The Image of the City by Temporarily Displaced Children: How Place-Based Citizen Science Contributes to Place Discovery

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This study focusses on spatial knowledge acquisition among Ukrainian children, temporarily displaced as a result of a war and newly arrived in the Netherlands. As part of a place-based citizen science project, we conducted two sketch mapping sessions, one before and one after the project, to explore youth's conceptualization of the environment following a three-month residency in the new city, and to assess the impact of a two-week citizen science project on place discovery. Methodologically, we investigate the semiotics of sketch maps supported by individual interviews, and characterize types of knowledge and experiences reflected in the data. The presented work suggests that the sketch map representations capture the physical, emotional, and social contexts of youth's interaction with the new environment, while place-based citizen science provides an opportunity for direct and indirect spatial knowledge acquisition and enrichment of the city image with new meanings, contributing to place discovery.

Keywords: mental mapping; sketch mapping; place discovery; context; residential displacement

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1 Introduction and Related Work

People develop mental maps of diverse environments throughout their entire lives, both from direct (e.g., visiting a place) as well as indirect (e.g., studying a map) environmental experiences (Montello and Freundschuh, 1995). These internal spatial representations encode information used for determining one's location and other spatial relationships, finding one's way between places and communicating spatial knowledge to others (Golledge, 1999). Sketch mapping is a well-established technique that affords a lens into the way people conceptualize and experience their environments, and has a long tradition of being used in two lines of research – investigation of spatial cognition and exploration of the dynamics of human–place relations. The studies in the first line of research are often framed around the concept of familiarity, being based on either the recollections of known environments or environments that have just been explored. Sketch maps are often assessed based on indicators such as completeness and the accuracy of spatial relations, allowing to explore various factors affecting the quality of internal spatial representations and spatial knowledge acquisition – the structure and scale of the environment, sources of knowledge (direct versus indirect), type of experience (e.g., locomotion versus stationary viewing), type of locomotion, the presence of proprioceptive or auditory information as well as individual differences (e.g., skills and personality) in mental mapping abilities (Ishikawa and Montello, 2006; Montello and Freundschuh, 1995; Schwering et al., 2022; Weisberg and Newcombe, 2018). More generally, it has been proposed that spatial knowledge acquisition occurs in stages, proceeding from

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landmark to route and further to survey knowledge (Golledge, 1999). Highlighting the complexity of environments and distortions in our memory and judgments, Tversky (1993) suggests to use a *cognitive collage* metaphor for internal representations of complex environments not known to us in detail (overlays of multiple thematic perspectives of a place), and a *spatial mental model* metaphor for internal representations of less complex and small-scale environments. Studies with children highlight the critical role of movement and repeated encounters with the environment in spatial knowledge acquisition (Herman and Siegel, 1978). Adult-level variations in cognitive mapping are present by age 12 (Nazareth et al., 2018), although some children at the age of 9 to 12 may yet find it difficult to integrate knowledge acquired from different routes (Golledge et al., 1992).

In another line of work, sketch maps provide rich insights into the dynamics of human–environment relations and illuminate the role of individual and sociocultural factors in the experiences of geographies of everyday life. Following the United Nations Convention on the Rights of the Child and more recent initiatives such as the UNICEF Child-Friendly Cities, there has been a steady growth in research on children's sense of connection to community and place in their local and wider worlds, where sketch maps provide a playful method for working with youth (Freeman et al., 2023; Gillespie, 2010; Kelley et al., 2012; Matthews, 1995; White and Green, 2012). Thus, Gillespie (2010) provides a revealing account of the evidence of psychosocial barriers in the sketch maps of children from a more restricted cultural background (Amish) in comparison to non-Amish children, who enjoy more freedom in exploring the same surroundings in the USA. Freeman et al. (2023) unveil the role of social space as the strongest connector for Pacific Island children's spatial encounters as displayed in their sketch maps. Den Besten (2010) explores the neighbourhood sketch maps by immigrant children in Paris and Berlin, highlighting how '(micro-)geographies of emotions' are intertwined with individual migration histories and access to resources. The sketch maps also reflect the role of extra-curricular education ('reception' classes where youth are introduced to the local cultural phenomena) through the depiction of cultural-architectural symbols of the cities.

