Landmark Use by Children in Route Descriptions

A Comparison between Two Age Groups

GEO 511 Master's Thesis

Author

Laura Maria Stehrenberger

10-725-307

Supervised by

Dr. Kai-Florian Richter[1]

Dr. Arzu Çöltekin

Faculty Representative

Prof. Dr. Sara Irina Fabrikant

Department of Geography, University of Zurich

Geographic Information Visualization and Analysis (GIVA)

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[1] Department of Computing
Umeå University
SE-901 87 Umeå
kai-florian.richter@umu.se

Abstract

This thesis investigates the role of landmarks in route descriptions by young children and aims at detecting differences in landmark use between two age groups. The use of cognitive landmarks and different environmental objects as well as the size and the possible representations of the landmarks in use are focused on in particular. 22 first graders (12 females and 10 males) and 25 fourth graders (12 males and 13 females) participated in the practical study. Firstly, a pre-test was conducted using the Water-Level Task, which is a test to assess the general spatial ability of the participants. Secondly, interviews were conducted in which the participating children were asked to provide verbal route descriptions. Subsequently, a classification scheme was developed, which was used to classify the landmarks mentioned during interviews. The classification scheme focused on five different aspects: environmental objects, saliency, perspective, size and representation. The results of the classification indicate that younger children use more landmarks of the classes *animal* and *vegetation* whereas older children prefer landmarks of the class *street*. The results demonstrate that first graders use smaller landmarks more frequently than fourth graders when describing their surroundings. Older children, with a higher score in the Water-Level Task, do not mention more landmarks when providing route descriptions, but they use significantly more direction indications different from landmarks. Additionally, the results show that younger children do not use more cognitive landmarks than older children. Differences in the use of landmarks were not only found between age groups but also between genders. In comparison to males, females use more cognitive landmarks that are understandable for a listener without additional explanations, which stands in contrast to prior research findings on landmarks use by genders. In conclusion, the results indicate that the use of landmarks in route descriptions by children changes with increasing age in a way that it is complemented with direction indications different from landmarks.

Keywords: Landmarks, Route Descriptions, Spatial Development, Spatial Ability

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1 Introduction

Everyday children get from home to school and back. They have to remember their route and have to navigate based on cues along their way in order to reach the right destination. These cues are known as landmarks and they do not only ease navigation but they also give structure to route descriptions.

When asking children where they live or how they go to school, their route descriptions are likely to differ from the descriptions adults would give. *"The world viewed form the eye-level of a young child is bound to be different to that of a fully developed adult"* (Matthews, 1992, p. 1). The main way of children coping with a geographical environment is playing in the given surrounding (Hart, 1979). Consequently, children experience large scale environments in another way than adults and they therefore differently describe objects and also use other objects to navigate (Matthews, 1992).

For children an object derives its significance from its use. For example, a bush which provides a screen for a hidden camp or a tree which can be climbed is more likely to be remembered than an unknown building along the way to school (Hart, 1979). Such objects (i.e. landmarks) serve as mental anchor points, ease navigation and are likely to be included in route descriptions. However, the objects may only have a meaning for the child and not for a listener who does not know the area.

A central characteristic of landmark is their saliency (Sorrows and Hirtle, 1999). For example, the spatial prominence, location or striking colour influences the saliency of a landmark. However, the perceived saliency of a landmark may vary between people according to context or experience (Caduff, 2007).

Furthermore, "perspective taking" is central when making route descriptions, and mental representations are used in this process. These mental representations of environments are created because people move in space and because spatial relations of landmarks or objects are changing in relation to the moving people (Tversky, 1996). The ability of taking on a perspective which is not one's own develops at a certain age. The initial perspective adopted by younger children is viewer centred and often called egocentric. In the process of growing up, children become able to use an environmental reference frame, which is called allocentric (Hart and Moore, 1973). Piaget and Inhelder (1956) describe

four periods in a child's development: the sensori-motor stage, the pre-operational stage, the concrete operational stage and the formal operational stage. In the third period, the concrete operational stage, a child's perspective develops from an egocentric to an allocentric perspective. This development starts at the age of seven and ends at the age of eleven. It is a turning point in intelligence at which a child becomes capable of logical thought. Their mental representations of the environment are no longer intuitive patterns and they no longer confuse their views with those of others.

As the perspective of children changes when growing up, the use of landmarks seems to change in parallel (Matthews, 1992). The way in which a child develops its cognitive mapping ability has been studied by geographers and psychologists alike (Altman and Wohlwill, 1978; Gould and White, 1974; Hart and Moore, 1973; Moore and Golledge, 1976). Nevertheless, studies vary in their approach. It is possible to classify the existing studies into those which look into qualitative changes in the ability of a child and others which examine the quantitative accretion of environmental knowledge (Andrews, 1973; Matthews, 1980). The Piagetian school, which belongs to the former, investigates how children externalize their mental representations of space (Beck and Wood, 1976; Piaget and Inhelder, 1956). The research of the Piagetian school sees cognitive structures as a result of the unfolding of different kinds of thought processes in successive stages. A child acquires knowledge and understanding of space through accommodation and assimilation. In contrast, those scholars who focus on the quantitative accretion of environmental knowledge (Blaut et al., 1970; Blaut and Stea, 1974) suggest that the spatial ability of young children does not exclusively follow successive stages according to their age but is rather influenced by external factors such as education or personal experience and therefore their spatial ability should not be underestimated (Matthews, 1984). They also argue that the view of younger children is not as egocentric as it is described by Piaget and Inhelder (1956).

The navigational behaviour and spatial learning processes of children have been studied in multiple ways, however, there are few studies that focus on the different use of landmarks in relation to the children's age. The aim of this master thesis is to address this research gap and to investigate the landmark use of young children with an empirical user study.

In this thesis, a classification scheme for landmarks was developed adapted from existing literature. The resulting classification scheme served as a foundation for the statistical analysis of the data. The user study examined route descriptions of two groups of participants in order to find differences in landmark descriptions between children of different age. If differences in landmark use are found, this information contributes to the wide-ranging research on landmark use of children during navigational tasks. On one hand it might strengthen the findings by Piaget and Inhelder (1956), if results indicate that the exocentric view of participants dominated the use of landmarks in verbal route descriptions. On the other hand, findings might speak against the developmental stages theory by Piaget and Inhelder (1956). They might indicate that egocentrism is overcome earlier in childhood and strengthen findings by other scholars (Blaut et al., 1970; Blaut and Stea, 1974) that a child is able to take on perspective of another person at a very early age.

The structure of this thesis is as follows. Firstly, an overview of the state of research is provided in Chapter 2. In this chapter the research gap is laid out. It serves as a foundation for the following chapters. Chapter 3 addresses the goals and hypotheses, which define the research frame of this thesis. Subsequently, the experimental design and methods of the user study are described in Chapter 4. The statistical results as well as the classification scheme are elaborated in Chapter 5. The discussion of the results in relation to the pre-established hypotheses as well as the limitations of the study are discussed in Chapter 6. Finally, the main findings are summarized and an outlook for future research is provided in Chapter 7. The material used for the user study is located in the Appendix.

2 Literature Review

This chapter presents an overview of the state of the art of two research fields that are combined within this thesis. Firstly, research on the concepts and use of landmarks is discussed. In this first part of the literature review, the term landmark is introduced and the saliency of landmarks is elaborated as well as different classification schemes for landmarks. Secondly, concepts of the development of children's spatial perception are explained and put into context to landmark use. In this second part the emphasis lies on different theories on how a child acquires spatial knowledge, the role of egocentrism in childhood and the use of landmarks by children of different age and gender. Lastly, the two research fields are combined and research gaps are identified.

2.1 Landmarks

The theory of landmarks is based on the book "The Image of the City" written by Kevin Lynch (1960). Lynch (1960) introduces a framework to analyse cities in terms of five inter-related components: nodes, edges, districts, paths and landmarks. The book addresses the imaginability of a city and shows its potential value as a guide for the building and rebuilding of cities. This thesis focuses on landmarks. The other four components are not addressed. Many researchers have examined landmarks and their importance for remembering, wayfinding and navigating through an environment (e.g., Richter and Winter, 2014; Hansen et al., 2006; Sorrows and Hirtle, 1999; Presson, 1987; Fehr, 1980).

In literature, *landmark* is a concept that is used in many (but also fundamentally different) ways. Researchers use the word landmark in the context of cognitive mapping and wayfinding but also in the context of electronic navigation. Some scholars use the term in a very general way in order to refer to any decision point people orient themselves by when navigating their way through the environment (Sorrows and Hirtle, 1999). Siegel and White's (1975) definition of landmarks, route and survey knowledge supports this generalised way of understanding the landmark concept. Presson and Montello (1988) argue that everything that stands out from the background may serve as a landmark. Sadalla et al. (1980) developed a reference point theory to conceptualize landmarks

which takes theories of spatial cognition into consideration. In comparison to the reference point theory, the anchor point theory of Couclelis et al. (1987) does not only focus on important reference points but combines regionalization, salient cue features and hierarchical structure into one theory explaining the cognitive organization of space. It becomes clear that landmarks can serve multiple purposes in wayfinding, depending on their definition. Golledge (1999) argues that landmarks are used either as navigational aids or as a concept of space organization. In this thesis the term landmark is understood in a broader sense and they are defined as follows:

A landmark may be everything that stands out from the background (Presson and Montello, 1988). Landmarks structure space and the environmental knowledge about it (Hirtle and Jonides, 1985) and serve as mental anchor points (Couclelis et al., 1987). Landmarks are used as decision points when navigating and give hints to the origin and the destination of a route (Michon and Denis, 2001). Within route descriptions, landmarks are important features as well (Denis et al., 1999). Humans use landmarks to give route instructions both in graphical and verbal instructions (Denis, 1997; Tom and Denis, 2003). Landmarks play an important role when acquiring knowledge on an unknown area and are therefore also used by children from an early age (Siegel and White, 1975). The saliency of objects determines whether they can serve as a landmark. The more attraction is drawn to an object, the more salient it is and the better it can be identified by a human (Hansen et al. 2006) and the more likely it is used as a landmark.

2.1.1 Landmark Saliency

Caduff (2007) assesses landmark saliency for adults to optimize navigation systems for the future. His work is based on the theory of Sorrows and Hirtle (1999), which also serves as a basis for this thesis. Sorrows and Hirtle (1999) define three categories of landmark saliency: visual, structural and cognitive.

Visual Landmarks

A *visual landmark* is an object that primarily stands out from the background because of its visual characteristics. This visual prominence may be due to the object's distinct spatial location, a noticeable contrast with surrounding features, or other visual characteristics

that make the object particularly memorable (Sorrows and Hirtle, 1999). An example of a visual landmark might be St. Peter's Church in Zurich, Switzerland (see Figure 1).

Figure 1. Visual Landmark: St. Peter's Church in Zürich[2]

Structural Landmarks

Structural landmarks attract attention because of their location or structure in space. They might have a prominent location in the environment and may be highly accessible, for example, a crossing at the end of a road or a huge square in the centre of a city (Sorrows and Hirtle, 1999). An example of a structural landmark might be Paradeplatz in Zurich, Switzerland (see Figure 2).

Figure 2. Structural Landmark: Paradeplatz in Zürich[3]

[2] Source: http://tinyurl.com/gujcplg (accessed: 03.09.2016)

[3] Source: http://tinyurl.com/zjlywc4 (accessed: 03.09.2016)

Cognitive Landmarks

A *cognitive landmark* is an object which derives its relevance from its signification. An object or a feature may be a cognitive landmark because it is very typical or atypical in its surrounding environment. The perception of an object as a cognitive landmark tends to be more subjective. Consequently, it may be missed by those not knowing the object, location or environment (Sorrows and Hirtle, 1999). An example of a cognitive landmark might be a fire station or a post office, which is known by anyone. Another example might be a neutral building with flats and offices: the people who live or work in this building might use it as a cognitive landmark and others might not even notice it (see Figure 3).

Figure 3. Cognitive Landmark: Apartment Building in Basel[4]

2.1.2 Classification Schemes for Landmarks and Spatial Information

Classification schemes for landmarks other than saliency have been proposed by several researchers. Many of these classification schemes have been developed in order to assist and improve navigation systems (Anacta et al., 2016; Hansen et al., 2006; Klippel and Winter, 2005; Richter et al., 2012). Some of these classification schemes are briefly outlined in the following section.

[4] Source: http://tinyurl.com/j7w5rju (accessed: 03.09.2016)

Klippel and Winter (2005) developed a classification system of landmarks that focuses on point-like objects and classifies them with respect to their position along a route. They created a taxonomy to categorize the structural salience of objects. Another classification scheme is proposed by Richter et al. (2012). Their general classification scheme categorizes place descriptions according to different characteristic parameters. They use the classification scheme to demonstrate the existence of certain clusters of frequently used types of place descriptions in human communication. An alternative classification scheme is proposed by Hansen et al. (2006), who classify landmarks according to their function in route direction. Their classification consists of an eight-level taxonomy in which each level describes a different function a landmark can have. Additionally, Anacta et al. (2016) introduce a classification scheme for landmarks, which includes local and distant landmarks to support orientation but also facilitates construction of mental maps.

However, there are also a few classification schemes which were developed for other purposes than to assist and improve navigation systems. For example, Matthews (1984) investigates map elements drawn by children and focuses on different landmark categories. His classification scheme embraces the range of real-world features the participating children drew during his study. Matthews (1984) let the children draw their home area and their way to school. He categorizes the elements into six groups of features: functional, recreational, natural, transportational, personal and animal features. A similar classification scheme is introduced by Maurer and Baxter (1972) in which they classify landmarks named by young males to describe their suburbs. They focus on the categories and elements of the youth's imagery and introduce seven classes: structure, structure related, pathway, pathway related, animal, people and environment (natural). Their goal was to identify the perceptions and attitudes of their participants.

2.1.3 Verbal Route Description Containing Landmarks

Route descriptions are crucial for sharing spatial knowledge and are the main occasion in which landmarks are used (Richter and Winter, 2014).

"Verbal route instructions are explanations given by a director, intended to guide a mobile agent, the follower, toward a specific spatial destination. When following route instructions, the follower must parse and interpret the text, model the instruction's actions and

descriptions, and enact the instructions in the world, by performing these actions and recognizing the descriptions" (MacMahon et al., 2006, p. 1475).

In fact, an overwhelming majority of route descriptions given by humans refer to landmarks compared to geometric descriptions (Denis et al., 1999; Michon and Denis, 2001). For example, a route description reading "You have to turn left at the next intersection" is by far more likely than a description like "Turn left after 150m" (Richter and Winter, 2014).

Different studies in cognitive wayfinding research stress the importance of landmarks used at decision points when following route instructions (Denis, 1997; Daniel and Denis, 1998; Richter and Klippel, 2005). Anacta et al. (2016) found that landmark information is important in human wayfinding instructions. While local landmarks have a particular importance along the route, global landmarks help orient themselves in space.

Giving verbal route descriptions includes the process of taking on perspective of other people. When people describe a simple scene or a route, speakers often take on their listeners' perspective rather than their own (Schober, 1993). For example *right* and *left* are in general egocentric perspectives and it requires considerable effort to translate the spatial frame of the speaker into the listener's (Peterson et al., 1996). People's ability to take on a perspective which is not their own is revealed in their use of language when giving route descriptions (Tversky, 1996).

2.2 Development of Children's Spatial Perception

In large-scale environments, wayfinding is a fundamental process (Golledge, 1999). Through route planning, exploration and other forms of navigation we are able to use and manage spatial information. This ability depends on us being able to understand different representations of space, to use objects of reference and to plan routes to known or unknown places (Sorrows & Hirtle, 1999). These skills have to be learned and they start to develop at a very young age.

In the following sections the development of children's perception of space is discussed. First, the Piagetian theory about the children's conception of space is laid out. Second, different perspectives of spatial knowledge acquisition are discussed. Third, the

egocentrism in childhood is illuminated. Fourth, children's use of landmarks is shed light on. Last, gender differences in spatial abilities are discussed.

2.2.1 Children's Conception of Space

Piaget and Inhelder (1956) were among the first to study the child's conception of space. They identify four periods of cognitive development, which occur at more or less the same age for every child. *The sensorimotor stage* describes the first period of cognitive development. It lasts from birth up to two years of age, when a child changes from passive to active. At the end of this stage, a child establishes limited representations of the environment based on its experience. The following *pre-operational stage* extends over the period of five to nine years of age approximately. During this period, a child develops the ability to conceive space. Simple mental constructs, objects and symbols are the base for the children's first environmental knowledge. The children's thoughts are egocentric throughout this stage, which means they cannot take on the perspective of another person. *The concrete operational* stage starts at the age of seven and ends at about eleven years. It is a turning point in which a child becomes capable of thinking logically. The children's mental representations of the environment are no longer intuitive patterns and the children no longer confuse their views with those of others. *The formal operational stage* extends over the period of about the age of eleven to thirteen years. It is the period during which children develop an ability to conceive space entirely. If children have to imagine an abstract environment at this stage, they do not have to base their mental representations of this abstract environment upon real actions or real objects in space. At this stage, children no longer need to rely on experience for spatial knowledge (Piaget & Inhelder, 1956 in Matthews, 1992). Hart and Moore (1973) extend Piaget and Inhelder's (1956) ideas and describe three stages for the development of spatial understanding: *egocentric orientations*, a *fixed system of reference* and a *coordinated reference system*. However, Moore (1976) acknowledges that environmental understanding depends on more factors than only on the advancement through a number of qualitatively different stages. He argues that social background and experience need to be taken into consideration to a greater extent than it is done by Piaget and Inhelder (1956).

Furthermore, some researchers criticise Piaget and Inhelder's (1956) idea of developmental stages in a child's conception of space. For example, Blaut et al. (1970),

Catling (1979), Kurdek (1978) and Liben (1978) found that children have an understanding of space at a very early stage in life. They argue that the developmental stages theory does not appropriately explain these early abilities. They could not verify that certain spatial abilities are bound to a distinct age and stress that the individual development of children determines their spatial abilities in the early years.

2.2.2 How a Child Acquires Spatial Knowledge

A number of competing theoretical perspectives on how a child acquires spatial knowledge and understanding have been proposed. This chapter elaborates on three of these perspectives.

The first perspective, developed by Piaget and Inhelder (1956), proposes that children's acquirement of environmental knowledge follows a *hierarchical process* of understanding. At the lowest level, a child is only capable of landmark knowledge, which is essentially egocentric. At the next level, as the cognitive capabilities develop, landmarks are brought together into routes. During this stage, the shift from an egocentric to allocentric frame of reference takes place. At the highest level, the child is able to integrate and coordinate space in an abstract, metric and hierarchical manner. This hierarchical process depends on the general cognitive capacity of children and their environmental experience.

The second perspective, developed by Siegel and White (1975), proposes that spatial understanding develops in a *linear sequence*. Firstly, landmarks are noticed and remembered by the child. Secondly, the child acts in the context of these objects and establishes paths and routes between the landmarks until the whole environment is perceived. The theory of Siegel and White (1975) was examined and confirmed by other scholars such as Cohen and Schuepfer (1980) or Jansen-Osmann and Wiedenbauer (2004).

A third perspective, developed by Golledge (1978), proposes the *anchor point theory*. The environment is hierarchically ordered by places. This hierarchy consists of primary, secondary and tertiary nodes and the routes that link these nodes together. A primary node serves as an anchor point. A primary node can be a place which is known well by a child, such as a child's home. A secondary node is a place connected to the first node, for

example a school building. The remaining nodes of the hierarchy develop in steps until the whole environment is known.

In sum, the discussed theories disagree about whether the acquisition of spatial knowledge is a linear or a hierarchical process. However, they agree on the idea that there is a general progression from landmark knowledge to route configurational knowledge in a child's spatial knowledge development.

2.2.3 Egocentrism in Childhood

Egocentrism in childhood is the inability to differentiate between the cognitive concerns of others and those of the self (Elkind, 1967). In an egocentric reference frame, locations are described with respect to the particular perspective of a person. Conversely, in an allocentric reference frame, points are located within a framework external to the holder of the representation and are independent of the person's position (Klatzky, 1998). During childhood, children run through different forms of egocentrism.

Sensori-Motor Egocentrism (0-2 Years)

In the early months of life, the infant deals with objects as if the objects' existence was dependent on their immediate perception (Charlesworth, 1966 in Elkind, 1967). At this stage, infants lack the ability to differentiate between the object and the sense impressions. However, when reaching the age of about one year a child begins to seek an object even if it is hidden. A child is then able to differentiate between the object and the experience of the object (Elkind, 1967).

Pre-Operational Egocentrism (2-6 Years)

During the preschool period, the symbolic function becomes fully active and is noticeable in the acquisition and utilization of language. A child loses the egocentrism with respect to objects. However, a new egocentrism with regard to symbols evolves. At the start of this period the child is not able to differentiate between words and their referents. At this stage of development, a child believes that names inhere in the things they describe and consequently, that an object cannot have more than one name. This egocentrism becomes evident in the children's language. Towards the end of this period, a differentiation

between symbols and their referents is made. Additionally, a child can now take the two dimensions (e.g. height and width) of an object into account (Elkind, 1967).

Concrete Operational Egocentrism (7-11 Years)

In the concrete operational egocentrism period, a child learns to handle classes, understand relations and conserve quantities. A child is now able to formulate hypotheses and explanations about concrete matters. However, children are not able to differentiate between mental constructions and perceptual phenomena. When children at this stage construct a hypothesis, they assume that their hypothesis is a product of the perceived data rather than derived from their own mental activity. When the hypothesis seems to be wrong, children do not change their stance but reinterpret the data so that it fits their assumption once more. Toward the end of this period, children gradually abandon their operational thought and their egocentrism of childhood and instead adopt a new form of adolescent egocentrism. A child of eleven to twelve years of age is now able to conceptualize his or her thoughts as well as the thoughts of other people. Still, the child may not yet be able to differentiate between what others are thinking about and their own mental concerns (Elkind, 1967).

2.2.4 Children's Use of Landmarks

Finding and remembering places such as sources of food or one's home is one of the most ancient problems faced by humans and animals. Various mechanisms have evolved over time that allow humans and animals to navigate to desired locations and to locate themselves at a certain position. One common mechanism to find a desired location is to use landmarks or to encode visual cues near that location (MacDonald et al., 2004). The use of visual cues (e.g. landmarks) to find a place or goal by humans has for example been demonstrated by Spetch (1995). Spatial information can be encoded in many different ways by remembering visual cues on the way to a specific location. The strategies used by children to encode spatial information and to use landmarks changes as they mature. (Blades and Medlicott, 1992; Cornell et al., 1994).

