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Cornelia Thierbach & Alexandra Lorenz [*]

Abstract: *»Erforschung der Orientierung im Raum. Ein Methoden-Mix aus fokussierter Ethnographie und standardisierter Befragung im Rahmen eines sozialwissenschaftlichen Experiments«.* This paper discusses how focused ethnography and surveys can be mixed within a social experiment in order to explore orientation in space as a social process (and not only as a cognitive one) and to examine the role maps have during this process. Our research design is based on a three-step interdisciplinary methodology, mixing cartographic methods with surveys and ethnography: (1) Cartographers developed maps for several paths through a Berlin university building from the ground floor (starting point) to the roof-top (finish). (2) Between 2009 and 2013, a social experiment was set up during five social events that drew lots of visitors. Volunteers first answered a questionnaire and then participated in a race from the starting point to the finish, using a randomly assigned map and a randomly assigned route (factorial design without control group). At the finish area, respondents answered another set of survey questions and evaluated the assigned maps. (3) Along the selected routes, members of the research team conducted focused ethnography in order to observe interaction among respondents, between other people, the map and the built environment. Comparing these various data sources, we will discuss what methods are suitable to find answers to our research questions, which are among others: How does orientation work? What strategies do people use? What should maps for (indoor) navigation look like in order to satisfy user's needs? Afterwards we will present selected results.

Keywords: Constitution of space, interdisciplinary research, mixed-methods research (MMR), social experiment, survey, focused ethnography, maps, cartography.

[*] Cornelia Thierbach, Technische Universität Berlin, Institut für Soziologie, Sekretariat FH 9-1, Fraunhoferstr. 33-36, 10587 Berlin, Germany; cornelia.thierbach@tu-berlin.de.
Alexandra Lorenz, Technische Universität Berlin, Institut für Geodäsie und Geoinformationstechnik, Sekretariat H 12, Straße des 17. Juni 135, 10623 Berlin, Germany; alexandra.lorenz@tu-berlin.de.

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1. Orientation in Space as an Everyday Activity[1]

Fairy tales, myths and legends are often read to or by children and young adults, and many of them have problems of *wayfinding* as a subtheme. The fairy tale of Hansel and Gretel is probably the most famous example. When Hansel and Gretel were abandoned in the woods, Hansel dropped pebble after pebble on their way into the woods so that they all in all formed a guiding route. After they were left behind by their parents, they waited for the moon to rise, so they had enough light to see the pebbles and then just kept track of them to find their way back home.

Another example is the myth of Theseus and the Minotaur from Greek mythology. The Minotaur (half man, half bull) is a man-eating creature. It was kept imprisoned in a labyrinth, a complex construction no one would find their way out alive. When Theseus decided to go into the labyrinth, Princess Ariadne who loved him gave him a thread that he could use to find his way out of the labyrinth after he killed the Minotaur. She told him to secure the thread at the entrance of the labyrinth and unravel it while he went inside. He did so, and after killing the monster, he found his way out by winding up the thread.

In everyday life, we usually don't unravel threads or drop pebbles everywhere we go to make sure we will get back home. But we still learn how to orientate in space. The question is: How are we doing that? What strategies do we use? And last but not least, what role do maps play during the orientation process and what kind of maps are suitable to navigate us through (indoor) space?

In order to address these questions, we will discuss current knowledge on orientation in space (1.1) and present our concepts of space and orientation in space (1.2). We will then explain the research design and methods we used to answer these questions and discuss the strengths and weaknesses of different data types.

1.1 Orientation in Space: A Brief Overview of Different Research Strands

To orientate in space is one of our fundamental abilities to survive, for instance to find shelter or food. Getting lost raises a strange and uncomfortable feeling of uncertainty and we try to avoid it. Not surprisingly, orientation in space has been studied for a long time. Due to new technological developments, research

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on orientation currently becomes more relevant again, especially when it comes to the design of virtual realities or new (public) buildings and also regarding new possibilities to represent maps (e.g. 3D-models of whole cities). Research on orientation can be roughly categorized into three groups:

1. *Spatial abilities*: Psychologists such as Piaget and Inhelder et al. (1971) have examined how spatial abilities differ depending on age. They describe four development stages of spatial abilities. In the first phase (0-2 years), children are only able to perceive space. Their motoric and cognitive abilities are still limited and they cannot orientate in space. During the second stage (2-6 years), children learn to locate their body in their environment, but only from an ego-perspective. They are not able to locate something that they don't see. This will become possible for children in the third stage (7-9 years). During the last stage (11 years), children develop more abstract spatial conceptions. Besides age, other factors are conceivable to influence our spatial abilities (e.g. health condition).

2. *Studies Examining Wayfinding Using Conceptions of Mental Maps*: Mental maps are cognitive representations of the environment that serve to acquire, store and decode information about spatial location. This concept is used to explain spatial learning processes and the appropriation of spatial knowledge.

The psychologist Tolman (1948) was one of the first who developed the concept of mental maps. He experimented with rats that had to find food boxes in mazes and found that they are able to memorize their environment. This he explains by arguing that rats create and use a cognitive map to find their way to get food.

Lynch (2010), an urban planner, elaborates on this by describing what kind of properties, forms and functions these images or mental maps might have and that these images can be used as strategic tools for orientation. An *image of a city* may contain paths, edges, districts, nodes and landmarks. When comparing images (sketch maps of cities) of different people, they can differ in relative density, their range of abstractness or concreteness and also according to their structural precision.

Using such conceptions, various aspects of orientation in space were explored. For example, Siegal and White (1975) argue that mental maps contain landmarks, routes and Gestalt. They describe three stages in which *spatial knowledge* is acquired: Landmarks are memorized first (*landmark knowledge*), routes are connections between landmarks (*route knowledge*) and the last stage is to know a structure of an area (*survey knowledge*).

Passini (1984) emphasizes the *process character of orientation in space* and defines it as a constant finding of solutions to spatial problems. It is a cognitive process that requires three distinct abilities: a *cognitive mapping ability* to understand our surrounding, a *decision-making ability* to plan actions and a *decision executing ability* to actually *do* something (Passini 1984, 46). Further he explains that decision execution can be seen as a matching feedback mecha-

nism. This means that expected spatial information (cognitive maps) are compared to the environment. If they match, then the decision can be executed. If not, then we have to find a solution to this problem.

Conceptions of mental maps are used to explain how we get spatial knowledge and how we use mental maps to orientate in space, but they only deal with *orientation as a cognitive process* and therefore they comprehend *orientation as an individual task*.

3. *Alternative Concepts to Mental Maps*: Some researchers such as Ingold (2000) argue that the mental map-conception does not match our perception of the world at all: We don't see the world from a birds-eye-view. Rather, we acquire knowledge about our environment when we move through it or act in it: "[…] *we know as we go*, from place to place" (Ingold 2000, 229) and not *"before we go"* (Ingold 2000, 230). Therefore, he differentiates mapping, map making and map using. *Mapping* is defined as an ongoing process of acquiring knowledge about the world by moving through it. Maps are not part of this process; nobody makes or uses a map for that. So in his terms mapping equals wayfinding, *map-making* is cartography and *map-using* corresponds with navigation (Ingold 2000, 231). Of interest to us are the differentiation of two forms of orientation (wayfinding and navigation) and the emphasis on action processes in space.