The present study leverages sketch maps to explore the conceptualization of a new home city by Ukrainian youth who recently arrived in the Netherlands, contributing to the line of work that explores the role of cultural background and context in place conceptualization – temporal displacement is characterized by a high level of uncertainty and other key challenges associated with residential displacements, such as the interruption of social connections. The study also explores the impact of a place-based citizen science project on spatial knowledge acquisition and the development of emotional ties and meanings, characteristic of the 'place discovered' stage of place bonding, the latter known to contribute to the well-being of refugees (Sampson and Gifford, 2010; Trąbka, 2019). Finally, we provide some insights into the semiotics of sketch maps, which remains a largely scattered area, with Gieseking (2013) being one prominent effort to systematically review the analytic components leveraged in sketch mapping studies. In particular, we address the following questions: (1) Which information is encoded in children's sketch maps, and how?; (2) How do temporarily displaced children conceptualize their new environment after a three-month residence?; and (3) How does a short-term place-based citizen science project contribute to place discovery?

2 Data and Methods

2.1 The 'Water Rangers Twente' Project

The 'Water Rangers Twente' took place in the summer of 2022 in Almelo, a small city located in the Twente region of the Overijssel province, the Netherlands. The project was developed for the temporarily displaced youth from Ukraine and had several aims ranging from education to data collection, including place discovery by newly arrived children. Seventeen children took part in this pilot project, with an average age of 10.6 (SD = 1.9), 11 (64.7%) of them female. All of them arrived in Almelo around three months prior to the start of the project and were living in the same emergency shelter ('Noodopvang' in Dutch), that we will henceforth refer to as participants' home residence.

The core activity of the project represented fieldwork, whereby participants worked in four teams going on bicycle trips to urban blue locations across the city, collecting data on water quality, but also on the attractiveness of visited locations for recreation. Field trips were conducted every day over a two-week period. The teams had an equal amount of fieldwork time, with each team making five trips of four

hours each. At the beginning of a trip, the team leader indicated locations that the team was planning to visit on the map (each team received an A3 paper map of the area, centred on their home residence and scaled 1:20,000), and the accompanying person – the community manager or the project PI – planned the route and led the way. At the end of the trip, teams marked visited locations on the map. On average, three locations were visited per trip. Jointly, the teams explored 57 unique locations during the course of the fieldwork phase. To enhance the entertainment component and encourage the exploration of the geographical area, the project introduced a gamification element, whereby teams collected points for the number of visited locations, travel distances, a balanced geographical distribution of visited locations in relation to the home residence, and geocaching tasks to encourage exploration of new places for recreation.

2.2 Data Collection and Analysis

As part of the study exploring the impact of place-based citizen science on place discovery, we conducted two sketch mapping sessions, one prior ('pre-programme') and one after the programme ('post-programme'). Participants were gathered in the same room and received identical sets of drawing materials. Following basic instructions to work silently and independently, the children were given the following prompt: 'Using the given paper and the drawing materials, draw a map of Almelo based on your understanding. You may include features such as buildings, roads, nature features, neighbourhood areas, and any other places of interest. Please give a name or word label for any specific places, to the best of your understanding. You may leave areas blank or unlabeled if you wish.' Once participants finished sketching, they were provided with the following instruction: 'Now, please use this red pen to draw a heart or star on your favorite locations on the map.'

To better understand the depicted features, we conducted individual interviews on sketch maps with each participant, three days after the second map sketching session. The children were asked for permission to record the interview, and 10-minute semi-structured interviews were conducted by the community manager, who received training on the protocols and procedure. The interview protocol included one open-ended question ('How are these two maps different, and why?') as well as specific questions to clarify ambiguous features ('What is this?'), and through this process, additional labels were separately added to the original maps by the interviewer. As part of the project impact assessment study, we also conducted 45-minute focus groups with each of the four teams, with one of the open-ended questions relating to place discovery: 'How, if in any way, has the project helped you to discover the city?' All seventeen participants took part in the current study. The research procedure and written consent forms for parents and assent forms for the children were approved by the Research Ethics Committee at the Faculty Geo-Information Science and Earth Observation (ITC), University of Twente.

