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Through Different Lenses: A Comparative Study of Cultural Influence on Map Reading

GEO 511 Master's Thesis

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Abstract

This study examines how Swiss and Tamil participants living in Switzerland read maps based on their cultural backgrounds. The research uses a mixed design model, integrating an eye-tracking study with a preliminary test, questionnaire, and a paper folding test. Two research questions examine the influence of cultural background on perceptions and information processing, especially in map reading. The aim of the second research question is to demonstrate that Swiss individuals born in Switzerland, reflect Western cultural influences and, thus, have an analytical way of thinking. In contrast, Tamil individuals born in Switzerland, embodying East Asian cultural traits, are expected to exhibit a holistic way of thinking in processing spatial information. Through eye-tracking study, gaze patterns and decision-making processes during map exploration are revealed, illuminating the interaction between task-specific requirements and individual differences. The preliminary test challenges the stereotypical assumptions about cultural dichotomies by testing analytical and holistic thinking and general cognitive abilities through the psychological experiments of the Navon test, Stroop test, and quiz. By examining spatial ability, the paper folding test highlights the aspects of spatial manipulation skills that are common to all of the studied groups. The findings of all study parts highlight how complex cognitive responses are, going beyond simple cultural classifications. The findings show that cultural background influences cognitive processes in map reading, but consistent significance was not found. Apart from that, the significantly longer duration of fixations of Swiss individuals suggests analytical thinking, whereas due to lacking significance a consistent report of holistic thinking for Tamil individuals was failed. Other eye-tracking metrics claim a complex understanding of the interconnection of analytic-holistic thinking with Swiss and Tamil individuals, respectively, due to the lack of statistical significance. Future research should focus on longitudinal studies, and interventions designed to improve spatial cognition in multicultural settings. This study contributes to the understanding of spatial cognition in a variety of cultural contexts by providing a fundamental investigation into the complex interaction of cultural influences on map reading.

Keywords: culture, cross-cultural differences, holistic/analytic cognition, cultural background, Western and Asian cultures, individualism/collectivism, Swiss people/Tamil people, eye-tracking

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Abbreviation

AH	Analytic vs. Holistic
AI	Adobe illustrator
AOI	Area of interest
GIS	Geographic information system / science
IC	Individualism vs. Collectivism
NO	Novel object
PFT	Paper Folding Test
PO	Previously seen object
Po (small letters)	Previously seen objects with original background
Pw (small letters)	Previously seen objects without background
Pn (small letters)	Previously seen objects with novel background
RQ	Research question
SD	Standard Deviation
TOI	Time of interest
VWM	Visual working memory

1. Introduction

1.1. Problem Statement and Motivation

Maps provide information in a visual format on many different areas of the globe. Consequently, a variety of maps are created for various purposes. These maps, whose cartographic representation is regulated by several authorities, cover a wide range of user groups, and provide a large amount of content. Accordingly, the layout and design of the maps' content are essential. For example, tourist maps are made specifically for the locations on which they are intended to display distinctive geographic information. Therefore, in order to create effective, rapid, and simple communication between the user and the map, the right map design must be chosen.

The design of the map is essential since it determines whether the map's purpose is clear and understandable for further interactions with the map. Cartographers are constantly debating how to aesthetically construct a map that supports the ability to deliver accurate information. The design of a map will affect how a person perceives the world (Montello, 2002). In line with this, any product's first impression serves as a description of our cognitive abilities (Montello, 2002). Recent studies claim that perceptual processes and cognitive abilities cannot always be regarded as universal for all people. The findings show that the perceptual processes and cognitive abilities are influenced by cultural backgrounds (Nisbett & Miyamoto, 2005).

The focus of more recent studies lies in examining political, economic, and sociocultural factors in the relationships of cognition and culture. Based on that the holistic and analytic perception theory was formulated by Nisbett based on earlier theories and research (Nisbett et al. 2001; Stachoň et al., 2018; Peng & Nisbett, 1999). One of the well-known studies, which illustrates a significant difference between two cultures regarding holistic and analytic, comes from Masuda and Nisbett's work (2001). According to this theory, authors examined that East Asians have a holistic thinking, whereas Westerners have an analytical thinking (Nisbett et al., 2001). The analytic cognitive style assumes that people focus on the features of the objects, while the holistic cognitive style suggests that people are prone to focus on the interconnection between objects and the background (Nisbett et al., 2001; Stachoň et al., 2018). Most of the studies in the cognition psychology and culture fields are based on the holistic and analytic theory (Masuda & Nisbett, 2001; Stachoň et al., 2018; Lacko et al., 2020). The studies that have examined the theory of holistic and analytic cognition to date have mostly compared Westerners, who focus on objects rather than background context (analytic) and East Asian cultures, which focus on the

relationship between the objects and their environment (holistic) more than on the object itself (Nisbett et al., 2001; Zhang & Seo, 2015).

According to earlier research on cross-cultural issues and cognitive psychology, culture is important for both cognition and visual perception (Montello, 2002). In the 1930s and 1940s cross-cultural research became more popular, where a data collection from cross-cultural survey was provided to use to compare the cultures of the world (Ember & Ember, 2009). Interest in the connection between cognition and culture first arose in the beginning of the 20th century, until then there had only been little attempt to investigate the effect of culture on perception and spatial information (Lacko et al., 2020; Stachoň et al., 2018; Nisbett & Miyamoto, 2005).

1.2. Goal & Overview of the Study

Despite efforts over the years to investigate cultural differences in cognition taking various variables into consideration, very few studies have concentrated on the cultural differences in cartographic outputs and cognitive processes (Stachoň et al., 2018, Lacko et al., 2020). The selection of the study group, which is mainly made up of university students and largely consists of the same cultures, presents a significant research gap when it comes to the analysis of cultural differences. In particular, the majority of the research considered the USA or Western Europe to be in the West and China, Korea, and Japan to be in East Asia (Stachoň et al., 2018, Lacko et al., 2020).

The aim of this research is to examine to which extent attention can have potential differences on cartographic outputs. Thus, the study's theoretical framework, holistic and analytic cognitive style allow for cross-cultural comparisons of cognitive and perceptual functions (Stachoň et al., 2018). The work from Masuda and Nisbett inspired the author of this study to explore possible cultural differences on maps and also to use a part from Masuda and Nisbett's study design in a different way. Thus, this study aims to test the difference between two cultural groups which have not been considered so far in the cross-cultural research in cartography.

The user study is set up with five tasks with questions regarding five different maps, as it will be described in chapter 3.1. To be more specific, in Masuda & Nisbett's study design an aquarium video was used, whereas maps are used in this research (Masuda & Nisbett, 2001). Based on the map object sizes and the visual variables of colour hue, each map was created uniquely. To finish off the user study, participants have to answer some questions regarding the first map from the evaluation task. To understand on which part of the maps the participants focused, the screen-based eye-tracking technology is used in the user study. To deepen the knowledge on different

aspects of holistic and analytic thinking, the whole study consists of different parts. The preliminary test focuses on psychological experiments and questions to get an overview of the holistic and analytic differences between the two cultural groups. The paper-folding test is another part of the study, which examines the participant's spatial ability.

Thus, this study will provide new insights of cognitive psychology generally and cross-cultural cartography research specifically by offering fresh perspectives on holistic and analytical cognitive styles. Furthermore, in contrast to the majority of research that concentrated on university students, this one will concentrate on individuals who have not completed a tertiary education. As far as the author is aware, this is one of the few studies to employ Masuda & Nisbett (2001)'s study design on cartographic outputs (Chua, Boland & Nisbett, 2005). Furthermore, no prior research has looked at the cultural differences between Tamil residents in Switzerland and Swiss nationals who are not students. Thus, it is an attempt to look into how Swiss and Tamil people's cultural backgrounds affect their ability to read maps.

Below, the study's anticipated findings and research questions are listed. This thesis includes a theoretical section in the following chapter. For a better understanding of the research question and the experiment, contextual data related to culture, cognition, and cartography will be given. Throughout the chapter respective literature will also be reviewed. In chapter 3 detailed information about the study design and the applied methods are given. The study's results are gathered in chapter 4, while they are discussed in chapter 5. Conclusions, restrictions, and suggestions for further research are provided in the last chapter.

1.3. Research Questions

For this thesis, the following research questions are formulated of the above-mentioned research gaps:

RQ1: "Do people from different cultural backgrounds perceive and process information differently?"

RQ2: Does the cognitive processing of cartographic outputs differ between Swiss individuals born in Switzerland, reflecting Western cultural influences with an analytical thinking, and Tamil individuals born in Switzerland, embodying East Asian cultural traits with a holistic thinking?

1.3.1. Hypotheses & Expected Results

The following outlines the expected results, which were determined by conducting a literature review prior to the study. It must be mentioned that both the research questions are discussed in separate subchapters but complement each other.

1.3.1.1. RQ1: Cultural Influence

The first hypothesis concerning the research question 1 is that a person's identity and cultural background have an impact on how they think and how they perceive the world, especially when it comes to reading maps. Thus, we predict that people with different cultural backgrounds will display different cognitive patterns, which will influence how they perceive and process information, especially spatial information.

Philosophers and psychologists have long assumed that cognitive abilities and visual perception are universal and attention, categorization, memory, and casual analysis are the same for everyone in each culture (Nisbett & Masuda, 2003). A significant contribution to the research field of culture and cognition was carried out by Lev Vygotsky and his colleagues (Ardila, 2016). Vygotsky's findings have shown that cultural factors have an impact on human cognition, which he described in several papers in the 1930s (Ardila, 2016). Other researchers have also looked into whether other elements play a role in understanding the connection between culture and cognition (Berry, 1992; Dasen & Heron, 1981).

To point out the relationship between culture, cognition, and cartography, only a few studies have been carried out so far. The study from Stachoň and his colleagues (2018) introduced particular outcomes, where a user study with Chinese and Czech map users was completed.

People are expected to use their accessible knowledge unconsciously when perceiving, processing, and paying attention to information mapped through experience, as various studies that are covered in chapter 2 demonstrate. This experience, which is influenced by cultural factors, has to be remembered beforehand (Oyserman, 2011).

1.3.1.2. RQ2: Holistic vs. Analytic

The second hypothesis proposes that there are distinctions in the cognitive processing of cartographic outputs between Tamil individuals born in Switzerland, who are expected to display a holistic thinking influenced by East Asian cultural characteristics, and Swiss individuals born in Switzerland, who are likely to exhibit an analytical thinking influenced by Western

cultural factors (Triandis, 2001; Hofstede, 2010). We forecast that these cultural variations will appear as disparities in how maps are navigated and interpreted.

If there is a interconnection between culture and cognition, then the question of whether a particular pattern can be identified arises, according to the hypothesis of the first research question, chapter 1.3.1.1. As already mentioned in chapter 1.1 (and elaborated in chapter 2.2), a rough division of "holistic" and "analytic" cognitive styles peculiar to a culture has been suggested through researchers such as Nisbett (Nisbett & Masuda, 2001, Nisbett et al., 2003).

One of the notable studies, which analysed the theory through attention and perception with Japanese and Americans, significantly illustrated the difference between holistic and analytic thinkers (Masuda & Nisbett, 2001). Another study by Chua, Boland, and Nisbett (2005) examined scene perception utilising eye-tracking technology and images of backdrops and focal items. Chinese students were more inclined to believe that the background contains crucial information, whereas European American students showed less interest in the background but greater attention to primary objects.

As mentioned before, Swiss, and Tamil people born in Switzerland are in the focus of this thesis. The experiment of this study is thought to address research question 2 by providing evidence that Swiss people have an analytical cognitive style and Tamil people have a holistic cognitive style. Tamil individuals see objects in relation to their environment, so we expect that they will be more sensitive to backdrop changes in this experiment than Swiss people.

1.4. Cultural Selection

As figure 1 portrays, Swiss culture is often known for its strong focus on individualism. Individualistic societies place high value on independence, self-expression, and personal autonomy. Individuals are encouraged to seek personal objectives and accomplishments, such as desired careers and their personal interests in Swiss society (Hofstede, 2001). Tamil culture, on the other hand, leans more towards collectivism. Collectivistic cultures prioritise shared well-being, interdependence, and group harmony. Relationships with the family are important in Tamil (Sri Lankan) communities, and choices are usually made with the group's best interests in mind, such as marriages (Triandis, 1995). According to Hofstede's research (more in Chapter 2.1), Switzerland appears to score higher on Individualism, whereas Tamil culture is linked to higher scores for collectivism (1980). These cultural differences in individualism and collectivism can have an influence on various aspects of daily life. Thus, to shed light on how

individuals from various cultural backgrounds differ in cognitive abilities in daily tasks, Swiss and Tamil people living in Switzerland were chosen to be investigated.

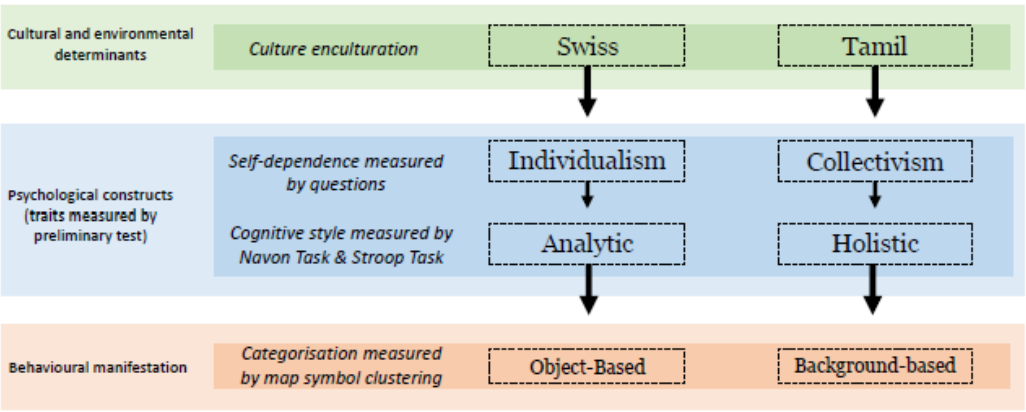

Figure 1: Research model used for sample division adapted and modified by Lacko et al. (2020)

2. Background

In this chapter, the hypothesis from RQ1 will be discussed and a brief overview of the variables and processes that affect how people perceive map design are discussed. Thus, the chapter's primary goal is to provide an explanation of the background and significance of the cross-cultural research, which forms the basis of this study. This will be followed by the discussing what the term "culture" means and its concepts. The relationship between culture and cognition is described briefly, along with the development of the cognitive styles that is specifically relevant to cartography. In particular, the study by Masuda and Nisbett, which aids in understanding the study design from the experiment of this thesis, will be discussed in detail. Further information regarding the tourist map design and earlier research will also be covered below.

2.1. Cultural Background

2.1.1. Cross-Cultural Research

As a scientific method, cross-cultural research, which involves comparing and contrasting the norms, practises, and other aspects of other communities, is a systematic investigation of human psychological processes and practises across cultural barriers (Ilesanmi, 2009; Matsumoto & Juan, 2013). Researchers attempt to investigate whether or not information about individuals and their characteristics from one culture can be applied to other cultures through the use of cross-cultural research methods (Matsumoto & Juang, 2013). Consequently, cross-cultural research attempts to explain why certain things and certain behaviours happen to be the way they are (Ilesanmi, 2009). However, the findings of cross-cultural research in psychology, as a whole, extends well beyond simply improving the study's methodology. It is a method of comprehending universally applicable human behaviour concepts. In order to contribute to a cultural psychology, cross-cultural research looks at whether psychological theories and principles are culturally specific (true for some people of some cultures) or universal (true for all people of all cultures) (Matsumoto & Juang, 2013). It also tests if people from different cultures are alike or distinct, looking for possible gaps in our knowledge. This shift significantly impacts how psychologists see a variety of human behaviour-related concepts, which is of great importance for all areas of human lives, specifically in the multicultural world we live (Ember & Ember, 2009).

Around the turn of the 18th and 19th century, the first scientific attempts to conceptualise culture, examine its effect, and find distinctions between individuals from different cultures were made. The foundational studies were those of William H. R. Rivers and Edward Burnett Tylor, who made the first cross-cultural comparisons (Ember & Ember, 2009; Ilesanmi, 2009). However, the cross-cultural research started to become popular in the 1930s and 1940s through George Peter Murdock in Yale (Ilesanmi, 2009). The "Ethnographic Atlas," which Murdock constructed and which contains data from more than 600 societies, had a profound and wide influence on cross-cultural studies (Ember & Ember, 2009). Other pioneers of cross-cultural research are Francis Galton, Frederic Bartlett, Wilhelm Wundt, and Franz Boas (Jahoda & Krewer, 1997). However, the most important turning point in the field of cross-cultural research happened after the "*Journal of Cross-Cultural Psychology was founded in 1970"*, which is regarded as the start of contemporary cross-cultural psychology (Shimmack, 2020). With the development of psychology, many scientists have realised that some, but not all, findings and ideas that were originally believed to apply to everyone are in fact culture bound. As a result of this realization, cross-cultural research is becoming popular (Matsumoto & Juang, 2013).

2.1.2. What is Culture?

2.1.2.1 Cultural Definition

To understand the cultural perspective of different research fields such as psychology, what the term "culture" means needs to be discussed. The word "culture" can be used in different ways and in different research fields; thus, it is a blurry and complex term. Even, the concept of culture can have different definitions in different cultures (Oyserman & Lee, 2008; Matsumoto & Juang, 2013; Montello, 1995). Apart from that, there exist many components of culture, such as objective culture, subjective culture (knowledge shared in a group), social culture (shared norms of social behaviours), and material culture (methods used to share goods) (Cohen, 2009; Matsumoto & Juang, 2013). These are some of many factors, why defining culture is a difficulty (Cohen, 2009). Still many years ago, more than 160 definitions of culture were gathered and organised by Kroeber and Kluckhohn (1952 in . Below some definitions of culture from different researchers are listed:

"Culture is a complex whole which includes knowledge, beliefs, arts, morals, law, customs, and any other capabilities and habits acquired by a human as a member of society" (Tylor, 1871 cited by Spencer-Oatey, 2012);

"Culture is the collective programming of the mind that distinguishes the members of one group or category of people from others" (Hofstede, 1991);

"Culture consists of patterns, explicit and implicit, of and for behavior acquired and transmitted by symbols, constituting the distinctive achievements of human groups, including their embodiments in artifacts; the essential core of culture consists of traditional (i.e. historically derived and selected) ideas and especially their attached values; culture systems may, on the one hand, be considered as products of action, and on the other as conditioning elements of further action" (Kroeber & Kluckhohn, 1952 cited by Spencer-Oatey, 2012).

Focusing on Kroeber & Kluckhohn's definition, they emphasise that culture is both the result of human actions and has a direct impact on human action. This section of their definition makes it evident that an incident can be understood in various ways by two persons with different cultural backgrounds due to the impact of culture on a human's assessment, thinking and perception. Thus, it is of great importance to differentiate "culture" from the terms "nationality", "race", and "ethnicity", due to the fact that the nationality or the native place does not define to which culture one belongs (Matsumoto & Juang, 2013). For example, Switzerland is a country with a variety of cultural groupings. Thus, individuals born in Switzerland with different cultural backgrounds do not necessarily indicate that they will behave as typical Swiss citizens.

In this study, inspired by Hofstede's works (1991, 2001), the term "culture" is interpreted as that a group of people share norms, beliefs, traditions, practices, behaviours, and values, which is a complex and ever-changing concept. It includes the way members of a society or community interact with one another, and their environment is shaped by this social construct. Understanding and appreciating cultural differences is crucial when it comes to geography, especially cartography, in order to effectively create cartographic outputs.

2.1.2.2 Culture: Mental Programming

To everyone, culture is a learning process over their lifetime. According to that, each person includes patterns of thinking, potential acting, and behaviour (Hofstede, 1991). By analogy to programming a computer, Hofstede refers culture as a process of mental programming, in which teenagers acquire not just the language, but also the thinking and behaviours of their social environments (1991). According to Hofstede et al. (2010), programming begins in the family and spreads to the neighbourhood, place of employment, school, living community, and peers. Since everyone undergoes different programming due to different social environments, mental programs vary in this world. This mental programming resides in each and every person

(Spencer-Oatey, 2012). This does not imply that individuals are similarly designed to computers (Hofstede, 2010). Hence, it does not mean that mental programmes determine human behaviour (Spencer-Oatey, 2012).

According to Hofstede, mental programming happens on three levels: human nature, culture, and personality, which is represented in Figure 2 (1991). *Human nature* characterizes inborn feelings such as anger, happiness, sadness, fear, love, shame, and empathy. Such emotions teach us how to interact with other people. *Personality* is the level of mental programming, which is different for each person. Both inherited and learned traits make up each person's unique personality. Environment and individual experiences influence its growth (Hofstede et al., 2010; Matsumoto & Juang, 2013; Cohen, 2009; Spencer-Oatey, 2012). The second level on which Hofstede focuses is *culture* which is acquired (2010). How people express their feelings and emotions is learned by their culture in which they grow up. Everyone acquires knowledge how to behave in certain situations through people from their daily lives (Matsumoto & Juang, 2013).

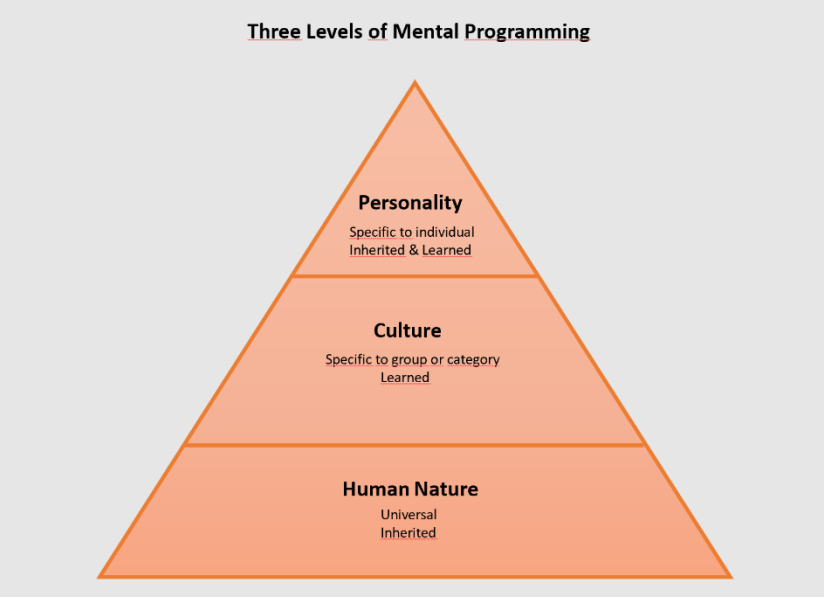

Figure 2: Three Levels of Mental Programming. Adapted from "Culture and Organizations: Software of the Mind" by G.Hofstede, 2010, Copyright 2010 by McGraw-Hill (Hofstede, 1991; Hofstede et al., 2010)

2.1.2.3 Values: Individualism & Collectivism

Culture can also be regarded as a system of information and meaning, which may be used to describe different facets of our way of life (Matsumoto & Juang, 2013). Thus, there are different elements of culture, such as beliefs, language, norms, and values. Hofstede refers values as the

core of culture (2010). Values are invisible for people who bear them. Yet, these values guide human behaviours, which are expressed through rituals, patterns of thinking, and symbols (Spencer-Oatey, 2012). This system of values differentiates one group of people from another, which leads to cultural diversity. Several scientists have approached to study and explain how cultures differ from each other (Matsumoto & Juang, 2013). The approach by Geert Hofstede is a popular one, where he came up with a system of five dimensions of values that differentiate cultures (Hofstede, 1991; Matsumoto & Juang, 2013).

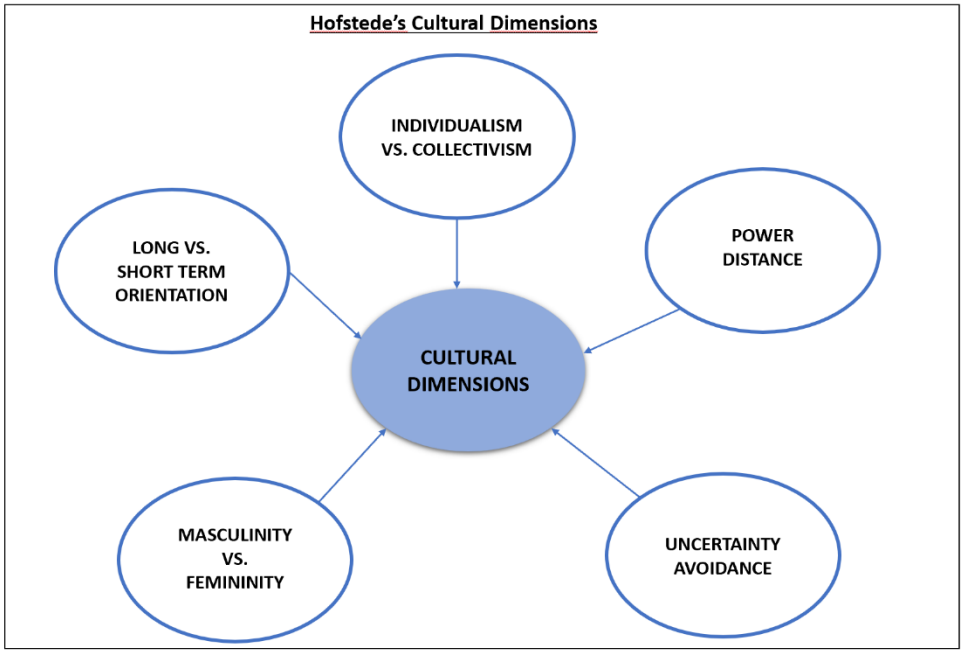

Figure 3: Hofstede's Cultural Dimensions. Adapted from "Culture and Psychology" by Matsumoto & Juang, 2013, Copyright 2013, 2008 by Wadsworth, Cengage Learning (Matsumoto & Juang, 2013; Hofstede et al.,, 2010)

As figure 3 illustrates, the five dimensions are individualism vs. collectivism, long vs. short term orientation, power distance, uncertainty avoidance and masculinity vs. femininity (Hofstede et al., 2010). Of all these five dimensions, the well-known and mostly used dimension in cross-cultural research is, *Individualism vs. Collectivism* (IC) (Matsumoto & Juang, 2013). Most studies use this dimension to understand cultural differences in different scientific aspects (Oyserman & Lee, 2008; Matsumoto et al., 1996; Triandis, 2001).

The IC dimension describes how much a society's population is integrated into groups (Hofstede et al., 2010; Matsumoto & Juang, 2013; Triandis, 2001). Collectivistic culture creates a foundation for its people so that they can experience interdependence, the need for rules to

prevent chaos, conformity to in-group norms, reluctance to cooperate with members of other groups, integrity in their own groups, and responsibility for actions and outcomes to shared societal values. In contrast, people in individualistic cultures often act independently and according to their own sentiments and unique traits, prioritise their own interests over those of other or social rules, and attain their own goals. (Triandis, 2001; Oyserman & Lee, 2008; Hampton & Varnum, 2020). Therefore, practicing such social in-groups' norms may have an impact on how people perceive, think about, and interact with situations and activities (Hampton & Varnum, 2020). The following table 1 lists the common differences between IC societies, according to Hofstede and his colleagues (2010). Several tools have been used to measure IC, varying from self-report to implicit and neurological measurements (Hampton & Varnum., 2020).

Table 1: Differences between Individualistic and Collectivistic Societies. *Cited from "Dimensionalizing Cultures: The Hofstede Model in Context" (Hofstede, 2011)*

Individualism	**Collectivism**
Everyone is supposed to take care of him- or herself and his or her immediate family only	People are born into extended families or clans which protect them in exchange for loyalty
"I" – Consciousness	"We" –Consciousness
Right of privacy	Stress on belonging
Speaking one's mind is healthy	Harmony should always be maintained
Others classified as individuals	Others classified as in-group or out-group
Personal opinion expected: one person one vote	Opinions and votes predetermined by in-group
Transgression of norms leads to guilt feelings	Transgression of norms leads to shame feelings
Languages in which the word "I" is indispensable	Languages in which the word "I" is avoided
Purpose of education is learning how to learn	Purpose of education is learning how to do
Task prevails over relationship	Relationship prevails over task

IC differs between cultures geographically – across countries, for example Western Europe and North American cultural groups are more of an individualistic group, whereas Africa, Middle East and Asia are more of a collectivistic group (Hofstede, 1991; Hofstede et al., 2010; Matsumoto & Juang, 2013; Triandis & Gelfand, 2012). Furthermore, the degree of IC can differ among nations based on factors like religion, socioeconomic status, and even cities (Kitayama et al., 2006; Varnum et al., 2010, Hampton & Varnum, 2020). However, further research is necessary to determine the exact extent of IC's influence on personality (Hampton & Varnum, 2020).

There are more concepts of culture discussed by different authors. Only a few well-known concepts have been discussed in detail above, which are of great importance for this study. After considering the ideas presented above, we conclude that culture is a broad phenomenon represented by objects, behavioural patterns and ideas that may be altered through different factors. In addition, it differs throughout different geographical regions, religions, social lifestyles, generations, family backgrounds and more (Triandis, 2001). Hence, the need for cross-cultural research is of great importance. Most studies referred to in the later chapters, found that people's opinions were shaped throughout their lives (Nisbett & Miyamoto, 2005; Oyserman & Lee, 2008; Ji & Yap, 2016). For example, people in ancient times have shaped by their way of life, namely, hunting or nomadism. Today, the world civilization changed as a result of religious growth, colonialisation, land exploitation, technology growth, language, traditions, societal structure, relationships between people, lifestyle, and other factors. Hence, cross-cultural psychology is an emerging area which tries to understand how cultural variations affect how individuals visualize or analyse certain things (Oyserman & Lee, 2008).

2.2 Culture and Cognition

Cultural psychology is a separate field within psychology that has emerged with the goal of focusing on the intersection of cognition and culture (Ember & Ember, 2009). The study of cultural psychology examines how culture affects human behaviour, thought and emotion. Although earlier psychological research served as the foundation for the study of culture and cognition, cultural psychology was first formally recognised as a subfield in the middle of the 20th century (Ember & Ember, 2009; Triandis, 2001).

Jean Piaget laid the groundwork for the early developments of cognitive psychology/ cultural psychology, in order to discover a connection between cognition and culture. According to Piaget (1936, 1964), adaptation to one's environment through behaviour is what sustains one's lifelong cognitive development. Initially, Piaget believed that only internal factors influenced cognition, but subsequently he stated that external factors also influenced learning (Tuddenham, 1966). Another important study by Lev Vygotsky's follower Luria (1931) claimed that "culture", which is defined as a concept of beliefs, values, language, and behaviour, shapes mental capacities like perception, attention, and memory. Vygotsky's research focused on the significance of social interaction, cultural resources, and language's influence on cognitive processes. An important finding from Vygotsky (1978), which gained attention, was that language influences our mental abilities, while Piaget reported that language has no impact on cognition (Luria, 1931). While

some scholars, like Piaget and Vygotksy, have studied mental abilities and stages of development, others have looked at social and ecological elements that impact the connection between culture and cognition (Dasen & Heron, 1981; Berry, 2019). Researchers such as Nisbett, Geertz, and Shweder were crucial in the late 20th century in laying the groundwork for the discipline of cultural psychology (Oishi & Graham, 2010). In particular, Nisbett's work examined how cultural differences in cognition affect perception, reasoning, and problem-solving skills (Nisbett & Miyamoto, 2005; Oishi & Graham, 2010; Nisbett, 2003; Nisbett et al., 2001).

Today, scholars from around the world contribute to the understanding of the cultural differences in cognition as cross-cultural research became more common (Ember & Ember, 2009). Cultural psychology is an emerging discipline that keeps investigating the complex connections between cognition and culture in a range of other disciplines Oishi & Graham, 2010; Ember & Ember, 2009).

2.2.1 Cognitive Style

Examining cognitive style in relation to culture and cognition looks at how individually preferred cognitive patterns are shaped and influenced by cultural variables (Kozhevnikov, 2007). The term "cognitive style" describes a person's preferred and habitual method of information processing, problem solving, and decision making. It includes the various patterns and techniques people use when performing cognitive tasks (Kozhevnikov, 2007). Examining cognitive style in relation to culture and cognition offers important new perspectives on the variety of human thought processes. This interdisciplinary field advances our knowledge of how cultural settings affect people's information processing, and decision-making. Bendler and Beller (2011) also noted that most cognitive research focused on examining and evaluating cognitive diversity in the Western world. Thus, investigating from not only one point would partially fill the research gap.

In their analysis of cross-cultural research on psychological difference proposed Witkin and Berry that an individual's eco-cultural surrounding impacts their field dependence – the extent to which they perceive an item is influenced by its surroundings, which renders a different dimension of cognitive style (Ji & Yap, 2016; Witkin & Berry, 1975). A tight social structure and sedentary agricultural ecological settings are specifically related with the field-dependent perceptual mode, whereas a loose social structure and mobile hunting ecological settings are connected with the field-independent perceptual mode (Ji & Yap, 2016). One of the most influential theoretical frameworks on cognition and culture, through cognitive style, is the

research from Nisbett and his colleagues (Ji & Yap, 2016; Masuda & Nisbett, 2001; Nisbett, 2003; Nisbett et al., 2001). American and European countries are considered to have "analytic" cognitive style, where the respective people separate the object from its background and focus on the objects only. In contrast, People from East Asian countries (China, Korea, Japan) have a "holistic" cognitive style, where they mostly focus on the background, and make decision through experiences (Nisbett & Miyamoto, 2005; Nisbett, 2003; Nisbett et al., 2001; Kitayama et al., 2003). The framework of analytical and holistic cognition is used in the majority of cross-cultural research. A study from Chua, Boland and Nisbett (2005) examined the scene perception utilising eye-tracking technology, images of backdrops, and focal items. According to their findings, Chinese students were more inclined to believe that the background contains crucial information, whereas European and American students showed less interest in the background and a greater attention to the primary objects.

Differences in perception are influenced by attentional differences among cultures. In a perception test from Savani and Markus (2012), Americans focused on the main objects, whereas Japanese participants paid more attention to the overall information more evenly. There are more studies which focused on the difference between analytic and holistic thinkers, where mostly American and East Asian countries were considered (Kuwabara & Smith, 2012; Huang & Park, 2013). Although these studies highlight the distinctions between an analytical and holistic cognitive style as well as its traits, it is important to remember that the results are not always uniform and cannot be generalised to all Western and Asian nations. Therefore, it is crucial to consider civilizations other than the United States, China, Korea, or Japan, as well as additional variables like gender, age, and academic background.

2.2.2 Masuda & Nisbett: Attending holistically versus analytically

The study from Masuda & Nisbett is a notable and a well-known research, where the difference between American and Japanese people was investigated. The participants were given an underwater scene (Figure 4) to look at for a given time period. The findings show that Japanese people allow their eyes to wander more freely over the entire image, whereas Americans fixate their gaze more intently on the focal objects (Masuda & Nisbett, 2001). The participants were first shown an underwater scene, and they thereafter had to explain what they had seen. While Americans began by mentioning the big fishes they saw, Japanese were more likely to describe the entire view, including the colours, plants, and the location. The next assignment involved showing the participants 45 previously seen things and 45 novel objects. The backdrop was altered for each of the 90 items, so each one may have the pre-existing background, none at all,

or a brand-new background. Indicating whether or not they had seen the object was a need (Masuda & Nisbett, 2001).

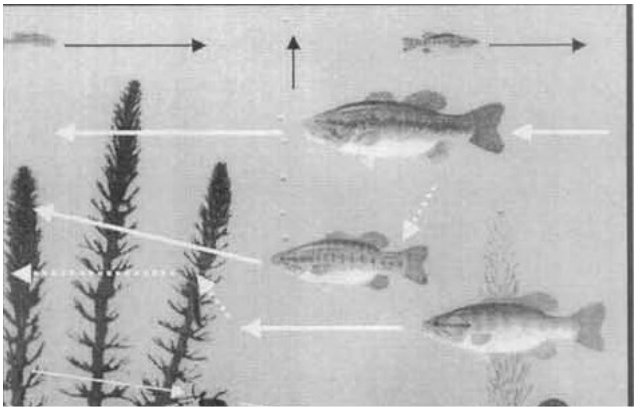

Figure 4: An example of the animated underwater scene of the study from Masuda & Nisbett (2001). The direction of the figures' movements is illustrated by arrows. Adapted from Masuda & Nisbett (2001).

According to Nisbett, the disparity suggests a larger gap between the ways that East Asians and Westerners perceive the world (Masuda & Nisbett, 2001). There are increasing evidence that East Asians think holistically, due to the reason that they are more of a collectivist culture who foster group harmony and decide with experience-based knowledge. They concentrate on every element of a scene and how each part relates to the others (Tomasi et al., 2023). On the contrary, Western people emphasise being independent and their individual liberty, because of which they are attentive to specific objects (Tomasi et al., 2023).

In a research created by Nisbett, Chua, and Boland (2005), an eye-tracking device was used to evaluate where the participants' attention was focused on the photographs. This study was inspired by the work of Masuda & Nisbett (2001). Chinese individuals moved their eyes between the object and the background more than American participants, who mainly kept their gaze on the primary object, the researchers discovered. Such studies highlight the existence of the analytic and holistic cognitive style, which differentiate Western and Asian cultures. Meanwhile, the work from Masuda & Nisbett (2001) is a well-known research, which portrays that culture shapes the process of thought, attention, and memory.

2.3 Cartography and Cognitive Style

Only in recent decades, an increased focus on the intersection of culture and cognition in the context of cartography, or the study of map reading, and perception has been detected. Communication and navigation become much easier when cartographic designers know how people's cultural backgrounds affect how they read and use maps (Cosgrove, 2008).

The way a map is designed affects how a map reader perceives the respective map due to the reason that maps are cognitive tools (Montello et al., 2018). Thus, the link between cartography and cognition is a topic that is best understood with knowledge of map perception. The study by Żyszkowska (2015) revealed that map perception occurs in four stages. The intuitive stage is the period in which principles derived from practical experience and intuition were used to guide map creation (Żyszkowska, 2015). The psychophysical phase covers the process of how people react to the features of spatial symbols in the development of creating a map and how they interpret and reason from it afterward. The third stage, the cognitive phase deals with mental systems that are in charge of processing information and completing various tasks linked to visual search, spatial memory, attention and more. The fourth stage, the cognitive-digital, is the current phase with which the cartographers are dealing. In that stage, the rise of web-based, animated, digital, multidimensional maps and maps created with programming languages are of importance. Additionally, apart from dealing with eye movements and visual perception again, higher-level tasks with knowledge creation and map-based spatial decision-making tasks are the new trends where cartographers are refocusing their interest (Żyszkowska, 2015).

There are only few studies which exist in the field of cognitive psychology and map perception, as mentioned in the introduction earlier (chapter 1.1). Early studies on spatial representation and how cultural factors influence the way people perceive space have been conducted by Edward T.Hall and J.Brian Harley (Cosgrove, 2008; Jacob, 1996). Over time, semiotics in cartographic design, language and map reading, technological advances, and recently research in cross-cultural map use and the integration with cognitive science are some key points of the investigation of cultural influences on spatial cognition and map use (Jacob, 1996). Cognition plays a role in visual image and design, spatial analysis, data collection, and even decision processes. Thus, researching about cognition and cartography helps to improve the functionality, usability and visualization of spatial information. Thereby, it is crucial to remember that each map user may have unique cognitive styles and skills (Montello, 2002; Tian et al., 2022). Researchers, such as Oyserman (2011), Montello (2002) and Tian and his colleagues (2022) emphasized that culture may affect how a map user's mind is influenced and

works. The development of cognitive cartography was crucial in this regard since it made it possible to analyse how people perceive map components, graphic symbols, etc (Montello, 2002).

The study by Tian and her colleagues (2022) is among the most recent studies that are known in the field of spatial ability and cross-cultural variations. Researchers in this study examined Chinese and Malaysian individuals' spatial abilities. Everyone has spatial ability in their lives, but only a minority of research on the subject has shown how culture affects spatial ability. Eye tracking was employed, and tasks including spatial visualisation, mental rotation, spatial orientation, and spatial correlation were resolved in order to demonstrate how culture influences spatial ability and the cultural differences between Malaysian and Chinese university students (Tian et al., 2022). The study's researchers postulated that Chinese participants would perceive things holistically, whereas Malaysian Chinese people would perceive things analytically. These anticipations did not unfold as expected. In this way, the study advances our knowledge of how culture affects spatial ability. Additionally, this study is one of the few that concentrated on cultural groupings that are homogeneous in terms of culture but varied in terms of geography, the effect of ethnic cultures, and other factors.

The cognitive style, map reading, processing, and interpretation of cartographic information is the research topic of the study from Lacko and his colleagues (2020). As many studies, Lacko used the theoretical framework of holistic and analytic cognitive styles to investigate the difference between Central European and East Asian students through map reading tasks. According to the results of an online hypothesis testing procedure called IISS – *Independent and Interdependent Self Scale* (Lu & Gilmour, 2007) - , Asians were comparatively more collectivist than Europeans (see Figure 5; Above). On the other hand, CMMS – *Categorization of Multivariate Map Symbols* – revealed that Asians adhere to the holistic way of thinking, while Europeans subscribe to the analytical mindset (see Figure 5; Bottom). Apart from that the authors were able to show that cross-cultural differences exist between Czech and Chinese/Taiwanese people (Lacko et al., 2018). For significant results, further research was suggested for a better understanding.

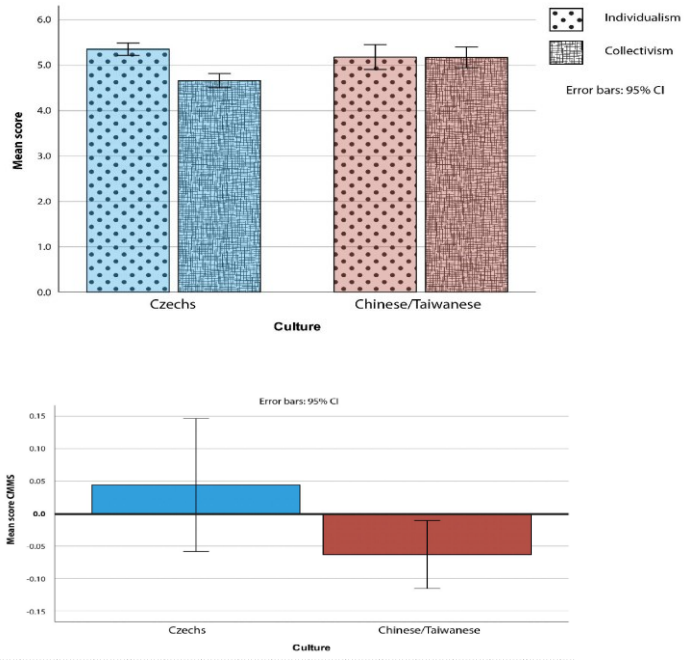

Figure 5: Cross-cultural differences between Central European and East Asian participants. (Lacko et al., 2020). The plot above represents the findings of IISS and the plot at the bottom CMMS results, where "low value" means "holistic mindset". (Lacko et al., 2020). Copyright 2020 by Studia Psychologia..

Stachoň and his colleagues presented particular results through their user study (2018). Czech and Chinese map users, specifically university students, were asked to complete map reading tasks on the localization of a cartographic symbols and background fragments from reference maps (see Figure 6). Considering the variety of holistic and analytical cognitive techniques, researchers employed the FLT – *Framed-Line Test* – from Kitayama and his colleagues (Kitayama et al., 2003) to measure the cognitive modalities. As a result, the only two sorts of tasks that participants had to complete were localising backdrop segments from the map and localising given figural symbols in reference maps. These tasks were followed by an adaption of FLT that needed to be solved.

The researchers anticipated that East Asians would do significantly better at the relative task in FLT, indicating that they are more holistic. In addition, people with holistic cognitive style would be quicker at exploring the background segment than analytic thinkers who focus on focal objects. The findings showed how map reading differs across cultures, but the hypotheses could not be statistically supported. Western participants displayed a holistic manner of cognition, whereas Asian individuals displayed an analytical approach. Listed as some of the many reasons

for such contradictory results were the small diversity of participants, and the subject matter of the study (Stachoň, 2018).

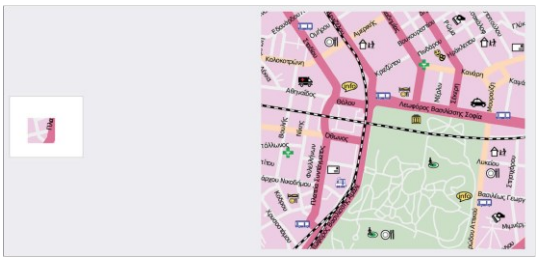

Figure 6: Example of the map reading task stimulus "Locate the background segment shown on the left" (Stachoň et al., 2018).. Copyright by OpenStreetMap contributors. Adapted from "Cross-cultural differences in figure-ground perception of cartographic stimuli (Stachoň et al., 2018).

Based on the aforementioned studies, we may hypothesise that people may unintentionally use their available knowledge throughout the information processing, decision-making, and judgement processes in order to be reasonably based on their experiences (Oyserman, 2011). Such available knowledge is caused by routine living, habits, and - most importantly for this research - the cultural upbringing (Oyserman, 2011). To understand this knowledge and its accessibility, it could be beneficial for individual testing. It is also essential to compare different countries and cultures and to take into consideration individuals who are not university students.

