

Developing a serious game for the 15-minute neighbourhood transition: Lessons learned from an expert workshop

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ARTICLE INFO

Keywords:

15-minute neighbourhoods
Co-creation
Serious game

ABSTRACT

Popularity of the 15-minute city concept has been increasing in recent years. The concept is seen as a way to improve accessibility, sustainability, and liveability; however, there are knowledge gaps in finding successful pathways for its implementation. For instance, there is scarce research on the barriers and needs of different population groups for the uptake of the 15-minute city concept. The contribution of this study is to investigate how a serious game focused on 15-minute neighbourhoods can be developed as a tool to eventually contribute to the co-creation of neighbourhoods. For this, a serious game was developed and experimented with during an expert workshop, where four teams played the game and designed a 15-minute neighbourhood. The workshop's results show how the developed game could potentially help stakeholders and civil society, such as researchers or municipalities, understand citizens' perspectives. However, the game as is needs future adaptations to fit the local context of players better and have an impact on the co-creation of neighbourhoods. When applied with real stakeholders in real urban settings, the game could contribute to real-world co-creation processes to give citizens a voice to share their needs within the development of 15-minute neighbourhoods.

1. Introduction

Popularity of the 15-minute city concept has been increasing in recent years, gaining momentum of the global COVID-19 pandemic and the subsequent restrictions on travelling (Pozoukidou & Chatziyiannaki, 2021). The concept, as proposed by Carlos Moreno in 2015 and described in Moreno et al. (2021), promotes the design of urban space where all citizens can access essential services and daily needs in their neighbourhoods, within 15 min of cycling or walking, thus contributing to more safe, liveable, and sustainable cities (Moreno et al., 2021). Several cities such as Utrecht, Paris, Buenos Aires and Barcelona, but also smaller cities and towns, have ambitions towards becoming a 15-minute city. These cities are also facing a substantial increase in number of inhabitants for the next decades. Population growth compels the city to rethink its current urban plans and policies regarding housing, energy, and mobility provisions. Moreover, large urban growth coupled with the need for more sustainable transport asks for the restructuring of cities and their neighbourhoods, by adapting infrastructure, mobility

systems and land use, with the ultimate goal of improving accessibility, sustainability, and liveability (Allam et al., 2022; Pozoukidou & Chatziyiannaki, 2021).

Studies on the 15-minute city primarily focus on the concept itself (as described above), and the potential impact of the 15-minute city on walking and cycling accessibility (e.g., Boulange et al., 2017; Caselli et al., 2022; Graells-Garrido et al., 2021; Knap et al., 2023). However, there is scarce research on the barriers and needs of different population groups for the uptake of the 15-minute city, both in the process of becoming a 15-minute city as well as the desired amenities of its citizens. The 15-minute city concept may have different understandings and perceptions in different spatial concepts and by different population groups. Additionally, there are knowledge gaps in finding successful pathways for the implementation of the 15-minute city as a planning concept to achieve a sustainable and liveable urban transition, not only in urban cores but also in the urban outskirts. It is still not fully clear which essential services, such as mobility hubs, grocery stores, or healthcare centres, are required to have in 15-minute neighbourhoods

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<https://doi.org/10.1016/j.cstp.2025.101428>

Received 5 November 2024; Received in revised form 12 March 2025; Accepted 13 March 2025

Available online 14 March 2025

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by residents in both urban centres and outskirts, and this potentially differs per city and neighbourhood (Graells-Garrido et al., 2021).

Public participation of different population groups in the development of the 15-minute city is a promising approach to get an understanding of the local context, and citizens' needs and barriers. Key challenges in current participatory processes are, amongst others, the requirement of specific knowledge about the topic, something that citizens often do not have, and the different expectations on the engagement and influence of the process between the public and urban planners (Brandesen, 2021; Quick, 2014). Overcoming these issues, co-creation is a promising method of directly involving citizens actively and engagingly, by creating the urban space in collaboration between urban planners and citizens (Remesar, 2021). For this purpose, serious games were introduced in co-creation processes, with the prospective advantage of including the real needs of different groups (Brandesen, 2021), being more attractive for citizens (Ampatzidou et al., 2018; Flores et al., 2023), and being able to make complex topics more tangible (Ampatzidou et al., 2018).

Combining the research gap on the development of 15-minute and the ability of co-creation to overcome this gap, the objectives of this study are (1) to develop a serious game within the context of the 15-minute neighbourhood, and (2) collect an experts' opinion on the game's design and usefulness. As such, this study contributes to the literature by offering the first version of a serious game, which can be used as a starting point in the co-creation of 15-minute neighbourhoods. When its effectiveness is tested by applying the game in a real-life context, it could develop more awareness of the diversity in needs and interaction between different citizens in the development of 15-minute neighbourhoods. This study describes the development of the game, the game itself, the testing of the game during an expert workshop, the results and a discussion and conclusion section on the usefulness of the full game as well as the usefulness of certain game elements.