Another interesting study that opposes the mental maps-conception is that of Laurier and Brown (2008). They use an ethno-methodological approach and show quite vividly that *navigation* is a *group activity*, respectively, a *group performance* containing different practices, like asking somebody for help, dividing the group and each person has a look from a different perspective etc. Therefore they examine two different settings with real map readers and describe their course of actions. In the first setting, a group of tourists tries to find their way through a city using a guidebook and other resources to find a specific building. In the second setting a group of people makes a road trip by car and they use a road map. They show that for orientation in space not only maps and perspectives are of interest, but also the other group members, locals, the built environment, other publications, signage and texts. They all have got to be aligned. Their description points out the process character of orientation and they focus on observable action, interaction and group performances.

The studies presented here focus on different aspects of orientation in space, namely: individual spatial abilities, spatial knowledge, conceptions of mental maps, orientation as procedure, and different settings. All of these factors seem to play an important role, but still have to be synthesized into one approach (see subsections 1.2-1.4).

Most of these studies on spatial abilities and mental maps are dominated by psychologists and urban planners and conceptualize wayfinding as an *individual task*. These approaches are often used when it comes to developing maps or to designing buildings, because even when somebody is on her own, she has to

understand where she is supposed to go next to find a certain location. Generally, these studies do not pay attention to the fact that in everyday (public) life we are often not on our own. Instead, we are either in *(small) groups* or we are *surrounded by other people* who pass by or mind their business at certain places. We are very often able to ask somebody for help, but we can also try to figure out if we are in the right place or not by simply observing what people do at a certain place. Therefore, sociological approaches typically focus more on *interaction*, e.g. Laurier and Brown (2008). We, too, plead for such a perspective.

Finally, many important terms are often just mentioned and not properly defined. This sometimes makes it hard to figure out, if researchers mean the same in various studies. To give an example, the term "space" by itself has different meanings and is defined in many different ways not only across disciplines but even in one single discipline as sociology (see Baur et al. 2014, in this HSR Special Issue). Our next step is therefore to discuss our approach to orientation in space and to clarify our understanding of the following terms: space, knowledge, frame, action, strategic action and interaction.

1.2 Orientation in Space from a Social Constructivist's Point of View

In order to be able to synthesize the various factors discussed above and include the idea that *other* people are usually around us in everyday life and may help us orientating, we use a social constructivist perspective. Starting with Martina Löw's (2001, 2008) approach to space, we argue that the constitution of space as well as knowledge about space is produced through action and interaction. For Löw spaces are "relational orderings of people (living entities) and social goods" (Löw 2008, 38) and are constituted by means of two processes (concurrent processes in everyday life):

Spacing means that social goods and people have to be positioned or position themselves in relation to other things or living entities. For example, the room we are sitting in at the moment contains two desks; on each is a laptop and in front of each desk is a chair. The desks are located opposite of each other, so we both can face each other when we sit behind our desks as we do now. On both sides of the room you can find a bookshelf.

Placements have to be connected to form spaces through processes of perception, ideation, or recall. Such processes are called *synthesis* (Löw 2008, 35). You just synthesized information by concluding that desks, laptops, chairs, people sitting behind their desks, and action of working are often found in office spaces.

But, of course, we can also move the furniture and make something completely different out of the room. So, on one hand, the positions of the furniture in the room structure the space and tell us what to do there, which is what we

repeatedly do on workdays. But, on the other hand, we can rearrange the room and do something else in there. That is what Löw means when she points out that *ordering* includes *action* and *structuring* (Löw 2001, 225). During the courses of action, spacing and synthesis are mutually dependent and also depend on the context of action. Therefore, we can also state that space is socially constructed.

People and social goods may have certain *external effects*. People may place themselves or arrange positioning and influence the constitution of space by facial expressions, gestures, or speech. Social goods or objects may influence the constitution of space by their shape, smell or noises. This creates an *atmosphere* which could result in processes of *inclusion* or *exclusion*, not only for individuals but for (social) groups who have the same sense of well-being or sympathy at a place (Löw 2001, 65). For example, when you go out to a club, you sometimes have to know the dresscode in order to make sure you get in and do not feel alienated. Consequently, synthesis and spacing are bound to social group specific actions. You may identify a space as a specific one, because you have learned through socialization what kind of space you are dealing with and also how to act in it, at least you can recall similar contexts or you'll get to know new ones. That implies that the constitution of space is also tied to processes of *socialization* and *negotiation*, like what is suitable or what is inappropriate.

As Löw's (2001, 2008) approach defines spaces as outcomes of actions and positioning (spacing) which are also based on a construction process (synthesis), it is tightly linked to the term action and incorporates our thought that usually *we are not on our own when it comes to finding a specific location*. According to this approach, it also makes a difference when we see and observe other people or social goods at a certain place because it gives us an idea whether we are on the right track or not while orientating or navigating in space.

As mentioned earlier, we also have basic *knowledge* about different spaces and what they should look like even though we have never visited them, actually, due to our experiences or what we have heard about them. Phenomenologists such as Berger and Luckmann define knowledge as "[…] the certainty that phenomena are real and that they have definable characteristics." (Berger and Luckmann 2003, 1; own translation) They explain the production of knowledge through three basic processes: externalization, objectivation, and internalization, which are dialectically correlated. *Externalization* is the process of expressing something and thereby making it accessible to others. *Internalization* is kind of the opposite, meaning it is the process of assimilating the reified world during *socialization* (Berger and Luckmann 2003, 65).

The processes of typification, institutionalization, legitimation, and socialization explain the connection between both subjective and objective reality (Knoblauch 2005, 156), e.g. an individual's personal construction of space and

a social group's construction of space. *Typification* takes place in a person's mind. She categorizes her experiences while looking for similarities and differences. At a specific moment in time and space she matches her current experiences with already made ones, she recalls them and so, she can deal with a present situation using common courses of action (Berger and Luckmann 2003, 33). These typifications may be *objectified* or reified via a broad range of sign systems. Probably, the most important one is language. Because we often use linguistic objectivations, we are able to set up a common, societal stock of knowledge, which can be passed on during *socialization*. That is why our own knowledge and the knowledge of another person, at least partially, overlap and we are all aware of that. That is to say, we are all sharing a stock of knowledge (Berger and Luckmann 2003, 43). Our everyday stock of knowledge is structured by relevancies. That means, we do not have to know (and also do not want to know) everything (Berger and Luckmann 2003, 46-7). Therefore knowledge is distributed differently (Berger and Luckmann 2003, 47). Different kinds of habits may become *institutionalized* (Berger and Luckmann 2003, 57). In order to archive that, habits have got to be typified by actors reciprocally (Berger and Luckmann 2003, 58). This is how they become institutions. By this, they are made accessible to each member of a social group. But only when it is passed on to the next generation the objectivity of the institution hardens (Berger and Luckmann 2003, 63).

