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Cross-Cultural Differences In Topographic Map Design Perception

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unter der Anleitung von

Univ.Prof. Mag.rer.nat. Dr.rer.nat. Georg Gartner, TU Wien

und

Univ.Ass. Mag.rer.nat. BA. Silvia Klettner, TU Wien

durch

Bibigul Zhunis

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MASTER'S THESIS

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by

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Cross-Cultural Differences In Topographic Map Design Perception

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TU Wien

Author:	Bibigul Zhunis
Study course:	Cartography M.Sc.
Supervisors:	Univ.Prof. Mag.rer.nat. Dr.rer.nat. Georg Gartner (TU Wien)
	Univ.Ass. Mag.rer.nat. BA. Silvia Klettner (TU Wien)
Reviewer:	M.Sc. Edyta Boguchka(TUM)

Chair of the Thesis Assessment Board:	Univ.Prof. Mag.rer.nat. Dr.rer.nat. Georg Gartner (TU Wien)

Date of submission: 10.09.2020

STATEMENT OF AUTHORSHIP

Herewith, I declare that I am the sole author of the submitted master's thesis entitled: **"Cross-cultural differences in topographic map design perception"**.

I have fully referenced the ideas and work of others, whether published or unpublished. I further declare that I have not submitted this thesis to any other institution.

Vienna, 10.09.2020 Bibigul Zhunis

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ABSTRACT

It is common knowledge that the visual appearance of a map makes a significant contribution to its quality and functionality. But do we perceive it differently at the scale of cultures? Are there any group behavioural patterns in cognitive performance whilst communicating a map? The aim of this thesis was to broaden current knowledge of how individuals with different cultural mindsets perceive, read, and interpret the map itself. Particularly, it was examined through the topographic map variables due to its exceptional design specific to one country.

The user experiment on the detection of differences in cognitive performance through the map-reading tasks and topographic map design assessment was executed among 50 participants from the European and Central Asian countries. For that reason, the map samples were created replicating the design style of Austrian and Kazakhstan national mapping agencies. The data inputs gathered after the think-aloud session were then analyzed and discussed. The findings provide some contradictory and yet significant knowledge of patterns and psychological phenomena accompanying a map perception by the users with a different mentality.

Keywords: *topographic map design, cross-cultural differences in cognitive styles, cognitive development, cultural dimensions, Western and Asian mindset.*

TABLE OF CONTENTS

ABBREVIATIONS

BEV	Bundesamt Für Eich- Und Vermessungwesen
BKG	Bundesamt für Kartographie und Geodäsie
CFT	Compound Figure Test
CMMS	Categorization of Multivariate Map Symbols
ČÚZK	Český Úřad Zeměměřický a Katastrální
FLT	Framed-Line Test
GCS	General Commission for Survey
IC	Individualism – Collectivism
IGN	Institut Géographique National
IGNTC	Instituto Geografico Nacional Tommy Guardia
IISS	Independent and Interdependent Self-Scale
NMA	National Mapping Agency
SD	Standard Deviation
TL	Tightness-Looseness
USGS	United States Geological Survey

1. INTRODUCTION

1.1 Motivation and Problem Statement

Topographic maps are among the most prevalent cartographic means of communication. It is common knowledge that this type of cartographic representation has highly detailed content, and covers multiple user groups as it is recognized as being regulated, in most cases, by state authorities. Its design is referred to as specific to a particular country, showing its unique geographic landscape and places of interest. The content organization and map design are of prime importance here. Thus, the map design is responsible for easy, fast, and effective "user-map" interaction.

Great importance is attached to the design of a map because it is responsible for how our further communication with this map. There are ongoing discussions in and around cartography on how to accomplish a visually appealing product that advances the ability of a map to provide information in most accurately. It is assumed that the first impression of the product is defined by our cognitive abilities. As a part of it, the cognitive perception is shaped under different circumstances, viz, linguistic diversity, historical background, societal trends, experience and knowledge, socioeconomic and political system, and most of all by the level of interaction with a surrounding world which, in general, shapes cultural identity.

Previous studies in cross-cultural and cognitive psychology have speculated that culture plays a bridge-building role between cognition and visual information perception. L. Vygotsky's sociocultural and cultural-historical theory emphasizes the role of linguistic and sociocultural context in the development of cognitive style. According to this theory, our mental abilities such as attention, sensation, perception, and memory are shaped under the extensible concept "culture": a model of socially accepted behaviour, beliefs, values, language, and means of intellectual adaptation characterizing people as one entity (Vygotsky, 1934, 1960, 1979). The earliest steps in the field of cartography were made by Montello (2004) who was holding the position that the "*synergy*" of psychology and cartography will improve the perception of geovisualization mediums.

Investigations of this teamwork inevitably be a subject for discussions due to the high demand for producing a map that fully covers "art-science-technology" aspects of cartography. However, only several studies focused on bringing together cross-cultural background, cognitive processes, and cartographic outputs (Stachoň et al., 2018; Lacko et al., 2020).

1.2 Research Objectives and Questions

The purpose of this thesis is to investigate to what extent a cultural background influences the process of interaction (perception, attention, learning, and interpretation of the cartographic information) with a specific topographic map design. With this in mind, the study aims to address the following research questions:

- Do people perceive and process this information differently? Is there a presence of cross-cultural diversity? If yes, how and to what extent does cultural background influence cognitive abilities, and style? (Obj4)
- What role does the topographic map design have in the process of map reading and information extraction? (Obj3)

To meet the general purpose and tackle the aforementioned points, the following objectives must be achieved:

(Obj1) To review the literature related to the phenomenon of culture, cultural background, cross-cultural differences, cognitive style, topographic map, and its design;

(Obj2) To construct an ad hoc map stimulus for the experiment based on the design guidelines of two mapping agencies;

(Obj3) To carry out interviews among 50 participants from the European and Central Asian countries;

(Obj3) To execute map-reading tasks for assessing the ease of finding objects on a map (the cognitive ability of learning) and find differences in processing the information;

(Obj4) To distinguish which map design elements are accentuated by the participants from European and Central Asian countries;

(Obj5) To discuss the discrepancies or similarities in map content interpretation.

It is assumed that the results of the work should either confirm or deny the hypothesis that cross-cultural differences can be detected in the process of map interaction.

1.3 Thesis Outline

This thesis work is divided into five chapters. Chapter two contains a literature review, which provides introductory information for better understanding the background of this research. Papers from cultural, cross-cultural and cognitive psychology, anthropology, cognitive geography and cartography are reviewed and outlined here in order to have a look at research questions from a broader perspective. The next chapter describes the creation of map samples, the methodology and setup of the experiment. The results of the

experiment are acquired, statistically analyzed, and examined under the hypotheses in chapter four. Conclusions, limitations and recommendations for future studies are given in the final chapter.

2. LITERATURE REVIEW AND RELATED WORK

This literature review provides a brief overview of the processes and factors involved in map design perception. Thus, first of all, it attempts explain the concept of culture and cultural dimensions, and to put to one side the types of cultural differences. Next, it characterizes how cultural background and cognition are connected to each other and describes the formation of cognitive style which is involved in cartography particularly. Moreover, the chapter presents information about the topographic map, its design, and previous studies.

2.1 Cultural background

2.1.1 What is culture?

Before examining the relationship between cultural background and cognitive processes involved in the process of map perception, it is worth identifying the notion of culture and its importance in the understanding of what constitutes a cultural background.

"***Culture***…*is that 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);*

*"**Culture** is a model of socially accepted behaviour, beliefs, values, language, and means of intellectual adaptation characterizing people as one entity" (Vygotsky, 1930);*

"***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);*

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

"***Culture*** *is the shared knowledge and schemes created by a set of people for perceiving, interpreting, expressing, and responding to the social realities around them" (Lederach, 1995);*

"***Culture*** *is a set of attitudes, values, beliefs, and behaviours shared by a group of people, but different for each individual, communicated from one generation to the next" (Matsumoto, 1996);*

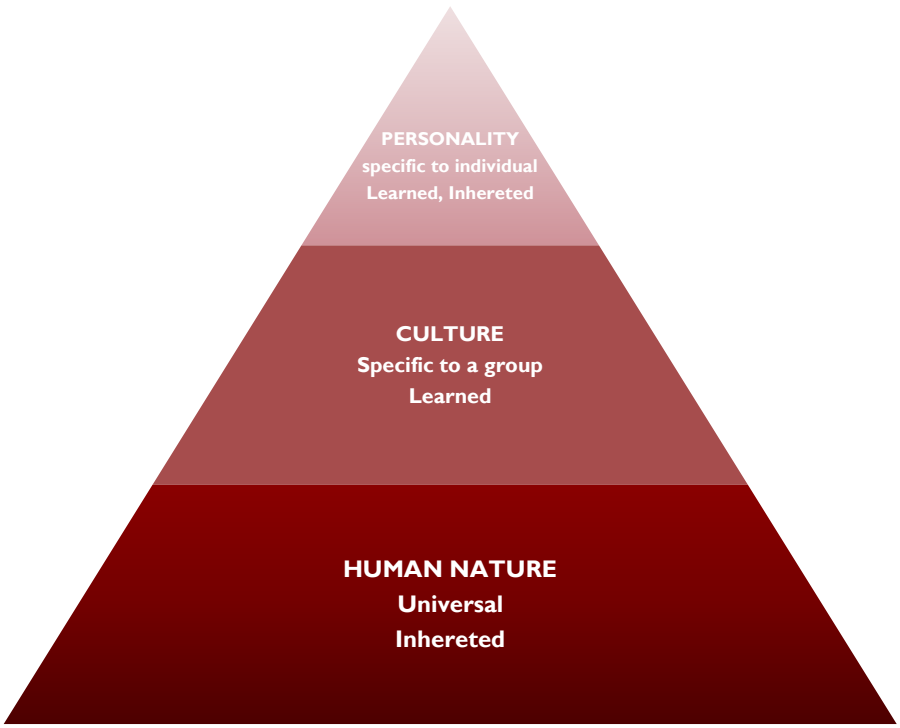
"***Culture*** *is learned from the people you interact with as you are socialized. Watching how adults react and talk to new babies is an excellent way to see the actual symbolic transmission of culture among people. Two babies born at exactly the same time in two parts of the globe may be taught to respond to physical and social stimuli in very different ways. Culture is also taught by the explanations people receive for the natural and human events around them (Lustig & Koester, 1999).*

Remarkably, culture is a commonly known but at the same time fuzzy, loose and quite complex concept. It is important to separate "culture" from other terms like "race", "ethnicity", and "nationality". As y Matsumoto & Juang (2012) stated, two persons of the same biological and physical features (racial) may have similar or, on the contrary, different cultural characteristics. Here, Phinney (1996) indicated the controversial and complex role of ethnicity as ethnic differences in cognitive, parenting styles can explain most psychological scenarios and phenomena. Yet, exactly which variables are present here is not well-defined. As for the nationality, citizenship status does not necessarily define a person's cultural profile; culture is a learned process not given by default or place of origin. It means that if a person's country of origin does not imply that he will behave like a typical citizen of country X at least because multiple cultural groups may exist within country X.

Based on the conclusions of an anthropologist Clifford Geertz (1973) that *"man is an animal suspended in webs of significance he himself has spun"*, it has become clear that surrounding semiotic signs help us to create a unique paradigm of life and guide our actions throughout it. In other words, a specific social pattern might be familiar only to those, who has faced it before, because it requires understanding and interpretation of symbolic codes existing within a group of people.

Figure 2.1

Three levels of uniqueness in mental programming



Note. Adapted from "Software of the mind" by G.Hofstede, 1997, p.5. Copyright 1996 by McGraw-Hill.

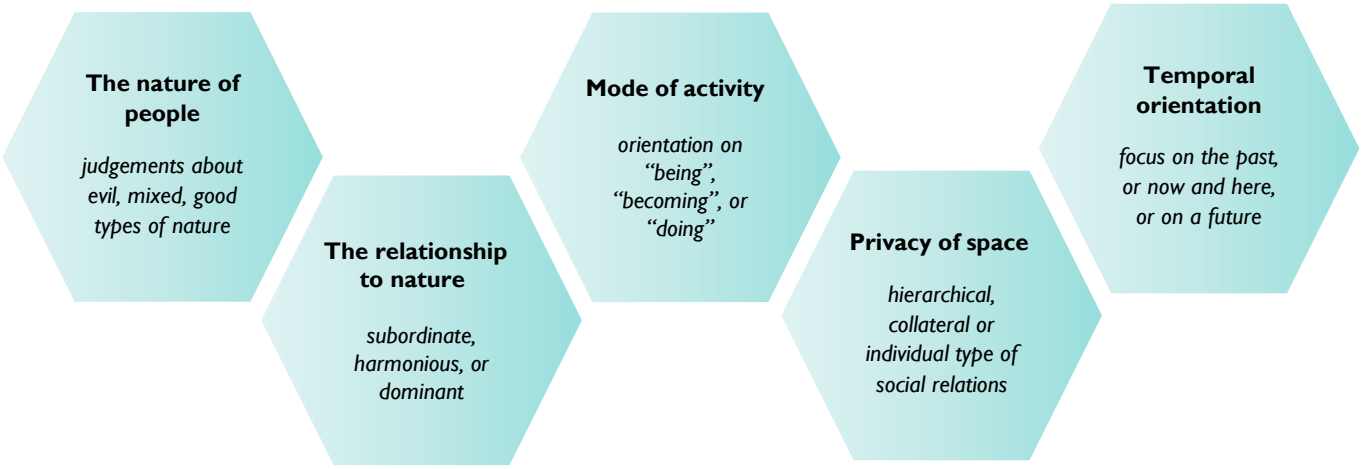
But where is the place and the level of influence of a culture on designing this unique paradigm? Hofstede (1996) emphasized the role of culture in shaping an individual's personality, behaviour, and abilities. Referring to his three levelled model of uniqueness (Figure 2.1), all human beings share common *human nature* characteristics like primitive psychological and physical performance. Subsequently, a group of people united by one geographical territory, outlook on life, traditional beliefs and customs, or way of communication adopts a specific *cultural* imprint which is also responsible for the interpretation of human nature. The *personality* can be understood as a synergy of collective programming known as culture and individual experience.

2.1.2 Cultural dimensions

The structure of culture as a particular entity was explored in the Kluckhohn-Strodtbeck Value Orientations theory (Kluckhohn & Strodtbeck, 1961 as cited in Hills, 2002), based on which differences between cultures occur in finding an individual approach to basic existential needs. It includes an understanding of human nature, connection with the natural world, appreciation of time, mode of human activities, and type of relationship between members of society, which are outlined in Figure 2.2.

Figure 2.2

Kluckhohn-Strodtbeck Values Orientation Theory



Note. Adapted from "Kluckhohn and Strodtbeck's Values Orientation Theory" by M. Hills, 2002, *Online Readings in Psychology and Culture,* 4 (https://doi.org/gfsnks). Copyright 2002 by International Association for Cross-Cultural Psychology.

According to Matsumoto (1996) external factors like *environment* (a lack or abundance of natural resources), *population density* (tightness and looseness among people), *the level of*

affluence (less or more reliance on others), *the use of communication technology* (self-dependence), *climate* (adaptation to natural conditions) might influence how societies reflect their relation to those cultural dimensions.

Similarly, another fundamental values theory shown in Figure 2.2 was modelled by Hostede in 1980 (1980a; 2011b) and extended 30 years after (Hofstede et al., 2010). *Hofstede's dimension paradigm* was used as a framework for comparing cultures at the national level by evaluation of each dimension from 0 to 100. The first version of the experiment was conducted in 76, and later in 93 countries, which was later complemented by Minkov and colleagues (G. H. Hofstede et al., 2010; Minkov, 2017). Freely accessible data of Values Survey Module 2013 was published on Hofstede's personal website[1]. Table 2.1 demonstrates the characteristics of each dimension.

Nonetheless, research limitations taking place in such probabilistic models like generalizations about the country, the inability to explore the differences on an individual level, and the lack of coherence and relevance might arise here. In order to address these weak points, other cultural frameworks observed in Thomas & Peterson's work (2015) "*Cross-Cultural Management: Essential Concepts"* are may be considered.