2. Literature review: co-design games in urban planning

In the transition towards 15-minute cities, an important aspect is the active participation of citizens to acknowledge local problems and needs (Pozoukidou & Chatziyiannaki, 2021). Public participation, where citizens and communities participate and cooperate in decision-making of policies that concern them, allows for policies to better fit with the needs of citizens (Arnstein, 1969; Pappers et al., 2020). There are many different approaches to involve citizens in the decision-making process, ranging from focus groups, and project review teams to collaborative design exercises (Quick, 2014). Arnstein's ladder of participation categorizes those different forms of participation, defining more passive methods of participation (e.g. providing information) to active participation where citizens influence the final decisions (Arnstein, 1969). A downside of the more passive participatory processes is that it can lead to certain challenges that could decrease the impact of participation, such as trust issues between citizens and planners, the engagement of citizens in complex decision-making, and the inclusivity of the process (Brandesen, 2021; Quick, 2014).

Co-creation, where people create something new together, is often mentioned as a good participatory design method to actively involve citizens (De Koning et al., 2016). Sanders and Stappers (2008) refer to co-creation as "*any act of collective creativity, i.e. creativity that is shared by two or more people*" (Sanders & Stappers, 2008, p. 6), while co-design is often referred to as a more specific instance within the co-creation process, where different stakeholders work together in a collective design process (De Koning et al., 2016; Pappers et al., 2020; Sanders & Stappers, 2008).

In co-creation processes, there is a relation between an organization and citizens, where the organization requires direct and active input from its citizens, meaning that citizens themselves get a leading role (Brandesen, 2021). Moreover, co-creation focuses on innovation and creativity, to collectively design public space (Leino & Puumala, 2021).

In this light, co-creation can be a tool to overcome some of the challenges that are faced in more passive participatory processes. Brandesen (2021) states that underrepresented, vulnerable groups might be more likely to participate in co-creation processes compared to these passive methods, as they individualize participation and integrate experiential knowledge. Additionally, co-creation can form citizens' view of the public space and increase awareness of their role (Remesar, 2021). This does not mean that co-creation tools are an easy participatory method to use. It requires a substantial effort to organize and implement co-creation within a project; it is time-consuming and should be organized in a local, familiar setting on a long-term scale (Brandesen, 2021; Leino & Puumala, 2021).

Co-design is the process of designing together with the intended end users (Havukainen et al., 2020), and design games are a tool often applied in co-design processes to increase engagement and participation of different stakeholders at the beginning of a design process (Poplin, 2011; Vaajakallio & Mattelmäki, 2014; Zhang & Zurlo, 2021). Design games are tools for co-design that make use of "*game elements in non-game contexts*" (Deterding et al., 2011, p. 11), to trigger participants' imaginations as a source for design ideas (Vaajakallio & Mattelmäki, 2014). Games that are specifically referred to as serious games have a similar, serious purpose, other than only entertainment (Krath et al., 2021). The games aim to collaboratively design urban environments (Habracken & Gross, 1988), by directly involving the people designed for (Brandt, 2006).

Design games exist with many different purposes and functions but generally, the games promote a creative and explorative attitude, facilitate envisioning a future design and help to define the interaction between the participants (Brandt, 2006; Vaajakallio & Mattelmäki, 2014). Therefore, most design games use tangible, stylised game materials to increase creativity and rules like turn-taking to structure the game and create interactions (Brandt, 2006; Zhang & Zurlo, 2021). Developing a narrative within the game could also benefit its effectiveness by creating meaning (Sousa, 2023). Furthermore, there is a need to balance between complexity and playability, as the challenge of the game should match the abilities of the player (Habracken & Gross, 1988; Zhang & Zurlo, 2021). Often, there is limited competition between the players of a design game, but tension is created by an overarching goal or personal challenge (Vaajakallio & Mattelmäki, 2014). Additionally, analogue design games, compared to their digital counterparts, could benefit the inclusivity of the game. People are more familiar with analogue tools (e.g. paper and pencil) than with digital tools, which are also difficult to develop (Slingerland et al., 2024). Therefore, analogue games could be the better option for groups with a lack of experience with digital media, as well as increase the interaction between players (Flores et al., 2023).

Regarding the impact of co-design games, Ampatzidou et al. (2018) found that the application of serious games could benefit social learning, and make participation more attractive and tangible for participants (Ampatzidou et al., 2018). Flores et al. (2023) applied a serious game with future users of autonomous shuttles and found that applying the game increased the engagement of the relatively older adults in the participatory process (Flores et al., 2023). This effect is limited by a potential lack of resources and adaptability of the games, i.e. it is a lot of effort to tailor a game to a local situation (Ampatzidou et al., 2018). Another potential pitfall is the oversimplification of the game, which limits the potential impact and the engagement of local citizens (Sousa et al., 2022). Not only the game itself impacts its effectiveness, but exogenic variables also play a role. Time of day or the location the game is played, influence the energy level of the players, which by itself influences potential impact of the game (Sousa, 2023).