To sum up, *knowledge (including knowledge about space(s)) is socially constructed. Spaces are produced, reproduced and changed via interaction with others*. Consequently, there is a *stock of common knowledge about how to orientate in space.*

When enacting spatial knowledge in a specific *situation*, we usually refer to *frames* (Goffman 1980) that help us to understand what is going on in a situation. Frames are principals of ordering experiences and interactions. They are our view on a current situation when we ask ourselves, what is going on here (Goffman 1980, 16-9)? This also includes the fact, that different people may have different views on a situation. We can state that there is some kind of a definition or meaning of a situation that guides our perception and interpretation of reality, as well as our action and interaction. When it comes to orientation in space, it makes a difference in what kind of frames and contexts we are orientating. For example, when we get off an air plane, we can often just follow the crowd to the baggage claims to receive our luggage as most other passengers. It becomes obvious that frames play an enormous (often unconscious) role in our everyday lives and thus also in wayfinding or orientation in space.

That we rely on a common stock of knowledge during orientation does not mean that everybody orientates in the same way. We have a *subjective stock of knowledge* that we can rely on and that is also how we know what works best for us. During the *process of orientation*, people thus may use different kinds of *strategies* to achieve a goal: One person might be able to read a map well;

others look out for symbols that guide the way. Both of these options to orientate oneself in space are differently relevant to different persons. When Goffman talks about strategic interaction, he refers to a calculating way of looking at interactions that aim at maximizing personal benefits (Goffman 1981, 10). This he describes as *games* where rational actors observe a situation and then decide from a range of different possibilities that come to mind on how to react on it. Navigational tasks are similar to games without opponents. We therefore want to speak of *strategic actions* instead. So, we assume that people use different strategies during the orientation in space, especially during navigational tasks.

1.3 The Role of Maps during Navigational Tasks

Maps are very important for the constitution of space, since they convey knowledge about space. Essentially, they are representations of space. Sociologically, they can be seen as a *means of communication*. Their content has to be understood by its users (Pickles 1992; Harley 1992; Harley and Woodward 1987; Kraak 2001). Otherwise they fail to guide us. At the same time, they also produce space (Dünne 2008, 51-52; Baur et al. 2014, in this HSR Special Issue). They help us to get (at least) a cognitive image of the world. So, we are able to picture certain locations or ways to get from A to B, even though we haven't actually been there before.

Debates in human geography and in cultural studies stress that maps are *socially constructed*, too, which corresponds with what we have described earlier. Every visual representation displays a subjective selection of aspects that are relevant for a specific map task and also the way they are presented is of significance, since it shows social intentions and influences the way users perceive it. Thus, maps are not just an image or representation of the world, they include more than just facts and therefore they are never objective (Harley and Woodward 1987, xv; Harley 1992, 234-37; Cosgrove 2005, 30-1).

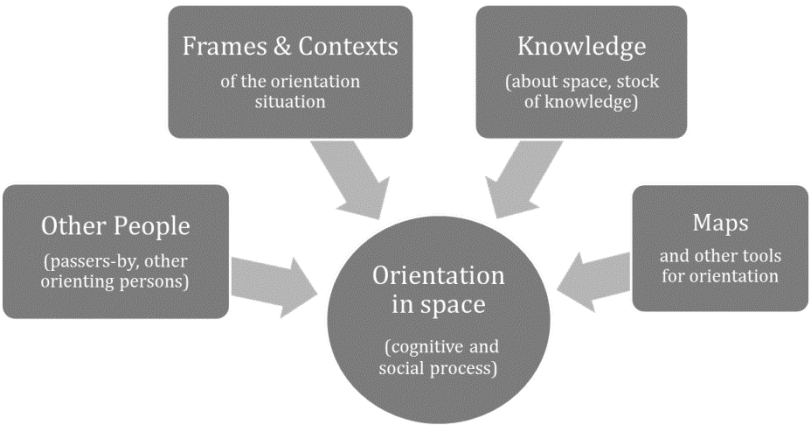
While questions about map design and guidelines as well as standards for map design are constantly debated in cartography (e.g. Kueh 2007; Puikkonen et al. 2009; May et al. 2003; Vinson 1999), social sciences discuss them only in the margins. Mainly, the ideological content of maps is of interest here, which is communicated through the way the world is represented in maps (Barnes and Duncan 1992; Löw, Steets and Stoetzer 2008; 67-71). An exception is Röhl and Herbrik's (2008) study on maps of imaginary spaces during role playing games. They show that maps not only help us to locate ourselves in the world, but also they can be used as means to actively create a meaningful place in which we are entangled. Finally, when we think about the users of maps, it is obvious to us, that there is an urgent need to evaluate map design aspects in order to improve their usability.

1.4 A Sociological Model of the Orientation Process

Figure 1 summarizes the factors that influence orientation in space and that we have to keep in mind for data collection, data processing, and data analysis:

1) *Strategic Action:* We can assume that people act strategically when it comes to navigation through space.
2) *The Role of other People:* Orientation is not only a cognitive process, but may be additionally considered as a social one. That is because we define space as well as knowledge as socially constructed, meaning through actions and interactions with other people.
3) *Frames and Contexts:* Spatial orientation takes place in different contexts and frames, which help us to understand what is going on in a situation and they guide our actions.
4) *Knowledge:* When we orientate in space we can resort to a stock of knowledge.
5) *Maps* are crucial to navigation tasks because they represent spatial knowledge visually. Map design aspects have got to be evaluated.

Figure 1: Factors Influencing the Orientation Process

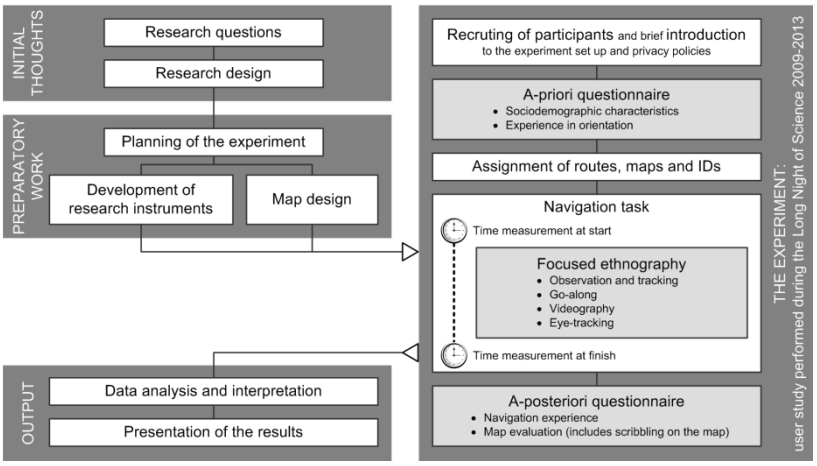


2. A Social Field Experiment of Map Use as Research Design for an Interdisciplinary Collaboration between Cartography and Sociology

Our main research questions deal with the process of orientation, strategies people apply during orientation, and what kind of maps are suitable to navigate us through space. Such extensive research questions seem to be overextending the skills of just one discipline. Thus, our collaboration between cartography and sociology is a perfect match that ensures different areas of expertise: cartographic methods and social research. Our research team decided to perform a *social field experiment* (Atteslander 2006; Friedrichs 1985; Zimmermann 1972) on orientation and map use. Figure 2 summarizes the research design we developed together with Nina Baur.

We started by identifying relevant research topics and the formulation of our research questions, which we already presented above. Consequently, we prepared our field experiment. For the sociologists (Nina Baur and Cornelia Thierbach), this included the development of all research instruments (e.g., survey questionnaires and focused ethnography). For the cartographer (Alexandra Lorenz) this involved choosing several paths through a Berlin university building from the ground floor (starting point) to the roof-top (goal) and designing indoor navigation maps for these paths.