Table 2.1

Ten Differences Between Hofstede's Dimensions

Power distance (PDI) acceptance or rejection of hierarchy and authority	
Small	**Large**
Use of power should be legitimate and is subject to criteria of good and evil	Power is a basic fact of society antedating good or evil: its legitimacy is irrelevant
Parents treat children as equals	Parents teach children obedience
Older people are neither respected nor feared	Older people are both respected and feared
Student-centered education	Teacher-centered education
Hierarchy means inequality of roles, established for convenience	Hierarchy means existential inequality
Subordinates expect to be consulted	Subordinates expect to be told what to do
Pluralist governments based on majority vote and changed peacefully	Autocratic governments based on co-optation and changed by revolution
Corruption rare; scandals end political careers	Corruption frequent; scandals are covered up
Income distribution in society rather even	Income distribution in society very uneven
Religions stressing equality of believers	Religions with a hierarchy of priests

[1] http://www.geerthofstede.nl/

Uncertainty Avoidance (UAI)

evasion or following of rules (technology, law, religion)

Weak	Strong
The uncertainty inherent in life is accepted and each day is taken as it comes	The uncertainty inherent in life is felt as a continuous threat that must be fought
Ease, lower stress, self-control, low anxiety	Higher stress, emotionality, anxiety, neuroticism
Higher scores on subjective health and wellbeing	Lower scores on subjective health and well-being
Tolerance of deviant persons and ideas: what is different is curious	Intolerance of deviant persons and ideas: what is different is dangerous
Comfortable with ambiguity and chaos	Need for clarity and structure
Teachers may say 'I don't know'	Teachers supposed to have all the answers
Changing jobs no problem	Staying in jobs even if disliked
Dislike of rules - written or unwritten	Emotional need for rules – even if not obeyed
In politics, citizens feel and are seen as competent towards authorities	In politics, citizens feel and are seen as incompetent towards authorities
In religion, philosophy and science: relativism and empiricism	In religion, philosophy and science: belief in ultimate truths and grand theories

Individualism/Collectivism (IDV)

level of humans´ integration into groups and society

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

Masculinity/Femininity (MAS)

focus on assertiveness, success or on social activities, family

Minimum emotional and social role differentiation between the genders	Maximum emotional and social role differentiation between the genders
Men and women should be modest and caring	Men should be and women may be assertive and ambitious
Balance between family and work	Work prevails over family
Sympathy for the weak	Admiration for the strong
Both fathers and mothers deal with facts and feelings	Fathers deal with facts, mothers with feelings
Both boys and girls may cry but neither should fight	Girls cry, boys don't; boys should fight back, girls shouldn't fight
Mothers decide on number of children	Fathers decide on family size
Many women in elected political positions	Few women in elected political positions
Religion focuses on fellow human beings	Religion focuses on God or gods
Matter-of-fact attitudes about sexuality; sex is a way of relating	Moralistic attitudes about sexuality; sex is a way of performing

Long/Short Term Orientation (LTO)

openness or reluctancy to up-to-date approaches, norms

Most important events in life occurred in the past or take place now	Most important events in life will occur in the future
Personal steadiness and stability: a good person is always the same	A good person adapts to the circumstances
There are universal guidelines about what is good and evil	What is good and evil depends upon the circumstances
Traditions are sacrosanct	Traditions are adaptable to changed circumstances
Family life guided by imperatives	Family life guided by shared tasks
Supposed to be proud of one's country	Trying to learn from other countries
Service to others is an important goal	Thrift and perseverance are important goals
Social spending and consumption	Large savings quote, funds available for investment
Students attribute success and failure to luck	Students attribute success to effort and failure to lack of effort
Slow or no economic growth of poor countries	Fast economic growth of countries up till a level of prosperity

Indulgence/Restraint (IND)
allowance or suppression of gratification of basic desires

Higher percentage of people declaring themselves very happy	Fewer very happy people
A perception of personal life control	A perception of helplessness: what happens to me is not my own doing
Freedom of speech seen as important	Freedom of speech is not a primary concern
Higher importance of leisure	Lower importance of leisure
More likely to remember positive emotions	Less likely to remember positive emotions
In countries with educated populations, higher birthrates	In countries with educated populations, lower birthrates
More people actively involved in sports	Fewer people actively involved in sports
In countries with enough food, higher percentages of obese people	In countries with enough food, fewer obese people
In wealthy countries, lenient sexual norms	In wealthy countries, stricter sexual norms
Maintaining order in the nation is not given a high priority	Higher number of police officers per 100,000 population

Note. Adapted from "Dimensionalizing Cultures: The Hofstede Model in Context" by G.Hofstede, 2011, *Online Readings in Psychology and Culture*, 2(1) (https://doi.org/cbjq). Copyright 2011 by International Association for Cross-Cultural Psychology.

As regards **individualism-collectivism (IC)**, collectivist culture creates a common platform for its members so that they feel the presence of common fate and goals, interdependence, involvement to others lives, integrity, the necessity to have rules to avoid chaos in it, conforming to ingroup norms, unwillingness to cooperate with members of outgroups, and responsibility for the behaviour and results to societal shared values. Whereas, in an individualistic culture, its members tend to behave autonomously and based on their subjective feelings and individual attributes, achieve personal targets, and follow personal benefit rather than agreed-on rules and obligation (H. Triandis et al., 1988; H. Triandis, 1989; H. Triandis, 1995; Harry C. Triandis, 2001; Oyserman & Lee, 2008). Hence, following the norms of social ingroup might affect how humans perceive, process and relate to the situation and tasks.

The IC cultural syndrome can be seen when it varies geographically - *across countries,* e.g. North American and Western Europe cultural groups have a more individualistic profile than in East Asia, Africa, Middle East, and Eastern Europe (G. Hofstede, 1980; G. H. Hofstede et al., 2010; M. Gelfand et al., 2011; Harry C. Triandis & Gelfand, 2012). Moreover, the level of IC may differ *within one country* (Vandello & Cohen, 1999; Kitayama et al., 2006),

type of social status (Varnum et al., 2010; Grossmann & Varnum, 2011), *level of urbanization* (Sevincer, as cited in Hampton & Varnum, 2017). Despite this, the degree of impact of IC on personality itself needs more examination.

Pelto's classification of cultures depending on their **tightness and looseness (TL)** describes the strength and nature of social norms in a society, the strength of sanctioning and deviance from those norms (Pelto, 1968). The experiment advocated the assumption that tight cultures dictate that their members strictly follow societal norms, values, and thus, creates a homogeneity within it, and depicts all marginal deviations from it. Also, variables influencing the indexes of cultural tightness were considered as life-threatening factors, traditional versus industrialized structure, political system, economic and judicial safety, freedom of restriction or choice, the level of happiness and satisfaction, tolerance and acceptance of other cultural norms, variation in personalities, perception, individualism-collectivism, uncertainty avoidance, power distance, masculinity-femininity, indulgence–restraint.

Likewise, Triandis (1989) further investigated the degree of tightness-looseness. In line with him, the phenomenon of TL is correlated to the homogeneity of a culture (H. Triandis, 1989; Carpenter, 2000; M. J. Gelfand et al., 2006). Carpenter (2000) has noted that in this type of culture "norms are explicit and stringently enforced, individuals must conform to group values, and tolerance for deviation is minimal". For a while after, a research carried out by Uz (2014) additionally confirmed its essential role in giving a specific imprint, and developed the index and framework for cultural TL. His study covered the questions of:

- how historical and ongoing threats for life create strict norms and predictable attitudes within a group of people: the higher is the number of threats - the tighter the society should be;
- how sociopolitical factors affect one's behaviour: the greater is the dependence from a traditional type of human activities, and institutional regime, the tighter is the society;
- how the psychological outlook of a society is shaped: the less tolerant are the members of a society to dissimilar members and divergent moral norms, and the weaker they feel the freedom of choice, the tighter is the society.

Gelfand et al. (2006) looked at this process from a broader perspective. They maintain that TL starts from a family with broad or narrow socialization levels in tight and loose cultures, respectively. In tight cultures, a child is raised by following admitted societal norms and rules, wherein the case of disobedience or indiscipline, misbehaviour he can receive punishment. Moreover, this is more strengthened during the stage of education and after transferred to the working environment. Some key findings essential for seeing a comparison between different cultures were derived:

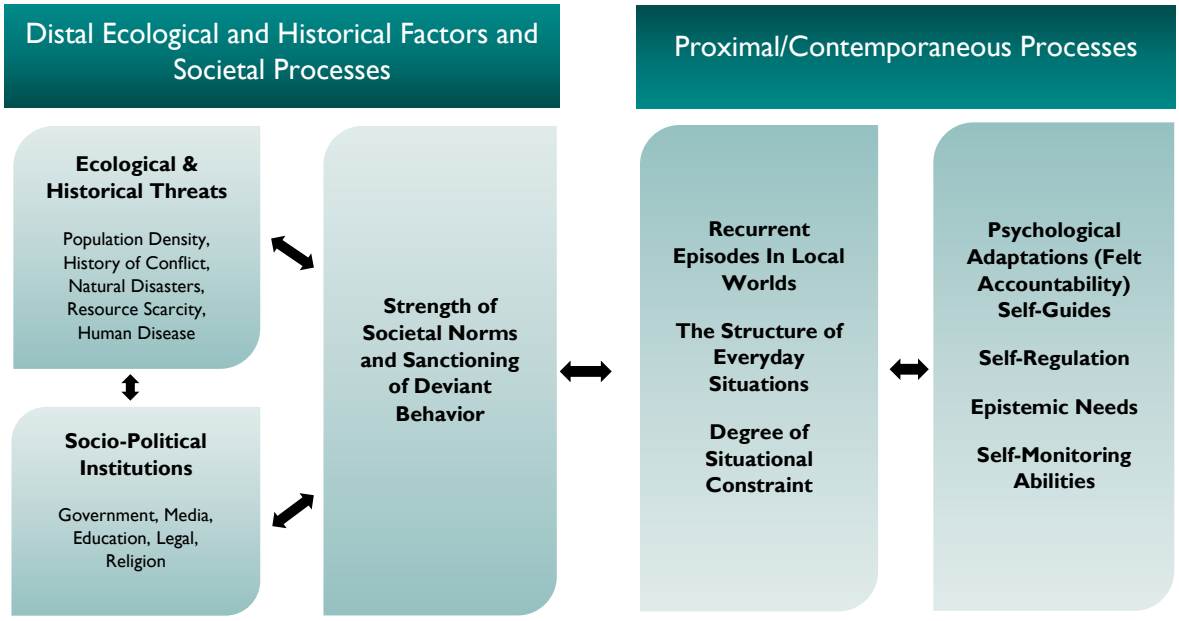
- **Felt accountability** – psychological mechanism when individuals tend to analyse and meticulously check their behaviour while being judged by others and one's self

(self-criticism). Furthermore, there is a heightened feeling in a tight society that they might receive a reward or punishment if they meet or do not public expectations (Frink & Klimoski, 1998);

- **Self-guides** – known also the self-digest regulatory system that sorts "hypostases" of oneself: actual, ideal, and ought self (Higgins, 1996). The latter demonstrates the degree of influence of normative notions which is higher in tight societies. Thus, individuals in tight societies might have a so-called *kiasu* tendency, simply 'fear of losing' or a situation of preventing the failure whereas individuals in loose ones pay more attention to meeting the goals (Wu & Dai, as cited in Gelfand et al., 2006);
- **Regulatory strength** – explains how individuals in tight societies have advanced self-regulatory strength in a sense of being self-monitored and sceptically self-judged according to the accepted notions (Gelfand et al., 2006);
- **Decision-making styles –** are also reflected by the TL mechanism, namely, information acquisition, perception, processing, and further evaluation in problem-solving situations. That is, in loose societies individuals allow themselves to neglect constraints, find outside the box solutions which might be accepted as "impractical and disrespectful for customs" (Kirton & Baily, as cited in Gelfand et al., 2006).

Figure 2.3

Tightness-Looseness Model



Note. Adapted from "Differences Between Tight and Loose Cultures: A 33-Nation Study" by M. Gelfand, J. Raver, L. Nishi, L. Leslie, J. Lun, B. Lim, I. Duan, A. Almaliach, S. Ang, J. Arnadottir, Z. Aycan, K. Boehnke, P. Boski, R. Cabecinhas, D. Chan, J. Chhokar, A. D'Amato, M. Ferrer, S. Fischlmayr, R. Fischer, M. Fülöp, … S. Yamaguchi, 2011, *Science (New York, N.Y.)*, 332, pp. 1100-4. (10.1126/science.1197754). Copyright 2011 by International Association for Cross-Cultural Psychology.

These theoretical findings were eventually supported by Gelfand et al. 's (2011) study with participants from 33 nations. Based on the results, a multilevel theory of tightness-looseness containing the factors that influence TL was designed (see Figure 2.3). Under this extensive investigation, collectivist countries as Pakistan and South Korea showed relatively high tightness indexes =12.3 and =10.0 as compared to collectivist but loose societies of Brazil and Venezuela with a score =3.5 and =3.7, respectively. Individualistic countries such as Norway (=9.5), Portugal (=7.8), East Germany (=7.5) were surprisingly tight, and societies in the Netherlands (=3.3), Israel (=3.1), Hungary (=2.9) reported low scores and, thus, were considered as loose. Notably, the tightness index of the western region of Germany represented by Rhineland-Palatine/Frankfurt (=6.5) was lower than in the eastern part of the country where Chemnitz was located (=7.5). This provides an idea that TL phenomenon differs not merely at the national but also the regional level within one country.

Following all the concepts indicated above, we conclude that culture is an extensive phenomenon represented as things, thoughts, and behavioural patterns, which can be modified both by internal and external forces. Moreover, it varies across generations, geographical location, historical background, genetic constitution, religious preferences, social lifestyle, economic activity, political situation, etc. Hence, the emergence of *cross-cultural psychology* made sense. For instance, Herodotus, who observed cultural diversity in ancient times, discovered that people's judgements were modelled according to their way of living: hunting, nomadism, agriculture, and finally civilization. In the times of feudal and then the capitalist system, knowledge about human's position in the spatio-temporal context was vital; thus, the exploration of new cultures became required.

By now, the "shape and content" of the world civilization changed due to the discoveries and land invasions, religious expansion, presence of the supernatural world, development of science, art and literature, authentic customs and traditions, language and societal structure, parental relationships, lifestyle and employment, and so on. The emergence of a modern understanding of cross-cultural psychology in the 1960s was an important milestone in the history and future of humanity. Lonner's explanation formed the basis of Berry et.al's (2002) general definition which stated that it is "the study of similarities and differences in individual psychological functioning in various cultural and ethnocultural groups; of the relationships between psychology and socio-cultural, ecological and biological variables; and of ongoing changes in these variables".

2.1.2 Culture vs Globalization

However, it seems that the aforementioned cultural profiles might undergo changes across time too. There is room for another force that might blur cultural distinctions in new generations towards one universal culture without any borders (Rushton, 2004; Hassi &

Storti, 2012). Globalization processes such as migration flow, the rapid growth of information and Internet technologies, integration in the domain of education, science, politics, and economics, detachment from a traditional way of living, customs, shifts in moral-ethic views etc. can be referred to those transformational forces.

Similarly, Kaasa and Minkov (2020) argue that the phenomenon of cultural convergence-divergence is present nowadays. A recent study covered the analysis of data from the World Values Survey within a time range 1995-1998 and 2010-2014. It has revealed aberrations concerning the convergence in *parents´ view of children behaviour* (acting autonomously and maturely), *divergence in moral attitudes* (family planning and divorce, birth and suicide, abortion, sexual orientation), and *relative stability in the relationship to religion, family, friends, work, leisure* for the last decades. The authors assert that the establishment of union political structures with shared regulations, global industrialization, consumer goods and rapid growth of technologies, communication means (Kerr et al., as cited in Kaasa & Minkov, 2020) are powerful tools in shaping cultures. Even so, the speed and direction of those changes are not uniformly ubiquitous. As seen in Holton's work (2000), the processes of homogenization (when culture is more or less standardized due to the Westernization), polarization (when cultural wars arise between Westernization adherents and its opponents), and hybridization (when one culture borrows specific patterns of another due to the intense interrelations) might be evidence of this phenomenon.

Globalization might interfere with cultural processes. It is worth pointing out McLuhan's theory of a "global village" (1964) which comprises the "simultaneity" of cultures, unavoidability and multidimensionality of interaction with the outer world and others, the inevitability of affirming a cultural identity, and the possibility of cultural hegemony. Yet, there are no straight answers on the cultural consequences of globalization.

2.2 Culture and Cognition

2.2.1 Cognitive Development

The earliest steps in cognitive psychology made by Swiss epistemologist Jean Piaget were served as a basis for finding a link between culture and cognition. Piaget (1936, 1952, 1964) has considered that lifelong cognitive development is maintained by a person's adaptation to the surrounding world through their behaviour. Originally, Piaget held a position that cognition is affected only by inner factors (biologic maturation), but later, he reported that the process of learning is also crafted by external circumstances and current psychological state. At this point, he mentioned *epigenetic* (biologic factor), *equilibration* (synchronization with the social and environmental world), *social factors of interpersonal coordination* (information exchange), *educational and cultural transmission tools* as they aid the transitional and influential interaction of outer and inner forces.

Nevertheless, Piaget did not explore the degree of influence of the social environment across cultures, especially on the later stages of cognitive growth. Pierre Dasen (1977), a genetic psychologist, first investigated the universality and validity of Piaget's theory due to its relevance mostly to the Western world. The experiment with 5 to 33 months infants from France and the Ivory Coast showed that the influence of cultural environment was significant according to the difference in performance. He pointed out four cultural variables: *societal complexity* (seen during colour encoding processes), *visual environment* (causing illusions), *socialization and adaptation* (controlling the field-dependence, field-independence position), *psychophysiological factor* (occurring in colour spectrum perception). And yet, an anthropologist Ember Carol (Ember & Ember, 2009) found shortcomings in the explanation of those cross-cultural differences since no evaluative component is attached to measuring different life experience and adaptational conditions.