2.4 Tourist Map

Tourist maps are one of the well-known cartographic products which help non-local people to explore a new place and to promote places (Zheng, 2014). The rising desire of society to travel and see different locations and cultures is one of the main factors driving the growth of tourism, thus, the growth of tourist maps (Jancewicz & Borowicz, 2017). Such tourist maps represent the geographical distribution of a specific area in a simplified manner with only the needed information for the visitors. Points of interest and landmarks such as famous districts, places for sightseeing, museums, restaurants, and parks are visually highlighted in tourist maps (Jancewicz & Borowicz, 2017). Kowalczyk (2015 in Jancewicz & Borowicz, 2017) states that tourist maps are not defined for a specific target audience, because different tourists may have different interests, while landmarks with a specific visual appeal may be used for a variety of purposes.

For example, one tourist map user is interested in the famous landmarks and the museums, while another one is eager to know the shopping places. Thus, the main task for map designers is to evaluate these components and who will be using the map (Jancewicz & Borowicz, 2017).

For the tourist maps, elements of topographic contents play an important role for field orientation (Jancewicz & Borowicz, 2017). Thus, if a map can be used as an orientation, depends on the accuracy of depicting geography in a clear manner, which is of great difficulty. Apart from that, similar to how global geographic maps are shown, tourist maps display linear aspects, such as transportation networks or waterway networks in a more generalized way (Eboy, 2017). In order for a tourist map to be useful and clear to map users, it is also crucial to proportionally incorporate landmarks, pathways, district names, boundaries, and locations of interest. In Chapter 3.3, an example of a tourist map from the city of Belgrade is presented, which displays how the landmarks, points of interest, and other information are highlighted (Figure 12).

The tourist map used in this thesis was selected since it is currently among the most commonly utilised cartographic products. As was previously noted, travelling and learning about different cultures is considered a "lifestyle" recently, which is why more people are using tourist maps (Jancewicz & Borowicz, 2017). Signs and landmarks from the tourist map design can be utilised in this thesis' experiment. Since the majority of tourist maps already visually draw attention to key information—for instance, the tourist map of Belgrade draws attention to it by using the colour red (figure 12)—other tourist maps that are appropriate for this research were created especially for this thesis (for further details, see chapter 3.3).

As a summary of chapter 2, the study of the connection between cognition and culture explores how cultural contexts influence perception, decision-making, and cognitive functions (Ember & Ember, 2009). Cultural differences can be seen in cognitive style, which is a term used to describe personal preferences for information processing, such as holistic versus analytical thinking (Nisbett & Miyamoto, 2005). In the context of cartography, how cultural context affects map reading, spatial cognition, and design is examined here. People's views, preferences, and interpretations of maps are influenced by their cultural origins, which affects how they navigate and comprehend geographical information. People's encoding, processing, and recall of information from maps are influenced by cultural elements including language, symbols, and spatial relationships. These variations in culture also apply to map design since many societies may have particular preferences for particular types of representation and symbols used in maps. Ultimately, producing effective, user-focused maps that appeal to a variety of customers requires an understanding of the cultural impacts on map reading and the differences between

each society. After going over the main points of the cultural influence on cognition in the context of cartography and applying all the knowledge from this theoretical section, the next chapter will provide specifics regarding the study of this thesis and the objectives for which the experiment was designed.

3. Methods

The workflow and methodology of the experiment are explained in the following section.

3.1. Study Design

First, the concept was evolved. In order to analyse the hypotheses of this thesis outlined in chapter 1.3, an experiment with eye-tracking was set up. The experiment was shaped into four sections (see Figure 7). It has to be pointed out that this study has a mixed design model, which combines quantitative and qualitative research methods to gain a more thorough, elaborated understanding of the research (Field et al., 2012). In the first part, the participants solved a preliminary test, which included psychological experiments and a quiz. The aim of this part is to find out, if the participants solve tasks and answer question with a holistic or analytical cognitive style.

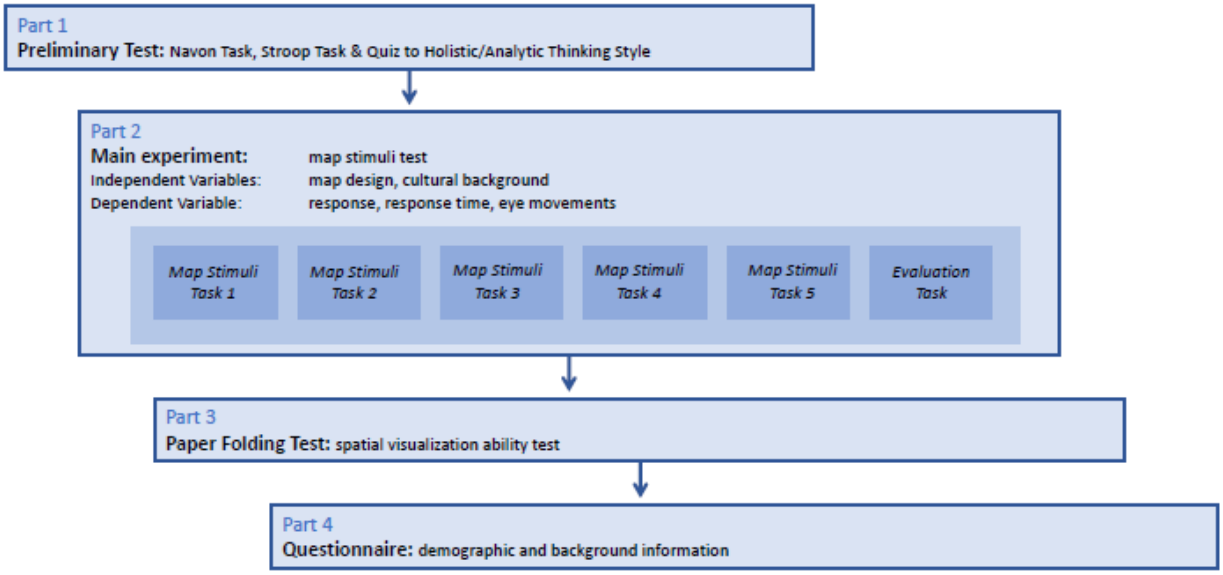

Figure 7: Overview of the study design

In the main experiment, five tasks needed to be solved. In each task a map display and a set of map stimuli were presented where the participants had to answer whether they had seen them or not, as in Masuda & Nisbett's work (2003). In addition, an evaluation task was added to the main experiment in order to collect qualitative information about the participants' perceptions of the displayed maps. The first of two independent variables which were manipulated in the

main experiment is the analytical style (cross-culture, between-subject) with two levels: analytic (Swiss) and holistic (Tamil). The second independent variable is the question type (within-subject, map types in main experiment). Respectively, the dependent variables are the measured data, such as accuracy, response time, reaction time, fixation duration and number of fixations in AOI. The experiment setting and its environment is the extraneous variable of this study. An extraneous variable is a factor which might influence the outcome of the experiment, although it is not the experiment's focus (Tobii AB, 2023d). For all participants the lighting conditions, the location, the experiment materials, the process, and the experiment conductor were the same. Cross-cultural studies using qualitative methodologies are noted in the cultural research field (Wutich et al., 2021). Though an empirical approach was used here, it integrates qualitative and quantitative methods, such as in Masuda & Nisbett's work (2001).

After the main experiment a spatial ability test in form of a Paper Folding Test was added to measure the three-dimensional spatial visualization ability (Workman & Lee, 2004). A spatial ability shows individual differences in spatial tasks performance (Ishikawa & Kastens, 2005). Lastly, a questionnaire about demographic and background information of the participants completed the study. In order to ensure that responses to background information questions had no impact on the main experiment, the questionnaire was carried out in the end.

3.2. Preliminary Test

The aim of the preliminary test was to gain prior knowledge about holistic and analytic cognitive styles and whether the Tamil participants and Swiss participants could be differentiated in to holistic and analytic thinkers. Therefore, I set up two psychological experiments and a quiz. All the tasks were gathered together and conducted with Psytoolkit (Stoet, 2010, 2017). Each participant solved all the three subtasks in the same order, as they are listed in the following subchapters, 3.2.1 to 3.2.3. The recorded measures in the Navon task are reaction time and accuracy. For the Stroop task the recorded measure is reaction time and for the quiz the response was collected. All these measures represent the dependent variable of this preliminary test.

3.2.1 Navon Task

For the first experiment of the preliminary test, Navon's well-known task was used (Navon, 1977). According to his study, there are global and local features when things are arranged in groups. For instance, in figure 8, the example looks like an H, which is the global feature. The numerous small letters X that makes up the figure are distinguished as the local feature (Stoet, 2010. 2017; Navon, 1977). Analytical and holistic theories suggest that the analytical cognitive

style is associated with local processing, while the holistic cognitive style is associated with global processing (Peterson & Deary, 2006). To distinguish between holistic and analytical thinkers, various studies employ variations of Navon figure to assess an individual's local and global processing (Lee et al., 2021; Lacko et al., 2020; 2023).

Figure 8: Navon task example (Stoet, 2010, 2017)

PsyToolkit developer Gijsbert Stoet already designed a Navon Task, which we translated into German language, and which functioned as the first experiment of the preliminary test (see Appendix A) (Stoet, 2010, 2017). The implementation has 50 trials and for each trial the participants have 2 seconds to decide whether they see a target (H or O in the task) (Stoet, 2010, 2017). According to several studies, as mentioned by Lacko and his colleagues, at least 32 number of trials is considered satisfactory for Navon test(2020; 2023). A task instruction in the beginning and a feedback at the end are given. According to the theory and other studies, people with global processing (holistic cognitive style) should answer faster and with fewer mistakes (Navon, 1977; Lee et al., 2021; Lacko et al., 2020). This leads to our assumptions for this task that Swiss people will be relatively slower on a global level and relatively quicker on a local level than Tamil participants (Peterson & Deary, 2006; Lacko et al., 2020).

3.2.2 Stroop Task

One of the most often used psychological experiments is the Stroop Task, which was first mentioned in English by John Ridley Stroop (1935). The Stroop phenomenon illustrates that it is easier to name the ink colour if it matches the colour word (congruent). Whereas a delay in response time arises if the ink colour and the colour word mismatch, illustrated in figure 9 (incongruent). Thus, the delay in reaction times between congruent and incongruent stimuli illustrates the Stroop effect (MacLeod, 1991).

Figure 9: Example of Stroop trials from Psytoolkit (Stoet, 2010, 2017)

There exist many variations with other stimuli than coloured words based on the Stroop effect (Stoet, 2010, 2017; MacLeod, 1991). Additionally, many studies aimed to determine gender, age, or language differences on the Stroop task (Baroun & Alansari, 2006; Strickland et al., 1997). A study from Alansari and Baroun revealed with their study that Kuwaiti college students achieved greater performance than British counterparts on Stroop colour and word test, which predicts that cultural variable influences cognition (2004). Using Stroop-type tests, some research examined the hypothesis of local and global processing between individuals (Martin, 1979; Alivisatos & Wilding, 1982). There is no particular research that connects the Stroop test with holistic-analytic theory, as far as the author of the thesis is aware of. Based on that, the purpose of this preliminary test experiment is to determine whether or not participants from Tamil and Swiss backgrounds can be distinguished using the Stroop test, and consequently, whether or not culture affects the Stroop task performance which is based on the holistic and analytical theories. Given the lack of research on the relationship between culture and Stroop interferences, it remains unable to establish a clear hypothesis regarding which cultural group will perform better. As a result, it is anticipated that there would be significant variation in the Stroop test results between the two groups, with one group performing significantly better than the other.

In this task again, an available Stroop Test from Psytoolkit was re-designed into German language (Stoet, 2010, 2017). For the images, the programm Inkscape was used (Inkscape, 2023). The experiment has 40 trials with instructions in the beginning and, lastly, a feedback about the response times in congruent and incongruent stimuli. To calculate the Stroop effect, the average response time in incongruent is subtracted from congruent trials (Stoet, 2010, 2017). Instead of naming the colours, as in the original study, the requirement in the experiment was to press the respective first letters of the colours on the computer keyboard. This makes it easier to measure the key presses only and not the time it takes to name the colours (Stoet, 2010, 2017). The independent variables of this task are the congruent and incongruent stimuli, whereas the dependent variable is the total reaction time. In Appendix B, an example of some trials from the task is illustrated.

3.2.3 Quiz

As already mentioned, in chapter 1 and in chapter 2.2, holistic thinkers classify objects based on the relationships and the family resemblance, whereas analytic thinkers classify based on the objects, their characteristics and rule-based category (Masuda & Nisbett, 2001). In a study from Chiu (1972), three objects at a time were shown to American and Chinese children and they were asked to pick two suitable objects and to justify their answer (Masuda & Nisbett, 2001; Chiu, 1972). The same test was used for a quiz to find out a person's way of thinking on the internet (CummingsRL, 2017, Access:12.07.23). For example, in Figure X, choosing the answer "train" would lead to holistic thinking, because bus and train are public transportations. Choosing "ticket" would mean rule-based category due to the fact that without a ticket one cannot use the train.

As mentioned in chapter 2.2.2, Masuda & Nisbett asked their participants to describe what they had seen in the 20 seconds aquarium video shown beforehand (Masuda & Nisbett, 2001). Inspired by this study method, we included two questions with two images each besides the eight questions with the triple objects (Figure 10, bus). In the last two questions with the images, participants had to choose among two sentences, which were based either on holistic or analytic thinking. In Appendix C, the full quiz part is included. Here is an example from the quiz, in figure 11, an image of a table is illustrated. Option A was "A wooden table with seating for six people can be seen in the picture." Which refers to the analytic thinking style and option B referring to the holistic one "On the image, a table can be seen, which serves as a gathering spot for people to assemble and share a meal." (translated from German)(Stoet, 2010, 2017). We anticipate that Swiss people will select more analytical options than holistic ones whereas Tamil people will select less analytical options.

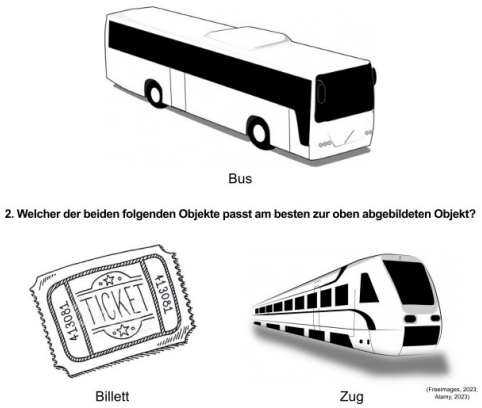

Figure 10: Example of one quiz trial with three objects in German language designed with Inkscape, inspired by CummingsRL (2017, Access: 12.3.23)

Figure 11: Example of one quiz trial with an image, inspired by Masuda & Nisbett (2001)

3.3. Main Experiment

The main experiment's goal was to look into the degree to which attention might be assumed as holistic or analytic (Masuda & Nisbett, 2001). Therefore, the memory for environment and for objects where they have been displayed in the map and in the stimuli from the map will be examined. Each participant solved five tasks with five maps and in each task with one map 18 stimuli from the respective map were displayed to answer, if they had been seen or not. Before the actual experiment was conducted each participant had to solve a trial task in order to understand the structure of the main experiment. To measure the eye movements, the eye tracking technology was implemented. This method analyses where participants look on the maps and how they read them (Brodersen et al., 2002). After the map-reading task about remembering map cut-outs from five maps, an evaluation task was conducted as the qualitative part of the main experiment.

Creating the maps and selecting the map stimuli for the task was undoubtedly the most significant aspect of this study and this eye-tracking experiment. In the next subchapters, the essential steps for creating the maps and the respective tasks are explained.

3.3.1. Map Samples Creation

3.3.1.1. Selection stage

Tourist maps are vital tools because they graphically identify notable locations, restaurants, parks, and other places of interest so that people may find their way to the locations that most interest them (Grabler et al., 2008). Today, out of all the cartographic outputs, tourist maps are the ones that are physically utilised most. Due to their poor landmark recognition and lack of context information, digital maps are frequently utilised as navigational tools rather than as tourist maps (Grabler et al., 2008). More information about tourist map was elaborated in chapter 2.4.

According to that, in this main experiment, maps were based on the tourist map designs. Tourist maps are generalized, and the informational content is not overloaded. The aspects of simplicity-complexity play an important role in designing a map, for which reason some map elements were reduced in each map. Features such as map scale display or map legend were eliminated from the study maps. As already discussed in chapter 2.4, the example of a tourist map which has inspired the maps from the main experiment is presented in Figure 12.

The location of the map was an important decision. The main experiment was created for experimental purposes, thus, any familiarity with the location had to be avoided. Therefore, we chose the city of Belgrade as from Figure 12, due to the reason that no participants could read and understand the local language. Belgrade functions as an adequate location for the map samples considering the fact that this place includes waterbodies, green fields, narrow streets, and wide streets (Figure 12). For the trial task a place in Oslo, Norway was chosen with two example map cut-outs (see Appendix H (map samples slides).

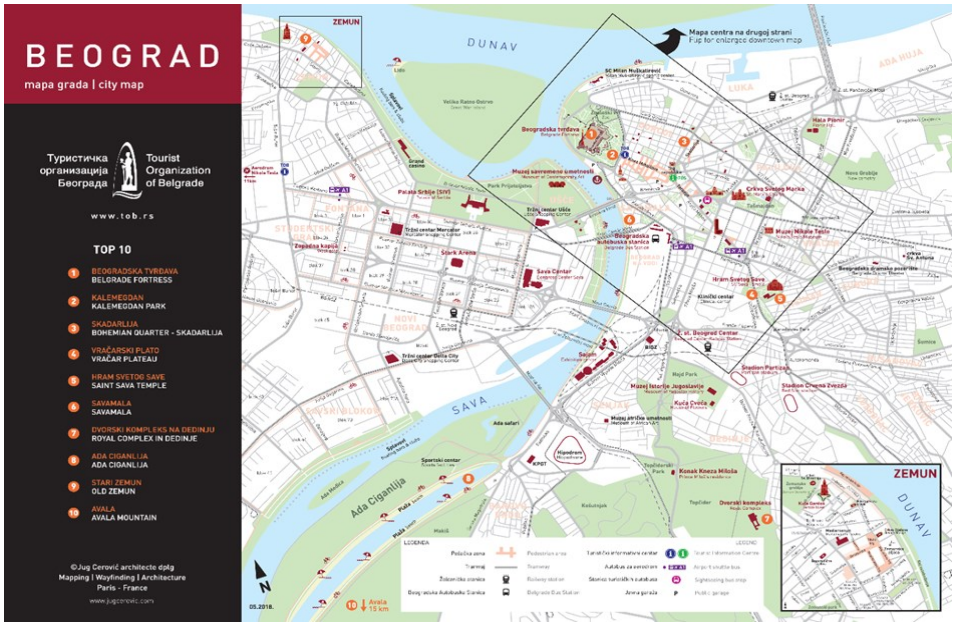

Figure 12: Inat, 2023: Belgrade Tourist Map (Access: 12.07.23)

3.3.1.2. Creation stage: Base Maps

After selecting the location and the tourist map design, the next step for creating map samples was to get a first draft of the map skeleton in the respective colours. MapTiler is a global map service provider, where most of the maps are based on OpenStreetMap data (Maptiler, 2023, Access: 13.07.23). Here, everyone can use the available base maps, modify the colours as one wishes to, and can use it for further research. Instead of the online version of MapTiler, in this study, we used MapTiler plug-in from QGIS Desktop 3.30.2 (QGIS.org, 2023) to create the base of each map (Figure 13). For the novel stimuli of the map, for each base map, the same base map with another location was exported, which are called novel base maps here. Figure 13 illustrates the first base map. The other four base maps and the novel base maps are listed in the Appendix D & E.

Providing a visual representation of data is an essential process in visualisation. The mapping of numbers to colours is one of the most significant and essential aspects of this process (Moreland,

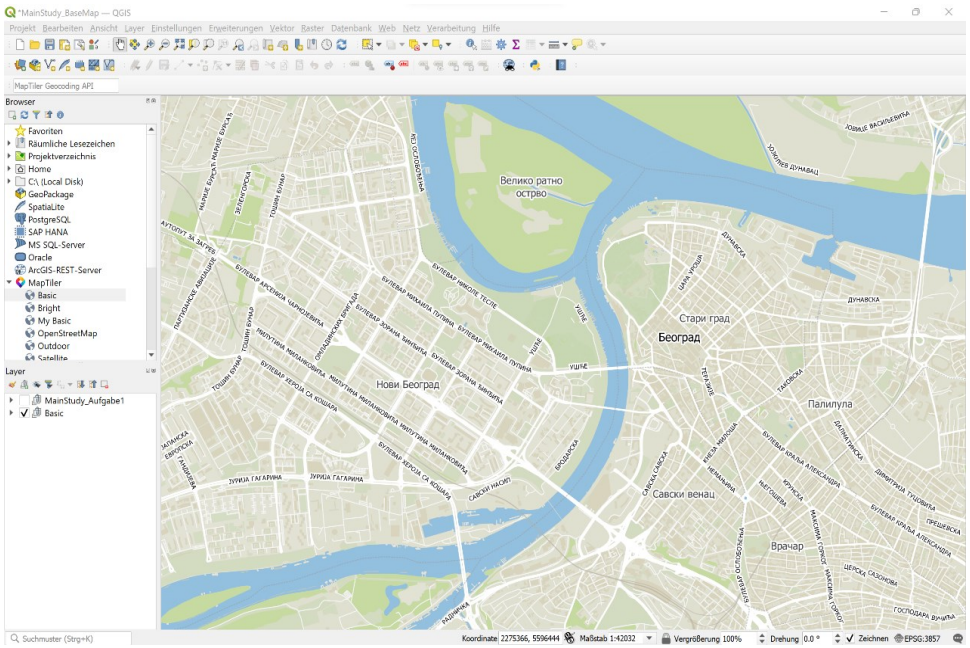

Figure 13: Screenshot of QGIS with MapTiler plug-in for creating the first base map of the main experiment.

2009). Choosing colours based on the nature of the data will ensure that the message of the map is understandable. In this main experiment (the same colours for base map 2 & 3) different colour values were chosen for each base map. In base map 1 (Figure 14), we decided to use the same colour values as from the basic map design from MapTiler (Figure 13). Here the colour lightness for the water bodies and the green areas were slightly changed, and the buildings were removed. Base map nr. 1's colour choices are inspired by the Swiss topographic map design (swisstopo, 2023). For the base maps nr. 2 & 3, we opted for grey colours and the main roads

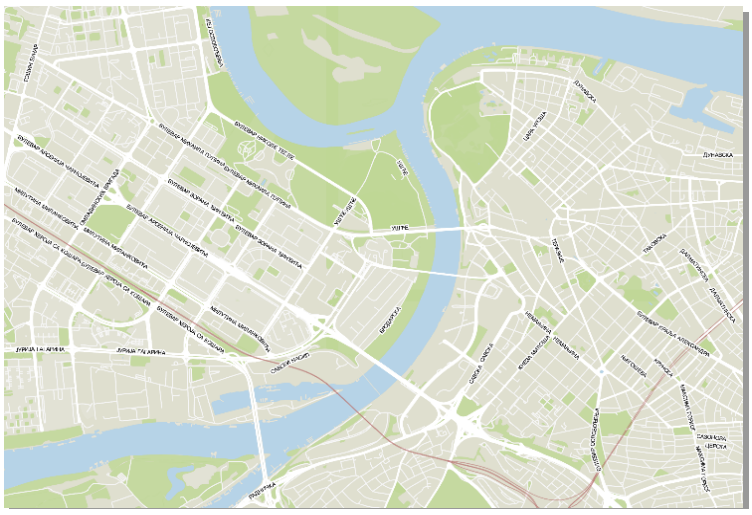

Figure 14: Base Map Nr.1 created with QGIS Desktop (QGis.org, 2023)

were coloured in a different colour (see Appendix D, Figures 50 & 51). Base map nr. 4 is represented in light colours and, in contrast, base map 5 has highly visible colours, such as dark red (Appendix D, Figures 52 & 53). In general, each map is coloured differently to avoid bias and to compare the maps and their results, which will be elaborated in subchapter 3.3.2. All the base maps were exported as .pdf, .svg, and .ai files for further design. In addition, the map for the trial task was used without any changes and without any symbols on it.

3.3.1.3. Creation stage: Symbols

The last step for the final maps was to place the symbols and the attractions on the base maps. Therefore, Adobe Illustrator and icons from public domain vectors were used (Adobe In., 2023; Public Domain Vectors, 2023). First of all, we opened the .ai-file with AI, where a second layer was created. In this layer the icons were imported and positioned on the whole base map. On each map five attractions such as the cathedral and five symbols such as the petrol sign were included (i.e., see figure 15).

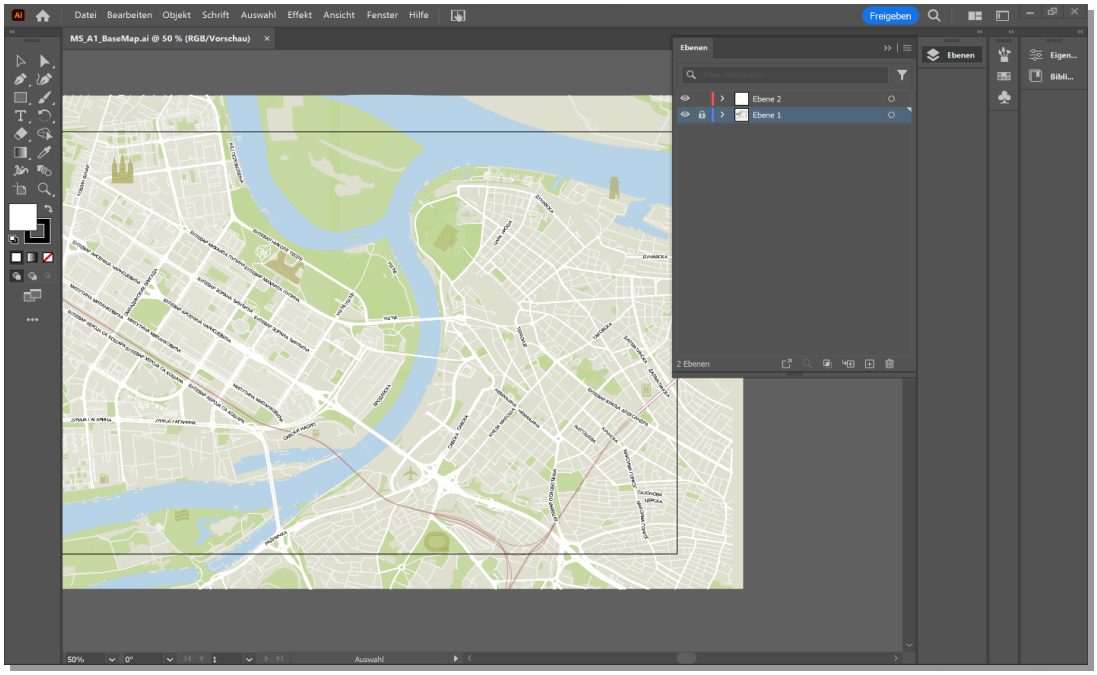

Figure 15: Screenshot of Adobe Illustrator while creating the first final map.

When creating thematic symbols, it is important to encode information about the represented object, which will help map users to understand the symbols' meaning and to locate it in a visual search (Forrest & Castner, 1985). In addition, search time decreases depending on the places and their positions. The maps for this study do not aim to make participants understand the

relationships between symbols and its surroundings. Thus, some icons are located in order to understand the relationship between them, and some icons are positioned at random places. The colours are different for each map according to the base map colours. Additionally, the novel base maps were designed with the icons used in the respective base maps. The reason for choosing different colours for the symbols and the base maps and generating a novel base map with the same icons will be elaborated in the next subchapters 3.3.2 and 3.3.3, where the final study maps are illustrated (Figures 16-20).

3.3.2. Map Designs

The goal of the map design was to minimise complexity while concentrating solely on the study's objectives and research questions. Five maps with the same goal were created to examine the research question and the hypotheses with different designs and with different symbols (Figure 16-20). The novel map design outcomes, which were used for the novel map cut-outs are listed in the Appendix E, more in subchapter 3.3.3. The level of visual information that a person can retain simultaneously for ongoing tasks is explained by their visual working memory (VWM) capacity (Isbell et al., 2015). Different studies found out that the capacity of VWM is limited (Isbell et al., 2015). Hence, the maps were designed minimally to ensure that the participants were able to observe the map thoroughly in the given time. Ten symbols were added to each map to allow participants to observe it without overloading it with information, as the purpose of this experiment is not to determine the maximum amount of memory that can be used. The bigger symbols are defined as attractions in the Area of Interests (AOIs) tags and the smaller symbols as signs in the AOI tags (read more about AOI in chapter 3.3.3).

Map Nr.1

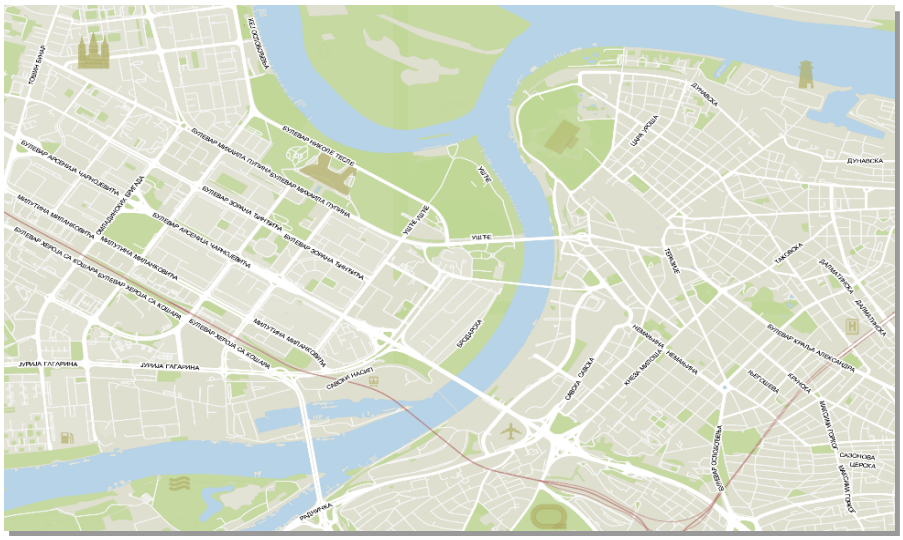

Figure 16: The final version of map nr. 1, which was used for the main experiment

The goal of this map was to find out how the participants observe the map, according to the hypotheses from chapter 1.3.1. As mentioned in subchapter 3.3.1.2, light colours for the base map were used. The aim in this map was to colour the icons inconspicuously so that the icons do not stand out from the rest. Therefore, a saliency analysis was carried out for each map, which will be elaborated in the subchapter 3.3.2.1. The assumption throughout the study, especially for all five maps, is that Tamil participants will focus on the background and will observe field-dependently, whereas Swiss participants will focus on objects and its characteristics and will observe field-independently. Therefore, the assumption for map nr.1 is that Swiss participants will have a higher total of fixation duration than Tamil participants, whereas Tamil individuals will have a higher number of fixations than Swiss individuals. This hypothesis is expected to be true for the whole map and also for the icons (symbols) on the map, differentiated into attractions (bigger icons) and signs (smaller icons).

Map nr.2 and Map nr.3

Figure 17: The final version of map nr. 2, which was used for the main experiment

The second and third map (Figure 17 & 18) consist of the same colours for the base maps and the icons. On the second map, the streets are further apart, there are a lot of green areas, a river, and other free spaces. In contrast, the third map consists of tight streets, more street labels, less green areas, and no river. The goal is to compare both maps, for which reason one map with wider streets and one map with narrow streets were chosen. The presumption as for map nr.1 is that the number of fixations will be higher for Tamil than Swiss participants, whereas the total of fixation duration is higher for Swiss individuals. This is assumed for the icons from the

respective maps, too. Map nr. 2 and map nr. 3 will also be compared to each other in order to reassure the assumptions mentioned before and to find out if the choice of different city infrastructures have an influence on the outcome.

Figure 18: The final version of map nr. 3, which was used for the main experiment

Map nr.4 and Map nr.5

As maps nr.2 & 3, the 4th (Figure 19) and 5th map (Figure 20) will also be compared to each other. Therefore, the colours of the base maps were changed but the colour of the icons and the location of the city are the same for both maps.

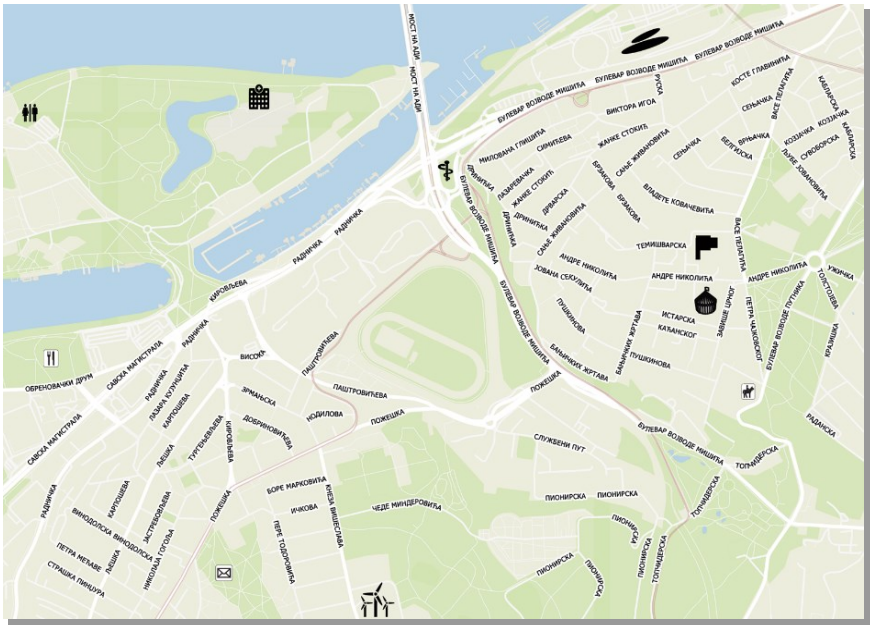

Figure 19: The final version of map nr. 4, which was used for the main experiment

The colours of base map nr.4 are light so that the icons are in the focus. Whereas map nr.5 consists of highly visible base map colours, so that participants are irritated by the colour choice. In general, the aim of the last two maps is to compare a map focusing on the icons (Figure 18) with a map focusing on the surroundings (Figure 19) through colour choices. Despite the different colour choices and the different focuses, it is expected again that Tamil participants will have a lower total of fixation duration and Swiss participants a lower count of fixations. With the comparison of maps nr. 4 and 5, the prediction is that the colour choices of the maps will not

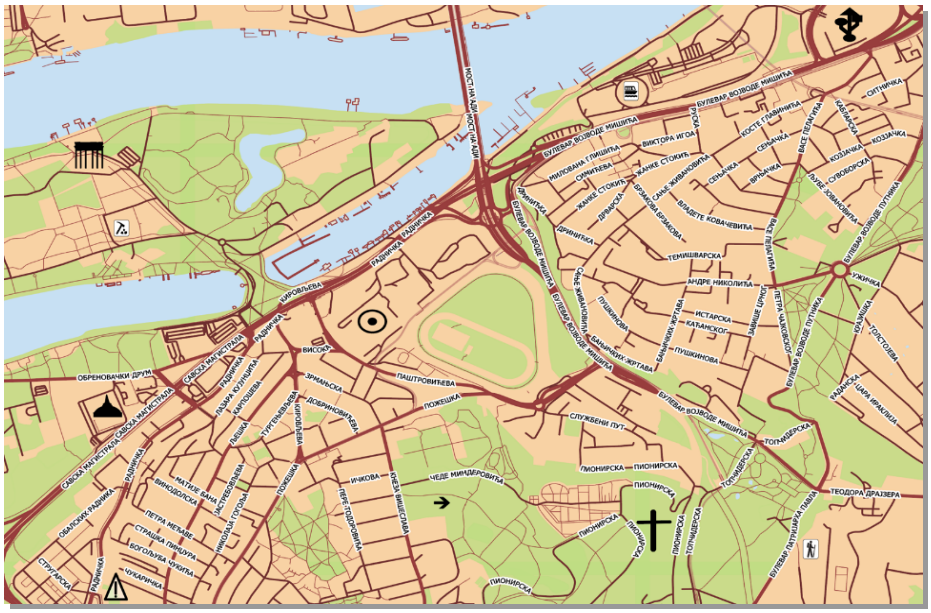

Figure 20: The final version of the map nr. 5, which was used for the main experiment

have an influence on the assumptions about both groups related to the number of fixations and the total fixation duration.

Finally, all five maps will be compared in order to see whether there are any differences between them, considering the hypothesis about the number and duration of fixations for participants who are Swiss and Tamil.

3.3.2.1 Saliency Analysis

The human visual system selectively attends to the relevant areas of interest within a scene in order to process the enormous amount of incoming information. Thus, it has been suggested that, attention is drawn to areas or things that stand out from the background when people look at visual scenes without any specific objective in mind (Koehler et al., 2014, Walther & Koch, 2006). Fixations, a series of rapid eye movements, are the means by which the selective

attention process is accomplished. It is crucial to predict the areas where the human eye fixates, as these regions may be utilised for the task creation (Borji & Itti, 2013). Computational models known as visual saliency models are used to forecast the areas in which the human eye fixates. Such saliency models make use of bottom-up processes or top-down processes. The top-down model is a goal-oriented process dependent on high-level elements including previous knowledge, user expectations, task question, and scene context. On the other hand, bottom-up model is an autonomic, stimulus-driven mechanism, where certain elements of a scene, such as colour, edges, motion, or brightness unintentionally attract one's attention (Bisley & Goldberg, 2010). From the bottom-up perspective, it has been proven that saliency models can predict eye movements (Koehler et al., 2014). Saliency models can therefore be used to test the selection of the map layout in cartography as well as to predict eye movements (Fabrikant et al., 2010).

Saliency analysis was employed in this study to establish which regions of the map will be given more attention than others. A saliency analysis is helpful in choosing the map cut-outs for the tasks because each map design is unique, containing diverse scenes, symbols, and colours. Each of the five map designs should include its own saliency map. Thus, the saliency model created by Walther and Koch was employed to forecast which areas of each of the five maps from the main experiment will be focused on by the participants in order to select the respective map cut-outs for the tasks (more in 3.3.3) and to test if the saliency maps are more or less different for each map design (Walther & Koch, 2006).

The five maps' saliency maps were created using SaliencyToolbox – Version 2.3 (Walther & Koch, 2006) from Matlab R2023a – Version 9.14.0 (Matlab, 2023). Walther and Koch's saliency model (2006) is based on the initially developed attention system by Itti and his colleagues (1998). Colour, orientation, and intensity are the three relevant features for a saliency map, with equal weight on each of them.

The saliency maps for the first and fifth maps are shown in figure 21. Appendix F contains the saliency maps from the other task maps. As might be expected, the separated green areas and waterbodies in the first map have the highest saliency values. A higher saliency value is rather assigned to some of the larger symbols/attractions than to other symbols with a lower saliency value. In contrast to map nr.1, map nr.5 features bright colours that make the location of the attractions and symbols more challenging. As a result, the saliency map has the highest saliency value at the crossroads on the map.

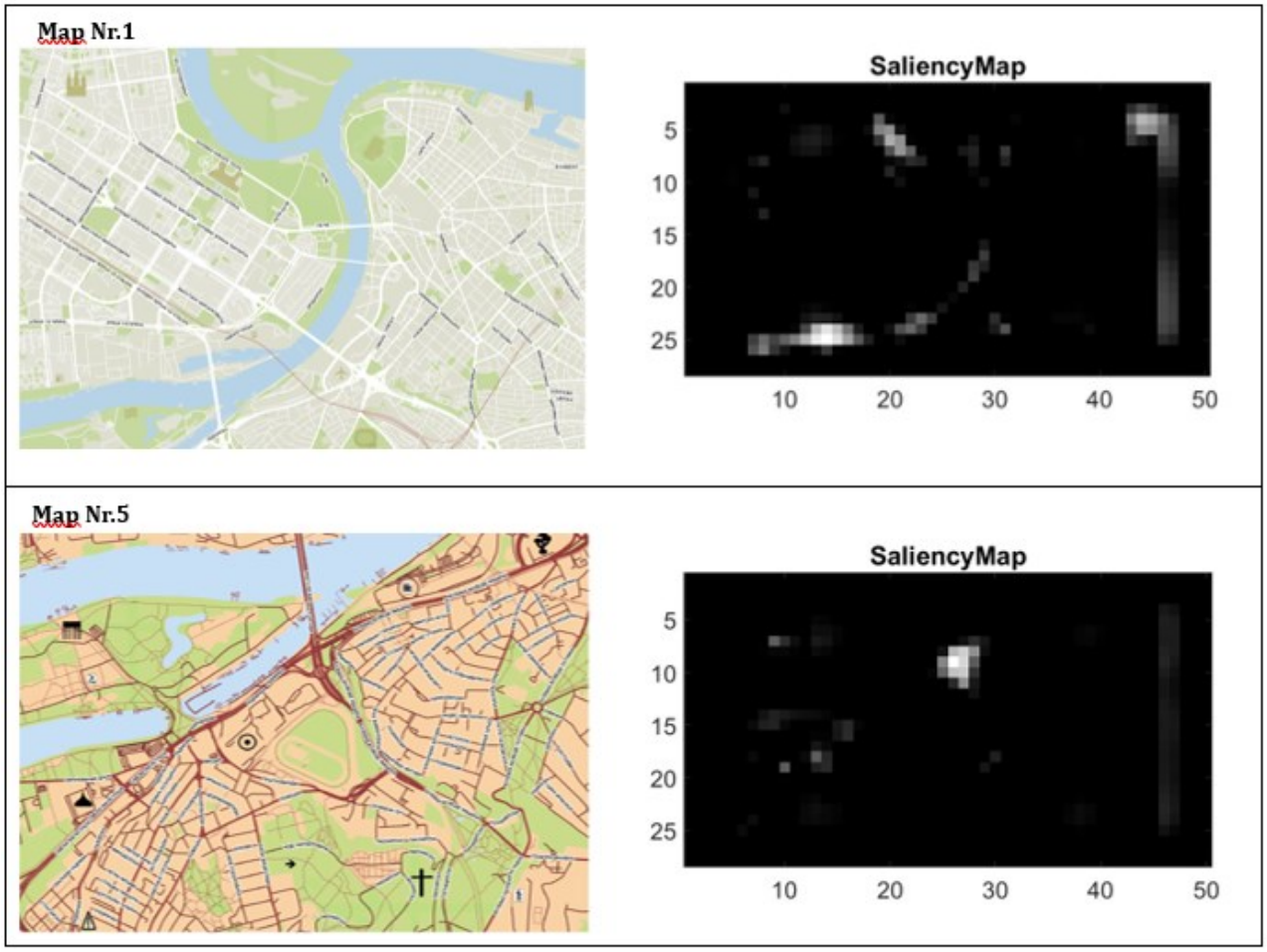

Figure 21: Maps nr. 1 and 5 with their saliency maps. Low salience is represented in dark colours, whereas high salience is represented in bright colours.

3.3.3. Map Stimuli Creation & Trial Planning

In the main experiment, after each map 18 map stimuli (cut-outs) were shown to the participants. Eight of the 18 map cut-outs had appeared in the respective map. Objects from these pictures include symbols, attractions, and background stimuli from the prior map. The other eight map cut-outs consist of objects which had not appeared in the map display. The stimuli were combined with objects and the background information, as illustrated in table 2 (Masuda & Nisbett, 2001). Each previously seen or not seen object could have the original background, no background, or a novel background, which means a background that did not appear in the map display. In total, six different conditions were there: a) previously seen objects with original background, b) previously seen objects with no background, c) previously seen objects with a novel background, d) novel objects with the original background, e) novel objects

with no background, f) novel objects with a novel background (Masuda & Nisbett, 2001). In the study from Masuda and Nisbett (2001), for 90 map stimuli with previously seen and not seen objects 46 focal fish, 14 moving animals, 16 not moving animals and 14 field objects were included. According to that, in our main experiment, we have chosen nine attractions, six symbols and signs, and three field objects for each map display task considering the saliency analysis as previously mentioned in subchapter 3.3.2.1. In Appendix G, the prepared map cut-outs/stimuli for each map are illustrated.

Table 2: Examples of objects used as stimuli for the maps. *Task condition names were used from the study from Masuda and Nisbett (2001).*

		
Previously seen object with the original background	**Previously seen object** with no background	**Previously seen object** with a novel background
		
Novel object with the original background	**Novel object** with no background	**Novel object** with a novel background

More uncertainty exists in answers estimated from fewer trials than from many trials. The results of a few trials might not be as indicative of the truth as those of many trials (Lacko et al., 2023). The experiment's duration may increase if many trials are tested, and the participants' attention spans might decline over time. Consequently, the trial design for this examination was carefully planned to follow the study design from Masuda and Nisbett (2001).

Figure 22 shows how the 18 questions for each task - five tasks in sum - were asked. Masuda & Nisbett used 90 objects to let the participants decide if they have seen them in the previous

aquarium scenario or not (2001). According to this, in the main experiment, 90 map cut-outs for all the five map displays were designed. The 90 map cut-outs were elements from the shown map and the novel map. The map stimuli have the exact same size as they were represented in the map itself. As illustrated in Figure 22, in each task the same question (if you have seen the map segment in the previous map) was asked and participants were able to click on "Yes" or "No". In Appendix H, all the tasks from the main experiment are illustrated.

Figure 22: Screenshot of one task from the main experiment in German language.