Both sketch maps and transcripts of verbal data (interviews and focus groups) were coded in Maxqda (v. 22.2.1, 2022). In sketch maps, each feature was coded with respect to two aspects: the shape and the label, if any (e.g., 'Shape: ambiguous, Label: none', 'Shape: point, Label: Aktion (name of the store)'). Cases for which the semantics of the feature could not be derived from the shape or the label were marked for clarification during the interviews. Following the interviews, an additional section 'Comment' was added to the dataset, e.g., 'Shape: ambiguous, Label: none, Comment: Big neighbourhood on the map'. Combined together, information on these three aspects helped to define the semantics of the feature (e.g., a neighbourhood or a store). Features were further grouped into four broad categories: built space, green space, blue space, and other. Following Gillespie (2010), we also added an additional level of annotation to capture features reflecting 'recreation' and 'socialization'.

3 Results and Discussion

In what follows, we address the key findings and their discussion in relation to three research questions.

RQ 1. Which information is encoded in children's sketch maps, and how?

To this question, we provide initial insights into the aspects of spatial knowledge and platial experiences and their representation in both pre-programme and post-programme maps.

In many cases, the shape of a depicted feature provided a direct reference to their semantics. The most recognizable features were roads, houses, lakes, and rivers. The semantics of some places could

be derived through objects associated with them (e.g., depiction of fruit and vegetables on top of a house-shaped feature, representing a grocery store), or a combination of objects semantically belonging to one place (e.g., water, sand, chaise lounges, and a sun umbrella to represent a beach; cars and gasoline pumps to represent a gas station). Some children preferred to depict features as points or location icons. The semantics of the feature was then often conveyed through labels or additional symbols (e.g., a cross for a hospital). Many labels were straightforward (e.g., names of the stores), but some represented referential metonymies, with the place being labelled by one of its salient features. Notable examples include 'armchair' for a pond with an armchair dumped into the water, 'rabbits' for a park with a high population of rabbits, and 'litter' for a visibly littered pond. Some labels represented comments reflecting the observation of a place over time, e.g., 'has dried out' next to a pond-shaped feature. Other labels represented elaborated descriptions reflecting experiences with places (e.g., 'the legendary lake with a small island') or their location (e.g., 'a place downtown'). Some features remained ambiguous and would not be identifiable without comments provided during the interviews, such as a rectangle for a football pitch and a curved line for a road (which could also be a river).

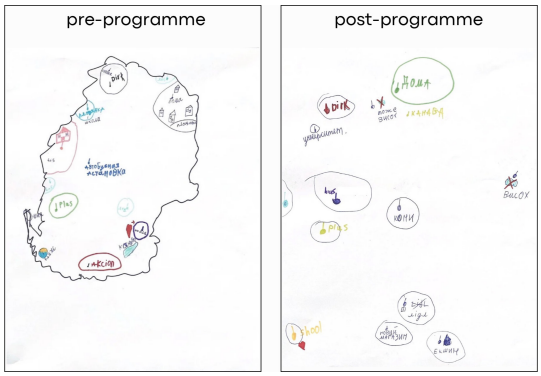
A number of peculiar patterns were observed by the authors and addressed by participants in the interviews. Semantic uncertainty was often represented through question marks or explicit labels 'do not know what this is' or 'some stuff'. Positional uncertainty could be observed through a visible difference in the depiction of semantically similar features within one sketch map. For instance, in one sketch map, we observed three instances of particular roads (drawn in a rather distinguishing manner) as well as multiple curvy lines, drawn in a rather abstract manner and representing the general knowledge of the existence of these features but not their concrete instances. Another interesting pattern referred to drawings of seemingly random objects such as hot air balloons and rabbits. At first glance, such objects lacked a clear denotative content and could be regarded as semiotic noise (Zelianskaia et al., 2020). However, children accounted for including such features as being frequently seen in the area. Indeed, hot air balloons are frequently seen in the skyscape of Twente, while rabbits are frequent visitors in urban parks and gardens. Finally, another peculiar feature – a boundary around the drawn area – represented the participants' awareness of unfamiliar areas and their spatial knowledge gaps (e.g., 'I didn't know what was there [beyond], so I just draw a line').