Lynch (1960) was among the first to categorize the content of maps into five major elements (nodes, edges, districts, paths and landmarks). In his study, adults drew sketch maps by hand. Most studies replicating Lynch's methodology focus on adults as well

(Francescato & Mebane, 1973, Orleans, 1973, Walmsley, 1984 in Matthews, 1992). Nevertheless, some authors also focus on children or multiple age groups in their studies, which are discussed in the following paragraph.

Many researchers present evidence that children younger than six years of age use landmarks in a different way than older children do (Blades and Spencer, 1987; Fehr, 1980; Nardini et al. 2008 and 2009; Waller, 1986). Older children use landmarks to recall spatial locations whereas this behaviour could not be found in younger ones (Anooshian and Young, 1981; DeLoache, 1986; Presson, 1987). Therefore, older children are more likely to make use of landmarks than younger children when describing routes (Waller, 1986). The finding of Waller (1986) stay in contrast to the findings of Jansen-Osmann and Wiedenbauer (2004), who found that second graders rely more on the presence of landmarks than sixth graders, which might result in an increased use of landmarks by second graders in route descriptions.

A difference between age groups was not only found regarding the frequency of landmark use in route descriptions but also regarding the position of these landmarks in the route descriptions of the children. Cohen and Schuepfer (1980) found that second graders are influenced by the position and the sequence of landmarks whereas sixth graders are not significantly influenced by it in a decision task. Additionally, Cohen and Schuepfer (1980) state that second graders focus on specific landmarks whereas sixth graders demonstrate a greater ability to extract and integrate route information other than landmarks.

In other tasks in which children do not have to decide on routes but have to select photographs showing landmarks, differences between age groups are visible as well. It could be shown that when choosing landmarks from pictures to depict critical route-orienting landmarks, second and fifth graders select different landmarks compared to college students (Allen, Kirasic, Siegel, and Herman, 1979).

Differences between age groups are not only observable in how routes containing landmarks are described but also in how these routes are memorized. Allen et al. (1979) provide evidence that children and adults attend to different landmarks when memorizing a route. For example, children may look for and register salient landmarks but may not consider their uniqueness or movability. Further differences according to age were found by Spencer and Lloyd (1974), who show that children under seven years tend

to see the environment primarily in human and natural terms (i.e. they notice living things) and to give prominence to personal details. Older children ignore these personal details.

However, there are also similarities between younger and older children in the use of landmarks. Matthews (1984) coded children's home areas and their journey to school and found that both younger and older children use landmarks as mental anchor points but he suggests that the awareness of space grows as the children get older.

2.2.5 Gender Differences in Spatial Abilities

Spatial abilities of children do not only vary between different age groups but also between genders. Girls and boys behave differently when playing or navigating in indoor or outdoor environments, which has been demonstrated by many researchers (Harris, 1978 and 1981; Newcombe, 1982; Siegel and Schadler, 1977 in Matthews, 1992).

There are studies, in which the performance in spatial tasks between genders is focused on. Some of these are discussed in this section. Boys outperform girls across a broad range of spatial tasks as shown by Siegel and Schadler (1977). Across different age groups boys are likely to be more accurate in spatial tasks than girls. In their meta-analysis of the characterisation of spatial difference between genders, Linn and Petersen (1985) prove that boys outperform girls on mental rotation tasks at any age. Additionally, they found that spatial perception is easier for males than for females in general (Linn and Petersen, 1985). However, Linn and Petersen (1985) state that a shift between gender performances occurs regarding spatial perception. At the age of four, girls outperform boys. At ages five and seven, boys slightly outperform girls. By eleven years, boys perform significantly better than girls. Between ages seven and eleven the difference between boys' and girls' scores increased threefold. Ecuyer-Dab and Robert (2004) state that males outperform females on both solving navigational-related spatial problems and on understanding physical principles. Their results are based on theoretical and empirical foundations of two evolutionary models. Dabbs et al. (1998) tested men and women in giving directions using local maps and in identifying locations on a world map. They show that males are better than females at tasks requiring mental rotation. It has to be considered that the two latter studies were conducted with adults and not with children and that these difference might not occur in younger participants. However, males do not

outperform females on all spatial tasks. Dabbs et al. (1998) suggest that males and females perform equally well in object location memory. Linn and Petersen (1985) state that no gender differences exist in spatial visualisation skills either. There are also spatial tasks at which girls are better than boys. Girls show superior spatial memory compared to boys (Ecuyer-Dab and Robert, 2004).

Additionally, there are also studies which do not focus on differences in performance of girls and boys in spatial tasks but on the general perception of space. Jansen-Osmann and Wiedenbauer (2004) found that females especially rely on the existence of landmarks in various spatial tasks. MacFadden et al. (2003) show that females tend to give directions that feature landmarks and right/left turns, whereas males more often include distance and cardinal information in written route descriptions. These findings correspond with the findings of Miller and Santoni (1986), who prove that males at the age of 11 and 19 years use more Euclidean cues and were more accurate than girls when giving direction indications. They state, however, personal experience variables influence these gender differences.

2.3 Research Gap

The child's acquisition of spatial understanding is examined in many studies and is controversially discussed. The use of landmarks plays an important role in this debate and has been studied by many researchers in the context of wayfinding, navigation performance and accuracy of drawn maps or identification of differences in aerial photographs (see Chapter 2.2.4). However, there still exist research gaps on the subject of how children see the world and how they talk about it.

The first gap concerns the combination of Piaget's and Inhelder's (1956) developmental stage theory and Sorrows' and Hirtle's (1999) salience of landmarks theory. The question can be asked whether the saliency of landmarks changes for children when they grow up. Especially, the transition from an egocentric to an allocentric frame of reference is under-explored in the age group of children of seven to eleven years of age, which is examined in this thesis. Many studies test the child's reaction to colour or geometry (Learmonth et al., 2002; Nardini et al., 2008), which influence the saliency of landmarks. However, the

saliency of real-world objects (e.g. landmarks) for children of different age groups has not been studied yet. Thus, there is a lack of knowledge which needs to be investigated.

A second gap evolves from the research on the use of landmarks by children of different ages (see Chapter 2.2.4). Matthews (1984) shows that older children use more landmarks when drawing maps of their home area or their way to school. Is this difference also visible when children give verbal route descriptions? Verbal route descriptions have not been investigated yet. Therefore, the question of whether older children also utilise more landmarks in verbal descriptions of their way to school and not only when they draw maps of it needs to be investigated.

A third research gap can be identified when looking at the landmark use of girls and boys. Several researchers found that there are differences in the performance in spatial tasks between genders and also in the perception of space (see Chapter 2.2.5). Nevertheless, the landmark use and the perception of landmark saliency have not yet been examined in detail for young males and females. Consequently, further research is necessary to answer the question whether boys use different landmarks than girls and whether the saliency of landmarks is differently perceived by girls and boys of the same and of different ages.

3 Research Questions and Hypotheses

The aim of this thesis is to investigate the landmark use by children of different age groups and gender. As discussed in Chapter 2, children develop their spatial knowledge step by step and use landmarks in different ways. There are two schools of thought. One group of researchers (Piagetian school) argues that a child proceeds through clearly defined developmental stages, which determines their ability to take on the perspective of others at an age of about eight years. The other group of researchers argues that children are already able to take on the perspective of others at an early stage and this ability cannot be directly linked to their age but rather to their individual development and experiences. This leads to the broad question if descriptions of an environment change when children grow up and, if this is the case, whether the use of landmarks changes as well and whether this change can be attributed to a child's transition from an egocentric to an allocentric spatial understanding. Consequently, following the core question arises: *Does the use of landmarks by young children change with their age?*

Based on the research gaps mentioned in Chapter 2.3 this core question was divided into three detailed research questions and resulting hypotheses that lead to the experimental framework of this thesis.

Research Question 1

Do younger children more often use cognitive landmarks when giving route descriptions than older ones?

Hypothesis 1

Younger children use more cognitive landmarks when describing their way to school than older children.

Hypothesis 1 is based on the assumption that the saliency of landmarks is differently perceived by different age groups and whether the landmarks chosen by younger children are likely to be more personal because they still have an egocentric view of the world. (Piaget and Inhelder, 1956). Our assumption is that younger children are not yet able to discern whether an object they go past on their route is only salient to them or whether it can be salient to anybody. Therefore, the route descriptions of younger children are

assumed to contain more personal (cognitive) landmarks than the descriptions of older children.

Research Question 2

Does the number of described landmarks increase with age?

Hypothesis 2

Older children use more landmarks than younger children when describing their way to school.

Studies have shown that children of different ages use landmarks in a different way (see Chapter 2.2.4) Matthews (1984) for example shows that older children use more landmarks when drawing maps of their ways to school. Our assumption is that a similar behaviour can be observed for verbal route descriptions as well. Hypothesis 2 aims to show that verbal route descriptions of older children contain more landmarks than the descriptions of younger children.

Research Question 3

Do girls and boys use different landmarks when describing their way to school?

Hypothesis 3

Girls and boys use other landmarks when they describe their way to school.

Hypothesis 3 aims to show that girls and boys of different age groups use different landmarks. Multiple studies found (see Chapter 2.2.5) that the spatial abilities of males and females are not the same in various spatial tasks. Our assumption is that boys use different landmarks than girls to describe their environment because they behave and play differently and because they see the world through different eyes (Matthews, 1992).

Post-Hoc Hypotheses

Post-hoc hypotheses were formulated when the data had already been collected. Three further research questions were formulated because during data collection, new phenomena became observable. The following three research questions aim to find out whether these phenomena actually exist.

Research Question 4

Do older children use more direction indications than younger children?

Hypothesis 4

Older children use more direction indications than younger children.

During the interviews it was noticeable that older participants more often described their way to school using direction indications other than landmarks in comparison to younger children. Hypothesis 4 aims to show that this tendency is evident in the collected data.

Research Question 5

Do younger children more often use smaller landmarks than older children when describing their way to school?

Hypothesis 5

Younger children more often use smaller landmarks than older children when describing their way to school.

During the interviews it was visible that younger participants preferably used smaller landmarks when they described their way to school compared to older children. Hypothesis 5 aims to show that this tendency is evident in the collected data.

Research Question 6

Do younger children more often use point-like landmarks whereas older children more often use linear landmarks when describing their way to school?

Hypothesis 6

Younger children more often use point-like landmarks and older children more often use linear landmarks when describing their way to school.

During the interviews it was noticeable that younger participants preferably used point-like landmarks when they described their way to school. Older children used more linear landmarks. Consequently, hypothesis 6 aims to show that this tendency is evident in the collected data.

4 Methods

4.1 Participants

Male and female participants between 7 and 11 years were recruited for the practical experiment of the study. The reason for focusing on these age groups was to be able to identify differences in landmark use between two age groups formed by first and fourth graders and, to check whether a shift takes place in the spatial understanding, description and landmark use of the children at the age of eight years from an egocentric to an allocentric point of view (see chapter 2.2.1). Therefore, it was essentials to have a group of participants which is under and one which is over the stage of eight years. The study was conducted with male and female participants to be able to check whether differences in the special abilities of males and females observed by scholars are also visible between girls and boys when they describe landmarks (see chapter 2.2.5). 47 children participated in the study. 22 first and 25 fourth graders of four different school classes (two classes on each grade) were interviewed. The gender distribution was as follows: 12 girls and 10 boys in the younger and 13 girls and 12 boys in the older group.

To ensure that the children describe more or less the same location so that the described landmarks and collected data are comparable, all of the participating children went to the same school. The user study was conducted in the German speaking part of Switzerland in the canton of Zurich in a rural municipality that consists of about 3500 inhabitants. The municipality has a typical village structure with a butcher, a bakery, a petrol station and two churches which can be considered as good mental anchor points for navigation. The school of the village has a very prominent location and is situated just next to one of the churches. The study was conducted indoor. The pre-test took place in the classrooms of the participating classes. The actual study was carried out in separate rooms just next to the classrooms.

Figure 4. Separate classroom where interviews took place.

Figure 5. Separate classroom where interviews took place.

4.2 Procedure

At the beginning of the recruitment process of the participants, the head of the school was contacted to get permission for the whole study. After permission was given, two teachers with first graders and two teachers with fourth graders were willing to participate. Due to the fact that participants were underage, their parents had to give permission for the participation of their children. The parents were sent a letter composed of three parts. In the first part, it was briefly explained what their children are going to do and what the study's aim is. In a second part, there was a form which the parents filled out with their name and signature to give permission for (or to refuse) the participation of their child in the study. This form was sent back to the teachers. The teachers sorted the participants in *"yes- and no candidates"* and only provided me with the information about the ones who

got permission. In a third part, I asked the parents to draw their child's way to school on a map of the whole area of the village. The map had two purposes. On one hand, it was used to calculate the length of each child's way to school. On the other hand, the map was intended to be used as a control mechanism to have the possibility to pace out the participants' ways to school to check their descriptions for correctness. The maps were used in nine cases in which the participants' descriptions were not clearly understandable.

The distance travelled by each of the children was taken into consideration in the study because it may influence their route descriptions. The assumption was that the longer the children's way to school, the more landmarks are mentioned when it is described. The distance of each way was calculated using the addresses parents or teachers gave to me, the maps which were drawn by the parents and Google Maps[4]. The addresses were entered in Google Maps as the start points and the school address was taken as the endpoint. The navigation mode 'by foot' was activated and a distance estimation was provided by Google Maps. Afterwards, the pathways were adjusted using the information retrieved from the maps drawn by the participants' parents. The final length estimation by Google Maps was taken as the total distance for each of the children's ways to school. This distance was used to statistically analyse the correlation between distance and increasing landmark use.

4.3 Materials

4.3.1 Letter

As already mentioned (see Chapter 4.1), a letter consisting of study information, a permission form and a map was sent to all participants' parents. The map was created by combining several map images of the village taken from Google Maps. In order to provide total discretion, the name of the village and the map of the village is not show in any part of this thesis. The letter, the study information and the permission form can be found in the Appendix.

[4] Source: https://www.google.ch/maps (accessed: 10.02.2016)

4.3.2 Pre-Test

The pre-test required a see-trough measuring jug filled with water which needed to have similarities to a half full bottle of water and which was used to explain the Water-Level Task to the children. I explained the meaning of the term "water-level" in very simple words (e.g. "The line, where the water finishes…").

Figure 6. Measuring jug used for the explanation of the Water-Level Task.

I prepared an A4 working sheet for the Water-Level Task (see Appendix II). Six empty bottles tilted in different directions were arranged on the sheet. The bottles were adapted from the online Water-Level Task provided on the website "Molecules & Minds" (Steinhardt School of Culture, Education, 2005).

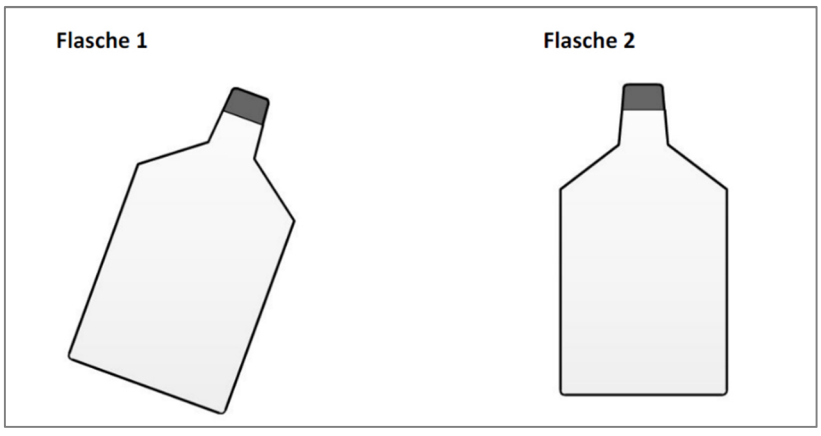

Figure 7. Water-Level Task. Two bottles of the A4 working sheet.

4.3.3 Interview

The interviews were recorded. In addition, I took some notes. The participants were also given pencil and paper to draw sketches or make notes, which was only done by one participant.

4.4 Experimental Design

In this section, the design of the experiment is described. The experiment was divided into two parts, into a pre-test and an interview part. The pre-test was considered to give more information about the overall spatial ability of the participants and the interviews were conducted to collect the primary data for the study.

4.4.1 Pre-Test: Water-Level Task

The Water-Level Task was developed by Liben and Golbeck (1980) based on Piaget and Inhelder (1956). Linn and Petersen (1985) categorize it as a test of spatial perception in which participants are required to determine spatial relationships with respect to the orientation of their own bodies. During the test, the subjects are given drawings of six straight-sided bottles tipped from upright (zero degrees) to 30, 45, and 60 degrees to the left and to the right. Participants are asked to draw a line inside each bottle to show where the water-level would be if the bottle was about half full and held in the shown position. Lines within 5 degrees of horizontal are counted as correct. Every correct answer is counted as one score, so the participants have the possibility to reach scores between 0 and 6 (Liben et al., 2010). The score reached in the Water-Level Task gives information about the spatial abilities of a person. The higher the score, the better the is spatial ability (Kalichman, 1988; Liben et al., 2010; Pulos, 1997; Thomas and Turner, 1991).

I assume that children with higher scores in the Water-Level Task have a better understanding of their environment and consequently give a more understandable and detailed description of their ways to school (e.g. they use more understandable landmarks and more landmarks in general). If the pre-established hypothesis 1 and 2 (see chapter 3) are found to be correct, this would mean that fourth graders outperform first graders in the Water-Level Task.

4.4.2 Interview

The interviews were conducted at the same school with the same children who had already carried out the Water-Level Task about a month before. Because of illness or other reasons, some participants did not participate in the interviews although they had completed the Water-Level Task. The setting of the interviews was as follows. The children were informed by their teachers that the interviews are going to take place on that day and that the lessons are going to run parallel to the conduction of the interviews. The interviews were held in a classroom just next to the classroom separated by a door. I called one child after the other. Only the child and I were present during the interview. The interviewees were informed that they do not have to take part if they felt uncomfortable. I informed each child that the interview will be recorded but no names will be included in the study. I told each child that there are no "right" or "wrong" answers and that he or she can speak freely of what he or she is thinking about right at that moment. It was important to stress that no camera was installed to film or take pictures of the children because some of the children feared that. Then I explained the task. They had to describe their way to school. I gave them the additional information that I do not know the area so their descriptions must be as clear as possible so that I would be able to find the way from their home to school.

Questions

The questions were designed to ensure homogeneity across the different interviews (see Appendix III for the original questions in German). All introductions and explanations were given verbally due to the fact that the participants' reading abilities were limited because of their age. During the interviews it was noted down if the children used pencil and paper for their explanations, if it was necessary to ask helping questions and if communication issues occurred.

The questions 1 to 7 were asked to all participants in order to get the interview started and to get some background information about the participants.

1. What is your name?
2. How old are you?
3. What is your mother tongue?
4. Do you come to school alone or with a friend / sibling(s)?

5. If in the company of somebody, is your companion older or younger than you?
6. Do you play at the schoolyard in your free time?
7. How do you get to school every morning (by bike, on foot or by car)?

The main goal of question 8 was to let the child speak freely about their way to school without being interrupted by me. If it was not necessary, no further questions were asked after question 8.

8. Can you explain to me how you get to school from home?

The questions a) to f) were used as backup questions if the child did not know what to talk about. In most of the interviews, some of these questions were selected to encourage the child to talk about their way to school.

a) What do you see on your way?
b) How do you find the way?
c) Do you remember certain things on your way?
d) Which size do these objects have?
e) Which colour do these objects have?
f) What do you do when you leave your house/step out of the door?

4.5 Transcription

The interviews were transcribed using a selective transcription (Höld, 2009). This means that not all spoken words and sentences were transcribed. First, I defined the categories "landmarks" and "direction indication". Second, all words falling into one of these two categories were transcribed.

Landmarks

All spatial objects the children mentioned were counted as landmarks (e.g. car, bus, pedestrian crossing, letter box, etc.)

Direction Indication

All indications which described the way of the child which were not spatial objects were assigned to this category ("go left", "go right", "go straight", and "turn over there", etc.).

For each participant I prepared an Excel sheet with these two categories. Afterwards, I listened to the recorded interviews. Every time a landmark or a direction indication was mentioned I stopped the recording and put the landmark or direction indication into one or the other category-list. In the end, the lists contained several words which then were used for the subsequent classification step.

It has to be mentioned that the category "direction indication" emerged from the data and was initially not intended to be included in the analysis. Only the quantity of direction indications was taken into consideration and not their content. Consequently, the direction indications have not been looked at in more detail during data analysis.

4.6 Landmark Classification Process

I classified landmarks according to five classification aspects (environmental objects, saliency, perspective, size and representation), which will be discussed in more detail in Chapter 5.1. However, some information about the classification process is provided in the following sections.

Firstly, before the interviews were conducted, I defined seven environmental object classes (*animal*, *building*, *vegetation*, *street*, *transportation*, *infrastructure* and *person*) based on existing literature. All landmarks used during the interviews were classified according to a classification table which included these seven object classes (see Table 1). I filled in the classification table parallel to going through all the transcription sheets. I used the classification table to assure that landmarks named by several children were always put into the same environmental object class. The process of filling in the classification table was as follows. To start with, I listened to the interview of the first participant. According to pre-defined classification rules I decided to which class the named objects belong to. Each time a new landmark appeared, I added it to the classification table. Every time an already listed landmark was mentioned, I included it into the classification but did not add it to the classification table again. In this way, landmarks which were mentioned more than once do not appear in the classification table twice but were always assigned to the same class of environmental objects. When going through the transcription sheets, it became clear that two further environmental object classes need to be added to the classification table, namely the classes *landscape* and *waterbody*. Secondly, I carried out the classification for the second aspect, namely

saliency, which includes *visual*, *structural* and *cognitive* landmarks. For this step, I looked at the mentioned landmarks again and also listened to the recordings once more. This was done to assure that the saliency of each object was determined correctly according to the context of the interview. Thirdly, I only looked at the landmarks which had been identified as cognitive landmarks in the precedent step to further classify them according to the aspect of perspective. I defined two perspective classes (*subjective* and *objective*) and classified the cognitive landmarks according to their subjective and objective understandability. Fourthly, I introduced a classification for the size of the landmarks. All transcribed landmarks were included in this classification step. I determined the size (*figural*, *vista* and *environmental*) of the landmarks and put them into one of these three classes. In a last step, I classified the landmarks according the aspect of representation. I took the extent (*point*, *line* and *area*) of each landmark into consideration.

