Malta	The pavement width remains the same, but the road width is reduced to add a cycle lane between the parking lane and the pavement. Signage to slow down vehicle speeds is installed.
Citizens	(SEI#5)	Gżira, Malta	The angled parking on the left is changed into parallel parking spaces and the pavement is widened. The driving lanes' width is reduced and parking on the right-hand side is removed and replaced with a continuous pavement and a two-way cycle lane. The traffic light crossing further down the road is kept and an extra pedestrian crossing is added next to the shop. Greenery, solar lighting, and bins are added along the street.

for analysis; less than 25 % of participants was defined as 'few', between 25 and 50 % as 'some', between 50 and 75 % as 'a lot of' and more than 75 % of participants as 'almost all' (Ferrer et al., 2015).

Results and discussion

The testing of the VULL platform in a workshop setting was a very useful step in this initial study as it allowed for a better understanding of people's reactions to the platform, allowing the researchers to ensure the platform works smoothly and thus can effectively collect the data and feedback required. From the initial questions of the VULL, the basic socio-demographic characteristics of the sample could be obtained. A total of 16 people participated in the VULL, including 10 males and 6 females aged between 20 and 72 years (avg. 33.5 years). Since this was a public workshop in which people could participate voluntarily, people interested in active travel may have been more inclined to attend and participate. Thus, the small sample of participants and the particular audience attracted to attend this workshop must be acknowledged when analysing and discussing the findings of this study.

Current barriers and issues in the urban environment

In terms of the main barriers experienced within the urban environment, road infrastructure design, which includes aspects such as the presence and quality of pavements, cycle lanes and street crossings, was the most rated major issue (78.6 %), followed by air pollution (64.3 %), safety from traffic (64.3 %) and noise pollution (57.1 %). Certain factors were deemed to be predominantly rated as moderate issues, including cleanliness of streets and pavements (78.6 %), trees/ green spaces (57.1 %) and street furniture (50 %). Land use (variety of shops, restaurants, schools, services...) (71.4 %) and safety from crime (71.4 %) were predominantly not rated as an issue. Similar to other research in this field, poor walking facilities and issues of traffic safety are prominent barriers to walking in urban environments (Ferrer et al., 2015; Kelly et al., 2011). However, unlike the findings of Ferrer et al. (2015) which show that the fear of crime was the strongest deterrent to walking, the participants in this study did not pinpoint safety from crime as a major issue. This finding coincides with the overall low crime rates in Malta, with the country registering the lowest crime rate in more than 15 years (Formosa, 2022).

VULL participants were also offered the space to add more detail regarding the walking barriers they experience in the urban environment. The participants were able to give very detailed accounts of how certain aspects of the urban environment currently affect their pedestrian experience:

"I noticed that the pedestrian paths are not built well. There are many holes and uneven path on the street which makes me pay more attention to my steps. This also makes the walk not accessible for people with special needs (wheelchair, etc.). Further, if it is raining, the uneven construction of the path will promote pool of water which is not comfortable for people to walk on. As I walk, I oftentimes get confused where to cross as the crosswalks availability is sort of limited (some spots don't even have crosswalks) which is not facilitating safety for the pedestrians. I also noticed the size of the pedestrian path is very small (maybe just one person can walk on the same time/line) which makes if two people coming from different directions meet, one has to go to the general path which can be burden if there's a car passing by at the same time" (VULL participant).

A lot of participants (64 %) detailed issues of poor pavement quality, maintenance and width, a lack of cleanliness and obstructions as major issues that deter them from walking. These have frequently been outlined as major influencing factors for walking as a mode of transport and which contribute to safety perception (Canas, 2021; Ferrer et al., 2015; Kelly et al., 2011). Some of the participants emphasised the feeling of unpleasantness during walks in the local urban environments, primarily due to feeling unsafe from high-speed traffic as a result of lacking traffic

calming measures. This coincides with a similar study which found that reducing vehicle speeds had a positive impact on the safety of pedestrians (Carlson et al., 2019).

Feedback on street experiment ideas

Through the VULL, feedback from the participants was acquired on the proposed street experiment ideas of the four different stakeholders (NGO, Academia, Government and Private Entity) as well as the idea proposed by citizens in the initial workshop. Interestingly, when analysing the responses from the VULL participants ($n = 13$) on all the proposed ideas (Table 3), the highest rated was that proposed by the citizens (SEI#5) (61.5 %) which included a street re-design to include a two-way cycle lane, wider pavements and more pedestrian crossings. Overall, the ideas proposed were well-received by the participants. The idea proposed by the government representative (SEI#1) received the most negative feedback, with 30.8 % rating it unfavourably. SEI#1 consisted of a coloured walking lane at street level to extend the pavement and introduce signage for speed control and road sharing.