Examples of further elements that occurred in the participants' sketch maps and invite for further analysis are code-switching between Ukrainian and Dutch in the labelling of places, the use of vernacular toponyms (e.g., one street in one of the sketch maps was labelled 'Pushkin street', which is a non-existent toponym in the area), the depictions of the Ukrainian flag – all hinting at the sketch mapping as a social act of *place-making* and *self-continuity* through the depiction of one's self by means of cultural and linguistic signs, and organization of a 'story' that links the familiar past and the present (Albers et al., 2021). These preliminary insights support the view that sketch maps should be treated as social acts that draw on socially available ways of making sense, 'rather than neutral depictions of an external reality or of an internal cognitive realm' (Van Ommen and Painter, 2005, p. 506).

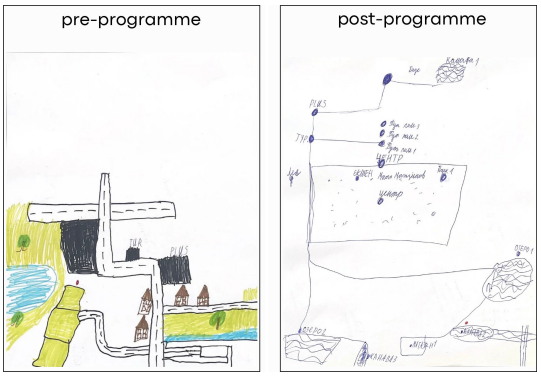
In terms of representation, most of the sketch maps adopted a bird-eye view, but we also encountered a street view depiction of the environment (Figure 1h). We also encountered a collage-like sketch map (Figure 1e), representing three non-integrated routes (to the school and two stores) alongside the detailed depiction of the home residence area, suggesting the co-existence of different types spatial knowledge (Siegel and White, 1975) and supporting the *collage* metaphor for internal spatial representations of large-scale environments (Tversky, 1993). In total, 484 features were identified in the pre and post-programme sketch maps, and the final coding scheme included 56 unique semantic codes. The built environment category had the largest variety of semantic codes and the highest frequency ($n = 320$), followed by urban blue space ($n = 95$), the urban green space ($n = 48$), and features categorized as 'other' ($n = 21$). The number of features included in each sketch map ranged from 4 to 31, with an average of 15.1 ($SD = 6.1$). The average number of features in pre-programme sketch maps was 15.1 ($SD = 5.6$), and in post-programme sketch maps, 15.2 ($SD = 6.7$).

RQ 2. How do temporarily displaced children conceptualize their new environment after a three-month residence?

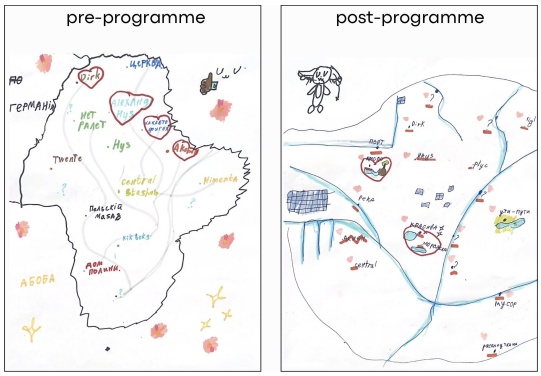
The pre-programme sketch maps showed a high level of agreement between the individual participants' sketch maps, with the home residence being represented in all sketch maps. According to previous