In summary, each mentioned landmark was classified according the five aspects environmental objects, saliency, perspective, size and representation. Only the cognitive landmarks were classified according to the aspect of perspective. A landmark can belong to the class animal, can be a cognitive landmark, can be objectively understandable, can have the size of the class figural and may be represented as a point feature all at the same time. All the mentioned landmarks were counted regardless of whether they were mentioned once or several times.

4.7 Statistical Analysis

The verbal data generated in the interviews was transcribed into excel tables and then classified as described in chapter 4.6. Afterwards, all the classified landmarks were summed up and transformed into quantitative values for each participant. This data set was then analysed using the IBM SPSS software.

In a first step, normal distribution tests were conducted. In a second step, the total values of each class were compared by carrying out Mann-Whitney tests, which were selected due to the fact that the data was not normally distributed. In a third step, the results were normalized per person in order to see the contribution of each group of participants to the total number of mentioned landmarks in each class. Results are considered as statistically significant at a p-value ± 0.05.

5 Results

In the following sections, the results of the classification and statistical analyses of the interview data are presented. The first chapter describes the classification scheme in more detail and gives insight into the different classification aspects. The following chapters cover the statistical analyses which were done after the classification. The data were statistically analysed in order to answer the different research questions. First, some descriptive statistics about the participants are discussed, followed by the chapters which lay out the results of the two age groups and genders.

5.1 Classification

One major part of this thesis is the development of a classification scheme to be able to quantitatively analyse the landmarks mentioned by the children during the interviews. The classification was carried out step by step and therefore was divided into five classification aspects (see Figure 8).

The first classification aspect classified the landmarks into environmental object classes as for example *vegetation*, *animals* or *buildings*. The classification of environmental objects was adapted from Matthews (1984) and Maurer and Baxter (1972). In a second step, landmarks were classified by the three classes of saliency (*visual*, *structural*, *cognitive*).This classification is based on the theory of Sorrows and Hirtle (1999). The third classification step only focused on the landmarks which had been identified as *cognitive* landmarks in the previous step. These *cognitive* landmarks were classified according to the aspect of perspective into *subjective* and *objective* landmarks depending on their understandability for others. The fourth classification step covered the aspect of different projected sizes of the mentioned landmarks (*figural*, *vista* and *environmental*) and is based on the theory of Montello (1993). In a fifth and last classification step, the spatial extent of the landmarks and their possible representation in *point*, *linear* or *areal*-like features were classified. This classification step was adapted from Hansen et al. (2006).

Figure 8 shows the different classification aspects and illustrates the dependencies of the classification steps. The environmental object classes stand on their own and do not

depend on any other classification aspect. The second classification aspect addresses the saliency of each object. This aspect serves as a foundation for the third classification aspect. In the third aspect, only the *cognitive* landmarks are taken into consideration and the *visual* and *structural* landmarks are left aside. The fourth and fifth classification aspects (size and representation) stand on their own.

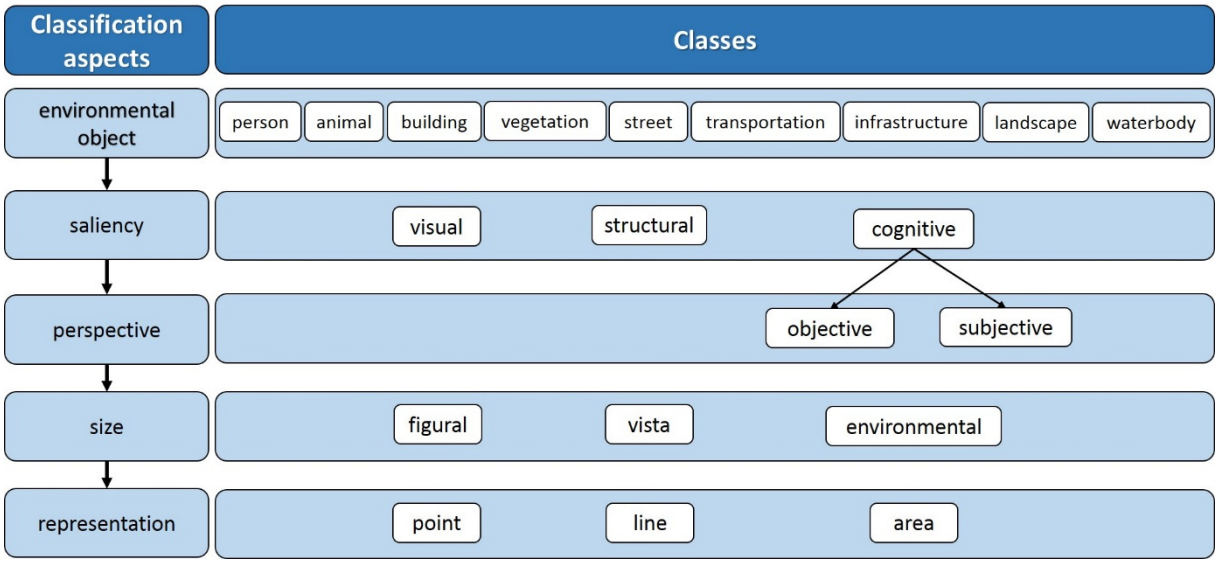

Figure 8. Classification scheme for landmarks.

To carry out the classification, rules were established to put the landmarks into the right aspect classes. These rules are discussed in the following subchapters.

5.1.1 First Aspect of Classification: Environmental Objects

According to the following rules, landmarks were classified into different environmental objects classes.

Class: Person

Children are likely to describe people when reproducing their way to school (Spencer and Lloyd, 1974). They see other children or parents along their way and mention them when describing it. Therefore, the class *person* was defined.

Class: Animal

When walking to school, children encounter different objects. Some are static objects and others are moving objects such as animals. Children are likely to remember and describe moving objects and therefore often refer to animals when giving route descriptions (Matthews, 1984; Maurer and Baxter, 1972). Consequently, the class *animal* was introduced.

Class: Building

Buildings of different types dominate the image of cities and villages. Houses stand on each side of the road and therefore often appear in route descriptions of children (Matthews, 1984). So, the class *building* was defined to refer to all landmarks describing a building.

Class: Vegetation

Children go past flowers, trees or bushes on their way to school. Plants attract the attention of the children because they are often included in games children play. (Matthews, 1984). Natural elements are likely to be reported by young children (Spencer and Lloyd, 1974). Therefore, it is imaginable that vegetation elements are mentioned in the route descriptions of the study participants. So, the class *vegetation* was introduced.

Class: Street

Like buildings, streets, paths and trails structure the image of a village (Matthews, 1984). Children follow the course of streets and they give a lot of meaning to them. The children may regard the streets as dangerous because of the traffic or they may see them as the ways leading to their friend‘s places. Consequently, the class *street* was defined. References to actual streets the children walk along but also mentioned street names were included in this class.

Class: Transportation

People in the study village use different means of transport to get to school, to go to work or in their free time. Therefore, the study participants encountered different types of vehicles on their way to school (Matthews, 1984). Accordingly, the class *transportation* was introduced.

Class: Infrastructure

Infrastructure is a broad term and consists of all elements which do not belong to the classes mentioned above. The main content of the class *infrastructure* is street furniture but the class also comprises elements such as playgrounds or car parks.

Class: Landscape

The class landscape was introduced to be able to classify objects mentioned by the participants that are different in scale. Most mentioned landmarks refer to small or single objects such as a tree or a house. However, some objects such as for example forest, grassland, hill or curve might not fit into the previously defined object classes. Consequently, the class *landscape* was introduced.

Class: Waterbody

A lake and several small rivers are located close to the study village. Therefore, several participants mentioned these objects. The class *waterbodies* contains all types of waterbodies such as lakes and rivers.

Table 1. *Environmental Objects Classification Table*

Environmental Objects								
Person	**Animal**	**Building**	**Vegetation**	**Street**	**Trans-portation**	**Infra-structure**	**Land-scape**	**Water body**
neighbour	cow	school	plant(s)	(gravel, steep) walk	car	bridge	hill	stream
children	cat	restaurant	tree(s)	street	bus	stairs	curve	lake
doctor	dog	house(s)	flower(s)	footpath	bike	waste container	land	
	sheep	gangway	bush(es)	alley	lorry	fence	village	
	bunny	farm	shrub(s)	roundabout		playground	quarter	
	frog	fire station		exit		schoolyard	settle-ment	
	hedge-hog	hair dresser		turn-off		letterbox	mountain	
	deer	chemist's		dead end		square	field	
	mouse	lunch-time supervision		crossing		seat	forest	
	high-land cattle	church		hiking trail		clock	grass-land	
		bank		pedestrian crossing		coasting slide	meadow	
		garage				barrier	tree nursery	
		post office				bike shelter		
		library				car park		
		bakery				ping-pong table		
		house gateway				turnstile		
		kinder garden				meeting point		
		carpenter				door		
		drugstore				bus stop		
		shop				building site		
		store						
		petrol station						

5.1.2 Second Aspect of Classification: Saliency of Landmarks

Saliency of landmarks is an important concept which was introduced by Sorrows and Hirtle (1999). They distinguish between *visual*, *structural* and *cognitive* landmarks. The landmarks mentioned during route descriptions were classified using this concept. A limitation is that a landmark might be *visual* and *cognitive* at the same time. For this thesis, each mentioned landmark was only assigned one type of saliency. Which type of saliency was considered to be the most suitable depended on the context of the interview.

Class: Visual Landmarks - Colour

Colour is a strong attribute influencing the saliency of a landmark (Sturges and Whitfield, 1997). Landmarks have different colours and different colours affect people differently. Some colours might be found frequently in one environment but not the other. Because of this, if landmarks were described with colour they were classified as *visual* landmarks.

Class: Visual Landmarks - Texture

The texture of an object can be very eye-catching (Caduff and Timpf, 2008). Consequently, the texture of an object influences its saliency. Therefore, if the texture of a landmark was mentioned it belonged to the *visual* class.

Class: Visual Landmarks - Visibility

The visibility of an object is crucial when defining classification categories (Caduff and Timpf, 2008). The visibility was assessed by examining the sentence structure used by the participants. If a participant gave a description such as "…then I see", or "…comes to my sight", the mentioned landmark were put into the *visual* class.

Class: Structural Landmarks - Partitioning or Connecting of Environmental Elements

The structural salience of a landmark depends on where the landmark is located (Röser et al., 2012). Some objects such as piles, turnstiles or pedestrian crossings can partition an environment into different pieces. Other objects can connect two elements which are apart from each other for example bridges or large squares which connect streets or two

parts of a village. Such objects are important for the structure of the environment and were therefore put into the class *structural* landmarks.

Class: Structural Landmarks - Position

The position of an object earns its significance from its relation to the position of other objects in the environment (Sorrows and Hirtle, 1999). The saliency of an object, for example, depends on whether an object is behind or in front of another object. So, if the relative position of a landmark was mentioned during the interviews, the landmark was put into the class *structural* landmarks.

Class: Cognitive Landmarks - Names

Landmarks such as streets or other objects have names (Tom and Denis, 2004). These names sometimes describe the object of interest quite well in one case (e.g. library, "Station Street") but make no sense to a stranger in another case (e.g. the name of a restaurant or the name of a person). Names of restaurants in Switzerland often carry the names of animals. In such cases, the name is not describing the object itself and with no further knowledge, a stranger could be misled. So, names which are not self-explanatory and need background knowledge were included into the class *cognitive* landmark.

Class: Cognitive Landmarks - Content

Some landmarks are important to and described by a child because of their content (Duckham et al., 2010). One example might be the farm a child walks past on his or her way to school. The child remembers this farm because the child's parents usually buy eggs there. If a participant gave additional information about a landmark which was not relevant to navigate to school, this landmark was regarded as a *cognitive* landmark too.

Class: Cognitive Landmarks - Meaning

The saliency of a landmark can also evolve from its meaning (Duckham et al., 2010). Some environmental objects such as the school building, a library or a playground are attached importance because they are known well by the children (e.g. "The school is the place, where I have to go every day." or "The library is the place where I can read and borrow books."). These types of landmarks were assigned to the class *cognitive* landmark.

5.1.3 Third Aspect of Classification: Perspective of Cognitive Landmarks

Landmarks belonging to the class cognitive landmark can be divided into two the sub-classes *objective* or *subjective*. This subdivision is necessary because it is of interest whether younger children use more *subjective* landmarks than older children. Consequently, a third classification step was carried out to compare the *subjective* and *objective* understandability and the usefulness for navigation of the mentioned landmarks. The classification scheme for this aspect was as follows:

Class: Objective

All landmarks which are well known and generally understandable to anyone and do not require any contextual knowledge belong to the class *objective*. Some examples are forest, school, playground, fire station or petrol station.

Class: Subjective

All landmarks which are only understandable to people who have contextual knowledge of these landmarks and the area the landmarks are located in belong to the class *subjective* (e.g. “Lea’s house”, “the Lion” or “Dr. Berli”). Landmarks which are not helpful for navigation because they can change their location belong to this class as well (e.g. a person, “my neighbour”, bunny or bus).

5.1.4 Fourth Aspect of Classification: Size of Landmarks

The size of landmarks differs. Some landmarks are smaller than the study participants and others are larger. In order to address and compare the different sizes of the landmarks a fourth classification step was carried out.

Montello (1993) distinguishes between four major classes of psychological spaces in order to structure different size descriptions of space: *figural*, *vista*, *environmental* and *geographical*. He puts emphasis on the functional properties of these four psychological spaces. The distinction between them is made on the basis of the projective size of a space relative to the human body and not based on its actual or apparent absolute size. This means that large spaces viewed from a distance can be interpreted as a small space. Based

on this theory, the fourth aspect of my classification included three types of sizes to which the mentioned landmarks were assigned to.

Class: Figural

The *figural* space is smaller than the human body. Its properties can be directly perceived from a viewpoint without considerable locomotion. According to Montello (1993) *figural* space is the space of small objects, distant landmarks, or pictures. For this study, all mentioned landmarks which are actually smaller in size than the human body were included into the class *figural* (e.g. letter box, bunny, etc.).

Class: Vista

The *vista* space is as large as or larger than the human body. However, it still can be seen from a place without considerable locomotion. *Vista* space is the space of small valleys, horizons, town squares and single rooms (Montello, 1993). For this study, all landmarks which can be perceived from one viewpoint but are larger than the human body are included into the class *vista* (e.g. pedestrian crossing, car park, etc.)

Class: Environmental

Environmental space is larger than the human body and surrounds it. This space is too large or otherwise obscured to be perceived at once without appreciable locomotion. It is the space of neighbourhoods, cities and buildings (Montello, 1993). For this study, all landmarks which are larger than the body and need locomotion to be fully perceived are assigned to this class (e.g. forest, village, etc.).

5.1.5 Fifth Aspect of Classification: Representations of Landmarks

Landmarks have different properties. One of these properties is the spatial extent of landmarks, which determines how a landmark is represented on a map. Hansen et al. (2006) define a classification scheme for landmarks based on their conceptual level and categorize them according to the way humans conceptualize the functional role of the landmarks' spatial extension. Landmarks may be represented as a function of either point-like, linear or areal objects depending on how they are used in the route finding

process. Following Hansen et al. (2006) or Gerber (1984), in this study, the landmarks are classified into three classes: *point*, *line* and *area*.

Class: Point

Point-like landmarks are environmental objects which can be represented as single points on a map, for example trees, a car or a single house.

Class: Line

Linear landmarks are environmental objects which have a linear extent and can be represented as lines on a map, for example streets, rivers or paths.

Class: Area

Areal landmarks are environmental objects which cover a larger area and expand over a surface. An example could be a forest or a meadow.

5.2 Participants

58 children participated in the study. Due to communication difficulties and language problems some of the participants could not complete the experiment and their data were excluded from analyses. There were some participants who did the pre-test but did not want to participate in the practical experiment. The final sample consisted of 47 participants between the age of 7 and 11 years. The sample was partitioned into two groups: grade 1 and grade 4. The age of the 22 participants in grade 1 was between 7 and 9 years (M= 7.18, SD = 0.59). Only two participants in grade 1 were 9 years old, the other participants were 7 years old. The age of the 25 participants in grade 4 was between 9 and 11 years (M= 9.88, SD = 0.53). Most of the fourth graders were 10 years old.

5.2.1 Years of Living in the Village

The number years the children had lived in this particular village with their families was one of the background information which was gathered to get an impression about the participants' knowledge of the area. The categories were as follows: less than one year, more than one year, more than two years, more than three years and more than four years

(see Table 2). Over 72 % of the first graders had lived in the village for more than four years. Over 92 % of the fourth graders had lived in the area for more than four years.

Table 2. *Participants' years of living in the village*

	Grade 1 (n = 22)		**Grade 4** (n = 25)	
Years	Total Participants	(%)	Total Participants	(%)
< 1	0	0	1	4.0
> 1	2	9.1	1	4.0
> 2	2	9.1	0	0
> 3	2	9.1	0	0
> 4	16	72.7	23	92.0

5.2.2 Mother Tongue

Different mother tongues are spoken by the participants (see Table 3). The majority of participants only speak Swiss German (grade1 = 81.8 %, grade 4 = 76.0%). The remaining participants speak Swiss German and a second language (grade 1 = 4.5 %, grade 4 = 16%). Over 86 % of the first graders and 92 % of the fourth graders speak and understand Swiss German perfectly.

Table 3. *Different mother tongues of participants*

	Grade 1 (n = 22)		**Grade 4** (n = 25)	
Mother tongue	Total Participants	(%)	Total Participants	(%)
Arabic	1	4.5	0	0
Serbian	0	0	1	4.0
Swiss German	18	81.8	19	76.0
Swiss German & English	1	4.5	1	4.0
Swiss German & German	0	0	2	8.0
Swiss German & French	0	0	1	4.0
Tamil	2	9.1	0	0
Portuguese	0	0	1	4.0

5.2.3 Water-Level Task: Score

The participants were asked to fulfil a Water-Level Task in order to assess their general spatial ability. Different scores were achieved from 0 up to 6. The first graders achieved scores from 1 to 5 (*Mdn* = 2) and the fourth graders from 1 to 6 (*Mdn* = 2). In Figure 9 it is visible that grade 4 (B) shows a larger variety of scores than grade 1 (A). The mean score in grade 1 is *M* = 2.05 and in grade 4 it is *M* = 3.08. The data is not distributed normally and therefore a Mann-Whitney test was conducted in order to find differences between the two groups. A significant difference was found between grade 1 and grade 4 (*U* = 174, *Z* = -2.466, *p* = 0.014, *r* = 0.36). Fourth graders reached higher scores than first graders and the effect size was medium.

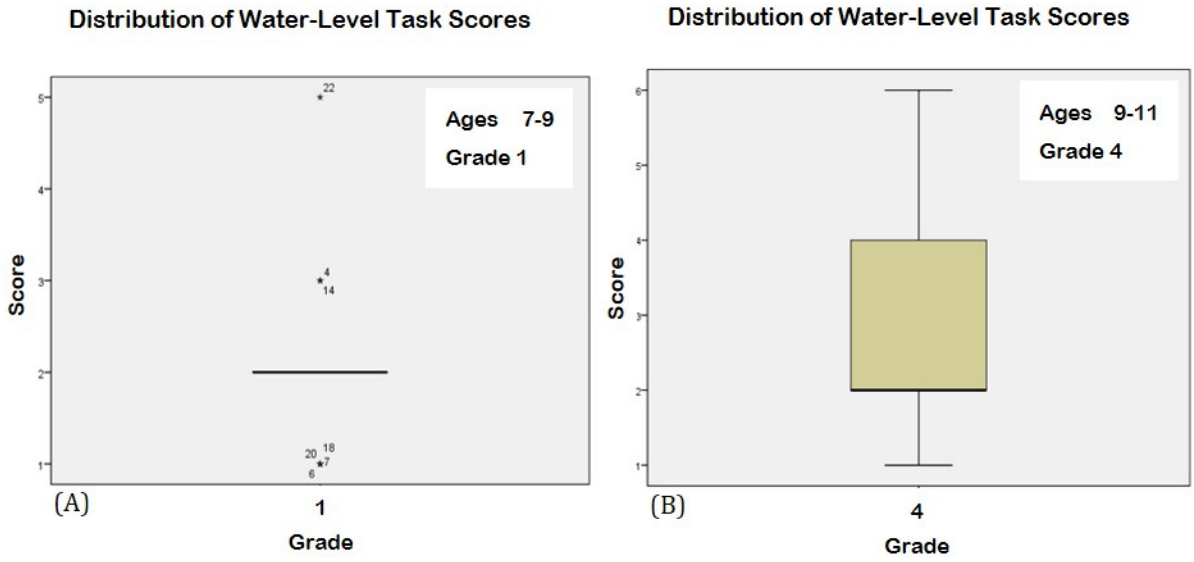

Figure 9. (A) Water-Level Task scores of first graders. (B) Water-Level Task scores of fourth graders.

5.3 Landmarks, Direction Indications and Distances

Each child gave a route description containing landmarks and direction indications. Additionally, for each child, a total travelled distance was calculated. The total values of these three components are discussed in this section. Subsequently, the normalized values are statistically analysed.

The two age groups differed in the total count of mentioned landmarks and direction indications. First graders mentioned 183 landmarks in total, whereas fourth graders

mentioned 211 (see Table 4). A difference between the two groups was found in the number of mentioned direction indications. The first graders used 110 direction indications in total, whereas the fourth graders used 226. The travelled distance per participant in grade 1 is 1164.55m and 962.40m in grade 4. This is a difference of 202.15m between the age groups. In general, the fourth graders' ways to school were shorter than the ones of the first graders (see Table 4).

Table 4. *Total number of landmarks, direction indications and distances in grade 1 and grade 4*

	Grade 1 (n = 22)		**Grade 4** (n = 25)	
Category	Total	Per Participant	Total	Per Participant
Landmarks	183	8.32	211	8.76
Directions	110	5	226	9.04
Distance	25620	1164.55	24060	962.40

The distribution of the data is shown in Figure 10. The median (*Mdn*) in boxplot B varies between grade 1 and grade 4. Boxplot A shows a slight difference and boxplot C shows almost no difference in medians. Consequently, regarding landmark use (A) and travelled distance (C), no difference exists. Regarding the total count of direction indications (B), a difference between the two groups is visible.