Another significant contribution was carried out by Soviet Union psychologist Lev Vygotsky and his schools´ followers - A. Leontiyev, A. Luria, P. Galperin, P. Zinchencko, A. Zaporozhec, D. Elconin and others. Being opponents of Piagetian theory, they argued that our mental abilities such as attention, sensation, perception, and memory are shaped under the extensible concept of "culture": a model of socially accepted behaviour, beliefs, values, language, and means of intellectual adaptation characterizing people as one entity. This hypothesis was supported by Luria's study (1931) on the mental activity of adults residing in Central Asia where huge cultural, social transformations and restructuring of life took place (in Uzbekistan).

Luria's social experiment aimed to examine the dependence of mental processes from sociocultural and historical contexts, how participants perceive and code various shapes and colours, how do participants classify and explain the classification, are they able to abstract away. All participants were without a degree and divided into five categories:

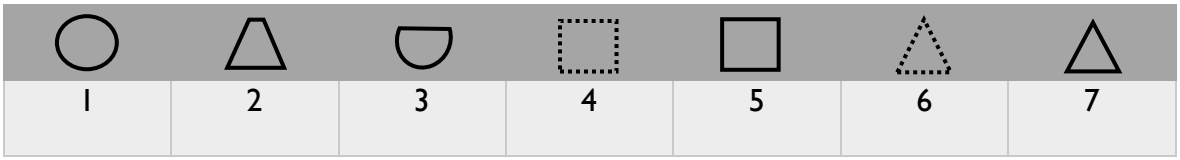
- women that were not involved in any social activities;
- peasants also not involved in socialized labour but who had own farm;
- women who attended short-term teaching training but were still illiterate;
- active members of the collective farm and young people who completed short courses after school;
- women who were admitted to a teacher's college after two or three years of study, also with a low level of education.

Participants went through different tasks: naming, grouping by similarity, categorization, colour coding, abstract thinking and reasoning. One of the tasks was related to naming and grouping of the symbols illustrated in Figure 2.4. The first three participant groups have associated the symbols with every day a priori familiar subjects like a plate (1), tent (2), women bracelet (3), beads (jewellery) (4), the mirror (5), watches (6), stand for the kettle (7) whereas other groups were able to give their geometrical names. Discrepancies in

categorization were also visible: again, the first three groups considered only their basic shape while making a decision, while more literate participants could differentiate figures according to other common properties.

Figure 2.4

Numbered symbols and groups of geometric figures



Note. Adapted from A.R. Luria. Cultural differences and intellectual activity (*А.Р.Лурия. Культурные Различия и Интеллектуальная Деятельность*) by Psychology OnLine.Net, 2006. (https://www.psychology-online.net/articles/doc-613.html). In the public domain.

Undoubtedly, this complex and multi-criteria study nowadays needs more practice and enhancements but several important conclusions were drawn from it: the influence of labour activity, practical needs, life experience, emerged historical and social transformation (October revolution, the establishment of Soviet regime, and a rapid transition from a nomadic lifestyle to sedentary, forced industrialization), notable social stratification, low literacy was shown there. Similarly, Cohen (2001) has reported that problem-solving abilities are crafted during or related to human existence as a result of social and psychological interactions emerging in response to the local conditions.

Vygotsky's theory of cultural-historical development of 1930 (in English sources: Sociocultural Theory of Cognitive Development) shed light on the factors that form human development from the earliest stages. Vygotsky (1960, 1979) described the transformation of natural psychological functions to cultural higher cognitive development, e.g. mechanical memory evolves into superior logical. On top of that, his research showed that beliefs, values and so-called "mediator tools for intellectual adaptation of culture" are consistently and directly affecting human cognitive development and, thus, his behaviour. He concluded that the surrounding setting is a source of psychological development that fills and designs the content of conscious and unconscious layers.

Most attention in his research was given to the role of language. While Piaget affirmed that the language acts as an independent body and has no impact on the cognition and mind, Vygotsky (1934) asserted that language as one of the above-mentioned tools modifies the entire course and structure of mental functions. It is aided by "various forms of numbering, mnemonic devices, algebraic symbols, works of art, writing, charts, diagrams, maps, drawings, all kinds of conventional signs, etc." (Vygotsky, 1982).

Language shapes consciousness, slices reality, and, thus, develops a particular world-view. This can be also seen in *Sapir-Whorf hypothesis* or *linguistic relativity theory* (Sapir, 1929; Whorf, 1940; Holmes, 2001; Lucy, 2001), which states that language plays a crucial role in shaping our perception in response to cultural needs: "how we look at the world is largely determined by our thought processes and our language limits our thought processes". Heron and Simonsson (as cited in J. Berry & Dasen, 2019) also accentuated the importance of language as a medium of instruction that will increase the probability of a person's exposure to cognitively relevant values of the culture with which that language is associated. As evidence of the already stated concepts, Boroditsky's (2001) study between Mandarin and English speakers confirmed the concept of linguistic determinism when thoughts and actions are regulated by language properties (reading style, vocabulary, grammatical gender, reasoning and action order, and priority).

Whereas Piaget, Vygotsky, and other researchers put more attention on mental functioning and its developmental stages, others have investigated whether other (social, socio-cultural, ecological) factors are presented to understand the relationship between cultural setting and cognition. In particular, Dasen and Heron (1981) noted that during the concrete operational stage of cognitive development such quantitative factors as urbanization, acculturation, schooling and literacy rate, ecocultural relevance, the cognitive ambience are influential. This was proved by the observation of spatial skills of nomadic, hunting, gathering people and agricultural, sedentary way of living.

Likewise, Berry (1992; 2019) affirmed that group behaviour and primitive culture are influenced by ecology and sociopolitical context and determined an *"ecocultural approach"* to the group's and individual's adaptation. It follows the idea that biological and cultural aspects interact with ecological conditions, and the development of individual's behaviour adapts itself to the culture and ecology. A recent study of Varnum et.al (2010) observed the *social orientation hypothesis* which originates from ecology, level of socialization, wealth condition, historical or human-made threats associated with social tightness or looseness, individualism and collectivism processes. In a much larger sense, this process also involves the influence of demographic situation, societal conformity and structure, hierarchy levels, housing and mobility, social stratification on cognition.

2.2.2 Cognitive style

Given the fact that cognition is "touched" by culture, then other questions appear in our mind: Does it create a specific patternable behaviour? How many of them we can observe in the world? How can we distinguish, describe and classify a cognitive style? Following literature review should shed light on how cognitive style might differ.

An interesting comparison was illustrated in Norenzayan et al.'s work (2007) where the human mind and cognition were analogous to the computer machine. In line with it, the *input* differs across cultures, due to ecological, social conditions, and the *output* is in the form of beliefs and behaviour. Similarly, Segall (1963) posited that the input expresses "perceptual inference habits", Bender and Beller (2011) have concluded that cognition is a result of processing and content. While the processing part is universal to all human beings and separate from the context (i.e. cultural background), the content differs across cultures. The evidence of that can be seen simply in how students, workers, tourists from different countries gathered in one place understand things and perform differently. The authors have also remarked that the majority of research in the cognitive field put a spotlight on exploring and judging cognitive diversity by the developed, industrialized, and educated Western world. Hence, the lack of research could be a possible explanation of the position of "looking from one point",

Notwithstanding, there is an assumption that rough division by "**analytic**" and "**holistic**" represents cognitive styles specific to one culture. For instance, social psychologists (R. E. Nisbett et al., 2001; R. E. Nisbett, 2003; R. Nisbett & Masuda, 2003; R. Nisbett, 2004; Miyamoto et al., 2006; R. E. Nisbett et al., 2008) have advocated the view that Western cultures are more analytic and independent and Asians are, on the contrary, holistic and interdependent. A recent study has shown a correlation between cognitive styles and social orientation (Oyserman & Lee, 2008; Varnum et al., 2010) depicted in Table 2.2 and Table 2.3. Notably, Nisbett and Masuda (2003) analyzed them based on the discrepancies in attention and perception, grouping, categorization, prediction, reasoning, use of logic and critical thinking. The key point was that people from two distinct cultural zones showed differing results: holistic viewers were relying on experience-based knowledge, focused mostly on the background, on the whole picture, whereas analytic thinkers were separating the object and its background, paying attention to the focal objects.

Afterwards, Boduroglu et al. (2009) investigated the attentional breadth and focus, judgement on informativeness, and scene and relationships encoding between Americans and East Asians. The experiment revealed that Asians are quicker to detect colour changes but slower in seeing changes in the centre of the composition. The bottom line was that contrasting patterns of perception and behaviour were possibly caused by linguistic diversity, the complexity of the urban environment, intellectual traditions, societal trends and norms within a group or society, tightness of social relationships, the place of "self" within a group or society, upbringing methods, and family relationships.

However, one must be aware of not jumping to a conclusion in this matter because of the lack of coherence between individual and group levels: how accurate group features represent individual characteristics (Varnum et al., 2010)? To illustrate, independence/interdependence dimensions might have different circumstances and expressions on an individual level, or some scores would show small correlation within the

group whereas an aggregated group indicator might show a strong one (Shweder, 1973; Kitayama et al., 2009).

Table 2.2

Analytic Versus Holistic Cognitive Patterns

Analytic Cognition		Holistic Cognition
Field independent Narrow Focus on salient objects with intent to manipulate them	**Attention**	Field dependent Broad Focus on relationship of elements, background
Taxonomic, focus on a single dimension or shared property	**Categorization**	Thematic, focus on functional relationship or overall similarity
Dispositional Traits and attributes of individuals determine events	**Attribution**	Situational External forces, context, and situations determine events
Analytic Use of formal logic Trends continue	**Reasoning**	Dialectical Middle Way philosophy Trend reversals are likely

Note. Adapted from "The Origin of Cultural Differences in Cognition" by Varnum, M. E. W., Grossmann, I., Kitayama, S., & Nisbett, R., 2010, *Current Directions in Psychological Science*, 19(1)(9–13) (https://doi.org/cks2h8). Copyright 2010 by Association for Psychological Science.

Table 2.3

Independent Versus Interdependent Social Orientation Patterns

Independent social orientation		Interdependent social orientation
Individualism Autonomy	**Values, beliefs**	Collectivism Harmony
Independent self-construal Personal social identity Self as bounded	**Self**	Interdependent self-construal Relational social identity Self as overlapping with close others
Higher propensity of socially disengaging emotions Happiness as a disengaging emotion	**Emotions**	Higher propensity of socially engaging emotions Happiness as an engaging emotion
Individual achievement Self-enhancement Ego-inflation	**Motivation**	Achievement for in-group Self-criticism Self–other interconnection

Note. Adapted from "The Origin of Cultural Differences in Cognition" by Varnum, M. E. W., Grossmann, I., Kitayama, S., & Nisbett, R., 2010, *Current Directions in Psychological Science*, 19(1)(9–13) (https://doi.org/cks2h8). Copyright 2010 by Association for Psychological Science.

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2.3 Cognitive style and Cartography

Knowledge about map perception underlies the topic of the relationship between cognition and cartography. As seen in Żyszkowska's (2015) study, there are four phases of map perception. The *intuitive* phase implies practical experience and psychological mechanisms which are aided by appropriate map design. The next phase, i.e. *psychophysical*, involves the process of human reaction to the properties of cartographic symbols in the process of map content and its further interpretation and reasoning. Here, a methodological system of visual variables mentioned in *"Semiology of Graphics"* (Bertin, 1983), Imhof's (1972) colour use strategies, and works (e.g. Arnheim, 1954; Tufte, 1995) might contribute to a better product result. The third stage, i.e. *cognitive,* concerns high order mental mechanisms that are responsible for information processing and succeeding in multiple tasks related to spatial orientation, representation, knowledge acquisition, e.g. attention and memory, visual search, and so on. Thus, Gestalt theory (Koffka, 1922; Köhler, 1929; Wertheimer, 1959; Köhler & Pratt, 1969) can aid in producing a well-balanced, consistent map design. And finally, the *cognitive-digital stage* is tightly connected with the emergence of web-based, digital, animated, multidimensional, close to reality navigational maps, or maps constructed by programming languages.

Only several studies have been done particularly in the field of map perception and cognitive psychology. Insights in the cognitive field bring to the table higher usability, functionality and better visualization of spatial information because cognition is involved in data acquisition, visual picture and design, spatial analysis and decision-making processes. Bearing in mind that map users may have different cognitive styles and abilities, Montello (2004), Oyserman

(2011) also stressed the role of culture (i.e. *situated cognition*). As such, the emergence of cognitive cartography was vital: it allowed the perceptual process of map elements, topographic terrain visualization, graphic symbols, etc. to be examined (Potash; Castner, as cited in Montello, 2004).

Integral cooperation of psychologists and cartographers has resulted in Stachoň et al.'s (2013) scrutiny on the user's cognitive style in a map reading process. A study-case with a set of map symbols varying in shape, size, colour, intensity, orientation, and structure coupled with map reading tasks observe how people process and choose information. One of the outcomes was that the set with distinct features showed a high correlation ($r = 0.37$; $r = 0.40$; $p < .05$) between reading tasks and the user's cognitive style.

Cognitive style *- individual differences in the way people perceive, think, solve problems, learn, and relate to others (Witkin, Moore, Goodenough, and Cox, as cited in Kozhevnikov, 2007);*

Cognitive style *historically has referred to a psychological dimension representing consistencies in an individual's manner of cognitive functioning, particularly concerning for acquiring and processing information (Ausburn & Ausburn, 1978);*

Cognitive styles *are individual difference variables that presumably describe a person's preferred and characteristic way of perceiving, learning, and thinking (Bengston, as cited in Holland, 1982);*

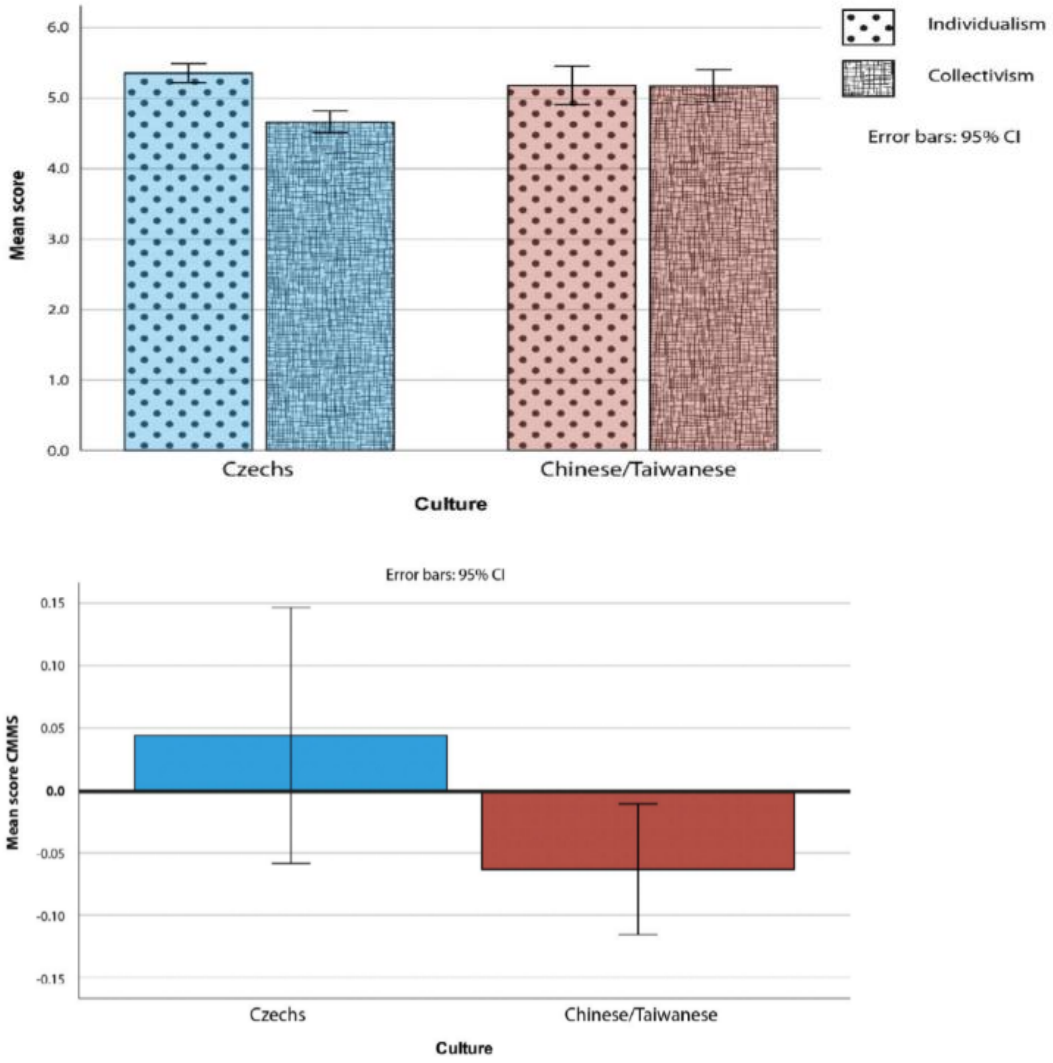
Ory et al.'s (2015) study has obtained arguments supporting the presence of mental processes, e.g., perception, learning, memory/recall in the process of map reading. Therefore, the evaluation framework for graphical elements, namely, road network, water features, vegetation and relief representation, labelling style, settlement zones, was applied toward understanding the relationship between recognition, experience and topographic design style. Furthermore, the authors found representative map elements that were participating there such as visualization of relief, touristic points of interest (signature information); road network, settlement areas, forest (visual salient information). Labelling and typography (located information) and other graphical characteristics (secondary information) were minor. The limitation of this empirical study was that only participants with a certain level of map experience were involved - experts.