Active citizen participation should play an important role in the development of 15-minute cities, addressing the needs and barriers of its citizens (Pozoukidou & Chatziyiannaki, 2021). As discussed previously in other work, a serious game, focused on the co-design of 15-minute neighbourhoods, can be a good facilitator for these participatory

processes. The game that is developed in this study will build upon the reviewed literature, focusing on developing an easy-to-understand, analogue game that, potentially, could be adapted to the context of multiple cities (Ampatzidou et al., 2018; Brandt, 2006).

3. Methodology

The design game, *the 15-minute neighbourhood game*, has been developed at the University of Twente and includes elements of an exploratory design game (Brandt, 2006) and serious game (Krath et al., 2021), and is adapted from an earlier version of the *SmartHubs* design game, which was developed to co-design a mobility hub in The Hague, The Netherlands (Tellioglu et al., 2023, pp. 37-40).

3.1. Development of the game

The 15-minute neighbourhood game (15mN-game, in short) is designed as an exploratory design game, where the players can create different configurations of a neighbourhood, by placing the design elements on the game board (Brandt, 2006). The goal of the game is to design a neighbourhood that fulfils and satisfies the goals and needs of the player's character. The concept of the 15-minute city is not an explicit part of the game while playing, to prevent the need for knowledge on the topic and to decrease the game's complexity (Brandtsen, 2021; Sousa et al., 2022). However, during the workshop, the participants were briefly introduced to the concept.

The 15mN-game board is the backbone of the design game, which has 49 square fields to place elements. The game board does not represent a real-life location to the players, eliminating potential prior knowledge (as suggested by Brandt, 2006), but the layout can be changed depending on the context the game is played. The board of the game as well as its game materials can be seen in Fig. 1. The game has been developed as an analogue game since tests with an AR game during the *SmartHubs* project showed lower cooperation and discussion compared to an analogue board game (Tellioglu et al., 2023). In the next sub-sections, the different game elements, their purpose, and development are discussed in detail. An overview and examples of the game elements are provided in Appendix A.

3.2. Design elements

One of the most essential elements of the game, concerning the research objective, is the different services that might be constructed in the neighbourhood on the game board. Moreno et al. (2021) state that citizens need to fulfil six essential urban functions in their

neighbourhood to enjoy a high life quality: living, working, commerce, healthcare, education, and entertainment (Knap et al., 2023; Moreno et al., 2021). For the purpose of the game, living and working elements are not considered, but are expected to be located in the neighbourhood nevertheless as the players play as residents or local entrepreneurs. The design elements of the game include commercial, healthcare, and educational elements, as well as meeting elements (related to the function of entertainment). Deciding which specific design elements to add to the game proved to be difficult, as literature showed that it is still not exactly known which essential services are required in a 15-minute neighbourhood (Graells-Garrido et al., 2021). Recent literature research on the 15-minute city concept shows a wide range of services mentioned to be reach within the 15-minute threshold (Molinares et al., 2024). The most frequently mentioned amenities, such as parks, schools, health services and shops, are included in the game. The exact selection of design elements per urban function were determined by the authors of the paper. Furthermore, transportation elements are added to be able to analyse the trade-off between having local amenities or travelling towards the city centre.

Every element has a pre-determined amount of so-called *15mC-points*, based on the element's contribution to the 15-minute city concept. The existence of these points is unknown to the players at the start of the game; hence their decision-making process is not influenced by this. The number of points per element was determined by the authors of the paper, who are working in the field of the 15-minute city. The points can be used at the end of the game to compare different configurations with each other. To do so, the 15mC-score is determined by adding all 15mC-points of the design elements on the board. The design elements, the number of available cards, their size and their 15mC-points can be seen in Table 1.

3.3. Character cards

The character cards consist of eight different personas, with different descriptions of residents or entrepreneurs. Since the game was not designed for any particular neighbourhood nor played by residents themselves, personas have been used. Personas are a technique that can be used to describe citizens and potential users to others (Brandt, 2006). The benefit of using personas is their assistance in designing for a specific target, focusing on the local users. However, it can be difficult for players to empathise with a persona when the persona description is lacking information (Brandt, 2006; Pruitt & Grudin, 2003). Per persona, a description of the character's name, age, role, most used mode of transportation and a personal characteristic is provided. An example of the character cards can be found in Appendix A.



Fig. 1. The 15mN-game board and game elements.

Table 1
Overview of design elements, their characteristics, and results from the workshop.

Design elements	I.	II.	III. ^x	IV.	Design elements	I.	II.	III. ^x	IV.
Local bus stop	2*	1	2p	100 %	Loading & unloading zone	1	2	3p	75 %
Café	1	2	3p	100 %	Gym	1	4	3p	75 %
Restaurant	1	4	3p	100 %	Park	3	2,4 ⁺	4p	75 %
Dentist	1	2	4p	100 %	School	1	6	4p	75 %
Small healthcare centre	1	4	5p	100 %	Library	1	4	4p	75 %
Parking for bikes	4*	1	1p	88 %	Parking for cars	2*	2	0.5p	25 %
Small shop	2	2	3p	88 %	Petrol station	1	3	1p	25 %
Taxi stand	1	2	1p	75 %	Large public transit stop	1	8	1p	0 %
Shared bikes	2*	2	2.5p	75 %	Local supermarket	1	6	5p	0 %

I. = Number of available elements, II. = size of element, III. = 15mC-points of the element, IV. = Average selection percentage of element.

