

# Visualizing Vagueness in Sketch Maps

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**Abstract.** Vagueness in sketch maps is evident but is understudied. This paper presents various ways in which vague places are visualized in sketch maps. We analyzed 40 different types of sketch maps of Muenster, Germany taken from our research group database that depict selected vague places in the city. We identified seven types of visualizations and found that people usually combine these types of visualizations in representing vague places.

**Keywords:** Spatial vagueness, visualization, sketch map, wayfinding

## 1 Introduction

Uncertainty refers to the cognitive state arising from the imperfection that results when making observations about the real world [1]. When dealing with spatial information, exemplary sources of uncertain information are sketch maps, where the real world is schematized in a distorted yet plausible manner. The information contained is valuable in tasks such as wayfinding despite being uncertain. Different types of uncertainty are manifested in sketch maps such as *inaccuracy*, *inconsistency* and *vagueness*. Of particular interest in this study, is the visualization of vague places. In this paper we focus on how different kinds of vague referents are visualized from an analysis of a number of sketch maps in Muenster.

Terms used in natural language are often vague, meaning there are boundary cases where it is unclear whether a qualifier, such as *tall* or *big*, applies or not. This is also true of places, where it is not clear whether a given location belongs to a vague vernacular region such as *city centres* as a consequence of their boundaries not being crisp. Delineation and visualization of such vague regions from volunteered geographic information or in the context of information retrieval has been studied by others [2]. These typically use kernel density estimates of sampled locations in a vague region to generate and visualize the boundary with a dependency on parameters such as the kernel size, number and spatial distribution of sampled points. The problem of visualization is approached here from the perspective of cognition, with the sketch maps serving as a reflection of the spatial representation.

## 2 Background

Several kinds of vague references are encountered in linguistic expressions. A vague reference is one, where it is unclear whether a predicate (such as ‘big’, ‘tall’, ‘mountain’) applies to it or not. A direct consequence of this is that the spatial extents and boundaries of the referents are unknown or ill-defined. Three distinct categories are of interest in spatial information [3]:

- General descriptions of places, which use count nouns such as *downtown*, *market-place*, *lake* which in many cases have unclear extents.
- Referenced places such as *Hafen* (harbour) or a university campus which are associated with specific space but exhibit similar problem with boundaries.
- Spatial relations such as *is near*, *in front of*, *along the* etc. commonly used in qualitative route descriptions.

In the context of this study on sketch maps, spatial vagueness refers exclusively to the first two categories. This includes places such as the Schloss (castle), which are well defined with a crisp administrative boundary. In vernacular usage, the administrative boundaries are largely ignored and the referent often includes the main representative feature or structure as well as other features in its vicinity. Also included are cases, where the place is non-contiguous and spatially partitioned into several chunks, which collectively are referred to by a single term. Other terms may be classified as vague. For instance, a large church or blue building, describe a landmark. However the qualifiers such as, *large* and *blue*, are attributes whose purpose is to highlight the salience of the referents in contrast to surroundings and are ignored here.

An important consideration is that of scale when dealing with maps. A point sufficient to represent a vague place on a small scale map, does not adequately convey the spatial extent on a large scale map. For a given scale, cartographic techniques generally employed in metric maps make use of label position and size to indicate the location, sometimes associated with a point or line feature, without explicitly marking the boundary of a place [4]. In dynamic maps, the zoom level alters level of detail of features and labels, with more local and additional information visible as the scale increases. Sketch maps are static, do not adhere to any standard techniques and offer a good insight into how people perceive and illustrate vague referents. The various visualization styles encountered in maps drawn at the scale of a city are discussed in the next section. Inaccuracies and inconsistency in position and orientation are ignored in the analysis, with the emphasis being on visualization of vague spatial features.

Sketch maps have been used in many studies as a tool to visualize how people represent their environment [5,6,7]. However, the aspect of correctness has been extensively studied such as the distortions in sketch maps [8]. Some scholars have looked at possible approaches to address the cognitive errors of representations in sketch maps using qualitative methods [9]. Although distortions are inevitable in sketch maps, there are other aspects that make it reliable and effective in communicating spatial information that might be helpful in wayfinding. There are elements which are

not shown in metric maps but are included in sketch maps. Visualizing vagueness in sketch maps is an understudied topic in spatial cognition. Hence, we investigate this aspect as we find it necessary to have an idea of how vagueness is usually represented in spatial descriptions.