Figure 2: Overview of our Research Design



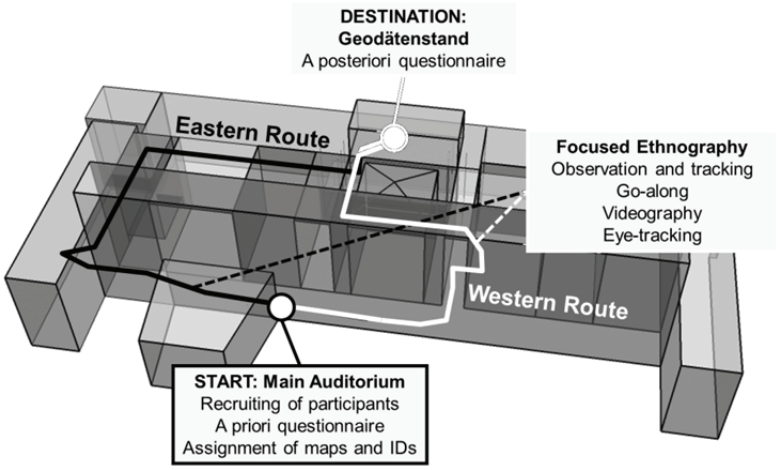
On this basis, between 2009 and 2013, we set up a social experiment (factorial design without control group) during five social events that drew lots of visitors. Field work was supervised by Nina Baur, Leila Akremi and Cornelia

Thierbach and was conducted by sociology students of Technical University Berlin. Specifically, the students recruited volunteers for the experiment. After being recruited, volunteers first answered a questionnaire and then participated in a race from the starting point to the goal, using a randomly assigned map (factor 1) and a randomly assigned route (factor 2). At the goal, respondents answered another set of survey questions and evaluated the assigned maps.

Along the selected routes, students supervised by Cornelia Thierbach (and in some years additionally by René Tuma) conducted focused ethnography in order to observe interaction among respondents, between other people, the map and the built environment. Figure 3 visualizes the experiments' setup and the two selected routes within the university's main building.

The most important aspects of our research design, such as sampling, experiment context, variation of map contents, variation of routes, controlling of compound factors and identification numbers will be discussed in the following sections. Main data and methods we apply in our experiment (namely surveys, focused ethnography and scribbling on maps) will be discussed in the following chapter.

Figure 3: Setup of the Experiment



When it comes to the analysis and interpretation of collected data, members of both disciplines (sociology as well as cartography) have been discussing assumptions, preliminary results and final results together. Of course, not everything is of interest to everyone, and some kinds of data are more relevant than others, but all in all it is important to get ideas from different points of view, to detect similarities and differences. It enriches both our perspectives. Cartographers are interested in the evaluation of maps and in the end in developing a

catalogue of design recommendations for indoor navigation maps. Sociologists focus on the constitution of space, on the social process of orientation, on orientation strategies and hence, on spatial practices. However, both perspectives are needed when it comes to improving research instruments for the next run and to discussing what kind of map variation should be designed for it. This might either be the improvement of maps or (and this is what we have done mostly) to focus on different cartographic methods which might also influence user's satisfaction with maps.

Because the experiment was organized as a trend design of six waves (the last wave being planned for 2014), we could enhance the research design from year to year, learning from the findings of the previous years.

2.1 Sampling Strategy and Context: Long Night of Science

Three problems we had to solve: finding *people* who orientate themselves with our developed maps, finding a *proper location,* and of course we needed a *time schedule* when data collection was taking place. We chose an annual event called the "Long Night of Science" (Lange Nacht der Wissenschaften, LNDW) (LNDW e. V., Pressestelle TU Berlin)) as a frame for the social field experiments in five consecutive years (2009 till 2013). For this event, all scientific institutions and departments in Berlin and Potsdam are invited to present themselves to the public by giving lectures, presenting research results, displaying installations, conducting guided tours through their laboratories, explaining experiments or demonstrations and so on. The LNDW is supposed to give everybody an idea of what is going on in different scientific communities, to get children and young adults interested in science and of course to arrange a fun program for this huge event.

Using the LNDW as framework guarantees us a broad base of people, since it draws a crowd of people who are interested in science. They actually have to pay an entrance fee in order to get in and to get entertained with news, lectures and experiments. Families are more than welcome. There are special tours arranged for kids, and last year the experiment was part of one. This of course influences our sample.

The main building of the Technische Universität Berlin (where the experiment took place) is a very popular location at the event. In 2013, about 9.000 visits were counted (con gressa GmbH 2013). Here, one attraction is the great science show that is usually presented by a famous German TV host. Another attraction is the project "fantastic worlds of sound". Both are located on the ground floor near the starting point of our experiment. During breaks, crowds of people just pass by and interviewers may ask them to participate in our project. Additionally, there are lots of other projects that guarantee continuous flow of people to visit the main building.

Convincing people to participate in our project is fairly easy. They pay to participate in scientific projects, and we have prepared an additional list of good reasons when we recruit people:

1) Visitors are part of real scientific research and as such are able to see new developments in map design.
2) People like to take the challenge of a race.
3) We promise participants a free cup of coffee or juice. Additionally, the view over Berlin's landscape is exceptionally beautiful from our finish area. Both together guarantee a couple of minutes of rest.
4) Actually not decisive, but nice to have, are our tombola and little incentives at the finish area.

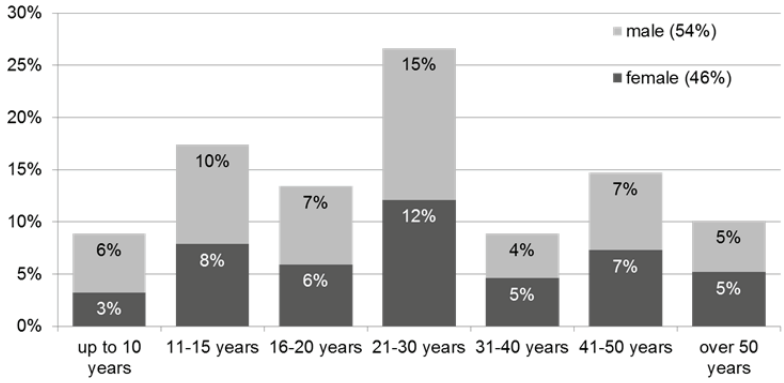
Actually, we included a question about reasons to participate in our a posteriori questionnaire in 2009. Basically, most people answered, that they wanted to have fun, were interested in science, wanted to see the rooftop and enjoy the view, and there was also a kind of peer-pressure involved, meaning that if only one person out of a group wanted to participate while we recruited them at the entrance mostly the whole group participated in order to not split up or to be kind (own data, 2009).

By participating in this event, we thus have a date for data collection which is the date of the event. On the one hand, this frees us from inviting a lot of people to the experiment or recruiting them from outside the building walls. On the other hand, this poses a sampling problem in so far as only people interested in science and able-bodied enough to walk up to the 5th floor of a university building could participate. The event also pressured us in logistically preparing data collection, because we could not reschedule it. All preparation needs to be done by this date. About 100 persons are involved in the field phase per wave. Additionally, the event only lasts for seven to eight hours. When something goes wrong, we cannot rerun it. Sometimes, mistakes only show up at the end of the day and we therefore just have to deal with them.