Notes: (*) These elements had to be placed as a “package deal” (i.e., all elements at once) but could be removed as a single element. (+) Three park elements were available: 2 of size 4 and 1 of size 2. (x) The 15mC-points of the elements were not revealed to the players during the game.

3.4. Evaluation cards

On the evaluation card, the player needs to fill in two sections. At the start, every player formulates a personal goal, based on their character card and the description of the persona. This helps the participants to empathize with their character and establish their needs (Krath et al., 2021). At the end, the player fills in the satisfaction score, a Likert-scale score ranging from low (1) to high (5), stating their satisfaction with the final neighbourhood design and the alignment with the character’s personal goal and needs, to motivate players to evaluate the outcomes.

3.5. Action dice

The action dice is a regular six-sided dice thrown by a player once every round. The outcome is linked to a certain action (e.g., placing or removing an extra element in negotiation with another player), which may be performed. This action dice adds an element of unpredictability to the game and allows players to work together, discuss and negotiate to achieve their goal, revealing the personal choices of the players (Krath et al., 2021).

The 15mN-game consists of three phases. *Before the start of the game*, the player gets a character card and evaluation card, determines a personal goal based on the persona and writes it down on the evaluation card. This is not shared with the others. *During the game*, when it is a player’s turn, the player performs two actions: (1) placing or removing a design element token and arguing why, (2) throwing the action dice and performing the corresponding action. An important part of the game is the interaction (i.e., discussing or negotiating) between the players. Therefore, the moderator encourages the players to argue why a certain action is performed, and other players should react to this. In this way, an understanding of the needs of different characters will form, also when the game is played with practitioners instead of actual end-users. The game ends after a certain time which is set by the moderator. *After the game*, the player fills in the satisfaction score based on the final design. The moderator collects the satisfaction scores and computes the final 15mC-score based on the 15mC-points. The final design, score and lessons learned are discussed among all players.

3.6. The expert workshop

The game was experimented on during a challenge-based workshop, which took place during a European Consortium of Innovative Universities (ECIU) conference in Barcelona between 2–5 October 2023. The goal of the workshop was to gather experts’ opinions on the game. The workshop had three parts: (1) an introduction to the topic of 15-minute cities and an explanation of the game, (2) playing the game, and (3) an evaluation and discussion of results. During the workshop, four separate groups composed of eight participants played the game for 35–40 min. Each group was moderated by a game master, while two other moderators observed the process at the four tables.

The participants of the workshop were asked to design a neighbourhood from the perspective of a local citizen or entrepreneur, which was represented by the personas on their character cards. The participants of the workshop (n = 32) are primarily working at universities or research institutions (88 %), and only a small number are affiliated with a public organization (8 %) or the private sector (4 %). The participants originate from a wide range of different European countries, such as Portugal, Spain, Sweden, Lithuania, Finland, and others.

Data was collected by the moderators of the game, who observed the groups during the game. The moderators wrote down their observations on the ‘gamemaster sheet’, and they were asked in advance to focus on interesting discussions, arguments, and trade-offs between players. After the game was finished, the moderators noted all the elements placed on the game board. Furthermore, the participants of the workshop were asked to voluntarily fill in a short, anonymous, online survey about their experience. The questions focused on their affiliation and country of residence, overall experience, the usefulness of the game as a tool, and their preferred 15-minute neighbourhood design out of the four designed neighbourhoods during the workshop. The participants of the workshop were notified beforehand of the objectives of the workshop. Furthermore, they were informed that data gathered from the observations and the online survey did not contain any personal information.

4. Results

The results are divided into two subsections. The first discusses the results of the game itself, focusing on the selected services, final neighbourhood designs and the interactions between the players. The second subsection focuses on the evaluation of the game as a co-creation tool.

4.1. Results of the workshop and the neighbourhood designs

During the workshop, four different neighbourhoods were designed by the participants. The final designs are visualised in Fig. 2, where the differences between the four designs already become visible. Due to the limited space on the game board, not all elements could fit the team’s final designs. Table 1 (column IV) shows the average selection percentage per element. Some elements, such as the *restaurant* or *small healthcare centre* are chosen in every design, while some are never placed, namely the *large public transport stop* and *supermarket*. Sometimes, these elements were initially placed throughout the game but were removed by another player. As pointed out by two of the moderators: “*The supermarket is too big*” and “*Players tend to remove large items to open up space for other (smaller) elements*”. *Car parking* and the *petrol station* are also contested elements and are only placed by the car-enthusiast persona, referred to as “*saboteur*” by one moderator, highlighting the conflict of interests amongst some of the players.