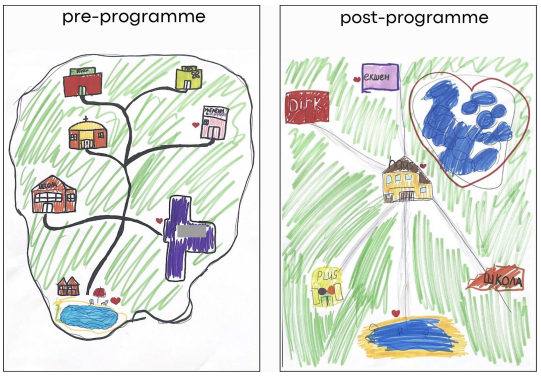
(a) Boundary around the drawn area



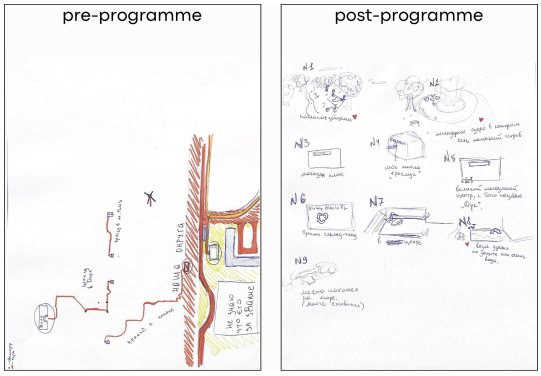
(b) Size of the drawn area



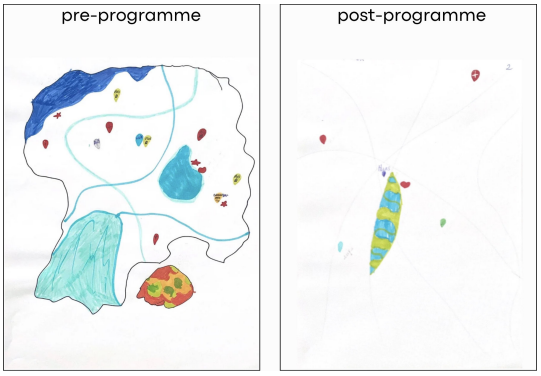
(c) Topological accuracy



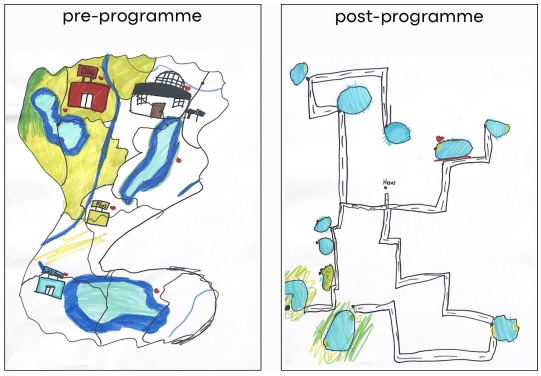
(d) Centring the home



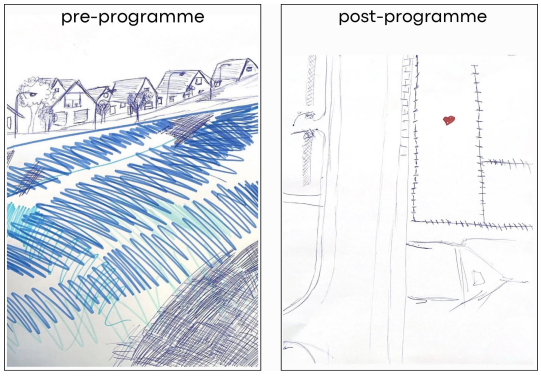
(e) Types of spatial knowledge



(f) Salience of the geocaching activity



(g) Urban blue spaces



(h) Perspective

Figure 1: Examples of pre and post-programme sketch maps drawn by the participants of the study. Each pair of sketch maps demonstrates an example of prominent differences between participants' pre and post-programme maps, captured in the supplementary labels. Where depicted in the original sketch maps, the name and the house number of the home residence have been concealed.

studies, the participants' homes often shape the prominent 'heart' of sketch maps (Gillespie, 2010; Van Ommen and Painter, 2005), suggesting that the current residence place provides a home-like environment for the youth and is associated with positive emotions, which is also supported by the fact that it is often marked as a favourite place in the sketch maps.