So far, we have been able to recruit over 1.000 participants per year with different professional and social backgrounds. Among them are people of all age groups, (with the exception of really young children and people with walking disabilities or with problems of the cardiovascular system; that is due to the navigation task that includes walking stairs for about five to seven stories). For legal and ethical reasons, kids under the age of 12 were asked to be accompanied by related adults or friends.

For example, in 2011 1.140 people participated. The youngest contestant was 4, the oldest 78 years of age. The gender distribution was almost balanced, that is 54% male participants and 46% female participants. Figure 4 shows both, age distribution and gender distribution in 2011.

Figure 4: Age and Gender Distribution in 2011 (n=1.140).



2.2 Variation of Complexity of the Orientation Situation: The Routes

That the main building is a real attraction during the Long Night of Science was not the only reason why we chose it as location for our experiments. The main reasons are the properties of the building itself, which enabled us to control the complexity of the orientation situation in the form of different routes (factor 2) in our experiment: It was reconstructed after destruction during World War II and consists of a complex architectural structure with two components: an old building and a new building that are linked through an intricate system of staircases that sometimes take the form of rat runs and thus, are hard to find (not only) for people who do not know the building at all. Additionally, both building parts exhibit different roof levels and different floor heights which eventually make it hard to figure out on what floor of one building part one has to change over to the other.

The finish area of our experiments lies on top of the old building part, which is on the fifth floor of the old building, but on the sixth floor of the new building. However, participants are able to access it from both building parts. All in all, it is a complex environment for navigational tasks. It is thus well suited for our experiments and a difficult challenge for designing indoor navigation maps and their testing.

We assumed that the complexity and length of a route influence the orientation process. Hence, we decided to vary both by choosing two different routes. Both start at the entrance hall of the main building in front of the main auditorium and lead to the Geodätenstand, a geodetic laboratory on the roof. The average walking time for people who are not familiar with the routes is about ten minutes. The Eastern route is a bit longer than the Western route and is characterized by fewer decision points and turns, one long corridor without

visual cues, and only one changeover between both building parts. Therefore, it is much simpler. In contrast, the Western route is shorter, but more complex. This is due to more changeovers, route parts are within and outside the building, and more windings. Thus, it is also more complicated to visualize the route from a cartographic point of view.

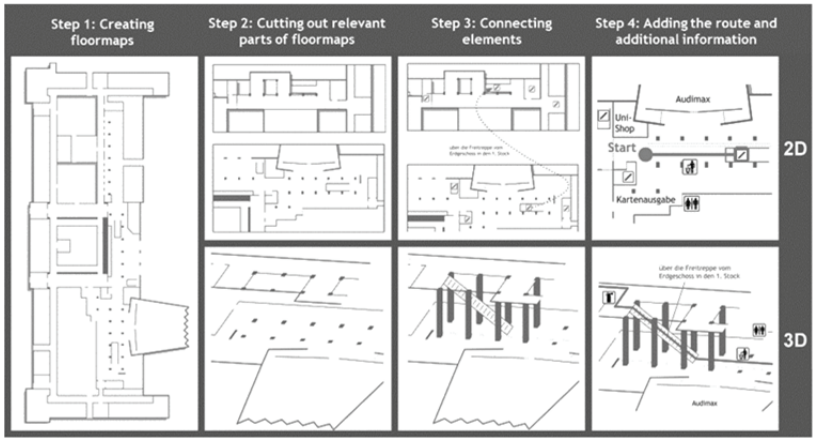
2.3 Variation of Complexity of the Maps: Creation of Maps and their Variations

In order to find out what kind of map is suitable to navigate people best to a location, we have to develop *different map variations* (factor 1 in our experimental design). These variations should be done systematically, so we would be able to identify the reasons for why a specific map variation works better or is preferred by users. We have to decide what kind of map features should be tested (e.g. perspective: 2D or 3D, additional information: in form of texts or pictures etc.) This also means that they have got to be used in a real scenario because only when put to the test they might be judged by their effectiveness to guide. This too, suggests that we could observe real map users during the orientation process as well as let them evaluate the used maps after navigation.

We developed paper maps in A4 size because the route should be visible at a glance. Without being folded, the map should contain all relevant information for visitors to find the goal. Providing navigational devices would have been out of budget and too hard to ensure the return of the devices.

The map variations are based on existing floor plans. We generalized them for the final representation scale (step 1), i.e., we had to identify and select relevant architectural structures, simplify the geometries and exaggerate important details. For the purpose of navigation, we decided to only distinguish indoor hallways, rooms, outdoor paths, and roof areas, each colored appropriately. Additionally, we had to amalgamate building parts in accordance to their function. For each floor, we cut out the relevant parts and arranged them accordingly (step 2). Afterwards, we had to insert connecting elements like pillars or stairs (step 3). Then we added the route and navigational hints and symbols. Figure 5 shows the basic steps of map creation in brief.

Figure 5: Map Creation Process



The maps have got to be designed correspondingly for both routes; otherwise we cannot for sure explain whether something is caused by map features or by route differences. In addition, map design aspects vary systematically for each route. This gives us the opportunity to analyze their suitability with respect to context settings. In 2011 for example, we focused on two map design aspects: representational perspectives (2D and 3D) and two types of landmark representations per route (natural versus artificial landmarks represented as symbols along the Western route and natural landmarks represented in symbol versus textual form along the Eastern route). Figure 6 points out what map (# equals number of map) contains what kind of representational perspective and what kind of landmark representation. If you want to have a look at these maps visit our website of the Institute of Geodesy and Geoinformation Science (Lorenz).[2]

Figure 6: Systematic Variation of Different Cartographic Methods Applied and Evaluated in 2011

#	Western route	#	Eastern route
11	2D natural landmarks (symbols)	12	2D natural landmarks (symbols)
13	3D natural landmarks (symbols)	14	3D natural landmarks (symbols)
15	2D natural + artificial landmarks (symbols)	16	2D natural landmarks (symbols + words)
17	3D natural + artificial landmarks (symbols)	18	3D natural landmarks (symbols + words)

Routes and maps are assigned randomly to the participants. Thus, participants are sorted into one of the experimental groups. In 2011, we had eight experi-

[2] <http://www.tu-berlin.de/?id=110900>.

mental groups and no control group, i.e. every case received one of the maps as a treatment.

2.4 Challenges in Social Experiments – Controlling for Confounding Factors

While conducting social experiments, errors might occur either caused by the experimenter or by test persons (Zimmermann 1972).

Experimenter bias occurs if the experimenter's expectations influence the participants during the experiments. Further, the experimenter can be seen as a stimulus to respond because of her personality or her social background and thus also influence participants unconsciously. This, we are avoiding by experimenter training and giving them specific instructions on how to word directions. Also, the maps were randomized in advanced, and experimenters could not see them before having given them to the participants of the experiment. Additionally, we are employing many experimenters with diverse backgrounds.

Demand characteristics describe the way test persons adapt to the experimenter's expectations. Even if no expectations are mentioned, participants interpret the situation and think about what the outcome is, why they are doing it. This was limited by using many experimenters. It relativizes individual interpretations.