Lacko et al. (2020) have contributed research questions and methodology to the topic of cartographic information reading, processing, interpretation and cognitive style. Their experimental study on map reading tasks has tested the validity of holistic/analytic cognitive styles among Central Europeans and East Asians. The results of an ad hoc procedure, namely, **IISS** showed that the Asian group was relatively collectivist (mean = 5.17 in the collectivist subscale and mean = 5.18 in the individualistic subscale) in comparison to Europeans (mean = 4.66 in the collectivist subscale and mean = 5.35 in the individualistic subscale) as shown in Figure 2.5; Left. Meanwhile, **CMMS** showed that Europeans conform

to the analytical mindset with a mean value = -.044, SD = .360; and Asians – with the mean value = -.063, SD = .172 adhere to the holistic way of thinking (see Figure 2.5; Right).

Figure 2.5

Cross-cultural differences between Czech and Chinese/Taiwanese participants



Note. The Left figure represents the results of IISS. The Right figure demonstrates CMMS (where high value means analytic, low value - holistic mindset; the results on a scale between -1 (holistic) to 1 (analytic)). Adapted from "Cross-Cultural Differences in Cognitive Style, Individualism/Collectivism and Map Reading between Central European and East Asian University Students" by Lacko, D., Šašinka, Č., Cenek, J., Stachoň, Z., & Lu, W.-L., 2020, *Studia Psychologica*, *62(1):23-43* (https://doi.org/d7rr). Copyright 2020 by Studia Psychologica.

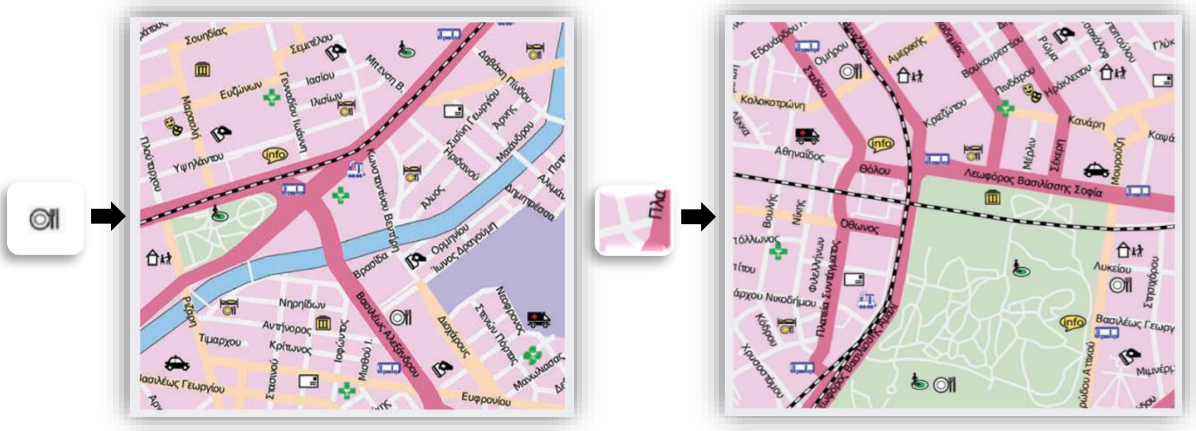
However, the diagnostics of cross-cultural differences might not be as prominent as expected. Peculiar outcomes were introduced in Stachoň et al.'s (2018) recent user study observation. Thus, a methodology engaging map-reading tasks on the localization of a

cartographic symbol and a segment from a background map (see Figure 2.6) was introduced to Czech and Chinese map users. Scholars took into account the diversity in holistic, analytic cognitive approaches and, hereby, implemented Kitayama et al.'s FLT (Kitayama et al., 2003) for measuring of these modes of thought. In this regard, different levels of tasks were presented. The first task was to highlight an analogous line related to *decontextualization, detection of discrepancies* in analytic style, and the ratio to the background frame connected to the *contextualization, detection of similarities and relationships* in holistic approach (Oyserman, 2011). The findings showed cross-cultural differences in map reading process but surprisingly did not support the hypotheses. Asians demonstrated an analytic approach, and Western participants, on the contrary, a holistic mode of thought. Equally distributed and unexpected FLT result, a shift in socio-cultural context in their home countries, the use of Western digital communication means, rapid dissemination of Western hardware and software, small diversity of participants, the field of study were given as reasons for such contradictory conclusions.

Being able to draw upon the above-mentioned research, we can speculate that individuals might unconsciously "turn on" an accessible knowledge in the process of information processing, judgement, and attitude to be reasonable in experience (Oyserman & Sorensen, 2009; Oyserman, 2011). Simply put, accessibility is a result of priming (Srull & Wyer, 1979; Strack et al., 1993) or of routine life and habits (Bargh, as cited in Oyserman, 2011). That is, accessible knowledge has to be placed in memory beforehand. It also might help in testing at the individual level.

Figure 2.6

Test stimulus used in the map-reading test



Note. Examples of the test stimulus used in map-reading test version A "Locate the symbol shown on the left" and test version B "Locate the background segment shown on the left". Adapted from "Cross-cultural differences in figure-ground perception of cartographic stimuli" by Stachoň, Z., Šašinka, Č., Čeněk, J., Štěrba, Z., Angsuesse, S., Fabrikant, S. I., Štampach, R., & Morong, K., 2018,

2.4 Topographic map design

2.4.1 Topographic map

***Topographic map**, cartographic representation of the Earth's surface at a level of detail or scale intermediate between that of a plan (small area) and a chorographic (large regional) map. Within the limits of scale, it shows as accurately as possible the location and shape of both natural and man-made features. Natural features include relief, which is sometimes mistakenly understood to be the sole feature characterizing a topographic map, and hydrographic features, such as lakes and rivers; man-made features include other characteristics of the subject area, such as cities, towns, and villages, and roads, railroads, canals, dams, bridges, tunnels, parks, and other features (Encyclopedia Britannica, n.d.);*

*A **topographic map** is a two-dimensional representation of the Earth's three-dimensional landscape; a detailed and accurate illustration of man-made and natural features on the ground such as roads, railways, power transmission lines, contours, elevations, rivers, lakes and geographical names (Natural Resources Canada, 2014).*

In other words, topographic maps are highly precise cartographic products at a large scale reflecting the spatial composition of the surrounding world in a reduced, generalized and figurative-symbolic way. **Relief** (e.g. mountain systems, glaciers, valleys, lowlands, glaciers), **hydrography** (e.g. lakes, rivers, canals, streams, currents, swamps, rapids), **vegetation** (e.g. forested areas, gardens and parks), **transportation** (highways and motorways, roads, trails, airports, anchorages, etc.), **cultural** (settlements areas, main buildings, power transmission network, TV and radio stations, hospitals, towers, beacons, religious places, parking, towers, ruins and other significant places), **boundaries** (state, regional, recreational, military), toponymy (water objects, place names, boundary and relief names) are depicted on topographic maps (Natural Resources Canada, 2014).

Accurately representing natural and man-made objects and following mathematical rules and topographic nomenclature, this type of map covers a wide range of application and use in everyday life that requires a highly detailed observation of an area, viz, research, engineering and construction works, cadastral, land management, and tax activities, transportation network, urban planning, agricultural land use, industry, forestry, military and defence operations, economic and strategic planning, tourism, etc.

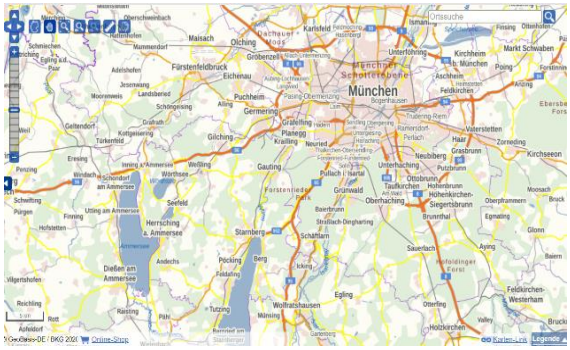
The topographic map having a high-level of graphical and semantic representation of a distinct part of the territory can be considered as the most prevalent, trusted and powerful medium for the communication of spatial information. Kent (2009) holds the position that

topographic maps are constructed from the individual perspective of a particular society, depicting an uncommon terrain with a unique imprint on needs and cultural values formed under historical and geographic circumstances. As seen in Figure 2.7, National Mapping Agencies (NMAs) around the world distribute their own set of objects (physical, economic, and cultural features), design guidelines, and permitted level of details and complexity.

Figure 2.7

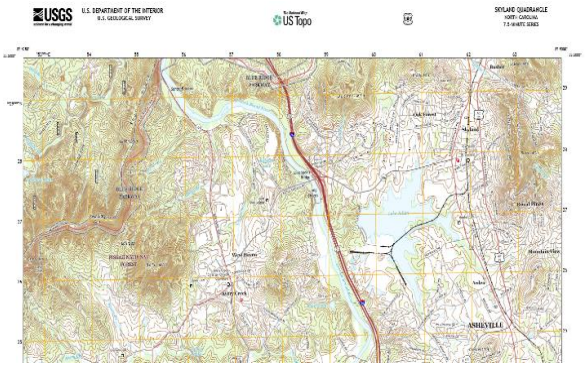
National Topographic Maps

Germany



Note. WebAtlasDE Viewer, n.d. by Bundesamt für Kartographie und Geodäsie, 2020. (http://sg.geodatenzentrum.de/web_bkg_webmap/applications/webatlasde/webatlasde.html). Copyright 2020 by BKG. In the public domain.

USA



Note. TNM Download, 2019 by U.S. Geological Survey - Department of the Interior/USGS, 2019. (https://viewer.nationalmap.gov/basic/?basemap=b1&category=histtopo,ustopo&title=Map%20View#productSearch). Copyright 2019 by USGS. In the public domain.

Switzerland

Note. Swiss Geoportal, 2020 by the Federal Office of Topography swisstopo, 2020. (https://map.geo.admin.ch). Copyright 2020 by swisstopo. In the public domain.

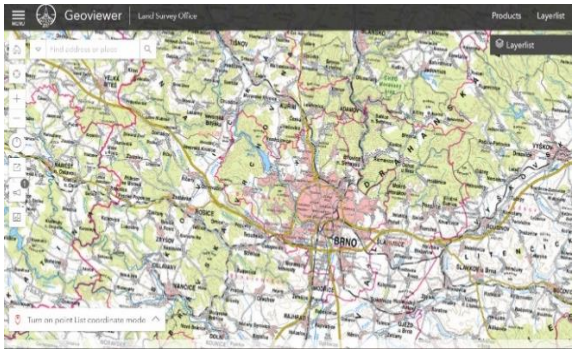
France

Note. Géoportail (IGN), 2019 by L'Institut national de l'information géographique et forestière, 2019. (https://www.geoportail.gouv.fr/). Copyright 2019 by IGN. In the public domain.

Australia

Note. 1:250 000 Scale Topographic Map, 2013 by Australian Government - Geosciences Australia, 2017.(http://geoscience-au.maps.arcgis.com/apps/opsdashboard/index.html#/7e8e72ea0cc042f588d1883d0e57d855). Copyright 2020 by Commonwealth of Australia (Geoscience Australia). In the public domain.

Czech Republic

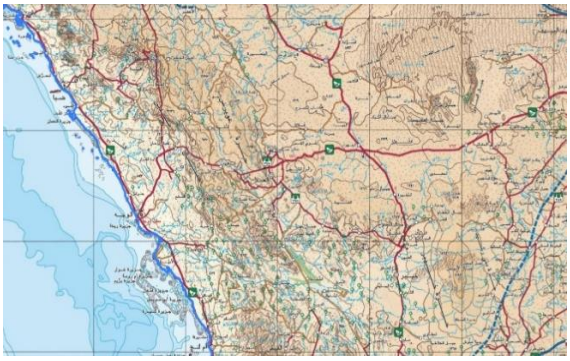


Note. Geoprohlížeč, 2020 by Český úřad zeměměřický a katastrální, 2020. (https://ags.cuzk.cz/geoprohlizec/?id=8910c49c4e1049f382140db266682a7c_1w). Copyright 2020 by ČÚZK. In the public domain.

Panama

Note. Mapa Topográfico Escala 1:25 000, 2011 by Instituto Geografico Nacional Tommy Guardia, 2020. (https://sigigntg.anati.gob.pa/portal/apps/webappviewer/index.html?id=96c46429e3c349b9b4a987096e1e1a5c). Copyright 2020 by IGNTC. In the public domain.

Saudi Arabia



Note. 1:25,000 scale Topographic Map, n.d. by The General Commission for Survey of Kingdom of Saudi Arabia, 2020. (https://www.gcs.gov.sa/En/ProductsAndServices/Products/BaseMaps/Pages/Topographic-Map-25K.aspx). Copyright 2020 by GCS. In the public domain.

Even though NMAs produce topographic maps at different scales and follow cartographic standards and guidelines, there are some limitations in their availability and use. It is well known that such comprehensive depiction of spatial information might face some restrictions for the purpose of privacy, secrecy, the importance of data and its narrow use in most states. For instance, in accordance with the governmental laws on the level of secrecy of cartographic, topographic, aerial, geodetic survey and gravimetrical materials, topographic sheets at the scale of **1:50.000 and larger** of the territory of Russian

Federation (Administration of the President of Russia, 2015), Republic of Kazakhstan (Ministry of Justice of the Republic of Kazakhstan, 1999), Kyrgyz Republic (Ministry of Justice of the Kyrgyz Republic, 2013), former Soviet countries (Veldi & Bell, 2019); **1:250.000** - in India (Survey of India, n.d.; World, 2010) are not for available for public use or civil purposes without permission or license.

Meanwhile, topographic maps at the larger scale, e.g. **1:24.000** produced by the U.S. Geological Survey (*USGS*); **1:25.000** – in Switzerland *(swisstopo),* Spain *(Instituto Geográfico Nacional)*, Italy *(Istituto Geografico Militare),* Saudi Arabia (*General Commission for Survey Saudi Arabia*), Panama *(Instituto Geografico Nacional Tommy Guardia);* **1:50.000** maps produced by NMAs of Canada (*Natural Resources Canada*), Great Britain (Ordnance Survey, n.d.), Australia (*Geoscience Australia*), are possible to observe or download for the Internet user.

The topographic map for this thesis was chosen due to its unique style on a national level; map content accuracy and quality established and scrutinized by governmental structures; familiarity and trustworthiness for the general map user. However, original topographic maps of two countries were not possible to compare for several reasons discussed in the following chapters, and thus, only the design style elements were adopted.

2.4.1 Topographic map design

On top of everything described above, the design and visual appearance of the topographic map makes a major contribution to its reading and interpretation by the map user. Notably, the presence of science and technology is seen on this map due to high scientific requirements and broad scale of map users and purposes. Indeed, pioneer cartographers shared similar views on that topic. Key statements concluding that the quality of the map depends on its aesthetic appearance (Wright, 1942), that the artistic side plays a crucial role in achieving a broader and qualitative scientific product (Robinson, as cited in Krygier, 1995) and joint work with scientific and technological approaches result into an aesthetic and informative map (Eckert, as cited in Goldsberry, 2007), that a poorly designed map distorts our interpretation or maximize confusion (Monmonier, 1996) were earlier made.

Those concepts become specifically valid when it comes to the design of topographic maps whose main aim is to meet multiple goals of several target groups and be highly functional for public and civil use. The aforestated concepts were confirmed in the case study on topographic map design assessment handled by Ortag (2009). Based on the results of 153 respondents (both experts and non-experts), such cartographic variables as colour scheme, readability and clearness, relief and 3D impression, font style and colour contrast play a key role in map perception. This confirms Imhof's quote that "the highest possible accuracy in respect to map scale, good geometric significance, good characterization of shapes, highest

possible clearness and good readability, simplicity and clearness of graphic expression and finally, as the sum of all these qualities, a special kind of beauty which is inherent to a map".

Discussions on how one can identify a cartographic style and achieve both functional and aesthetically pleasing topographic map design have been the subject of considerable debate among cartographers for many years. Vujakovic & Kent (2009) hold the position that topographic maps are constructed from the individual perspective of a particular society, depicting an uncommon terrain with a unique imprint on needs and cultural values formed under historical and geographic circumstances. For that reason, various systematic approaches in this matter such as a descriptive *comparison of symbolization* (Olson and Whitmarsh, as cited in Kent, 2009), *classification by legend content* (Piket, as cited in Kent, 2009), observation and *description of map elements associated with a specific phenomenon* (e.g. surface, hydrography, landscape, cultural, and so on) (Forrest et al., Collier et al., as cited in Kent, 2009) were implemented earlier.