Apart from the home residence, the same core features (found within approximately a mile) repeated in many of the maps: a school, nearby grocery stores and supermarkets, a playground, a gas station, a lake with a beach, and a park. Many of these places, especially the stores, were referenced by name. These findings are in line with previous research suggesting that the recently arrived youth feel most at home in places that are close to where they live and go to school. The latter may represent 'safe places' from which recently arrived youth 'venture forth to explore the geographies of their new social and physical environment' (Sampson and Gifford, 2010, p. 121). In the context of newly arrived Ukrainian families, young children might also have limited freedom to explore the area without the supervision of adults, and the area exploration might be embedded into activities such as doing groceries with family members, which would explain the relatively high number of grocery stores and supermarkets represented in sketch maps. The occurrence of the same unique places across the maps might also indicate knowledge exchange about newly discovered places (such as stores and parks) within the community.

While many sketch maps included the same core features, further depicted features reflected the participants' interests and experiences. Thus, recreation places drawn by male participants often included football pitches and a stadium. Several sketch maps made generous use of natural elements such as forests and trees, lakes, rivers, and canals. Examples of places that occurred in one or two sketch maps only and represented more unique, individual experiences included a hospital, a church, a kickboxing club (the participant shared encountering the place by incidence and making a mental note to come back and try out this sport), and a stationery store (the participant shared being a keen drawer). In comparison to research on sketch maps by children who have been residing in their areas (Freeman et al., 2023; Gillespie, 2010), we have encountered little evidence for socialization at this stage, one exception being the depiction of a home of a new local Dutch friend in one of the sketch maps.

There were also notable differences in the geographical area covered and the level of detail. In two sketch maps, the drawn area was confined to the immediate area surrounding the home residence and included meticulous details, such as road marking, a bus stop, a horse stable across the road, small ditches (together with water plants), and a parking lot next to the home residence. One of these sketches adopted a street view, providing a rather artistic and vivid three-dimensional representation of the street where the home residence is located, with street lamps and trees, houses with chimneys and plants in the windows, reflecting the participant's keen observation and close interaction with the immediate environment. Other sketch maps, in contrast, included a much larger geographical area extending to the city centre (e.g., the municipality, the train station, cafes, and shops), with one sketch map including a border with Germany. This diversity might reflect different situations among the newly arrived families, whereby some of them are more mobile (e.g., have a car) and can explore the city with greater convenience; it might also reflect the participants' natural curiousity about the geography of the new environment and its indirect exploration through online maps – as shared during the interview by the participant who included Germany, they had taken time to study the area through Google Maps.

Apart from the home residence, places marked as favourite included schools, a football pitch, a lake with a beach, a stationery shop, a grocery store, a supermarket, a horse stable, and McDonald's. Some of the participants marked multiple places as favourite (sometimes with multiple hearts), with one participant drawing one large heart around the whole depicted area, suggesting a growing place attachment to the new environment.

RQ 3. How does a short-term place-based citizen science project contribute to place discovery?

Comparison of numbers of types of features in pre and post-programme sketch maps revealed a decrease in the number of built environment features, from 69.7% to 62.6%, although it maintained its position as the most prominent category of features. The number of blue space features increased

from 13.3% to 25.9%, while the number of green spaces saw a small decrease, from 11.2% to 8.6%. A two-sample t-test revealed no statistically significant difference in the total number of depicted features per participant across the phases ($t(29.14) = -0.06$, $p = 0.95$). However, a qualitative analysis of sketch maps, supported by the analysis of interviews and focus groups, revealed several patterns reflecting the salience of the experience of participating in the place-based citizen science project, and the acquisition of different types of spatial and platial knowledge.