Although all the stimuli with the six different conditions (Table 2) were created and randomly used for all the 90 tasks, only the previously seen objects, especially the previously seen object with novel background were of importance. In order not to confuse the participants with the same map cut-outs and tasks, the stimuli with the 6 different conditions were used. We predict that all the participants will answer stimuli with original background and previously seen objects without background with "yes". Apart from that it is expected that Tamil participants will answer previously seen objects/stimuli with a novel background with "no", whereas Swiss individuals will answer that they have seen them. To analyse this assumption specific predictions were created to simplify the analysis with Tobii Pro Lab (more in the next subchapter) and metrics such as accuracy, response time, and the number of mouse clicks for respective answers were used. The assumptions which support the hypothesis from RQ2, are the following:

- The accuracy of "yes" answers for Swiss participants will be higher than the accuracy of "no" answers for Tamil individuals.

- The response time for objects with a novel background will be higher for participants with Tamil background than Swiss participants.
- The frequency of "yes" answers in map cut-outs of figures with a novel background will be higher for participants with Swiss cultural background than with Tamil cultural background.

3.3.3 Eye Tracking & Experimental Design with Tobii Pro Lab

3.3.3.1 Fundamental Principles of Eye Tracking

In both normal and clinical populations, "*the eyes have been a window to the mind for more than a century"* (Karatekin, 2007). Almost everything we do requires eye movements due to the reason that we perceive the world through our eyes. Therefore, eye tracking techniques can enhance our knowledge of the mind and how it develops. Our eyes convey an extensive amount about what we are thinking and experiencing (Karatekin, 2007; Brodersen et al., 2002). The eye tracking studies' main principle is that people direct their attention to scene aspects that they process at that specific moment (Wedel et al., 2023). Eye tracking is an objective method, where measures regarding the visual attention to specific scenes are quantitively recorded (Wedel et al., 2023). The fact that the data obtained by eye tracking can be quite enormous in size and difficult to analyse is perhaps its main disadvantage (Brodersen et al., 2002). The first eye tracking studies in cartography were conducted in the 1970s. Nowadays, the influence of the eye tracking method is noticeable in cartographic research (Krassanakis & Cybulski, 2019).

There exist different types of eye movements. The most important one is the eye fixations, which refers to the moment when someone's eyes rest on a point (Tobii AB, 2019). On the other hand, saccades are the eye movements, where the eye rapidly moves from one to another point (Tobii AB, 2019). These types of eye metrics allow for the assessment of various metrics. The number and duration of fixations are two metrics of interest in eye-tracking studies (Tobii AB, 2019; Brodersen et al., 2002). In addition, other eye tracking metrics such as the area of interest (AOI) will be discussed in detail below. For this study the number of fixations, fixation duration, mouse clicks in the "yes" or "no" AOIs, AOIs of the maps, attractions, and the signs, and the time to the first mouse click will be analysed. Due to the scope of this master thesis only these few eye-tracking metrics will be considered.

3.3.3.2 Execution in Tobii Pro Lab

The eye movements were monitored using the Tobii TX300 screen-based eye tracker and Tobii Pro Lab software (refer to chapter 3.6 for further details). The Tobii Pro Lab software provides

functionality to support the researcher through all phases of an eye tracking study (Tobii AB 2019, 2023c). The design of an experiment can be implemented directly or a designed experiment with other software can be implemented in Tobii Pro Lab. Thus, first this study was designed in PowerPoint (see Appendix H) and then implemented in the Tobii Pro Lab -Version 1.217 (Microsoft, 2023a; Tobii AB, 2023b). In PowerPoint, for the first task, the first base map was portrayed followed by the 18 questions as shown in figure 22 3.3.3. As the first task, all the other four tasks were designed. Through text slides, instructions were displayed in the beginning, end and in between each task. Two timelines were added to a single project in Tobii Pro Lab: for the trial task and another for the main experiment (see Appendix J). All the slides created in PowerPoint were added to the project in Tobii Pro Lab (Microsoft, 2023a). Each map in each task was displayed for 45 seconds and without any mouse click the first question of the respective task appeared. For the other map stimuli, the participants were instructed to click on "Yes" or "No" to advance from one map stimuli to the next. Additionally, the clicks from each question were recorded if the answer was a "Yes" or "No" through AOIs.

Definition of Areas of Interest (AOIs)

In order to conduct a more methodical and statistical analysis of the eye tracking data, areas of interest (AOIs) were established (Tobii AB, 2023e). It is quite uncommon for people to fix their gaze on the same spot on a stimulus. To everyone this problem, researchers establish areas of interest (AOIs) on a stimulus that are particularly relevant to a particular study (Drusch et al., 2015).

The questions' stimuli covered the AOIs for the responses "Yes" and "No" (see Figure 23). Finding the final responses was the aim of the AOIs for the stimuli with the questions, where the mouse click metrics were observed. Possible answers could also be clicked outside the "yes" or "no" box. Therefore, both AOIs were selected to be larger than the provided "yes" or "no" answer boxes to click in order to detect every final response (mouse click).

Gaining an understanding of the observation process and determining the difference between Swiss and Tamil participants is the aim of the AOIs in the map stimuli. In the stimulus of all the five maps the symbols were covered as AOIs (see Figure 24). Ten symbol element AOIs in total were produced for each map as a result. In addition, the symbols were divided into groups of attractions and signs through AOI tags. The objective of the symbol element AOIs is to compare participants from both groups by analysing the eye-tracking metrics, number of fixations, and fixation duration. There are ten Areas of Interests of the symbols for each map, with the AOI

sizes varying according to the symbol sizes, and one AOI for the whole map. A preliminary analysis revealed that the symbol sizes were used to determine the AOI sizes for the symbols in order to avoid having a negative impact on the eye tracking data and to enable the detection of fixations.

Figure 23: Screenshot of the division of a question stimulus into question element AOIs based on a question stimulus example from the first map tasks

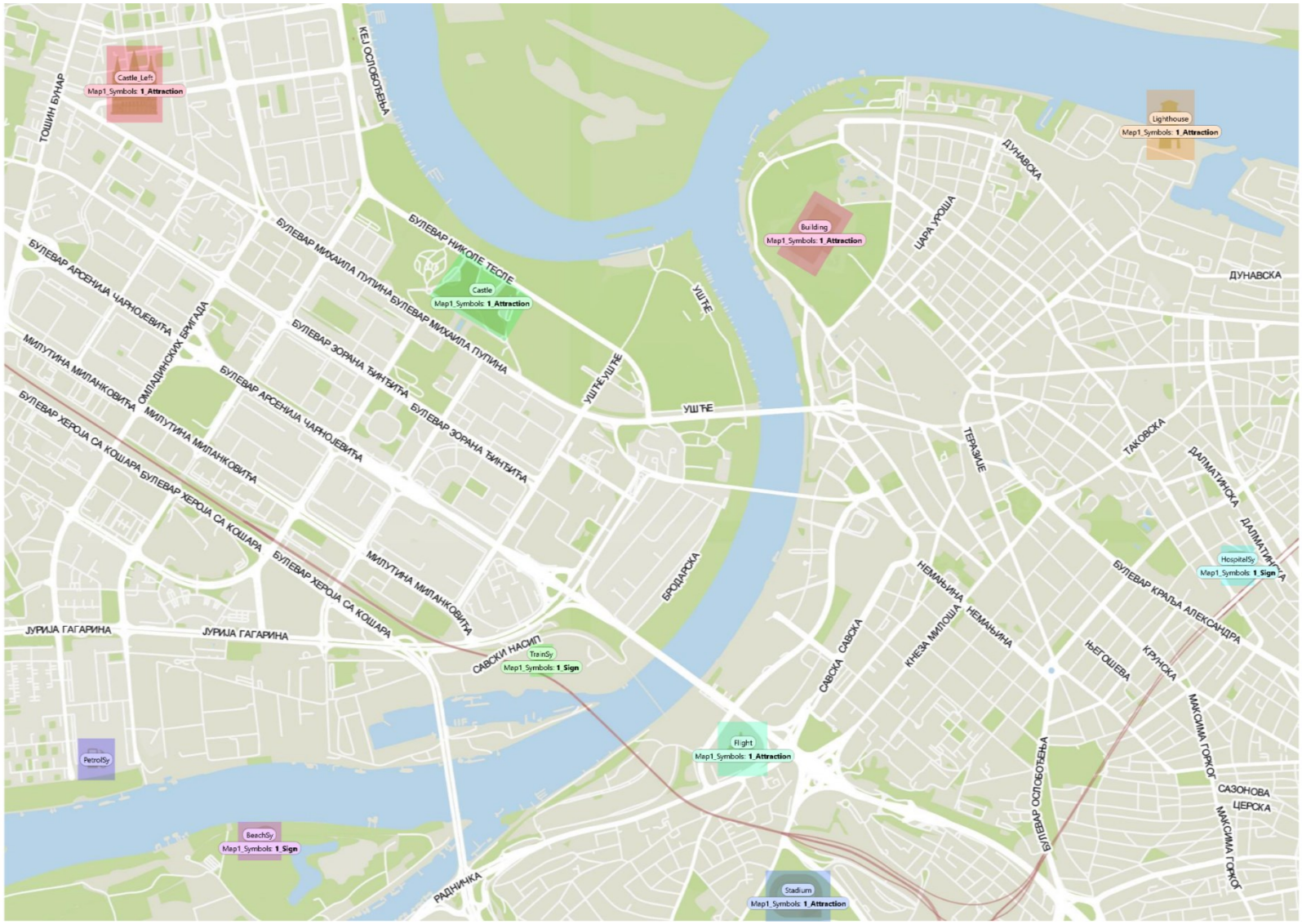

Figure 24: Screenshot of the division of a map stimulus into map symbol element AOIs based on the first map stimulus example without the AOI of the whole map for a better visualization

I-VT Filter

As the application of eye-tracking methodologies increases, the issue of how to quantify fixations so that relevant visual processing is captured under particular conditions is an important step in the analysis of eye movement data (Trabulsi et al., 2021). Fixation identification is the process of separating and differentiating fixations from saccades (Salvucci and Goldberg, 2000; Trabulsi et al., 2021). Tobii Pro Lab thus employs the velocity-based I-VT filter from a variety of algorithms which exist (Olsen, 2012).

In Tobii Pro Lab a default I-VT filter is provided, since different studies can be designed with the Tobii programm (Tobii AB, 2019). Additionally, the filter can be customised. The minimum fixation duration is a crucial parameter obtained from the I-VT filter (Olsen, 2012). According to Olsen (2012), the minimum fixation length is the smallest amount of time that fixations can last and acts as a cutoff point for fixations that are too brief. Fixations can be longer when processing an image or map than when reading (Rayner, 2009). Thus, determining the minimum fixation duration can be challenging. The default value in Tobii Pro Lab is 60 ms (Olsen, 2012). Salvucci and Goldberg (2000) recommend ranges between 200 and 400 ms, however Rayner (2009) suggests values between 100 and 350 ms depending on reading or visual tasks. The minimum fixation duration was set at 60 ms for this study, despite the recommendations having a lower minimum value. Considering the fact that the tasks were completed on a computer screen, the default setting from Tobii Pro Lab was selected to prevent data loss since the task completion time was rather short. Therefore, it appeared beneficial to maintain the short fixations in order to improve the data processing (Trabulsi et al., 2021).

Eye Tracking Data Export

One of the difficulties is the enormous amount of data that eye tracking generates. It is simple to get lost in the data, which also makes selecting appropriate metrics for the study analysis challenging. Exporting pre-processed metrics from Tobii Pro Lab helped deal with the size of the datasets. Two different kinds of data exports are produced by Tobii Pro Lab: AOI- and interval-based. Every AOI from every interval and every recording has its own row in an AOI-based file (Tobii AB, 2023f). An interval-based file is used especially for analysing the data in statistical analysis software. In this case, the interval is shown for the entire duration of the time of interest (TOIs) (Tobii AB, 2023f). All of the metrics from the answers were exported as aoi-based files to make the data analysis process easier. Each map's metrics were exported as individual AOI-

based files. As a result, for simpler analysis, just the metrics required for the answers and the maps were exported individually.

3.3.4 Evaluation Task

The last part of the main experiment investigated whether or not cultural background had an impact on cognitive performance. Thus, it functioned as a debriefing of the first part of the main experiment. Such debriefings can be conducted in many forms, e.g. questionnaires in written form or questions asked verbally (Martin, 2008). In order to do this, participants were verbally instructed to assess the design element of the five maps, particularly the first map. The instructor recorded the participants' responses on prepared sheets for each participant (see Appendix I for the whole evaluation task). The majority of the questions related to the first map, which required participants to rate the design of the first map, indicate what in particular caught their attention first, what they liked about the first map, and what they did not. The participants were also questioned about how frequently they use tourist maps, whether they plan to use them in the future, which of the five maps they liked best, and which ones they did not.

For the answers mostly the Likert scale was used. The reason for using this scale is that it makes it possible to convert a subjective response into objective findings (Joshi et al., 2015). As a result, qualitative answers can be transitioned into quantitative measurement. Open-ended questions were asked and here the answers were categorized into the prepared topics for the questions **ii, iii, vii**. Given the aforementioned, the questions **i, iv, v**, and **vi** questions were used to indicate a 5-scale rating defining the positive and negative variables (such as attractive-not attractive).

3.4 Paper Folding Test

The participants will need to complete a spatial ability test on paper folding after gathering all the necessary information about the cultural influences on map reading. A study by Tian and his associates reveals the impact of culture on people's mental images, spatial references, and spatial memory (2022). The findings indicated that there was little variation in the spatial abilities of individuals from various cultural backgrounds (Tian et al., 2022). Korean students were able to outperform American students on the paper folding test, according to Workman and Lee's (2004) statistically significant findings. Coutrot and his colleagues (2018) conducted a study wherein a cognitive task utilising a mobile app was developed to assess spatial navigation abilities globally. In tasks that assessed spatial perception ability, Chinese children outperformed Malay children, all children being aged between 8 to 12, demonstrating cognitive differences across the globe (Coutrout et al., 2018 cited in Tian et al., 2022). However, in a study by Janssen and Geiser (2012), German students performed better in the Mental Rotation Test than Cambodian students did. All these studies emphasise the value of including a test of spatial ability in the study in order to compare the two cultures' spatial abilities and remove any bias. Most Tamil immigrants in Switzerland came from Sri Lanka and settled there in the early 1980s (Wanner & Fibbi, 2010). Despite being born in Switzerland, the immigrant parents' customs, values, and language were nurtured in their children during their upbringing. Furthermore, we need to consider the influence that Swiss education has had on them. If a variation in spatial ability between Tamil people and Swiss people both born in Switzerland exists, it must be confirmed in order to understand the cultural differences of this study on multiple levels (Tial et al., 2022). Given that no particular study has been able to demonstrate which culture thinks holistically and which thinks analytically, particularly when it comes to the paper folding test, we therefore anticipate that there will be a cultural influence between the Swiss and Tamil participants, with one group performing noticeably better than the other.

PFT requires participants to *"mentally fold the complex figures and mentally transform two-dimensional flat diagrams to three-dimensional solid forms"* (Workman & Lee, 2004). Participants are challenged to mentally carry out challenging three-dimensional spatial visualisation tasks, where mental rotation and spatial manipulation abilities are in the foreground (Ekstrom et al., 1976). Each participant has three minutes to complete each of the two sections of the test (see Appendix K). Each section consists of ten questions. Each task has an illustration of a "*piece of paper being folded, and a hole punched in it on the left side of the paper"* (Workman & Lee, 2004). Five potential solutions are listed on the paper's right side. The five drawings that depict the paper with holes after being opened must be chosen by the participants (Workman & Lee, 2004).

The number of drawings that participants correctly identify will be the final score. The scale for the score is 0 to 20. Before the timer starts, the task description with an example task is given. Since the PFT originally appears in English, the entire study was translated via Deepl into German language (2023).

3.5 Questionnaire

The study's final component is a questionnaire that includes general inquiries and background information related to the study. Age, gender, highest level of school, employment, location of birth of participants and their parents, country where participants lived the majority of their life, bilingualism, degree of map knowledge, and other questions regarding how traditional they are were all covered in the survey. The Appendix L contains the whole questionnaire. PsyToolkit was used to programme and execute the questionnaire (Stoet, 2010, 2017).

Numerous relevant studies have shown that gender can always play a categorization role, because men and women tend to conduct particular tasks differently (Bosco et al., 2004). For the question about age, we asked the participants to write down their age. The reason was that the required age group was already between 18 to 40. Thus, we decided to have the participants specify their exact age. After that for the question about their profession, the participants were asked some questions, where they had to enter a numerical value on a Likert scale (Stoet, 2010, 2017). Four questions were generated according to the holistic and analytic cognitive styles. Due to the reason of the different meanings of traditionality, again three questions were generated, which analyse the traditionality of each participant from different perspectives. Following up, if one was raised up bilingually is also of importance as well as the level of map uses, such as google maps or ski touring maps.

3.6 Experiment Settings & Procedure

The Tobii TX300 eye tracker (data rate: 300Hz, binocular, accuracy: 0.3 deg) was used throughout the entire experiment in the eye movement lab which is located at the University of Zurich (Tobii AB, 2023c). Windows 10 was utilised, and the eye tracking device was connected to a 23.8-inch monitor with a 1920 x 1080 pixels resolution. Accordingly, the high resolution was used to present the stimuli. No windows allowed for the same lighting conditions for each participant in the eye-movement lab. Additionally, the study was carried out in June while there were no lectures that month due to the summer break.

The participant and the experiment conductor were the only people present in the room throughout the experiment. To enable a quiet environment, at a time only one participant was

summoned. The participants were instructed to take a seat in front of the computer once they had entered the room (see Figure 25). Before starting the study, the participants were asked to sign the consent form (see Appendix L). The experiment conductor then gave them an introduction before each study part. For the preliminary test, the same computer as for the eye-tracking study was used. For the main experiment, participants had to sit still, so that all the eye movements could be recorded.

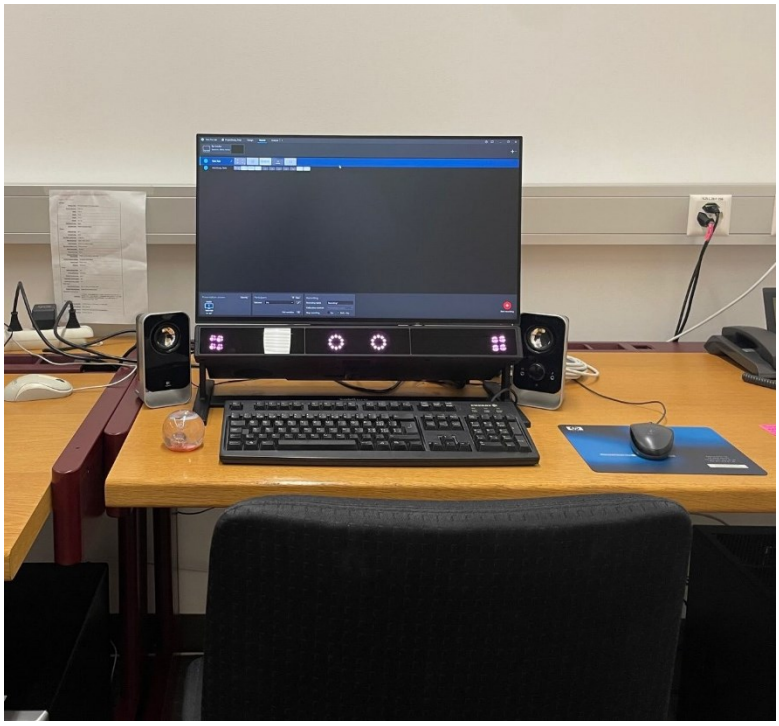

Figure 25: Workstation arrangement in the eye movement lab. A tool to rest the left hand was provided, and the main experiment and the questionnaire were solved using the mouse. The keyboard was used for the preliminary test and the questionnaire.

Eye shape and geometry vary from person to person, which makes eye movement tracking more challenging (Tobii Pro AB, 2023a). The eye tracker was calibrated for each participant in order to minimise these challenges and obtain accurate eye tracking data (Tobii Pro AB, 2023a). On a light grey background, six white target circles were displayed at various locations during the calibration process. The participants' objective was to follow those targets so that the tracker could gather information about their eyes and gaze (Tobii Pro AB, 2023a). After a first calibration a trial task with two subtasks were presented to become familiar with the study format and the Tobii Pro Lab software. The actual study tasks were completed after the trial task, which was followed by another calibration that was set up similarly to the first one.

Following completion of the eye tracking portion of the study, participants were required to transfer to the grey seat (see Figure 26), where they used pens and paper to complete the paper-folding test. The participants then had to return to their place (see Figure 25) and complete the questionnaire. The experimenter was present during the entire trial, short breaks were provided if desired, and questions could be asked if anything was unclear.

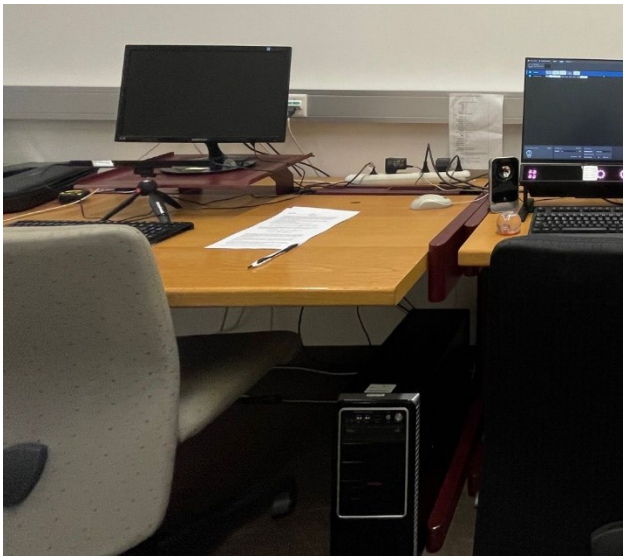

Figure 26: Setup of the workstation for the paper-folding test.

Before the actual study, a pilot experiment with two volunteers was carried out. The pilot study's objectives were to calculate study duration and assess the eye-movement lab procedure in advance. After the initial draft, the first pilot experiment was carried out. Here, some adjustments to the way questions were answered were required, but not to the map stimuli or the arrangement. The study's final design was established based on the comments and the findings, which was evaluated in a second pilot experiment setting. The study was finished by both participants in 35 to 45 minutes. The results of the pilot research confirmed that the corresponding formats are appropriate for the data analysis.

3.7 Sample

Participants who meet specific requirements were contacted for the experiment, as the difference between only Swiss and Tamil people was examined. 40 participants between the ages of 18 and 40 took part in the study. Results from various studies state that cognitive abilities decrease with normal aging (Ariel & Moffat, 2018; Beaudet et al., 2015). Therefore, people between the ages of 18 to 40 were required. The individuals were split into two groups

considering their backgrounds, which were identified by cultural, psychological, and environmental constructs as illustrated in Figure 1 from chapter 1.4 (Lacko et al., 2020). The participants from Switzerland who were born there as well as their parents represent Western culture. The second category consists of Tamils from Sri Lanka, who live and were born in Switzerland but whose parents were from Sri Lanka. They symbolise Asian culture. It is entirely possible to demand that each person's forefathers should belong to the Swiss and Tamil cultures. But it is crucial to limit the demands. Parents and children make up the majority of households. The participants' and their parents' cultural backgrounds are crucial for this reason. The location of the participants' parents and their own births, as well as the nation in which they have lived the majority of their lives is significant for this reason. These facts were gathered through the questionnaire, which is covered in chapter 3.5. Previous research has frequently been done only with students (e.g., Stachoň et al.,2018a; Lacko et al., 2020). As a result, only individuals who did not pursue tertiary education were considered.

As the whole study deals with colour schemes on computers, in the participants' invitation (see Appendix N) people with colour blindness were excluded and before starting the study they were re-asked to confirm that they are not colour-blind. Participants were recruited through the author's workplace and personal environment. Following the selection of the candidates, recruitment details were sent by email or Whatsapp (see Appendix N). The study included 40 people in all, with 20 male and 20 female participants. Eight male and twelve female volunteers participated in the study for the Swiss group, whereas eight female and twelve male participants were assigned to the Tamil group.

3.8 Statistical Analysis

With the exception of the questionnaire and certain portions of the preliminary test, which additionally were subjected to qualitative examinations, all four parts of the study's data analysis were conducted using quantitative and qualitative methods. The data was exported from Psytoolkit and statistically evaluated using RStudio - Version 2023.09.1+494 for the preliminary test (RStudio Team, 2023; Stoet, 2010, 2017). As previously stated, paper and a pen were used for the paper folding test. The test results were corrected by the study author (supervisor), which were then analysed using Excel and RStudio - Version 2023.09.1+494 (RStudio Team, 2023; Microsoft, 2023b). Moreover, RStudio - Version 2023.09.1+494 & Excel was used for statistical analysis of the questionnaire, the evaluation task and for the analysis of the main experiment data (RStudio Team, 2023; Microsoft, 2023b). The answers from the main experiment had to be derived from the Tobii Pro Lab data export by analysing the click metrics

per "yes" or "no" AOI tags. Thus, an AOI-based file with the click metrics and the response time was exported for the 90 map cut-outs only and all the eye movement metrics about fixations were exported as one AOI-based export for the five maps only. In addition, heatmaps were generated from Tobii Pro Lab to analyse and compare eye-tracking data with the statistical analyses. Due to a recalibration problem of 2 Swiss and 1 Tamil participants, eye-tracking data of these participants were not considered for the heatmaps. Furthermore, the significance level for each and every statistical analysis was set at $\alpha = 0.05$.

4 Results

4.1 Preliminary Test Findings

This chapter contains the findings from the preliminary test that was administrated to Swiss and Tamil individuals in order to investigate their holistic and analytical cognitive styles. Before beginning the main study on cultural influences in map reading, this first phase, which consists of the Navon test, Stroop test, and a quiz, provides a basic inquiry into the cognitive processes of the participants. The preliminary test results provide information about the participants' cognitive processes and set the stage for a more in-depth analysis of the ways in which culture affects map reading.

4.1.1 Navon Test Results

Global, local, and no features were tested in the Navon task, and the results—respective reaction times and errors from each condition—serve as the task's data. Only the global and local response times and errors from these data are crucial for our analysis. The mean reaction time from Tamil participants is higher in global and local conditions than the reaction time from Swiss participants (Table 3). Additionally, it is evident that the Tamil participants had a higher mean reaction time than Swiss participants in both tasks with global and local conditions in the boxplot (Figure 27) of the Navon task distribution according to the conditions differentiated between the two groups. Nevertheless, there is no statistically significant difference revealed by the Wilcoxon rank-sum test between both groups regarding the global (w=165, p=0.3505) and the local (w=166, p=0.3648). The effect size for global condition is low (r=0.092) and for local condition medium (r=0.164).

Table 3: Mean & Standard Deviation of Global & Local Conditions per Cultural Background

	Switzerland (Swiss)	**Sri Lanka (Tamil)**
Global Condition Reaction Time (in ms)	Mean: 924.9 SD: 367.51	Mean: 993.0 SD: 397.24
Global Condition Errors	Mean: 4.85 SD: 3.28	Mean: 5.8 SD: 3.33
Local Condition Reaction Time (in ms)	Mean: 1011.65 SD: 328.43	Mean: 1089.0 SD: 187.98
Local Condition Errors	Mean: 5.05 SD: 3.38	Mean: 4.25 SD: 3.04

Tamil participants responded to stimuli with local features faster than with global features, whereas Swiss participants responded to tasks slightly faster under global conditions than under local conditions. Swiss people ought to be faster at the local level and Tamil people at the global level, according to our hypotheses from chapter 3.2.1.

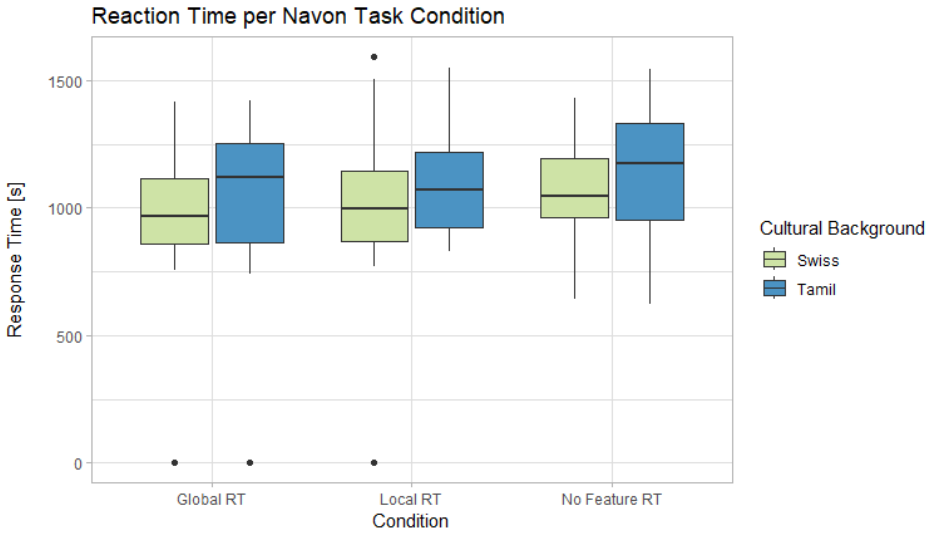

Figure 27: Boxplot of the three conditions used for Navon task differentiated between Swiss and Tamil group

In addition, contrary to the assumptions in chapter 3.2.1, Tamil people had more errors on a global scale, whereas Swiss people had more errors on a local scale (Table 3). However, according to the results of the Wilcoxon rank-sum test, there are no appreciable differences between Swiss and Tamil people when it comes to errors at the global (w=162.5, p=0.3137, r= 0.287) and local level (w=229, p=0.438, r=0.249). According to these findings, Tamil participants in this study performed better at the local level with fewer errors than Swiss participants did at the global level with fewer errors on the Navon task. This would imply that Tamil people think analytically and Swiss people holistically, but these findings are not statistically significant.

4.1.2 Stroop Effect

As noted in chapter 3.2.2, stimuli from both congruent and incongruent treatments were utilised in the Stroop task. For all subjects with Swiss and Tamil background, the mean reaction time for incongruent trials (Mean: 1138.75, SD: 241.05) is longer than for congruent trials (Mean: 1069.70, SD: 155.46). In the incongruent tasks, Tamil participants had a higher median than Swiss participants, but the Swiss participants' median is just marginally higher. Even so, the Tamil group had a higher mean across both treatments (Table 4). In addition, regarding the

Stroop effect, the Tamil participants' median is slightly higher than Swiss participants' (Figure 28).

Table 4: Mean & Standard Deviation of Stroop Test Features per Cultural Background

	Mean (ms)	Standard Deviation (ms)	Median (ms)
Swiss Congruent	1056.45	125.5935	1070
Tamil Congruent	1082.95	182.9261	1054.5
Swiss Incongruent	1137.75	145.4043	1144.5
Tamil Incongruent	1139.75	313.2549	1232
Swiss Stroop Effect	81.3	107.9342	101
Tamil Stroop Effect	56.8	339.8776	111.5

The mean Stroop effect of the Swiss group is 81.3 ms, compared to 56.8 ms for the Tamil group. This would imply that Tamil individuals vary less from Swiss participants in their responses to the stimuli under congruent and incongruent circumstances. The Wilcoxon rank-sum or t-test was used to assess the statistically significant difference between the Swiss and Tamil groups after taking the data's normality into account. The Stroop effect has a low effect size (r=0.0898) and an insignificant difference between the Tamil and Swiss groups, according to the t-test (w=178.5, p=0.5699). Additionally, there is a statistically insignificant difference between both groups in the incongruent (t-test: t=0.30725, df=22.794, p=0.7614, r=0.0082) and congruent (t-test: t=-0.5341, df=33.656, p=0.5968, r=0.0917) conditions with small effect sizes. Concluding, there is no difference between Swiss and Tamil individuals in solving Stroop tasks, according to the evidence.

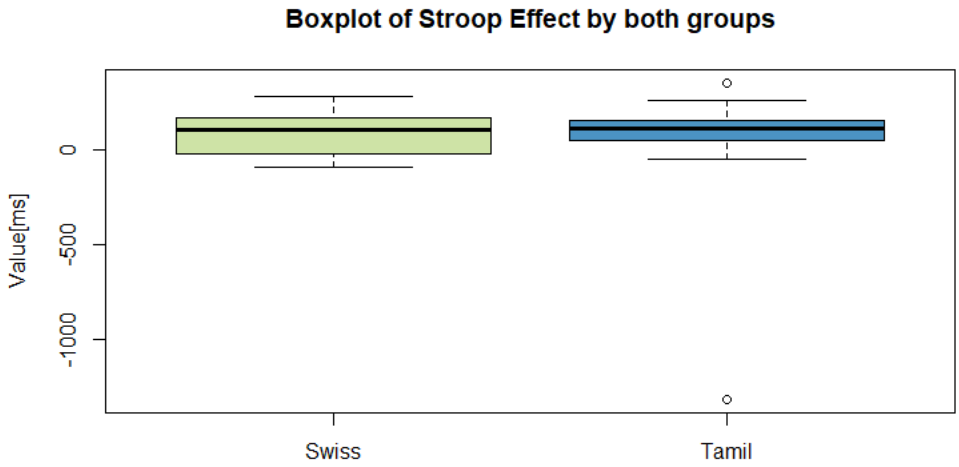

Figure 28: Box plot of Stroop effect difference between Swiss and Tamil participants

4.1.3 Quiz Results

The participants were required to complete a quiz consisting of 10 questions as the last part of the preliminary test to see if there were any differences between the responses of the Tamil and Swiss participants. One answer per question was aimed towards holistic thinkers, while the other was oriented towards analytical thinkers. The average number of analytic answers in the quiz for all the participants is 6.9 (SD: 2.1).

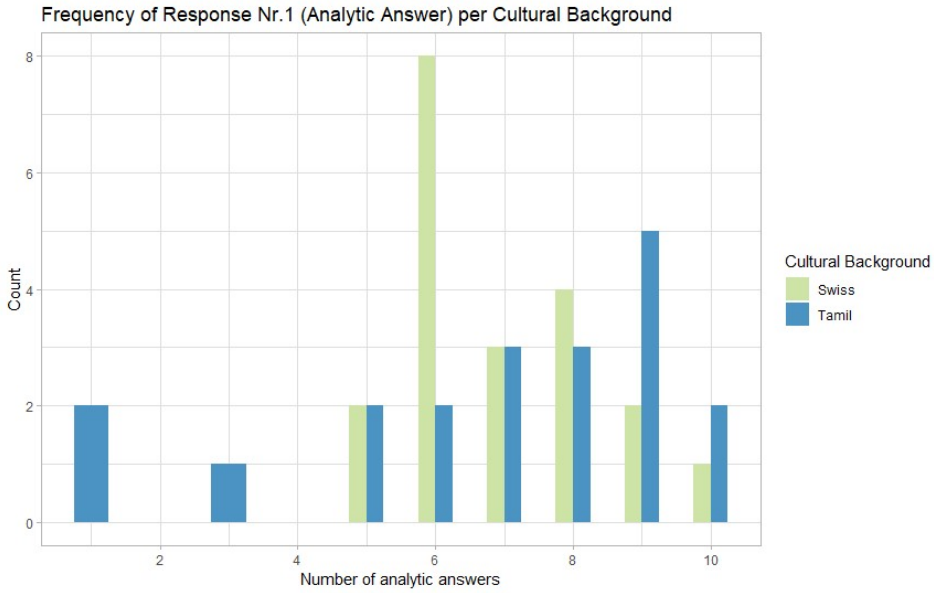

Figure 29: Relative Distribution of analytic answers per cultural background

The frequency of analytical responds varies slightly between the Tamil (mean: 6.85, SD: 2.7) and Swiss (mean: 6.95, SD: 1.4) individuals. Figure 29 shows the frequency of analytical responses in the quiz. A statistical analysis with t-test (comparing the means of the two groups) produced a nonsignificant difference (t=0.14715, df= 28.461, p=0.8841) with a low effect size (r=0.0276), indicating no cultural variation in the frequency or number of analytical replies between the two groups.

After considering all three preliminary test subparts separately, it can be concluded that none of the tests present a significant difference between Swiss and Tamil people regarding the analytic and holistic cognitive styles. To analyse the second research question in more detail, the results from the eye tracking study, the main experiment of this thesis will be portrayed in the next chapter.

4.2 Main Experiment Results

The purpose of the eye tracking experiment itself is to look into possible variations in the cognitive processing of cartographic outputs between two different cultural groups – Swiss individuals born in Switzerland and Tamil individuals born in Switzerland. All task results are included in each group. In the study design, cultural background is a between-group and an independent variable that separates Swiss and Tamil people, but it is also used to compare how it affects the dependent variables, which are duration of fixations, and number of fixations, in this study. The within-group variable is represented by the maps or map types. As a result, both samples are independent even though every group performed the same tasks with the same maps (Field et al., 2012). The outcomes from all of the maps and the tasks related to the map cut-outs will be shown in the following chapter. Lastly, the evaluation task outcomes will be reviewed in chapter 4.2.3, and a summary of the key findings will be provided in chapter 4.2.4.

4.2.1 Overview of Eye-Tracking Metrics over all Maps & Symbols

In this section, a comprehensive overview of the key-eye-tracking metrics used in the study, including fixation duration, the number of fixations across all five maps, and specific analyses focusing on attractions and signs between Swiss and Tamil group will be presented. Symbols were analysed as separate AOIs over all maps additionally, because those are critical elements within maps, attracting attention and influencing navigation decisions. Furthermore, the potential differences in eye-tracking metrics across the five maps and between the two cultural groups was explored using ANOVA. The two eye tracking metrics fixation duration and number of fixations were investigated in detail. The average amount of time participants spent fixating on particular AOIs within the maps is reflected in the mean duration of fixations per AOI (Brodersen et al., 2002). The second metric is the number of fixations, which measures the frequency of eye movements, offering insights into the participants' exploratory behaviour (Tobii AB, 2023e). Both metrics together mirror the overall viewing pattern. A total number of fixations indicates that the participants looked more frequently between the AOIs (Brodersen et al., 2002). Inspired by the results from Zhang & Seo's study how the cultural difference through the amount of fixation time & the number of fixations on a food item is shown, only the number of fixations and the fixation duration were used for our study (2015).

Table 5 shows that the Swiss participants exhibited longer fixation duration in both AOIs symbols and maps compared to Tamil participants, which resulted in a statistically significant difference. Swiss individuals spent slightly more time fixating at certain areas within the map &

the symbols AOIs than Tamil individuals. These differences were examined statistically through the Wilcoxon signed-rank test, due to the non-normal distribution (Table 5). Even the effect sizes are large, which is of interest, when interpreting the results.

Table 5: Eye-Tracking Metrics Overview over all maps & symbols. The inclusion of the effect size r indicates that the mean difference between the Tamil and Swiss participants was significant, as indicated by the italicised values.

AOI	Cultural Background	Fixation Duration (s) *Mean*	*SD*	Number of Fixations *Mean*	*SD*
Maps (1-5)	*Swiss*	31.82	6.66	121.18	24.40
	Tamil	28.83	4.96	116.32	19.36
Symbols (from Maps 1-5)	*Swiss*	0.60	0.83	1.71	2.07
	Tamil	0.28	0.59	0.94	1.70
P-Value (with effect size r)		Maps: *p < 4.296e-10, r= -0.44* Symbols: *p < 2.2e-16, r= -0.82*		Maps: t-test -> p = 0.09 *wilcox-> p=0.016, r= -0.17* Symbols: *p < 2.2e-16, r= -0.76*	

Interestingly, Tamil participants had slightly a lower number of fixations in the maps AOIs and the symbols AOIs than Swiss participants. The number of fixations data of Tamil individuals were normally distributed, while the data from Swiss individuals were not normally distributed. Due to that reason the data was investigated with both, the Wilcoxon signed-rank test and the dependent t-test, which resulted in an insignificant and a significant difference, as table W portrays. In this study, due to the not normal distribution of one data, the significant difference of the Wilcoxon rank-sum test will be considered. Apart from that, the standard deviations of symbols AOIs was found to be higher than the mean, which suggests notable variability in the participants' eye-tracking metrics. This high degree of dispersion indicates that the cultural variations for both eye-tracking metrics of the symbols AOIs across the five maps, highlight the diversity of fixation duration and number of fixations within the datasets.

As with fixation duration effect sizes, the low effect sizes for the number of fixations need to be considered when interpreting the results. It is crucial to realise that even in cases where a statistical test generates a significant result, the impact of altering the variable might not actually be worth anything. Because of this, in addition to statistical significance, the effect size is of great importance for the examination (Field et al., 2012). Field and colleagues (2012) state that a value greater than 0.5 denotes a strong effect, 0.3 suggests a medium influence, and 0.1 is regarded as

a small effect. If the effect size is negative, it indicates that the second cultural group is associated with a decrease in, for example eye-tracking metrics, compared to the first cultural group (Field et al., 2012). Guidelines for partial eta-squared are as follows: "*0.01 means a low effect, 0.06 a medium effect, and 0.14 a large effect*" (Field et al., 2012).

A 5 (map types) x 2 (cultures) ANOVA was conducted to explore the impact cultural background and map types have on fixation duration. A significant F-value (F (1, 194)=13.104, p=0.000376) indicates that cultures have a significant impact on the total fixation duration. The effect size (eta-squared =0.0616) suggests a moderate influence on fixation duration. The F-value for map types is statistically insignificant (F(1, 194)=1.372, p=0.245179), suggesting that the mean differences across map types may not be significant. The effect size (eta-squared= 0.0258) portrays a small influence. Furthermore, Tukey's multiple comparisons were examined, which illustrates a significant difference in fixation duration between Tamil and Swiss participants, again (p= 0.000376). Additionally, the homogeneity of variance and the normality can be assumed through Levene test and Shapiro test.

The 5 (map types) x 2 (cultures) ANOVA results of number of fixations, for the factor cultural background revealed nonsignificant effect, F(1, 194) = 2.481, p=0.117. Similarly, for the map types variable, the ANOVA indicates a nonsignificant effect, F(4,194) = 1.940, p=0.105. Effect sizes indicate a small influence for cultural background (eta-squared =0.012) and map types (eta-squared =0.038) on number of fixations. Due to absence of statistical significance post-hoc comparisons were not executed. The following two figures illustrate the mean total fixation duration and mean number of fixations per map type and for both cultures (Figure 30 & 31).

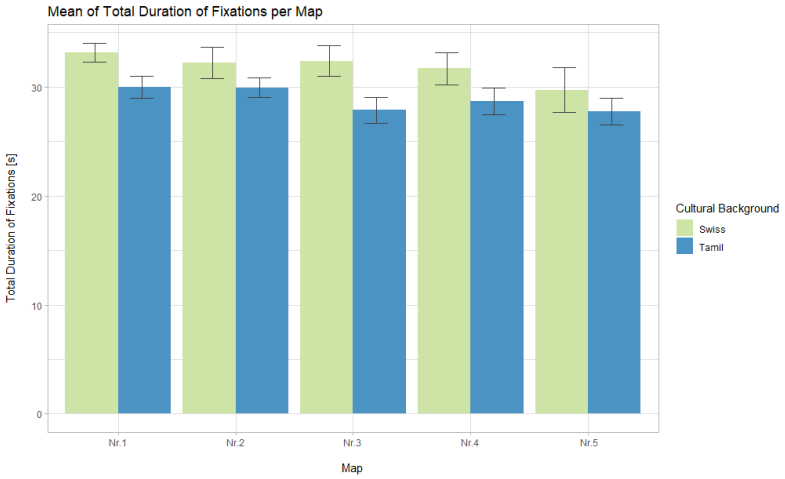

Figure 30: Average total fixation duration [s] per map type and cultural background. Error bars show one standard error plus or minus.

After investigating the eye-tracking metrics results over all maps and examining potential differences between different map types, in the next section, map 1, map 2 vs. 3, and map 4 vs. 5 will be presented in detail considering the fixation duration and number of fixations.

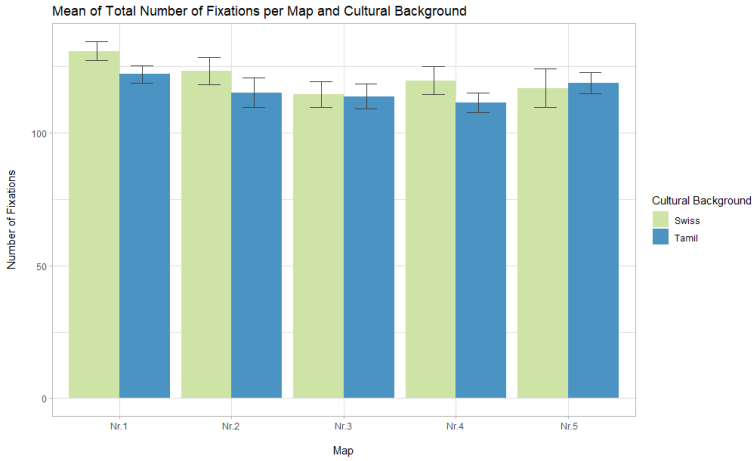

Figure 31: Average total number of fixations per map type and cultural background. Error bars show one standard error plus or minus.

4.2.2 Analysis of Map 1

In this subchapter, we focus on the results of the eye-tracking analysis of map nr.1. comparing the Swiss and Tamil participants' fixation duration and number of fixations. Thus, the investigation is about how participants from different cultural backgrounds explored and approached Map 1.

Table 6: The statistical findings show how the means of two eye-tracking metrics for each type of map were compared between the two cultures. The effect size r is included when the italicised entries indicate a significant mean difference between both groups.

