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It's GIrls' Day! What sketch maps show about girls' spatial knowledge

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Abstract

This paper describes the analysis of sketch maps from girls who participated in the Girls' Day annual event in Germany. The event caters to girls from Grades 7 – 10 as an opportunity to experience various jobs that might interest them in the future, typically within the STEM-disciplines. One of the performed activities was asking the girls who participated to draw a sketch map of an area they are familiar with. We are interested in finding out how girls externalize the environment they were told to draw. The activity also helps us understand how they organize their environmental knowledge through sketch maps. This descriptive work deviates from gender comparison of map-making by focusing only on girls. This paper allows us to understand differences of girls' cognitive abilities based on what they have drawn on the map. The results showed that girls draw map ranging from egocentric pictorial representation with few details to survey structured map. More than 40% of the girls have included landmarks and streets outside the region of interest showing a more global view of the area. Landmarks frequently drawn showed visual, structural and cognitive characteristics. This study contributes to research related to better understanding of the cognitive abilities of young adults, particularly girls.

Keywords: spatial knowledge, sketch maps, girls, landmarks, Girls' Day

1 Introduction

People's cognitive map varies which shows different ways of how one's spatial knowledge is externalized. Some people sketch a known area with fewer details while others draw a more detailed map. Many factors could explain such differences such as environmental experience [1], spatial abilities [2,3] or gender [4]. There are various ways of how people acquire spatial knowledge. Siegel and White's [5] hypothesis show development of how people first learn the environment which is through paths. Montello [6] claim that adults already acquire landmark and configural knowledge when new in the environment. The elements which help build one's spatial knowledge had been investigated by Lynch [7]. Among them, landmarks appear to be widely used and extensively studied in the area of spatial cognition from its characteristics [8], function [9,10] and importance of location [11] specifically in wayfinding.

Development of spatial knowledge among children has long been investigated by psychologists, geographers, and cognitive scientists. Two opposing theories evolved from this research: In the constructivist approach it is being argued, that children are born without knowledge of space, and without a conception of the objects, which occupy and structure that space [12]. They construct their knowledge from the experiences they make in space. The nativist approach states that spatial understanding may be innately available to infant [13]. In the empiricism approach, spatial knowledge is primarily from sensory experience using basic minimal inbuilt capacities [14]. An adaption of these approaches could take a notion of innate abilities that are, contrary to the nativist approach, not impenetrable to each other but can be combined to create a comprehensive spatial representation of location, thus supporting the empiricist claim of using an intertwined mix of abilities to form a spatial representation that actually improves through interaction, as claimed by constructivists.

Sketch maps are spatial representations visualizing how people externalize their environment. Researchers have long analyzed cognitive aspects of sketch maps [15,16,17]. Tversky [15] investigated what sketch maps tell about how one thinks but that distortions are inevitable. On the other hand, other researchers have investigated correctness of sketch maps as it externalized what people know about the environment which could also show other important information that could not be found in metric maps [18,19]. Sketch maps have also been used in assessing what children have learned [20,21] and the differences of their cognitive abilities [22]. In this study, we focus our investigation on the girls' sketch maps based on a) mapping abilities; b) characteristics of landmarks and c) location of landmarks and streets comparing with metric maps. Results showed that more than 40% of the girls included other landmarks and streets that were not part of the region of interest. These could be helpful landmarks which they considered important to be shown for orientation purposes. This paper contributes to the study on understanding spatial knowledge of young adults.

2 Participants and Method

There were 13 girls from various schools aged 11 to 13 who participated in the annual Girl's Day event at the Institute for Geoinformatics, University of Muenster.

The girls were asked to draw any spatial feature they could remember inside the Promenade which is a bike and pedestrian lane encircling the city center. We gave them the cathedral in the center of the study area as a reference point.

They were given an A4 paper and a pen. No example was provided in order not to influence how they will draw the sketch map. They were given a maximum of 15 minutes to draw the map.

3 Results and Discussion

3.1 Mapping abilities

The girl's mapping abilities differ as shown in the sketch maps in Figure 3. Although, the task was to draw only features inside the Promenade, it showed that some of them mapped other features outside it. The inclusion of these features suggests that some people consider the importance of global features in externalizing any environment. It also showed in route maps wherein participants tend to remember and draw other landmarks both along and off the route in their sketch maps [23]. This shows that some people tend to include spatial features that will help the person orient himself/herself in the environment such as landmarks that are distant.

Figure 3 shows the different types of sketch maps some of the girls have drawn. Following Moore's [24] classification of sketch maps – Level I, Level II, and Level III, we identified similar-like classification from the girls' sketch maps. For Level I, the maps show an egocentric representation of the environment. An example is the Sketch map 1 where the participant only drew the church and some surrounding features. Sketch map 2 shows an example of Level II which is partially coordinated landmarks and streets. On the other hand, sketch maps 3 and 4 show some of the girl's survey representation of the area which could fall under Level III classification. The maps show coordinated spatial features and including other landmarks outside the study area.

3.2 Landmark characteristics

Prominent landmarks play a big role in place knowledge and navigation [8]. This is evident in most of the girls' sketch maps. The most common landmarks recalled and drawn are churches. Among all the landmarks drawn in Table 1, one is situated outside the Promenade which the girls included in their sketch map. This suggests that some girls have a global view of the environment and have considered it important to draw landmarks not only situated inside the area of interest but also those outside it which could be deemed important for orientation purposes.