Kent (2009) raised the subject of developing a critical methodology for topographic symbol classification by analyzing the similarities and discrepancies in their cartographic design style. Afterwards, he came up with classification according to the typology of landscapes, colour hue, and visual hierarchy. Consequently, Vujakovic & Kent (2009) developed a "cluster analysis" model for comparison: classification of landscape, colour hue, "white space", typography, and visual hierarchy. Another approach based on the content generalization and symbolization parsing (colour scheme, line and point features) was proposed by Ory et al. (2013).

This research will review and observe in detail the classification of two cartographic design styles considering the aforementioned approaches. Since the content of topographic maps is created, updated, and supervised by the governmental authorities, they follow standardized guidelines and technical specifications. But first and foremost, they have developed their design elements suitable for spatial information visualization and several purposes of different user groups.

3. METHODOLOGY

This chapter explains the methodology and workflow of the user study research from the creation of map stimuli and the conduction of the experiment.

3.1 Methodological approach

A hybrid (both qualitative and quantitative) approach was applied to address the research objectives and questions in a sensitive manner. Quantitative measurements were intended to examine:

- the state of cognitive abilities as attention, perception, and learning between two user groups by recording the time needed to solve the task;
- the trend in perception of the map content varying in design styles within a cross-cultural context;
- the role of topographic map design style in serving its main purposes – effective "map-user" communication, proper information visualization, and knowledge extraction;
- variations in self-orientation on a map, the ranking of map elements, and its reasoning among participants from two user groups.

Furthermore, the qualitative method was used to convey participants´ opinion, associations, logical strategies, and feedback during the whole session.

3.2 Map samples creation

3.2.1 Selection stage

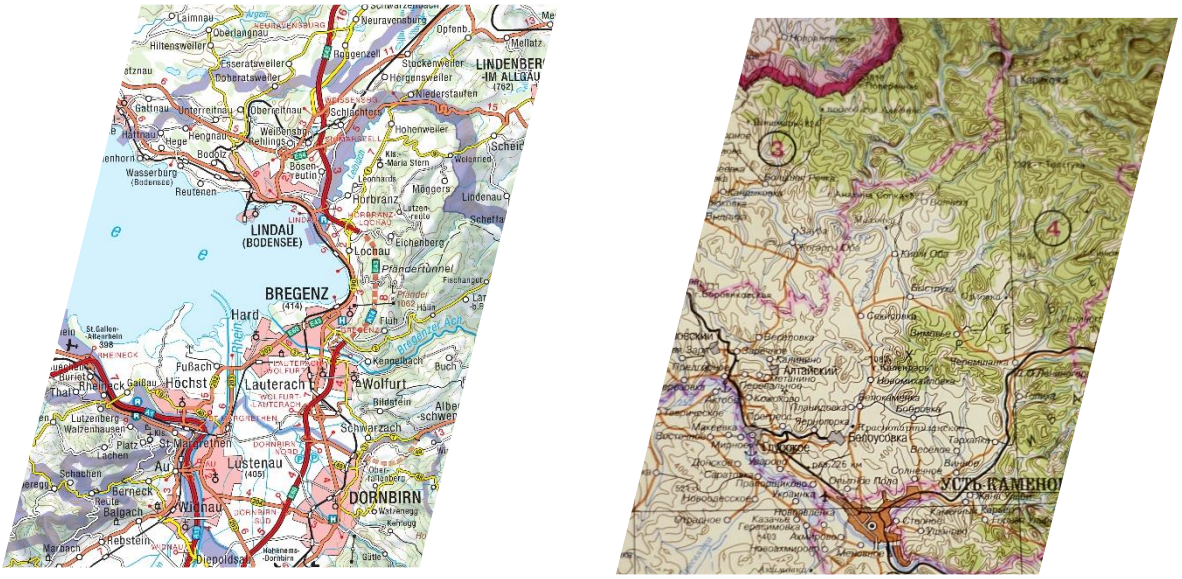
Map samples´ design is replicating the topographic style of two NMAs:

- Federal Office of Metrology and Surveying (BEV) of the Federal Ministry of Digital and Economic Affairs of the Republic of Austria (Map 1);
- Committee of Geodesy and Cartography of the Ministry of Digital Development, Innovation and Aerospace Industry of the Republic of Kazakhstan (Map 2).

In the case of Map 1, the topographic map was derived from freely available product section (Bundesamt für Eich- und Vermessungswesen – Support – Produkte – Unentgeltliche Produkte des BEV - Kartographische Modelle - Kartographisches Modell 1:250 000 Raster). And for Map 2, a paper map of the same scale was ordered from the National Fund of Cartography and Geodesy.

Figure 3.1

Original map samples´ source: topographic map of Austria and Kazakhstan



Note. Left: Adopted from *Kartographisches Modell 1:250 000 (Raster KM250-R)*, 2019 by Bundesamt Für Eich- Und Vermessungwesen, 2019. (https://www.bev.gv.at/portal/page?_pageid=713,1604790&_dad=portal&_schema=PORTAL). Copyright 2019 by Bundesamt Für Eich- Und Vermessungwesen (BEV). In the public domain. Right: Adopted from Republican State Enterprise "National Fund of Cartography and Geodesy", 2012, printed map. Copyright 2012 by Republican State Enterprise "National Fund of Cartography and Geodesy". Ordered.

Having in mind that the aspects of visual balance and simplicity-complexity play a significant role in that case, the level of map elements´ density on two map samples was brought to one level so that some map elements were reduced. The tables below show correspondingly matched map elements that were used for each of the maps.

Linear features: for instance, Austrian topographic maps of the mentioned scale provide more detailed information of transportation network: standard gauge railway (multiple and single tracks), railway under construction, narrow railway, rack railway, cable car, chairlift, cableway for goods, motorway (dual carriageway, under construction), primary and secondary routes, first, second, and third-order roads, roads under construction, roadways, fair weather road, footpath), and accompanying information, like the route number, distance in kilometres, service area, car parks, junctions, and tollbooths. Whilst the topographic map does not contain a large range of categories because in the Soviet Union topographic maps were mainly produced for the terrain representation (physical geography,

military topography), and there was a separate map for transportation means. As for the demarcation and boundary lines, they were present on both maps.

Table 3.1

Table with analogous symbols for linear features on two topographic maps.

lines of communication			
Austrian map			**Kazakhstan map**
standard gauge railway – railway station			railway road – railway station
motorway: completed			motorways
primary route			improved seal-coated road
secondary route			
first order road			seal-coated road
roadway			improved dirt road
footpath			dirt road
route number			-
distance in km – motorway - road motorway			distance in km – motorway - road motorway
			
boundary			
Austrian map			**Kazakhstan map**
state border			state borders
province boundary			oblast borders
administrative district boundary			region borders

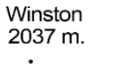
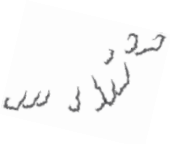
Note. Left: Adopted from *Kartographisches Modell 1:250 000 (Raster KM250-R)*, 2019 by Bundesamt Für Eich- Und Vermessungwesen, 2019. (https://www.bev.gv.at/portal/page?_pageid=713,1604790&_dad=portal&_schema=PORTAL). Copyright 2019 by Bundesamt Für Eich- Und Vermessungwesen (BEV). In the public domain.

Right: Adopted from Republican State Enterprise "National Fund of Cartography and Geodesy", 2012, printed map. Copyright 2012 by Republican State Enterprise "National Fund of Cartography and Geodesy". Ordered.

Relief representation: due to distinct climate and natural conditions, the represented relief features differ from one map to another. In particular, the Kazakhstan map illustrates quite interesting and unfamiliar features to European map users such as stony placers, mounds and hillocks, dry beds, cliffs, ravines and gullies, rare forests, small forest areas, separate groups of bushes, separate groups of saxaul (a woody plant of the Haloxylon group), reed and cane thickets, sands (hilly, ridge, even, cellular, dune), passable and impassable salt marshes, karsts, takir (salt flats, playas), rocks-outliers.

Table 3.2

Table with analogous symbols for terrain representation on two topographic maps.

terrain representation			
Austrian map			**Kazakhstan map**
principal contour / elevation value			main contours and their labels
contour			additional contours (horizontals)
spot elevation			elevation marks
rocks			rocks

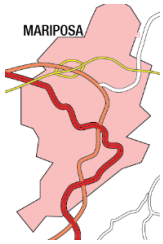
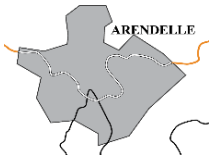
Note. Left: Adopted from *Kartographisches Modell 1:250 000 (Raster KM250-R)*, 2019 by Bundesamt Für Eich- Und Vermessungwesen, 2019. (https://www.bev.gv.at/portal/page?_pageid=713,1604790&_dad=portal&_schema=PORTAL). Copyright 2019 by Bundesamt Für Eich- Und Vermessungwesen (BEV). In the public domain.
Right: Adopted from Republican State Enterprise "National Fund of Cartography and Geodesy", 2012, printed map. Copyright 2012 by Republican State Enterprise "National Fund of Cartography and Geodesy". Ordered.

Surface objects: regarding the landcover objects, it must be noted that the difference was found only in the presence of the industrial area on the Austrian map

which has the same representation as a small settlement on Kazakhstan maps. However, forested areas, large settlement, settlement, soggy soil areas and swamps with reeds, orchard and garden were analogous. The latest two were not used in the map samples´ creation.

Table 3.3

Table with analogous symbols for landcover objects on two topographic maps

landcover			
Austrian map			**Kazakhstan map**
white space			white space
forest			forest
large settlement			large settlement
-			small settlement
settlement			settlement

Note. Left: Adopted from *Kartographisches Modell 1:250 000 (Raster KM250-R)*, 2019 by Bundesamt Für Eich- Und Vermessungwesen, 2019. (https://www.bev.gv.at/portal/page?_pageid=713,1604790&_dad=portal&_schema=PORTAL). Copyright 2019 by Bundesamt Für Eich- Und Vermessungwesen (BEV). In the public domain. Right: Adopted from Republican State Enterprise "National Fund of Cartography and Geodesy", 2012, printed map. Copyright 2012 by Republican State Enterprise "National Fund of Cartography and Geodesy". Ordered.

Symbology: as for the graphical symbols, there were also discrepancies in their variety. Beyond matched symbols between two maps, Austrian maps illustrate monasteries, castles

and ruins, alpine huts and power stations. wind turbines, refineries, oil-, gas tanks and wells, view towers, cave. Meanwhile, Kazakhstan maps depict monuments and mass graves (beds of honour), waste heaps and rock dumps, tower-type capital structures, surface and underwater stones.

Table 3.4

Table with analogous symbols for graphic symbols on two topographic maps

Austrian map			Kazakhstan map
individual objects			
church			Buddhist and other temples
mine			mine
factory			plants and factories
transmitting station			TV and radio mast
beacon			lighthouse
hospital			hospital
air traffic			
aerodrome in correct positioned representation			aerodrome
airport			

Note. Left: Adopted from *Kartographisches Modell 1:250 000 (Raster KM250-R)*, 2019 by Bundesamt Für Eich- Und Vermessungwesen, 2019. (https://www.bev.gv.at/portal/page?_pageid=713,1604790&_dad=portal&_schema=PORTAL). Copyright 2019 by Bundesamt Für Eich- Und Vermessungwesen (BEV). In the public domain. Right: Adopted from Republican State Enterprise "National Fund of Cartography and Geodesy", 2012, printed map. Copyright 2012 by Republican State Enterprise "National Fund of Cartography and Geodesy". Ordered.

Labelling: typography (font style and size) for the labels is more sophisticated on the Austrian map: the font size was categorized for 8 settlement types: towns having more than 100,000, 25,000, 5 000, 2,000 and less than 2,000 inhabitants; settlement with more than 5,000, 2,000 and less than 2,000 residents. Furthermore, the label colours for valleys, mountain passes, mountain ranges, glaciers, national parks, and military restricted areas were delineated in a straightforward way. Glaciers on the Kazakhstan map are illustrated by a graphic symbol but not named as an Austrian one.

Table 3.6

Table with analogous symbols for labelling on two topographic maps

typography			
Austrian map			**Kazakhstan map**
town > 100 000 inhabitants	SHARNWICK	SHARNWICK	large cities > 50,000 inhabitants
town > 25 000 inhabitants	Rivendell	Rivendell	small towns with less than 50,000 inhabitants
settlement > 2 000 inhabitants	Surabaya	Surabaya	villages
settlement < 2 000 inhabitants	Werowocomoco	Werowocomoco	rural settlements
district	KELEWAN	KELEWAN	city or village districts
water	Rivia Lake	RIVIA LAKE	water
mountain / mountain range	Karstark	KARSTARK	mountain / mountain range
valley	Cloverfeld	CLOVERFELD	valley

Note. Left: Adopted from *Kartographisches Modell 1:250 000 (Raster KM250-R)*, 2019 by Bundesamt Für Eich- Und Vermessungwesen, 2019. (https://www.bev.gv.at/portal/page?_pageid=713,1604790&_dad=portal&_schema=PORTAL). Copyright 2019 by Bundesamt Für Eich- Und Vermessungwesen (BEV). In the public domain. Right: Adopted from Republican State Enterprise "National Fund of Cartography and Geodesy", 2012, printed map. Copyright 2012 by Republican State Enterprise "National Fund of Cartography and Geodesy". Ordered.

Water bodies: water objects on the original Kazakhstan map are displayed quite detailed: the coastline of lakes and water reservoirs, rivers with the width of more or below 300 meters, dried-out rivers (creeks), the direction of flow, rapids, high-risk flood zones, and its navigability, water level marks, the starting point of regular shipping, marinas and anchorages, dams, wells and springs, ferry crossings.

Table 3.6

Table with analogous symbols for water bodies on two topographic maps

waters			
Austrian map			**Kazakhstan map**
unnavigable river-stream - direction of flow			rivers and streams - arrows indicating the direction of flow of rivers
lakes			lakes

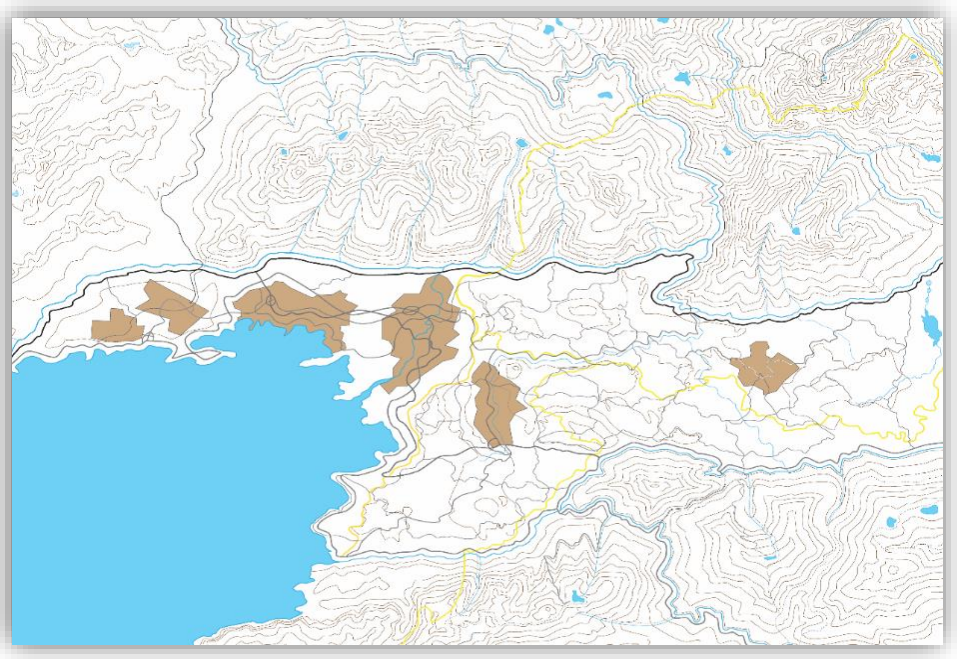
Note. Left: Adopted from *Kartographisches Modell 1:250 000 (Raster KM250-R)*, 2019 by Bundesamt Für Eich- Und Vermessungwesen, 2019. (https://www.bev.gv.at/portal/page?_pageid=713,1604790&_dad=portal&_schema=PORTAL). Copyright 2019 by Bundesamt Für Eich- Und Vermessungwesen (BEV). In the public domain. Right: Adopted from Republican State Enterprise "National Fund of Cartography and Geodesy", 2012, printed map. Copyright 2012 by Republican State Enterprise "National Fund of Cartography and Geodesy". Ordered.

3.2.2 Creation stage

The user-study materials were created for the experimental purposes where it was essential to avoid any familiarity. Therefore, the content of map samples was made-up and constructed in Adobe illustrator © 2019 Adobe Creative Cloud software for the purpose of making an analogy to a classic topographic map, basic natural and artificial features were drawn such as mountain ranges and peaks, forested areas, water objects, settlement areas, road network, man-made objects. The names were acquired from books (e.g. Rivendell, Elantris, Deltora, Broceliande), games (Terrania, Eisenwald, Erenor, Boletaria, Edenia), ancient towns and historical places from all over the world (e.g. Werowocomoco, Petropolis, Daphnus, Qarnawu, Karanog), TV shows (e.g. Quahog, Lannister, Karstark, Tyrosh, Arendelle, Elendel), real places (e.g. Fortaleza, Zacatecas, Hokitika, Wailuku, Stratham). In addition, the depicted area, map scale and legend were not given to the participant as a way of evoking intuitive feelings during the experiment.