Furthermore, errors concerning the *external and internal validity* have got to be taken into account (Behnke, Baur and Behnke 2006; Friedrichs 1985). External validity describes the extent to which results may be generalized. Internal validity refers to the accuracy of measurements.

The described experiment is a so called field experiment (Friedrichs 1985; Atteslander 2006; Zimmermann 1972). It is therefore very close to reality and guarantees a high external validity. However, an absolute control for confounding factors is impossible. Thus, the internal validity is lower when compared to laboratory experiments.

Hence, we have to control for confounding factors, which is one of the key elements of experimental designs. It is realized in order to eliminate external influences, or at least to identify them and to control them at best. In our case, we tried to do so by using a *factorial design without a control group* (Behnke, Baur and Behnke 2006) involving the following elements:

1) *Measuring of Control Variables:* The survey questionnaires include questions about prior experience, demographic information, experiences during the navigational task, course of action, usage, and evaluation of the assigned map. According to our theoretical approach, these variables influence the navigational task.
2) *Treatment, Division in Experimental Groups and Randomization:* We perform a controlled variation of map design features and routes. Participants are assigned different maps (*treatment*). The assignment is realized random-

ly (*randomization*). These maps divide participants into groups that have to follow one of two parallel routes and into groups testing different kinds of map variations (*division in experimental groups)*. Experimental groups are of similar size. This is realized by sorting the created maps in two piles (one for the Eastern route, one for the Western route) and the map variants within each pile must be ordered in a specific way. None of the instructors should change the order, e.g. hand out an apparently easy-to-read-map to people they know or prefer.

3) *Time capture:* After being assigned their map, participants start the race and the start time is captured (*pre-measurement*). At the finish, we stop our time capture (*post-measurement*).
4) *Additional hints*: The appliance of ethnographic methods during the navigational task helps us to find out which variables might be useful for further interpretation.

2.3 Privacy Policies and Record Linkage: The Identification Number-System

Due to privacy policies, we do not collect personal data that can be linked to a specific person or that enable us to draw conclusions about who a test person is in real life. But we still want to combine different data of our applied methods (record linkage), e.g. create one dataset which contains answers to questions of the a priori questionnaire and of the a posteriori questionnaire. Hence, every participant receives an identification number before the navigational task starts. At the same time, we inform participants about privacy policies and emphasize the fact that the entire staff signed a declaration on the protection of personal data. This ensures that none of the data collected during this social experiment is going to be passed to third parties, nor do we execute person-related analysis. If a participant wants to join the tombola after the navigational task, she of course has to give us her address, because we want to ensure that we could send her the prize if she is not present during the drawing of lottery tickets. Additionally, that is how we can inform test persons about first research results if they want to. Hence, the address and name of a participating person has to be written down on a separate lottery ticket. This ensures that we are not able to link personal information to the data collected during the experiment.

In order to connect data from both questionnaires and other applied methods, the identification number has got to be passed out to participants, and it has got to be written down by researchers at several places. It is important to give strict rules about who documents the number where and when.

3. Data and Methods

Until now, we dealt with our constructivist's point of view on orientation in space, our research questions, and we presented our research design as a framework. The next step is to elaborate on the applied methods and to explain in brief why we applied them and how. Additionally, we will present some of our results later on.

Figure 2 already names all methods we applied, so far they are: survey questionnaires, scribbling on the map, time measurement and ethnographic methods (observation, tracking, go-alongs, videography and eye-tracking). While the survey questionnaires and the time measurement are mandatory for the research design, ethnographic methods may vary each year. Due to their qualitative character they are more flexible in execution than survey questionnaires and short-term modifications may be included.

3.1 Time Measurement

As we stated before, time measurement is needed for our methodological framework as social field experiment. It is one of the key elements of the factorial design. But it was originally and in addition planned as a way to measure the effectiveness of the maps. The idea behind this was that if participants are able to find the goal very fast they were assigned a good map.

It turned out that this did not work at all. First, not all participants took the experiment as seriously as predicted. So, not all of them actually ran up the stairs in order to get to the goal as quickly as possible to win the challenge. Plus, we observed situations where e.g. children wanted to go faster than their accompanying parents or friends. Secondly, we were surprised by the huge number of participants that we could not cope with at the finish as quickly enough as needed. Queues arose. Of course we reorganized the second year, whereby we doubled number of experimenters but could not avoid queues totally.

Therefore, we decided to drop this kind of measurement for data analysis, but still keep it in order to keep participants' motivation high and to do justice to key elements of the research design.

3.2 Survey Questionnaires

Instead, for a proper evaluation of maps, we used the *survey questionnaires* that on one hand contain questions about prior experience with maps, orientation and the specific environment because these factors influence the orientation process. On the other hand we have to include specific evaluating questions about the map variations. All map variations have got to be graded in order to grasp the overall satisfaction with a map variation. In addition, we ask for

rating specific map characteristics that we systematically varied in order to explore why one map variation is graded best.

We can only draw conclusions when comparing the results of each map variation with the other ones. We therefore, have to make sure that each map variation gets tested as often as the others, i.e. the number of members for each treatment group has to be about the same. Also, we have to poll every participant due to the representative demands when operating with statistics. Survey questionnaires also enable us to gather socio-demographic data of participants. Additionally, we can ask for their opinions to various topics concerning maps and orientation. All of this provides us with an overview of all contestants and it gives us the opportunity to make either social group specific statements or treatment group related statements.

To get to the heart of it, the a priori questionnaire asks for participants' knowledge of the main building, self-assessment of their orientation and map reading abilities, their prior experiences in wayfinding and for socio-demographic data (sex, age, education and occupation). The a posteriori questionnaire deals with contestants' approach to the navigational task, reasons for stops, their opinion about the route, their overall satisfaction with the assigned map, and it also asks for evaluating specific map characteristics.

Concerning the form of questions, we mainly used closed-ended questions, but also open-ended and semi-open questions. We used closed-ended questions when we already knew all possible choices a participant could answer, e.g. if they have been in this building before (yes or no). Semi-open questions allow a clarification if none of the above named choices fit to the participants' opinion, e.g. how did you approach to the navigational task (other, please classify). Open-ended questions are either used when we did not want to limit participants' choices to answer or we did not know all possible choices. Both were the case when we wanted to know what was good or bad about a map or what other information the map should have contained. Of course, it is more complex and time-consuming to analyze, but also much richer in information.

The questionnaires were revised each year in order to incorporate findings of previous waves into the next wave. While most questions were kept constant in order to be able to compare the waves, we dropped some questions that did not seem important after the first analysis and instead included new ones for exploring various research topics. E.g. one year, we asked people if they preferred paper maps or electronic maps in form of an app on their smart phones and why. The year after, we developed closed-ended questions for preference explanations based on participants' answers.

During the first wave of the experiment, we also learned that survey questionnaires should be adapted to the age of our participants. Specifically, very young children did not understand all of the questions asked and could not concentrate on all of the questions due to the length of the questionnaires. Hence, with the help of Susanne Vogl, we developed questionnaires for chil-

dren (up to the age of 9 years), for young adults (ranged 10 to 14 years of age) and we kept the third kind for adults (above 14 years of age). These questionnaires differ in length (meaning the younger the participant the fewer questions she has to answer) and in linguistic style. But all of the questions a participant child has to answer, the adult has to answer, too.