To understand better the unfavourable rating towards SEI#1, the participants' comments on whether such an intervention would encourage them to walk more and detailed feedback were analysed. For SEI#1, the main negative feedback was concerning the design of the painted walking lane, particularly on the lack of segregation or physical barrier between pedestrians and road traffic:

“Good to see more trees and space for walking and cycling, but the design of the street doesn't look safe to me, there needs to be a physical barrier between cars and bicycles/pedestrian, and/or at least a kerb” (VULL participant on SEI#1).

“It is an improvement but does not feel very safe from a pedestrian standpoint. I would much prefer a pavement to serve as some sort of barrier as it looks like cars could still drive into and park on the pedestrian strip. Additionally, one wide pavement would be better than a narrow pavement and a narrow pedestrian strip on the road. The design as it appears now is not very favourable with regards to accessibility for wheelchairs and pushchairs” (VULL participant on SEI#1).

Considering this feedback, SEI#1 also resulted in a mixed response on whether such an intervention would encourage them to walk, as although a lot of the participants agreed (53.8 %), a few felt that it would not encourage them (15.4 %) and some were unsure (30.8 %). Comparing this with the feedback for the other street experiments, the ideas proposed by S#3 and S#2 had all participants (100 %) in agreement that such interventions would encourage them to walk, whilst S#5 had almost all (84.6 %) and S#4 had a lot of participants (61.5 %) in agreement.

Furthermore, the open-ended questions in the VULL were capable of capturing very good feedback from the participants on the interventions proposed, highlighting aspects they favour, potential issues and input based on their own lived experiences. For example, for the idea proposed by S#4, the aspect of dooring for cyclists was emphasised by some of the VULL participants in their feedback and remarked on how this design would affect their travel behaviour:

“These worry me a little as the cycle lane is vulnerable to dooring, particularly by passengers, who are even less likely to look than drivers.

I'd walk there but I'd cycle with traffic and use the cycle lane only as a contraflow. Hitting the door that way has less consequences” (VULL participant on SEI#4).

Additionally, VULL participants who frequently make use of the streets with the proposed experimentation could provide further contribution on the current shortcomings of the streets and the potential impact of the experiment:

“I've had to walk through this area many times and crossing through is a nightmare; this would make the walk feel safer and overall more pleasant” (VULL participant on SEI#2).

“I ride this street twice a day and is very busy and already problematic to filter through, mostly southbound (towards High Street from Pietà). Narrowing down the lanes and keeping parking both sides, while not addressing through-traffic of this street, will make it impassable by bicycle”(VULL participant on SEI#1).

This feedback from the community, especially the detailed input from frequent users or those living near the proposed areas of intervention, allowed for the identification of certain issues and useful recommendations based on personal experience. This is a particularly noteworthy finding, along with the poorly received idea proposed by the government stakeholder, as it emphasizes the crucial input citizens can have in designing such street experimentation. Including participants in the planning and development process is crucial also to prevent issues of resistance and disapproval later on at the implementation stage (Kyr-iakidis et al., 2023). From the analysis of the stakeholder interview data conducted in a previous study (Scerri & Attard, 2023), these findings further challenge the current consensus held by decision-makers, who favour street experimentation but advocate for a top-down approach, in which intervention ideas are created and designed by local authorities and planners and presented at later stages to the community for feedback.

Moreover, the VULL data also provided examples of additional interventions that could feature in the proposed street experiments. A lot of participants emphasised the importance of looking at the bigger picture rather than the street experiment on its own to ensure that other aspects are taken into consideration, including traffic re-routing, connectivity, network density and parking management systems. Additionally, certain elements of the street experiments, such as the introduction of greenery and trees were positively received by a lot of the participants, but a few remarked on the type of vegetation, their location and their upkeep and maintenance. A lot of participants also reacted positively to changes in the road infrastructure, particularly the increased pavement widths, segregation of pedestrians and cyclists from traffic and improved crossings which have all been identified in the literature as characteristic elements of walkable environments (Bozovic et al., 2021; Morar & Bertolini, 2013). Some participants also advocated for more traffic calming measures to be introduced:

“Better but still needs interventions to slow traffic down and reduce overall volumes, such as chicanes, speed tables...” (VULL participant on SEI#5).

Although the VULL was tested within a small workshop sample, it was also able to reveal varying perspectives and conflicting opinions on certain elements, such as people's perception of reducing or re-

Table 3
VULL participants' rating of ideas proposed by stakeholders ($n = 13$).