Map type	Fixation Duration (s)	Number of Fixations
Nr. 1	*p-value = 0.004701 (r = -0.14)*	*p-value = 0.0001883 (r= -0.18)*
Nr. 2	*p-value = 0.002643 (r = -0.48)*	p-value = 0.2924
Nr. 3	Wilcoxon: *p-value = 0.0004194 (r = -0.56)* t-test : *p-value = 0.01727 (r= 0.38)*	p-value= 0.8948
Nr. 4	*p-value = 0.007404 (r= -0.42)*	p-value = 0.2061
Nr. 5	*p-value = 0.02633, (r= -0.11)*	p-value = 0.5073

For map 1, the mean fixation duration for the Swiss individuals was 33.15s (SD: 3.89), whereas for the Tamil individuals the mean fixation duration was 29.97 (SD: 4.42). The Swiss participants

exhibited slightly higher fixation durations (Figure 30). To test possible variations in fixation duration between the two cultural backgrounds, a Wilcoxon rank-sum test was used. As represented in Table 6, the results indicate significant differences with a low effect size. Moving to the number of fixations, the Tamil participants showed a lower number of fixations (mean: 122.20, SD: 14.72) than Swiss participants (mean: 130.95, SD: 16.3). Similar to fixation duration, a Wilcoxon signed-rank test was performed to assess potential differences in the number of fixations between the Swiss and Tamil individuals. The outcomes reveal significant variations in the number of fixations based on cultural background with a low effect size.

Furthermore, AOIs for attractions and signs, generalized as symbols, were defined to capture potential differences of the participants' attention based on cultural background not only on the whole map, but also on both symbol groups for a better understanding. Wilcoxon rank-sum tests were employed to assess cultural variations in the distribution of eye-tracking metrics for attractions and signs. As table 7 shows, the results suggest significant differences in both eye-tracking metrics of attractions AOIs and in number of fixations of signs AOI. This implies that for the AOIs of attractions in map 1 the Swiss participants have a statistically significant higher fixation duration than the Tamil participants with a small effect size. Meanwhile, the Tamil individuals have a significantly lower number of fixations for attractions than Swiss individuals also with a small effect size. The cultural variation of signs for fixation duration is statistically not significant, whereas the variation of signs for number of fixations is statistically significant with a low effect size. The means of both eye-tracking metrics for the AOIs of attractions and signs for both cultural backgrounds are listed in table 10 under Appendix O. The high standard deviations relative to the mean of eye-tracking metrics of attractions and signs imply that substantial variability in fixation durations within each group indicates individual differences among the participants.

Table 7: The statistical findings show how the means of two eye-tracking metrics for each symbol group AOI per map type were compared between the two cultures. The effect size r is included when the italicised entries indicate a significant mean difference between both groups.

Map type	AOI Symbols	Fixation Duration (s)	Number of Fixations
Nr. 1	Attractions	*p-value < 0.001 (r= -0.26)*	*p-value < 0.001 (r= -0.27)*
	Signs	p-value = 0.1598	*p-value = 0.04438 (r= -0.15)*
Nr. 2	*Attractions*	*p-value < 0.001 (r= -0.26)*	*p-value < 0.001 (r= 0.17)*
	Signs	*p-value < 0.001 (r= -0.25)*	*p-value < 0.001 (r=-0.24)*
Nr. 3	Attractions	*p-value < 0.001 (r= -0.37)*	*p-value < 0.001 (r=-0.37)*

	Signs	*p-value = 0.001374 (r= -0.22)*	*p-value = 0.007619 (r=-0.19)*
Nr. 4	*Attractions*	*p-value = 0.007404 (r= -0.42)*	*p-value = 0.2061 (r= 0.22)*
	Signs	*p-value < 0.001 (r = -0.27)*	*p-value < 0.001 (r = -0.25)*
Nr. 5	*Attractions*	*p-value = 0.009961(r= -0.18)*	*p-value = 0.04129 (r= -0.18)*
	Signs	*p-value < 0.001 (r= -0.31)*	*p-value < 0.001 (r=-0.29)*

Further analysis illustrates how many seconds participants from both cultural backgrounds have spent on each attraction and sign from map 1 for both eye-tracking metrics (Figure 32 & 33). In both plots, mostly Swiss participants spent most of the time and most fixations on the symbols.

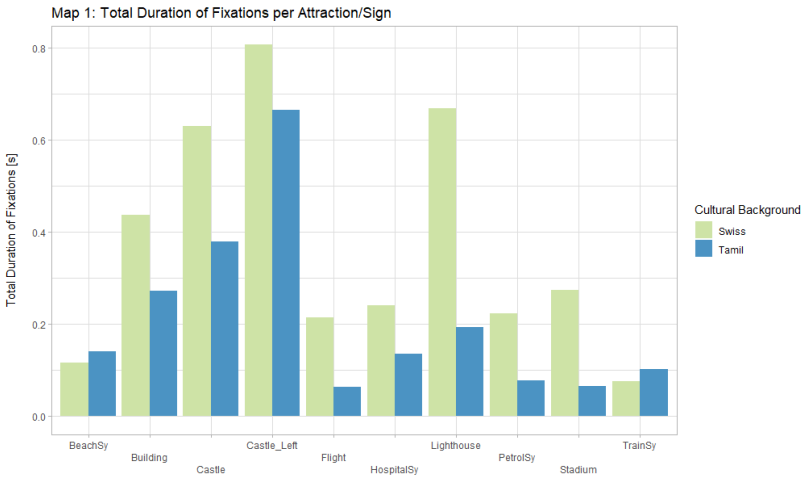

Figure 32: Mean total duration of fixations per symbol of map 1 based on cultural backgrounds. Symbol names which end with "Sy" are defined as signs. The others are attractions.

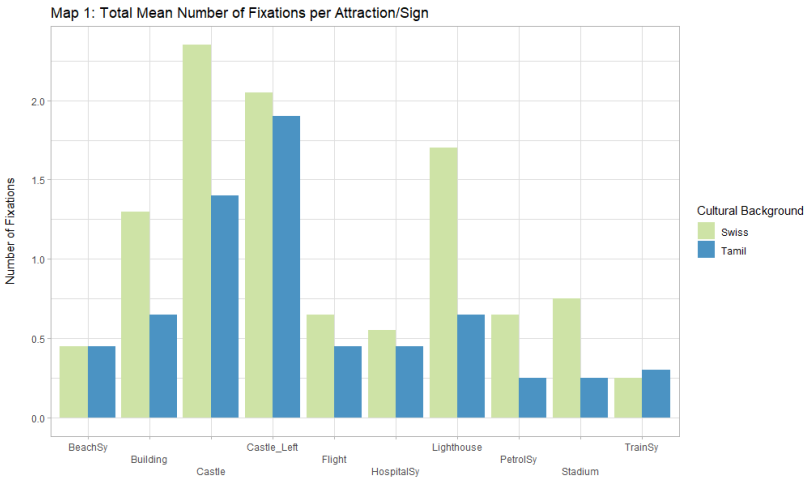

Figure 33: Mean total number of fixations per symbol of map 1 based on cultural backgrounds. Symbol names which end with "Sy" are defined as signs. The others are attractions.

The findings shed light on fixation duration, the number of fixations of map nr. 1 and its symbols, attractions, and signs, contributing to the research question of this study if there are potential differences between Swiss and Tamil participants, respectively if Swiss individuals are analytical thinkers and Tamil individuals' holistic ones. Overall, it appears that Swiss participants exhibited higher fixation duration and a higher number of fixations than the Tamil participants on map 1.

The heatmaps in Appendix P also show all of the findings derived from the plots and observations mentioned before. According to Tobii AB (2023g), these maps display the proportion of time spent on each area of the image, namely the five maps in this study. Based on their qualitative analysis, these maps demonstrate the fixations, which were mostly found in the map display (Tobii AB, 2023g). Furthermore, in figure 74, one can see that the viewing pattern of the Tamil participants is slightly different and more clustered than the pattern from the Swiss participants. However, it is clear that for both Swiss and Tamil individuals, the symbols, (especially the street labels and the attractions) gained a substantial level of interest.

4.2.3 Comparative Analysis: Eye Tracking Metrics for Maps 2 and 3

The following subchapter presents the results of the eye-tracking metrics analysis of map 2 and 3, which were compared to each other through ANOVA. In a first approach, focusing on map 2, the Tamil participants exhibited a lower fixation duration (mean: 29.91s, SD: 3.98s) than the Swiss participants (mean: 32.21s, SD: 6.46s). The Swiss participants (mean: 123.45, SD: 23.31) have a higher number of fixations than the Tamil participants (mean: 115.30, SD: 24.94). As table 6 illustrates, the mean difference in fixation duration is statistically significant, with a medium effect size, whereas the difference in the number of fixations is nonsignificant. If we look at the tables 7 and 10 (from Appendix O), the Swiss participants have a higher number and duration of fixations than the Tamil participants in both symbol groups, which are significant with low effect sizes and high standard deviations (Table 10) .

In map 3 also, the Tamil individuals significantly (mean: 27.86s, SD: 5.26s) exhibited lower duration of fixations than the Swiss individuals (mean: 32.38s, SD: 6.16s), while the participants with Swiss background (mean: 114.7, SD: 21.79) achieve a slightly higher number of fixations than participants with Tamil background (mean: 113.8, SD: 20.95), which indicates a nonsignificant difference (Table 6). Here the t-test and Wilcoxon rank-sum test were conducted, due to the reason that the data from Tamil participants were normally distributed, and data from Swiss participants not normally distributed. The results from both tests indicate a significant cultural variation with medium effect sizes (Table 7). Focusing on the symbols of map 3, the Tamil participants have a significantly lower duration and number of fixations than the

Swiss participants, where the effect sizes for both eye-tracking metrics for attractions are medium and for signs low. Again, the standard deviations are high for both eye-tracking metrics and both groups, which implies that there is a considerable dispersion in fixation duration and the number of fixations (Table 7).

To compare both maps, a 2 (map types) x 2 (cultural backgrounds) ANOVA was carried out to analyse the influence of the cultural background and map types on the total duration of fixations for maps 2 and 3. The F-value (1, 77) = 7.7570, p=0.0074 indicates that the cultural background has a substantial impact on the total duration of fixations for maps 2 and 3, where the effect size (eta-squared = 0.0889) has a large impact. The F-value (1, 77) = 0.579, p=0.4492, indicates nonsignificant mean differences across both map types. Tukey's post hoc comparisons were investigated and reassured the significant difference between the Swiss and Tamil individuals. Overall, the eta-squared values suggest that the cultural background of the participants plays an important role as to distinctions in the fixation duration over map nr.2 and map nr.3.

Another 2 (map types) x 2 (cultural backgrounds) ANOVA was carried out to investigate the impact of Swiss and Tamil cultural backgrounds, and map types on the total number of fixations for maps 2 and 3. Neither the F-Value (1, 77) = 0.793, p=0.376 for cultural background or the F-value (1, 77) = 1.017, p=0.316 for map types are statistically significant. Thus, the eta-squared values of cultural background (eta-squared = 0.0101) and map types (eta-squared = 0.0129) contribute a small effect to the total number of fixations. In general, the ANOVA suggests that neither map types nor cultural background significantly influence the number of fixations. Due to the nonsignificant differences, further analysis was not conducted.

The key results from comparing maps 2 and 3 demonstrate that the Swiss participants have a significantly higher fixation duration than the Tamil participants in both maps, whereas potential cultural variations in number of fixations were insignificant. Considering the ANOVA results of both eye-tracking metrics, significant cultural differences between the Swiss and Tamil cultural background were found regarding the total duration of fixations, whereas the results from the ANOVA of the number of fixations resulted in nonsignificant distinctions between both groups.

In figure 75 from Appendix P, the heatmaps from maps 2 and 3 show that the Swiss participants rather focused on the symbols, whereas the Tamil participants focused on the symbols and their surroundings.

4.2.4 Comparative Analysis: Eye Tracking Metrics for Maps 4 and 5

Maps 4 and 5 were subjected to separate analysis, followed by a comparison between both maps focusing on the eye-tracking metrics, fixation duration and the number of fixations, in the same manner as the previous three maps were analysed. As in the other three maps, the Swiss participants (mean: 31.68, SD: 6.6) have significantly higher fixation duration than the Tamil participants (mean: 28.67, SD: 5.49), in map 4. On the other hand, again the Tamil individuals (mean: 111.4, SD: 16.84) have a nonsignificant lower number of fixations than the Swiss participants (mean: 119.85 ,SD: 24.0). The p-values and the visualization of the means of each eye-tracking metrics are illustrated in table 6. As the results from all the other maps (Table 7 & Table 10), focusing on the symbols of map 4 show, the Tamil participants fixate on the attractions and signs for a much shorter period of time and with fewer fixations than the Swiss participants, both being statistically significant. For the duration of the fixations on the attractions, the effect size is medium; for the number of fixations on the attractions, it is low. Furthermore, the effect sizes for both eye-tracking measures are small. Again, there appears to be a considerable range in both the duration and the number of fixations, as indicated by the high standard deviation for both symbol groups and eye-tracking metrics.

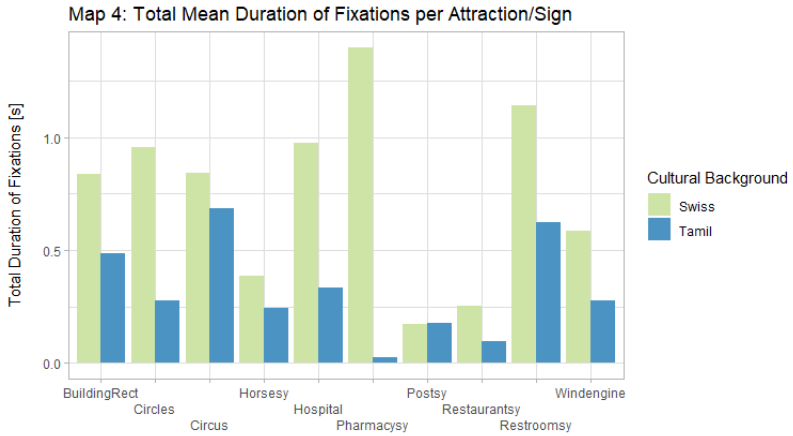

Figure 34: Mean total duration of fixations per symbol of map 4 based on the cultural backgrounds. Symbol names which end with "Sy" are defined as signs. The others are attractions.

Moreover, the total mean of both eye-tracking metrics for each map was visualised as an additional result, which does not directly address the research questions of this thesis (Figure 34). The plots of the other maps with the total mean duration and number of fixations per attraction/sign are listed in Appendix O, figures 66-73. It is interesting to see that the Tamil people have a mean overall fixation length of almost 0 seconds, whereas the Swiss people have a

substantially longer fixation period for the "pharmacy" sign from map 4 (see Figure 19). The same goes for the number of fixations for the "pharmacy" sign, as Figure 35 portrays.

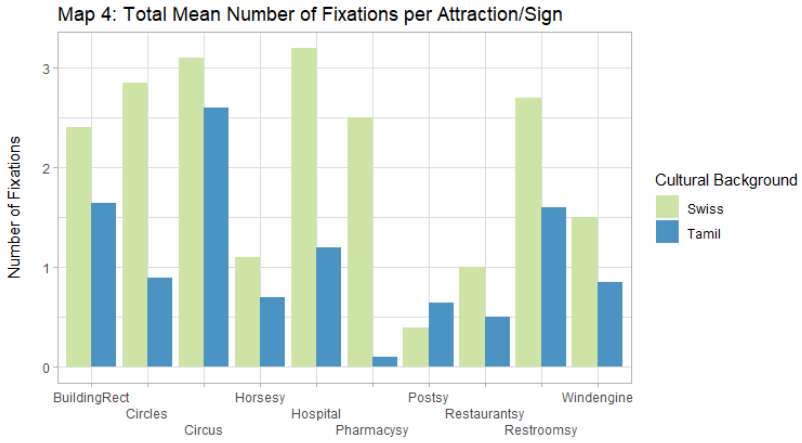

Figure 35: Mean total number of fixations per symbol of map 4 based on the cultural backgrounds. Symbol names which end with "Sy" are defined as signs. The others are attractions.

Only in map 5, the participants with Tamil background (mean: 118.90, SD: 17.73) have a slightly higher number of fixations than the participants with Swiss background (mean: 116.95, SD: 32.74), which resulted in a nonsignificant difference (Table 6). As in all other maps, also in map 5, the Tamil participants (mean: 27.74, SD: 5.49) have a significantly lower fixation duration than the Swiss individuals (mean: 29.7, SD: 9.25), where the effect size is moderate (Table 6). The individuals with Tamil background exhibit a considerably reduced duration and number of fixations compared to the people with Swiss background when focusing on the symbol groups, attractions, and signs (Table 10). Although the standard deviations are high, as for the symbol groups of other maps, the effect sizes are rather low for attractions and medium for signs with significant difference in both eye-tracking metrics (Table 7).

Again, ANOVA 2 (map types) x 2 (cultural backgrounds) for examining the influence of cultural background on fixation duration for maps 4 and 5 was conducted. The F-value (1, 77) = 2.644, p=0.108 with eta-squared= 0.0328 for cultural background and the F-value (1, 77) = 0.900, p=0.436 with eta-squared= 0.0112 for map types suggest nonsignificant effects on fixation duration with small proportion of variance explained. Furthermore, the interaction effect was, not statistically significant, which suggests that the influence of cultural background on fixation duration did not significantly differ across both map types 4 and 5.

The two-way ANOVA performed to examine the impact of the cultural background on the number of fixations for both maps 4 and 5 suggest that neither map types nor cultural background significantly influenced the number of fixations for map 4 and map 5 (Cultural

Background: F(1,77)= 0.376, p= 0.541, eta-squared=0.00485, Map types: F(1,77)= 0.189, p=0.665, eta-squared= 0.00243). The effect sizes for both cultural background and map types are very small.

Finally, the main findings from maps 4 and 5 show that, in both maps the participants from Switzerland had considerably longer fixation durations than the participants from Sri Lanka (Tamil), whereas possible cultural differences in the number of fixations were not statistically significant. When comparing the total fixation duration and the number of fixations, both ANOVA results revealed nonsignificant differences between the two groups. As in maps 2 and 3, the heatmaps from maps 4 and 5 (Figure 76) from Appendix P indicate that although Tamil participants concentrated on the symbols and their surroundings, the Swiss participants were more interested in the symbols themselves. Concluding, so far, the eye-tracking metrics across all the five maps were analysed. In the next chapter other important eye-tracking metrics, response time, accuracy, and frequency will be analysed regarding the tasks.

4.2.5 Response Analysis

In this subchapter, results from a comprehensive analysis of the responses from the participants of both cultural backgrounds are presented, paying particular attention to three key dimensions: frequency of yes/no answers, accuracy, and response time. The purpose of this analysis is to offer nuanced perspectives on how the Swiss and Tamil people approach the given tasks. By carefully examining their answers, the aim is to identify any patterns, variances, or cultural influences that might contribute to a deeper understanding of the cognitive functions required in map reading. The upcoming investigation will clarify whether cultural influences have a major impact on how participants make decisions, make accurate decisions, and react quickly to stimuli on the task.

However, as mentioned in chapter 3.3.3, the map cut-outs/stimuli from the 90 tasks were randomly prepared with 6 different conditions, only previously seen objects with original background (po), without background (pw), and with novel background (pn) were of importance for the results and the analysis. The novel objects with original background (no), without background (nw), and with novel background (nn) were only used for the overall results (see Table 2 for examples).

4.2.5.1 Yes and No Frequency

In the following, the frequency of "yes" and "no" answers provided by the participants from Swiss and Tamil cultural backgrounds will be inspected in response to 90 tasks featuring various

map cut-outs. Our focus, as beforementioned, narrows to three specific conditions, po, pw, and pn, with pn, being the crucial condition to analyse the hypothesis of this research (chapter 1.3 & 3.3.3).

Figure 36 portrays the mean frequency of each task condition (called taskinfo in the analysis) of previously seen objects per cultural background and for each "yes" or "no" answers. One can see that the difference between the Swiss and Tamil participants for each task condition is roughly the same. Focusing on the the pn task condition, slightly more Tamil individuals answered the map cut-outs with pn condition with "no", whereas the Swiss individuals answered the pn map cut-outs with "yes" mostly. In Figure 37, the frequency of yes/no answers of the pn condition is visualized more clearly. As already mentioned, in percentage about 65% of Swiss participants answered with "yes" to pn map cut-outs and the other 35% with "no". About 37% of Tamil participants answered with no, meanwhile 63% saw the previously seen object with novel background.

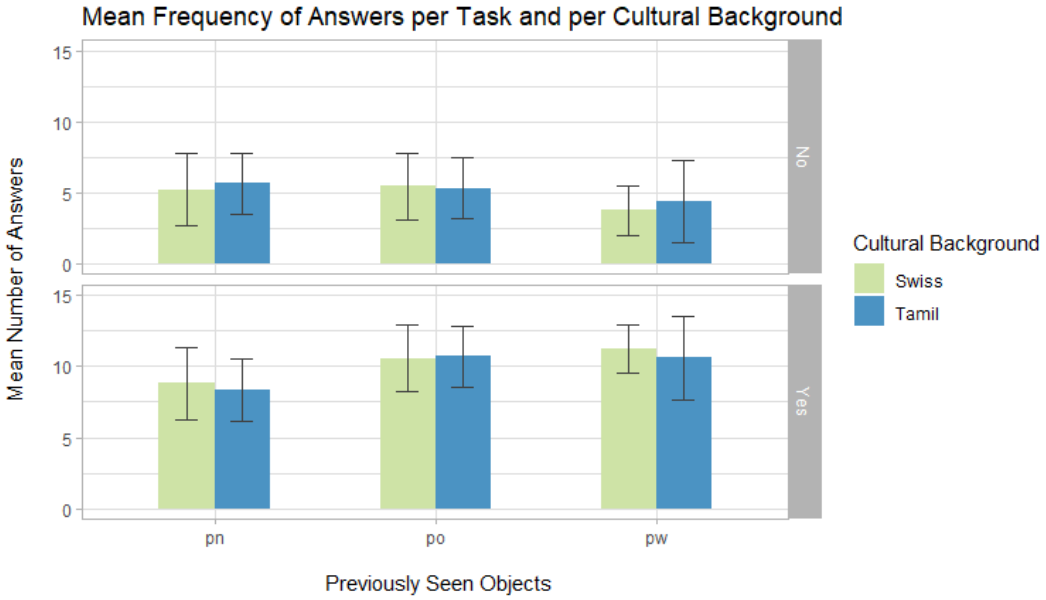

Figure 36: Mean frequency of answers per task condition based on the cultural backgrounds and divided into "yes" and "no" answers. Error bars indicate +/- standard deviation of each task condition and each answer.

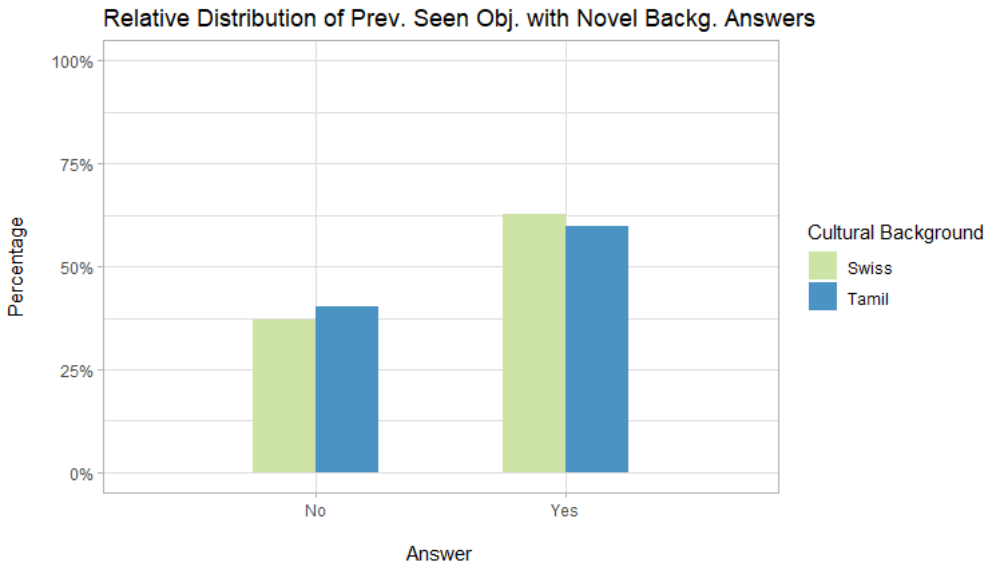

Figure 37: Relative Distribution of mean frequency of answers for task condition pn based on cultural backgrounds and divided into "yes" and "no" answers.

Figure 38 shows that the frequency of "yes" and "no" answers for the Tamil participants varies more than for the Swiss participants specifically in tasks with pn condition. On the contrary, po conditioned tasks exhibited more variability in the frequency of yes/no answers for the Swiss individuals. The frequency for both answers did not vary considerably between both cultural backgrounds in pw conditioned tasks. To analyse the influence of the cultural background and the task conditions on the frequency of "yes" responses across the 90 tasks from all maps, a 3 (task conditions) X 2 (cultural backgrounds) ANOVA was conducted. We performed a mixed-design NOVA because the study as a whole uses a mixed-design model. The task conditions po, pw, and pn are within-group variables, and the cultural background is the between group variable. These task conditions are the focus of our analysis, in particular the pn condition. The F-value (1,116) =0.560, p=0.4557 for the cultural background indicates a nonsignificant impact on the "yes" response frequency with a small effect size (eta-squared= 0.0045).

Whereas the F-value is (1,116)= 4.364, p=0.0149 suggests a significant influence of task conditions on the frequency of "yes" responses with a moderate effect size, indicating a notable influence on response frequency (eta-squared= 0.0697). Due to significant influences, Tukey's multiple comparisons were conducted for both variables. Since cultural background already has a nonsignificant difference, post-hoc tests from the task condition were of relevance. All the participants had a significantly lower frequency of "yes" answers in pw condition than pn (p=0.0278) and lower frequency in pw compared to po condition (p=0.0357). While the

homogeneity of variances could be assumed through Levene's test, an abnormal distribution was detected. But, according to Field and his colleagues (2012) the ANOVA is robust to not normally distributed data. To conclude, cultural background does not significantly influence "yes" responses frequency, while specific task conditions do.

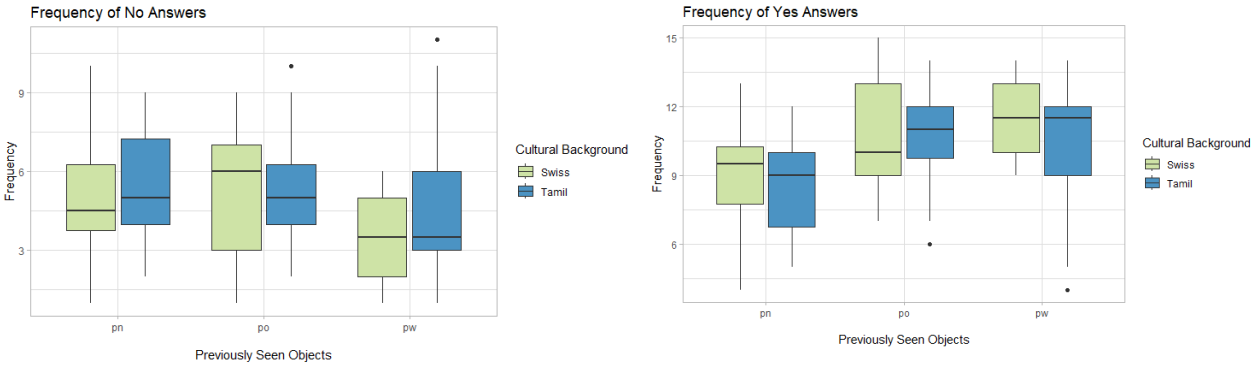

Figure 38: Box plots of frequency of "yes" and "no" answers for each task condition per cultural background. The box illustrates the 25th and the 75th percentile, the line inside the box is the median, and the whiskers specify the range, which is often 1.5 times the interquartile range (RStudio Team, 2023).

The same ANOVA as for the frequency of "yes" answers was conducted for the frequency of "no" responses. The results are the same as for the frequency of yes responses. The F-value (1, 116)= 0.560, p=0.4557 is not significant for cultural background, while the F-value (1, 116)= 4.364, p= 0.0149 is significant for the three task conditions. The post hoc tests from Tukey's multiple comparisons revealed significant differences between pw-pn, and pw-po. This demonstrates a significantly lower frequency of "no" responses in pw condition compared to pn (p=0.0278) and po (p=0.0357). The effect size for the cultural background (eta-squared= 0.0045) is small, and moderate for the task condition (eta-squared= 0.0697) as from the ANOVA results from the frequency of "yes" answers.

The main findings show that the specific map cut-outs with a particular task condition (po, pw, pn) influence the frequency of "yes" or "no" answers, but cultural background does not significantly influence the frequency of "yes" or "no" answers. Next, the results from the accuracy of "yes" answers will be presented.

4.2.5.2 Accuracy

The accuracy was estimated with the frequency of "yes" answers. From the total of 90 tasks encompassed, 16 po, 15 pw, and 14 pn conditioned tasks were included. The accuracy was

calculated by the frequency of "yes" responses divided by the total number of each task condition answered by each participant. As table 8 and figure 39 present, the Swiss participants have a higher accuracy in pw and pn answers, whereas Tamil participants have a higher accuracy in answers of the task condition po. The task condition pn suggests lower accuracy for the Tamil participants, which concludes that Swiss participants responded with "yes" to pn tasks. This would imply that the hypothesis about the participants with Swiss background have analytical thinking and the participants with Tamil background holistic thinking. Comparing the accuracy of the Swiss participants over the three task conditions, the Swiss individuals have a higher accuracy rate in the pw condition and a lower accuracy rate in the pn condition. Exactly the same can be applied to the Tamil participants with different accuracy rates than the participants with Swiss cultural background.

Table 8: Mean accuracy of "yes" answers per cultural background and based on the task condition. Accuracy was calculated for each participant based on the frequency of "yes" answers. It is rounded up to 1 decimal place.

Task Condition	**Cultural Background**	**Mean Accuracy**
No background (PW)	Swiss	74.4%
	Tamil	70.7%
With original background (PO)	Swiss	66.0%
	Tamil	66.9%
With novel background (PN)	Swiss	62.9%
	Tamil	59.6%

The accuracy of responses was investigated through a 2 (cultures) x 3 (task conditions) ANOVA. The ANOVA results provide insights into how both factors contribute to variations across different task conditions. The cultural background factor has a nonsignificant difference, $F(1,114) = 0.485$, $p=0.486$, eta-squared= 0.0039, with a very small effect size. A statistically significant effect of task condition could be found, F-value$(2,114) = 5.182$, $p= 0.007$, indicating a moderate effect size (eta-squared= 0.0827). The interaction effect of the cultural background and task condition is not significant, $F(2,114)= 0.265$, $p=0.768$ with a low effect size (eta-squared= 0.0042). Tukey's post hoc tests were performed solely for the task condition variable, and the results showed a significant difference ($p=0.00478$) between the task conditions pw and po. The results from two-way ANOVA suggest that the task condition significantly influences accuracy, with a moderate effect size. This implies that with 72.5% accuracy (SD: 15.8%) previously seen objects without background (pw) are significantly more accurate than previously seen objects with original background (po) (mean accuracy: 66.4%, SD: 13.8%).

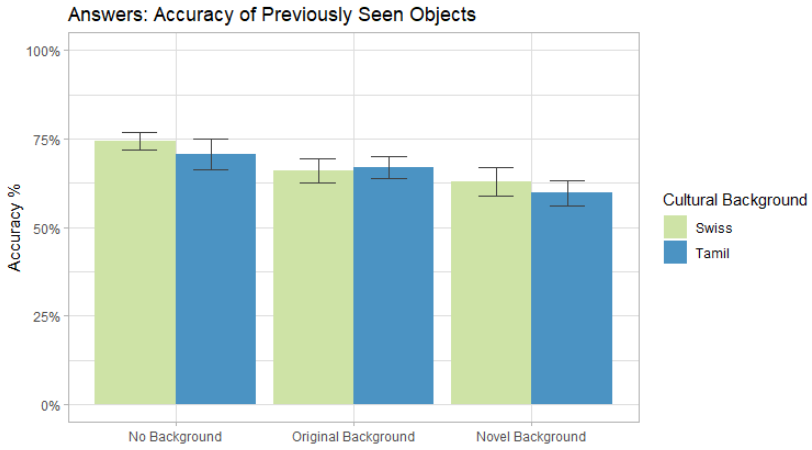

Figure 39: Accuracy of previously seen objects. Error bars indicate +/- 1 standard error of each task condition and for each cultural background.

4.2.5.3 Response Time

Overall, it took the participants 2.23s (SD: 1.29s) to respond if they had seen the map stimuli/cutout or not considering all the six task conditions. The Tamil participants needed significantly more time than the Swiss participants to respond (Table 9). Focusing on the pn task condition, the Tamil individuals spent more time to decide than the Swiss individuals. Considering the "yes" answers of the pn condition only, it took the Swiss participants slightly longer to click the "yes" answer, while it took the Tamil participants more time to answer the pn conditioned task with "no" than the participants with Swiss cultural background.

Table 9: Mean response time for yes/no questions based on the cultural background. We rounded the response time to two decimal places. The inclusion of the effect size r indicates that the mean difference between the Tamil and Swiss cultures was significant, as indicated by the italicised entries.

Mean Response Time [s]	**Swiss**		**Tamil**		**P-Value**
	Mean	**SD**	**Mean**	**SD**	
Overall (all 6 task conditions)	2.20	1.72	2.26	2.23	*p-value=0.02015 (r= -0.39)*
PO Condition (yes)	2.24	1.78	2.23	1.89	p-value= 0.2833
PW Condition (yes)	1.61	0.88	1.64	1.34	p-value= 0.4713
PN Condition (all)	2.34	1.95	2.65	3.07	p-value= 0.717
PN Condition (yes)	2.09	1.82	2.04	2.46	p-value= 0.1487
PN Condition (no)	2.77	2.08	3.56	3.63	p-value= 0.3328

The higher response time of Tamil participants compared to the Swiss participants regarding the "no" answers from previously seen objects with novel background (pn) indicate that the individuals with Sri Lankan (Tamil) background were affected by the manipulation (Masuda &

Nisbett, 2001). Whereas the higher response time of the Swiss participants compared to other task conditions also suggests an effect of manipulation. However, the Wilcoxon signed-rank test showed that none of the three conditions indicate a significant difference between both cultural backgrounds. Besides, the standard deviations are rather high, which has to be considered. The response time in these tasks defines the time from reading the questions to clicking on one of the yes or no AOIs. Even though response time is a useful measure for studying cognitive processes, if it isn't randomised properly or with time the learning effect, may cause for less reliability (Hockley, 1984). Thus, response time was only analysed vaguely.

4.2.6 Results of the Evaluation Task

The participants were asked to rate the map design and what they initially noticed about the first map only in the first half of the evaluation questionnaire (see Figure 16). Questions concerning maps in general were posed in the second part, although disparities in approaches between the two cultures can be examined, it is crucial to emphasise that no significant distinctions resulting from the cultural background are visible. On a scale of 1 to 5, the majority of the Swiss participants (n = 20) rated the first map design's attractiveness as 3- average (35% of all the Swiss participants) and 4 – attractive (35% of all the Swiss participants). The first map, however, was rated as 2–unattractive by the majority of the Tamil participants (25% of all Tamil participants) and 3–average attractive by 40% of all the Tamil participants. When the Wilcoxon rank-sum test was used to compare both cultural backgrounds, the findings showed that there was an insignificant difference ($p=0.1713$). Figure 62 in Appendix O shows how the first map's attractiveness varies by cultural background. Furthermore, the majority of the the Swiss participants noticed the waterbodies and the symbols on the map first (symbols: 50%, waterbodies: 40% of all the Swiss participants). Besides 45% and 35% of all the Tamil participants noticed the symbols and waterbodies initially.

All of the participants agreed that the symbols (10% in Tamil and 20% in Swiss) and map colours (20% in each of the two groups) were the best choices overall. Conversely, the Tamil participants (totalling 80% of all the Tamil participants) felt that the map's unclearness, colour choices, and symbols were the least appealing aspects, and the majority of the Swiss participants (40 % of all the Swiss participants) disliked the map's language.

In general, it is essential to determine the participants' level of familiarity with tourist maps because this information affects how they approach problems and assess the maps. The examination of the question about the participants' familiarity with tourist maps reveals that the

majority of the Swiss participants are unfamiliar, while the Tamil participants' familiarity ranges from unfamiliar to familiar (refer to Figure 40). The plot thus demonstrates that both groups, who are well-versed in tourist maps, are clearly in the minority. Furthermore, while a greater number of the Swiss participants had no familiarity with tourist maps, a greater number of Tamil participants did. However, a significant difference between both groups regarding the familiarity of maps could not be found (p=0.3824).

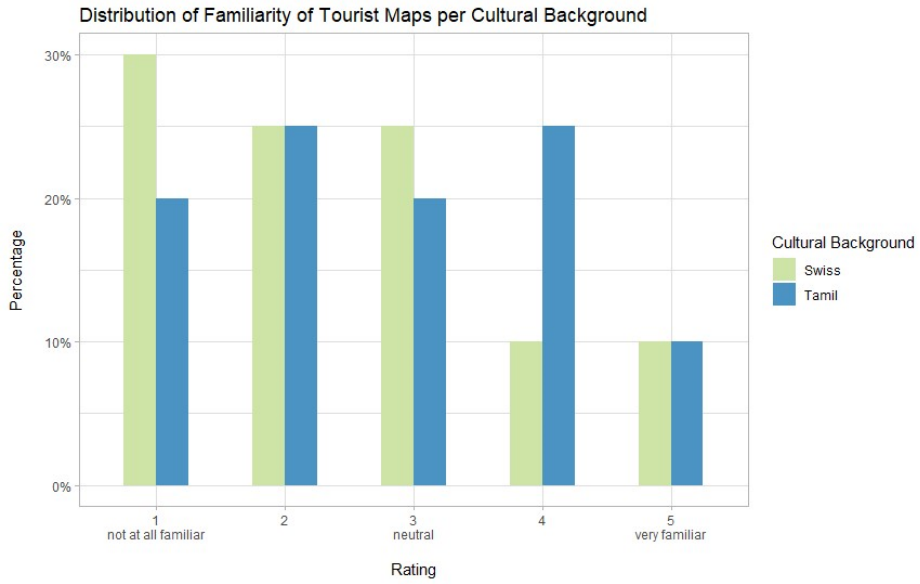

Figure 40: Relative Distribution of familiarity with tourist maps per cultural background. Each cultural background distribution is calculated individually (Swiss: 100%, Tamil: 100%)

Apart from knowing how to use tourist maps, most Tamil participants said they were very unlikely to use them or not at all (40% and 30% of all Tamil participants, respectively), while 20% of the Swiss participants (Tamil participants: 5% most likely) said they would most likely use them in the future. It is also highly unlikely that the majority of the Swiss participants will ever use tourist maps (see Appendix O Figure 63). With the Wilcoxon rank-sum test (p= 0.1801), a nonsignificant difference was found. Finally, participants were asked to select their favourite and least favourite map (without the example map) out of all the maps that were shown during the main experiment. Out of all the maps, 35% of the Swiss participants preferred the fourth map and 30% the first map, while 30% of the Tamil participants preferred the second and fourth maps (see Figure 17 and 19 show which maps are meant). The fifth map (see Figure 20) is the one that both groups (Tamil: 60% of all the participants, Swiss: 80% of all the participants) dislike most. Matching all the other statistical results an insignificance resulted with the Fisher-

test (p=0.2986) for the favourite map and also a non-significance of p=0.4834 for the most disliked map.

In summary, the main experiment, utilizing eye-tracking technology, demonstrated eye movement patterns in cognitive processing by the Swiss and Tamil individuals. Notable findings include the Swiss participants exhibiting longer duration of fixations and an even higher number of fixations than the Tamil participants. Cultural influences were evident in the attention to AOIs of symbols for the eye-tracking metric fixation duration, too. Analyses of yes/no answers based on the task conditions resulted in an insignificant cultural influence, whereas the task conditions exhibited a significant influence. The evaluation results rejected the cultural variations of the Swiss and Tamil group on cognitive abilities. These findings collectively contribute to a nuanced understanding of cultural influence on cognitive processes in map navigation and interpretation.

4.3 Spatial Ability of Swiss & Tamil participants

In the Paper Folding test, around 68% of all the participants had average scores (Figure 41). The overall mean score of all the participants was 10.35 scores (SD: 3.6) with a majority having a score around 12.

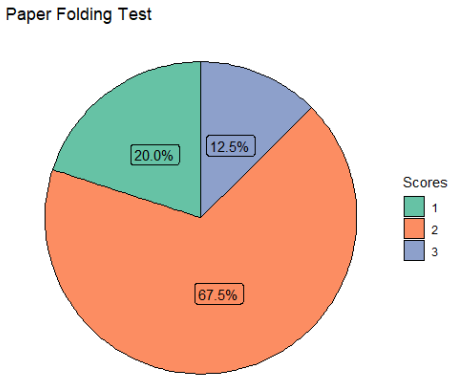

Figure 41: Pie chart of paper folding test of the score for all the participants

Dividing the participants into their respective groups, Swiss or Tamil, the mean score for the Tamil people is 9.75 (SD: 3.8) and for the Swiss people 10.95 (SD: 3.3). The Swiss and Tamil groups did not significantly differ from one another, despite the Swiss group's slightly higher mean (t = -1.0625, p = 0.2947), according to the t-test. The findings illustrate an insignificant disparity between the Swiss and Tamil individuals regarding the scores of the Paper Folding test. As the boxplot in figure 42 shows, the variability of both groups is more or less the same. But the median score of the Tamil participants is lower than the median score of the Swiss participants, which aligns with the mean score.

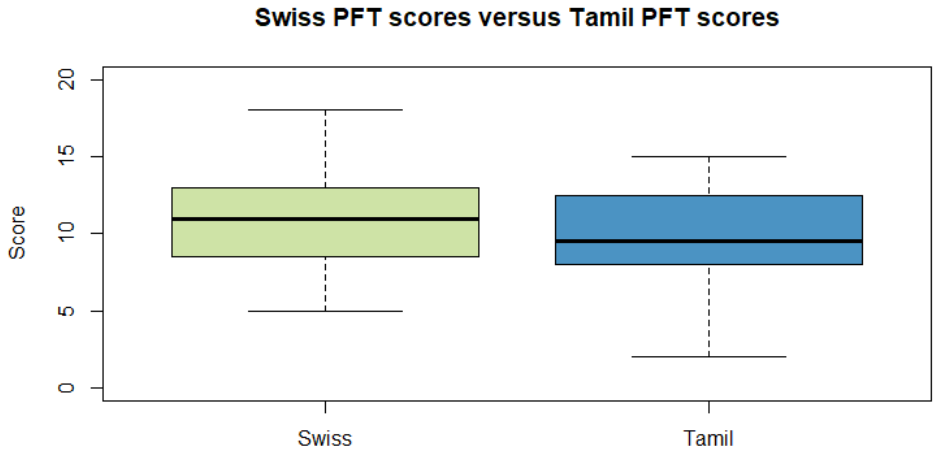

Figure 42: Box plot of paper folding test score between the Tamil and Swiss participants. The box illustrates the 25th and the 75th percentile, the line inside the box is the median, and the whiskers specify the range, which is often 1.5 times the interquartile range (RStudio Team, 2023).

4.4 Overview of the sample

As mentioned above, 40 participants, 20 with a Swiss and 20 with a Tamil background, took part in this study. The questionnaire is cited in the appendix.

Gender: Overall, the gender distribution in this study is equal for both groups with 20 female, 20 male and 0 other participants. Eight men and twelve women make up the gender structure of the Group Swiss while the participants of the Tamil group were divided into twelve men and eight women. As a result, 50% (Tamil: 20%, Swiss: 20%) are women and 50% (Swiss: 30%, Tamil: 20%) are men. Men predominate in the Tamil group while women do in the Swiss group.

Age: The participants' average age was 25.3 years (SD: 3.07). The Swiss group portrays almost the same mean age of 25.4 years (SD: 3.41) as the Tamil group with the mean age of 25.2 years (SD: 2.75). The age range of the Swiss group is 21 to 33 years and 18 to 29 years of Tamil group.

Educational level: Around 60% and 45% had an educational level of finishing an apprenticeship in the Swiss and the Tamil group respectively. 20% of the Swiss and 35% of the Tamil participants completed the vocational baccalaureate, whereas the highest completed education for 15% Swiss and 15% Tamil participants was the professional education (HF). As expected, none of the participants completed a tertiary education at a university or a professional educational institution, due to the reason that only participants without a tertiary education were invited for the study. Both groups indicate a similar pattern regarding the proportions of the education levels.

Profession: According to assumptions of different studies, people who often deal with figures in their job, work independently, and make decisions on their own tend to be analytic thinkers (Nisbett & Miyamoto, 2005; Nisbett et al., 2001). Whereas people who have contact with other people in their profession, work with their colleagues and make decisions together with them, are mostly holistic thinkers. Therefore, including a Likert scale range from 1 - 5 (never to always), the participants responded to four questions about the tasks they perform on a daily basis as part of their profession. The following figure 43 presents the relative distributions of the responses to the four questions. While the Swiss participants encounter people more often than Tamil participants, the latter are more frequently required to engage with their coworkers, work with figures, and make independent strategic decisions.