The participants of the workshop tried to focus on their own goals but, as one moderator put it: “*Alliances are formed between certain*



Fig. 2. The final designs of the neighbourhoods during the workshop.

players” to succeed in both their goals. This means that there is cooperation and attention to the overall design, for instance: “Parking [for cars] is placed at the outskirts of the area” which is in line with the personal goals of some players, who tried to achieve a “bikeable city” or “car-free zones”. The overall results of the final designs are highlighted in Table 2, showing the number of empty fields, their scores regarding the 15mC-points, the average satisfaction score of its players and the share of participants (n = 30) who voted for the design when comparing the four during evaluation. The number of empty fields implies how efficient and dense the neighbourhood has been designed. The players in group C fully filled their game board, while group A still has some space left. When comparing the designs based on the placed elements and their 15mC-score, the players of design C found a consensus between mobility and non-mobility services, while other designs focused more on either one of the two. The high satisfaction (based on the individual players per game) and vote share (overall score of all players) suggest that

participants value this combined design, with a more balanced combination of mobility and non-mobility services.

The participants scored their satisfaction with the final design based on the success of their personal goal and their persona. The personal goals differed between the games and the players, ranging from very element-specific goals (e.g., “To have in the neighbourhood a local supermarket, park and healthcare system”) to more generalized policy goals such as “Minimizing the use of cars to 10 % of travel trips”. It is easier to decide, both for the player as well as the moderators, if the first goal is succeeded compared to the latter. This phenomenon can be seen in the revealed satisfaction scores; players with a concrete goal, focusing on specific services, have a higher satisfaction score. Furthermore, a clear difference in satisfaction scores can be seen between players with car-oriented and active or public transport-oriented personas. The overall lowest scoring characters are the personas who travel often using their car as they often did not see their goals achieved in the final design of the neighbourhoods.

Table 2
Results of the four final designs of the 15mN-game during the workshop.

Game	Noteworthy design choices	Empty fields	Total 15mC-score	Average Satisfaction score	Participant vote share
A	<ul style="list-style-type: none"> – Healthcare elements are placed together. – Only design without the taxi stand and school. 	6	48	3.1	7 %
B	<ul style="list-style-type: none"> – Only design without a gym. 	3	52	3.9	30 %
C	<ul style="list-style-type: none"> – Mobility hub is created at the edge of the neighbourhood. – Only design without library & with petrol station. 	0	50	4.7	37 %
D	<ul style="list-style-type: none"> – Healthcare elements and gym are placed together. – No private car-related elements. 	2	51	4.2	27 %

4.2. Evaluation of the game

From the perspective of the participants, who primarily have a background in the research field, 72 % state that the 15mN-game can be a useful tool to identify the needs of different population groups, regarding the 15-minute city (see Fig. 3). Participants who are not positive about the usefulness, think there are other methods to gather information on the needs of citizens or that the game should be combined with other tools. Participants mentioned potential additions to the game, such as including a monetary perspective. Also, some participants were missing the dimensions of living and working (Moreno et al., 2021), the two urban functions of a 15-minute city not covered by the design elements in the game. In addition, one participant suggested improving the game by providing the possibility to add functions on top of other ones and even combine them, thereby facilitating a multilayer and three-dimensional perspective for the game. This idea follows principles of compact city and mixed-uses that support walkability and livability (Jacobs, 1961; Sim, 2019). Furthermore, one of the moderators experienced that some of the participants (especially academics) critically challenged the rules of the game and established arguments and alliances to change them.

The participants were neutral (8 %) or positive (92 %) about their experience with playing the game. The interaction between players was

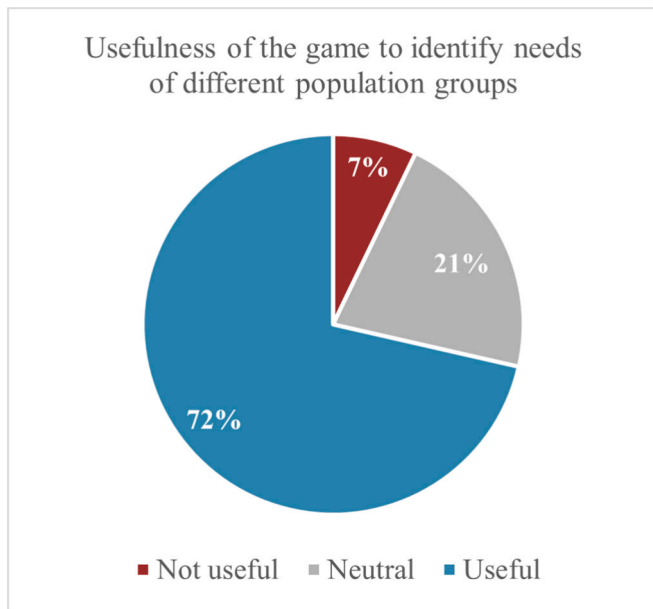


Fig. 3. Assessment of the usefulness of the 15mN-game as tool.

valued as generally positive and cooperative, with some exceptions of players assessing others as egoistic and not listening to their needs and preferences (see Fig. 4). Overall, the moderators valued the enthusiasm and ability of the participants to engage with their personas, something which is generally a concern when using personas in a design game (Brandt, 2006). The game was evaluated using feedback from the participants and the moderators.