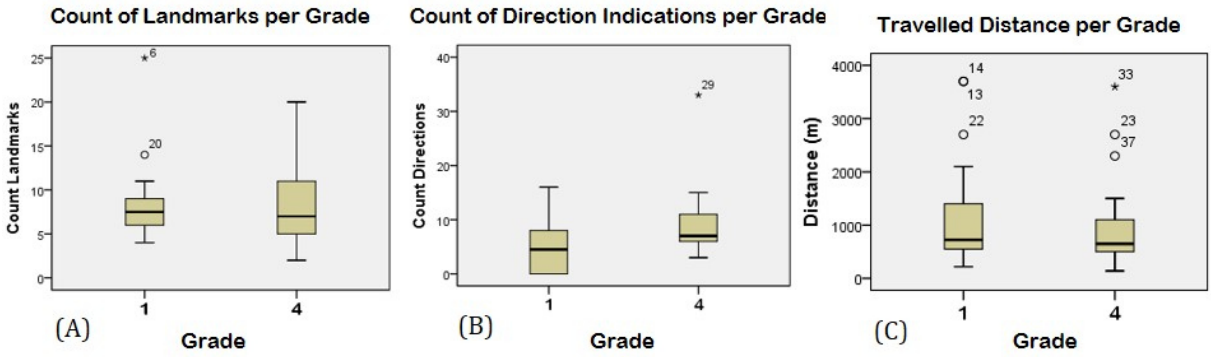

Figure 10. (A) Comparison of the total count of mentioned landmarks per participant grouped per grade. (B) Comparison of the total count of mentioned directions per participant grouped per grade. (C) Comparison of the daily travelled distance to school per participant grouped per grade.

These findings were tested with a Mann-Whitney test since the data is not normally distributed. First, the difference between the grades was tested. Regarding the number of used landmarks ($U = 249$, $Z = -0.555$, $p = 0.579$) and the travelled distance ($U = 202$, $Z = -1.335$, $p = 0.182$), no significant difference was found. The number of mentioned

directions showed a statistically significant difference (U = 173, Z = -2.180, p = 0.029, r = 0.32). Fourth graders used more direction indications than first graders (see Table 5). The effect size was medium.

Table 5. *Mann-Whitney-Test of landmarks, direction indications and distance in age groups*

	Mann-Whitney-Test		
	Grade 1 vs Grade 4 (n = 47)		
Landmark Class	U	Z	p
Landmarks	249	-0.555	0.579
Directions	173	-2.180	**0.029**
Distance	202	-1.335	0.182

Note: Bold and underlined value is significant (at $p < 0.05$).

A Mann-Whitney test was conducted since the data is not normally distributed to find differences between the genders. No difference could be found (see Table 6).

Table 6. *Mann-Whitney-Test of landmarks, direction indications and distance in gender groups*

	Mann-Whitney-Test		
	Male vs Female (n = 47)		
Landmark Class	U	Z	p
Landmarks	248	-0.577	0.528
Directions	245.5	-0.631	0.564
Distance	243.5	-0.419	0.675

In Figure 11, the diagrams show the relative distribution of landmarks and direction indications of first and fourth graders to the total numbers discussed above. Participants in grade 1 covered 46% of all mentioned landmarks during the study. Participants in grade 4 used 54% of all landmarks. The difference in the mentioned direction indications was larger between first and fourth graders. First graders used 33% of all direction indications, whereas fourth graders named 67% of the total mentioned direction indications.

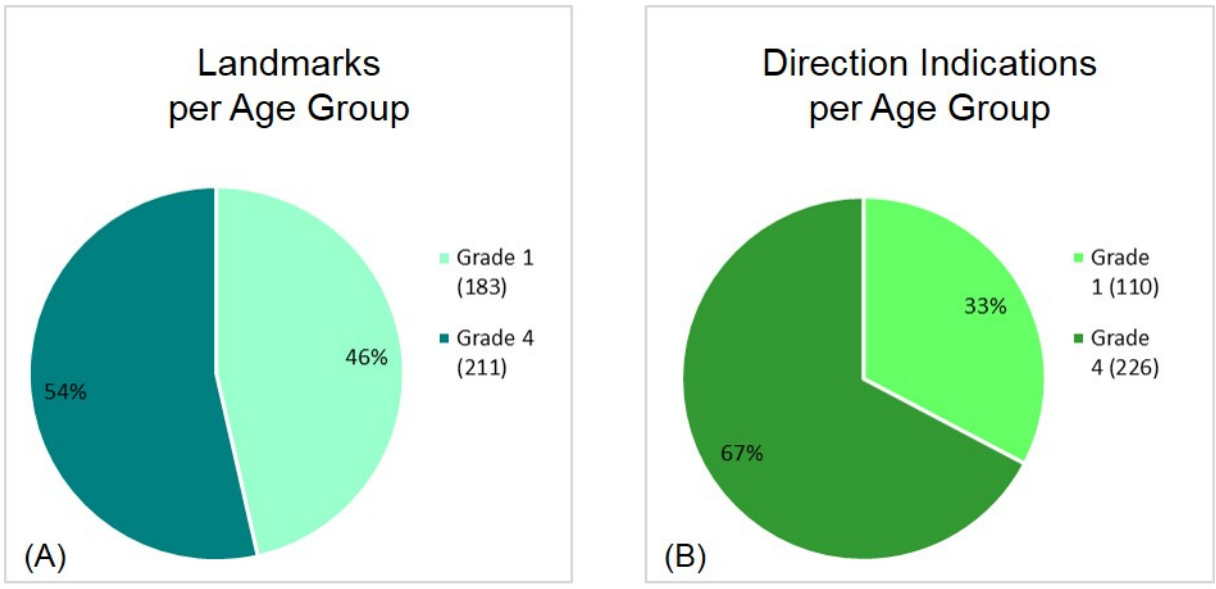

Figure 11. (A) Relative contribution of first and fourth graders to the total count of landmarks. (B) Relative contribution of first and fourth graders to the total number of direction indications.

The data was also analysed for gender differences in both age groups. Since data is not normally distributed, a Mann-Whitney test was performed to compare male and female participants in grade 1 and grade 4 (see Table 7). No statistically significant difference in travelled distance, in mentioned directions and in the amount of used landmarks was found between genders in grade 1 and grade 4.

Table 7. *Mann-Whitney-Test of landmarks, direction indications and distance in grade 1 and grade 4 comparing genders*

	Mann-Whitney-Test					
	Grade 1 (n = 22)			**Grade 4** (n = 25)		
	Male vs Female			Male vs Female		
Landmark Class	U	Z	p	U	Z	p
Landmarks	52.5	-0.499	0.628	55.5	-1.231	0.225
Directions	57.5	-0.167	0.867	65	-0.832	0.410
Distance	51.5	-0.178	0.862	69	-0.491	0.650

Since the data is not normally distributed, a Mann-Whitney test was performed to compare male and female participants of the same age group (see Table 8). No statistical significant difference between genders in the number of landmarks, the number of mentioned direction indications and the travelled distance to school was found.

Table 8. *Mann-Whitney-Test of landmarks, direction indications and distance in males and females comparing grades*

	Mann-Whitney-Test					
	Male (n = 22)			**Female** (n = 25)		
	Grade 1 vs Grade 4			Grade 1 vs Grade 4		
Landmark Class	U	Z	p	U	Z	p
Landmarks	37	-1.524	0.140	67	-0.599	0574
Directions	43	-1.128	0.259	47	-1.690	0.091
Distance	41	-0.952	0.382	60	-0.981	0.347

5.3.1 Landmarks' and Direction Indications' Correlation with Distance

Since the data is not normally distributed, a Spearman's rank-order correlation was carried out to determine the correlation between the distance travelled to school and the count of landmarks (see Figure 12). A weak positive correlation between distance and landmarks was found, which was statistically significant (r_s = 0.377, p =0 .009). Since the data is not normally distributed, a Spearman's rank-order correlation was carried out to determine the correlation between the distances travelled to school and the number of mentioned direction indications (see Figure 12). A small positive correlation between distance and direction indications was found, which was not statistically significant (r_s = 0.132, p =0 .375).

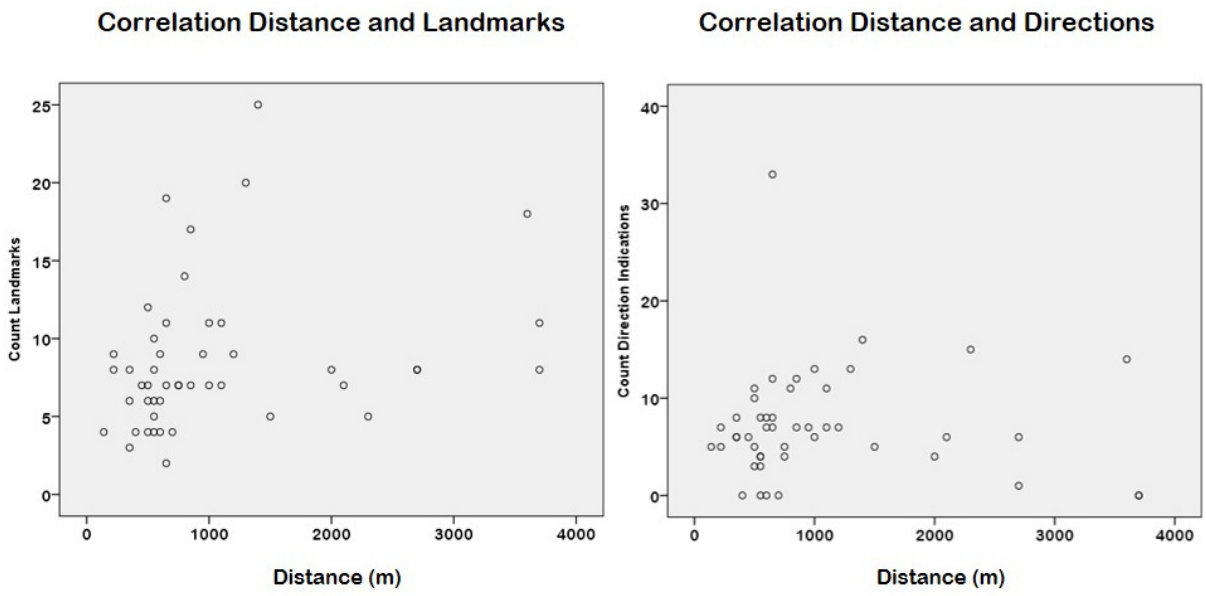

Figure 12. (A) Correlation between distance and count of landmarks. (B) Correlation between distance and direction indications.

5.4 Environmental Objects

At first, the differences between the two age groups were looked at in the usage of environmental objects. In Figure 13, the diagrams show the total contribution of each environmental object class to the total number of landmarks for grade 1 and grade 4. Differences are obvious in the class *animal*, *vegetation*, *street* and *transportation*. The class *animal* contributes more to the total number of landmarks in grade 1 (8%) than in grade 4 (2%). The class *vegetation* contributes more to the total number of landmarks in grade 1 (13%) than in grade 4 (3%). The class *street* contributes less to the total number of landmarks in grade 1 (20%) than in grade 4 (31%). The class *transportation* contributes more to the total number of landmarks in grade 1 (7%) than in grade 4 (1%).

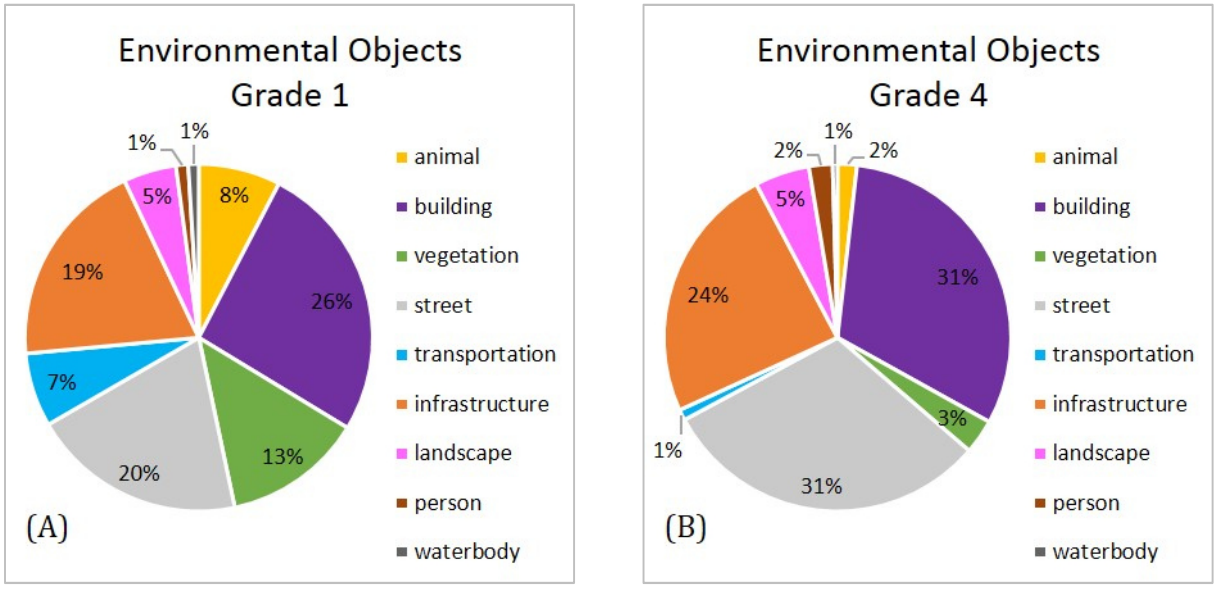

Figure 13. (A) Relative contribution of each environmental object class to the total number of landmarks in grade 1. (B) Relative contribution of each environmental object class to the total number of landmarks in grade 4.

Since the data is not normally distributed, a Mann-Whitney test was performed to determine differences between the two age groups (see Table 9). Differences between grade 1 and grade 4 were statistically significant for the classes *animal* (U = 204.5, Z =-2.026, p = 0.043, r = 0.30), *street* (U = 168, Z = -2.294, p = 0.022, r = 0.34) and *vegetation* (U = 190, Z = -2.073, p = 0.038, r =0.30). Objects of the classes *animal* and *vegetation* were more frequently mentioned by first graders, whereas fourth graders favourably mentioned landmarks of the class *street*. The effect sizes were medium for all three cases.

Table 9. *Mann-Whitney-Test of environmental objects in age groups*

	Mann-Whitney-Test		
	Grade 1 vs Grade 4 (n = 47)		
Landmark Class	U	Z	p
Animal	204.5	-2.026	**0.043**
Building	231.5	-0.931	0.352
Infrastructure	230	-0.967	0.333
Landscape	270	-0.129	0.897
Person	272	-0.132	0.895
Street	168	-2.294	**0.022**
Transportation	220	-1.791	0.073
Vegetation	190	-2.073	**0.038**
Waterbodies	261	-0.704	0.481

Note: Bold and underlined value is significant (at $p < 0.05$).

In a second step, the differences between genders were focused on. In Figure 14, the diagrams show the total contribution of each environmental object class to the total number of landmarks for male and female participants. When looking at the distribution of landmark classes between genders of both grades, it is obvious that male participants (31%) used more objects of the class *street* than the females (22%). Male participants also mentioned *people* (1%) when describing their way whereas females did not (0%). Female participants seem to have used more landmarks of the class *animal* (6%) than male participants (2%).

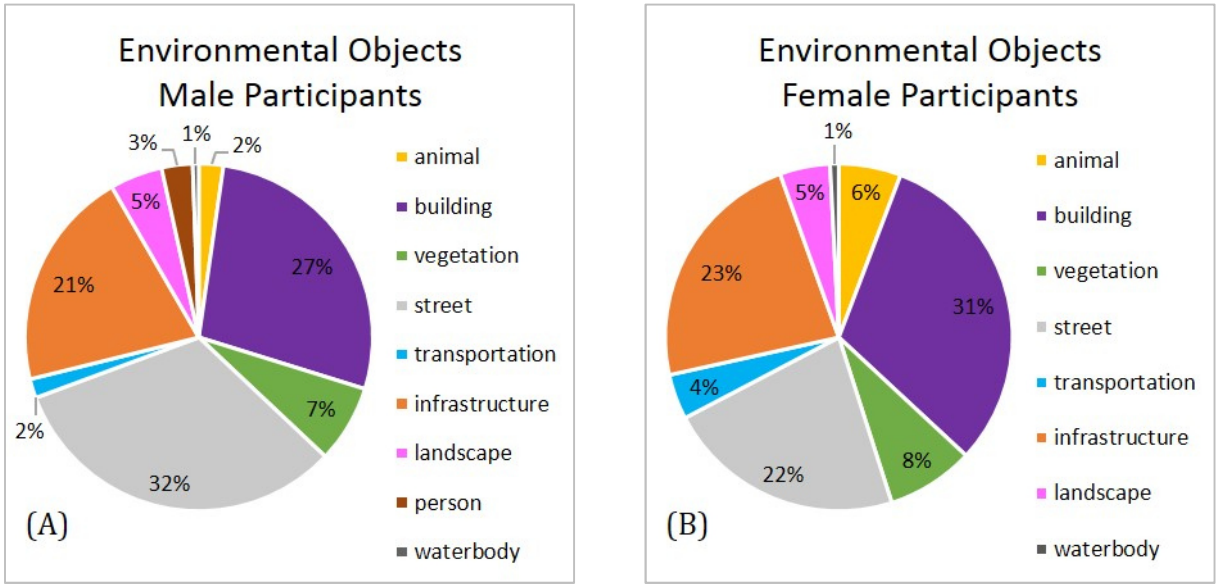

Figure 14. (A) Relative contribution of each environmental object class to the total number of landmarks for male participants. (B) Relative contribution of each environmental object class to the total number of landmarks for female participants.

Since the data is not normally distributed, a Mann-Whitney test was performed to determine differences between the results for males and females in both age groups (see Table 10). Only the difference in the class *person* is significant (U = 225, Z = -2.203, p = 0.028, r = 0.32). Males used the class *person,* whereas females did not. The effect size is small.

Table 10. *Mann-Whitney-Test of environmental objects in gender groups*

	Mann-Whitney-Test		
	Male vs Female (n = 47)		
Landmark Class	U	Z	p
Animal	261.5	-0.388	0.698
Building	261	-0.299	0.765
Infrastructure	266	-0.193	0.847
Landscape	268.5	-0.168	0.867
Person	225	-2.203	**0.028**
Street	194	-1.737	0.082
Transportation	248.5	-0.836	0.388
Vegetation	224.5	-1.231	0.218
Waterbodies	266.5	-0.428	0.669

Note: Bold and underlined value is significant (at $p < 0.05$).

In a third step, the differences between age groups of the same gender and the difference between different genders in the same age group were looked at (see Figure 15).

For male participants in grade 1 and grade 4 it is visible that the younger boys used much more landmarks of the class *vegetation* (15%) than the older ones (1%). The older boys seem to have used more landmarks of the classes *street* (34%) and *infrastructure* (24%) than the male participants of grade 1 (16%). Girls of grade 1 used more landmarks of the class *animal* (9%) compared to the older ones (1%) but they used less landmarks of the classes *street* (17%) and *buildings* (26%) than the older female participants (28%, 36%). Landmarks of the class *transportation* were not used by girls in grade 4. In grade 1, the usage of the class *infrastructure* (16%, vs 22%) and for the class *street* (24%, vs 17%) differed between male and female participants. In grade 4, the usage of the class *street* (34%, vs 28%) and of the class *person* (5%, vs 0%) differed between male and female participants.

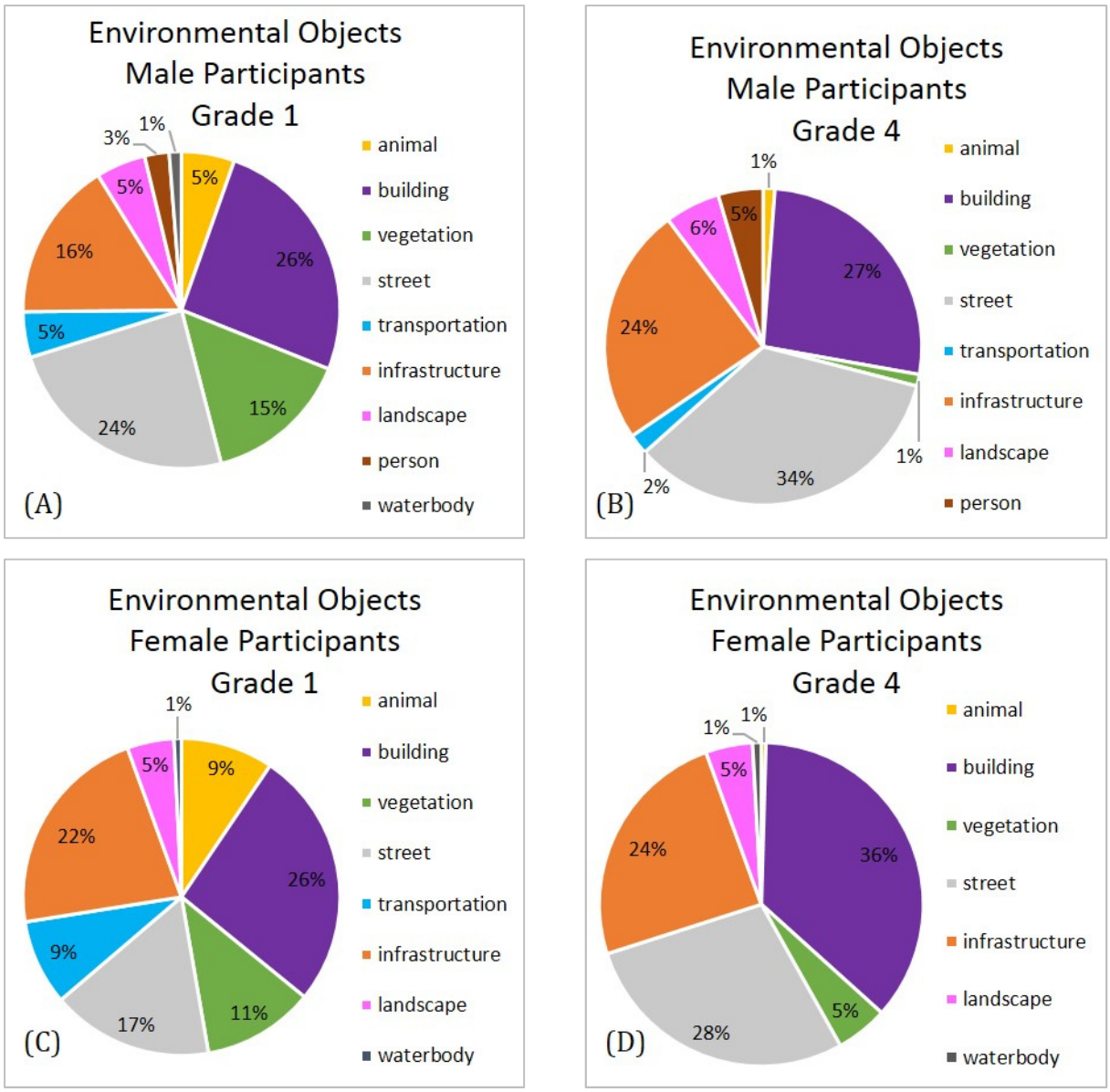

Figure 15. (A) Relative contribution of each environmental object class to the total number of landmarks for male participants in grade 1. (B) Relative contribution of each environmental object class to the total number of landmarks for male participants in grade 4. (C) Relative contribution of each environmental object class to the total number of landmarks for female participants in grade 1. (D) Relative contribution of each environmental object class to the total number of landmarks for female participants in grade 4.