Summing up and considering our remarks about the research design and our theoretical approach, survey questionnaires fulfill various functions: they help us to control for compounding factors, they are of particular interest for the evaluation of the map variations and they are also important concerning the content of our research project.

3.3 Scribbling on Maps

In order to get a closer look at what points on the route and with the assigned map contestants felt comfortable or had problems with, we also provided them with black and white printouts of the assigned maps they tested. On those, participants can make *scribbling and markings*. Additionally they may *comment* on them close to the visual material (no complicated descriptions for a specific location are needed). This is especially beneficial for map evaluation and map optimization. Unfortunately (but understandably), not all of the participants use this opportunity to voice their experience and opinion.

3.4 Focused Ethnography

Our research goal is to analyze four aspects of orientation which are presented in figure 1, namely: the influence of frames and contexts of the orientation situation, the role of maps and their evaluation, and the influence of spatial knowledge and of other people to orientation. A lot of it can be grasped with the quantitative methods described above. However, they do not sufficiently explain *how orientation* is realized. Rather they can give us insights whether something we assumed earlier respectively found out during the experiment the year before arose and how it is distributed additionally to their opinions and attitudes. To be able to explain how this works we need qualitative data, which grasp the action of participants and their interaction with each other, with people outside the experiment's frame, the map and the built environment and what strategies they use. In order to collect such kind of data, we have to be present when orientation is actually performed.

Neither surveys nor qualitative interviews seem to be a suitable method because people might not be completely aware of what they do in detail in order to find a specific location, they might just happen to do "automatic" movements. On the other hand, people might not be able to remember what they did, e.g. at a decision point. And even if they do, they might not be able to explain it. Therefore, we decided to additionally apply *focused ethnography*.

Focused ethnography (Knoblauch 2001) concentrates on action, interaction and communication structures in specific situations that are especially interesting from a theoretical point of view, e.g. doctor-patient-conversations, examination situations or PowerPoint presentations. Although field visits are very short compared to conventional ethnography, this kind of research practice compensates by collecting lots of detailed data. In addition to the researcher's observations, experiences, and fieldnotes, data are often recorded by technological devices, such as video cameras and dictation machines.

All of these characteristics fit our research project: We are focusing on the orientation process during the event "Long Night of Science". Data collection only takes places during a couple of hours, which is a very short time period. Also, we are collecting lots and various kinds of data and we record a couple of them on film or tape. (Sub)research questions therefore, have got to be specified beforehand and we have to assign suited methods to each research question.

In general we decided to apply our focused ethnography overt, non-participant and unstructured, in accordance with Friedrichs' (1985) typology of observation. This means, that all participants are aware of the possibility of being observed or filmed. Furthermore, they can identify researchers by our dress code (black shirt and jeans) and our name tags. Researchers are supposed to not interfere during the navigational task and we do not have a strict category system to check off. Rather, we want researchers to describe and record what they have witnessed.

Observation is one of the main methods in ethnography. Consciously, the researcher observes what is going on (what she sees, hears, smells, feels) and writes jotting notes and later on fieldnotes (Emerson, Fretz and Shaw 2011). This method is especially suited when it comes to the exploration of processes, relationships, courses of action, and patterns of interaction. So to speak, whenever the researcher wants to figure out *what is going on* and *how it is put into practice*. Also, it is often used when little is known about the object of research. Using this method the researcher will get to know her field of interest and she can explore and gather information according to her research questions. Observers were particularly asked to focus on participants' action, conversations and interaction between participants, other non-participants, their surroundings and the maps. This, they should write down in fieldnotes as detailed as possible. Therefore, we would be able to identify and analyze orientation practices, strategies and the influence of the experiment's frame. Observations were organized in two different forms: at fixed location points along the two routes (1) and as tracking of several participants (2).

Fixed location points were chosen at crucial decision points to observe orientation practices and how people decide which way to go next. Moreover, observers should document whether everything works out smoothly concerning the flow of the experiment. To coordinate at what location and at what specific

time who is supposed to observe, we created work schedules that fulfilled various criteria: none of the researchers should observe longer than two hours without a break because concentration decreases. After half an hour or an hour positions should be changed in order to keep concentration high and to enable various insights due to observers' selected perception. Last but not least, as many location points as possible should be occupied, especially at crucial points on the route.

When we talk of *tracking* participants we mean that observers follow them during the whole navigational task on both routes and describe in their fieldnotes what happened during this period of time. In doing so, we can get a feeling of which parts of the routes are more difficult to comprehend and which ones are easy to figure out. Additionally, we hope to grasp navigational routines of single persons or groups and to get to know whether people use a strategy along the whole route, which one it is or if something occurred only in a specific situation or "accidentally". Of particular interest during tracking is how leadership and negotiation processes about the next steps are realized. Also, we have the chance to accompany participants that might get lost within the building. These persons would probably not pass our fixed observation points and we would not know what happened and how they got lost otherwise. In accordance with the fixed location points, also the tracking is scheduled for the observers. There should not be too many of them at the same time. Also, following people up to the roof top is exhausting depending on how fast participants go. Therefore, a change of tracking observers is needed after 30 minutes. Both forms of observation are suited to grasp body movements, action, at least parts of conversations and also interaction. But it is limited depending on how far away participants are from the observer and in what direction they move. It is also limited to observers' perceptive faculty and their ability to remember everything in detail. Also we are not able to observe what is on participants' minds, what opinions they have and what their prior experiences are. This is only accessible when they voice it during observations or in the questionnaires, if we ask for it and participants also answer these questions.

Kusenbach (2003) introduces *go-alongs* as qualitative research tool which combines participant observation and interviews. She argues that go-alongs are convenient to investigate (among other research topics) environmental perception and spatial practices. To conduct a go-along the researcher accompanies informants on their outgoings. By asking, listening and observing she gets insights on the informants' experiences, practices and interactions.

In 2012 and in 2013 we conducted a couple of go-alongs with different subresearch questions, such as perceived sounds and noises or participants perception of the main building and their associations with it. Unfortunately, this only worked out partially. Informants were usually too preoccupied with the competition and the navigational task that they did not want to talk about their perceptions at the same time constantly. In our opinion it is also a challenge for re-

searchers to get people into unrestrained talking. For that, the duration of the experiment is simply too short. But in those cases when this method went smoothly, we received very interesting insights.

As noted before, while conducting focused ethnography it is common (but not mandatory) to use technological devices for recording data. With the support of René Tuma and his student researchers we are also applying *videography* (Tuma, Schnettler and Knoblauch 2013) during the navigational task of the experiment, that is, researchers film participants. The method aims at analyzing courses of interaction with a constructivist's approach. Therefore, the recordings have got to center on all actors who are involved in the situation. Later on, different sequences have got to be selected for detailed video interaction analysis. This includes a theoretical sampling strategy following Grounded Theory (Strübing 2008; Glaser and Strauss 1999) and also the appropriate processing of the visual data with regard to the research questions. Additionally, transcripts are produced. Comparing and contrasting different cases, we are able to identify typical patterns of interaction and work out characteristics due to the situational context. The data medium of film allows conserving speech as well as body movements, gestures, mimic and practices, when recorded. Additionally, it can be analyzed and discussed by fellow researchers, because the video data can be presented to them. The possibility to watch scenes over and over again or to play them in slow motion is beneficial. On the other hand, it is limited to the image composition that the recording researcher chose. The recording researcher should not intervene situations of interest. Similar to our observations, the data collection using camcorders is organized in the same way (at fixed location points and tracking participants). But the goal of analysis is slightly different, due to the analysis of interaction, conversations and body movements captured on film and not only by memory or field jottings in case of observation.