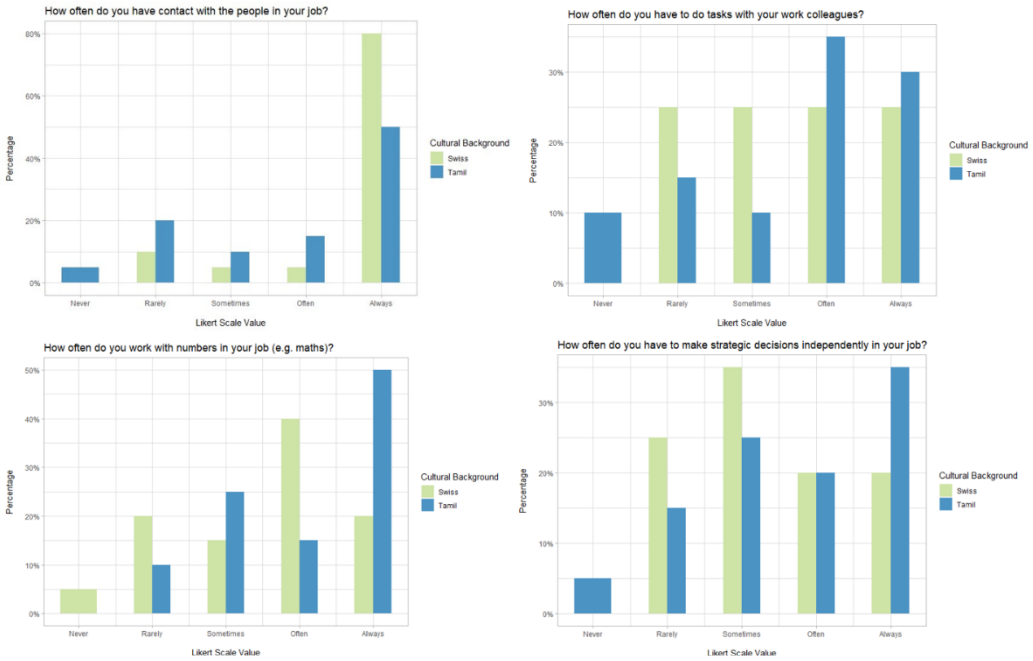

Figure 43: Relative distributions of questions related to profession per cultural background

Birthplace of the participants and the parents: The participants were all born in Switzerland and have lived there for most of their lives. Each participant's mother and father were both born in Sri Lanka or Switzerland, respectively. Consequently, 20 participants have Swiss-born parents, and 20 participants have Sri Lanka-born parents. As a result of this, we are able to distinguish between the Tamil and Swiss participants.

Bilingualism: All the Tamil participants were raised bilingually. 16 participants from the Swiss group were raised with only one language and 4 participants were also raised bilingually. Hence, 60% of all the participants (Tamil: 50% & Swiss: 10%) were raised bilingually, whereas 40% (Swiss participants only) were raised monolingually.

Map use: In terms of how often participants use maps, in a Likert scale from 1 to 5 (never to always) the mean answer for Swiss participants lies between "sometimes" and "often", whereas for Tamil participants the mean lies between "often" and "always". Participants from both groups use maps often (Swiss: 30%, Tamil: 27.5%), Tamil participants use maps slightly more than the Swiss participants as the mean answers show. However, the difference is not significant (w=157.5, p=0.1974), according to the Wilcoxon rank-sum test.

Cultural festivities: A person's thought process and approach to problems are influenced by how traditionally they are or were raised. As a result, the first question about traditions inquired

how frequently each participant celebrates the festivities of their own culture. The mean responses for the Tamil and Swiss groups are "sometimes" and "rarely", considering the range from 1 to 5 from the Likert scale. The relative distribution of cultural celebrations in figure 44 shows that the majority of Tamil participants celebrate their celebrations rarely or often, while the Swiss respondents' responses ranged from "never" to "often". The Wilcoxon rank-sum test revealed an insignificant variation between the answers from the Swiss and Tamil participants (w= 220.5, p=0.5599).

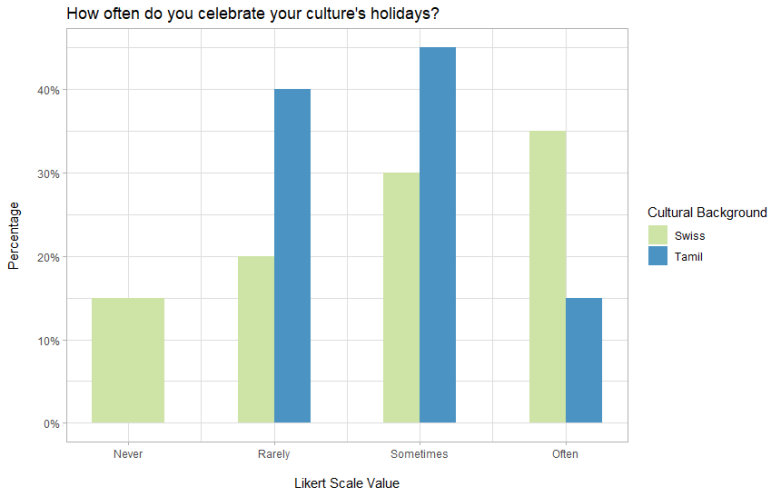

Figure 44: Relative distribution of celebrating cultural festivities answers per cultural background

Traditional stories: Human cultures include storytelling as a way for individuals to share history or attempt to understand one another through stories (Hancox, 2011). Such narratives affect how one perceives events and experiences, which in turn affects how one reacts to challenges (Hancox, 2011). Hence, the participants in this study were asked what kinds of stories they would tell their children. The options available to the participants were a story recounted by their parents, a well-known story with which most people are familiar, or invented by oneself tale. 20% of Tamil participants (27.5% of all the participants) would probably narrate an invented story, while only 7.5% Swiss participants would prefer to narrate a story invented by themselves. The majority of the Swiss participants (22.5%) chose to narrate a story told by their parents, whereas 17.5% of the Tamil participants would narrate a story recounted by their parents. Lastly, only 12.5% of the Tamil and 20% of the Swiss participants would tell a well-known story to their children. A Chi-square test was conducted to see if a statistically significant relationship between the Swiss or Tamil participants and their choice of one of the three stories is present. Because the Chi-square test was selected, all of the expected frequencies are higher

than 5. The test results (x-squared = 3.215, p = 0.2004) indicated that there is no statistically significant interconnection between the three stories and the cultural background.

Personal evaluation of being traditional: The final tradition-related question assessed each participant's perception of their own level of traditional values. The mean for participants from Switzerland is between "rarely" and "sometimes" on a Likert scale of 1 to 5, while the mean for participants with a Tamil background is between "sometimes" and "often" (Mean: 3.4, SD: 0.75). In comparison to the Swiss participants, the Tamil participants believe they are more traditional, according to the relative distribution of their responses to this question (Figure 45). The Wilcoxon rank-sum test shows a significant difference between both groups (w=64.5, p=0.0001036). Due to the statistical significance, one can say that the Tamil participants saw themselves as more traditional than the Swiss participants.

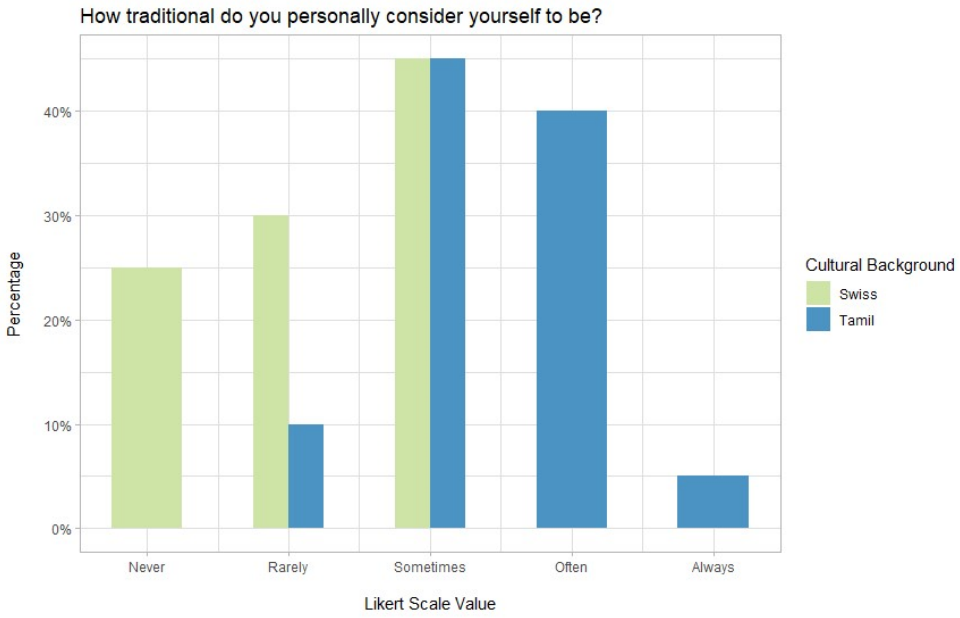

Figure 45: Relative distribution of participant responses to questions about how traditional they see themselves

5 Discussion

5.1 General Discussion

This section summarises and discusses the findings of this thesis and its research and offers insights into the complex interactions between cultural factors and cognitive processes in map reading and understanding among the Swiss and Tamil participants living in Switzerland.
The preliminary test was designed to measure the individuals' cognitive styles across cultures and included Navon, Stroop, and holistic-analytic quiz items. The results showed insignificant differences between the Tamil and Swiss participants, which was contrary to our expectations. This implies that, at a preliminary level, people from these cultural backgrounds responded to general holistic-analytic questions with similar cognitive tendencies.

The main component of this thesis was an eye-tracking experiment in which the subjects interacted with five different maps, each of which had 18 tasks. Eye tracking relies on the fundamental assumption that people process the image they are currently looking at (Padilla et al., 2018).

Overall, the findings showed that the fixation durations of the Tamil and Swiss participants differed significantly. While the Tamil subjects did not demonstrate a significantly higher number of fixations, contradicting the expectation of a holistic cognitive style, the Swiss respondents demonstrated analytical thinking, as evidenced by longer fixation durations. The participants with Swiss background showed a significantly higher number of fixations than the Tamil respondents. Deeper understanding of the participants' cognitive strategies was obtained from the evaluation task from the eye-tracking experiment that mainly concentrated on the first map. It supported the eye-tracking findings and validated the insignificant difference between the Swiss and Tamil participants. The detailed examination of their cognitive processes during map interpretation provided the more general results. All the maps' designs ensured an important context and a feedback. The paper folding test, which determines spatial ability, did not find any statistically significant variations between the Tamil and Swiss participants. This shows that, in the specific context of map reading and its manipulation of the map cut-outs, the participants' cultural background did not significantly affect their performance. The background information questionnaire helped with both the interpretation of the experiment's findings and the understanding of the participants' cultural context. Summarizing the key findings, this study reveals a complex picture of how cultural background and mental processes interact while reading maps. The beforementioned findings will be discussed in detail in the following subchapters.

5.2 Cultural Influence on Map Reading

Comprehending the impact of culture on cognitive processes is crucial for understanding the psychology and behaviour of people. The term "culture" is a complex concept, which can be interpreted from different perspectives in different ways. One of the famous researchers who interpreted culture in different aspects is Geert Hofstede (Hofstede, 1980, 1991, 2001; Hofstede et al., 2010). Hofstede refers to culture as a mental programming that sets one group of people apart from another (1991). Beliefs, traditions, customs, norms, values are all incorporated into this programming to influence how people perceive and engage with the surroundings (Cohen, 2009). One of the fundamental theories for understanding cultural differences is the cultural dimensions theory from Hofstede (1991; Matsumoto & Juang, 2013). These dimensions shed light on how cultural preferences for social relationships, gender roles and more vary. One well-known dimension of many he identified is "Individualism versus Collectivism" (Matsumoto & Juang, 2013; see Figure 3). Groups which are represented by the dimension of individualism are common in Western cultures, such as Europe. Here, personal goals, freedom and individual achievements have priority. Whereas collectivistic cultures, such as Asian cultures, emphasize group harmony, and cooperation within the group. In such groups, family and the community are prioritised over personal goals. The individualism-collectivism dimension influences many aspects of life, such as decision-making processes and relationship attitudes (Matsumoto & Juang, 2013). Thus, understanding such cultural differences is of great importance for many researchers and even for a better understanding of cross-cultural interactions.

Early pioneers like Lev Vygotsky, who advanced our knowledge of how culture influences cognitive development, are credited with starting the study of the relationship between culture and cognition (Luria, 1931). Since then, many researchers like Nisbett, Berry, and Triandis have contributed to the study of cultural psychology, which became more popular in the 20th century (Ember & Ember, 2009; Nisbett, 2001; Triandis, 1995; Berry, 1992). Thereby, the study of how cultural influences affect human behaviour in terms of perception, problem-solving, decision-making, memory and more gave rise to the field of cross-cultural research (Ember & Ember, 2009). A wide range of approaches was used in modern cross-cultural research, such as experiment examinations or cross-cultural comparisons. New technological advancements contribute to the understanding of cultural influences on cognition (Oishi & Graham, 2010).

The main topic of this study is the importance of cultural influence on cognitive processes, especially in the area of map reading. In the context of cartography and map perception, cultural influences shape individuals' cognitive styles, how they read, navigate, interpret, and perceive

spatial information. Cognitive processes are deeply ingrained in a person's cultural background, that is why they are not universal (Cosgrove, 2008). Analysing literature regarding the topic of the connection between culture and cognition, in the context of cartography and other fields, highlights the significance of cultural variations when figuring out how people interact with cartographic outputs and other information. People from different cultural backgrounds view maps through different lenses, which not only affects their cognitive styles but also how they interpret spatial information. Understanding the effects of how culture facilitates creating maps that accommodate different cognitive styles improves efficiency, understandability, and accessibility across cultural barriers. In addition, recognising the significance of cultural disparities is crucial for education and communication. In particular, for this thesis, how tourist from different backgrounds, perceive and interact with maps is influenced by cultural effects on cognitive functions. Comprehending these cultural effects is essential to produce maps that appeal on a global level.

Studies on cross-cultural psychology, like the one by Masuda & Nisbett (2001), have drawn attention to differences in cognitive styles between East Asian and Western cultures. There is only a small amount of literature examining the complex connection between culture and spatial cognition, which are mostly based on the analytic-holistic thinking theory by Nisbett (2001). Such studies found cross-cultural differences between Western and East Asian cultures but were mostly unable to statistically prove those findings (Tian et al., 2022; Lacko et al., 2020; Stachon et al., 2018). It must also be considered that mostly university students took part in those studies, which creates a research gap and raises the question if different cognitive patterns regarding cartographic outputs would have resulted in different findings. Apart from that mostly Chinese or Japanese students were selected from East Asian cultures and American students from Western cultures (Masuda & Nisbett, 2001; Tial et al., 2022; Lacko et al., 2020).

The assumption that cultural background has a major impact on cognitive styles during map reading forms the theoretical basis of this study, which is supported by many researchers from different fields (Nisbett & Miyamoto, 2005; Oishi & Graham, 2010; Nisbett, 2003; Nisbett et al., 2001; Oyserman, 2011; Jacob, 1996). A person's cultural background includes both their nationality and the larger cultural context that shaped their worldview (Oishi & Graham, 2010). In this study, we have anticipated that people's methods for reading spatial information and navigating maps will reflect their holistic and analytical thinking. Different research studies already investigated the holistic and analytical cognitive styles between Western and Asian cultures but were not always successful in finding a significant difference or significantly

different cognitive patterns between various cultural backgrounds in the context of cartography (Stachon et al., 2018; Lacko et al., 2020; Tial et al., 2020).

The theoretical framework of this study acknowledges the cultural dimension as the crucial factor of map reading among many other important factors. Traditional theories of map reading frequently concentrate on mental functions like visual perception and spatial reasoning (Cosgrove, 2008; Jacob, 1996). Through the incorporation of cultural influences into such frameworks, the understanding of the possibilities in which people from various cultural backgrounds interact and read cartographic outputs is expanded. By considering the most frequent theory on analytic-holistic thinking for our study, an investigation of cultural variations in a larger framework of map reading is enabled and broadens the research of the cultural influence on cognitive processes in the context of cartography.

The literature review of topics about culture and cognition reveals that a person's identity and cultural background affect their cognitive abilities. Numerous studies demonstrate that people with diverse cultural backgrounds display unique cognitive patterns that influence how they interpret and process information (Vygotsky, 1978; Dasen & Heron, 1981; Witkin & Berry, 1975; Ember & Ember, 2009; Chua, Boland & Nisbett, 2005; Oishi & Graham, 2010; Kuwabara & Smith, 2012; Berry, 1992). Although the impact of culture on cognitive patterns is a well-known study field in recent times, the particular context of cartography generates complex results, with only a small number of publications pointing to significant variations (Tian et al., 2022; Stachon et al., 2018; Lacko et al., 2020). Notably, the source stated the cultural influence on map reading, but did not consistently report significant differences in cognitive patterns related to cartography.

5.3 Holistic vs. Analytical Thinking: Analysis of Hypotheses

5.3.1 Fixation Duration

When comparing the Swiss and Tamil participants, fixation duration became apparent as a critical variable in understanding the cognitive processes underlying map reading. The Swiss participants exhibited longer fixation durations over all five maps than the Tamil participants. As mentioned in the chapter of results, even comparing the symbol groups of attractions and signs separately for each map resulted in significantly higher duration of fixations. Only for the symbol group of signs in map 1, the Swiss participants have an insignificantly higher fixation duration than the Tamil participants, which shows that the findings depend on which map type was presented. Through the findings of the 5x2 ANOVA over all five maps, and the 2x2 ANOVA of the

comparison of maps 2 and 3 for the eye-tracking metric, fixation duration, was exposed to a significant influence of cultural background. The findings that the participants from Switzerland had longer fixation durations supports the initial hypothesis that people with Western cultural backgrounds are more likely to think analytically. The hypothesis that the Swiss participants, who embody Western cultural characteristics, examine map symbols in greater detail and with greater focus is supported by earlier research indicating that people in Western cultures frequently concentrate on individual objects and their details (Masuda & Nisbett, 2001; Kitayama et al., 2003; Zhang & Seo, 2015; Chua, Boland & Nisbett, 2005).

The observed pattern might be explained by the individualistic character of Western cultures, where people value autonomy and independence above all else. This cognitive inclination is consistent with the longer fixation durations that have been noted, indicating a systematic and thorough analysis of map features. In addition, the Swiss participants' longer fixation duration could be interpreted as a sign of heightened attention to detail or a tendency for more granular processing of spatial information. The observed higher fixation durations from the Swiss participants, is in line with other research and cultural psychology theories on cognitive styles and visual attention in Western cultures (Zhang & Seo, 2015; Chua, Boland & Nisbett, 2005; Šašinková et al., 2023). An emphasis on the significance of individual objects in visual scenes is often noted in these studies, which indicate a preference for analytical thinking. Studies conducted across cultural disparities have repeatedly tried to show the differences in cognitive styles between East Asian and Western cultures, with the former favouring holistic thinking and the latter tending towards an analytical approach (Masuda & Nisbett, 2001; Zhang & Seo, 2015; Chua, Boland & Nisbett, 2005; Šašinková et al., 2023).

Even with these noteworthy results, caution should be used when extrapolating these findings to all Swiss and Tamil people living in Switzerland. Every cultural group is inherently diverse, and individual variances may have an impact on cognitive styles. Furthermore, other factors, such as familiarity with map reading, and language proficiency contribute to the observed fixation duration disparities, which were found in this study. Map using is common among the participants with Swiss and Tamil backgrounds, and since all the participants were born in Switzerland, German language proficiency is guaranteed.

Despite the significant cultural variations of the symbols, attractions and signs, the findings should be considered with restrictions. The standard deviations are higher than the means of fixation duration for each symbol group. This suggests that the practical significance of that difference is limited while a significant difference is detected. In summary, while the statistical

tests of both symbol groups indicate that the Swiss participants have a higher duration of fixations than the Tamil participants, the interpretation should consider the limited practical significance due to the mostly low effect size and the high variability within each group. Therefore, the findings suggest the need for further research to investigate additional variables that might explain the high variability. The high variability in each group implies that individuals with the same cultural background exhibit diverse eye movements. Considering other factors is essential for a comprehensive interpretation beyond cultural influences.

5.3.2 Number of fixations

Our comprehension of the cognitive styles of Tamil and Swiss participants while map reading is further impacted by the analysis of the number of fixations. It is crucial to interpret the findings with respect, because in contrast to the Tamil participants, the Swiss participants showed mostly higher number of fixations. Considering the difference over all maps together, the Swiss individuals had significantly more fixations than the Tamil individuals. Focusing on the number of fixations of map 1 only, a significantly higher number of fixations was detected for the Swiss participants. Furthermore, the Tamil individuals had a higher number of fixations only in map 5, which resulted in a nonsignificant finding. For both symbol groups (attractions and signs) of all the five maps, the Swiss individuals had a significantly higher number of fixations than the Tamil individuals. The findings that the Swiss participants had more fixations challenges the hypothesis of RQ2 and goes against the prediction that the Tamil participants, who represent holistic thinking, would have a greater number of fixations. Interestingly, the significance of the variation in the number of fixations varies among all the five maps, which is significant for all maps together and map 1 considered alone, but not for map 2, 3, 4 and 5 alone. Notably, the significance varies depending on the map, with only map 1 exhibiting statistical significance, but differences by analysing map 2 vs. 3, map 4 vs. 5. All maps together did not exhibit significant cultural influence on the number of fixations. This variance specific to maps implies that cultural influences on the number of fixations might vary depending on the context.

The findings challenge the assumption that people from East Asian cultures, such as the Tamil participants, naturally adopt a holistic cognitive style. Only a few studies were able to present that East Asians show holistic thinking by having less fixation numbers than Western cultures (Chua, Boland & Nisbett, 2005). Most of the studies did not consider the number of fixations and were able to present that East Asians have holistic thinking (Zhang & Seo, 2015; Masuda & Nisbett, 2001). Based on current research, there appears to be a complex and multifaceted relationship between cognitive styles and culture considering the number of fixations. In

addition, as before mentioned, there do not exist many studies which analysed the number of fixations in relation to cognitive styles. The map-specific variance highlights the sensitivity of cognitive processes to stimuli, highlighting the need for an in-depth knowledge of the interaction between visual stimuli and cultural background. As for fixation duration, the significance that has been observed for symbol groups over all maps indicates that the increased frequency of fixations among the Swiss participants is not limited to particular map elements, but rather encompasses a range of symbols. Along with a significant difference and high effect size, the high standard deviation could suggest that although there is a significant difference between both groups overall, there are large individual differences in each group's performance. The significant impact of cultural background on the measured variable is indicated by the high effect size, which highlights the practical significance of the observed variations. The variability in standard deviation may result from other unconsidered factors. Interestingly, there are only insignificant differences, if we focus on the symbol groups of attractions and signs for each map alone. As mentioned before, the high standard deviations from these symbol groups of each map (Table 10 in Appendix O) raise questions on the consistency of the observed pattern. This variation could be a sign of different cognitive approaches among the Swiss and Tamil participants.

The observed pattern of the number of fixations may have resulted from the Swiss and Tamil participants' adaptation of their cognitive strategies to diverse cultural stimuli, given their multicultural environment and the same educational background since all the participants were born and raised in Switzerland. The complexity of the map types may have an impact on the variance specific to a given map, with map 1 possibly evoking a cognitive approach distinct from the other maps. Individual differences must be considered as they may have a great impact on cultural influences, given the variation in cognitive strategies among cultural groups. In addition, to learn more about how cultural background and visual stimuli interact, future studies may examine the effects of map-specific features on eye movement patterns and consider other eye-tracking metrics for a deeper understanding.

Comparing the heatmaps with both eye-tracking metrics analysis, mentioned above, there is only a minimal similarity between saliency analysis (Figure 21 from Appendix F) and the heatmaps of the eye movements (Appendix P). The eye-tracking study applied free-viewing tasks in order to predict eye movements. The bottom-up processes are the focus of the saliency model (Walther & Koch, 2006). The model predicted that some symbols in each map are in the focus, while the focus would mostly rely on the green and blue areas of the maps. If we compare the heatmaps

with the eye movement metrics analysis, there is also little agreement. Heatmaps of map 2 to 5 (Appendix P) portray how the Tamil participants have more fixations on other parts of the maps than the symbols compared to the Swiss participants. The same difference was found by Zhang and Seo, who analysed visual attention towards food images (2015).

5.3.3 Response: Frequency of Yes/No Answers

The hypothesis that Swiss individuals have analytical thinking and Tamil participants holistic thinking is supported by the finding that the participants from Switzerland show a higher frequency of "yes" answers, while the Tamil participants show a higher frequency of "no" answers in the pn task condition. The observed variations in yes/no frequencies are task-specific, as suggested by the significant result concerning task condition influence but not cultural background influence (ANOVA from 4.2.5.1). Chua, Boland & Nisbett (2005) were able to point out with their study that East Asian cultures –Japanese participants in their study – were affected by the novel backgrounds, whereas independently of the background American participants – representing Western cultures – were able to answer more accurately. The Masuda & Nisbett's study also portrays that Japanese participants are more manipulated by the different backgrounds for the focal objects than American participants, which also resulted in a nonsignificant difference (2001). Masuda & Nisbett's work (2001) is confirmed by our study concerning the frequency of yes/no answers of the pn task condition. As we expected, the Swiss participants answered more pn task questions with "yes" than the Tamil. Notably, the Tamil participants answered the pw task conditions with the answer "no" more often than the Swiss participants, which could lead to the assumption that the Tamil participants were manipulated by the variation of backgrounds, whereas the Swiss participants focused on the objects only. Furthermore, due to the absence of insignificant results for cultural background influence, assumptions about consistent cultural influences on the frequency of answers are challenged and the need for a deeper understanding is suggested.

One reason for the observed task condition significance is that different task conditions might cause varying cognitive demands, which in turn may influence the participants' decision-making strategies. Individual differences within the cultural groups may account for the lack of significance of the influence of cultural background and the higher variability in the pn task condition answers of Tamil participants (Figure 40), highlighting the diversity of decision-making tendencies even within particular cultural contexts. Apart from that, making decisions while reading a map is a complex process and variables other than cultural background may be

important. Although linguistic ability and map familiarity was examined, factors such as map symbol familiarity, or individual cognitive styles may influence the answers.

5.3.4 Response: Accuracy

The examination of the accuracy of the previously seen objects with, without, or novel background align with the findings from the frequency of yes/no answers. The results of accuracy shed light on the precisions of the responses of the participants during the map reading tasks. The observed difference that the Swiss participants exhibit higher accuracy in the pn tasks aligns with the hypothesis that cultural background influences the accuracy of decision-making during map reading and underscores the holistic thinking of Tamil participants and the analytical thinking of Swiss participants. As for the frequency of yes/no answers, the influence of cultural background is not significant for all three task conditions (po, pw and pn), whereas the task-specific differences are significant for all participants. Existing literature on the accuracy of decision-making highlights also an insignificant result of cultural influence on such tasks (Masuda & Nisbett, 2001). As mentioned in other eye-tracking metrics, individual differences within groups may account for the lack of significance of cultural background influence. Different task conditions impose varied cognitive demands, which influences the decision-making process of the participants because of which the task condition resulted in a significant influence. More detailed examination of task conditions may prove beneficial for future research in order to identify the particular cognitive mechanisms that underlie accurate decisions in various map-reading situations, which would help to design more effective tasks to investigate the cultural influence on such tasks.

5.3.5 Response: Response Time

Response time analysis provides fascinating information about how cultural background and temporal components of cognitive processing interact when reading maps. Even though it takes the Tamil participants significantly longer to respond over all six task conditions, the differences in particular task conditions of previously seen objects with original background (answer yes), without background (answer yes), and novel background (yes and no answers) call for a more thorough examination of the cultural effect on response time due to the insignificance for each task difference between both cultural backgrounds. The hypothesis regarding cultural differences in response time of cognitive processing during map reading is initially supported by the finding that it took the Tamil participants significantly longer to respond to all six task conditions. Although it took the Tamil individuals longer to respond for tasks with pn condition

(yes and no answers) than the Swiss individuals, a statistical significance could not be exhibited. Considering the "no" answers of the pn task condition, it took the Tamil participants longer to choose an answer than the Swiss participants again without significant difference. Thus, the hypothesis is disproved by the insignificant variations in response times for previously seen objects with a novel background (pn task condition) (see Table 9). These variations imply that task-dependent cultural influences for novel objects with different backgrounds on response time may exist. Additionally, the higher response time of the Tamil participants over all the task conditions and only for the pn task condition (all answers and no answers alone) suggest that the Tamil individuals were more confused with the different backgrounds than the Swiss participants. This finding supports the hypothesis that the Swiss individuals have analytical and Tamil individuals holistic thinking. Due to the lack of significance further investigation is needed here. There exist only a few studies, where dwell time on visual elements was analysed. However, a specific research where response time was analysed in relation to manipulated tasks is not known to the author. In any case, the existing research on response time in cross-cultural studies points out the complexity of temporal dynamics and emphasises the importance of taking task-specific influences on cognitive processes into account (Šašinková et al., 2023). Furthermore, there may be individual differences in response times between the Tamil and Swiss groups, as indicated by the high standard deviations that were seen in some task conditions.

To understand the significance of overall response time difference between both cultural backgrounds and the insignificant difference for po(yes), pw(yes) and pn(all) task conditions, the other task conditions need to be analysed. People from different cultural backgrounds modify their cognitive strategies according to the particular requirements of the task, which could account for the insignificant differences in certain task conditions. In addition, in the eye-tracking study the same task with the same question was portrayed, thus, the learning strategy could influence the response time, which should be examined in further research for a better understanding of the results (Farashahi et al., 2018).

5.3.6 Synthesis of Eye-Tracking Study Findings

The eye-tracking study results indicate a significant pattern in the cognitive preferences of the Swiss people, pointing to a preference for analytical thinking. But when it comes to the Tamil participants, our research has challenges proving that this subgroup consistently tended to think holistically. The observed individual differences between the Tamil participants suggests that the cognitive patterns are more complex than our original theories could have predicted.

The observation of individual variations among the Tamil participants emphasises the need for more research projects. The Tamil participants may differ from one another since they were born in Switzerland, where there is a strong likelihood of Swiss educational influence and multiculturalism. Future studies ought to take Tamil participants living in Sri Lanka or Tamil participants living in Switzerland who had a Sri Lankan education and were not raised in Switzerland into account.

5.3.7 Maps Evaluation and Questionnaire Responses

Participants from both cultural backgrounds argued that they had seen the waterbodies and the symbols first. The absence of statistical significance implies that the subjective interpretation of the first observed aspect of the first map was similar for all the participants. This supports the theory that similar reactions to some visual components may be obtained by people from different cultural backgrounds (Wong et al., 2018). Moreover, the participants from Switzerland rated the map design higher than the Tamil, which is consistent with their opinions of the first map design's disadvantages and advantages. All the participants found the map's colour and symbols to be the most appealing, but the Tamil participants gave the map a lower rating due to map unclearness, colour choice and symbols, and most Swiss participants gave the map a higher rating due to their only distaste for its language. Considering the disliked aspects of the first map, we can interpret that the Tamil participants focused on aspects regarding the background, and the Swiss participants focused on focal aspects. This supports the significant finding of fixation duration for map 1 between both groups but fails to support the significant finding of the number of fixations for map 1 between both groups. The perceived pros and cons of map 1 might represent characteristics that are independent of cultural context, indicating that there might be some cultural neutrality to map design principles.

The lack of statistically significant disparities in the degree of familiarity with tourist maps suggests that both the Swiss and Tamil individuals were about equally exposed to and at ease with the style of cartography that was presented. Based on their multicultural environment, the participants may have modified their familiarity, leading to a convergence of answers. The Swiss and Tamil participants have similar intentions regarding their future use of the map, indicating that they have a common understanding of its usefulness. This underscores the potential universality of the presented cartographic style.

It appears that participants' preferences regarding the five maps were largely influenced by their own tastes rather than their cultural background, as evidenced by the lack of statistically

significant differences in liking particular maps. Although the difference in disliked maps is insignificant, most of the participants of both groups rated the fifth map as the least favourite. The contrasting colour choices for map nr.5 disrupted the visual attention of the viewers. The participants' likes and dislikes may be shaped more by their highly personalised aesthetic preferences than by cultural factors. In order to investigate that further, it is worthwhile to pose specific questions about the features of each map. This will allow the qualitative responses to be compared with the eye-tracking metrics and the results of the main experiment tasks.

The individual ranking of being traditional is an additional questionnaire finding that calls for discussion. Only one of the questions about tradition—the one from the questionnaire—had statistical significance. The results of the other two traditionalism questions were not statistically significant. The Tamil participants significantly rated themselves as more traditional than the Swiss. This result validates the theory that collectivistic individuals, who tend to think holistically, place greater value on traditional values, whereas individualistic people who place less value on tradition, tend to think analytically (Stopes-Roe & Cochrane, 1989; Triandis, 1995, 2001).

The obtained qualitative data remains valuable even in the absence of statistical differences. The individual participant's narratives and observations can offer deep context and subtlety that may be missed by quantitative measurements. Thus, to gain a deeper understanding of the complex perspectives of the participants, qualitative data can be subjected to thematic analysis in order to spot recurrent patterns

5.3.8 Preliminary Test and Paper Folding Test: Absence of Cultural Impact

5.3.8.1 Examination of Preliminary Test Results

Lacko and his colleagues used a compound figure test (developed test of Navon test) to examine the cultural difference between Czech and Chinese/Taiwanese participants based on the AH cognitive style theory (2020). They found that the Czech participants were faster in reaction times in both local and global tasks, which lead to inexplicable differences in cognitive styles. By comparing our findings to their study, we found the same differences for the Swiss participants. The Swiss have a quicker reaction time than the Tamil participants on global and local level, which contradicts the initial hypothesis of the Navon test that the Tamil individuals will have a quicker reaction time on a global level and supports the claim that the Swiss individuals have a quicker reaction time on a local level. Thus, the initial hypothesis of the Navon test is partially contradicted by the unexpected result that the Swiss participants exhibited quicker reaction

times in both global and local conditions. The low effect sizes contribute to the fact that the insignificant difference may have limited practical significance. Apart from that, the Tamil participants had more errors on a global level, whereas the Swiss participants had more errors on a local level, which complicates the understanding of the results and contributes to the complexity of the hypothesis. These findings cast doubt on the presumptions regarding the global-local processing styles and raise the possibility of a cognitive trend reversal. A closer look at individual variations within groups is warranted by the overall results' lack of statistical significance. Variability within the sample may be the cause of insignificant results. Although the general trend contradicts the hypothesis, the lack of significance suggests that definitive conclusions should be reached with caution. Investigating the specific traits that lead to these unexpected patterns may be helpful.

To the knowledge of the author, no study has been conducted where the Stroop test was directly implemented to investigate the cultural difference between different cultural background based on the AH cognitive style theory. As mentioned in chapter 3.2.2, the study conducted by Alansari and Baroun, indicates the cultural influence on cognition through the Stroop test (2004), but did not consider the holistic and analytical thinking of the two groups. In our study, the Swiss participants have quicker reaction times than the Tamil participants, which raises the possibility of a difference in how words and colours are processed simultaneously. The lack of significance, however, suggests caution when generalizing these results and the need for a more thorough investigation of cognitive disparities by including the error counts of the test as well. Although not statistically significant, the higher Stroop effect for the Swiss participants suggests that there may be differences in the two groups' stroop effect.

The hypothesis that the Swiss participants would show a significantly higher frequency of analytical responses is challenged by the insignificant difference in the mean frequency of analytical answers, although the frequency mean of analytical responses is slightly higher for the Swiss individuals. An examination of the noted slight elevation is required. The test results from Masuda & Nisbett (2001) portrayed a significant difference between American and Japanese participants. In chapter 3.2.3, it was found that the Swiss participants only paid attention to the focal objects and analytical thinking style, while the Japanese participants were more inclined to reflect on the viewed video with background information. Our study's results disprove the theory that the analytical and holistic thinking of the Tamil and Swiss participants differ significantly. Consequently, additional research is needed. For instance, examining the frequency of holistic responses for both groups or, as Masuda and Nisbett (2001) did, posing an open-

ended question to participants that allows them to respond with what they have observed and the reason behind their answer choice. This would be likely to provide a deeper understanding of the findings.

The observed trends of the whole preliminary test may be influenced by individual differences within cultural groups, underscoring the need for a more thorough investigation of cognitive variations. Given that each of the three subtasks had only a limited number of questions or trials, more trials, or the use of cognitive tests other than the Navon and Stroop test would be likely to result in a better understanding. There is a possibility that both groups have modified cognitive strategies in response to their common education system and the multicultural environment, which could lessen the impact of stereotyped cognitive differences. In addition, the limitations of the sample size may have an impact on the insignificant results. More robust insights and improved statistical power could be obtained with a larger sample size. Due to the complexity of cultural differences, it may not be possible for a single test to consist of three tests in shorter versions, to fully assess the range of subtle cognitive differences among people from different cultural backgrounds. Further research could consider more detailed understanding of the participants' cognitive strategies and cultural adaptations by combining quantitative measurements with qualitative research techniques.

5.3.8.2 Insights from the Paper Folding Test

The Swiss participants' higher mean score suggests that they may have superior mental rotation and spatial manipulation abilities (Ekstrom et al., 1976). It is important to be cautious when attributing this difference to cultural factors, though, given the lack of statistical significance. While the average scores of both groups differ slightly, the similar variability of the boxplots and the higher scores of the participants from Switzerland suggest that similar patterns are present in the overall distribution of the scores (Figure 42). The disparities in spatial ability between the two cultural groups is enhanced by the slightly lower median for the Tamil participants, which creates a subtle contrast. Relying solely on mean scores to draw conclusions about cultural differences in spatial ability is not encouraged due to the lack of statistical significance. Other values such as, how many errors were made, which tasks were responded with which answer, would possibly contribute to the spatial ability difference between the two groups and would explain the insignificant difference. A more nuanced investigation of spatial abilities is necessary, as the lack of significance may point to significant individual differences within each cultural group. As mentioned in chapter 3.4, different studies found different results. As Janssen and Geiser (2012) explain the findings from their study, the better performance of German students

could possibly explain that Germans prefer a holistic strategy and Cambodians analytical strategy. This would exactly imply the opposite of our hypothesis of this study. Tian and his colleagues (2022) were able to detect a minimal difference between Chinese and Malaysian Chinese people, where the Chinese participants exhibited slightly more accurate answers in a mental rotation task. Although, they were able to portray the influence of culture on spatial ability, they did not examine the influence of cognitive styles on culture. Considering these studies in our study instead of pointing to embedded cultural differences, the insignificant results might point to cultural adaptation, or the impact of various cognitive strategies learned through environmental exposure. The results of the paper folding test encourage reflection on cultural variations that might affect spatial ability. The pattern that has been observed may be explained by variables other than cultural background, such as educational experiences and exposure to spatial tasks.

5.4 Study Limitations

Addressing the following limitations and recognizing the study's boundaries is essential for an in-depth interpretation of the findings and for informing future research on the cultural influence on map reading. One limitation of this study is the focus on Swiss and Tamil individuals residing in Switzerland only, which limits the generalizability of findings to these particular cultural groups in this specific geographical context. Results should be extrapolated to different cultural contexts with caution. Time and device constraints limited the study's participant pool to young adults and restricted consideration to Tamil and Swiss citizens born in Switzerland. If the participants' age range had been larger, the study's findings would have been more credible. Furthermore, if Tamil participants who were not born in Switzerland had been considered, the findings' generalizability would have been less constrained. Nonetheless, they have been left out due to their lacking proficiency in languages. In addition, the study assumes a homogenous cognitive style for Swiss participants as analytical thinkers and Tamil participants as holistic thinkers. However, individual differences within cultural groups may lead to diverse cognitive styles, challenging the accuracy of such generalizations from another level, too. Despite these challenges, it can be said that the study's emphasis on Swiss and Tamil residents from Switzerland based on the analytic/holistic cognitive style and the study's criterion was successful.

Individuals map experience changes in their cultural beliefs and behaviours over time, as cultural adaptation is a dynamic process (Chua, Boland & Nisbett, 2005). Because the study was

done at a particular time, it might not have captured how cultural impacts on map reading have changed over time. Even so, the main focus of this research is the cultural differences between Swiss and Tamil people. It might not take into consideration additional relevant variables that could affect map-reading behaviour, like socioeconomic status, education level, or personal experiences. Besides all these limitations this study is an attempt to analyse cultural influence on map reading and functions as a base for further research.

Apart from that, the small sample size from this study may not fully represent the entire Swiss and Tamil populations in Switzerland. It may not be extensive enough to consider all aspects of cognitive diversity within Swiss and Tamil communities in Switzerland. The recruitment of participants with the study's criterion was a challenge itself. If a larger number of sample size had been evaluated for both cultural groups, the study's conclusions probably would have been more accurate. Despite this, given the time limits, a sample size of 40 participants with the respective study criteria is a success.

Another possible limitation of the research is its concentration on specific eye-tracking metrics, while other potentially informative metrics were left out. Even though the study looked at the fixation duration and number of fixations, these metrics only make up a small part of the wide range of eye-tracking metrics that are available. Further metrics that could shed light on the participants' cognitive process during map reading include saccade length, scan path patterns, and pupil dilation (Zhang & Seo, 2015; Wedel et al., 2022).

The lack of implications for the map reading task is another limitation of this study. Compared to other tourist maps that people use, the designs of the maps utilised in the main experiment are not as realistic or instructive. The degree to which a research situation mimics a real-world environment is never quite certain. However, the tasks' simplified tourist map designs had no adverse implications on the participants and the tasks themselves.

There is a limitation on the number of trials given for each task in the preliminary test. Larger numbers of trials for each preliminary test task would have produced more dependable study conclusions, much as the small sample size limiting factor. However, this study solely includes a portion of the preliminary test; it is not the main focus.

Finally, a number of issues made it difficult to compare the study with earlier research. Map reading or generally speaking, cartographic elements are not a usual way to estimate cultural variance between groups in the context of cross-cultural research. As a result, a comparison with earlier studies was limited in scope. But the author's objective was to investigate Masuda &

Nisbett's pre-existing study methodology within the framework of cartography (2001). It would have been interesting to compare with more previous research, though. To the best of the author's knowledge, no cross-cultural study has looked at the Tamil and Swiss communities in maps or in other fields of cultural influence on cognition. As a result, some of the findings in this thesis are preliminary and cannot be easily compared to other studies in the same field.

6 Conclusion

The extensive investigation of how cultural background affects map reading among Swiss and Tamil participants residing in Switzerland, including preliminary test, eye-tracking study, paper folding test, and a background questionnaire, provides subtle understanding of the complex interactions between cultural background and cognitive processes. It helped to examine the significant impact that an individual's identity and cultural upbringing have on their cognitive process, especially when it comes to map reading. Determining how people from different cultural backgrounds see, interpret spatial information, and existing research related to culture and cognition was the main objective. Secondly, the study focused on investigating particular differences in cognitive processing in the context of cartographic outputs based on analytic-holistic theory (Masuda & Nisbett, 2001). Differences between Tamil people, who embody East Asian cultural traits and are believed to have a way of holistic thinking, and Swiss people, who represent Western cultural influences and are expected to have an analytical way of thinking (Triandis, 2001; Hofstede, 2010). Finding out how these cultural variations might appear in how people interpret spatial information and use maps to navigate was the aim of the second objective. Our study used a mixed design model to enable a deeper investigation of effects and to produce more reliable and comprehensive research outcomes.

Reviewing previous research and studies on cultural influence supports the hypothesis that cultural background influences cognitive processes. Several studies have examined how culture affects cognitive processes, pointing out disparities in perception, memory, problem-solving, attention, and decision-making (Chua, Boland & Nisbett, 2005; Masuda & Nisbett, 2001; Kuwabara & Smith, 2012; Oishi & Graham, 2010; Oyserman, 2011; Hofstede, 2010; Triandis, 2001). The first hypothesis (RQ1) is partially supported by the findings of the preliminary test and the eye-tracking study. Our study, like earlier research, did not consistently report statistically significant variations in cognitive patterns associated with cartography (Tian et al., 2022, Stachoň et al., 2018; Lacko et al., 2020). The second hypothesis (RQ2) claims that there exist cognitive differences in the way Tamil individuals born in Switzerland and Swiss individuals born in Switzerland process cartographic outputs, influences by holistic and analytical ways of thinking style, respectively. Although some results, especially from eye-tracking study itself, support the hypothesis, there is conflicting evidence overall, and not all thedifferences from all the study parts achieved statistical significance. There are many different ways culture affects cognitive abilities, and disparities may not always follow established patterns.

To analyse cognitive variations in analytical and holistic ways of thinking in connection with general cognitive abilities, the preliminary test consisting of the Navon test, Stroop test, and a quiz was conducted. While some trends were found – for example, the higher frequency of analytical responses from Swiss people and cultural differences in the Stroop test, where the Swiss people react more quickly, and the local level results of Tamil people0s slower reaction time in the Navon test – it is crucial to be cautious when extrapolating conclusions from certain areas because of the lack of statistical significance and the low effect sizes.

The most important findings for this study come from the main part of this thesis, the eye-tracking experiment. Swiss participants show significantly longer fixation durations than Tamil participants, which suggests an analytical way of thinking. Generally, the Swiss participants have significantly higher fixation durations and fixation counts in almost all the five maps and for each symbol group, attractions, and signs, from each map. Despite the fact that the Swiss participants had a greater number of fixations over all the five maps, the lack of statistical significance suggests that cognitive processes are complex, possibly combining holistic and analytical tendencies. Higher "yes" responses frequency for participants with Swiss background and higher "no" answer frequency for the participants with Tamil background suggest possible cognitive patterns consistent with analytical and holistic way of thinking, respectively. The lack of statistical significance, however, highlights the need for cautiousness in interpretation and raises the possibility that cultural influences are less pronounced than initially assumed. The idea of analytical thinking is supported by the trend of the Swiss individuals providing more accurate pn (previously seen objects with novel background) tasks and "yes" answers. As Masuda and Nisbett (2001) state, the lack of statistical significance, however, suggests that the relationship between cognitive styles and accuracy under various task conditions needs to be investigated in greater detail. The Tamil participants showed longer response times overall, according to a thorough analysis of response times under all the six task conditions. Nonetheless, no statistically significant difference was found in the detailed analysis by particular conditions – po, pn, and pw, where the Tamil participants had longer response time in po and pn conditions. This implies that factors other than cultural background affect cognitive dynamics in response times, since for instance, learning strategy might have an influence as well (Farashahi et al., 2018). However, the qualitative finding is interestingly that Tamil participants might be more influenced by their diverse backgrounds lacked statistical significance as Masuda and Nisbett suggested (2001).