The boundary around the drawing disappeared in post-programme sketch maps (Figures 1a, d, f, and g) due to the need to represent the newly acquired knowledge – in the words of participants, 'to draw the whole city', 'to make all lakes fit, as well as stores, grass and nature'. The drawn area was often visibly larger and took up more space on the sheet of paper than the pre-programme sketch area (Figure 1b). Some post-programme sketches were characterized by an increased accuracy, both in relation to topology and distances, often as a result of indirect experience, i.e., working with the maps. For example, the sketch map in Figure 1c was drawn by a participant who was responsible for marking visited locations and identifying locations to visit during the following field trip on the paper map of the area. One can easily recognize the large canal with three prominent branches and some other salient features that the team had not visited during field work. In the interview, the participant confirmed remembering some of the elements 'from the map'. In some cases, the place of residence became more centred between the pre and post-programme phases, which may signal more adoption of home, or, again, the role of interaction with the project paper map that was centred on the place of the residence, as in Figure 1d. We have also observed a switch in the map perspective, from a street view to a bird eye view, as represented in Figure 1h.

In general, the post-programme maps reflected various salient experiences during the programme, which supports previous findings on the selectivity of sketch maps (Blades, 1990). Given the focus of the project, it is not surprising that many post-programme sketches included new urban blue spaces, often in an abstract way (e.g., clustered, as in Figure 1d), to show their existence, rather than location. Also roads were prominent in post-programme sketches, as in Figure 1g, reflecting the strong movement-related exploration component of the experience. The positive emotions experience by participants during the exploration of urban blue spaces were also reflected by the marking of such places as new favourites. The most explicit expression of the close interaction with new places and the positive emotions might be the sketch map in Figure 1e. The pre-programme map depicts in detail the area around home residence and three oft-travelled routes (to the school and two stores). The post-programme map lacks the spatial component, depicting instead a set of numbered places. The drawings of the places include vivid details (e.g., lakes, trees, islands, and youths themselves, having a picnic in one of the places, with bicycles parked nearby). Some of the places are marked with rich descriptions (e.g., 'the legendary lake with a small island' and 'the place that looks like a sea, with lots of blackberries'). The salience of the geocaching activity is visible in Figure 1f, where the post-programme map focusses – albeit, almost exclusively – on the water body from the second geocaching activity.

When interpreting reasons for the differences between the maps during the interviews, participants often referred to newly acquired spatial knowledge (e.g., 'Because I got to know the city better') and highlighted which new elements now had to be depicted. During the focus groups, participants often started the discussion of place discovery with urban blue and green spaces. Apart from the latter, participants also mentioned newly discovered landmarks (e.g., 'a place with a beautiful arch') as well as areas ('I have found out there is something behind the school and the store'). One participant found out that the city was not very big in comparison to their home city: 'It takes 20 minutes to get to the outskirts of this city, while it takes 3 hours in [name of their home city].' Participants also felt that active exploration of the city during the project increased their ability to recognize places and use them to navigate and self-orient:

> Q1: I think I started memorizing the routes better, after seeing more of the city – the different places I had never been before, the roads I had not travelled before.
>
> Q2: When we cycled around during this project, we got to see more places, and I can now more or less self-orient in city. If I find myself in some place, I can self-orient, recognize the road, and find the way home.

4 Conclusion

Although childrens' sketch maps may appear to be full of idiosyncrasies and individualistic expressions of the space represented, they allow us to gain a deeper understanding of how children adapt to the challenges of temporal displacement. By observing how geographical features encountered in the world are represented in mental maps as well as how social and emotional context is imprinted on such representations, we gain valuable insights into the ways in which children engage in place discovery through the active observation and exploration of the new environment. Activities such as place-based citizen science enhance spatial route and landmark knowledge, but also provide space for deep interaction with the environment through the multimodal sensing, leading to experiential, embodied knowledge of places. Enriching the youths' image of the city with emotional ties and meanings contributes to place attachment, which is known to have an impact on the well-being of displaced residents. Importantly, such projects contribute to inclusive citizen science and may provide insights that can inform child-friendly urban planning grounded in cultural plurality.

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Author Contributions

E Egorova acquired funding for the 'Water Rangers Twente' project and contributed the main idea of this study. CJ Bae contributed the details about the method. E Egorova performed the data collection. E Egorova and CJ Bae contributed to the data analysis and writing.

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