In 2013 we also used *eye-tracking* devices. These are glasses participants put on that contain a small camera that records their glance and shows their eye focusing point displayed by a hair cross. This gives us the opportunity to visually document an ego-perspective of participants' experiences during the wayfinding process and their use of the maps, to capture the focus of their gaze and to record simultaneously what they said and heard during the wayfinding task. To combine all of that is not possible with any other data collection technique. Especially, the focus of glances helps us to figure out what parts of the map and the physical environment are relevant for orientation. Moreover, in some cases a researcher with a camcorder followed participants with eye-tracking devices to record their body movements that the eye-tracking devices cannot capture due to the ego-perspective of its wearer.

For documentation purposes and researcher trainings, we also take pictures. This also helps us to recall the specific situation during the event, e.g. the setup of our information desks or the arrangement of furniture at the goal of the navigation task (Geodätenstand).

3.5 Mixing Methods

As you can see now, we applied various kinds of methods that aim at collecting quantitative and qualitative data. The reasons for that are: (1) There is no single method that helps us to acquire the needed data to answer all of our research questions. Rather we have to figure out which method is suited best in order to do so. This is shown in the above subsections. (2) We want to use the opportunity to combine these different kinds of data to enrich results. This happens at several stages of the research process.

First of all, we can voice *complementary research questions and combine different kinds of data*. For example, map variations differ in kinds and representation of landmarks. Now, in the survey questionnaires we let respondents rate the depicted landmarks and ask them how useful they were in their opinion during the navigational task. With the use of the eye-tracking-method we are able to analyze which landmarks raised participants' attention and which ones they looked out for. Additionally, we can see whether they saw them in reality during the navigational task and if they made the "right" connection. Or the researcher can analyze whether people were aware of being lost during the navigational task by interpreting the fieldnotes and how single persons or groups acted, interacted, talked or negotiated about the next steps and she can also analyze the answers of the survey questionnaire statistically and see, how many people admitted to got lost and why. Also the scribbling on maps may provide her with additional information about that.

Further, with the use of the identification number system we are able to link all data together when this number is noted or recorded. This should not be done in order to make person-related analysis, but to help to interpret what happened and finding explanations, so to speak for *verification*. For example, when the researcher analyzes fieldnotes of the observations and she might have the suspicion that this person knows the building really well, she can verify this with a look at the dataset created from the survey questionnaires or she may find out that this person is trained to orientate and to map use.

But, the data of each method do not have to be combined with the other kinds; it can be analyzed independently if it is wished. This always depends on the research questions. So, none of the methods play a supplemental or core part (Morse 2010) when it comes to the interpretation of data. They are equally valuable to us. It still has to be clarified that the research design only works out when including the key elements of the factorial design without control groups. Hence, the survey questionnaires are crucial for the research design. This also means that qualitative methods can vary over the years and are more flexible in appliance than the survey questionnaires.

4. Brief Presentation of Selected Results

With this research design and the applied methods we can find answers to our research questions on the orientation process, on the strategies people apply for orientation, and last but not least, on what maps for indoor navigation should look like to satisfy users' needs, as the following examples will illustrate. The results of the first presented research topic are based on data collected with focused ethnography in 2009, whereas results of the second are based on the analysis of the survey questionnaires in 2009 and 2011.

4.1 Identified Strategies of Orientation

We stated that people act strategically in order to find the goal. Analyzing the qualitative data of the focused ethnography, we were able to identify the following strategies:

First of all, we realized that *knowledge about space and about the route is preferably accessed and negotiated with others*. During the first run of the experiment we actually wanted only single persons to compete against each other. But participants were fighting tooth and nail against it. They insisted that groups should not be separated. Thus, we changed the setup of the experiment in 2010 and allowed single persons or parties to accomplish jointly the navigation task. And even if single persons were participating, they often met up with other participants on the way to the roof top.

Negotiations about the right track were organized in various ways: team members might be of equal status or a part of the group takes over leadership. They were lots of reasons how the latter was negotiated. Either the group just trusted the navigational abilities of a member, or she was able to give precise instructions and was therefore trusted, or someone found clues for the accuracy of her opinion in the built environment, or a person was so convinced about her opinion that she could persuade the others, or group members trusted the person holding the map due to the assumption that she must have more knowledge about the space they moved through.

To accomplish the task in groups enables group members to share tasks. E.g. one person looks out for a specific clue in real space, while the other tries to read and comprehend the map. But we could also witness that groups purposely split up, because they didn't think the others were right.

Secondly, we realized that participants *notice the presence of other people*. For instance, we observed one scene where a group was close to the finishing area and noticed a lot of people passing them by and they figured that they must be close. This assumption was confirmed by an information board saying "Geodätenstand". Also, participants listened to what other participants discussed.

Very often, we could observe that participants *followed other participants* that they saw from a distance. And also, some participants *walked exactly in*

the opposite direction of others. That was often the case, when participants realized that oncoming people already accomplished the navigational task and are on their way back to the main entrance. Sometimes, we witnessed that these people gave searching participants hints where to go next. And again there were others who *concentrated on their own wayfinding abilities* and did not care for others.

Participants not only talked to party members, but also to other *participants* in order to *share information* with them or they tried to *question researchers*.
Typically, when participants were not sure which direction to go next at decision points, they applied a *trial and error strategy*. That means that they walked one option a couple of meters and then decided if this was the right track. If not, than they went back to the decision point.

Moreover, we observed that participants used *other tools for orientation* such as maps displaying emergency exits or information boards.
Almost all of the observed contestants *aligned their assigned maps and bodies in correspondence to the built environment*.

All of these strategies illustrate that orientation is not only a cognitive process as presented in a lot of studies, but also a social one. They present action and interaction of participants with the maps, other tools for orientation, researchers and the built environment. This is what we also considered in our theoretical approach.

4.2 Evaluation of Maps: Representational Perspective and Landmark Benefit

As mentioned before, in 2011 we varied two map design aspects: the representational perspective and two types of landmark representations. In the following, we will present briefly evaluations' results on the influence of representational perspective and landmarks on navigational success. Therefore, we mainly analyzed data of the a posteriori survey questionnaire.

In general 3D maps perform better than 2D maps because they strongly enhance spatial understanding. For the representation of vertical structures 2D maps are almost as good as 3D maps, if additional textual information (navigation hints, floor numbers) are included. Users find landmarks very helpful depending on perspective and route complexity but regardless of the amount and type of landmark. Further, landmarks may not be regarded as helpful when added to an already complex or overloaded map design. For the representation of the statistical analysis that led to these results see (Lorenz et al. 2013).

Accordingly, we varied different kinds of cartographic methods in order to evaluate what properties a map should have to fulfill users' satisfaction. In our opinion maps should be easy to comprehend, so they support the user when orientating in space. The visual representation of space therefore has to allow

for proper synthesis of space and possible alignment of represented space and physical environment.

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