Subjective assessments of the maps, which tested the participants' perceptions, preferences, and intentions for future use, showed an alignment of views between the Tamil and Swiss participants. The qualitative richness of their answers highlighted common views of map utility and aesthetic preferences even in the absence of statistical differences. The task's qualitative findings provide deeper understanding of the participants' individual interactions with cartographic outputs, complementing the quantitative measurements in the mixed-design study model.

The spatial ability skills of the Tamil and Swiss participants did not significantly differ in the paper folding test. Little variation between participants with different cultural background was found in a study conducted by Tian and his colleagues (202). This implies that among the studied groups, there may be some degree of universality in spatial abilities or cultural adaptation. Although the Swiss individuals have a slightly higher score in paper folding test, the lack of statistical significance suggests further investigation into the variables influencing spatial abilities across a range of cultural backgrounds.

The extensive questionnaire about the participants offered contextual insights into the diversity within the studies groups by examining the participants' cultural background, educational background, from which university students were excluded, and question about traditionalism. Especially, the qualitative data about traditionalism enhanced the overall study by providing insights into participants' personal evaluation. Interestingly, the Tamil individuals significantly rated themselves as more traditional than the Swiss individuals, which implies that the Tamil individuals are holistic thinkers and the Swiss individuals' analytical thinkers (Triandis, 2001; Hofstede, 2010).

When all the data are analysed together, it becomes clear how complex and multifaceted the link is between cultural background and cognitive processes during map reading. The findings of this thesis and its study enlighten the cognitive preferences of the Swiss population, but the contradictory findings regarding the Tamil subgroup highlight the need for a more focused and in-depth examination. The lack of consistent statistical significance highlights the significance of taking individual differences, task-specific demands, and adaptations into account within a multicultural context, even though some patterns were in line with cultural expectations. Essentially, research on the cultural impact of map reading advances a number of disciplines by promoting a more comprehensive understanding of the ways in which cultural background affects cognitive functions and affects how people interact with spatial information.

6.1 Future Research

The present research has provided valuable insights into the cultural factors influencing map reading among Swiss and Tamil individuals residing in Switzerland. Expanding on these results, there are still certain unfilled research gaps in this thesis. Thus, it is beneficial to further investigate how cultural influences manifest themselves in various aspects of spatial cognition. Future work could examine other eye-movement metrics, such as saccades or scan path patterns to examine the cultural influence on spatial information. In addition, different map types with different colour schemes and symbols or even other map designs, such as topographic maps should be considered. In terms of the preliminary test, other psychological experiments with more trials can be conducted to get a prior knowledge about the cultural variation. Given that Ariel and Moffat (2018) focused on age-related differences in spatial cognition, it would be interesting to extend the study beyond the populations of Swiss and Tamil to include Tamil senior individuals who were born and raised in Sri Lanka and arrived in Switzerland as refugees. In general, a wider range of cultural groups with different educational background, socioeconomic status (Stachon et al., 2018) can be compared in comparative analyses to help identify aspects of map reading that are universal and culturally specific. Further investigation could incorporate real-world maps and scenarios that participants encounter in their daily lives. Including other spatial ability tests than just the paper folding test, such as mental rotation, perspective-taking, and spatial visualization tasks can help to provide a more thorough picture of the participants' spatial cognitive abilities (Tian et al., 2022). Additionally, task-specific studies were created to investigate how cultural background affects specific map-reading abilities like route planning, landmark identification, and spatial memory (Chang and Antes, 1987; Lacko et al., 2020; Yamamoto & DeGirolamo, 2012). Such task-specific study designs should be examined with different cultural groups and non-university students should be considered. Another interesting investigation would be to examine how acculturation and cultural adaptation affect changes in cognitive processes over time by conducting longitudinal studies. Long-term observations can provide insight into the stability or fluidity of cultural influence such as dynamic shifts in cognitive strategies (Calzada et al., 2016).

To sum up, the study provides a complex viewpoint on how culture affects map reading among Tamil and Swiss participants in Switzerland. The results underscore the complexity of cognitive processes, highlighting the importance of individualized and dynamic strategy to understand how cultural background influences map reading processes. As time goes on, more research works can broaden the knowledge, improve theoretical frameworks, and help create culturally appropriate interventions in the field of spatial cognition. To the best of the author's expertise, this is the first cross-cultural cartography study done with non-university students who have a Swiss and Tamil

background residing and born in Switzerland. Furthermore, it is the first study to use the study design from Masuda and Nisbett (2001) in the context of cartographic outputs. Therefore, the findings from this study are regarded as an important contribution to the field of cross-cultural research in the area of cartography.

7 Literature

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8 Appendix

A. Preliminary Test: Navon Test

```
options
  bitmapdir stimuli

bitmaps
  Lu
  Uo
  Uu
  Ul
  Ll
  Lo
  Ou
  Ol
  Tt
  Ts
  Th
  St
  Ss
  Sh
  Ht
  Hs
  correct
  wrong
  langsam
  cf_title
  instruktion1
  instruktion2
  instruktion3

fonts
  arial 18

table navon
  "Lu none 0"    Lu 2
  "Uo local 1"   Uo 1
  "Uu none 0"    Uu 2
  "Ul none 0"    Ul 2
  "Ll none 0"    Ll 2
  "Lo local 1"   Lo 1
  "Ou global 2"  Ou 1
  "Ol global 2"  Ol 1
  "Tt none 0"    Tt 2
  "Ts none 0"    Ts 2
  "Th local 1"   Th 1
  "St none 0"    St 2
  "Ss none 0"    Ss 2
  "Sh local 1"   Sh 1
  "Ht global 2"  Ht 1
  "Hs global 2"  Hs 1

task navon
  table navon
  keys b n
  show bitmap @2
  readkey @3 2000
  delay 500
  clear 1 2
  delay 500
  save @1 STATUS RT

block myblock
  message cf_title
  message instruktion1
  delay 500
  tasklist
    navon 50 all_before_repeat
  end
  feedback
    text color yellow
    text align left
    set &GlobalRT mean c5 ; select c4 == 1 && c3 == 2
    set &LocalRT  mean c5 ; select c4 == 1 && c3 == 1
    set &NoneRT   mean c5 ; select c4 == 1 && c3 == 0
    set &GlobalPE count ; select c4 != 1 && c3 == 2
    set &LocalPE  count ; select c4 != 1 && c3 == 1
    set &NonePE   count ; select c4 != 1 && c3 == 0
    text -200 -200 "Feedback Compound Figures Aufgabe"
    text -200 -150 "Reaktionszeiten pro Versuchsbedingung:"
    text -200 -100 &GlobalRT ; prefix "Globale Ebene (H or O): " ; postfix " ms"
    text -200 -50  &LocalRT ; prefix "Lokale Ebene (h or o):" ; postfix " ms"
    text -200 0    &NoneRT ; prefix "Überhaupt kein Ziel:" ; postfix " ms"
    text -200 50   "Fehleranzahl pro experimenteller Bedingung:"
    text -200 100  &GlobalPE ; prefix "Globale Ebene (H or O): " ; postfix " errors"
    text -200 150  &LocalPE ; prefix "Locale Ebene (h or o):" ; postfix " errors"
    text -200 200  &NonePE ; prefix "Überhaupt kein Ziel:" ; postfix " errors"
    text -200 250  "Drücke Leertaste um fortzufahren"
  end
```

Figure 46: Navon Test Coding from PsyToolkit (Stoet, 2010, 2017).

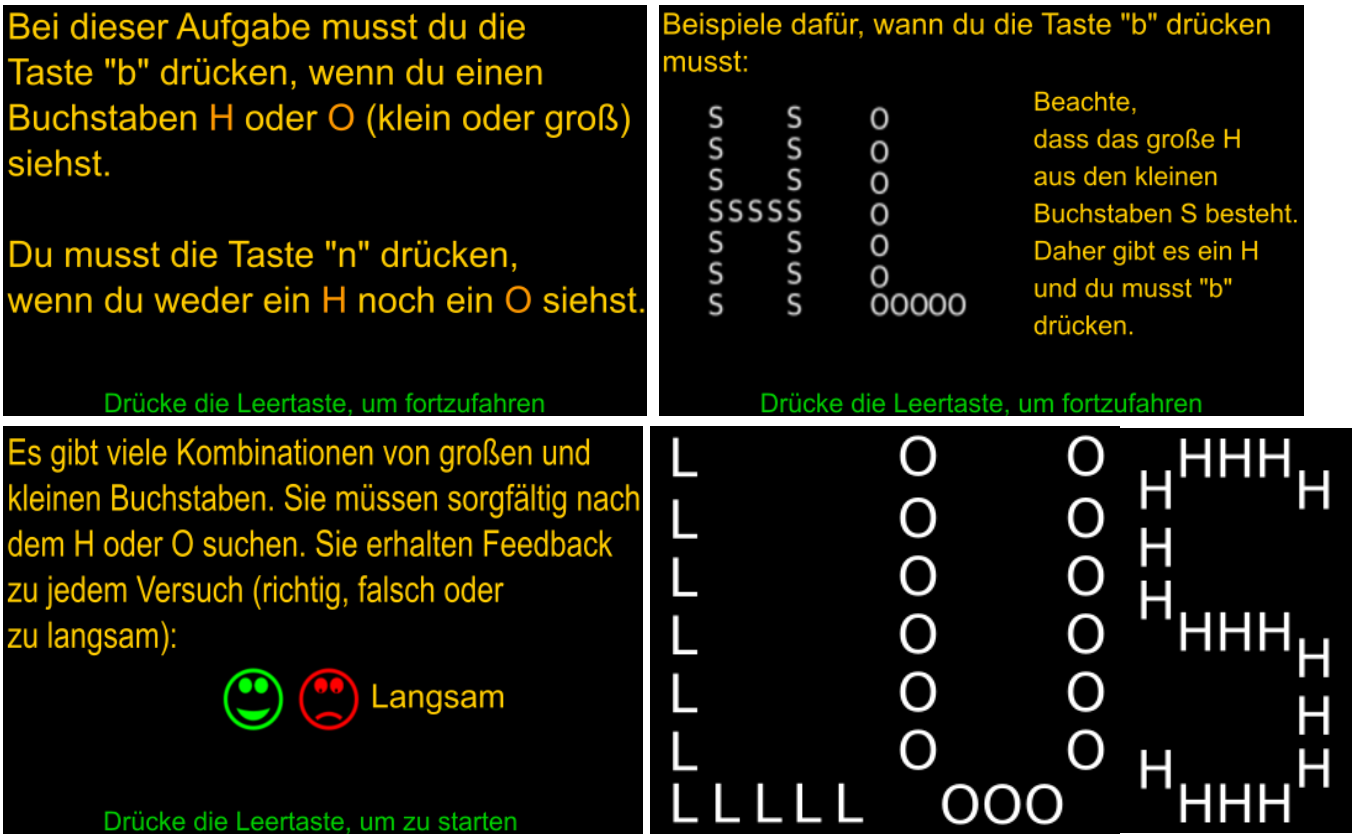


Figure 47: Instructions and three stimuli from Navon Task illustrated. Designed with Inkscape (2022).

B. Preliminary Test: Stroop Task

```
bitmaps
  instruktion1
  instruktion2
  richtig
  falsch
  fixpunkt
  gelbgelb
  gelbgrün
  gelbblau
  gelbrot
  rotgelb
  rotgrün
  rotblau
  rotrot
  grüngelb
  grüngrün
  grünblau
  grünrot
  blaugelb
  blaugrün
  blaublau
  blaurot

fonts
  arial 20

# table: write condition,stimulus,response

table stroop
  "gelb gelb     1" gelbgelb     4
  "gelb grün     0" gelbgrün     2
  "gelb blau     0" gelbblau     3
  "gelb rot      0" gelbrot      1
  "rot gelb      0" rotgelb      4
  "rot grün      0" rotgrün      2
  "rot blau      0" rotblau      3
  "rot rot       1" rotrot       1
  "grün gelb     0" grüngelb     4
  "grün grün     1" grüngrün     2
  "grün blau     0" grünblau     3
  "grün rot      0" grünrot      1
  "blau gelb     0" blaugelb     4
  "blau grün     0" blaugrün     2
  "blau blau     1" blaublau     3
  "blau rot      0" blaurot      1

task stroop
  table stroop
  keys r g b y
  delay 500
  show bitmap fixpunkt # stimulus 1
  delay 200
  clear 1 # remove fixpunkt
  delay 100
  show bitmap @2 # stimulus 2
  readkey @3 2000
  clear 2 # remove stimulus 2
  delay 500
  save BLOCKNAME @1 TABLEROW KEY STATUS RT

message instruktion1

message instruktion2

block training
  tasklist
    stroop 40  # run the stroop task 40 trials.
  end
  feedback
    text -100 0  "Deine Geschwindigkeit in korrekten Versuchen"
    set &StroopCon mean c8 ; select c4 == 1 && c7 == 1
    set &StroopInc mean c8 ; select c4 == 0 && c7 == 1
    set &StroopEffect expression &StroopInc - &StroopCon
    text -100 50  &StroopCon ; prefix "kongruent:    " ; postfix " ms"
    text -100 100 &StroopInc ; prefix "inkongruent: " ; postfix " ms"
    text -100 150 &StroopEffect ; prefix "Dein Stroop Effekt ist inkongruent minus kongruent: " ; postfix " ms"
    text -100 200 "Drücke Leertaste um zu beenden"
  end
```


Figure 48: Stroop Task Coding from PsyToolkit (Stoet, 2010, 2017).

Figure 49: Instructions and four from all stimuli from each colour represented. Designed with Inkscape (2022).

C. Preliminary Test: Quiz

Information screen
Before the participant decides to participate,
The following information is shown:
Liebe/r Teilnehmer/in,
Wir beginnen mit dem ersten Teil der Studie. Dieser Test besteht aus drei Teilen. Die Dauer dieser Umfrage beträgt etwa 15 - 20 Minuten. Für den Erfolg der Studie ist es wichtig, dass du die Anweisungen gut durchliest, ansonsten wende dich an die zuständige Person. Alle Daten werden anonym erhoben, sie können deiner Person nicht zugeordnet werden und werden streng vertraulich behandelt.
Vielen Dank für deine Teilnahme an meiner Studie und damit auch für deinen Beitrag.
Researcher information:
Vibiga Ruban
MSc Student
Department of Geography, University of Zurich
vibiga_96@hotmail.de

Consent prompt (needs to be ticked to be able to continue):
Please confirm that you want to participate in this survey. Your information (including computer IP) will be stored and might be used for research.

Questions/Items
Item number: 1

Teilnehmer_ID (Wird von Anweisende ausgefüllt)
The following item allows the participant to enter information with the keyboard
Item number: 2

Now participant is asked to respond in an embedded respone time test,
presented in the browser window.

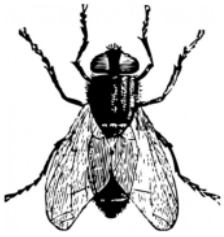
Item number: 3

Now participant is asked to respond in an embedded respone time test,
presented in the browser window.

Item number: 4

Biene

1. Welcher der beiden folgenden Objekte passt am besten zur oben abgebildeten Objekt?



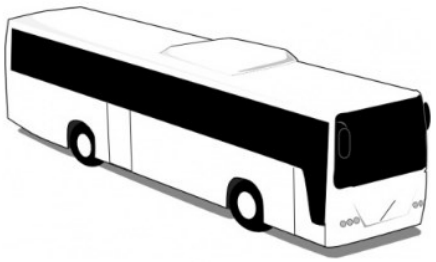
Fliege

Honig (Freeimages, 2023)

Welcher der beiden Objekte passt am besten zur oben abgebildeten Objekt?

1. A. Fliege
2. B. Honig

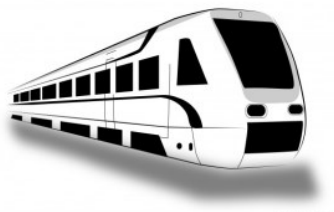
Item number: 5



Bus

2. Welcher der beiden folgenden Objekte passt am besten zur oben abgebildeten Objekt?

Billett

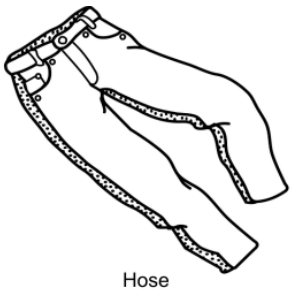


Zug (Freeimages, 2023; Alamy, 2023)

Welcher der beiden Objekte passt am besten zur oben abgebildeten Objekt?

1. A. Billett
2. B. Zug

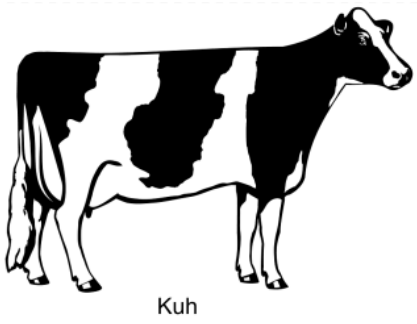
Item number: 6



Welcher der beiden Objekte passt am besten zur oben abgebildeten Objekt?

1. A. Beine
2. B. T-Shirt

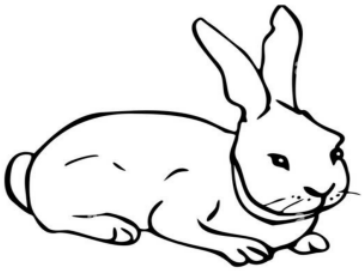
Item number: 7



Welcher der beiden Objekte passt am besten zur oben abgebildeten Objekt?

1. A. Milch
2. B. Stier

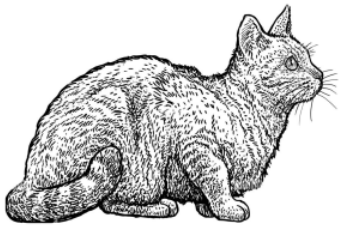
Item number: 8



Kaninchen

5. Welcher der beiden folgenden Objekte passt am besten zur oben abgebildeten Objekt?

Karotte



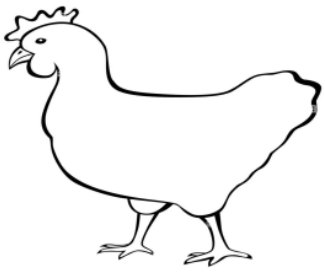
Katze

(Alamy, 2023)

Welcher der beiden Objekte passt am besten zur oben abgebildeten Objekt?

1. A. Karotte
2. B. Katze

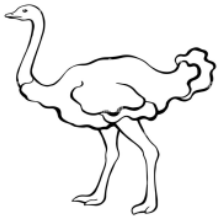
Item number: 9



Huhn

6. Welcher der beiden folgenden Objekte passt am besten zur oben abgebildeten Objekt?

Eier



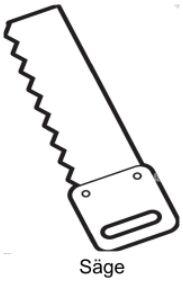
Strauss

(Alamy, 2023)

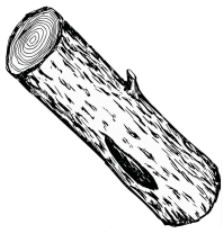
Welcher der beiden Objekte passt am besten zur oben abgebildeten Objekt?

1. A. Eier
2. B. Strauss

Item number: 10



7. Welcher der beiden folgenden Objekte passt am besten zur oben abgebildeten Objekt?

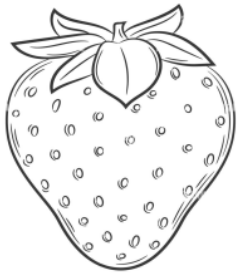


(Alamy, 2023)

Welcher der beiden Objekte passt am besten zur oben abgebildeten Objekt?

1. A. Holz
2. B. Hammer

Item number: 11



Erdbeere

8. Welcher der beiden folgenden Objekte passt am besten zur oben abgebildeten Objekt?

Erde

Himbeere

(Alamy, 2023)

Welcher der beiden Objekte passt am besten zur oben abgebildeten Objekt?

1. A. Erde
2. B. Himbeere

<u>Item number: 12</u>

Welche der beiden Aussagen passt deiner Meinung nach am besten zum oben abgebildeten Bild?

1. A. Auf dem Bild ist die Rückansicht einer jungen Person mit lockigen Haaren zu

sehen, welche rote Jacke und rote Schuhe trägt.
2. B. Auf dem Bild ist eine Person sitzend auf einer Bank zu sehen, wobei die Person zum Horizont über dem Meer blickt.

Item number: 13

Welche der beiden Aussagen passt deiner Meinung nach am besten zum oben abgebildeten Bild?

1. A. Auf dem Bild ist ein Esstisch zu sehen, welches aus Holz ist und Platz für 6 Personen bietet.
2. B. Auf dem Bild ist ein Esstisch zu sehen, welches ein Ort ist, an dem Personen zusammenkommen und eine Mahlzeit teilen.

At the end of the survey

At the end of the survey, the following information is shown to the participant:

Quellenverzeichnis:

Alamy (2023). Alamy Stock Photo. https://www.alamy.de/fotos-bilder/junger-stier.html?blackwhite=1&imgt=8&sortBy=relevant (Zugriff: 01.05.2023).

Freeimages (2023). Freeimages. https://www.freeimages.com/de (Zugriff: 01.05.2023).

IStock Photo (2023). Rückansicht einer jungen lockiges Frau tragen rote Jeansjacke auf einer Bank sitzend und wegsehen, Horizont über Meer – Stockfoto. https://www.istockphoto.com/de/foto/r%C3%BCckansicht-einer-jungen-lockiges-frau-tragen-rote-jeansjacke-auf-einer-bank-sitzend-gm1129154058-298179448?phrase=sitzende+person (Zugriff: 01.05.2023).

Tafelindustrie Style (2023). Esszimmertisch Milana Mango. https://www.tafelindustrie.de/Esszimmertisch-Milana-Mango (Zugriff: 01.05.2023).

D. Base Maps

Figure 50: Base Map Nr.2 created with QGIS Desktop (QGis.org,

Figure 51: Base Map Nr. 3 created with QGIS Desktop (QGis.org, 2023)

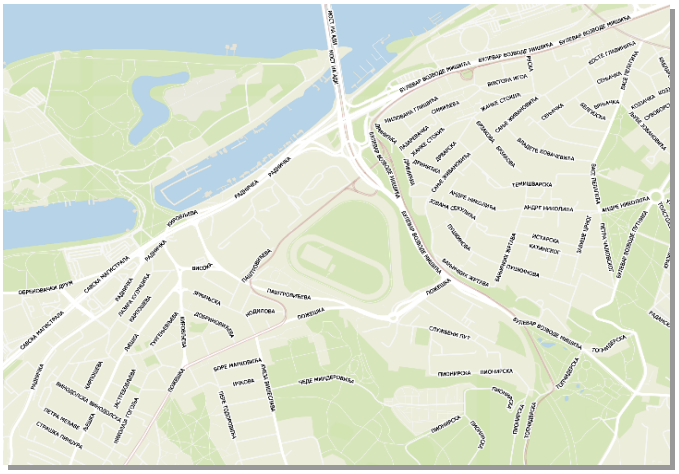


Figure 52: Base Map Nr.4 created with QGIS Desktop (QGis.org, 2023)

Figure 53: Base Map Nr. 5 created with QGIS Desktop (QGis.org, 2023)

E. Novel Base Maps

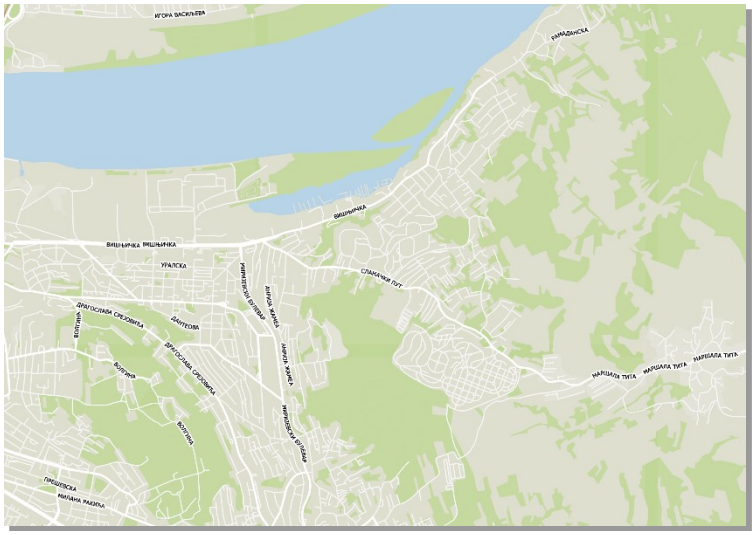


Figure 54: Novel Base Map Nr.1 created with QGIS Desktop (QGis.org, 2023)

Figure 55: Novel Base Map Nr.2 created with QGIS Desktop (QGis.org, 2023)

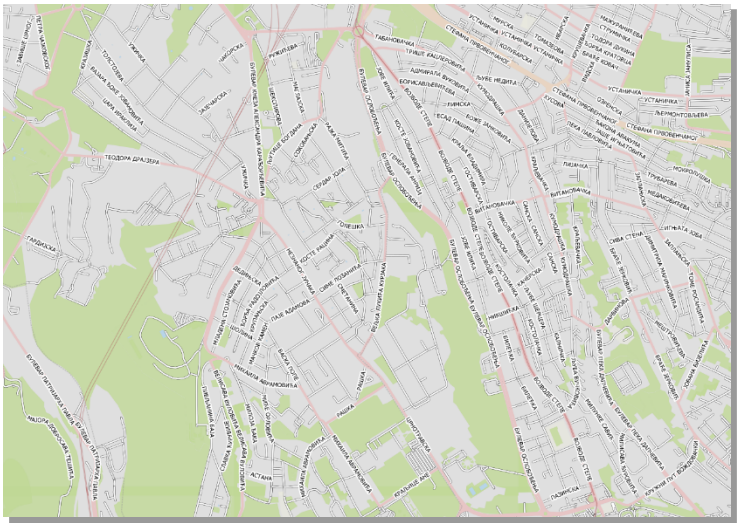


Figure 56: Novel Base Map Nr.3 created with QGIS Desktop (QGis.org, 2023)

Figure 57: Novel Base Map Nr.4 created with QGIS Desktop (QGis.org, 2023)

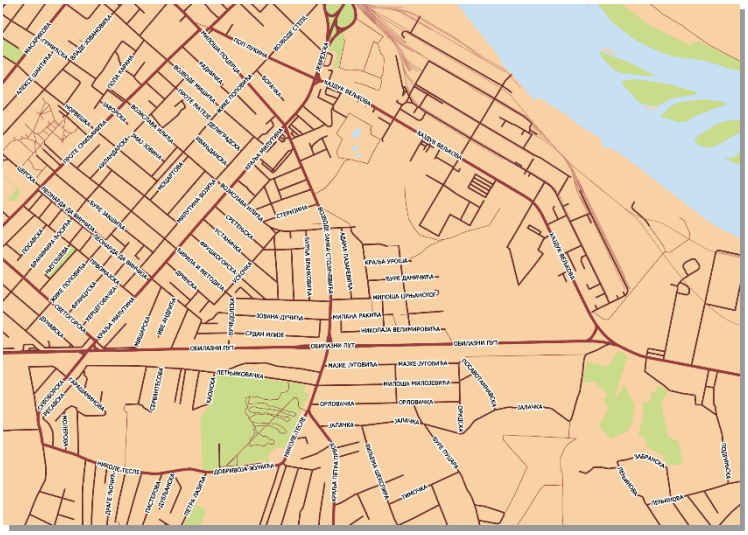


Figure 58: Novel Base Map Nr.5 created with QGIS Desktop (QGis.org, 2023)

F. Saliency Analysis

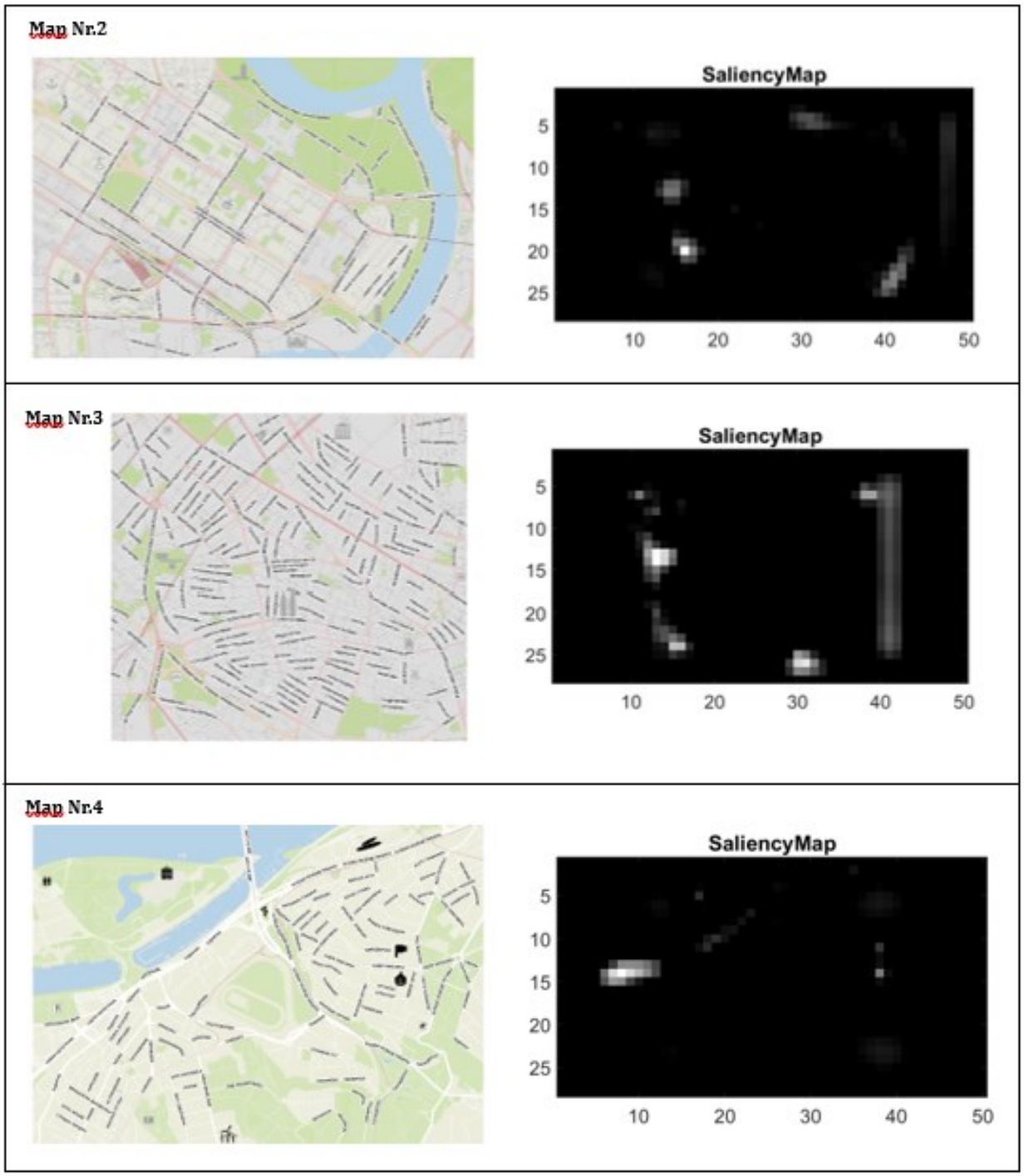
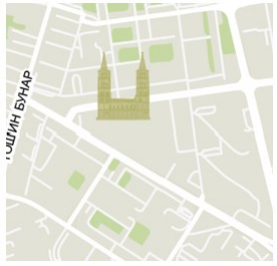
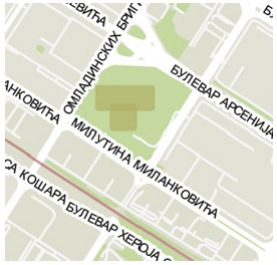


Figure 59: Maps nr. 2, 3 and 4 with their saliency maps. Low salience is represented in dark colours, whereas high salience is represented in bright colours.

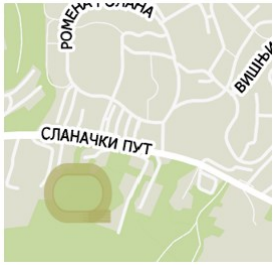
G. Map Cut-outs

The following figures show all the map cut-outs, which were created for the main experiment. Only a few map cut-outs were used.

First Map

PO: With Original Background	PO: Without Background	PO: With Novel Background	NO: With original Background	NO: Without background	NO: With Novel Background
					
					
					

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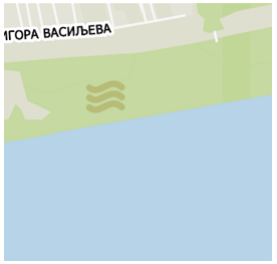
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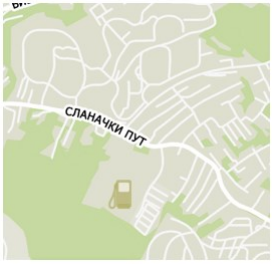
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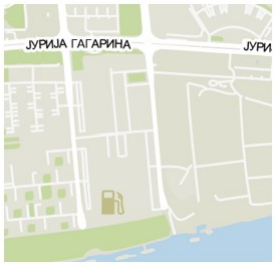
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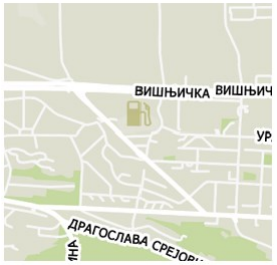
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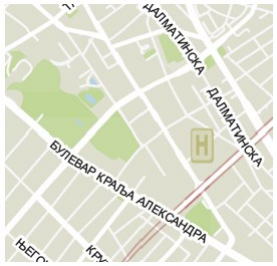
ДРАГОСЛАВА СРЕЈОВ

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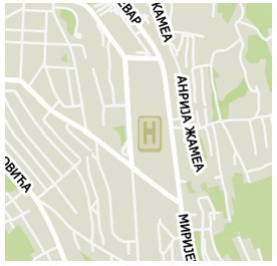
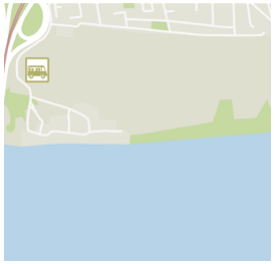
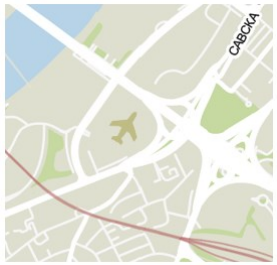
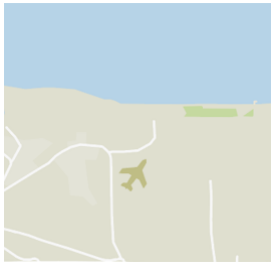
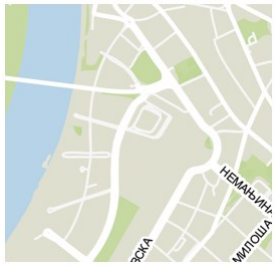
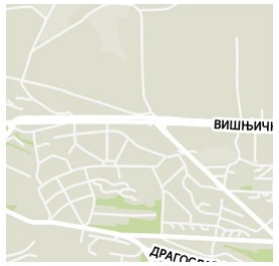
ДАЛМАТИНСКА
БУЛЕВАР КРАЉА АЛЕКСАНДРА


КАМЕА
АНРИЈА ЖАМЕА

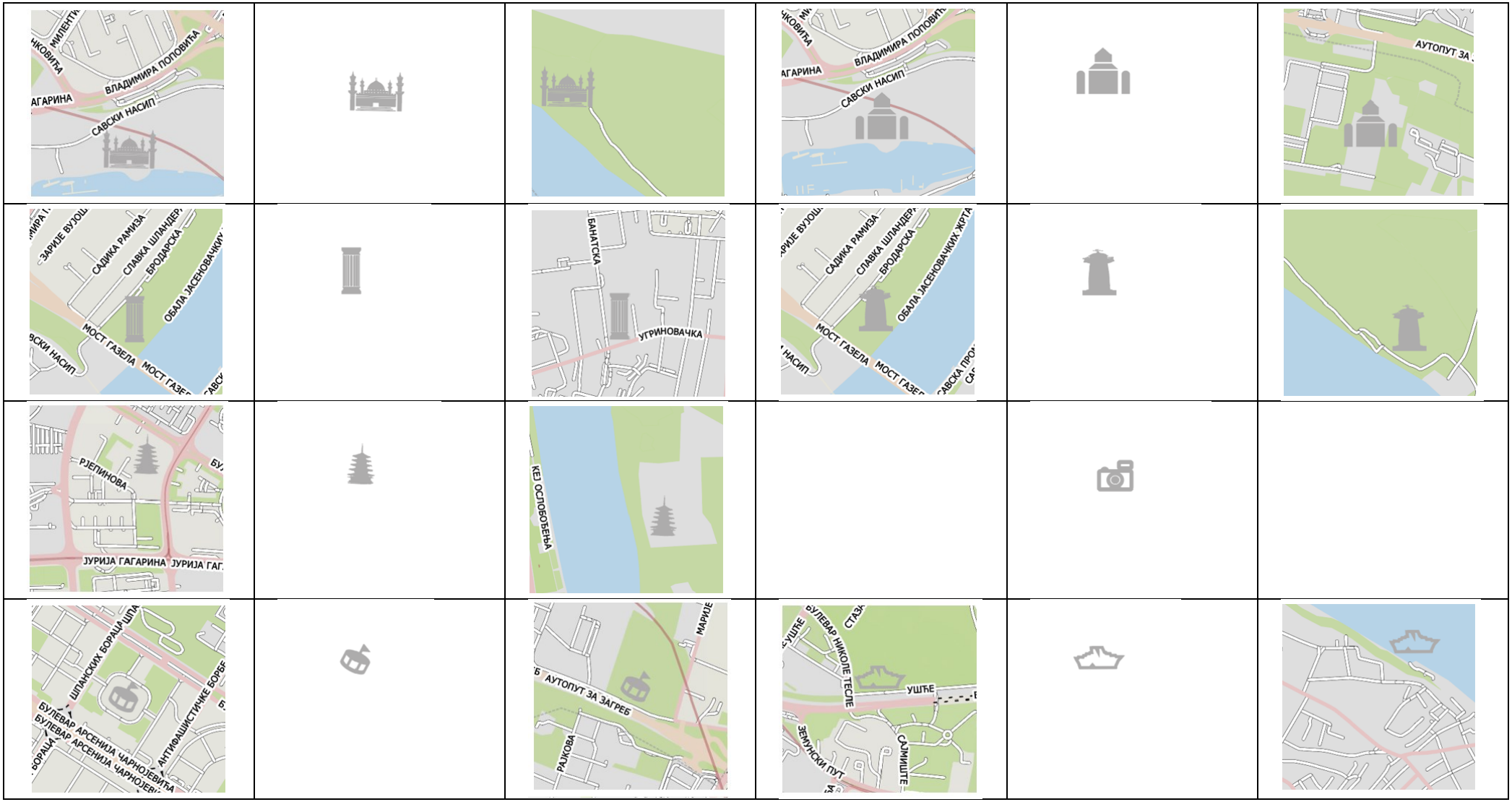
САВСКИ НАСИП



Second Map

PO: With Original Background	PO: Without Background	PO: With Novel Background	NO: With original Background	NO: Without background	NO: With Novel Background
					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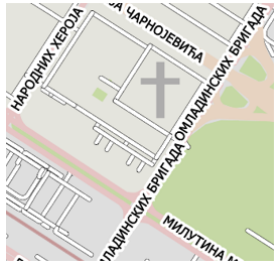
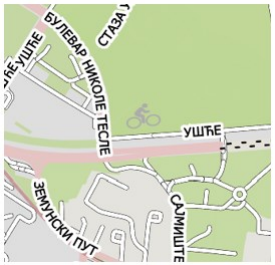
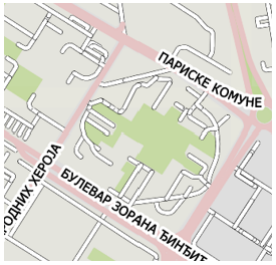
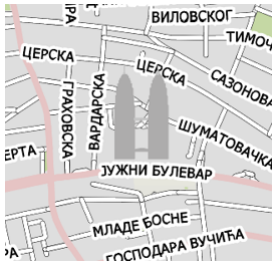
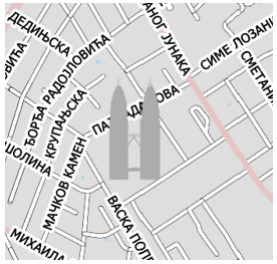
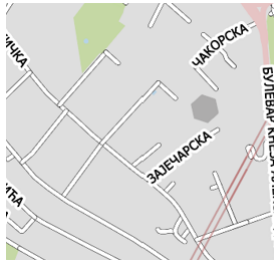
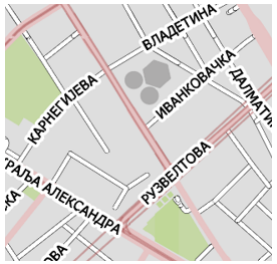
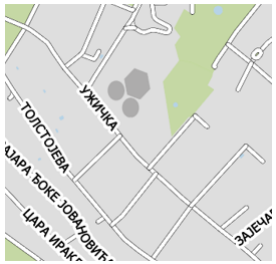
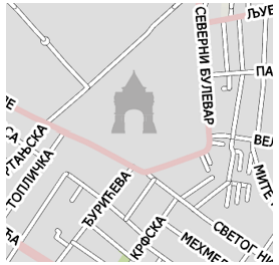
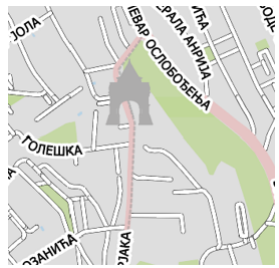
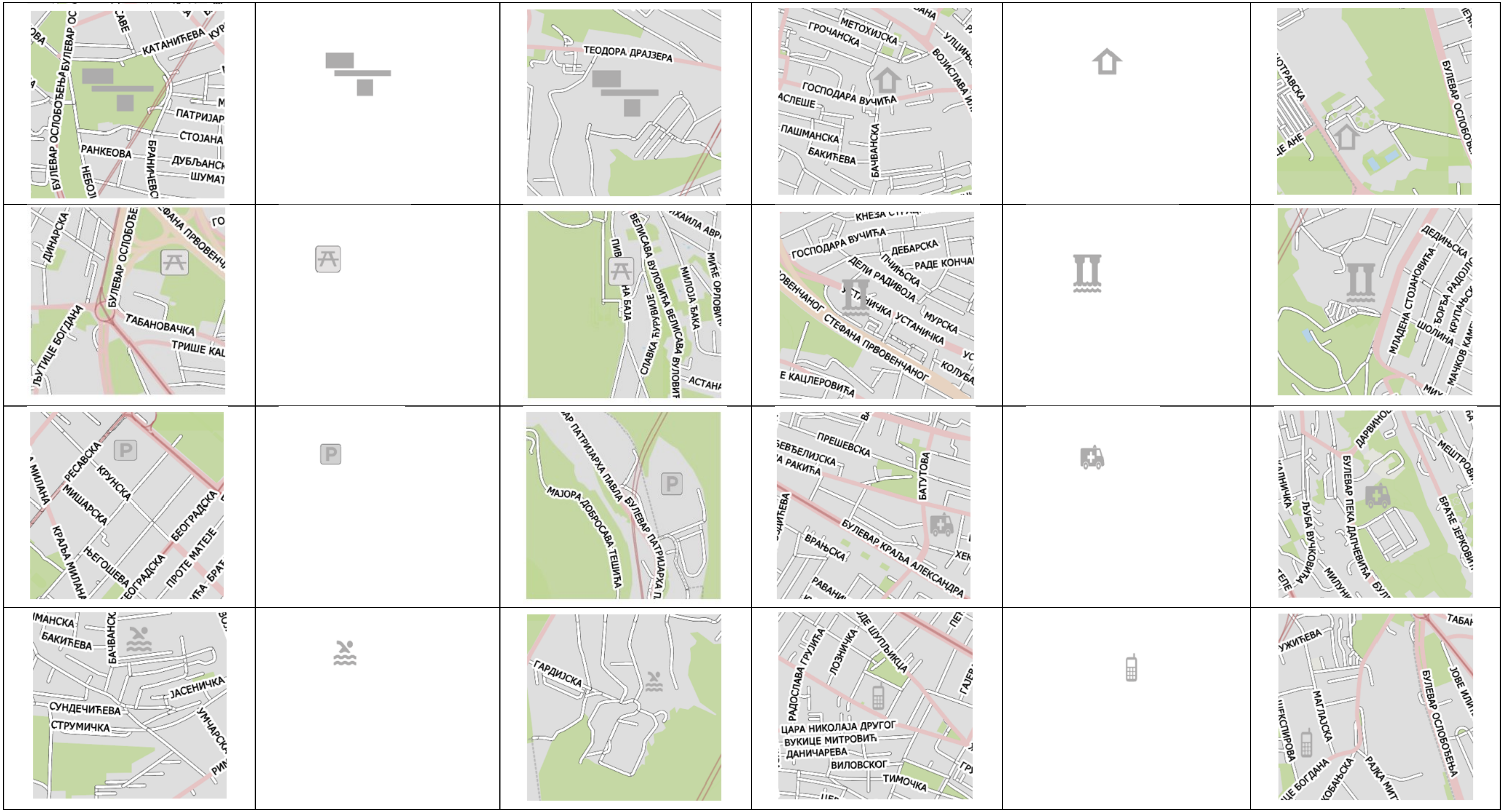
САВСКИ НАСИП
САДИКА РАМИЗА
СЛАВКА ШЛАНДЕРА
БРОДАРСКА
ОБАЛА ЈАСЕНОВАЧКИХ ЖРТАВА
МОСТ ГАЗЕЛА
БАНАТСКА
УГРИНОВАЧКА
РЈЕПИНОВА
ЈУРИЈА ГАГАРИНА
КЕЈ ОСЛОБОЂЕЊА
ШПАНСКИХ БОРАЦА
БУЛЕВАР АРСЕНИЈА ЧАРНОЈЕВИЋА
АНТИФАШИСТИЧКЕ БОРБЕ
АУТОПУТ ЗА ЗАГРЕБ
РАЛКОВА
МАРИЈЕ
БУЛЕВАР НИКОЛЕ ТЕСЛЕ
УШЋЕ
ЗЕМУНСКИ ПУТ
САМИШТЕ