Figure 3.2

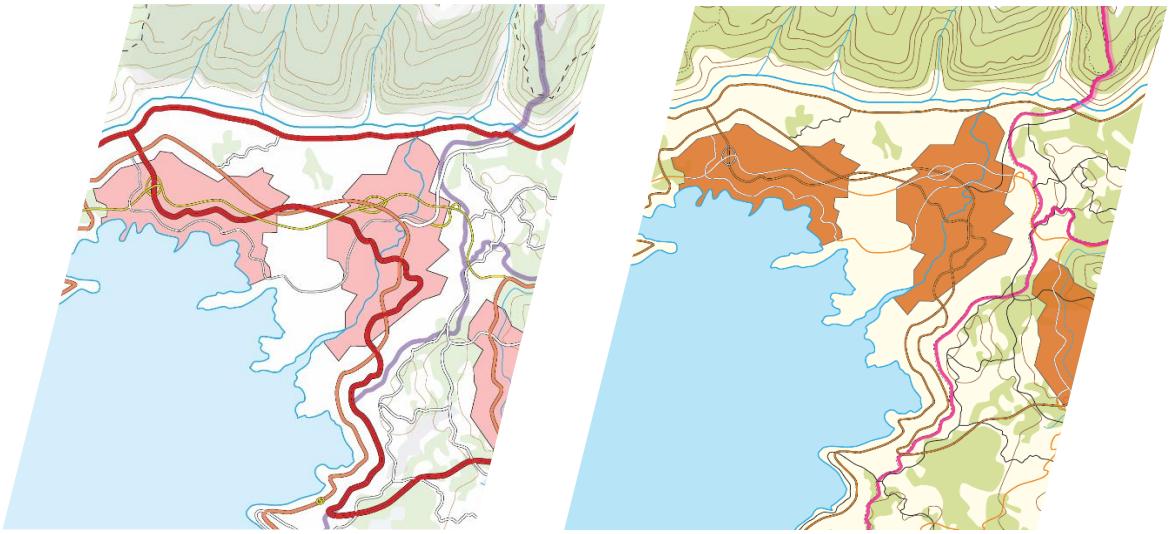
Sketch of the map sample produced for the experiment.



Note. The stage includes the construction of a skeleton of a map sample (lines and polygons).

Figure 3.3

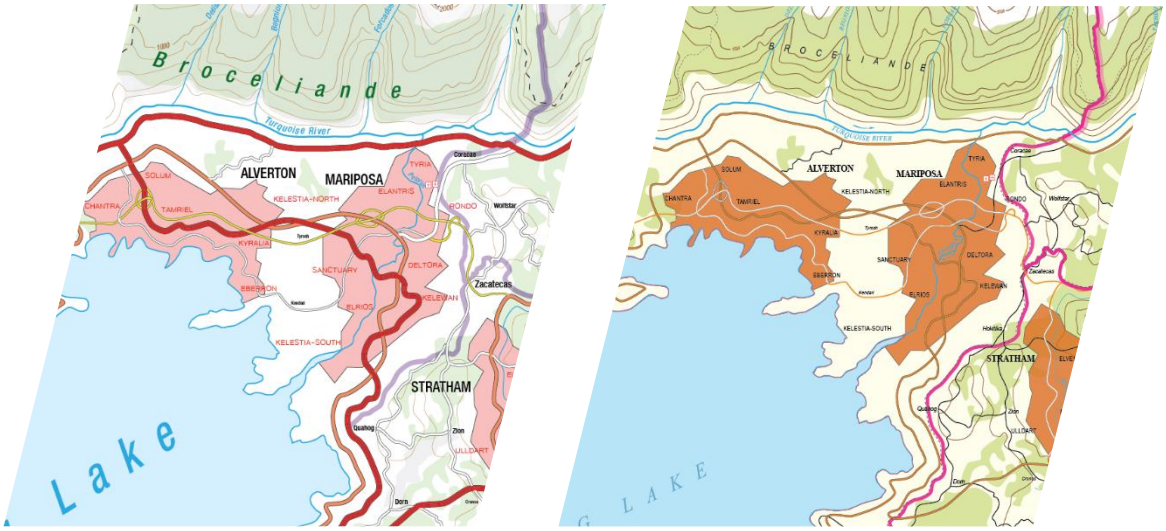
Sketch of the map sample produced for the experiment.



Note. Branching point: adding colour hues to the map skeleton according to the design style of the original map sample. Left figure: map sample using design guidelines of the topographic map of Austria. Right figure: map sample using design guidelines of the topographic map of Kazakhstan.

Figure 3.4

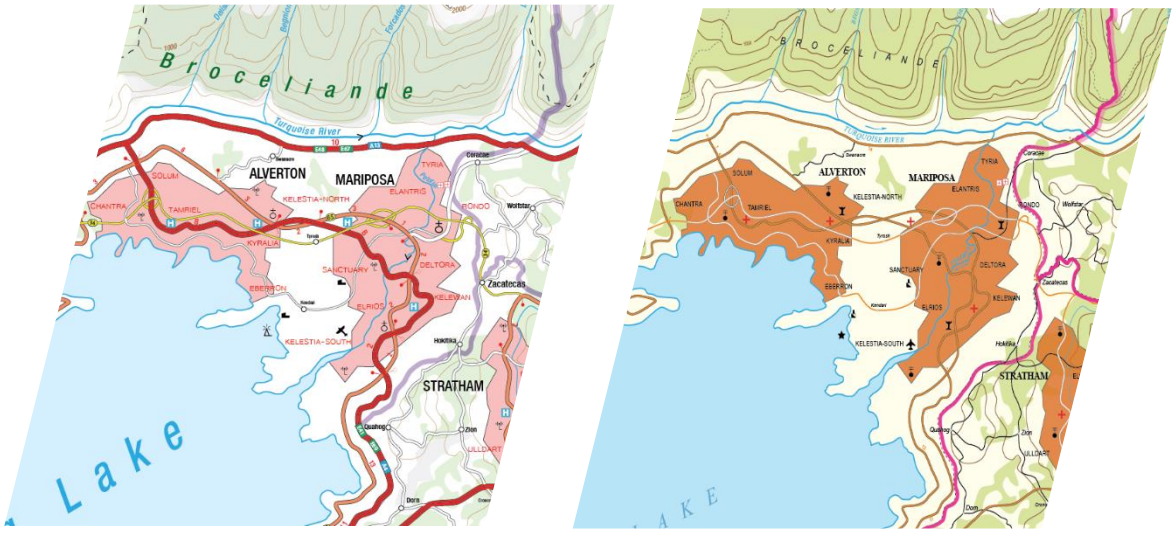
Sketch of the map sample produced for the experiment



Note. Adding labelling (font style) according to the map skeleton according to the design style of the original map sample. Left figure: map sample using design guidelines of the topographic map of Austria. Right figure: map sample using design guidelines of the topographic map of Kazakhstan.

Figure 3.5

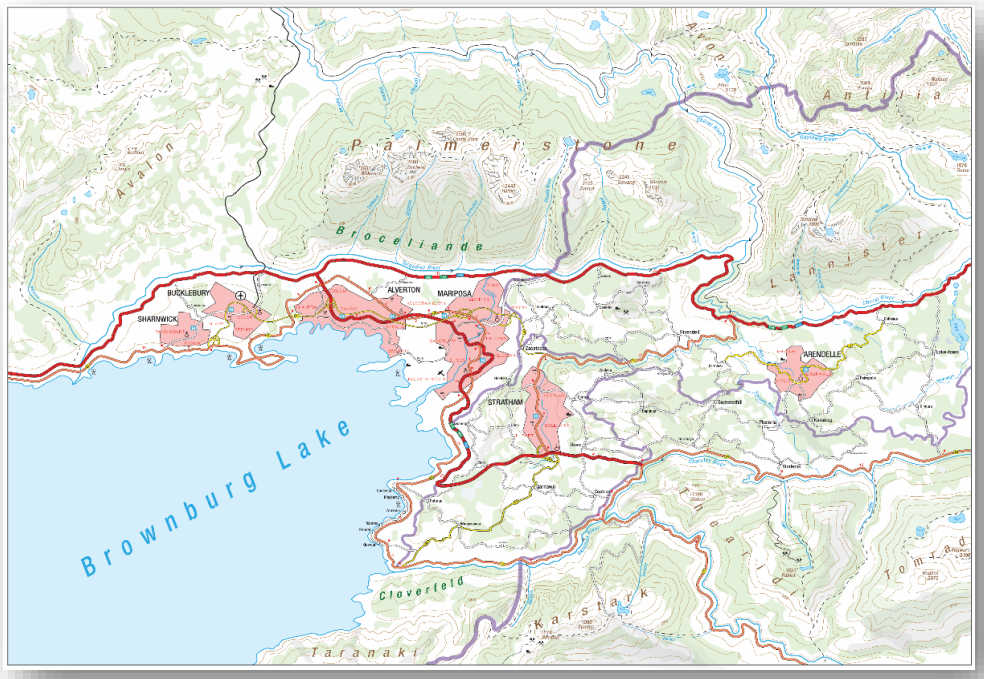
Sketch of the map sample produced for the experiment



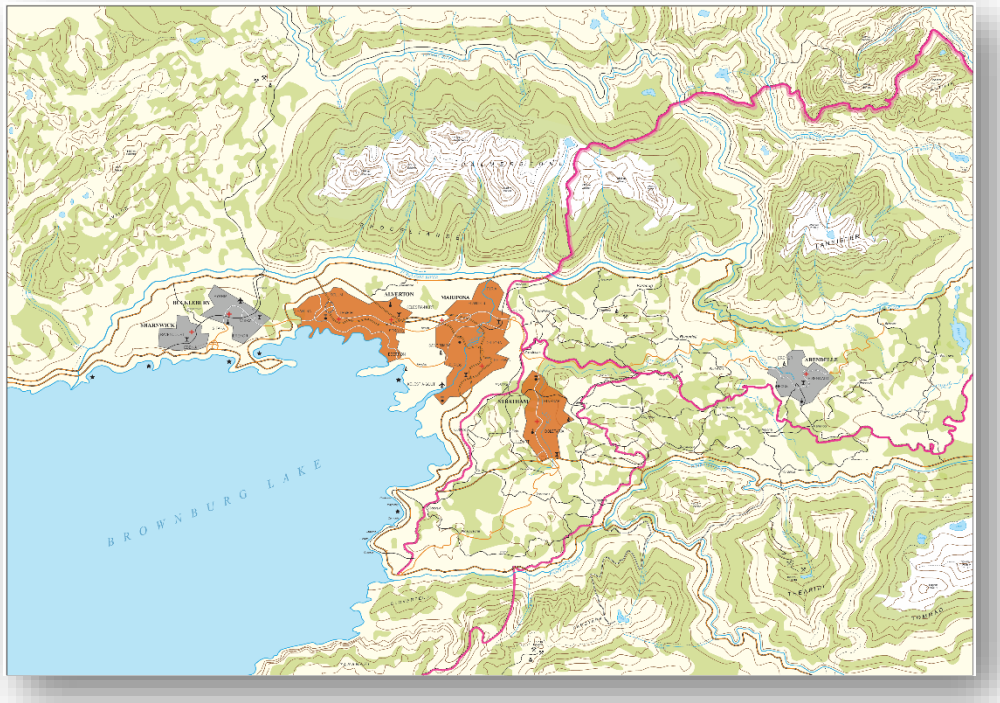
Note. Adding symbolization (graphic symbols) according to the map skeleton according to the design style of the original map sample. Left figure: map sample using design guidelines of the topographic map of Austria. Right figure: map sample using design guidelines of the topographic map of Kazakhstan.

Figure 3.6

Finished state of the map sample produced for the experiment



Note. Map sample I



Note. Map sample II

3.3 User group

The experiment was conducted among 50 participants aged between 15 and 40. The interviewees were divided into two groups (i.e. Asian, and Western) based on their background determined by cultural, environmental dimensions, and psychological constructs as illustrated in Figure 3.7. The first group consists of the participants from European countries, including Germany (n = 6), Bosnia and Herzegovina (n = 2), Russian Federation (n = 2), Great Britain (n = 2), and second - represents map users from Central Asian countries – Kazakhstan (n = 22) and Kyrgyzstan (n = 3).

Table 3.7

Research model used for user group division

Cultural and environmental determinants	**Culture enculturation**	***Western (Group 1)***	***Asian (Group 2)***
		⬇	⬇
Psychological constructs	Self-dependence measured by IISS	*Individualism*	*Collectivism*
	Cognitive style measured by CFT	*Analytic*	*Holistic*
		⬇	⬇
Hofstede's cultural dimensions model at the national level			

Note. Adapted and modified for the experiment from "Cross-Cultural Differences in Cognitive Style, IC and Map Reading between Central European and East Asian University Students" by Lacko, D., Šašinka, Č., Cenek, J., Stachoň, Z., & Lu, W.-L., 2020, *Studia Psychologica*, *62(1):23-43* (https://doi.org/d7rr). Copyright 2020 by Studia Psychologica.
Measured by IISS (Lu & Gilmour, 2007) and CFT - a modified version of the Navon´ CFT method (Navon, 1977).

At this point, previously mentioned model in *Chapter 2 Literature Review And Related Work* was used to confirm the relevance of the participants to a specific group. The following table represents the dimensions of the participants´ cultural background. It is accompanied by a bar chart clearly showing to what extent the cultural setting in one European and Central Asian states is distinct.

Table 3.7

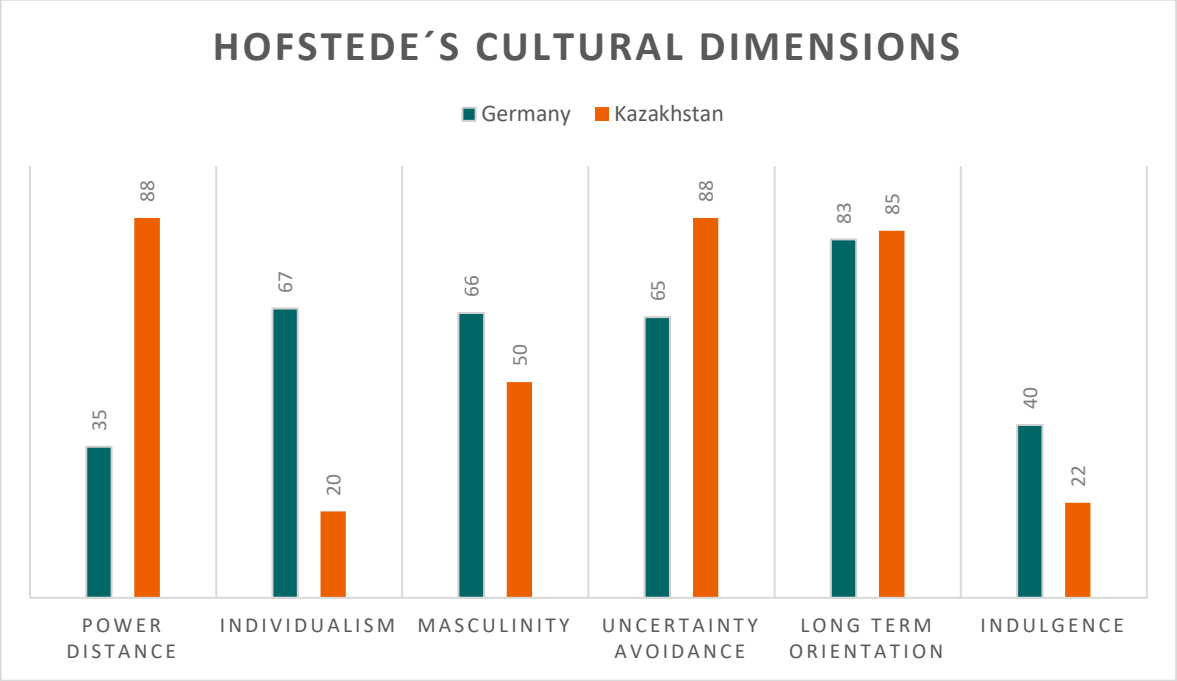
Dimension data matrix for six aspects of culture of Hofstede's model

	power distance	*individualism*	*masculinity*	*uncertainty avoidance*	*long term orientation*	*indulgence*
Germany	35	67	66	65	83	40
Bosnia and Herzegovina	90	22	48	87	70	44
Russian Federation	93	39	36	95	81	20
Great Britain	35	89	66	35	51	69
Austria	11	55	79	70	60	63
Italy	50	76	70	75	61	30
Czech Republic	57	58	57	74	70	29
Albania	90	20	80	70	61	15
Poland	68	60	64	93	38	29
Greece	60	35	57	100	45	50
Croatia	73	33	40	80	58	33
Denmark	18	74	16	23	35	70
Netherlands	38	80	14	53	67	68
Georgia	65	41	55	85	38	32
Hungary	46	80	88	82	58	31
Spain	57	51	42	86	48	44
France	68	71	43	86	63	48
Kazakhstan	88	20	50	88	85	22
Kyrgyzstan	75	21	null	null	66	39

Note. Adapted from *Dimension Data Matrix* by Geert Hofstede, 2016. (https://geerthofstede.com/research-and-vsm/dimension-data-matrix/). Copyright 2016 by Geert Hofstede. In the public domain.
Values for Kyrgyzstan were depicted as "null" in the original source; some missing values were adapted from "Are Scores on Hofstede's Dimensions of National Culture Stable over Time? A Cohort Analysis" by Beugelsdijk, S., Maseland, R., & Hoorn, A., 2015, *Global Strategy Journal*, 5. (https://doi.org/gcp2cw).
Copyright 2015 by John Wiley & Sons.