Table 3 provides an overview of the most important elements of the game, their intended purpose, and comments from the moderators on these specific game elements. Considering the design elements and the game board, the game board allowed for too many 15-minute neighbourhood services to be placed, reducing the trade-offs between the essential services and decreasing the complexity of the game, which is not in line with the initial purpose of these game elements. This generally allows players to place their character’s desired elements, especially the elements needed to fulfill their goal, reducing discussion on which amenities are really a ‘need to have’ in their neighbourhood, as consensus is reached quite often. This was mentioned by multiple moderators as well: players’ satisfaction seems to rely mostly on them achieving their goal, not on the design of the whole neighbourhood.

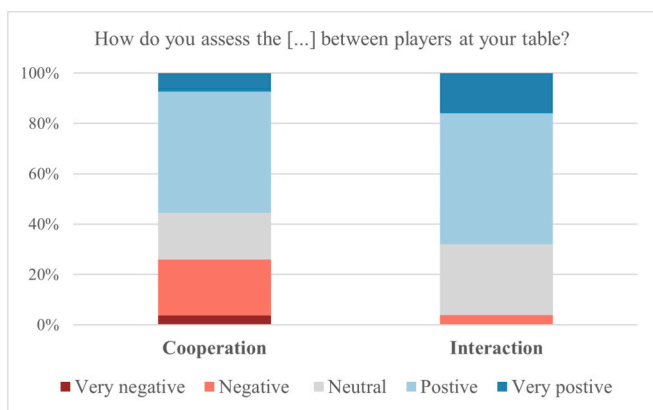


Fig. 4. Assessment of the cooperation and interaction amongst the participants of the 15mN-game.

Table 3

Overview of game elements, their initial purpose and summary of evaluation of functioning during the workshop.

Game elements	Purpose during game	Evaluation
Design elements	Discovering essential services & trade-off between services	<ul style="list-style-type: none"> There is a balance of popular and unpopular items [M.A] Some items seem too big and are never chosen or removed to make space [M.S, M.A, M.B] Removing items does not happen often, also at the end of the game when the board is full [M.C, M.A] Participants are missing housing as an element [M.C]
Character card	Facilitating players to design for (the goal of) a local citizen	<ul style="list-style-type: none"> Engagement of players with persona was high [M.A, M.C] Players focus on (re-)placing specific items since this is in line with their character [M.D] Some characters are more visible and have more impact on the game than others [M.C]
Evaluation card	Formulating a personal goal & stimulating to evaluate outcomes	<ul style="list-style-type: none"> Players tend to be fully satisfied when their targeted design elements are placed, with less focus on the general neighbourhood design [M.S] Satisfaction is very dependent on the specificity of the goal the player formulated [M.D] Difficult to determine if a personal goal is achieved when it is generically formulated [M.S]
Action dice	Stimulating negotiation and collaboration between players	<ul style="list-style-type: none"> Alliances are formed between players, especially those neighbouring each other at the table [M.S, M.C] Actions are predictable and not interesting after some time of playing the game [M.D]
Moderator	Guiding the participants and the game’s progress	<ul style="list-style-type: none"> After 30–35 min of playing, the game gets locked up, a moderator needs to step in and end the game [M.A] Moderator’s tasks are heavy, with both guiding gameplay and taking notes [M.S] Explanation of the moderator influences the way players formulate their personal goals [M.S]
Game board	Facilitating context & constricting the number of spaces	<ul style="list-style-type: none"> Board still allows for a wide range of design elements, especially when the larger elements are not placed [M.S] Players place certain elements at specific locations on the board, e. g., parking at the outskirts of the area [M.B] The game board is missing some level of detail [M.B]
15-minute city score	Comparing neighbourhood designs	<ul style="list-style-type: none"> No major differences in score between the games (see Table 2), might be caused by the game board allowing for too many design elements to be placed [M.S]

M.A, M.B, M.C and M.D = Evaluation by the moderator of games A, B, C and D, respectively. M.S = Evaluation from supervising moderators.

5. Discussion

The dynamics during the workshop of the 15-minute neighbourhood game aligned with the proposed benefits of serious games, namely, to increase the engagement and enthusiasm of its participants (Flores et al., 2023). Although the game was played during a workshop with experts

and not citizens themselves, the results showcase how a serious game can contribute to consensus-making and the discussion of various opinions of different population groups. The game grants players the option to set their own goals for their neighbourhood and to compare their viewpoint with others, allowing them to get feedback on their objectives and to connect with other players (Krath et al., 2021). These connections were visible during the workshop, as participants formed alliances with each other to achieve a (common) goal. During some games, this was more successful than others, and this is translated in both the final design as the satisfaction of the participants, emphasizing the benefit of collaboration in designing for citizens.