Since the data is not normally distributed, a Mann-Whitney test was performed to determine differences between male and female participants of grade 1 and grade 4 (see Table 11). No statistical significant differences were found.

Table 11. *Mann-Whitney-Test of environmental objects in grade 1 and grade 4 comparing genders*

	Mann-Whitney-Test					
	Grade 1 (n = 22)			**Grade 4** (n = 25)		
	Male vs Female			Male vs Female		
Landmark Class	U	Z	p	U	Z	p
Animal	56	-0.306	0.821	72.5	-0.530	0.769
Building	59.5	-0.033	0.947	69	-0.491	0.650
Infrastructure	50.5	-0.633	0.539	74	-0.219	0.852
Landscape	53.5	-0.519	0.674	72	-0.394	0.769
Person	48	-1.519	0.456	65	-1.502	0.503
Street	43	-1.141	0.283	52	-1.419	0.168
Transportation	59	-0.084	0.947	65	-1.502	0.503
Vegetation	58.5	-0.106	0.923	49.5	-1.958	0.050
Waterbodies	58.5	-0.198	0.923	72	-0.961	0.769

Since the data is not normally distributed, a Mann-Whitney test was performed to determine differences between male and female participants of grade 1 and grade 4 (see Table 12). The difference in the class *vegetation* is significant (U = 34.5, Z = -2.143, p = 0.032, r = 0.31). Younger boys used more landmarks of the class *vegetation*. The effect size of this difference is medium. When comparing female participants of both grades, no statistical significant difference could be observed.

Table 12. *Mann-Whitney-Test of environmental objects in male and female comparing grades*

	Mann-Whitney-Test					
	Male (n = 22)			**Female** (n = 25)		
	Grade 1 vs Grade 4			Grade 1 vs Grade 4		
Landmark Class	U	Z	p	U	Z	p
Animal	42	-1.620	0.105	61	-1.198	0.231
Building	56.5	-0.232	0.816	56.5	-1.173	0.241
Infrastructure	45	-1.002	0.317	70.5	-0.410	0.682
Landscape	53	-0.558	0.577	71	-0.460	0.646
Person	58	-0.196	0.845	78	0.000	1
Street	38.5	-1.428	0.153	44.5	-1.839	0.066
Transportation	51	-0.808	0.419	58.5	-1.878	0.060
Vegetation	34.5	-2.143	**0.032**	62	-0.939	0.348
Waterbodies	54	-1.095	0.273	78	0.000	1

Note: Bold and underlined value is significant (at $p < 0.05$).

5.5 Saliency of Landmarks

At first, the differences between the two age groups were looked at. Landmarks of the aspect saliency are divided into the classes *visual, structural* and *cognitive* (see Figure 16). On one hand, first graders use more *visual* landmarks (33%) compared to fourth graders (23%). On the other hand, fourth graders use more *cognitive* landmarks (42%) than first graders (34%). The use of *structural* landmarks is about the same in both age groups (33%, vs. 35%).

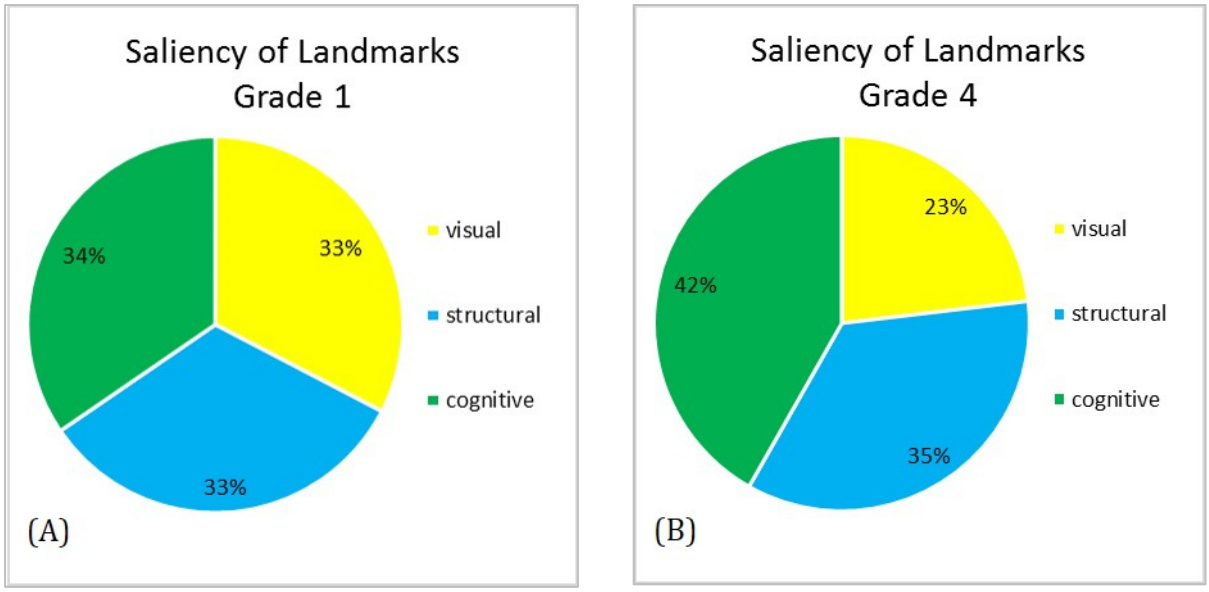

Figure 16. (A) Relative contribution of each landmark saliency class to the total number of landmarks in grade 1. (B) Relative contribution of each landmark saliency class to the total number of landmarks in grade 4.

Since the data is not normally distributed, Mann-Whitney tests were performed to determine differences between grades fore landmark saliency (see Table 13). No difference was found between age groups.

Table 13. *Mann-Whitney-Test of landmark saliency in age groups*

	Mann-Whitney-Test		
	Grade 1 vs Grade 4 (n = 47)		
Landmark Class	U	Z	p
visual	237.5	-0.804	0.422
structural	251.5	-0.502	0.616
cognitive	217	-1.240	0.215

In a second step, the differences between genders were focused on. When comparing male and female participants of both age groups, a difference is visible (see Figure 17). Female participants used less *visual* landmarks (25%) than male participants (31%). Female participants also used less *structiural* landmarks (32%) than male participants (36%). But females used more *cognitive* landmarks (43%) than males (33%).

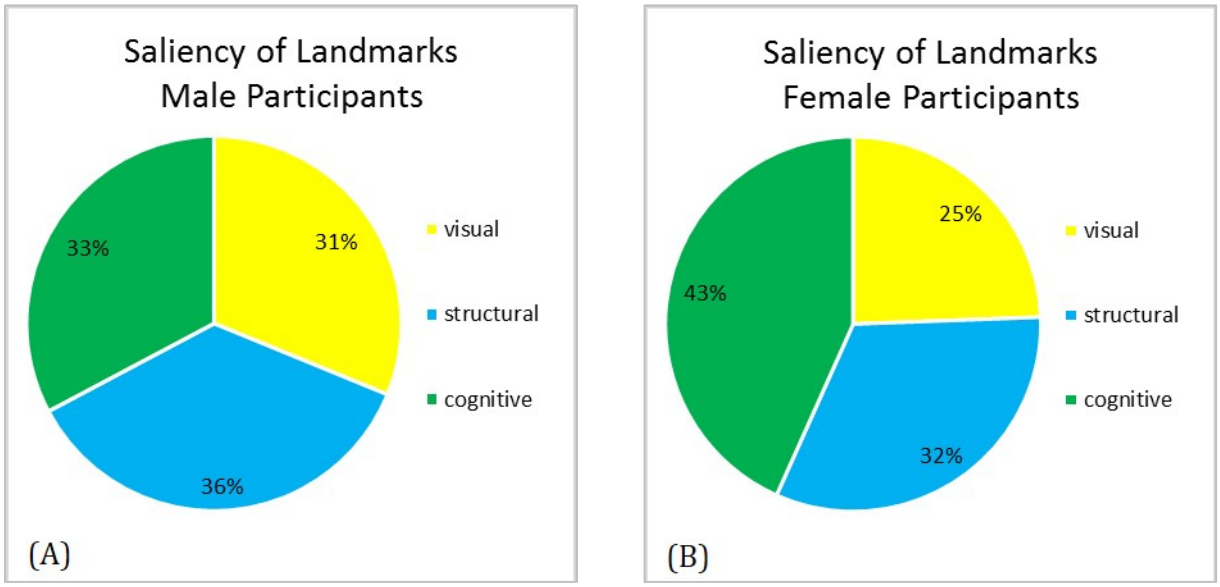

Figure 17. (A) Relative contribution of each landmark saliency class to the total number of landmarks for male participants. (B) Relative contribution of each landmark saliency class to the total number of landmarks for female participants.

Since the data is not normally distributed, Mann-Whitney tests were performed to determine differences between genders fore landmark saliency (see Table 14). No difference was found between the age groups.

Table 14. *Mann-Whitney-Test of landmark saliency in gender groups.*

	Mann-Whitney-Test		
	Male vs Female (n = 47)		
Landmark Class	U	Z	p
visual	225	-1.072	0.284
structural	246	-0.619	0.536
cognitive	218.5	-1.208	0.227

In a third step, the differences between age groups of the same gender and the difference between different genders in the same age group were looked at (see Figure 18). Male participants of grade 1 used less *cognitive* landmarks (26%) than the older group (38%).

Structural landmarks were used more frequently by boys of grade 4 (40%) than grade 1 (32%). *Visual* landmarks were used more frequently by male participants in grade 1 (42%) than in grade 4 (22%). Female participants in grade 1 and grade 4 differed the most in the usage of *cognitive* landmarks. Older girls used more *cognitive* landmarks (45%) than younger girls (41%). In both classes, *structural* and *visual*, younger and older girls behaved almost the same. In grade 1, male and female participants differ the most in the usage of *cognitive* landmarks. Boys in grade 1 used less cognitive landmarks (26%) than girls (41%). *Visual* landmarks were used more frequently by boys of grade 1 (42%) than by girls (25%). The use of *structural* landmarks was about the same for both genders in grade 1. In grade 4, the largest difference between the genders occurred in the class *structural* landmarks. Boys used *structural* landmarks more often (40%) than girls (31%). Girls in grade 4 used 2% more *visual* and 6% more *cognitive* landmarks.

Since the data is not normally distributed, Mann-Whitney tests were performed to determine differences between grades and genders for landmark saliency. However, none of these differences is statistically significant (see Table 15 and Table 16). There was neither a difference found between the age groups nor between genders.

Table 15. *Mann-Whitney-Tests of landmark saliency in grade 1 and grade 4 comparing genders*

	Mann-Whitney-Test					
	Grade 1 (n = 22)			**Grade 4** (n = 25)		
	Male vs Female			Male vs Female		
Landmark Class	U	Z	p	U	Z	p
visual	42.5	-1.160	0.254	74.5	-0.191	0.852
structural	57	-0.199	0.872	58	-1.090	0.295
cognitive	37.5	-1.490	0.140	72.5	-0.300	0.769

Table 16. *Mann-Whitney-Tests of landmark saliency in males and females comparing grades*

	Mann-Whitney-Test					
	Male (n = 22)			**Female** (n = 25)		
	Grade 1 vs Grade 4			Grade 1 vs Grade 4		
Landmark Class	U	Z	p	U	Z	p
visual	41	-1.255	0.228	77.5	-0.028	0.979
structural	47	-0.859	0.418	76.5	-0.082	0.936
cognitive	40.5	-1.297	0.203	69	-0.492	0.650

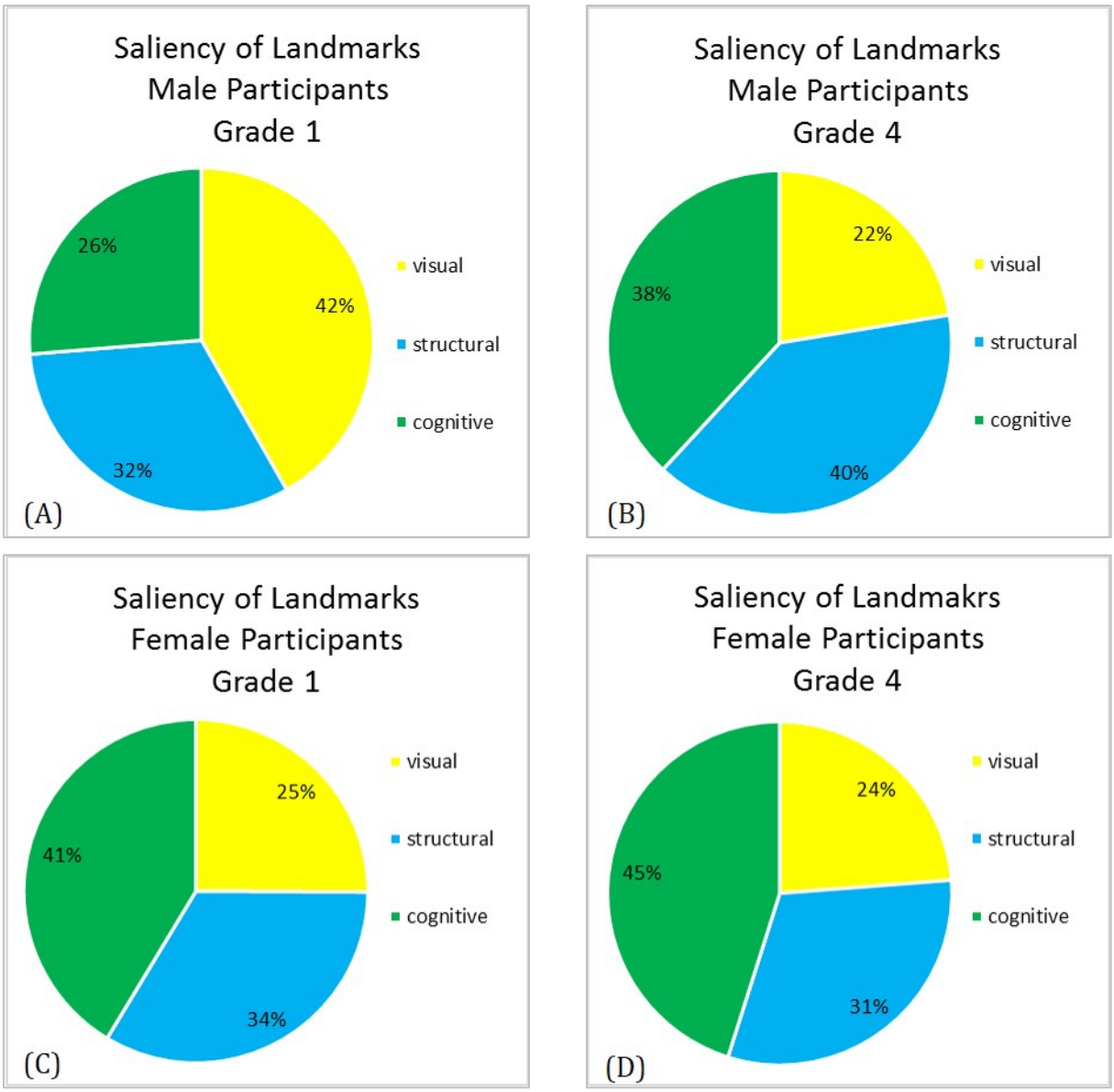

Figure 18. (A) Relative contribution of the landmark saliency class to the total number of landmarks for male participants in grade 1. (B) Relative contribution of the landmark saliency class to the total number of landmarks for male participants in grade 4. (C) Relative contribution of the landmark saliency class to the total number of landmarks for female participants in grade 1. (D) Relative contribution of the landmark saliency class to the total number of landmarks for female participants in grade 4.

5.6 Perspective of Cognitive Landmarks

At first, the differences between the two age groups were looked at for the use of different perspectives of cognitive landmarks. *Subjective* landmarks were used more frequently in grade 1 (28%) than grade 4 (16%) (see Figure 19). Objective cognitive landmarks were used more frequently in grade 4 (72 %, vs 84%).

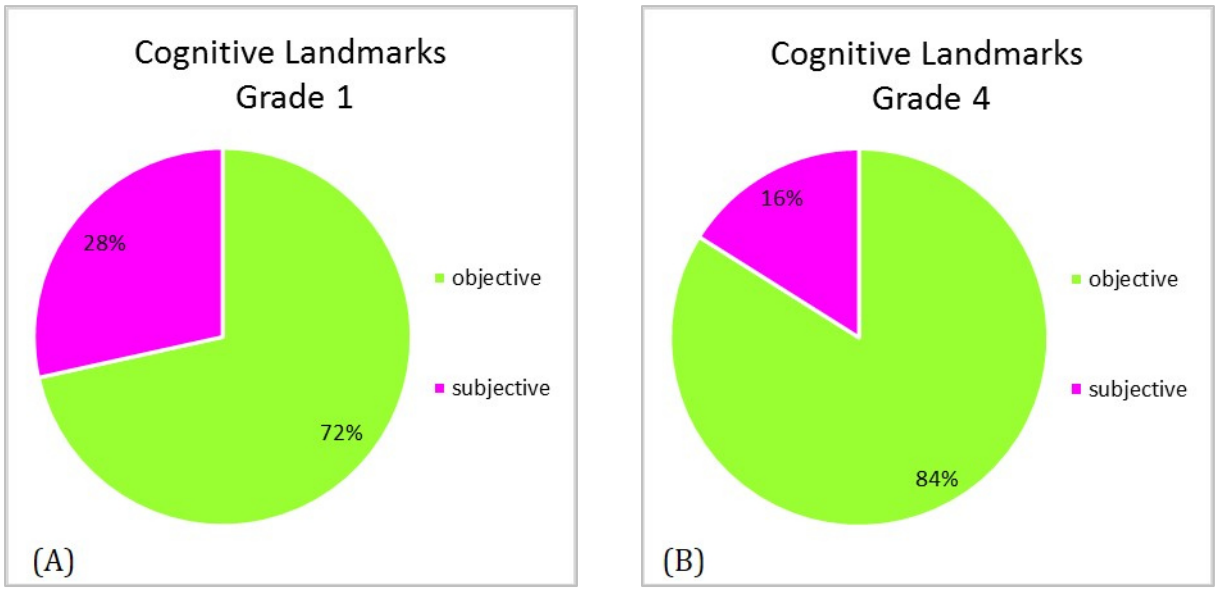

Figure 19. (A) Relative contribution of objective and subjective cognitive landmarks to the total number of cognitive landmarks in grade 1. (B) Relative contribution of objective and subjective cognitive landmarks to the total number of cognitive landmarks in grade 4.

Since the data is not normally distributed, a Mann-Whitney test was performed to determine differences between the two age groups (see Table 19). Statistical analyses show no significant difference between grade 1 and grade 4 in the use of objective and subjective landmarks.

Table 17. *Mann-Whitney-Test of cognitive landmarks in age groups*

	Mann-Whitney-Test		
	Grade 1 vs Grade 4 (n = 47)		
Landmark Class	U	Z	p
objective	199	-1.681	0.093
subjective	217	-1.319	0.187

In a second step, the differences between the genders were focused on (see Figure 20). Male participants of both age groups used more *subjective* cognitive landmarks (26%) in total than female participants (19%). However, all participants used more than three thirds of all the mentioned *objective* cognitive landmarks.

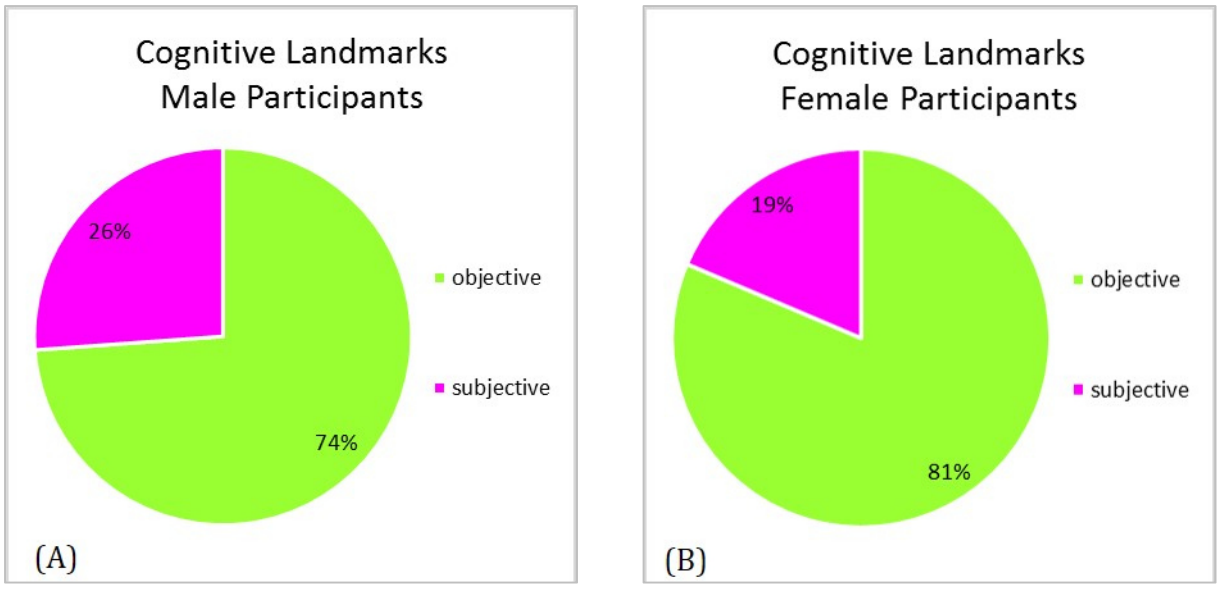

Figure 20. (A) Relative contribution of objective and subjective cognitive landmarks to the total number of cognitive landmarks for male participants. (B) Relative contribution of objective and subjective cognitive landmarks to the total number of cognitive landmarks for female participants.