 НАРОДНИХ ХЕРОЈА ЧАРНОЈЕВИЋА ОМЛАДИНСКИХ БРИГАДА МИЛУТИНА		 БАЧКА ПРВОМАЈСКА ШЕВИНА	 НАРОДНИХ ХЕРОЈА ЧАРНОЈЕВИЋА ОМЛАДИНСКИХ БРИГАДА МИЛУТИНА		 МАРИЈЕ БУРСАЋ ПУТ ЗА ЗАГРЕБ
 БУЛЕВАР НИКОЛЕ ТЕСЛЕ УШЋЕ ЗЕМУНСКИ ПУТ САЈМИШТЕ		 ГЛАВНА	 МИЛАНКОВИЋА МИЛУТИНА БУЛЕВАР ЦРВЕНЕ АРМИЈЕ		 ЗМАЈЕВА
 СТУДЕНТСКА НАРОДНИХ ХЕРОЈА					 АУТОПУТ ЗА НОВИ САД СПОЉНА МАГИСТРАЛНА ТАНГЕН УГРИНОВАЧКИ
 ПАРИСКЕ КОМУНЕ НАРОДНИХ ХЕРОЈА БУЛЕВАР ЗОРАНА БИЊИЋ					 ЗМАЈЕВА

Third Map

PO: With Original Background	PO: Without Background	PO: With Novel Background	NO: With original Background	NO: Without background	NO: With Novel Background
					
					
					


КАТАНИЋЕВА
СТОЈАНА
РАНКЕОВА
ТЕОДОРА ДРАЈЗЕРА
МЕТОХИЈСКА
ГРОЧАНСКА
ГОСПОДАРА ВУЧИЋА
ПАШМАНСКА
БАКИЋЕВА
БАЧВАНСКА
ДИНАРСКА
ТАБАНОВАЧКА
МИЛОЈА ЂАКА
ДЕБАРСКА
ПЧИЊСКА
ДЕЛИ РАДИВОЈА
МУРСКА
СТЕФАНА ПРВОВЕНЧАНОГ
ДЕДИЊСКА
ШОЛИНА
РЕСАВСКА
КРУНСКА
МИШАРСКА
ЊЕГОШЕВА
БЕОГРАДСКА
ПРОТЕ МАТЕЈЕ
МАЈОРА ДОБРОСАВА ТЕШИЋА
ПРЕШЕВСКА
БАТУТОВА
ВРАЊСКА
БУЛЕВАР КРАЉА АЛЕКСАНДРА
БУЛЕВАР ПЕКА ДАПЧЕВИЋА
ЈАСЕНИЧКА
СУНДЕЧИЋЕВА
СТРУМИЧКА
ГАРДИЈСКА
ЛОЗНИЧКА
ЦАРА НИКОЛАЈА ДРУГОГ
ДАНИЧАРЕВА
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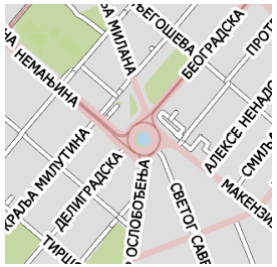
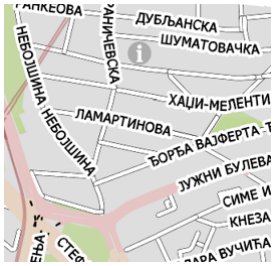
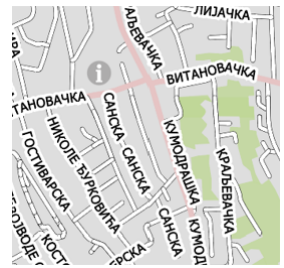
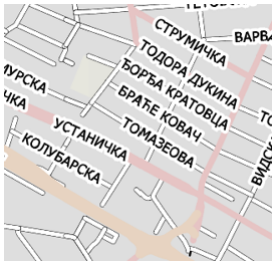
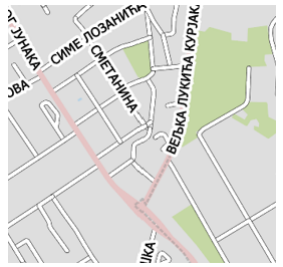
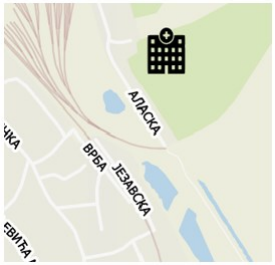
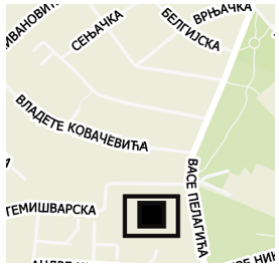
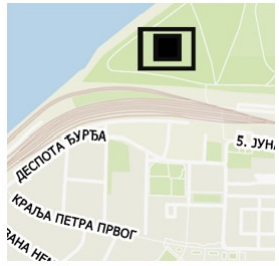
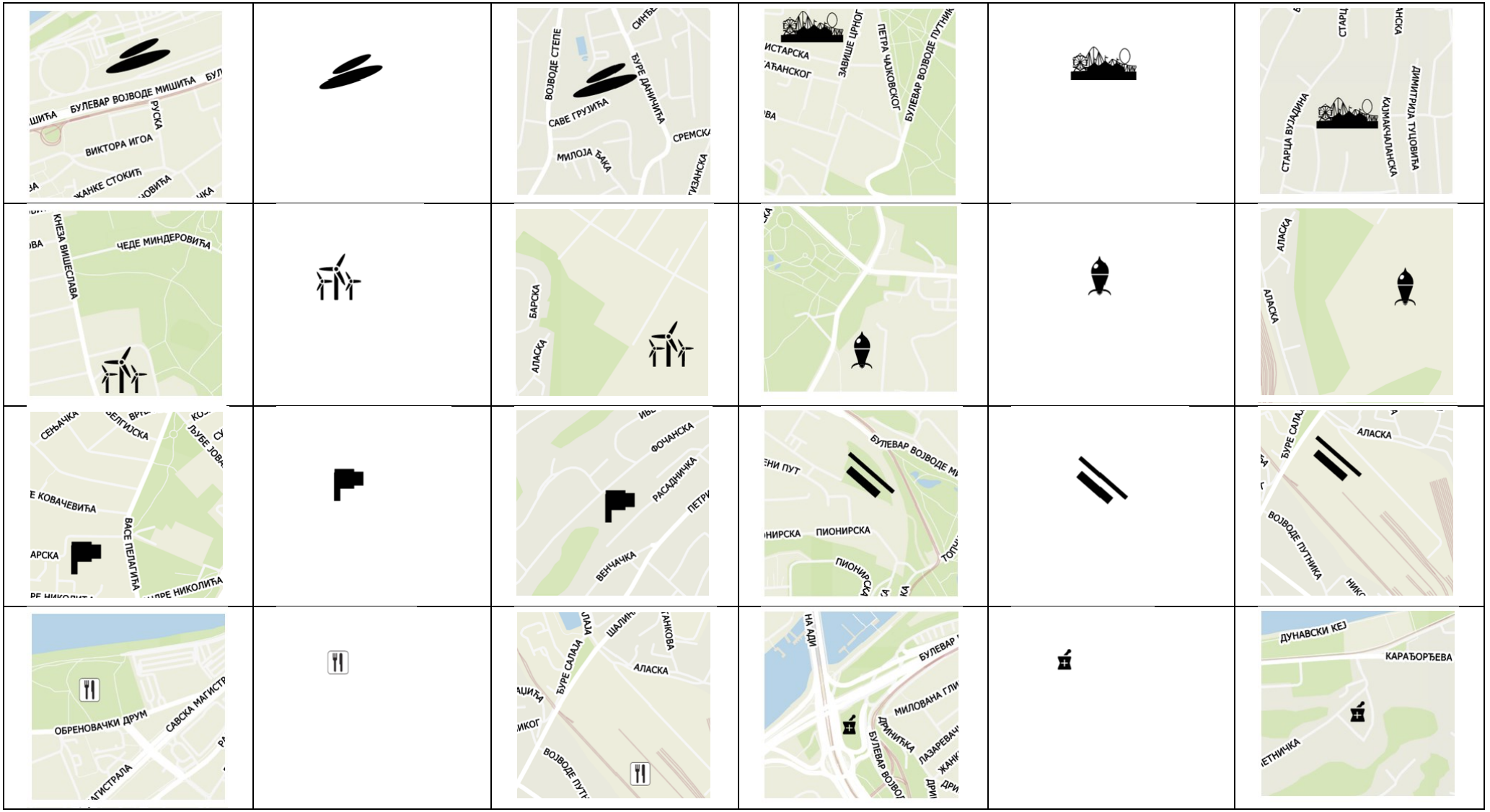
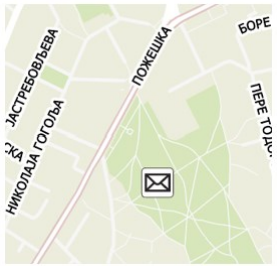
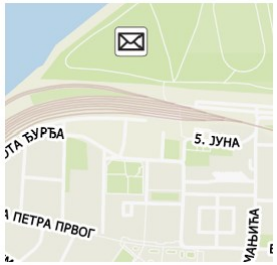
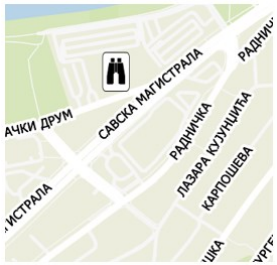
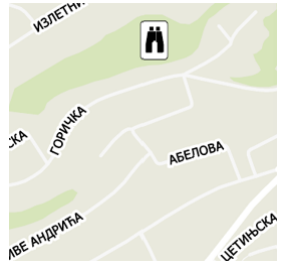
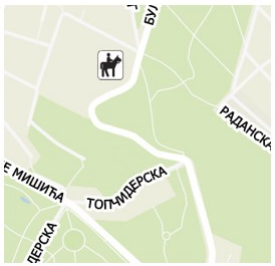
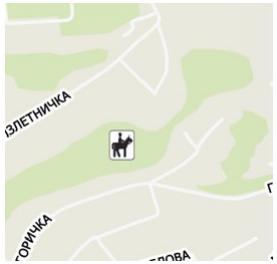
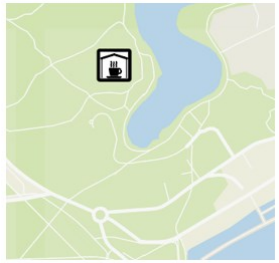
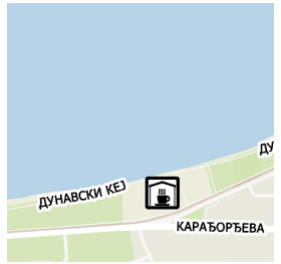
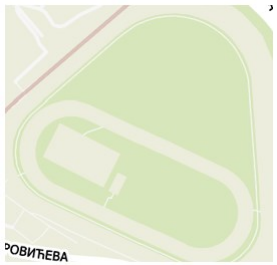
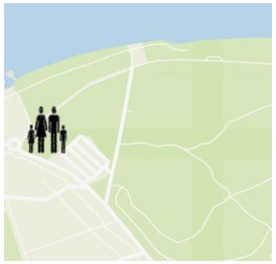
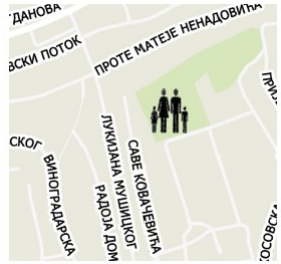
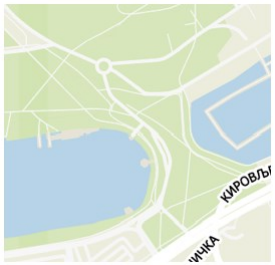
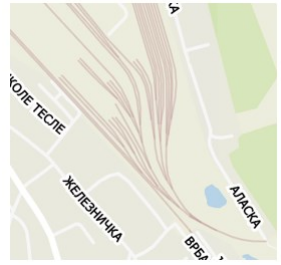
БУЛЕВАР ОСЛОБОЂЕЊА

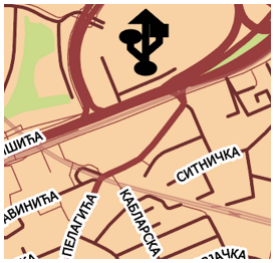
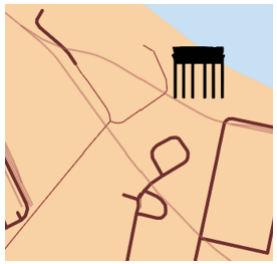
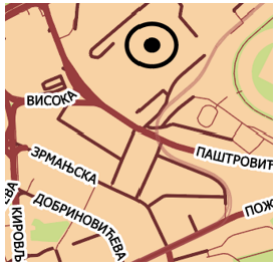
Fourth Map

PO: With Original Background	PO: Without Background	PO: With Novel Background	NO: With original Background	NO: Without background	NO: With Novel Background
					


БУЛЕВАР ВОЈВОДЕ МИШИЋА
РУСКА
ВИКТОРА ИГОА
ЖАНКЕ СТОКИЋ
ВОЈВОДЕ СТЕПЕ
САВЕ ГРУЈИЋА
БУРЕ ДАНИЧИЋА
СРЕМСКА
МИЛОЈА ЂАКА
ЗАВИШЕ ЦРНОГ
ПЕТРА ЧАЈКОВСКОГ
БУЛЕВАР ВОЈВОДЕ ПУТНИКА
СТАРЦА ВУЈАДИНА
ДИМИТРИЈА ТУЦОВИЋА
КАЛМАЧАЛАНСКА
КНЕЗА ВИШЕСЛАВА
ЧЕДЕ МИНДЕРОВИЋА
БАРСКА
АЛАСКА
СЕЊАЧКА
ЂЕЛГИЈСКА
ЉУБЕ ЈОВ
ВАСЕ ПЕЛАГИЋА
ФОЧАНСКА
РАСАДНИЧКА
ВЕНЧАЧКА
БУЛЕВАР ВОЈВОДЕ МИ
ПИОНИРСКА
ВОЈВОДЕ ПУТНИКА
ОБРЕНОВАЧКИ ДРУМ
САВСКА МАГИСТР
ШАПИН
ГАНКОВА
ДУНАВСКИ КЕЈ
КАРАЂОРЂЕВА
МИЛОВАНА ГЛИ
ДРИНЧИЋКА
ЛАЗАРЕВАЧ

 ПОЖЕШКА НИКОЛАЈА ГОГОЉА		 5. ЈУНА ПЕТРА ПРВОГ	 САВСКА МАГИСТРАЛА РАДНИЧКА ЛАЗАРА КУЈУНЏИЋА КАРПОШЕВА		 ГОРИЧКА АБЕЛОВА
 РАДАНСКА ТОПЧИДЕРСКА		 ГОРИЧКА			 ДУНАВСКИ КЕЈ КАРАЂОРЂЕВА
					 ПРОТЕ МАТЕЈЕ НЕНАДОВИЋА ВИНОГРАДАРСКА САВЕ КОВАЧЕВИЋА
					 ЖЕЛЕЗНИЧКА АЛАСКА

Fifth Map

PO: With Original Background	PO: Without Background	PO: With Novel Background	NO: With original Background	NO: Without background	NO: With Novel Background
					
					
					


ОБРЕНОВАЧКИ ДРУМ
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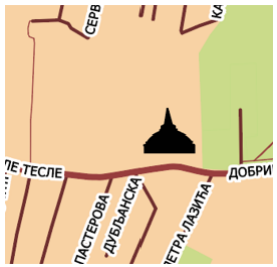
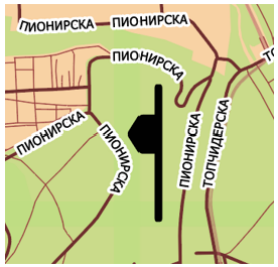
САВСКА МАГИСТРАЛА
РАДНИЧКА


ТЕСЛЕ
ДОБРИ
ПАСТЕРОВА
ДУБЉАНСКА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ПИОНИРСКА
ПИОНИРСКА
ПИОНИРСКА
ТОПЧИДЕРСКА


ЛЕТЊИКОВАЧКА
КАОНСКА
НИКОЛЕ ТЕСЛЕ
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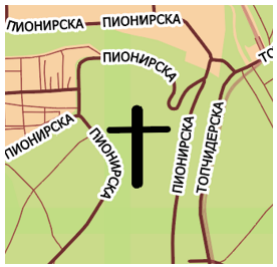
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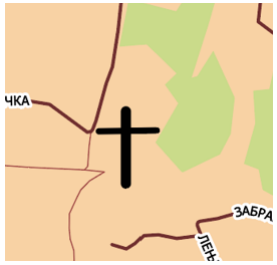
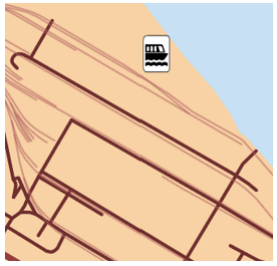
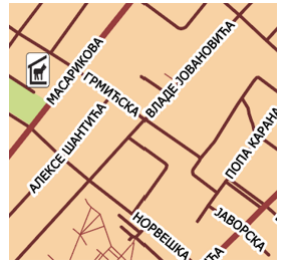

ЗАБРА


БУЛЕВАР ВОЈВОДЕ МИШИЋА
ВИКТОРА ИГОА


ВЕЉКОВА


ВОЈВОДЕ МИШИЋА

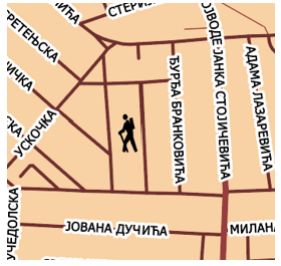


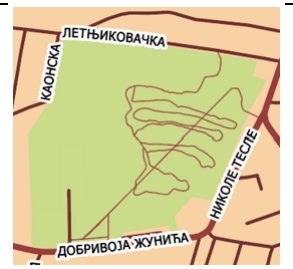

МАСАРИКОВА
ГРМИЧКА
ВЛАДЕ ЈОВАНОВИЋА
АЛЕКСЕ ШАНТИЋА
ПОПА КАРАНА
ЈАВОРСКА


ЧЕДЕ МИНДЕРОВИЋА
ПИОНИРСКА


МАЈКЕ ЈУГОВИЋА
ОРЛОВАЧКА
ЈАЛАЧКА
ТЕСЛЕ
ВИЉЕМА

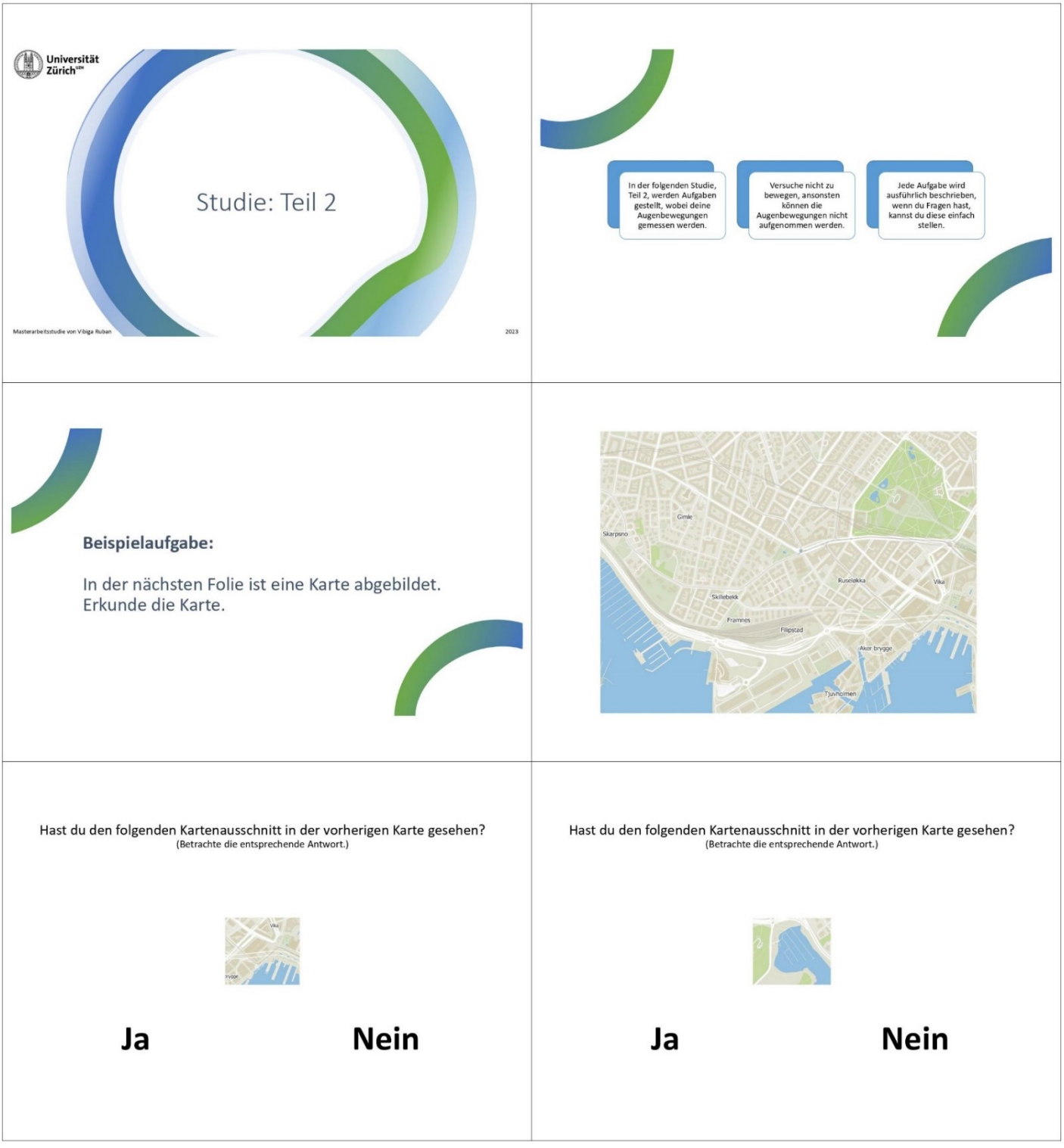

ТЕОДОРА ДРАЈЗЕ
БУЛЕВАР ПАТРИЈАРХА ПАВЛА


ВОЈВОДЕ ЈАНКА СТОЈИЧЕВИЋА
БУРЂА БРАНКОВИЋА
АДАМА ЛАЗАРЕВИЋА
ЈОВАНА ДУЧИЋА

 ОБАЛСКИХ РАДНИКА ПЕТРА МЕЋАВ СТРАШКА ПИЊУ БОГОЉУБА ЧУКИЋ ЧУКАРИЧКА РАДНИЧКА СТРУГАРСКА		 ЉА БРАНКОВИЋА А СТОЈИЧЕВИЋА А ЛАЗАРЕВИЋА МИЛАНА РАКИЋА ОБИЛАЗНИ ПУТ			
 БУЛЕВАР ВОЈВ УЖИЧКА ПЕТРА ЧАЈКОВСК ВОДЕ ПУТНИКА КРАЈИШКА					 ЛЕТЊИКОВАЧКА КАОНСКА НИКОЛЕ ТЕСЛЕ ДОБРИВОЈА ЖУНИЋА

H. Main Experiment Slides

The following figures show the main experiment slides, which were used for the main experiment and created in pptx-Format.



d) Hast du den folgenden Kartenausschnitt in der vorherigen Karte gesehen?
(Betrachte die entsprechende Antwort.)

Ja **Nein**

e) Hast du den folgenden Kartenausschnitt in der vorherigen Karte gesehen?
(Betrachte die entsprechende Antwort.)

Ja **Nein**

f) Hast du den folgenden Kartenausschnitt in der vorherigen Karte gesehen?
(Betrachte die entsprechende Antwort.)

Ja **Nein**

g) Hast du den folgenden Kartenausschnitt in der vorherigen Karte gesehen?
(Betrachte die entsprechende Antwort.)

Ja **Nein**

h) Hast du den folgenden Kartenausschnitt in der vorherigen Karte gesehen?
(Betrachte die entsprechende Antwort.)

Ja **Nein**

i) Hast du den folgenden Kartenausschnitt in der vorherigen Karte gesehen?
(Betrachte die entsprechende Antwort.)

Ja **Nein**

k) Hast du den folgenden Kartenausschnitt in der vorherigen Karte gesehen?
(Betrachte die entsprechende Antwort.)

Ja **Nein**

l) Hast du den folgenden Kartenausschnitt in der vorherigen Karte gesehen?
(Betrachte die entsprechende Antwort.)

Ja **Nein**

m) Hast du den folgenden Kartenausschnitt in der vorherigen Karte gesehen?
(Betrachte die entsprechende Antwort.)

Ja **Nein**

n) Hast du den folgenden Kartenausschnitt in der vorherigen Karte gesehen?
(Betrachte die entsprechende Antwort.)

Ja **Nein**

o) Hast du den folgenden Kartenausschnitt in der vorherigen Karte gesehen?
(Betrachte die entsprechende Antwort.)

Ja **Nein**

p) Hast du den folgenden Kartenausschnitt in der vorherigen Karte gesehen?
(Betrachte die entsprechende Antwort.)

Ja **Nein**

q) Hast du den folgenden Kartenausschnitt in der vorherigen Karte gesehen?
(Betrachte die entsprechende Antwort.)

Ja **Nein**

r) Hast du den folgenden Kartenausschnitt in der vorherigen Karte gesehen?
(Betrachte die entsprechende Antwort.)

Ja **Nein**

s) Hast du den folgenden Kartenausschnitt in der vorherigen Karte gesehen?
(Betrachte die entsprechende Antwort.)

Ja **Nein**

Aufgabe 2:

Erkunde die zunächst folgende Karte.

a) Hast du den folgenden Kartenausschnitt in der vorherigen Karte gesehen?
(Betrachte die entsprechende Antwort.)

Ja **Nein**

b) Hast du den folgenden Kartenausschnitt in der vorherigen Karte gesehen?
(Betrachte die entsprechende Antwort.)

Ja **Nein**

c) Hast du den folgenden Kartenausschnitt in der vorherigen Karte gesehen?
(Betrachte die entsprechende Antwort.)

Ja **Nein**

d) Hast du den folgenden Kartenausschnitt in der vorherigen Karte gesehen?
(Betrachte die entsprechende Antwort.)

Ja **Nein**

e) Hast du den folgenden Kartenausschnitt in der vorherigen Karte gesehen?
(Betrachte die entsprechende Antwort.)

Ja **Nein**

f) Hast du den folgenden Kartenausschnitt in der vorherigen Karte gesehen?
(Betrachte die entsprechende Antwort.)

Ja **Nein**

g) Hast du den folgenden Kartenausschnitt in der vorherigen Karte gesehen?
(Betrachte die entsprechende Antwort.)

Ja **Nein**

h) Hast du den folgenden Kartenausschnitt in der vorherigen Karte gesehen?
(Betrachte die entsprechende Antwort.)

Ja **Nein**

i) Hast du den folgenden Kartenausschnitt in der vorherigen Karte gesehen?
(Betrachte die entsprechende Antwort.)

Ja **Nein**

k) Hast du den folgenden Kartenausschnitt in der vorherigen Karte gesehen?
(Betrachte die entsprechende Antwort.)

Ja **Nein**

l) Hast du den folgenden Kartenausschnitt in der vorherigen Karte gesehen?
(Betrachte die entsprechende Antwort.)

Ja **Nein**

m) Hast du den folgenden Kartenausschnitt in der vorherigen Karte gesehen?
(Betrachte die entsprechende Antwort.)

Ja **Nein**

n) Hast du den folgenden Kartenausschnitt in der vorherigen Karte gesehen?
(Betrachte die entsprechende Antwort.)

Ja **Nein**

o) Hast du den folgenden Kartenausschnitt in der vorherigen Karte gesehen?
(Betrachte die entsprechende Antwort.)

Ja **Nein**

p) Hast du den folgenden Kartenausschnitt in der vorherigen Karte gesehen?
(Betrachte die entsprechende Antwort.)

Ja **Nein**

q) Hast du den folgenden Kartenausschnitt in der vorherigen Karte gesehen?
(Betrachte die entsprechende Antwort.)

Ja **Nein**

r) Hast du den folgenden Kartenausschnitt in der vorherigen Karte gesehen?
(Betrachte die entsprechende Antwort.)

Ja **Nein**

s) Hast du den folgenden Kartenausschnitt in der vorherigen Karte gesehen?
(Betrachte die entsprechende Antwort.)

Ja **Nein**

Aufgabe 3:

Erkunde die zunächst folgende Karte.

f) Hast du den folgenden Kartenausschnitt in der vorherigen Karte gesehen?
(Betrachte die entsprechende Antwort.)

Ja **Nein**

g) Hast du den folgenden Kartenausschnitt in der vorherigen Karte gesehen?
(Betrachte die entsprechende Antwort.)

Ja **Nein**

h) Hast du den folgenden Kartenausschnitt in der vorherigen Karte gesehen?
(Betrachte die entsprechende Antwort.)

Ja **Nein**

i) Hast du den folgenden Kartenausschnitt in der vorherigen Karte gesehen?
(Betrachte die entsprechende Antwort.)

Ja **Nein**

k) Hast du den folgenden Kartenausschnitt in der vorherigen Karte gesehen?
(Betrachte die entsprechende Antwort.)

Ja **Nein**

l) Hast du den folgenden Kartenausschnitt in der vorherigen Karte gesehen?
(Betrachte die entsprechende Antwort.)

Ja **Nein**

m) Hast du den folgenden Kartenausschnitt in der vorherigen Karte gesehen?
(Betrachte die entsprechende Antwort.)

Ja **Nein**

n) Hast du den folgenden Kartenausschnitt in der vorherigen Karte gesehen?
(Betrachte die entsprechende Antwort.)

Ja **Nein**

o) Hast du den folgenden Kartenausschnitt in der vorherigen Karte gesehen?
(Betrachte die entsprechende Antwort.)

Ja **Nein**

p) Hast du den folgenden Kartenausschnitt in der vorherigen Karte gesehen?
(Betrachte die entsprechende Antwort.)

Ja **Nein**

q) Hast du den folgenden Kartenausschnitt in der vorherigen Karte gesehen?
(Betrachte die entsprechende Antwort.)

Ja **Nein**

r) Hast du den folgenden Kartenausschnitt in der vorherigen Karte gesehen?
(Betrachte die entsprechende Antwort.)

Ja **Nein**

s) Hast du den folgenden Kartenausschnitt in der vorherigen Karte gesehen?
(Betrachte die entsprechende Antwort.)

Ja **Nein**

Aufgabe 4:

Erkunde die zunächst folgende Karte.

a) Hast du den folgenden Kartenausschnitt in der vorherigen Karte gesehen?
(Betrachte die entsprechende Antwort.)

Ja **Nein**

b) Hast du den folgenden Kartenausschnitt in der vorherigen Karte gesehen?
(Betrachte die entsprechende Antwort.)

Ja **Nein**

c) Hast du den folgenden Kartenausschnitt in der vorherigen Karte gesehen?
(Betrachte die entsprechende Antwort.)

Ja **Nein**

d) Hast du den folgenden Kartenausschnitt in der vorherigen Karte gesehen?
(Betrachte die entsprechende Antwort.)

Ja **Nein**

e) Hast du den folgenden Kartenausschnitt in der vorherigen Karte gesehen?
(Betrachte die entsprechende Antwort.)

Ja **Nein**

f) Hast du den folgenden Kartenausschnitt in der vorherigen Karte gesehen?
(Betrachte die entsprechende Antwort.)

Ja **Nein**

g) Hast du den folgenden Kartenausschnitt in der vorherigen Karte gesehen?
(Betrachte die entsprechende Antwort.)

Ja **Nein**

h) Hast du den folgenden Kartenausschnitt in der vorherigen Karte gesehen?
(Betrachte die entsprechende Antwort.)

Ja **Nein**

i) Hast du den folgenden Kartenausschnitt in der vorherigen Karte gesehen?
(Betrachte die entsprechende Antwort.)

Ja **Nein**

k) Hast du den folgenden Kartenausschnitt in der vorherigen Karte gesehen?
(Betrachte die entsprechende Antwort.)

Ja **Nein**

l) Hast du den folgenden Kartenausschnitt in der vorherigen Karte gesehen?
(Betrachte die entsprechende Antwort.)

Ja **Nein**

m) Hast du den folgenden Kartenausschnitt in der vorherigen Karte gesehen?
(Betrachte die entsprechende Antwort.)

Ja **Nein**

n) Hast du den folgenden Kartenausschnitt in der vorherigen Karte gesehen?
(Betrachte die entsprechende Antwort.)

Ja **Nein**

o) Hast du den folgenden Kartenausschnitt in der vorherigen Karte gesehen?
(Betrachte die entsprechende Antwort.)

Ja **Nein**

p) Hast du den folgenden Kartenausschnitt in der vorherigen Karte gesehen?
(Betrachte die entsprechende Antwort.)

Ja **Nein**

q) Hast du den folgenden Kartenausschnitt in der vorherigen Karte gesehen?
(Betrachte die entsprechende Antwort.)

Ja **Nein**

r) Hast du den folgenden Kartenausschnitt in der vorherigen Karte gesehen?
(Betrachte die entsprechende Antwort.)

Ja **Nein**

s) Hast du den folgenden Kartenausschnitt in der vorherigen Karte gesehen?
(Betrachte die entsprechende Antwort.)

Ja **Nein**

Aufgabe 5:

Erkunde die zunächst folgende Karte.

a) Hast du den folgenden Kartenausschnitt in der vorherigen Karte gesehen?
(Betrachte die entsprechende Antwort.)

Ja **Nein**

b) Hast du den folgenden Kartenausschnitt in der vorherigen Karte gesehen?
(Betrachte die entsprechende Antwort.)

Ja **Nein**

c) Hast du den folgenden Kartenausschnitt in der vorherigen Karte gesehen?
(Betrachte die entsprechende Antwort.)

Ja **Nein**

d) Hast du den folgenden Kartenausschnitt in der vorherigen Karte gesehen?
(Betrachte die entsprechende Antwort.)

Ja **Nein**

e) Hast du den folgenden Kartenausschnitt in der vorherigen Karte gesehen?
(Betrachte die entsprechende Antwort.)

Ja **Nein**

f) Hast du den folgenden Kartenausschnitt in der vorherigen Karte gesehen?
(Betrachte die entsprechende Antwort.)

→

Ja **Nein**

g) Hast du den folgenden Kartenausschnitt in der vorherigen Karte gesehen?
(Betrachte die entsprechende Antwort.)

Ja **Nein**

h) Hast du den folgenden Kartenausschnitt in der vorherigen Karte gesehen?
(Betrachte die entsprechende Antwort.)

Ja **Nein**

i) Hast du den folgenden Kartenausschnitt in der vorherigen Karte gesehen?
(Betrachte die entsprechende Antwort.)

Ja **Nein**

k) Hast du den folgenden Kartenausschnitt in der vorherigen Karte gesehen?
(Betrachte die entsprechende Antwort.)

Ja **Nein**

l) Hast du den folgenden Kartenausschnitt in der vorherigen Karte gesehen?
(Betrachte die entsprechende Antwort.)

Ja **Nein**

m) Hast du den folgenden Kartenausschnitt in der vorherigen Karte gesehen?
(Betrachte die entsprechende Antwort.)

Ja **Nein**

n) Hast du den folgenden Kartenausschnitt in der vorherigen Karte gesehen?
(Betrachte die entsprechende Antwort.)

Ja **Nein**

o) Hast du den folgenden Kartenausschnitt in der vorherigen Karte gesehen?
(Betrachte die entsprechende Antwort.)

Ja **Nein**

p) Hast du den folgenden Kartenausschnitt in der vorherigen Karte gesehen?
(Betrachte die entsprechende Antwort.)

Ja **Nein**

q) Hast du den folgenden Kartenausschnitt in der vorherigen Karte gesehen?
(Betrachte die entsprechende Antwort.)

Ja **Nein**

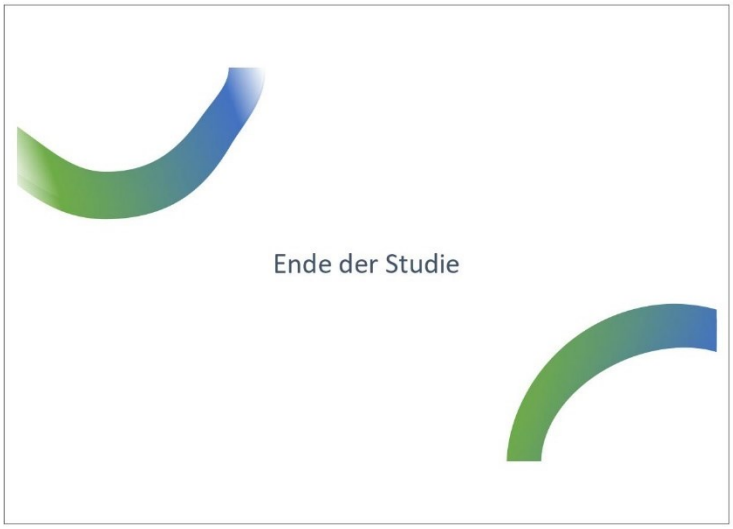
r) Hast du den folgenden Kartenausschnitt in der vorherigen Karte gesehen?
(Betrachte die entsprechende Antwort.)

Ja **Nein**

s) Hast du den folgenden Kartenausschnitt in der vorherigen Karte gesehen?
(Betrachte die entsprechende Antwort.)

Ja **Nein**

Aufgabe 6: Bewertungsfragen zur Karte


Ende der Studie

I. Main Experiment: Evaluation Task

In the following, the questions for the evaluation task from the main experiment are listed.

Bewertungsaufgabe 6: Studie Teil 2

Teilnehmer-ID:_____

	1	2	3	4	5
i. Wie attraktiv war das Kartendesign von der 1. Karte?	☐	☐	☐	☐	☐

1 – sehr unattraktiv, 2 – unattraktiv, 3 – neutral, 4 – attraktiv, 5 – exzellent

ii. Was hast du auf der 1. Karte zuerst gesehen?

- Symbole/Attraktionen ☐ Ja ☐ Nein
- Strassen ☐ Ja ☐ Nein
- Kartendesign ☐ Ja ☐ Nein
- Farben ☐ Ja ☐ Nein
- Gewässer ☐ Ja ☐ Nein
- Sonstige: _____ ☐ Ja ☐ Nein

iii. Was hat dir an der 1. Karte am besten gefallen?

a) Kartendesign	☐
b) Symbole/Attraktionen	☐
c) Farbwahl	☐
d) Andere:_____	☐

iv. Was hat dir an der 1. Karte am wenigsten gefallen?

a) Kartendesign	☐
b) Symbole/Attraktionen	☐
c) Farbwahl	☐

d) Andere:_____	☐

	1	2	3	4	5
v. Wie vertraut bist du mit solchen touristischen Stadtplänen?	☐	☐	☐	☐	☐

1 – sehr unvertraut, 2 – unvertraut, 3 – neutral, 4 – vertraut, 5 – sehr vertraut

	1	2	3	4	5
vi. Wie wahrscheinlich ist es, dass du auch in Zukunft Stadtpläne benutzen wirst?	☐	☐	☐	☐	☐

1 – sehr unwahrscheinlich, 2 – unwahrscheinlich, 3 – neutral, 4 – wahrscheinlich, 5 – sehr wahrscheinlich

vii. Welche der 5 verschiedenen Karten hat dir persönlich am besten gefallen, welches nicht?

Gefällt mir: _____

Gefällt mir nicht: _____

J. Tobii Pro Lab: Main Experiment Design

The following figures show how the main experiment was designed with Tobii Pro Lab.

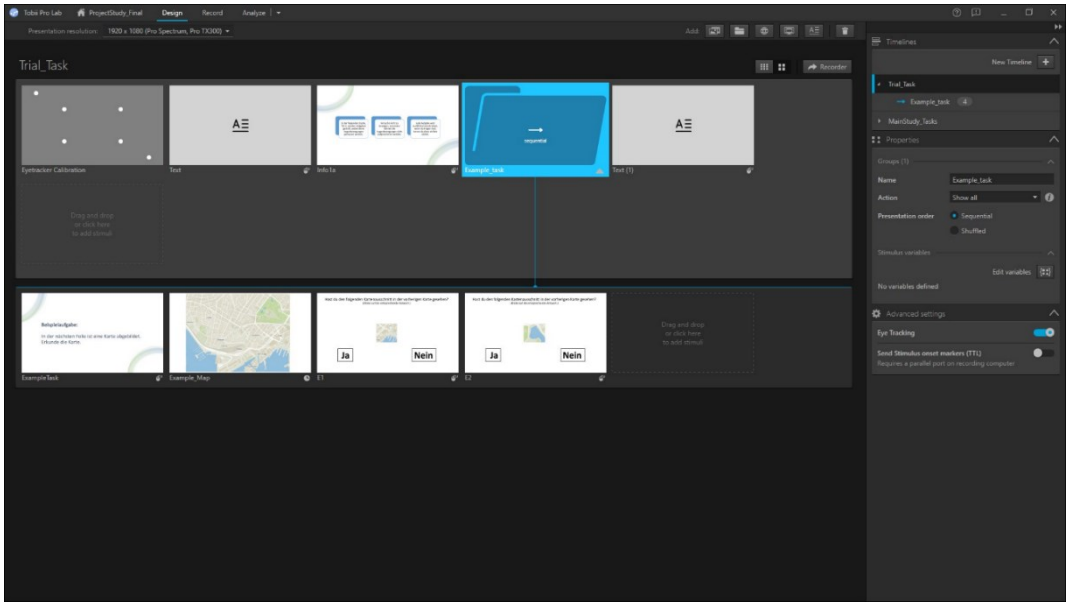


Figure 60: Trial task timeline design in Tobii Pro Lab

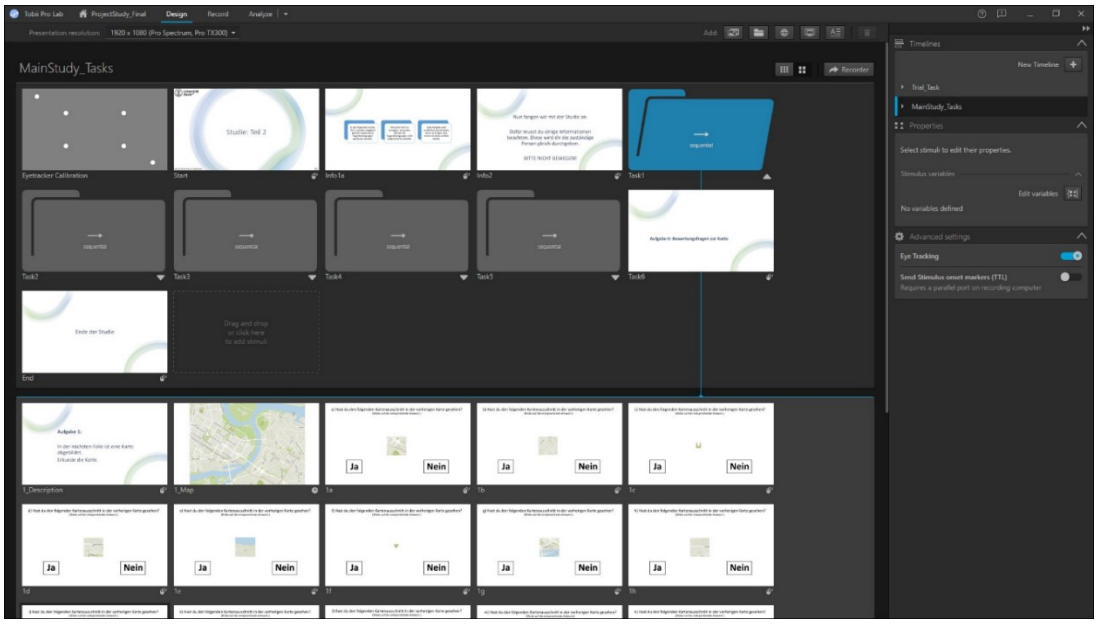


Figure 61: First task timeline design in Tobii Pro Lab

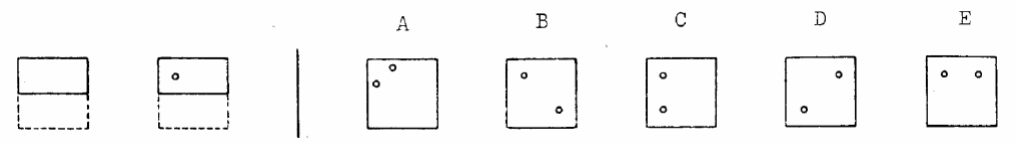
K. Paper Folding Test

Name / ID: _____

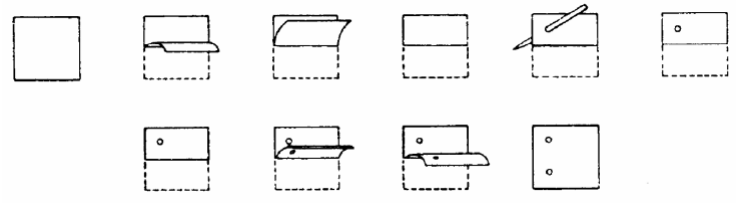
Papier-Falt-Test

Bei diesem Test sollen Sie sich das Falten und Entfalten von Papierstücken vorstellen. In jeder Aufgabe des Tests sind einige Figuren links von einer vertikalen Linie und andere rechts von dieser Linie gezeichnet. Die Figuren auf der linken Seite stellen ein quadratisches Stück Papier dar, das gefaltet wird, und auf der letzten dieser Figuren sind ein oder zwei kleine Kreise eingezeichnet, um zu zeigen, wo das Papier gelocht worden ist. Jedes Loch wird durch alle Papierstärken an dieser Stelle gestanzt.