Design games need a balance between complexity and playability, something which can be difficult to accomplish (Habraken & Gross, 1988). The evaluation of the current version of the 15mN-game showed how some elements, such as the game board or action dice, were a bit too straightforward. For instance, the action dice had a limited number of possible actions, which get predictable after playing for some time (see Table 3). This potential lack of complexity influences both the engagement of players as well as the creativity in designing the neighbourhood. The use of evaluation cards aided players in envisioning their goals and translating their persona's wishes into actions and created tension for the participants while playing (Vaajakallio & Mattelmäki, 2014). The game allowed for cooperative interactions and a properly structured play, helping participants to respect each other's decisions and get a sense of community. This can be beneficial when the game is played with actual citizens, outside the controlled environment of the workshop.

Co-creation is inherently a process where citizens are involved in (De Koning et al., 2016), something that was not the case during the workshop in which the game was tested. The usefulness of the 15mN-game as a tool for co-creation is thus challenging to assess directly. The use of personas helped the workshop's participants to keep residents and entrepreneurs with diverse backgrounds in mind, simulating a play with actual citizens (Brandt, 2006). To improve upon this point, the description of the personas could be enriched to increase the experience and engagement of the players. Nevertheless, personas should not replace the co-creation of 15-minute neighbourhoods with its citizens (Pruitt & Grudin, 2003), but can help practitioners and policymakers to engage with a more diverse range of the population (Neate et al., 2019) and show that needs and preferences are different for every citizen. The 15mN-game emphasised this during the workshop, by showing that the implementation of the 15-minute neighbourhood with its focus on active transportation (Moreno et al., 2021), can be a challenging concept for people who are currently car-oriented. If the game will be used as a co-creation tool for real-life city planning, it is important that a proper representation of the public is engaged in the process, including citizens with potential conflicting interests, vulnerable groups and stakeholders from different sectors. Additionally, the game could be adapted to its local context, while keeping in mind its basic principles and ease of playing (Zhang & Zurlo, 2021).

The 15mN-game also confirms that the idea of the 15-minute neighbourhood is not a "fit for all idea" (Pozoukidou & Chatziyianaki, 2021, p. 22). Every design during the workshop was unique, and players made different choices on the essential services that were needed in the neighbourhood. Still, similarities were observed for the most popular services (e.g., *restaurant or healthcare facilities*) and services that seem less essential (e.g., *petrol stations or large public transport stops*). Designing a neighbourhood is also a trade-off of valuable space, an element which was also captured by the game; there was a trade-off between single, larger elements (e.g., *supermarket*) to multiple, smaller elements, increasing the diversity of land use within the neighbourhood (Allam et al., 2022).

To increase the usefulness of the game as a (co-creation) tool, adaptations could be made. A first limitation of the game is that negotiating with each other and forming alliances might be easier to do so with the person sitting next to you. Furthermore, the actions initiated by

throwing the action dice asked the participants to discuss placing or removing an element with the person sitting to their left or right, emphasizing the connection with their direct neighbours even more, while the game should contribute to engagement with all different groups of the population. Currently, the urban functions of living and working are also not visualised on the game board for the sake of simplicity, having implications and possible limitations for the design of a neighbourhood with mixed-use. This could be incorporated in multiple ways, for instance, by explicitly mentioning or visualising houses and offices on the game board, or by having design elements that have a mixed-use as well, by including a vertical dimension, as one of the participants suggested.

The absence of bike infrastructure on the game board could also have affected the results, especially players' selection of transportation elements. In addition, proximity principles among different items of the game can be evaluated, as certain combinations of elements support walkability and other 15-minute city principles. For instance, the combination of some transportation elements facilitates the creation of different types of mobility hubs and mobility meeting points that respond to the specific context of sites and user/non-user needs (e.g., a space that combines bike parking, grocery shop and bus stop). Furthermore, during the workshop, the game board deliberately represented a non-existing location, so participants did not benefit from having pre-existing knowledge of the local context. However, the local context of the participants (e.g., their country of origin or own research field) might influence the decision-making process and design choices, affecting the results of the workshop. When utilizing the 15mN-game, an oversimplification of the local situation should be avoided, to provide citizens with enough context to be engaged (Sousa et al., 2022).

6. Conclusion

Co-creation of the 15-minute city, by actively considering the needs and wishes of different population groups, increases its utilization. This study has developed a serious design game as a participatory tool for the co-creation of 15-minute neighbourhoods and gathered experts' opinions on the usefulness of the game during a conference workshop (n = 32). Based on existing literature, the current version of *the 15-minute neighbourhood game* is developed as an analogue board game, where players are encouraged to interact and discuss their needs. After the workshop where the game was played for the first time, most experts stated that the game could be a useful tool for practitioners in the development of 15-minute neighbourhoods. Applying the game with real stakeholders in a real-world setting would be needed to demonstrate its effectiveness. It can be concluded that most game elements fulfilled their intended purpose, making the 15-minute neighbourhood game a first step towards a proper co-creation tool for the design of 15-minute neighbourhoods.