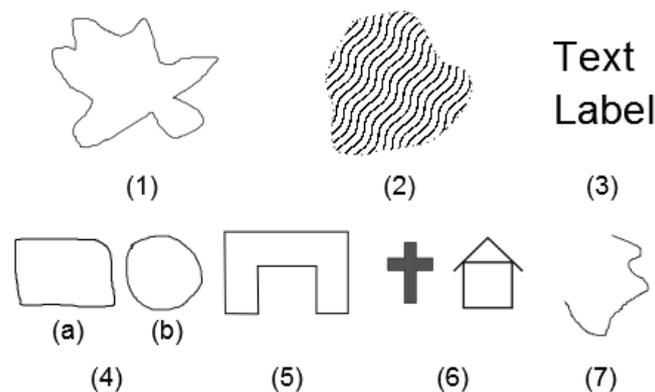
### 3 Empirical Study

#### 3.1 Identifying Vague Places

A preliminary evaluation of sketch maps was undertaken in order to identify vague places for the purpose of this study. We then checked the rest of sketch maps in the Spatial Intelligence Lab (SIL) database<sup>1</sup> to evaluate how the identified vague places are usually visualized. At the moment, the database consists of 209 sketch maps collected from various experiments of our research group. Among all these sketch maps, a total of 40 maps were analyzed because these included the identified vague places - the Schloss (Castle), a well-defined landmark, but sometimes treated as a region; the Universitaet Klinikum (UKM), a non-contiguous region and the Innenstadt (city center), a contiguous, but ill-defined region. These three places have been chosen not only because these are often mentioned in most wayfinding instructions but also people draw them differently either as a point feature or a regional feature.

#### 3.2 Types of Visualization

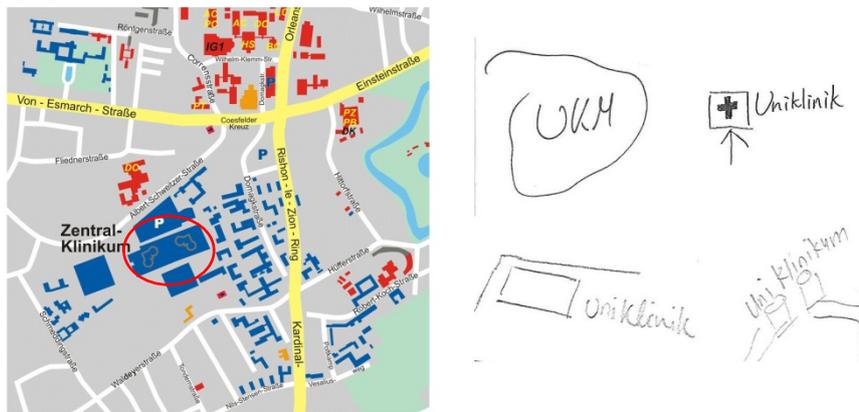
From these sketch maps, we identified various ways of how people visualized the Schloss, the UKM, and the city center. Figure 1 shows how the participants visualized the different vague places.



**Fig. 1.** Types of visualizations for vague places. (Fig.1.1 – irregular regions or places; 1.2 - unevenly shaded pattern; 1.3 – simple label; 1.4a – landmark in a bounded rectangle; 1.4b landmark in a bounded circle; 1.5 – as footprints; 1.6 – as symbols; 1.7 – incomplete shapes )

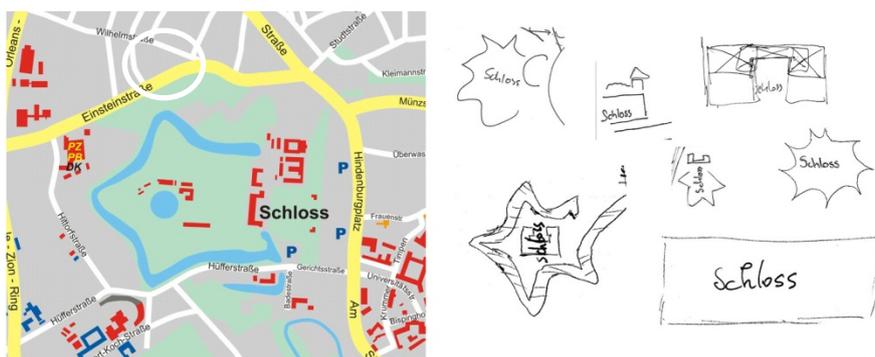
<sup>1</sup> <http://www.sketchmapia.de/main-downloads-area/sketch-map-database>

The following figures show both the metric map of the vague places and the different visualizations drawn in some sketch maps. Figure 2 shows the metric map of the location of the UKM (blue buildings). It shows also the dispersed buildings of the campus. In the sketch maps, people showed different ways of how they refer to the entire UKM. The campus itself has no formal boundary and people may refer to specific buildings located in the area as the UKM in general such as the case of the two towers (encircled).



**Fig. 2.** Metric map of UKM and visualizations in sketch maps  
(Map source: [www.uni-muenster.de](http://www.uni-muenster.de))

Figure 3 shows the Schloss and its surroundings. Most of the participants describe the whole Schloss in general not only referring to the building but the surrounding environment. It also reveals that some of them have drawn footprint to refer to the Schloss building.