Following the classification of Sorrows and Hirtle [8], the strongest landmarks in the environment showed the three properties (refer to Table 1): *visual*, *structural* and *cognitive*. Visual landmark refers to objects with distinct visual appearance such as the architectural design of buildings. Structural landmark pertains to the locational aspect and role of landmark in the space. Cognitive landmark, on the other hand, refers to landmark with personal meaning or importance which stands out in the environment.

Table 1: Characteristics of landmarks frequently drawn in sketch maps

Landmarks	#	Visual	Structural	Cognitive
Cathedral	11	•	•	•
Church 1	5	•	•	•
Roundabout*	5	•	•	•
City Hall	4	•	•	•
Bookstore	4	•	•	•
Church 2	3	•	•	•
Church 3	3	•	•	•
Parking Lot	3			•

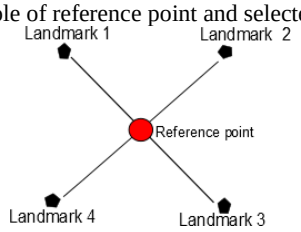
Note. The symbol # represents frequency of occurrence
**landmark outside the region of interest*

3.3 Comparison of sketch maps and metric maps

We compared with metric maps by counting the number of landmarks drawn in the sketch maps. We created a fix reference point or landmark (the cathedral) that frequently appeared in the sketch map. Figure 1 shows an example of the reference point and some selected landmarks. We selected a minimum of five landmarks in each sketch map and compared them with the correct placement in the metric map. This method is a simplified adaptation from Chipofya et al's [19] study but an extensive qualitative analysis of the landmarks and streets is beyond the scope of this paper.

In four survey type sketch maps tested, it showed that the girls have correct spatial relations of features which are close to the metric map. For instance in Figure 2, one of the girls drew landmarks outside the Promenade which showed almost correct positions when compared with the metric map. The average percentage of the four maps checked was 92.25% in terms of its correctness compared with the metric map. Sketch map 4 of Figure 3 incurred an average of 93.52% correctness where the girl drew landmarks both inside and outside the study area.

Figure 1: Sample of reference point and selected landmarks



With the cathedral as the reference point, it was easier for most girls to relate other prominent landmarks in the city as well as other distant landmarks. This relates to what Sadalla et al [25] highlighted in their study that making a prominent feature as reference point will make it easy for people to define positions of surrounding objects in space.

Figure 2: Overlaid sketch map and metric map

4 Conclusion

The sketch maps that girls drew showed differences in terms of details. Some girls have drawn less detailed sketch maps while others have drawn a survey map of the environment. In addition, some of the girls have included other spatial features that were not part of the study area. This could be for orientation purposes which they considered important to be externalized in the sketch map. This shows girls' awareness of the environment they are familiar with by including more features that will show an overall view of the area.

In comparing sketch maps with metric map, a prominent reference point played an important role in knowing the locations of adjacent spatial features in the environment which could help in the overall understanding of its spatial layout. This provides one way of knowing how to evaluate a person's knowledge of his/her environment.

This descriptive paper helps us further understand how girls visualize their environment which will develop more studies to facilitate girls' spatial thinking. For future work, spatial ability tests will be given to participants and an extensive qualitative analysis of the sketch maps will be conducted. We intend to use a recently developed drawing application for tablets which records the drawing sequence of the activity to better understand girls' spatial knowledge based on how they draw and organize the elements in the sketch map. It will also be interesting to compare sketch maps of girls across ages and cultures taking into account different experiences and exposure to maps and mapping in different educational systems.

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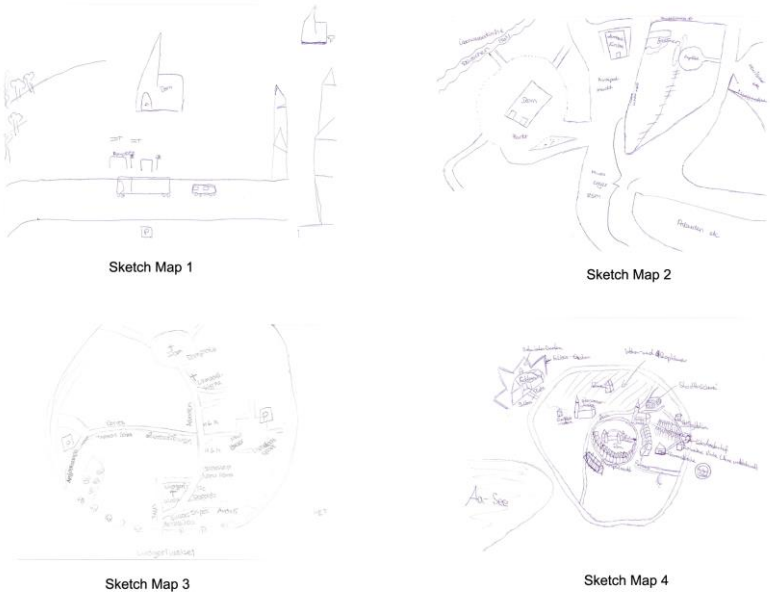
Figure 3: Examples of the girls' sketch maps



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