Figure 3.7

Hofstede´s cultural model



3.4 Survey structure and environment

The next step was building a questionnaire for the experiment, which in its turn was split into 4 sections: (1) contained personal data on the participant's background; (2), (3) (Part 1) described the core of the study when participants employed map-reading tasks, followed by the assessment of those tasks; and lastly, (4) (Part II) reported on map samples´ design assessment and feedback. The whole experiment was carried out without direct human interaction, orally and visually via communication platforms (Zoom, Skype, Telegram). Here, thinking aloud evaluation technique was used.

Think-aloud protocols *involve participants thinking aloud as they are performing a set of specified tasks. Participants are asked to say whatever comes into their mind as they complete the task. This might include what they are looking at, thinking, doing, and feeling. This gives observers insight into the participant's cognitive processes (rather than only their final product), to make thought processes as explicit as possible during task performance (Wikipedia, 2020).*

3.4.1 Personal data

Participants´ background information on age, sex, obtained level of education, academic background, employment status, cultural background (the place where they spent most of

their life), and level of familiarity with maps were collected. The question regarding cultural background needed a precise parsing whether the participant spent time more than one year in a cultural setting different from his native one because this information might be an explanation of the possible deviation in the results. For instance, there were cases when a participant from an Asian country spent five (exchange year at high school and undergraduate studies at university), or two academic years (graduate studies) in Western countries.

3.4.2 Quantitative method (Part I): Objective measurements

This section is considered to be the main core of the study. Participants had to accomplish map-reading tasks in finding a labelled place on two map samples. This was aimed at testing the participant's cognitive ability of attention, perception, and learning. Simultaneously, the time duration in seconds was recorded in a manner that the end of each question was as a "starting point", the moments of hesitation and question repetition were per se "pause point", and the end of the correct response was an "endpoint". The time was recorded until the participant provided the right answer. They had a couple of minutes to skim the map and become familiar with main geographic objects illustrated on it. Questions and tasks were announced as demonstrated below. It must be noted that the tasks were evenly distributed according to their relevance to **Map 1** (Q2, Q3, Q5, Q7, Q9), and **Map 2** (Q1, Q4, Q6, Q8, Q10). Thereby, the evaluation of the efficiency, readability, and legibility of map design variables was conducted afterwards.

Q1.1 Which river separates the Wilkinson and Baldwin mountain peaks?
Q1.2. What small town/village is located close to the airport in Bucklebury?
Q1.3. What is the highest point of the Palmerstone mountain system?
Q1.4. Which districts of Alverton city are closest to hospitals?
Q1.5. What large settlement/town is located on a most direct road connecting Mariposa and Stratham?
Q1.6. What lake does the Terrania River flow from?
Q1.7. What rivers flow in the Broceliande valley?
Q1.8. Which mountain system is surrounded by Choral and Daytown Rivers?
Q1.9. What are the closest city districts to the churches in Bucklebury and Sharnwick?
Q1.10. What rivers flow through the cities?

3.4.3 Qualitative method (Part II): Subjective measurements

The last stage of the experiment was aimed at supporting or rejecting the influence of cultural background on cognitive abilities. Thereby, participants were invited to examine the design/aesthetic component of two distinct map samples and subsequently answer open-ended questions.

At this point, a noticeably shortened version of AttrakDiff evaluation method (Hassenzahl, 2003; 2005) related to the attractiveness was adopted instead of numeric evaluation. The AttrakDiff is a technique developed by Hassenzahl et al. to assess the user's experience on the product's pragmatic quality (usability), hedonic aspect, and its attractiveness (appeal). In line with it, pragmatic values describe the user's behavioural characteristics whilst hedonic aspect highlights his psychological well-being (Hassenzahl, 2005). The AttrakDiff further determines three subdimensions of the hedonic aspect: stimulation, identification, and evocation. The *stimulation* refers to having a "novel, exciting functionality" in the product. The *identification* expresses the behaviour of a person being close to one of the optional products due to its ability "to communicate identity". The case when the product provokes associations, and memory, depicts individual experience and relationships that are valuable for a person (Prentice, as cited in Hassenzahl, 2005) is referred to *evocation*.

Taking into consideration the above, a bipolar semantic differential 5-scale ranking characterizing the negative and positive variables (e.g. good-bad) was represented by the following questions:

Q2.1.1 How attractive is the design of this map?	*Ugly - Attractive*
Q2.1.2 What feelings does the design of the map evoke?	*Discouragement - Motivation*
Q2.1.3 What feelings does the design of the map evoke?	*Confusion - Clarity*

where, *Q2.1.1 Ugly – Attractive* conforms to the attractiveness and hedonic attributes of identification and evocation, *Q2.1.2 Discouragement - Motivation* is explained by the hedonic dimension of stimulation, and *Q2.1.3 Confusion - Clarity* shows the pragmatic quality and usability. Each participant had to rate both map samples according to the aforementioned indicators, which was accompanied by the open-ended questions:

Q2.2.1 What particularly caught the eye on this map?
Q2.2.2 What did you like most on this map? (what was aesthetically appealing and pleasing)
Q2.2.3 What did not you like on this map? (what was irritating, creating conflicts and confusions)
Q2.2.4 Which of the maps is familiar particularly for you and why?

3.4.4 Experimental setup

The procedure used in the experiment is as described:

- Materials (i.e. map stimuli) were created specifically for the experimental purposes to avoid any familiarity, and, thus, they were made from scratch in Adobe program;
- "Thinking aloud" interviews were carried out using due to the location of the participants, and current pandemic situation constraints. It additionally allowed to give oral instructions, measure directly the time spent on each task, record all popping out comments and impression, observe the behaviour, and overall to supervise the process;

- A sample size of 50 participants aged between 15 and 40 years and spent most of their lives in European and Central Asian states was invited to participate in the experiment, but besides, no other a priori criteria were applied;
- Interviews were conducted in English and Russian languages;
- The whole procedure required ~ 30-40 but since the duration of each session was not strongly determined for participants, sometimes people spent around 50-60 minutes;
- PDF-reader programs were recommended to visualize map samples;
- The hardware exploited in the study had to be a computer screen with a diagonal min. 13 inches since the map-reading tasks were scattered around the map, otherwise, it could have added some noise to the results.

Considerable attention should be paid to the influence of following dimensions on the outcomes:

- **Cultural background:** it was crucial to distinguish between one's cultural background from other components of his identity. To do so, participants were asked to respond where did they spend most of their life and whether they can relate to that cultural environment;
- **Map experience level:** participants were allowed to assign themselves to the novice, competent, and expert group of users but additionally, it was done by the interviewer.

If a participant was familiar with basic geographic objects illustrated on a map, or was able to differentiate one map element from another, and had a low level of interaction, then he was attributed to the *novices*. If one was relatively confident, or was able to guess an illustrated map element, and used to interact with map sometimes, or indirectly, for work or educational purposes, then a participant was in the group of *competent* users. In the case of having professional knowledge in the cartography and GIS science, a participant was considered as an *expert*. This was positively correlated with the participant's academic background too;

- **The format of experimental materials***:* digital maps might be differently perceived than paper ones;
- **Hardware characteristics:** since the whole survey was carried out remotely, participants were asked to report the size of the computer screen, and the level of zooming while performing map-reading tasks.

4. RESULTS AND ANALYSIS

In this chapter, the experiment results are presented and analyzed by two user groups – Group I (European; Western) and Group 2 (Central Asian; Asian).

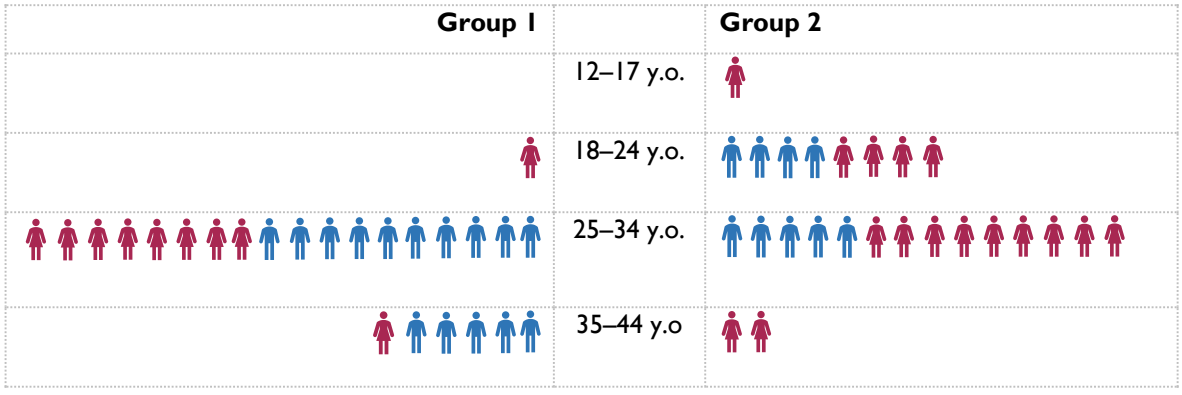
4.1 Users' background information

Age and sex distribution: As seen in Figure 4.1, 50 participants (26 males, 24 females) aged between 15 and 40 took part in the experiment. The youngest person in Group I *(M = 30, SD = 4.7)* was equal to 24 years, and the oldest – 40. As regards to Group 2 (*M = 26.08, SD = 4.94*), the youngest participant was aged 16 years and the oldest – 40. The discrepancy is shown in the age range of 18 – 24 years (n = 1 from Group I vs n = 8 from Group 2) and in the age group of 35 – 44 years (n = 6 vs n = 2 from Group I and Group 2, respectively).

The participants´ sex structure in Group I is represented by 15 males and 10 females whereas in Group II were 9 males and 16 females. There is a clear dominance of males in Group I, and females in Group II.

Figure 4.1

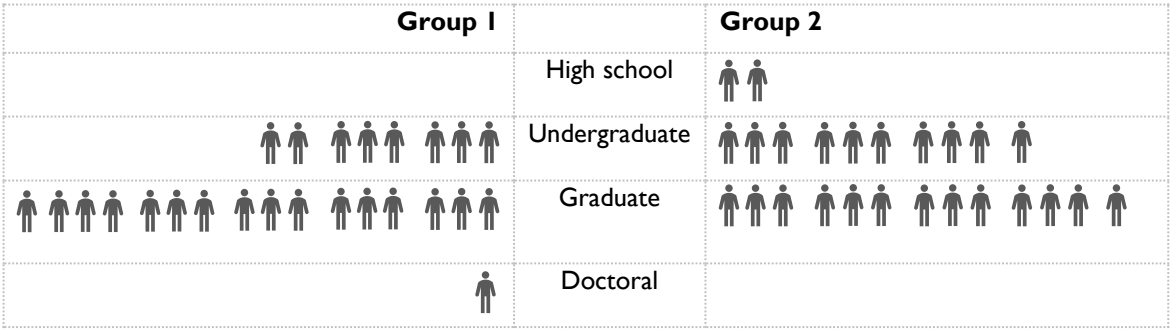
Age and sex structure



Schooling degree levels: The vast majority of participants from both groups have obtained a Bachelor's and a Master's degree. The only difference was in the presence of a holder of a Doctoral degree in Group I, and 2 participants without any degree in Group II.

Figure 4.2

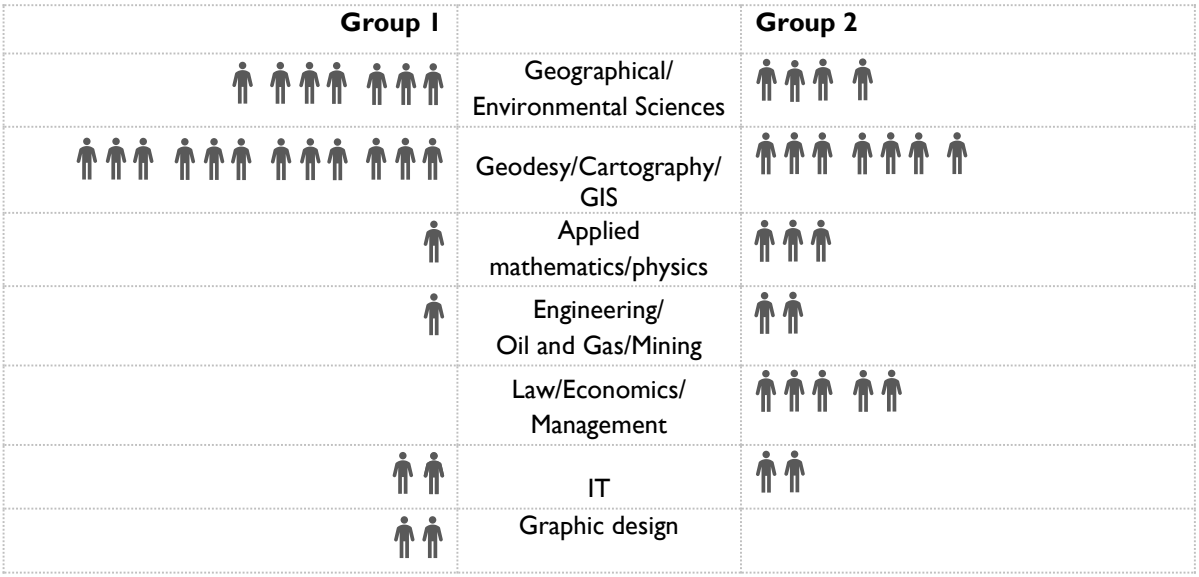
Educational background



Academic background: Group 1 consists mostly of the participants who have professional knowledge in Geodesy, Cartography, and GIS (n = 12), and Geography and Environmental Sciences (n = 6), whereas another group was more diverse. The majority of respondents (n = 23) represents all academic fields shown in Figure 4.3, and only two of them have not obtained any professional skills yet. Meanwhile, 7 respondents of those 23 have their majors in Geodesy, Cartography, GIS and 5 of them – in Law, Economics, Management.

Figure 4.3

Academic background information

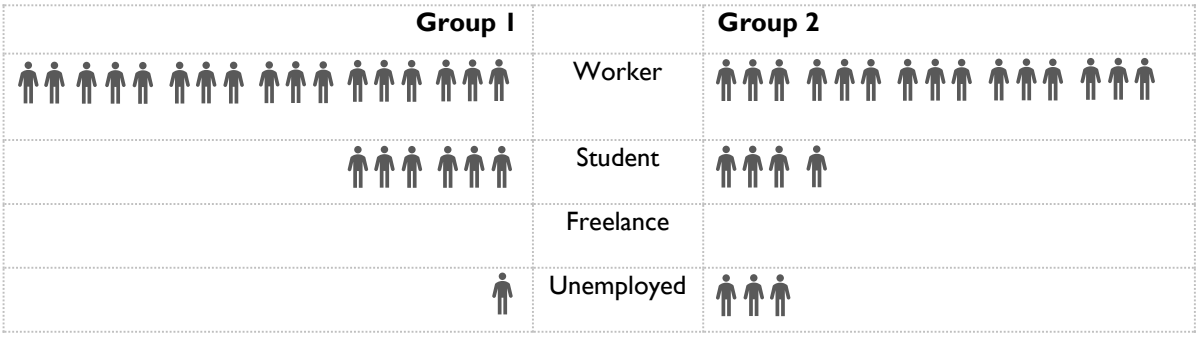


Employment status: the employment structure of participants within two groups is as follows: 17 participants out of 25 from Group 1 and 18 from Group II have a permanent

job; 6 and 4 participants from Group 1 and Group 2, respectively - are students; all others are not currently employed.