**Fig. 3.** Metric map showing the Schloss and visualizations in sketch maps

With regard to the city center, people define the area inside the Promenade (broken lines in Figure 4) as the city center. As shown in Figure 4, there are different ways how people draw the extent of the city center. Some visualized it with an incomplete boundary and with broken lines. Most people drew a circle and wrote the place name (Innenstadt or city center) inside the boundary.

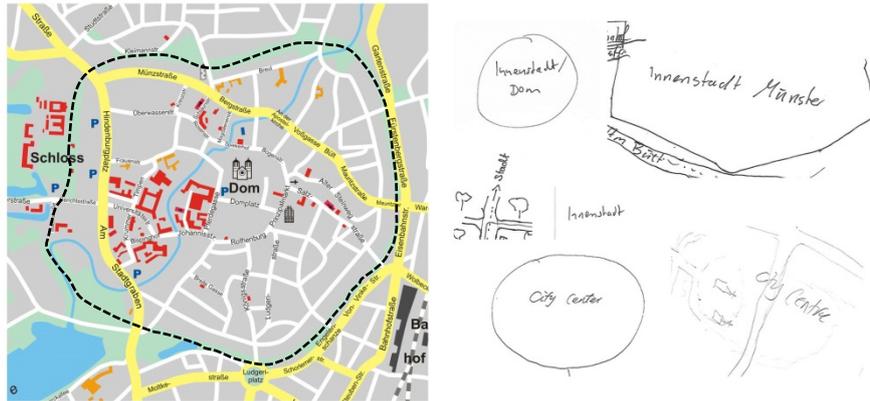


Fig. 4. Metric map with city center and visualizations in sketch maps

Table 1 shows the frequency of the classes mentioned. It presents the total number of visualizations of the vague places based on our classification. For UKM, the most common way of representing the area is through the third visualization, although some combine it with symbols. The Schloss, on the other hand, is visualized through the fourth type of visualization with labels. Participants would also use footprints to visualize the Schloss. As seen in the map, the Schloss has a distinct building footprint and a botanic garden behind it which was used by participants to visualize the region. The city center, as a vague place in itself, is visualized through name labeling with some of the participants visualizing it with either complete or incomplete boundary. A landmark within another spatial feature, which is the Promenade (see map), is used to represent the region.

In general, it shows that name labeling is the most common way of representing vague places with more than 50% of the total visualizations. Visualizations (Vis.) 4a and 5 ranked second and third, respectively.

Table 1. Frequency in visualization of vague places

Vague Places	Vis.1	Vis.2	Vis.3	Vis.4a	Vis.4b	Vis.5	Vis.6	Vis.7
UKM	1	0	6	2	0	0	2	1
Schloss	2	3	33	12	2	10	3	3
City Center	1	0	10	0	4	0	0	1
<b>Total</b>	<b>4</b>	<b>3</b>	<b>49</b>	<b>14</b>	<b>6</b>	<b>10</b>	<b>6</b>	<b>5</b>

Table 2 shows that there are many variations of visualizing vague places. Name label is the most common type but, this is combined with other visualizations. In the case of the Schloss, the most common combination is Vis.3 and Vis.4a. For the UKM, is Vis.3 combined with Vis 4.a and Vis. 6. The city center is usually drawn with a combination of Vis.3 and Vis.4b.

**Table 2.** Common combinations of the types of visualizations

	Vis.1	Vis.2	Vis.3	Vis.4a	Vis.4b	Vis.5	Vis.6	Vis.7
Vis.1			*					*
Vis.2			*					
Vis.3	*	*		*	*	*	*	*
Vis.4a			*			*		
Vis.4b			*	*				
Vis.5			*					
Vis.6			*					
Vis.7	*		*					

## 4 Discussion and Conclusion

People often use vague places particularly in giving wayfinding instructions, but these are hardly visualized in a map. With the sketch maps, we gain insights or ideas of how people normally visualize vague places. It resulted that people have varying ways in representing such places. Simple labeling appeared to be the most common method of describing vague places. But, oftentimes it is combined with other symbols or visualizations depending on how people represent the place either as a point feature or the whole region. Interestingly, people may draw a whole region and label it, although they only refer to one building. In cases where buildings are dispersed such as the UKM, people would usually refer to distinct features. This is commonly represented either as a point or a regional feature. Regarding the Schloss, participants tend to generalize the whole region as the Schloss wherein they include the botanic garden and the other buildings surrounding it. The city center, on the other hand, was visualized either as a regional feature or a simple annotation with text label without drawing any boundary.

This exploratory work paves way for further investigation on how people visualize vague places. It is considered helpful for such areas to be visually shown in maps or any navigation-related tools because most people use vague concepts in communication [10] and in providing wayfinding instructions. Through this approach, we gain insights of how other people visually represent vague places through sketch maps. The result of this study could be beneficial to researchers dealing with pattern recognition of sketch maps. This could also be used to enhance readability of maps as it provides insights to avoid visual clutters by showing only features of interest in the map.

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