Since the data is not normally distributed, a Mann-Whitney test was performed to determine differences between the two gender groups (see Table 20). The difference between male and female is statistically significant. Girls used more objective cognitive landmarks than boys (U = 167, Z = -2.389, p = 0.017, r = 0.34). The effect size of this difference is medium.

Table 18. *Mann-Whitney-Test of cognitive landmarks in gender groups*

	Mann-Whitney-Test		
	Male vs Female (n = 47)		
Landmark Class	U	Z	p
objective	167	-2.389	**0.017**
subjective	257	-0.413	0.680

Note: Bold and underlined value is significant (at $p < 0.05$).

In a third step, the differences between age groups of the same gender and the differences between different genders in the same age group were looked at (see Figure 21).

Male participants in grade 1 used subjective cognitive landmarks (39%) twice as much as male participants in grade 4 (17%). Girls in grade 1 used almost twice as much subjective cognitive landmarks (22%) as girls in grade 4 (15%). Comparing male participants in grade 1 to female participants in grade 1, males tended to use more subjective cognitive landmarks (39%) than female participants of the same age group (22%). Also in grade 4,

male participants used more subjective cognitive landmarks (17%) than female participants (15%) but the difference between the genders becomes smaller with age.

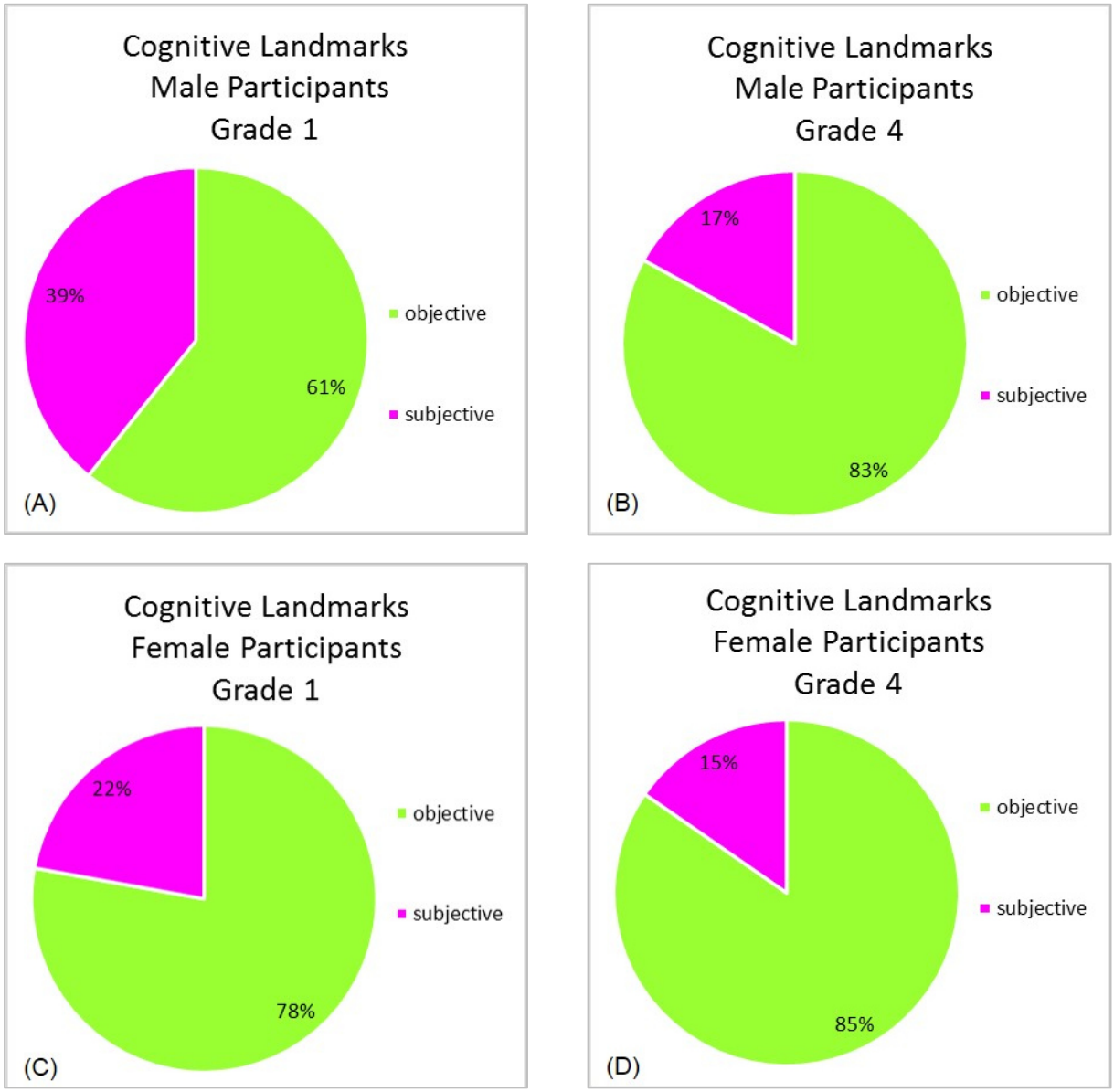

Figure 21. (A) Relative contribution of objective and subjective cognitive landmarks to the total number of cognitive landmarks for male participants in grade 1. (B) Relative contribution of objective and subjective cognitive landmarks to the total number of cognitive landmarks for male participants in grade 4. (C) Relative contribution of objective and subjective cognitive landmarks to the total number of cognitive landmarks for female participants in grade 1. (D) Relative contribution of objective and subjective cognitive landmarks to the total number of cognitive landmarks for female participants in grade 4.

Since the data is not normally distributed, Mann-Whitney tests were performed to determine differences between male and female participants in grade 1 and grade 4. A statistical significant difference was found. Girls in grade 1 used more objective cognitive

landmarks than boys (U = 25, Z = -2.348, p = 0.019, r = 0.49) (see Table 19). The effect size of this difference is medium. No difference was found between genders (see Table 20).

Table 19. *Mann-Whitney-Test of cognitive landmarks in grade 1 and grade 4 comparing genders*

	Mann-Whitney-Test					
	Grade 1 (n = 22)			**Grade 4** (n = 25)		
	Male vs Female			Male vs Female		
Landmark Class	U	Z	p	U	Z	p
objective	25	-2.348	**0.019**	58	-1.175	0.295
subjective	52	-0.549	0.583	76	-0.123	0.936

Note: Bold and underlined value is significant (at $p < 0.05$).

Table 20. *Mann-Whitney-Test of cognitive landmarks in males and females comparing grades*

	Mann-Whitney-Test					
	Male (n = 22)			**Female** (n = 25)		
	Grade 1 vs Grade 4			Grade 1 vs Grade 4		
Landmark Class	U	Z	p	U	Z	p
objective	33.5	-1.781	0.075	63.5	-0.851	0.395
subjective	42	-1.202	0.229	63.5	-0.851	0.395

5.7 Size of Landmarks

At first, the differences between the two age groups were looked at considering the size of the mentioned landmarks. The size of used landmarks varied between grades (see Figure 22). Grade 1 used more *figural* landmarks (15%) than grade 4 (3%). Landmarks of the size *environmental* were used more frequently by grade 4 (70%) than by grade 1 (59%). Landmarks of the class *vista* were used nearly equally often by both grades (26% vs. 27%).

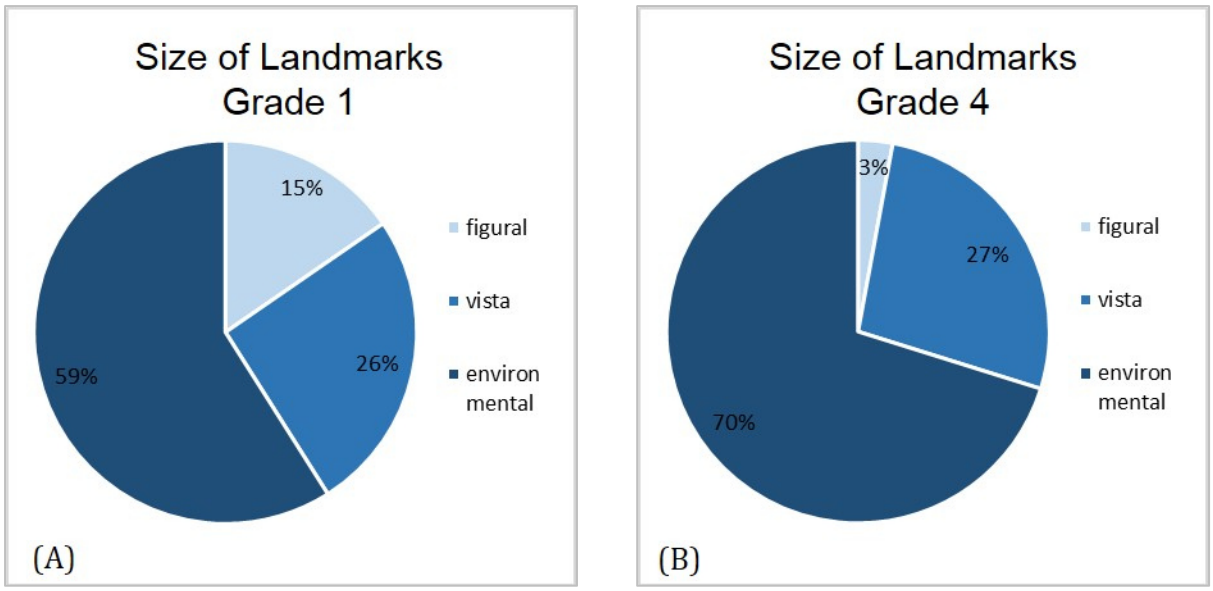

Figure 22. (A) Relative contribution of different landmark size classes to the total number of landmarks in grade 1. (B) Relative contribution of different landmark size classes to the total number of landmarks in grade 4.

Since the data is not normally distributed, a Mann-Whitney test was performed to determine differences between grade 1, grade 4 (see Table 21**Table 24**). First graders used significantly more landmarks of the size vista than fourth graders (U = 176, Z = -2.500, p = 0.012, r = 0.37). The effect size for this difference is medium.

Table 21. *Mann-Whitney-Test of landmark size in age groups*

	Mann-Whitney-Test		
	Grade 1 vs Grade 4 (n = 47)		
Landmark Class	U	Z	p
figural	176	-2.500	**0.012**
vista	226	-0.193	0.847
environmental	202.5	-1.550	0.121

Note: Bold and underlined value is significant (at $p < 0.05$).

In a second step, the differences between genders were focused on (see Figure 23). The sizes of used landmarks only differ slightly between the genders. Small differences are visible in the class *vista* between male (29%) and female (24%) participants. A slight difference is also visible in the class *environmental* between male (62%) and female (67%) participants.

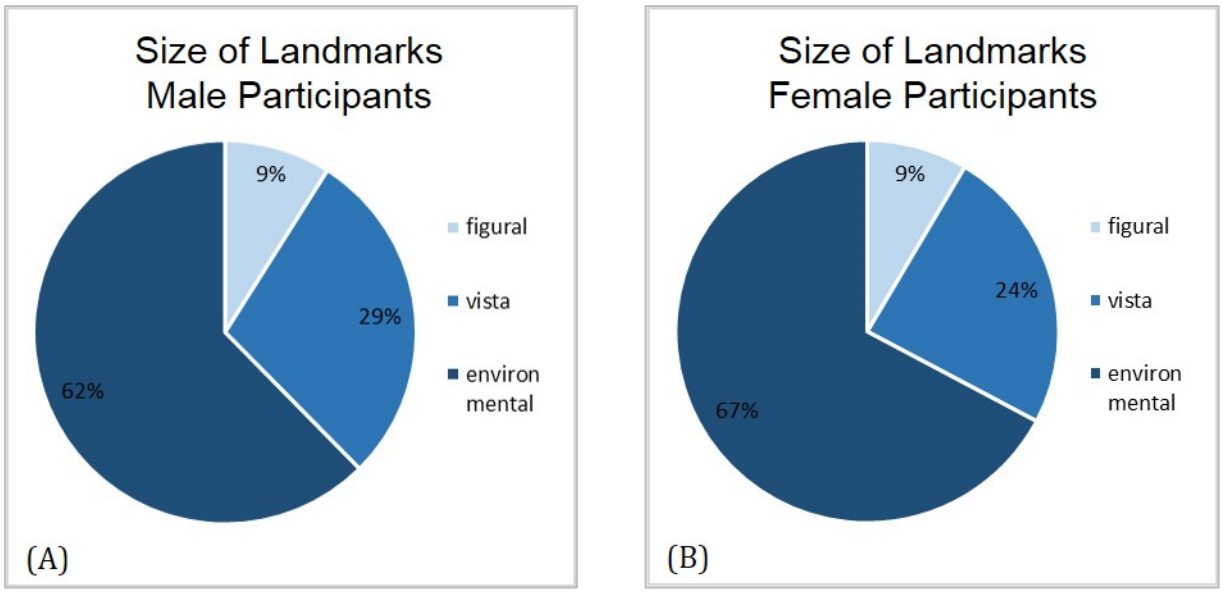

Figure 23. (A) Relative contribution of different landmark size classes to the total number of landmarks for male participants. (B) Relative contribution of different landmark size classes to the total number of landmarks for female participants.

Since the data is not normally distributed, a Mann-Whitney test was performed to determine differences between male and female participants (see Table 22). No difference was found between male and female participants.

Table 22. *Mann-Whitney-Test of landmark size in gender groups*

	Mann-Whitney-Test		
	Male vs Female (n = 47)		
Landmark Class	U	Z	p
figural	269	-0.152	0.880
vista	234.5	-0.867	0.386
environmental	232.5	-0.909	0.363

In a third step, the differences between age groups of the same gender and the difference between different genders in the same age group were looked at (see Figure 24).

Male participants in grade 1 used landmarks of the size *figural* more often (16%) than male participants of grade 4 (3%). Male participants of grade 4 used more landmarks of the size *environmental* (69%) than boys in grade 1 (55%). The usage of landmarks of the size *vista* was almost the same in both groups (28% vs. 29%). Female participants in grade 1 used landmarks of the size *figural* more often (15%) than male participants of grade 4 (3%). Female participants of grade 4 used more landmarks of the size *environmental*

(72%) than girls in grade 1 (62%). The usage of landmarks of the size *vista* was almost the same in both groups (23% vs 25%). Male and female participants in grade 1 showed almost the same usage of different sizes of landmarks. This statement is also applicable for male and female participants in grade 4.

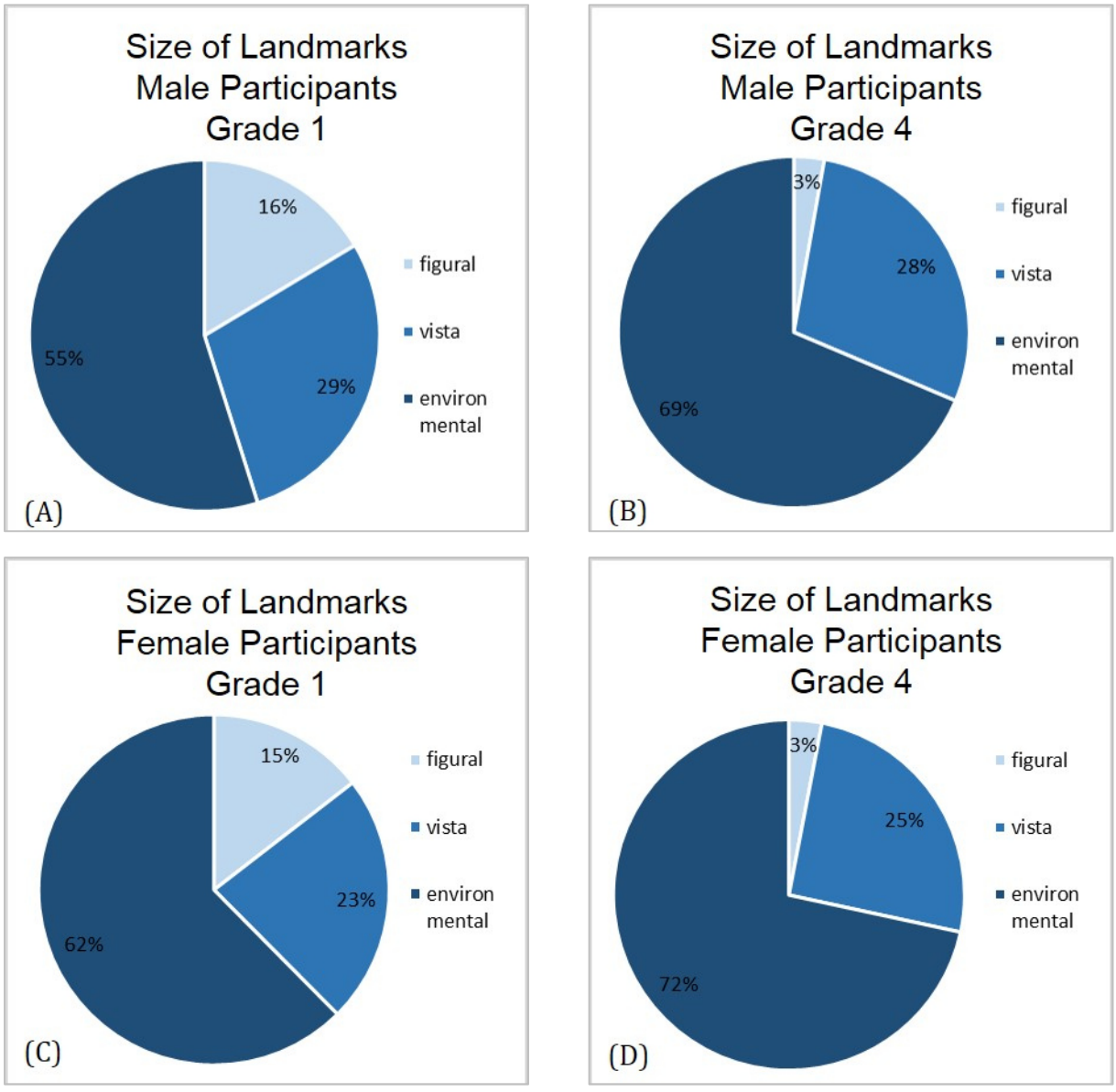

Figure 24. (A) Relative contribution of different landmark size classes to the total number of landmarks for male participants in grade 1. (B) Relative contribution of different landmark size classes to the total number of landmarks for male participants in grade 4. (C) Relative contribution of different landmark size classes to the total number of landmarks for female participants in grade 1. (D) Relative contribution of different landmark size classes to the total number of landmarks for female participants in grade 4.

Since the data is not normally distributed, Mann-Whitney tests were performed to determine differences between grade 1, grade 4, male and female participants. No

significant difference between the genders and the two age groups were found (see Table 23 and Table 24).

Table 23. *Mann-Whitney-Test of landmarks size in grade 1 and grade 4 comparing genders.*

	Mann-Whitney-Test					
	Grade 1 (n = 22)			**Grade 4** (n = 25)		
	Male vs Female			Male vs Female		
Landmark Class	U	Z	p	U	Z	p
figural	58.5	-0.106	0.916	72.5	-0.429	0.769
vista	50.5	-0.630	0.529	70	-0.438	0.689
environmental	45	-0.991	0.322	71.5	-0.355	0.728

Table 24. *Mann-Whitney-Test of landmarks size in males and females comparing grades.*

	Mann-Whitney-Test					
	Male (n = 22)			**Female** (n = 25)		
	Grade 1 vs Grade 4			Grade 1 vs Grade 4		
Landmark Class	U	Z	p	U	Z	p
figural	39.5	-1.569	0.117	48.5	-1.938	0.053
vista	58	-0.132	0.895	74	-0.219	0.826
environmental	36.5	-1.555	0.120	65	-0.710	0.478

5.8 Representation of Landmarks

At first, the two age groups were looked at in order to find differences between the possible representations of landmarks in the groups (see Figure 25). Grade 1 used more landmarks which can be represented as *points* (61%) than grade 4 (51%). The use of *linear* landmark was larger in grade 4 (33%) than in grade 1 (26%). *Areal* landmarks were used by grade 1 (13%) less often than in grade 4 (16%).

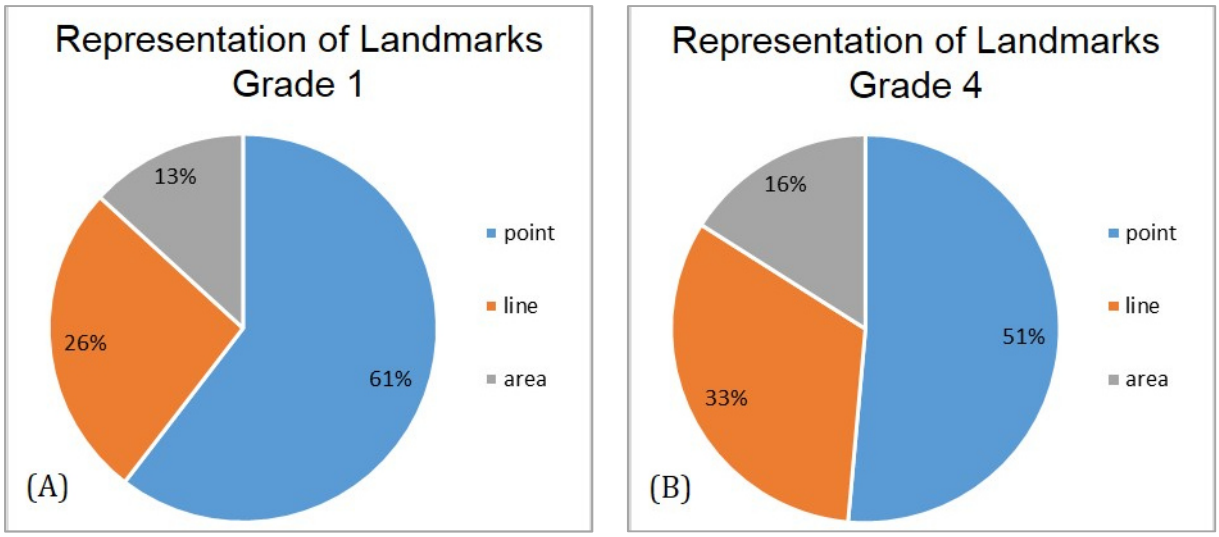

Figure 25. (A) Relative contribution of different landmark representation classes to the total number of landmarks in grade 1. (B) Relative contribution of different landmark representation classes to the total number of landmarks in grade 4.