Stakeholder Type	Street Experiment Ideas	Strongly Disagree (%)	Disagree (%)	Neutral (%)	Agree (%)	Strongly Agree (%)
Government Representative (S#1)	(SEI#1)	7.7	23.1	23.1	23.1	23.1
NGO Representative (S#2)	(SEI#2)	0	0	15.4	38.5	46.2
Academia Representative (S#3)	(SEI#3)	0	0	7.7	15.4	23.1
Private Entity Representative (S#4)	(SEI#4)	0	15.4	30.8	38.5	15.4
Citizens (S#5)	(SEI#5)	0	15.4	7.7	15.4	61.5

purposing parking spaces and the repercussions of street experimentation on different road users. For example, whereas some participants favoured and advocated for further reduction in parking spaces to discourage car use, other participants were hesitant on the matter:

“Overall loss of a significant area used for parking which may cause problems for the locals if no public large-scale garage is set up” (VULL participant on SEI#3).

“This doesn't seem to add much space for walking or cycling in an area which has a school whilst encouraging driving due to the overabundance of parking which will be left as is it seems” (VULL participant on SEI#1).

The re-purposing of on-street parking into alternative uses such as widened pavements, cycle lanes or street furniture (Bertolini, 2020; Gonzalez-urango et al., 2020) and the issue of traffic congestion (Keseru et al., 2016; Kyriakidis et al., 2023) have been identified in the literature as particular strong points of resistance. The support of such street interventions has been found to increase if parking in the periphery of urban areas is provided (Wooller et al., 2012) and also minimises cruising for parking spots within the urban area and the repercussions that come with it (Shoup, 2011).

In the final activity of the VULL, participants were able to input their own ideas of potential street interventions, by using the virtual sticky note board. The most upvoted ideas were focused on traffic calming and the design and planning of a consolidated walking and cycling network. The participants mentioned the introduction of traffic calming measures, particularly within village centres and residential streets, including aspects like greenery, chicanes and speed tables, echoing similar findings to Ferrer et al. (2015). Additionally, an idea was put forward to create a consolidated active travel network, which includes major destinations in and around the urban villages and towns, which emphasises the importance street network connectivity when planning for pedestrians (Gonzalez-urango et al., 2020).

Conclusion, limitations and future research

This study focuses on the collaborative participation of stakeholders at the planning and design stage of street experimentation. Considering the challenges associated with including different stakeholders and the community at this stage, the study proposes the use of a virtual urban living lab. Using a qualitative approach to collect ideas from key stakeholders, potential ideas for street experimentation could be visualised on an online participatory platform and feedback could be collected from the community. The findings show that VULLs can be a useful tool to firstly understand people's current challenges and barriers in the urban walking environment and secondly, obtain vital feedback on potential ideas proposed by stakeholders.

This preliminary study, however, has highlighted certain limitations and challenges relating of the VULL. Firstly, one must acknowledge the methodological limitations associated with digital tools and inclusivity, since certain social groups may be discouraged to participate in such studies due to their limited digital skills. Secondly, one must also acknowledge the small sample size of this study, and so this limits the generalisability of the findings. Considering these limitations, the use of the VULL structure can complement ULL as a digital tool used for community participation. As a particularly effective and efficient tool for data collection, its application can be further strengthened with in-person activities, especially at the site of the street experiment, to collect additional qualitative feedback and on-site observational data. This can also help to address issues of digital accessibility and diversity of participation.

The structured layout of the VULL proved beneficial to capture people's reactions and input in a straightforward manner, allowing for both quantitative and qualitative data to be collected. Through the analysis of the VULL data, the community reacted favourably to the street experiment idea proposed by citizens, reacting positively to the

inclusion of a two-way cycle lane, wider pavements and an increase in pedestrian crossings. Contrastingly, the idea proposed by the local government representative received the most negative reactions, with many remarking on the potential issues that can arise with a painted walkway at street level. These findings continue to emphasise the apparent disconnect between the different stakeholders in the local sphere of transport and street re-design and the gap in bridging all the stakeholders together. The findings of this research can provide a good source of feedback and information for policy makers and planners to consider which attributes of street experimentation are the most favoured by the community and what features of the built environment require the most immediate improvement.

Future research can build upon these findings and develop further to examine what factors influence people's preferences of street experiments. Although this study tests the VULL in a workshop setting, future research should seek to open the VULL to a wider audience, explore further additions of co-creative digital tools and test the platform as a fully virtual mechanism. Expanding the sample to include a variety of stakeholders and members of the community can also contribute to the understanding of the current barriers and obstacles that exist in bringing these actors together to co-create, deliberate and discuss. The VULL can also be extended and tested in other stages of the street experimentation process, including the implementation and evaluation of street experiments, allowing also for longitudinal data collection.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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