Eine der fünf Figuren rechts von der senkrechten Linie zeigt, wo die Löcher sein werden, wenn das Papier vollständig entfaltet ist. Entscheiden Sie, welche dieser Figuren richtig ist und zeichnen Sie ein X durch diese Figur. Versuchen Sie nun die folgende Beispielaufgabe. (Bei dieser Aufgabe wurde nur ein Loch in das gefaltete Papier gestanzt).



Die richtige Antwort auf die obige Musteraufgabe ist C und hätte daher mit einem X markiert werden müssen. Die folgenden Abbildungen zeigen, wie das Papier gefaltet wurde und warum C die richtige Antwort ist.



Bei diesen Aufgaben werden alle Faltungen, die gemacht werden, in den Abbildungen links von der Linie gezeigt, und das Papier wird nicht gedreht oder in irgendeiner Weise bewegt, außer um die in den Abbildungen gezeigten Faltungen zu machen. Denken Sie daran, dass die richtige Antwort die Abbildung ist, die die Positionen der Löcher zeigt, wenn das Papier vollständig entfaltet ist.

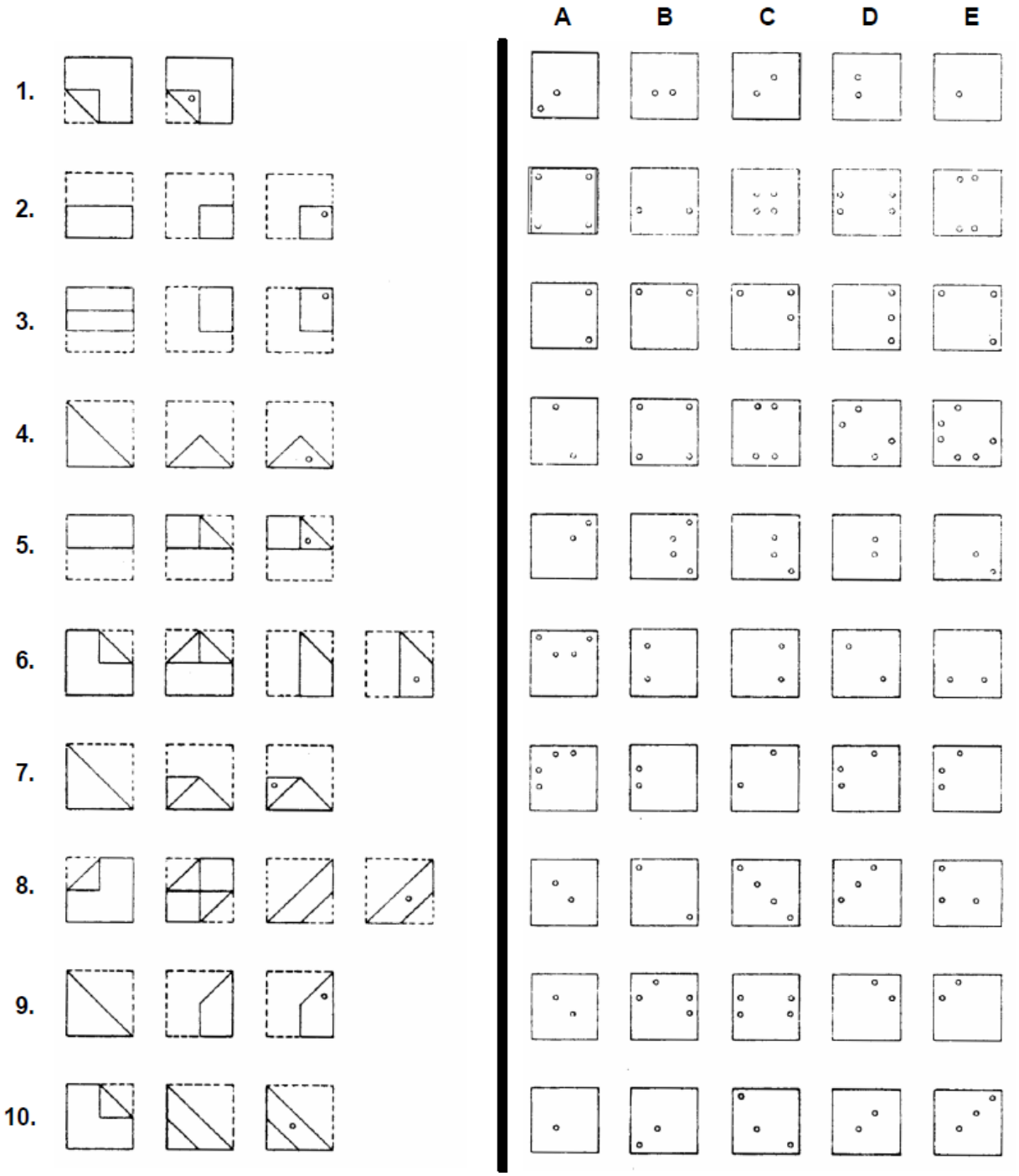
Die Punktzahl für diesen Test ergibt sich aus der Anzahl der richtig angekreuzten Punkte abzüglich eines Bruchteils der falsch angekreuzten Punkte. Daher ist es nicht von Vorteil, wenn Sie raten, es sei denn, Sie können eine oder mehrere der Antwortmöglichkeiten als falsch ausschließen.

Für jeden der beiden Teile dieses Tests haben Sie 3 Minuten Zeit. Jeder Teil besteht aus 1 Seite. Wenn Sie Teil 1 beendet haben, STOPPEN Sie. Bitte gehen Sie erst zu Teil 2 über, wenn Sie dazu aufgefordert werden, dazu aufgefordert werden.

BLÄTTERN SIE DIESE SEITE NICHT UM, BEVOR SIE DAZU AUFGEFORDERT WERDEN.

Seite 2

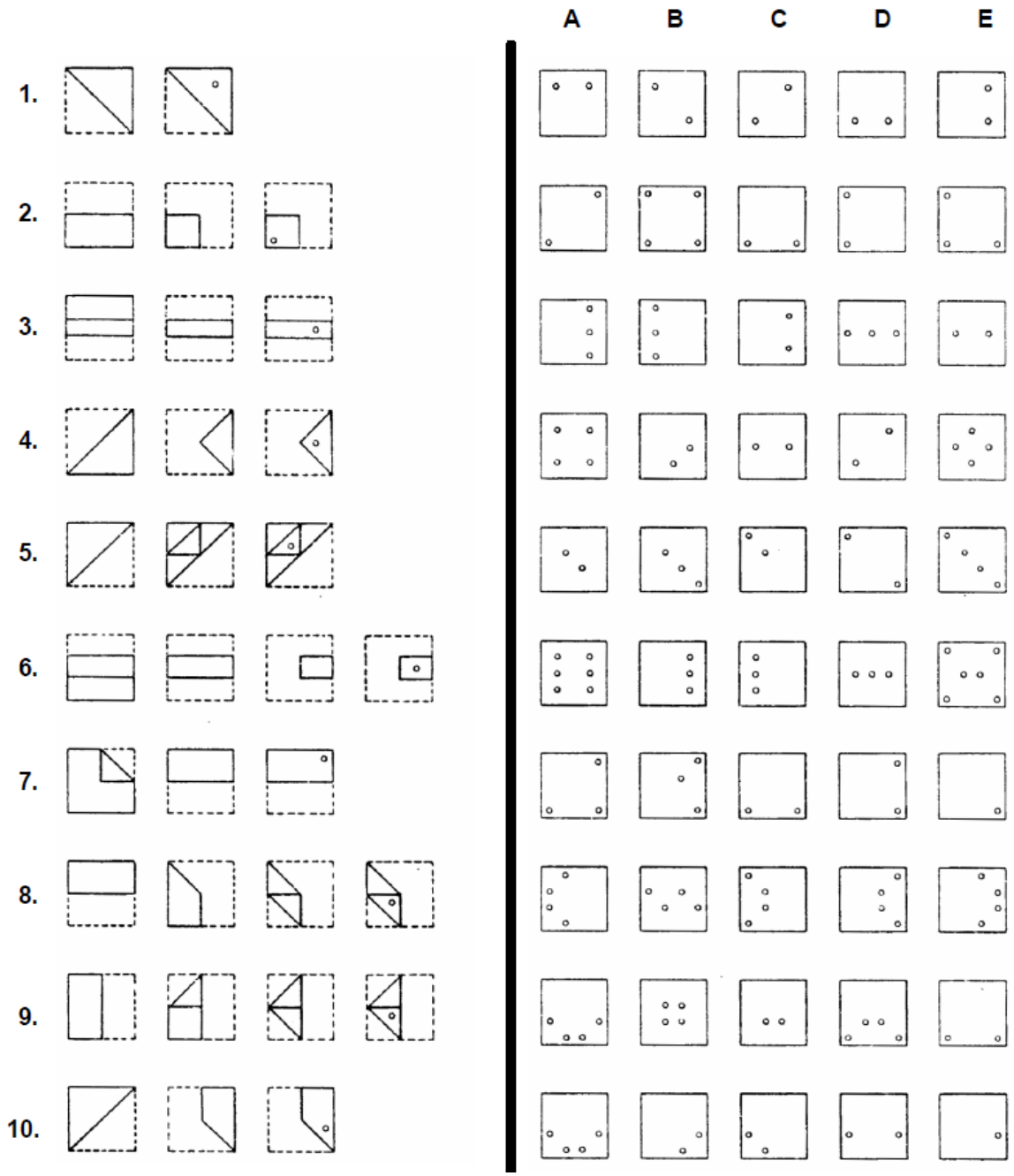
Teil 1(3 Minuten)



GEHEN SIE ERST AUF DIE NÄCHSTE SEITE, WENN SIE DAZU AUFGEFORDERT WERDEN.

STOP.

Seite 3



Teil 2(3 Minuten)

GEHEN SIE NICHT ZU TEIL 1 ZURÜCK, UND
GEHEN SIE ERST AUF DIE NÄCHSTE SEITE, WENN SIE DAZU AUFGEFORDERT WERDEN.

STOP.

L. Questionnaire

Information screen

Before the participant decides to participate,
The following information is shown:
Liebe/r Teilnehmer/in,
Nun findet der letzte Teil der Studie statt. Dazu würde ich gerne mehr über dich erfahren. Die Dauer dieser Umfrage beträgt etwa 5 - 10 Minuten. Für den Erfolg der Studie ist es wichtig, dass du den Fragebogen vollständig ausfüllst und keine Fragen auslässt. Alle Daten werden anonym erhoben, sie können deiner Person nicht zugeordnet werden und werden streng vertraulich behandelt.
Vielen Dank für deine Teilnahme an meiner Studie und damit auch für deinen Beitrag.

Researcher information:
Vibiga Ruban
MSc Student
Department of Geography, University of Zurich
vibiga_96@hotmail.de

Consent prompt (needs to be ticked to be able to continue):
Bitte bestätige, dass du an dieser Umfrage teilnehmen möchten. Deine Informationen (einschließlich Computer-IP) werden gespeichert und möglicherweise für Forschungszwecke verwendet.

Questions/Items

Item number: 1

Teilnehmer_ID (Wird von Anweisende ausgefüllt)
The following item allows the participant to enter information with the keyboard
Item number: 2

Wie alt bist du?
The following item allows the participant to enter information with the keyboard
1.
Item number: 3

Geschlecht:
1. Männlich
2. Weiblich
3. Andere

Item number: 4

Welches ist dein höchster Schul- oder Hochschulabschluss?
1. Oberstufe
2. Lehre/Ausbildung

3. Berufsmatura
4. Höhere Fachschule (HF)
5. Gymnasiale Matura
6. Sonstige (Bitte angeben)

Item number: 5

Wie oft hast du Kontakt zu den Menschen in deinem Beruf?
In this item, participants need use a slider to enter their information

1. 1=Nie, 2=Selten, 3=Manchmal, 4=Oft, 5=Immer

Item number: 6

Wie oft musst du mit den Arbeitskollegen/-innen Aufgaben erledigen?
In this item, participants need use a slider to enter their information

1. 1=Nie, 2=Selten, 3=Manchmal, 4=Oft, 5=Immer

Item number: 7

Wie oft arbeitest du mit Zahlen in deinem Beruf (z.B. Rechnen)?
In this item, participants need use a slider to enter their information

1. 1=Nie, 2=Selten, 3=Manchmal, 4=Oft, 5=Immer

Item number: 8

Wie oft musst du selbständig strategische Entscheidungen treffen in deinem Beruf?
In this item, participants need use a slider to enter their information

1. 1=Nie, 2=Selten, 3=Manchmal, 4=Oft, 5=Immer

Item number: 9

Wo bist du geboren?

1. Schweiz
2. Sri Lanka
3. Andere

Item number: 10

Wo hast du die meiste Zeit deines Lebens verbracht?

1. Schweiz
2. Sri Lanka
3. Andere

Item number: 11

Wo ist dein Vater geboren?

1. Schweiz
2. Sri Lanka
3. Andere

Item number: 12

Wo ist deine Mutter geboren?

1. Schweiz
2. Sri Lanka
3. Andere

Item number: 13

Bist du zwei- oder mehrsprachig aufgewachsen?

1. Ja
2. Nein

Item number: 14

Wie oft benutzt du Karten? (z.B. Google Maps, Skitourenkarten, Orientierungslaufkarten, Luftfahrtkarten, etc.)
In this item, participants need use a slider to enter their information

1. 1=Nie, 2=Selten, 3=Manchmal, 4=Oft, 5=Immer

Item number: 15

Wie oft feierst du die Feiertage deiner Kultur?
In this item, participants need use a slider to enter their information

1. 1=Nie, 2=Selten, 3=Manchmal, 4=Oft, 5=Immer

Item number: 16

Es ist Zeit einem Kind eine Geschichte zu erzählen, so du erzählst...

1. Eine Geschichte, die meine Eltern erzählt haben.
2. Eine Geschichte, die die meisten Menschen kennen.
3. Eine Geschichte, die ich frei erfunden habe.

Item number: 17

Für wie traditionell hältst du dich persönlich?
(1=Nie, 2=Selten, 3=Manchmal, 4=Oft, 5=Immer)
In this item, participants need use a slider to enter their information

1. 1=Gar nicht, 2=Eher nicht, 3=Teilweise, 4=Eher, 5=Sehr

At the end of the survey

At the end of the survey, the following information is shown to the participant:

Vielen Dank für deine Teilnahme!

M. Consent Form

Einwilligungserklärung zur Studienteilnahme

Masterarbeit – Kultureller Einfluss aufs Kartenlesen: Ein Unterschied zwischen Menschen mit schweizerischer und tamilischer Herkunft

2023

Teilnehmer-ID: _____

Zweck der Studie

Du bist eingeladen, an einer Studie zum «Kulturellen Einfluss aufs Kartenlesen» teilzunehmen. Das Ziel dieser Studie ist, neue Erkenntnisse zu gewinnen über den kulturellen Einfluss aufs Kartenlesen. Diese Studie wird von Vibiga Ruban im Rahmen ihrer Masterarbeit durchgeführt. Die Masterarbeit wird von Prof. Dr. Sara Fabrikant am Geographischen Institut der Universität Zürich betreut.

Ablauf der Studie

Die Studie ist in vier Teilen gegliedert. Falls du Dich entscheiden hast, an dieser Studie teilzunehmen, wirst Du im ersten Teil Aufgaben am Bildschirm lösen, wobei es um sich hier um «Navon Aufgaben, Stroop Effect Aufgaben» und ein paar Fragen handelt. Im zweiten Teil dieser Studie wird die Aufgabenstellung zuerst durch eine Beispielaufgabe erklärt, darauffolgend wirst Du weitere Aufgaben mit Karten selbständig bearbeiten, wobei Deine Augenbewegungen in diesem Teil aufgenommen werden. Die Aufnahme der Augenbewegungen ist ungefährlich. Nach diesem Aufgabenblock mit Karten am Bildschirm wirst Du im dritten Teil der Studie eine Aufgabe auf Papier lösen. Zum Schluss wirst Du einen Fragebogen ausfüllen, wobei Du auch einige Angaben zu Deiner Person ausfüllen wirst. Alle aufgezeichneten Daten werden anonymisiert. Dies bedeutet, dass Deine Antworten zu den gestellten Fragen am Computer, die Aufgaben mit den Karten sowie die Antworten zu den Aufgaben auf Papier und deine Augenbewegungen anonymisiert aufgenommen und verarbeitet werden. Das ganze Experiment findet im Eye Movement Lab (Y25-L-09) des Geographischen Instituts an der Universität Zürich Irchel statt. Die Studie dauert insgesamt ca. 45 Minuten.

Die Voraussetzungen für diese Studie sind, dass Du zwischen 18 und 40 Jahre alt bist. Du bist in der Schweiz geboren und hast in die meiste Zeit Deines Lebens in der Schweiz

verbracht. Beide Eltern sind in entweder in der Schweiz oder in Sri Lanka geboren. Du hast weder einen Universitäts- oder Fachhochschulabschluss (FH) und besuchst im Moment auch keine Universität bzw. Fachhochschule.

Vertraulichkeit der Daten

Alle Informationen, die in dieser Studie mit Dir in Verbindung gebracht werden könnte, werden vollständig vertraulich behandelt und nur mit Deiner schriftlichen Erlaubnis an Dritte weitergegeben. Mit Deiner Unterschrift erlaubst Du uns, die anonymisierten Ergebnisse dieser Studie zu publizieren. Dabei werden auf keinem Fall Informationen veröffentlicht, die es ermöglichen, Dich zu identifizieren.

Bekanntgabe der Ergebnisse

Wenn Du über die Ergebnisse der Studie informiert werden willst, bitten wir Dich, der Versuchsleiterin Deine Mailadresse oder Telefonnummer zu hinterlassen, damit eine Kopie der zukünftigen Publikationen zugestellt werden kann.

Einwilligung

Wenn du Dich entscheidest bei der Studie teilzunehmen, besteht die Möglichkeit jederzeit die Teilnahme ohne Begründung abzubrechen. Deine Entscheidung, an dieser Studie teilzunehmen, beeinträchtigt die zukünftige Beziehung mit der Universität Zürich nicht. Bei Fragen zögere nicht diese jederzeit zu stellen. Bei Fragen zu einem späteren Zeitpunkt, wird Vibiga Ruban (vibiga.ruban@uzh.ch) oder Prof. Dr. Sara I. Fabrikant (044 635 51 50, sara.fabrikant@geo.uzh.ch), sich zur Verfügung stellen. Eine Kopie dieses Dokuments wird dir per Mail oder auf Wunsch auf Papier zugestellt.

Mit Deiner Unterschrift bestätigst Du, obenstehende Informationen gelesen zu haben und willigst ein, unter den oben beschriebenen Bedingungen an der Studie teilzunehmen. Auch bewilligst Du mit der Unterschrift, dass Du die Voraussetzungen für diese Studie wahrheitsgetreu erfüllst.

Vor- & Nachname der Teilnehmenden: _____

Ort, Datum: _____

Unterschrift des/der Teilnehmenden:

_____

Vor- & Nachname der Studienleiterin: _____

Ort, Datum: _____

Unterschrift des/der Studienleiterin:

_____

Widerruf der Einwilligung

Hiermit möchte ich die Einwilligung, an der oben beschriebenen Studie teilzunehmen, widerrufen.

Vor- & Nachname der Teilnehmenden: _____

Ort, Datum: _____

Unterschrift des/der Teilnehmenden:

_____

Mit dem Widerruf der Einwilligung wird die Beziehung mit der Universität Zürich keinerlei beeinträchtigt. Der Widerruf kann jederzeit ohne Begründung beantragt werden.

Den Widerruf der Einwilligung bitte ich an Prof. Dr. Sara I. Fabrikant, Geographische Informationsvisualisierung und Analyse. Geographisches Institut, Universität Zürich, Winterthurerstrasse 190, 8057 Zürich zu senden.

N. Participants Invitation

The following recruiting message was sent to potential participants via Whatsapp as a PDF Sheet and via also via email:

Einladung zur Teilnahme an Masterarbeitsstudie – Vibiga Ruban

Liebe/r XY

Wie du schon mitbekommen hast, arbeite ich momentan an meiner Masterarbeit am geographischen Institut der Universität Zürich in der Vertiefungsgruppe GIVA (Geographic Information Visualization and Analysis). In meiner Masterarbeit untersuche ich den kulturellen Einfluss auf Kartenlesen, wobei ich spezifisch auf den Unterschied zwischen Menschen schweizerischer und tamilischer Herkunft fokussiere.

Gerne möchte ich dich als Studienteilnehmer/in einladen für diese Studie. Es ist eine computer-basierte Studie, wobei deine Augenbewegungen aufgenommen werden. Deshalb findet die Studie auch auf im Eye Movement Lab (Y25-L-09) auf dem Campus der Universität Zürich (Universität Irchel), welches sich an der Winterthurerstrasse 190, 8057 Zürich befindet, statt. Die Studie dauert ca. 45 Minuten. Deine Aufgabe wird es sein bestimmte Aufgaben bezgl. Kartenlesen zu lösen, während deine Augenbewegungen aufgenommen werden.

Mit der folgenden Telefonnummer oder Mail darfst du dich gerne bei mir persönlich melden für einen Termin:

Telefonnummer & Mailadresse

Die Termine kannst du so vorschlagen wie es dir passt und ich kann mich dementsprechend einrichten und das Eye Movement Lab buchen. Die Teilnahme kann auch an Wochenenden stattfinden.

Voraussetzungen für die Teilnahme:

- Alter: 18 – 40 Jahre
- Geburtsort: Schweiz

- Geburtsort der Eltern: beide in der Schweiz oder beide in Sri Lanka
- Keine Universität oder FH- Studenten oder Absolventen/innen
- Keine Teilnehmer, welche beruflich täglich mit Karten arbeiten
- Normale/korrigierte Sehkraft auf dem Computer

WICHTIG: Die Studiendurchführung ist der Hauptbestandteil meiner Masterarbeit. Deshalb bitte ich dich, den Termin definitiv wahrzunehmen.

Wenn du an meiner Studie teilnimmt, würde mir das eine grosse Freude bereiten und so trägst du zu meiner Masterarbeit auch einen wichtigen Beitrag bei. Vielen Dank für deine Hilfe und die Teilnahme im Voraus!

Gerne darfst du diese Einladung zur Studienteilnahme und alle Informationen auch mit weiteren Bekannten und Interessenten teilen.

Mit freundlichen Grüssen

Vibiga Ruban

O. Additional Results

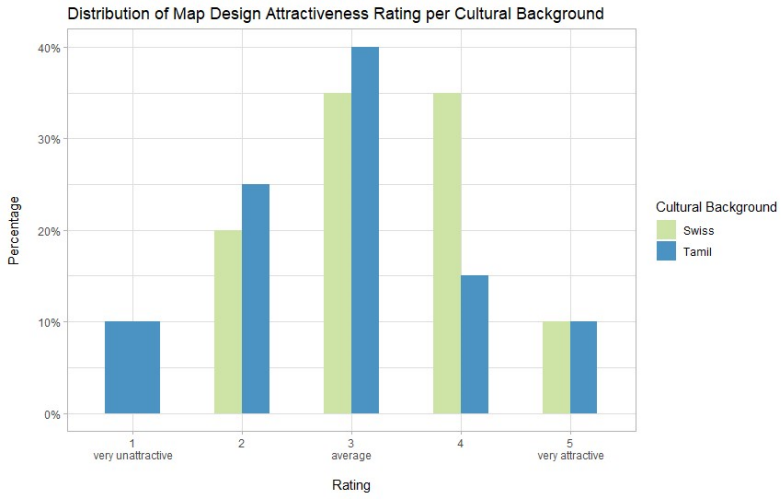


Figure 62: Relative Distribution of map design attractiveness for the first map per cultural background. Each cultural background distribution is calculated individually (Swiss: 100%, Tamil: 100%)

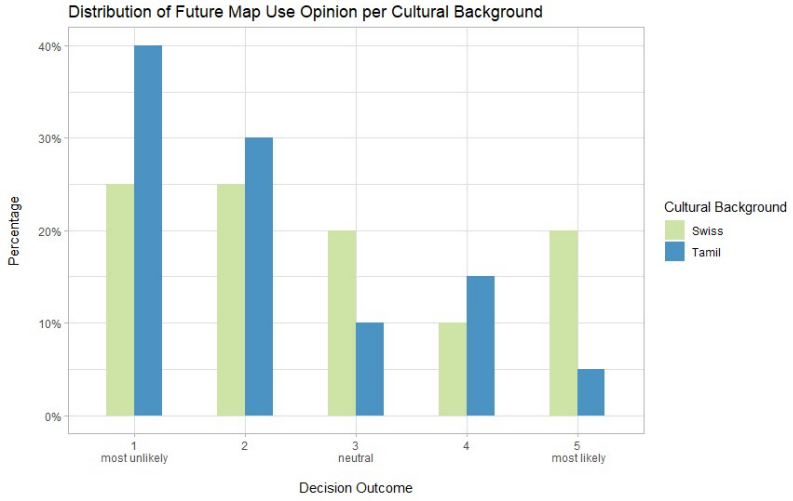


Figure 63: Relative Distribution of future map use opinion per cultural background. Each cultural background distribution is calculated individually (Swiss: 100%, Tamil: 100%)

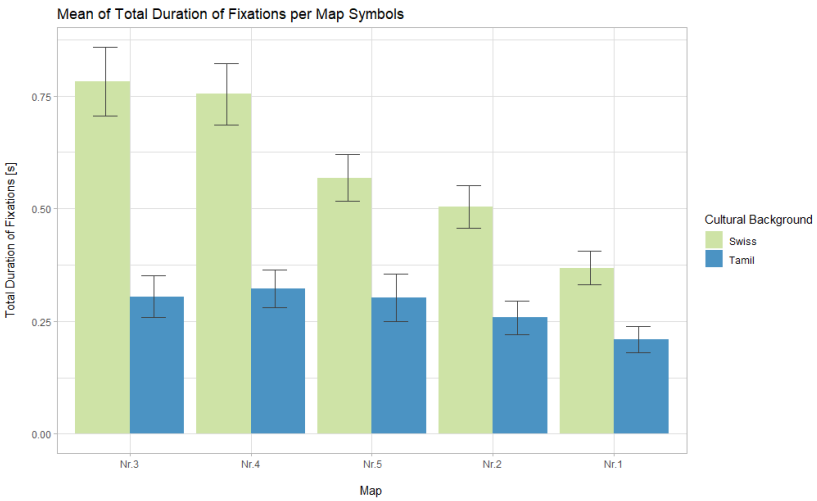


Figure 64: Mean total duration of fixations [s] per symbols of each map type and cultural background. Error bars indicate +/- 1 standard error. From left to right, maps are ordered from the highest mean to the lowest mean of Swiss cultural background.

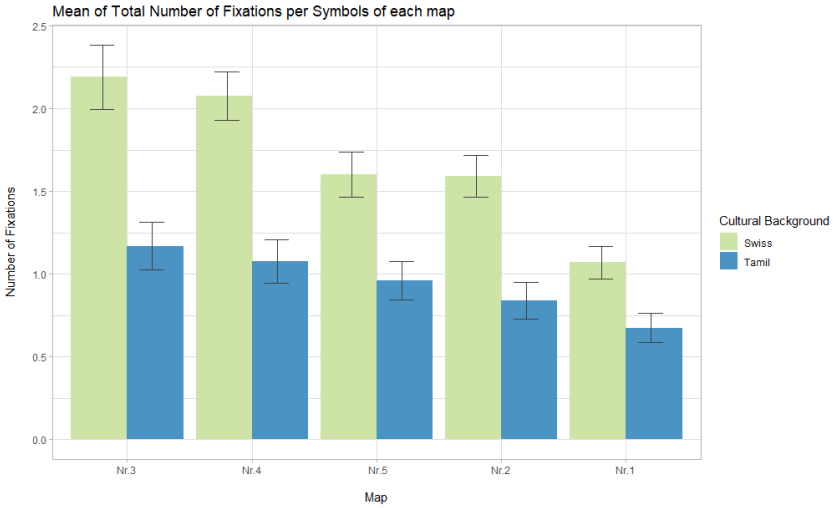


Figure 65: Mean total number of fixations [s] per symbols of each map type and cultural background. Error bars indicate +/- 1 standard error. From left to right, maps are ordered from the highest mean to the lowest mean.

Table 10: Eye-Tracking Metrics Overview of Mean and Standard Deviation of attractions and signs AOIs of each map type per Swiss and Tamil participants groups.

AOI	Cultural Background	Fixation Duration (s)		Number of Fixations	
		Mean	***SD***	***Mean***	***SD***
Map 1: Attractions	*Swiss*	0.51	0.59	1.47	1.57
	Tamil	0.27	0.49	0.88	1.42
Map 1: Signs	*Swiss*	0.16	0.32	0.48	0.80
	Tamil	0.11	0.25	0.36	0.77
Map 2: Attractions	*Swiss*	0.58	0.74	1.86	1.93
	Tamil	0.31	0.57	0.95	1.64
Map 2: Signs	*Swiss*	0.43	0.57	1.32	1.59
	Tamil	0.21	0.46	0.73	1.47
Map 3: Attractions	*Swiss*	1.11	1.24	3.19	3.09
	Tamil	0.44	0.80	1.60	2.41
Map 3: Signs	*Swiss*	0.45	0.76	1.19	1.91
	Tamil	0.17	0.40	0.74	1.51
Map 4: Attractions	*Swiss*	0.84	0.82	2.61	2.15
	Tamil	0.41	0.66	1.44	2.18
Map 4: Signs	*Swiss*	0.67	1.08	1.54	1.84
	Tamil	0.23	0.50	0.71	1.36
Map 5: Attractions	*Swiss*	0.61	0.77	1.73	2.03
	Tamil	0.42	0.94	1.27	1.92
Map 5: Signs	*Swiss*	0.53	0.70	1.47	1.83
	Tamil	0.19	0.44	0.65	1.28

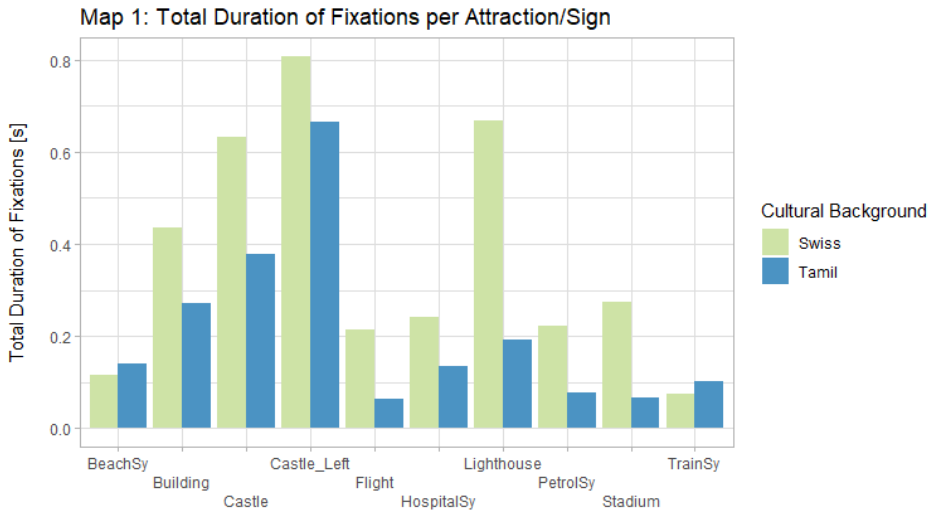


Figure 66: Mean total duration of fixations per symbol of map 1 based on cultural backgrounds. Symbol names which end with "Sy" are defined as signs. The others are attractions.

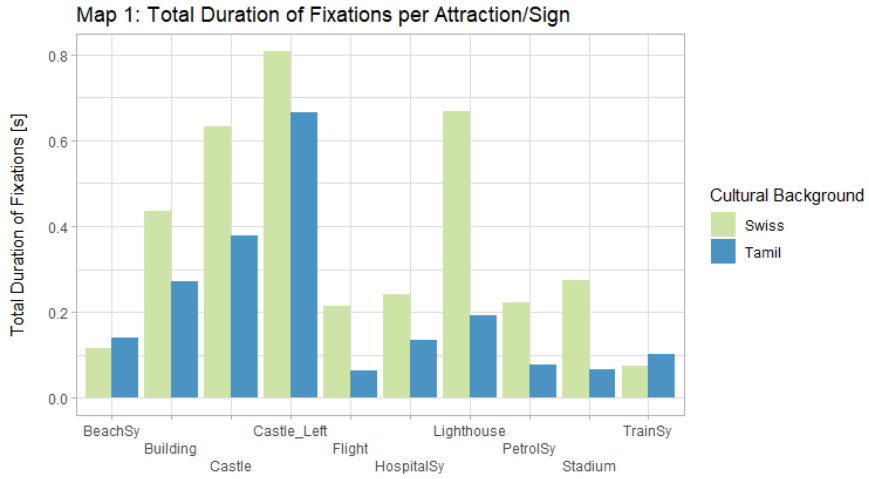


Figure 67: Mean total number of fixations per symbol of map 1 based on cultural backgrounds. Symbol names which end with "Sy" are defined as signs. The others are attractions.

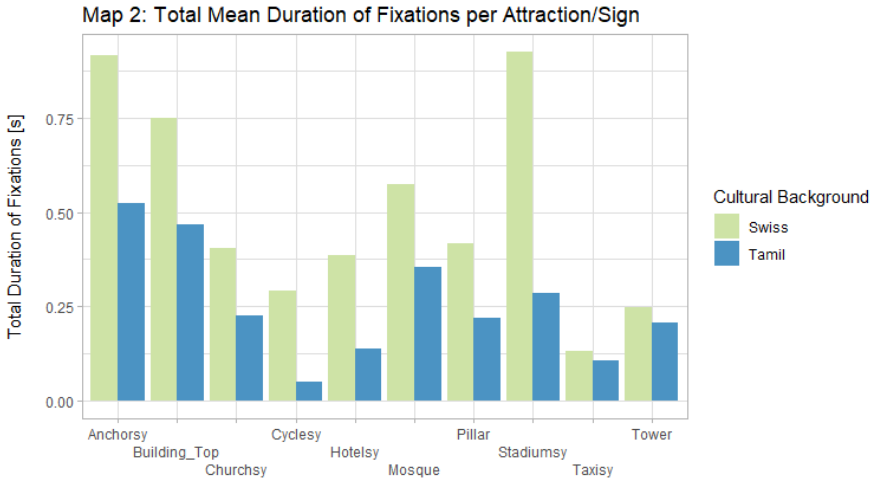


Figure 68: Mean total duration of fixations per symbol of map 2 based on cultural backgrounds. Symbol names which end with "Sy" are defined as signs. The others are attractions.

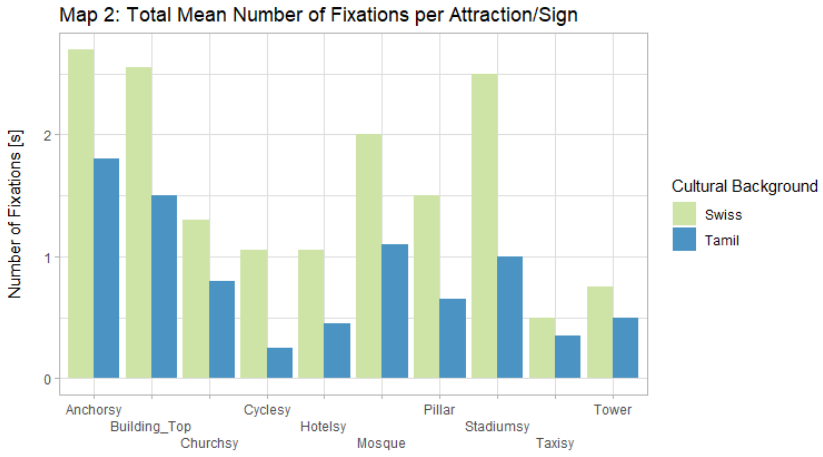


Figure 69: Mean total number of fixations per symbol of map 2 based on cultural backgrounds. Symbol names which end with "Sy" are defined as signs. The others are attractions.

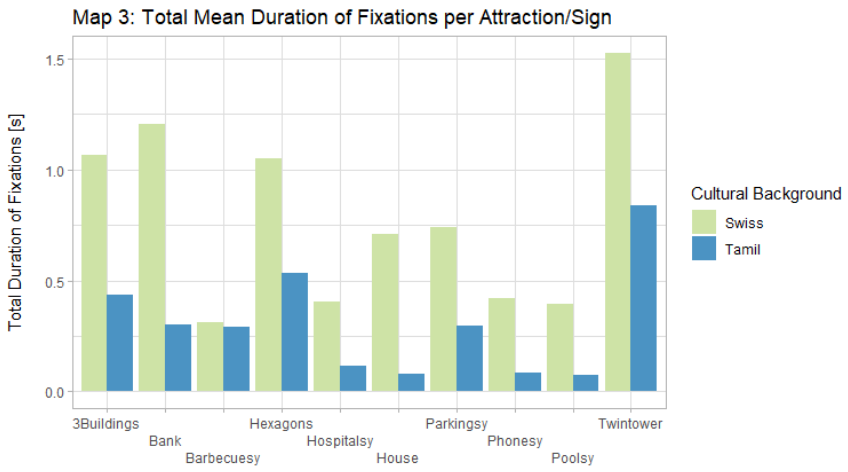


Figure 70: Mean total duration of fixations per symbol of map 3 based on cultural backgrounds. Symbol names which end with "Sy" are defined as signs. The others are attractions.

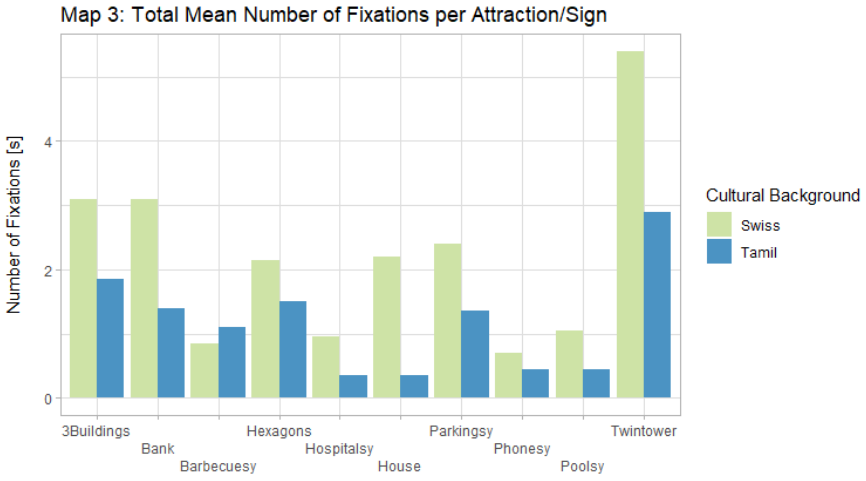


Figure 71: Mean total number of fixations per symbol of map 3 based on cultural backgrounds. Symbol names which end with "Sy" are defined as signs. The others are attractions.

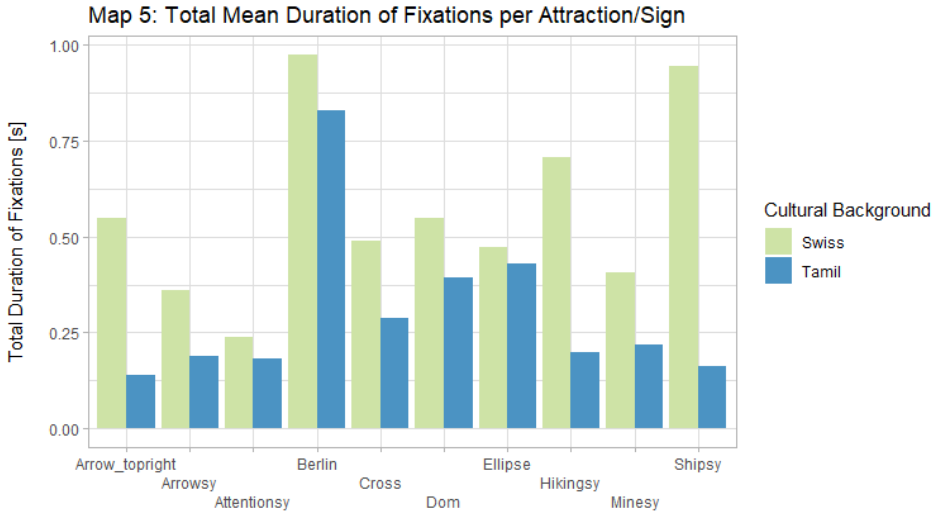


Figure 72: Mean total duration of fixations per symbol of map 5 based on cultural backgrounds. Symbol names which end with "Sy" are defined as signs. The others are attractions.

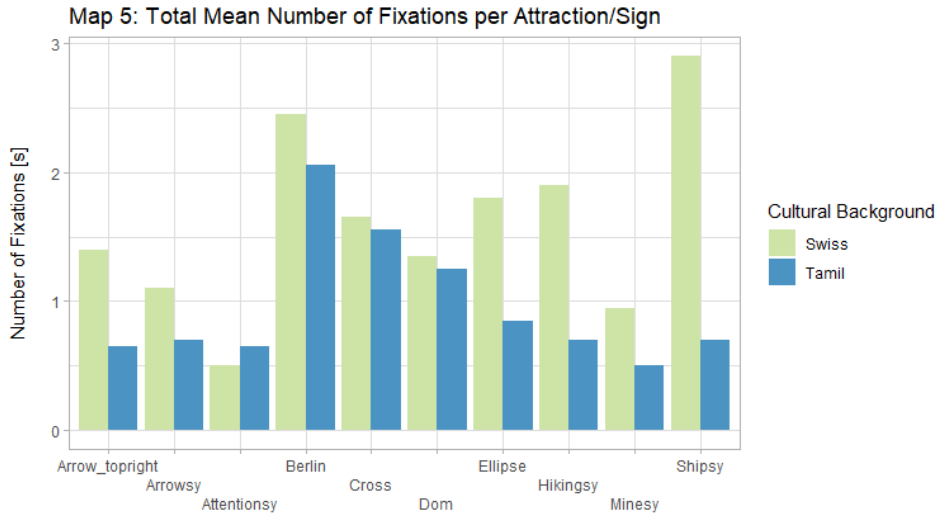


Figure 73: Mean total number of fixations per symbol of map 5 based on cultural backgrounds. Symbol names which end with "Sy" are defined as signs. The others are attractions.

P. Heat Maps

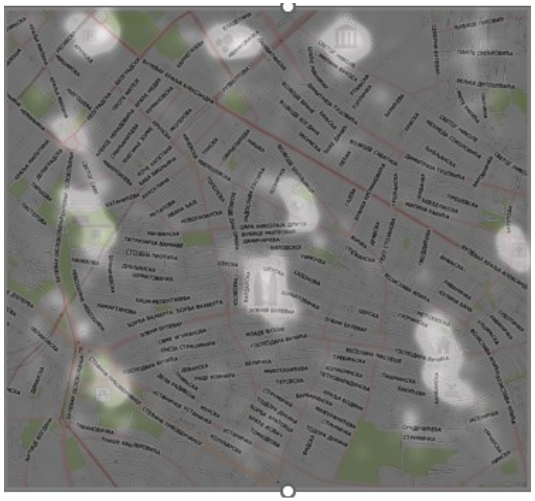
A – Map 1/Swiss

B – Map 1/Tamil

Figure 74: Heatmaps of map 1 of relative fixation duration per cultural background. Areas that are bright indicate areas that received greater attention than parts that are darker and less visible.

A – Map 2/Swiss

A – Map 3/Swiss



B – Map 2/Tamil

B – Map 3/Tamil

Figure 75: Heatmaps of map 2 & 3 of relative fixation duration per cultural background. Areas that are bright indicate areas that received greater attention than parts that are darker and less visible.

A – Map 4/Swiss

A – Map 5/Swiss

B – Map 4/Tamil

B – Map 5/Tamil

Figure 76: Heatmaps of map 4 & 5 of relative fixation duration per cultural background. Areas that are bright indicate areas that received greater attention than parts that are darker and less visible.

9 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.

Place, Date: Signature:

Neuenhof, 21.1.24 R. Vibiga

Vibiga Ruban