Since the data is not normally distributed, a Mann-Whitney test was performed to determine differences between grade 1 and grade 4 (see Table 25). Statistical analysis shows no significant differences between the two age groups.

Table 25. *Mann-Whitney-Test of landmark representation in age groups.*

	Mann-Whitney-Test		
	Grade 1 vs Grade 4 (n = 47)		
Landmark Class	U	Z	p
point	214.5	-1.292	0.169
line	217	-1.240	0.215
area	237.5	-0.828	0.408

In a second step, the differences between genders were focused on (see Figure 26**Figure 25**). The use of *areal* landmarks differed the most between male (13%) and female (16%) participants. Male and female participants of both grades used landmarks of all three representation options almost equally often. *Point*-like landmarks were used by males (56%) just slightly more than by females (56%). Also the difference in the usage of *linear* landmarks between males (30%) and females (29%) was very small.

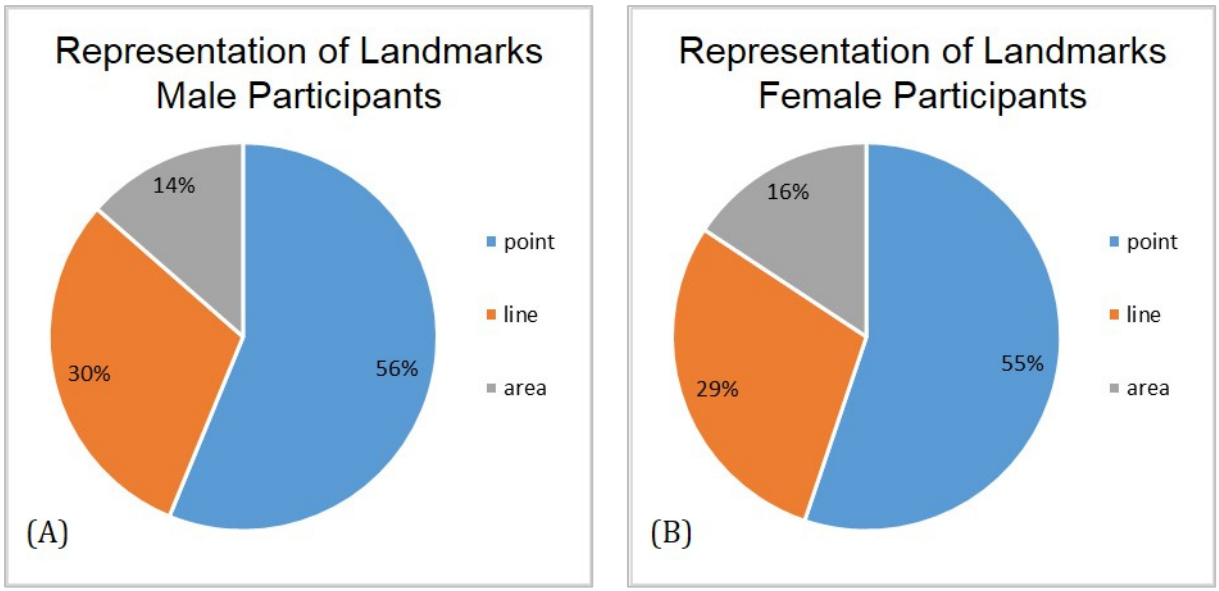

Figure 26. (A) Relative contribution of different landmark representation classes to the total number of landmarks for male participants. (B) Relative contribution of different landmark representation classes to the total number of landmarks for female participants.

Since the data is not normally distributed, a Mann-Whitney test was performed to determine differences between male and female participants. Statistical analysis shows no significant differences between the genders (see Table 26).

Table 26. *Mann-Whitney-Test of landmark representation in gender groups.*

	Mann-Whitney-Test		
	Male vs Female (n = 47)		
Landmark Class	U	Z	p
point	266	-0.192	0.848
line	247	-0.598	0.550
area	230.5	-0.983	0.326

In a third step, the differences between age groups of the same gender and the difference between the genders in the same age group were looked at (see Figure 27). Male participants in grade 1 used more *point*-like landmarks (65 %) than male participants in grade 4 (49%). *Linear* landmarks were used more frequently by male participants in grade 4 (36%) than by male participants of grade 1 (23%). *Areal* landmarks were used by male fourth grades almost as equally often (15%) as by male first graders (12%). Female participants in grade 1 and grade 4 showed no big differences in the usage of *point*-like, *linear* or *areal* features. In grade 1, male and female participants differ the most in the

usage of *point*-like landmarks (65% vs. 57%). In grade 4, the largest difference between male and female participants is visible for *linear* landmarks (36% vs. 29%).

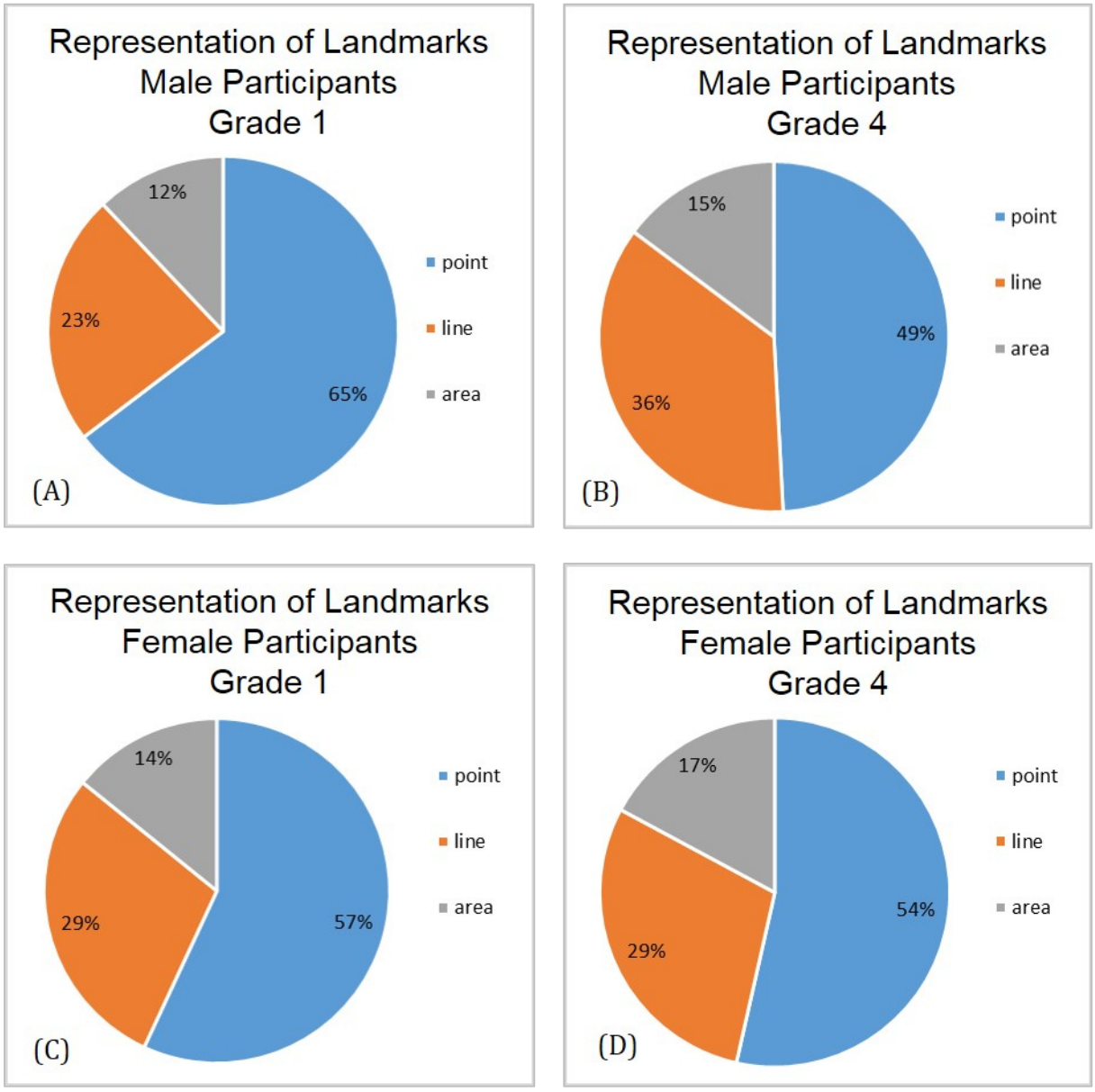

Figure 27. (A) Relative contribution of different landmark representation classes to the total number of landmarks for male participants in grade 1. (B) Relative contribution of different landmark representation classes to the total number of landmarks for male participants in grade 4. (C) Relative contribution of different landmark representation classes to the total number of landmarks for female participants in grade 1. (C) Relative contribution of different landmark representation classes to the total number of landmarks for female participants in grade 4.

Since the data is not normally distributed, Mann-Whitney tests were performed to determine differences between grade 1, grade 4, male and female participants. Statistical

analysis shows no significant difference between the two age groups and genders (see Table 27 and Table 28).

Table 27. *Mann-Whitney-Test of landmarks representation in grade 1 and grade 4 comparing genders*

	Mann-Whitney-Test					
	Grade 1 (n = 22)			Grade 4 (n = 25)		
	Male vs Female			Male vs Female		
Landmark Class	U	Z	p	U	Z	p
point	51.5	-0.562	0.582	73.5	-0.245	0.810
line	52.5	-0.498	0.628	50	-1.528	0.137
area	53.5	-0.452	0.674	60	-1.003	0.347

Table 28. *Mann-Whitney-Test of landmarks representation in males and females comparing grades*

	Mann-Whitney-Test					
	Male (n = 22)			Female (n = 25)		
	Grade 1 vs Grade 4			Grade 1 vs Grade 4		
Landmark Class	U	Z	p	U	Z	p
point	38.5	-1.421	0.155	74	-0.218	0.852
line	32	-1.858	0.063	74.5	-0.191	0.849
area	53	-0.494	0.621	64.5	-0.747	0.455

5.9 Summary of Results

In summary, the data analysis revealed that participants of grade 1 and grade 4 give different route descriptions when explaining their way to school to a stranger but not in all the landmark classes that were tested. The largest difference was found when comparing the number of direction indications given by first and fourth graders. The results showed that the mentioned landmarks and direction indications correlate with the length of the children's way to school. Regarding gender, the results revealed differences between male and female participants in the same age group but also differences across age groups for the classes environmental objects, saliency of landmarks, cognitive landmarks and the size of landmarks. Regarding possible representations of, landmarks no significant difference was found. The Water-Level Task revealed that fourth graders have a better understanding of space than first graders.

6 Discussion

In this chapter, the results are reviewed and set in the context of current research. The underlying question of this thesis was divided into six research questions which will be discussed in the following subchapters. The findings and the differences between gender and age groups are analysed and discussed separately for each research question. The chapter concludes by examining the limitations of the study.

The task performed by all study participants was to provide a route description of their way from home to school. The children were informed that the route description should be such that the interviewer could easily find the school destination following it.

The study showed that children generally know their everyday environment quite well but that they talk about it in different ways. Some participants gave very detailed descriptions and used a lot of landmarks in combination with direction indications. Others only mentioned a couple of landmarks or simply described their ways in left and right turns without any landmarks as reference points. Differences within the age groups were surprisingly large and the differences between males and females unexpectedly small. One reason for the former observation might be that the language skills and speaking abilities within the age groups varied largely. Therefore, the level of difficulty of the performed task was too high for some participants and just right or too low for others. However, the difficulty of the task was discussed with the teachers prior to the exercise and they rated it as suitable for both age groups.

Regarding the core question of this thesis, if the use of landmarks by young children changes with their age, it was observed that there are differences in the landmark use between first and fourth graders, but that they are not as large as expected. This finding is supported by the results of the Water-Level Task. The fourth graders showed higher variances in the resulting scores than the first graders but the medians of both groups were at two of six possible score points. This means that in general, the fourth graders performed better but a majority of them only reached two points like most of the first graders. However, the effect is relevant because the effect size was found to be medium for this test. It shows that the understanding of space improves with age but that it is not yet fully developed at the age of about ten or eleven years.

6.1 Research Question 1: Cognitive Landmark Use with Age

Examining the use of cognitive landmarks comparing two age groups was motivated by the research on the child's cognitive development from egocentrism to allocentrism (Charlesworth, 1966; Elkind, 1967; Piaget and Inhelder, 1956) and the research on the use of landmarks in route descriptions (Lovelace et al.,1999; Raubal and Winter, 2002; Richter et al., 2012). The general assumption of this thesis was that younger study participants use more cognitive landmarks than older participants. This assumption was made based on the findings of Spencer and Lloyd (1974). They found that children younger than seven years often give prominence to personal details when describing routes, whereas older children ignore personal details. Waller and Harris (1988) found that eight year olds show sensitivity to their listeners' needs, whereas five year olds are not yet able to adjust their descriptions to make them more understandable to their listeners. Therefore, it was assumed that older children can already distinguish between information which is only relevant to them, and information which can be relevant to anyone when looking for the right path based on their route descriptions. Consequently, it was assumed that younger participants use more cognitive landmarks than older ones.

Contrary to the expectations in hypothesis 1, the results showed that children of both age groups used about the same amount of cognitive landmarks when giving route descriptions. There were slight differences observable, though they were not statistically significant.

An explanation for these results might be that the transition of egocentric to allocentric might occur at an earlier age than the age of the (younger) participants. The two age groups (around 7 years and 11 years of age) were chosen according to the theory of Piaget and Inhelder (1956). However, there are several authors who argue against the general validity of the egocentrism theory. Blades and Spencer (1987) state that it is necessary to be more critical of Piaget's and Inhelder's (1956) findings from which they had derived their theory of a child's cognitive development from egocentrism to allocentrism according to specific stages. Hughes and Donaldson (1979) observed the behaviour of children and found that even children of three years of age were often able to adopt another person's perspective. Presson and Somerville (1985) also tested the concept of egocentrism as a specific age-related stage of cognitive development and could not

confirm the findings of Piaget. Acredolo (1977) let children memorize a room in an egocentric manner and let them perform different finding tasks with and without landmarks. He found that children at around five years of age tend to use an objective frame of reference, whereas younger children (three to four years of age) were more likely to repeat egocentric responses. The falsification of the hypothesis 1 of this thesis is in line with the findings of these mentioned scholars regarding that they do not confirm Piaget's and Inhelder's (1956) egocentrism theory. A clear age range for the development of an allocentric point of view could not be demonstrated and it has to be assumed that this development process starts earlier than at the age of seven.

In addition, the understandability of the cognitive landmarks was inspected. No difference was found between the two age groups. This means that the use of objectively understandable landmarks does not seem to be affected by the age difference. These findings contrast with the findings of the Water-Level Task. It was assumed that children with higher scores in the Water-Level Task also use more understandable landmarks because they have a better understanding of their environment. This could not be demonstrated in the study.

However, when comparing gender differences, it was found that girls use more understandable (*objective*) cognitive landmarks than boys. This result was found when comparing males and females of both age groups. As could be shown, the effect size of this difference is medium but still relevant. This shows that girls in the two tested age groups generally use more understandable Landmarks in their route descriptions than boys of the same age. When splitting up the data into smaller groups, it was found that the effect of using more *objective* cognitive landmarks can only be demonstrated in grade 1 between male and female participants. The effect was found to be even stronger in the younger age group compared to the already mentioned effect size of both age groups. Females of grade 1 used more understandable (*objective*) cognitive landmarks than male participants. The same effect could not be found for fourth graders. This means that girls of grade 1 outperform boys in this group. They were more capable of assessing which landmarks they had to include in their route descriptions to make them understandable to the interviewer.

These findings are contrary to most findings in literature which stress that males outperform females in spatial tasks (Harris, 1978; Linn and Petersen, 1985; Newcombe, 1982). However, these studies focus on map-reading skills and spatial orientation tasks and not on route descriptions. It is known that adult males and females differ in the way they give route descriptions (MacFadden et al., 2003). Dabbs et al. (1998) and Ward et al. (1986) found that adult males tend to give more distance information, whereas adult females prefer to use landmarks. Lawton (1994) shows that college undergraduates describe their wayfinding strategies differently. In his study, males were more likely to describe their position referring to distant reference points such as "North" or "downtown" and females rather gave step by step directions to reach the destination. Females were also more likely to report using a route strategy (attending to instructions on how to get from place to place), whereas males were more likely to report using an orientation strategy (maintaining a sense of their own position in relation to environmental reference points). This might be the reason why the route descriptions of girls in this study contained more understandable landmarks than the ones of the boys. It was not tested if the direction indications used by boys revealed a better understanding of the environment. Further investigations would be needed to clarify this issue. Cohen (1981) argues that caution is needed with respect to generalizing the superiority of males to females in spatial tasks. He states that gender-related differences in spatial skills are not entirely independent of the nature of the conducted exercise. He found that males tend to perform better only when the complexity of the task increases, which might not be the case for this study. There are also spatial tasks at which girls are better than boys. Females, for example, show superior spatial memory compared to males (Ecuyer-Dab and Robert, 2004). According to Maccoby and Jacklin (1974), gender-related differences in spatial skills become more profound at the age of puberty and the onset of adolescence. This might be another reason as to why the girls outperformed the boys in this study. Still, in literature there is no consensus about the development of gender-related differences (Matthews, 1992).

To sum up, the effect that more cognitive landmarks are used when children are younger could not be shown. However, younger girls use more understandable cognitive landmarks than boys at the same age.

6.2 Research Question 2: Increasing Landmark Use with Age

The investigation of the increasing use of landmarks with age was motivated by the findings of Matthews (1984). Several other authors present similar results in their studies. Jansen-Osmann and Wiedenbauer (2004) found that sixth graders recall more landmarks than second graders. Joshi et al. (1999) looked at children between 7 and 12 years and found that children who have more freedom to travel without adults on non-school journeys also show a greater use of landmarks and these were in particular the older ones. In hypothesis 2, this study assumed that fourth graders use more landmarks in verbal formulated route descriptions than first graders.

Contrary to this expectation, the results reveal no statistically significant difference between first and fourth graders in the number of used landmarks. A statistically significant difference could not be found even though fourth graders used more landmarks in total than first graders. In addition, there is no difference in the total number of used landmarks between genders. This result also stands in contrast to previous findings. MacMahon et al. (2006) state that females use more landmarks in route descriptions. Accordingly, Jansen-Osmann and Wiedenbauer (2004) found in their study that young boys recalled more landmarks than young girls, while women recalled more landmarks than men. Galea and Kimura (1993) found that there was a better recall of landmarks by female than by male participants in their study. However, this could not be demonstrated with the data used in this study. Consequently, hypothesis 2 needs to be dismissed. Still, the findings of this thesis correlate with a study by Heth et al. (1997). They found that children of different age groups (8 and 12 years) recalled about the same number of landmarks when they were instructed to remember a path and to pay attention to designated landmarks. However, the study of Heth et al. (1997) was not conducted in the same way as this study was conducted. Further studies would be needed to clarify the findings of this study.

To sum up, there is no increase in the number of used landmarks observable when comparing the landmark use of children of different age and gender.

6.3 Research Question 3: Environmental Objects and Gender Differences

The investigation of the different landmarks use comparing male and female participants was motivated by the scholarly debate about the differences in spatial abilities of males and females (Linn and Petersen, 1985; MacFadden et al., 2003; Miller and Santoni, 1986; Siegel and Schadler, 1977). The general assumption of this thesis (hypothesis 3) was that male and female participants use different landmark, when describing a route because of their different spatial abilities and because they grow up under different circumstances (Matthews, 1992). Males and females may choose different landmarks for their descriptions because different objects attract their attention and other landmarks are important to them.

The results showed that landmark use by males and females compared across age groups only differed in the class *person.* Boys more frequently described people than girls. As was shown, the effect size was medium. This highlights the relevance of this result. However, in total, only few people were mentioned during the interviews and the significant difference might come from the fact that girls did not mention people at all. Girls and boys in grade 1 seem to depict their environments using similar landmarks. No difference was found at the age of seven between genders. Accordingly, boys and girls in grade 4 also used similar landmarks when describing their environment. Nonetheless, a statistical significant difference was found for the landmark class *vegetation*, which was used more often by females. The effect size was medium and therefore indicates a relevant difference. These findings mostly correspond with the ones of Ross (2007). She let children take photographs of their journey to school and found that both genders chose similar elements. Photographs of local streets, back roads and paths and main roads were among the most popular photographed elements. Over the half of all photographs contained such elements. This was also found in the study of Matthews (1984). Natural features, parks, play areas and local grassy areas were depicted in just over a twelfth of the photos. Vehicles were mostly captured by children who were brought to school using such vehicles as a means of transport. Nevertheless, Ross (2007) only found few gender differences, which is in line with the results of this study.

In addition, differences between the age groups were looked at. Only few landmark classes were used differently between the compared groups. The results show that the use of the landmarks of the class *animal* differs between the age groups. Younger children use significantly more landmarks of this class. This result is relevant due to its medium effect size. The class *vegetation* is also used more frequently by younger participants. This effect is about as relevant as the previously mentioned difference in the class *animal*. These findings correspond to the results of Spencer and Lloyd (1974) as well as to the ones of Maurer and Baxter (1972). The fourth graders also used significantly more landmarks of the class *street* but this effect was smaller and therefore is not as relevant as the other results. Apart from that, no additional differences between first and fourth graders could be identified, which is contrary to the findings of Matthews (1984), who put emphasis on differences in environmental knowledge according to age. He pointed out that the difference is obvious in the frequency of the used elements and a wider array of information which develops with age. In his study, maps drawn by the older children were richer and contained other elements. Another difference was found in the study of this thesis when comparing male participants in grade 1 and grade 4. The younger boys used significantly more landmarks of the class *vegetation*. The relevance of this difference could be shown by the medium effect size. No significant difference was found when comparing female participants in grade 1 and grade 4.

Furthermore, two of the presented results correspond with the findings in literature. The results that younger boys use more landmarks of the class vegetation and first graders use more landmarks of the class animals are in line with the findings of Spencer and Lloyd (1974). They suggest that young children see the environment primarily in human and natural terms. This tendency is also visible in the results presented here. The finding that girls in grade 4 use more landmarks of the class vegetation can also be explained with findings by Matthews (1984). He states that natural elements are more important in earlier stages of childhood but that the natural environment is not completely filtered at these early stages. Together with recreational space, natural elements remain an important part of the perceived environment of children even at later stages of childhood. Therefore, older children as well use vegetation to describe their way to school.

To sum up, hypothesis 3 was only partly right. When looking at the overall result, no big differences between genders and age groups were found. A difference in the use of

landmarks between genders is visible in grade 4 for the class *vegetation*. In grade 1, no difference was found and the hypothesis must be rejected for that age group.