Still, the game in its current form could benefit from some adaptations, focused on improving the interaction between players and adding a level of detail to the neighbourhood on the game board, to make sure the game fits the local context of the players. Every neighbourhood and its local population groups have unique features and different needs, and serious games, such as the one proposed in this study, should adapt to this situation to be able to identify the needs of local citizens and engage them in the transition towards more sustainable and liveable cities. The 15-minute neighbourhood game could be adapted relatively easy, by changing the selection of design elements to fit the local context or by changing the size of the game board relative to the design elements, representing a larger neighbourhood or city. Adapting the game board's background to a local neighbourhood is also a way to adapt the game better to a new local context, potentially increasing its recognisability. That would be particularly relevant for an urban outskirts neighbourhood, where relevant 15mC elements may be different when compared to those of the urban core. Applying this game in an urban outskirts neighbourhood would be most beneficial if embedded in a wider co-

creation process involving a complete governance framework and equity-based policies. For example, to learn the acceptable travel times and essential activities that must be present in an outskirts neighbourhood by different types of residents (Molinares et al., 2024). However, using this form of co-creation can also be challenging, as it asks for additional resources, which might be scarce, to adapt the game to the local context and occasion.

For future research, the game should be played with citizens in real-life cases, for instance large area development projects. Preferably this happens in both urban as well as urban outskirts contexts, adapted to the local situation. By doing so, it can be tested if the game contributes to the development of 15-minute neighbourhoods in multiple contexts. Furthermore, the impact of the 15mC-points is something that could be researched more, focusing on the trade-off of citizens choosing between the need for local services or travelling towards the city centre. When the game is played in multiple settings, a more profound analysis could be made of both the importance of the six urban functions as well as their contribution to the 15-minute city.

CRedit authorship contribution statement

Kelt É. Garritsen: Writing – original draft, Visualization, Validation, Resources, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Anna B. Grigolon:** Writing – review & editing, Supervision, Resources, Project administration,

Methodology, Investigation, Funding acquisition, Data curation, Conceptualization. **M. Baran Ulak:** Writing – review & editing, Supervision, Resources, Project administration, Methodology, Investigation, Conceptualization. **Karst T. Geurs:** Writing – review & editing, Supervision, Methodology, Funding acquisition, Conceptualization. **Lars Bodum:** Writing – review & editing, Validation, Resources. **Andrea Victoria Hernández Bueno:** Writing – review & editing, Validation, Resources, Conceptualization. **Tom Børsen:** Writing – review & editing, Validation, Resources.

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.

Acknowledgements

The authors gratefully thank the SmartHubs team (Hilda Tellioglu, Gerfried Mikusch and Marco Kadic) from the TU Wien, ACUR department, for their major contribution to the design of the game materials. Additionally, the authors thank Karla Münzel (University of Applied Sciences Utrecht) for designing the SmartHubs game for the Dutch living lab, upon which the 15mN-game was based.

Appendix A. Game elements of the 15-minute neighbourhood game

Appendix A provides an overview of the most important game elements of the 15-minute neighbourhood game: four out of eight character cards describing the persona (Fig. A.1.), an example of the evaluation card every player gets (Fig. A.2.), the instructions corresponding with the number thrown with the action dice (Fig. A.3.) and a small selection of the design elements used to design the 15-minute neighbourhoods (Fig. A.4.).



Fig. A.1. Example of the 15mN-game Character Cards.

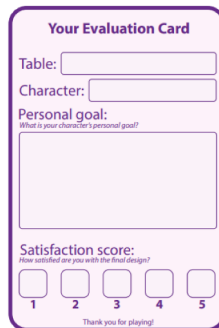


Fig. A.2. Example of the 15mN-game Evaluation Card.

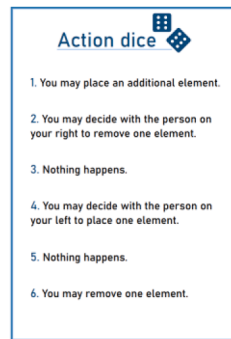


Fig. A.3. The 15mN-game Action Dice instructions.

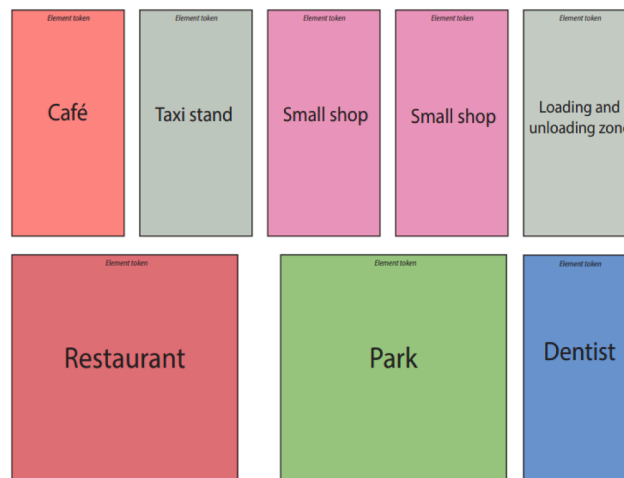


Fig. A.4. Selection of some of the 15mN-game Design Elements.

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