6.4 Research Question 4: Increasing Direction Indications with Age

Research question 4 emerged from the data. Hence, the investigation of it was not primarily literature driven but data driven. The assumption was that older children use more direction indications different form landmarks, whereas younger children primarily focus on landmarks in route descriptions. It was found that children in grade 4 used significantly more direction indications than children in grade 1. The relevance of this result could be demonstrated with the medium effect size. Consequently, hypothesis 4 cannot be rejected and must be accepted. It is shown that older children use more direction indications different from landmarks. These findings may be explained with the developmental stages a child goes through when growing up. As proposed by Siegel and White (1975), spatial understanding develops in a linear sequence, which means that children at a younger age recognise and remember landmarks. When they get older, paths and routes are established between these landmarks. This is also shown by Cohen and Schuepfer (1980) who found that second graders focus on specific landmarks whereas sixth graders demonstrate a greater ability to extract and integrate route information other than landmarks. Jansen-Osmann and Wiedenbauer (2004) found that second graders rely more on the presence of landmarks than sixth graders, which supports the findings of Siegel and White (1975) and those of Cohen and Schuepfer (1980). Consequently, older children may integrate this newly acquired route knowledge in their route descriptions by increasingly using direction indications rather than only describing landmarks.

To sum up, when children grow up they increasingly use direction indications, which is indicator for their broader understanding of their environment and use of route knowledge.

6.5 Research Question 5: Size of Landmarks According to Age and Gender

For research question 5 the general assumption was that younger children use more small objects than the older ones. This assumption was made based on the data but could be supported with findings of previous research (Matthews, 1992). The study shows that first graders use significantly more landmarks of the size *figural* than fourth graders do. The relevance of this difference could be shown with a medium effect size. Apart from this, no difference between male and female participants was found. In the size classes *vista* and *environmental*, no differences between the two groups were found. Still, it could be demonstrated that the assumption was right and hypothesis 5 cannot be rejected. Younger children integrated more objects of body size or smaller sizes in their descriptions. These findings correspond with the results of Heth et al. (1997). They found that older children (8 and 12 years) more often mention stable and distant landmarks, whereas younger children rather use smaller and movable objects. Abecassis et al. (1996) found a similar trend in the proportion of stable landmark selection but with groups of 7- and 11-year-old children. One explanation for this phenomenon is given by Matthews (1992), who found that younger children perceive the environment from another angle due to their body size and therefore other objects come into their sight. The viewpoint of young children is different from the one of older children and therefore different objects are seen, remembered and reproduced by children of different age. However, the body size of the participants has not been integrated in the analyses and it is not known whether the body size really influenced the result. Further investigations would be needed to check the correctness of this assumption.

In summary, it was shown that younger children preferably use smaller landmarks in route descriptions than older children.

6.6 Research Question 6: Representation of Landmarks According to Age and Gender

In research question 6 the assumption was that younger children use more *point*-like landmarks and that older children use more *linear* landmarks. During the interviews, this

tendency was noticed and therefore tested during the analyses. However, the results do not show differences in the gender or age groups. Younger children did not use more *point*-like landmarks and older children did not use more *linear* landmarks when describing their ways to school. Consequently, the hypothesis 6 has to be rejected. The results for hypothesis 6 stand in contrast to the results of hypothesis 3. In Chapter 6.3, it could be shown that fourth graders use significantly more landmarks of the class *street,* which are *linear* landmarks. But, it was not found that older children use more *linear* landmarks in general. This difference between the findings of hypothesis 3 and 6 might come from the fact that for example other environmental objects such as bridges are counted as linear features too but are not objects of the class *street*. If first graders used *linear* landmarks which were not of the type street, this might result in a shift of the distribution of objects in the different classes and might lead to a non-significant result.

Even if the hypothesis 6 has to be rejected, these findings still correspond to findings in literature. For example, Matthews (1984) found that young children use a combination of point and line stiles when they are asked to draw maps and not mainly use point styles. Also, line stiles are not primarily used by older children when drawing maps. Additionally, Gerber (1984) focused on map-reasoning and found that the competence of children in cartographic language understanding improves when children grow up. Nevertheless, age was not a significant factor for children's performance in cartographic language (usage of point, line and areal signs). However, it has to be mentioned that both above discussed studies were not similar to the study of this thesis and further research is needed to clarify possible gender and age differences in representations of used landmarks.

To sum up, no differences in the spatial representations of landmarks were found between genders and age groups.

6.7 Limitations of the Study

All in all, the analyses revealed that children in grade 1 and grade 4 use other landmarks when they describe their way to school. But, the difference is not as large as expected. Furthermore, it has to be considered that the study has some limitations that may have affected its results and should be taken into consideration.

6.7.1 Participants

First of all, the total number of participants needs to be discussed. 47 children participated in the experimental study, which is considered to be a large sample (Field, 2013). Nevertheless, a higher number of participants could verify the results and possibly make the found differences between the groups more significantly observable. Especially, when the participants were partitioned into groups (grade 1 and grade 2, male and female) and sub-groups (males of grade 1 and females of grade 1), small numbers of participants were compared. Therefore, some results might change or even become statistically significant with more participants.

Furthermore, not all of the participants have lived in the village for the same time. Some of them have just moved to the village and consequently do not know the area as good as participants who have lived there for their entire life. This may have affected the results of the study.

Additionally, the language understanding and speaking abilities of the participants differed. In general, the interviews were held in Swiss German. In three cases, the interviews were held in German because the Tamil and Arabian speaking participants did not understand Swiss German properly. In this way, all the participants were able to understand the instructions given by the interviewer. Consequently, regarding that all participants could engage in a conversation with the interviewer, the results are comparable. Still, huge differences in the speaking skills of the participants became visible during the interviews. Some children could formulate complex sentences and well-structured answers, whereas others were looking for words all the time and had difficulties in expressing themselves in a proper way. It would be necessary to assess the speaking abilities of each child with extensive tests to be able to determine how the speaking abilities influence the children's route descriptions. For this thesis, the influence of individual speaking abilities was not taken into consideration which may have affected the final results.

Besides, the level of excitement of the children was different during the interviews. Almost all participants were nervous before or during the interview although they were told that there are no right or wrong answers to the questions they are asked and that the interview is not an exam. Some of the participants overcame this excitement and talked freely.

However, some children stayed very nervous throughout the interview and were almost not able to speak at the beginning. The children's level of excitement during the interviews (and whether they were able to relax during the interview or not) influenced their route descriptions, and consequently the final results of this thesis.

Moreover, the individual state of development of each child is different and important to consider in further studies. Each child is at a certain point in his or her personal development. This personal development is not only influenced by the children's age. It has to be mentioned that some of the first graders were in a mixed class with third graders and these first graders seemed to be at a higher development level than the first graders who were not in a mixed class. The same applies to the fourth graders who were in a class together with fifth graders compared to the fourth graders who were not in a mixed class. The children of the mixed classes seemed to be more mature than the children of the same age of the non-mixed classes. This might also have influenced the performance of each group.

Likewise, the social and family background of each child is also important for his or her personal development. As stated by Matthews (1992), girls and boy are raised differently according to socio-cultural differences and traditions. Consequently, the results are also influenced by the way children are raised and individually supported by their parents.

Finally, some of the participants are accompanied by other pupils (siblings, friends, neighbours) on their way to school while others walk alone. A qualitative impression gained during the interviews was that children who are accompanied by older children or adults do not concentrate on their way as much as the ones walking alone or with younger children. Some of the participants mentioned that they just follow the others and do not have to remember the whole path. Hence, accompanied children could not describe their way to school in as much detail as the others. Subsequently, whether children are accompanied on their way to school or not and by whom they are accompanied may influence the way children take notice of their surroundings and how they describe them. Nevertheless, these findings were only qualitative and have not been further investigated. In further studies, this might be taken into account for data analyses.

6.7.2 Form of Travel

Almost all participants go to school on foot every day. Though, there were also children who are brought by car or come by bus. In total, there were six participants who come to school using a means of transport other than their own feet. Still, their route descriptions were quite similar to the descriptions provided by the children who walk to school. Prominent landmarks were used and similar objects were recalled. One difference was that the participants who are brought to school by a motorized vehicle also mentioned this vehicle in their route descriptions, whereas the others did not mention cars or busses. Accordingly, Joshi et al. (1999) found that the mode of transportation had no influence on their studies measures. Consequently, it was assumed that the interviews with participants who get to school by different means of transport can be included in the data analysis because the differences in the mentioned landmarks were very small. It is still possible that the perception of the environment of the children who walk to school is different from the perception of the environment of the children who were brought by car or bus.

6.7.3 Weather Conditions

The practical study took place in February and the landscape was covered in snow and looked differently than during other seasons. It is possible that the route descriptions differ according to how the environment looks and may also depend on the weather conditions. For example, one of the participants mentioned a coasting slide along her way to school. This landmark may not have been mentioned if the interviews had been carried out during the summer months or in spring. However, a lot of children mentioned grassland and cows or other landmarks which are not visible when snow covers the ground. Therefore, the influence of current weather conditions seemed to be quite small.

6.7.4 Interviewer

The interviewer was not known by the participating children. To prevent participants from being scared of the interviewer, the pre-test took place four weeks before the interviews were conducted. Like this, the children had become familiar with the interviewer before they were left alone with the interviewer during the interviews.

However, it is possible that the children would have given different route descriptions if they had not been interviewed by a strange person but by their teachers. This may have an influenced the result. Still, the teachers do not rate this fact as very limiting because the participants are used to get to know new people during the school year.

6.7.5 Correlation of Count of Landmarks and Travelled Distance

The number of mentioned landmarks and the distance travelled to school correlated in this study. This means that the longer the way is, the more landmarks are mentioned. Nevertheless, the correlation is weak and therefore this effect is not as large as expected. There are some cases in which the correlation is not visible. For example, some children had a long school way and only remembered few landmarks and others with a short school way who included several different landmarks and direction indications. Most children with longer (more than 1 kilometre) school ways were brought by car or came by bus and were not able to describe their way in full detail. Nevertheless, the correlation is weak but visible and may have slightly influenced the final result.

6.7.6 Classification Scheme and Rules

The classification of each landmark was carried out following predefined rules. These rules were defined by me on the basis of existing literature.

The classification rules and the classification itself have had a major impact on the result. For example, it had to be decided whether the landmark “pedestrian crossing” belongs to the landmark saliency class *structural* or *cognitive*. This landmark has a large effect because it was mentioned by around half of the children. There are good reasons for putting it in one or the other class.

A pedestrian crossing cuts the street into smaller parts and allows children to cross the street. However, a pedestrian crossing gets its strong meaning from the idea of allowing the child to cross the street at this specific point. Teachers told me that the children are taught a sentence like “This is where I cross the street and nowhere else.” Consequently, the meaning of this landmark is stronger than its structuring effect, so the landmark was classified as a *cognitive* landmark.

Another frequently used landmark was “house”. This landmark could be put in any of the three saliency classes (*visual, structural, cognitive*). For the decision to which of the classes the landmark should be assigned to, the context in which the landmark was mentioned was looked at. In sentences like “…then I see the blue house”, the landmark was put into the class *visual*. In sentences like “…at the next house I have to turn left”, the landmark was considered a *structural* landmark. If a child gave some more information about a particular house or if he or she knew the owner of the house, the landmark was put into the class *cognitive.*

The mentioned examples show that classification decisions have a large impact on the results of the study. A change of my classification scheme would also change the results and their interpretation.

7 Conclusion and Future Research

This thesis investigated the role of landmarks in route descriptions by young children and aimed to show differences between age groups and genders. Especially, the use of cognitive landmarks and their understandability and the different environmental objects as well as the size and the possible representations of them were focused on. Previous studies investigate the numerous roles of landmarks in navigation tasks but they neither substantially focus on children, nor on the environmental objects and the saliency of these landmarks. By proposing a classification scheme for landmarks and comparing two age groups, the present study explores how the usage of landmarks changes when children grow up.

The results show a slight variation in landmark use between first and fourth graders in route descriptions concerning the used environmental objects. *Animals* and *vegetation* are used more frequently by younger participants and *streets* are preferably mentioned by fourth graders. This suggests that natural landmarks (e.g. *animals* and *vegetation*) are more important to younger children, which was also implied by Spencer and Lloyd (1974). *Streets* are more often used by fourth graders, which indicates that they have more cross-linked mental maps than first graders. Still, the proof for this assumption is missing and further investigations would be needed to clarify the reasons for the preference for one landmark over another in different age groups.

Likewise, the saliency of landmarks was investigated and it was defined according to pre-defined rules. There is no proof showing that younger children use more *cognitive* landmarks than older children. In future studies, it might be a possibility to ask the participants in the end of the interview, why the named objects are important to them, to minimize interpretation errors during the classification process. Additionally, the use of an eye-tracking system when the children are on their way to school could also reveal some more details about the saliency of different landmarks.

Besides, it was shown that girls generally use more understandable (*objective*) cognitive landmarks than boys and that this difference is clearly evident when comparing males and females of grade 1. This finding is contrary to most study outcomes of the past, in which boys outperformed girls in spatial tasks and were likely to be more accurate across

different age groups (Linn and Petersen, 1985; Siegel and Schadler, 1977). However, there are also studies which show that the performance of girls and boys depends on the diagnostic exercise or the age of the males and females (Cohen, 1981; Maccoby and Jacklin, 1974). So, on one hand, it could be shown that there is no consensus in literature on gender differences in spatial tasks according to age and on the other hand, that the result of the study needs to be investigated in more depth to verify its validity.

Further, it was demonstrated that first graders use smaller objects (smaller than the human body) when describing their way to school compared to fourth graders. These findings support previous findings (Abecassis et al., 1996; Heth et al., 1997; Matthews, 1992). One explanation might be that first graders are not as tall as the fourth graders and that they therefore take notice of different objects. Still, there is a lack of explanations why and how the body size influences this result, so future investigations would be needed.

Moreover, the increasing use of landmarks with age (Matthews, 1984) could not be demonstrated, although fourth graders named more landmarks in total and also achieved higher scores in the Water-Level Task. Still, older children preferably mentioned direction indications other than landmarks in their route description, which implies that spatial understanding and reporting increases with age (Matthews, 1992). This finding correlates with the results of the Water-Level Task. However, further investigations are needed concerning the meaning of the direction indications. This study only covered the meaning of the landmarks and only analysed the direction indications quantitatively.

Additionally, results reveal no difference in the use of possible representations of landmarks. It was not verified that first graders use more *point*-like landmarks and there was also no proof for fourth graders to use more *linear* landmarks in their route descriptions. This result corresponds to prior findings (Matthews, 1984).

The demonstrated findings correlate in general with the model of the linear development of children's spatial perception from landmark to route knowledge, which was established by Siegel and White (1975) and Cohen and Schuepfer (1980). However, landmarks use does not change abruptly at the age of eight years, at which, the transition from an egocentric to an allocentric point of view ought to happen (Piaget and Inhelder, 1956). This finding questions the developmental stages theory proposed by Piaget and Inhelder (1956). It became evident that the ability to use objectively understandable landmarks

does not suddenly appear in the middle years of childhood (e.g. in the older group). Despite their lack of verbal skills, even the group of younger children in this study was able to give understandable route descriptions containing different landmarks, not only known by them. The increase in the level of ability to give route descriptions did not primarily become visible in the use of landmarks but rather in the way additional information and direction indications were added to the descriptions. These results support the findings of Blaut et al. (1970), Catling (1979), Kurdek (1978) or Liben (1978), who propose that children do not view the world as egocentrically as suggested by Piaget and Inhelder (1956). Acquiring spatial knowledge is not a process which occurs in defined stages according to age but is rather a complex development influenced by the social background, experience and individual maturity of each child.

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Appendix I – Letter to Participant's Parents

Dietikon, 10.02.2016

Liebe Eltern

Ich heisse Laura Stehrenberger, bin 25 Jahre alt und studiere an der Universität Zürich Geographie. Ich arbeite zurzeit an meiner Masterarbeit. Dabei untersuche ich, welche räumlichen Objekte für die Orientierung von Kindern auf ihrem Schulweg wichtig sind. Ein jüngeres Kind merkt sich auf dem Schulweg beispielsweise einen markanten Baum, wohingegen ein älteres Kind den Fokus mehr auf Gebäude (beispielsweise eine Bäckerei) legt. Um herauszufinden, welche räumlichen Objekte in einer Landschaft wichtig für Ihre Kinder sind, führe ich eine Studie durch, bei welcher Ihr Kind bzw. Ihre Kinder mitmachen dürften, wenn Sie Ihr Einverständnis geben (siehe Talon auf der nächsten Seite). Der Vorgang ist mit dem Schulleiter und den Lehrpersonen abgesprochen und bewilligt worden.

Ihr Kind würde mit mir zusammensitzen und einige Fragen über den Schulweg beantworten. Ich werde die Antworten für die spätere Analyse aufzeichnen (nur Ton und kein Video). Für die anschliessende Auswertung der Resultate würde zusätzlich Ihre Adresse benötigt werden, um die Distanz des Schulweges zu berechnen. Danach wird der Adressdatensatz wieder gelöscht und nicht weiterverwendet.

Alle verwendeten Informationen sind streng vertraulich und werden nicht an Drittpersonen weitergegeben. Ebenfalls werden in der Studie keine Namen und auch keine Ortschaften genannt, um Ihre Anonymität zu gewährleisten.

Ich bitte Sie, den untenstehenden Talon auszufüllen und ihn der Klassenlehrperson Ihres Kindes abzugeben. Bei allfälligen Fragen oder Unklarheiten dürfen Sie mich oder Frau Ritschard (1. Klasse) jederzeit kontaktieren unter: laura.stehrenberger@hispeed.ch oder m.ritschard@primarhausen.ch

Herzlichen Dank im Voraus.

Freundliche Grüsse
Laura Stehrenberger

Dietikon, 10.02.2016

Einverständnis Studie

Bitte geben Sie dieses Formular ausgefüllt Ihrem Kind wieder mit in die Schule. Besten Dank.

◯ JA, mein Kind darf an der Studie teilnehmen.

◯ NEIN, ich möchte nicht, dass mein Kind an der Studie teilnimmt.

Vorname des Kindes: _____

Klasse des Kindes: _____

Unterschrift Eltern: _____

Zusatzinformation für die Studie

Wir wohnen mit unserem Kind / unseren Kindern bereits ___ Jahre in dieser Ortschaft.

◯ > 1 Jahr ◯ > 2 Jahre ◯ > 3 Jahre ◯ > 4 Jahre

Einzeichnen des Schulweges in der Karte

Um den Schulweg Ihres Kindes nachvollziehen zu können, wäre ich Ihnen sehr verbunden, wenn Sie mir den ungefähren Weg in die mitgegebene Karte einzeichnen könnten. Auch diese Information wird selbstverständlich vertraulich behandelt.

Appendix II – Water-Level Task

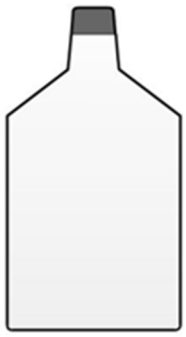
Name: _____ 10.02.2016

Wasserspiegel Aufgabe

Bitte zeichne in den untenstehenden Flaschen den Wasserspiegel mit einem Strich ein. Stell dir vor, die Flasche ist halb voll.

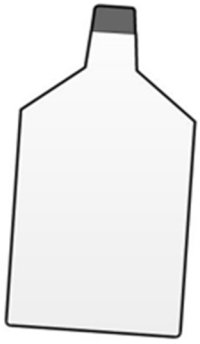
Flasche 1

Flasche 2

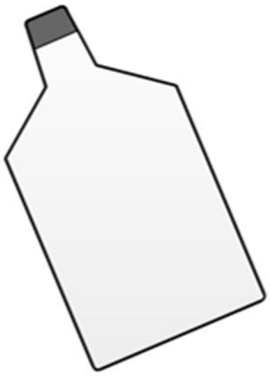


Flasche 3

Flasche 4



Flasche 5



Flasche 6

Appendix III – Study Script

Interview Vorbereitung 11.02.2016 Laura Stehrenberger

Drehbuch für die Studie

Ablauf des Interviews

1. Begrüssung des Kindes
    a. Noch einmal kurz Vorstellen
    b. Erklären, was ein Interview ist und wie es in etwa abläuft
        i. Ich stelle Fragen und mache dazu Notizen
        ii. Das Kind antwortet (es gibt keine richtige oder falsche Antwort)
    c. Mitteilung, dass das Gespräch aufgezeichnet wird (keine Kamera!)
    d. Mitteilung, dass das Kind nicht mitmachen muss, wenn es nicht mehr will
    e. Mitteilung, dass das Gespräch anonym ist
2. Erklären, was das Kind machen muss
    a. Fragen beantworten
    b. Den Schulweg erklären, sodass ich als eine Aussenstehende Person den Weg finden würde
    c. Ev. Schulweg zeichnen
3. Aufnahme starten
4. Interview (Fragen+ ev. Zeichnen) beginnen
5. Interview beenden
6. Aufnahme stoppen
7. Kind verabschieden und Danke sagen
8. Kind bekommt ein Schoggistängeli
9. Kind mitteilen, dass es das nächste Kind schicken soll

Fragen an das Kind

1. Wie heisst du?
2. Wie alt bist du?
3. Was ist deine Muttersprache? (Wie wird zu Hause gesprochen?)
4. Kommst du alleine in die Schule oder mit Freunden / Geschwister?
5. Wenn jemand mit dir mitkommt, ist er oder sie älter oder jünger als du?
6. Spielst du ausserhalb der Schulzeit manchmal in der Nähe der Schule oder auf dem Pausenplatz?
7. Wie kommst du zur Schule (zu Fuss, Velo, Trottetet/ Kickboard, Auto, etc.)?
8. Kannst du mir erklären, wie du von zu Hause in die Schule kommst (Wegbeschreibung)?

Zusatzfragen, falls das Kind (Start)- Schwierigkeiten hat den Weg zu beschreiben

a) Was siehst du unterwegs?
b) Wie findest du den Weg von zu Hause in die Schule?
c) Was (welche Objekte) merkst du dir auf dem Weg?
d) Wie gross ist dieses Objekt?
e) Welche Farbe hat dieses Objekt?
f) Was machst du, wenn du aus der Tür gehst?

Personal Declaration

I hereby declare that the submitted thesis is the result of my own, independent work. All external sources are explicitly acknowledged in the thesis.

Laura Stehrenberger

Zürich, September the 30th 2016