Figure 4.4

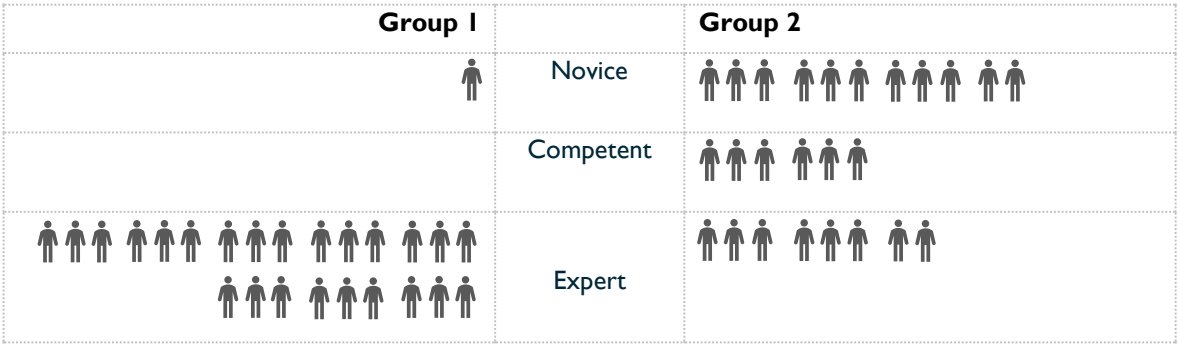
Employment status structure



Map experience level: One of the main aspects that influenced the results was a level of familiarity and interaction with maps. Participants were asked to refer themselves to one of the groups in an absolute way but were put on a par with others in a relative way. Only one person in Group 1 is not an experienced map user, and the rest (n = 24) are highly skilled, had strong academic knowledge or job experience, or just are using maps quite often in their everyday life. Group II is represented by expert map user who has a professional background in Cartography and GIS (n = 8) and, the competent users - mostly those who use maps indirectly: in their studies, books, some projects related to Cartography (n = 6). But half of the participants of Group 2 have noted that they had/are having a low level of interaction with maps in everyday life, especially with paper ones, even if they used to see them in the atlases during geography or history classes.

Figure 4.5

Map experience level



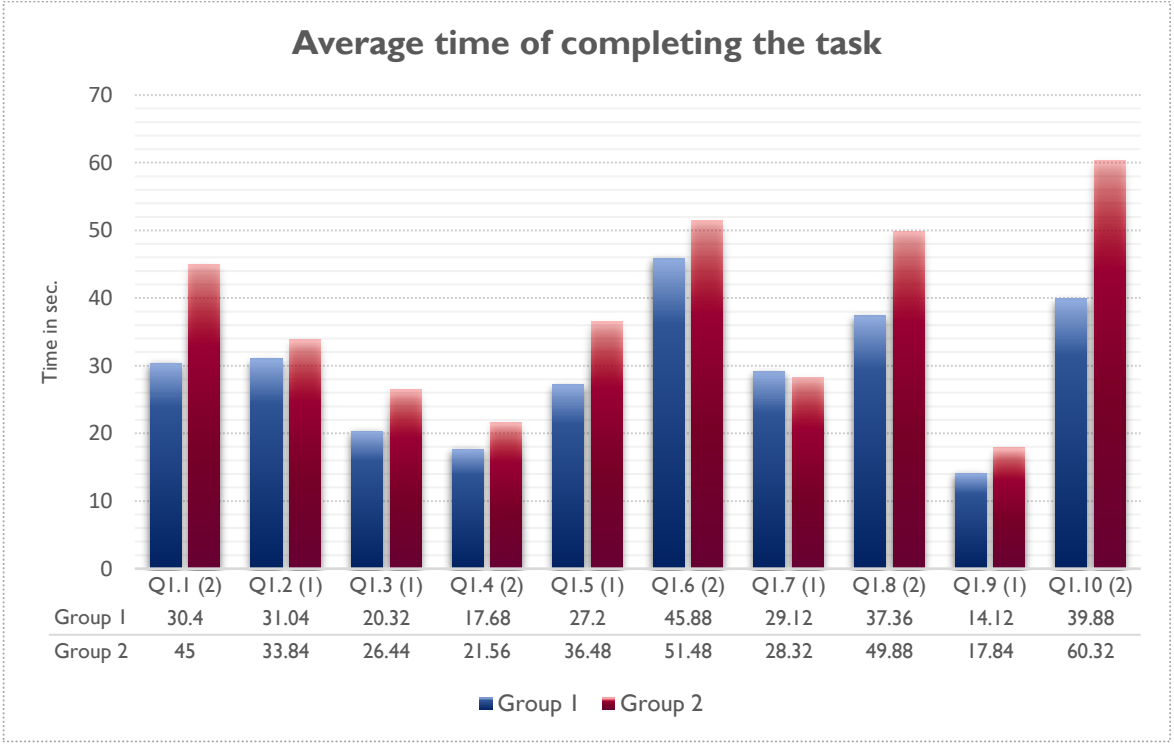
4.2 Quantitative method results (Part I)

This part of the experiment reveals the results of accomplishing map-reading tasks in seconds and the assessment the level of difficulty.

Time measurements: Having in mind that the tasks were attached to Map I and Map II design styles, they resulted into 500 (250 to Group I and the same sample set was related to Group II) numeric values containing the information about the time needed to complete each task. The trend analysis demonstrates the average time required to finish each of the tasks:

Figure 4.6

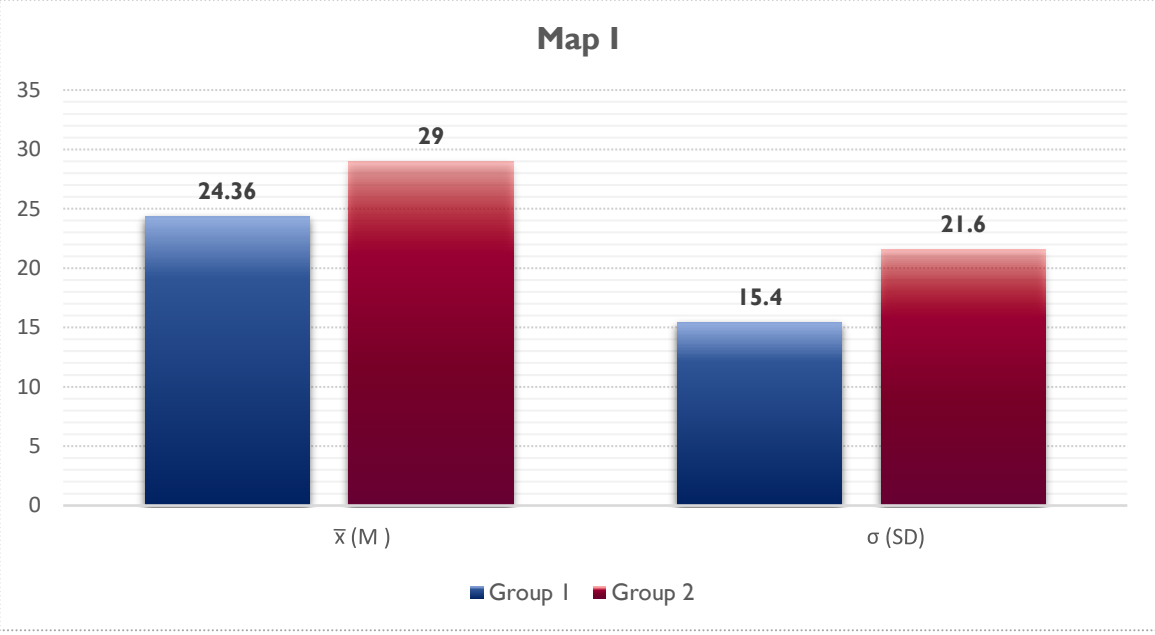
The mean values of time recordings for each question by Group I and Group II

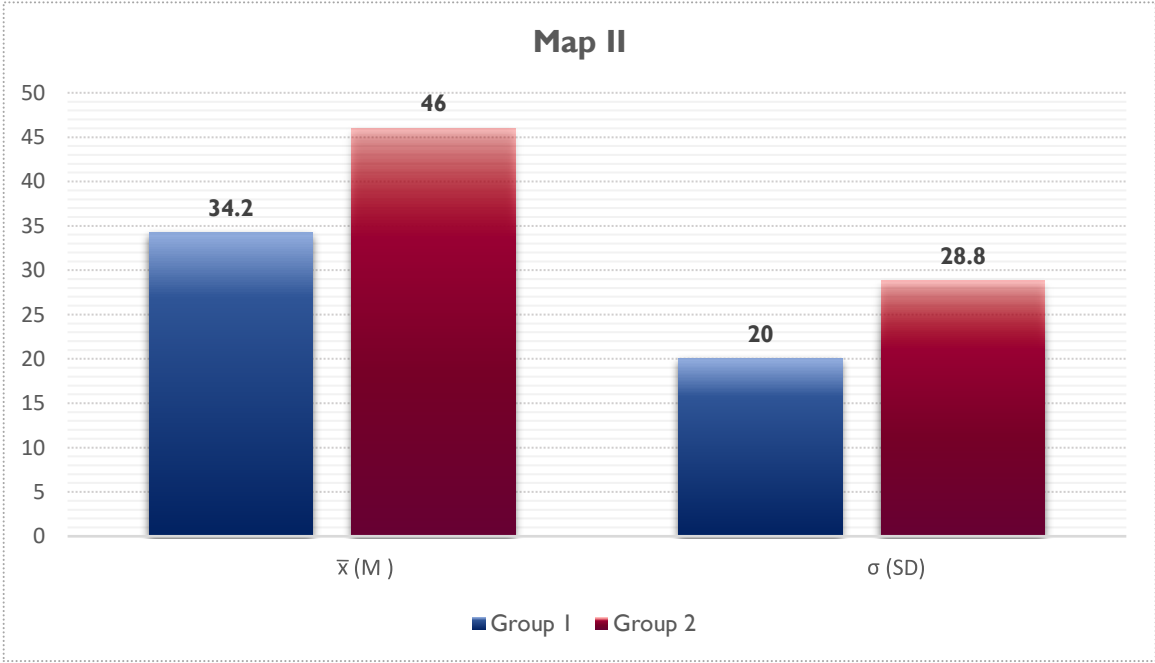


The overall time for **Group I** on Map I (*N = 125, M = 24.36, SD = 15.4*) and Map II (*N = 125, M = 34.2, SD = 20*) showed distinct values. **Group I** took significantly longer time on Map II (*N = 125, M = 46, SD = 28.8*) than on Map I (*N = 125, M = 29, SD = 21.6*) (Figure 4.7). Thus leads us to make a detailed analysis of two map samples. In line with the purpose of this work, expected to check the hypothesis that there will be significant differences in perception, attention, and learning cognitive abilities engaged in the reading tasks.

Figure 4.7

Comparison of mean and standard deviation values for Map I and Map II





Efficiency of the map design : At this point, for measuring to what extent a specific map design contributes to its efficiency and functionality, we will perform *Equal Variance T-distribution or Student´s T-test* (Gosset, 1908). The *t score* under the null hypothesis should depict the differences in performances of Group I and Group 2 on each of the map.

Map I

We hypothesize that participants from Group I will show faster performance on Map I rather on Map II, and Group II – vice- versa.

H_0 – the is no significant difference in the performance of Group I and Group 2 on Map I;
H_a – the is a significant difference in the performance of Group I and Group 2 on Map I;

Step 1: By substituting into the general equation, we get a specific one relevant to our sample size:

$$t_\varepsilon = \frac{|\overline{x_1} - \overline{x_2}|}{\sqrt{\frac{(n_1-1)s_1^2 + (n_2-1)s_2^2}{n_1+n_2-2}} \cdot \sqrt{\frac{1}{n_1}+\frac{1}{n_2}}} = \frac{|\overline{x_1} - \overline{x_2}|}{\sqrt{\frac{124s_1^2 + 124s_2^2}{248}} \cdot \sqrt{\frac{1}{125}+\frac{1}{125}}} = \frac{|\overline{x_1} - \overline{x_2}|}{\sqrt{\frac{s_1^2 + s_2^2}{5}}} = \frac{5|\overline{x_1} - \overline{x_2}|}{\sqrt{s_1^2 + s_2^2}}$$

where:

$\overline{x_1}$ – mean values of the sample set of Group I, $\overline{x_2}$ – mean values of the sample set of Group 2;
n_1 – number of records in a sample set of Group I, n_2 – in a number of records in a sample set of Group 2;
s_1 – standard deviation of Group I, s_2 – standard deviation of Group 2.

Step 2: For proceeding further we need to define the Degrees of Freedom for our case study which shows the number of values in the sample set that are free to vary:

$$D_f = n_1 + n_2 - 2 = 125 + 125 - 2 = 248$$

where:
D_f – the Degree of Freedom;
n_1 – number or records in a sample set of Group 1, n_2 – number of records in a sample set of Group 2.

Step 3: With these key values, we can calculate a t-score:

$$t_1 = \frac{5(24.36 - 29)}{\sqrt{15.4^2 + 21.6^2}} = \frac{23.2}{703.72} = 0.03$$

Step 4: Next, we need to specify the level of probability (level of significance, *p*) as a criterion for validation. A 5% value is assumed to be the p-value in our case. Using the value

of the Degree of Freedom as 48 and the level of significance as 5%, we use an online calculator tool since the critical values are not often used for D_f = 248 and receive *p = 0.488046.*

Step 5: The result states that the null-hypothesis is relevant to our case. This implies that both groups acted similarly on Map I.

$t_1\ (0.03) < t\ (0.488)$, so that we accept H_0.

Map II

Here, we make an assumption that participants from Group II will act faster on Map II rather on Map II, and Group I – will not. For further proceeding, we skip steps that are the same and stop at Step 3 and Step 5.

H_0 – the is no significant difference in the performance of Group 1 and Group 2 on Map II;
H_a – the is a significant difference in the performance of Group 1 and Group 2 on Map II;

Step 3: With these key values, we are able to calculate a t-score:

$$t_1 = \frac{5(34.2 - 46)}{\sqrt{20^2 + 28.8^2}} = \frac{59}{35} = 1.68$$

Step 5: The findings show that the calculated t-score is less than the probability score, and that the null-hypothesis is rejected. Meaning that there were significant difference between two groups on Map II.

$t_1\ (1.68) < t\ (0.488)$, so that we accept H_0.

If we compare the overall time spent by **Group I** *(t = 4280 sec; N participants = 25 * N questions = 10)* and **Group 2** *(t = 5705 sec; N participants = 25 * N questions = 10)* on Map II, we will notice that the difference between these groups on their performance on Map I was not significant as proved above but Group I again spent less time than Group 2 *(3045 sec vs 3573).*

No evidence for the hypothesis that Group I would perform better on Map I and Group 2 on Map II was found here. There are several possible explanations. First of all, this may have occurred because the Group I was keener with map reading (24 experts) whereas Group 2 was heterogeneus and comprised different levels of map experience. There were 19 people who had direct, 5 more – indirect relation to the field of cartography in Group 1; only one person was from another research area. In the meantime, 7 participants with professional cartographic knowledge and 4 from related fields make only a half of highly

skilled Group I. Another reason might be the regarding the design of map samples. Participants from both groups have asserted that the font size is too small, so it required more time to click and zoom, and thus, to lose time.

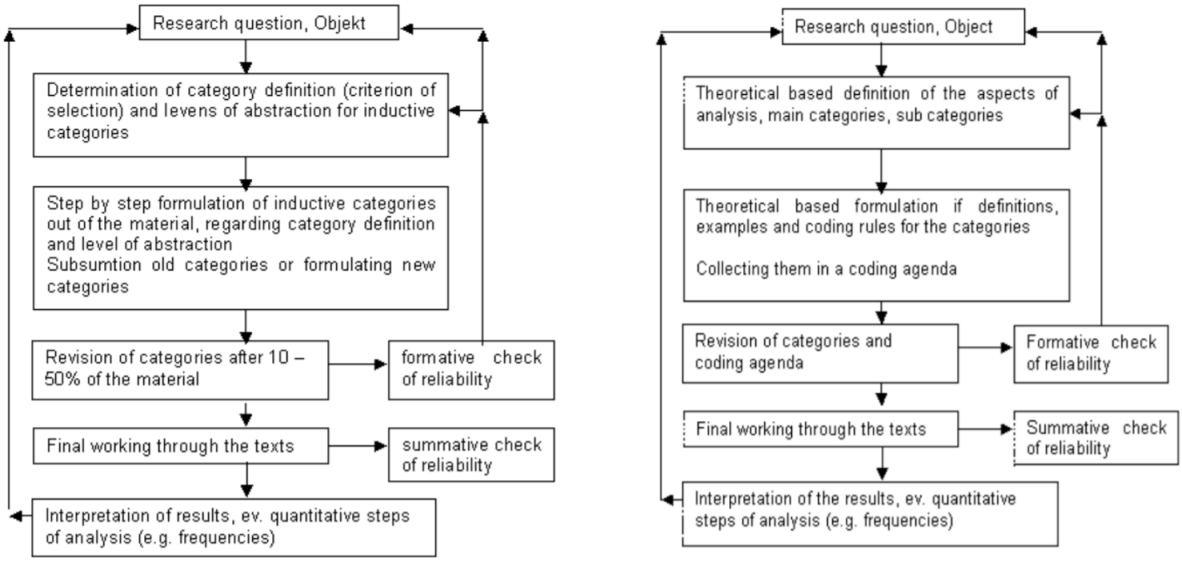
4.3 Qualitative method results (Part II)

All participants started their assessment and feedback from Map II. The transcription of the 50 guided interviews involving the qualitative approach resulted in 50 questionnaire pages. Whereas **Q2.1.1, Q2.1.2,** and **Q2.1.3** evaluation values (*see Subchapter 3.4.3 Qualitative method (Part II): Subjective measurements)* contained numeric values possible to analyse, open-ended questions, such as **Q2.2.1, Q2.2.2, Q2.2.3, Q2.2.4,** and **Q2.2.5,** combined with think-aloud protocol data requires another interpretation procedure. For that reason, the *qualitative content analysis approach* was chosen. It is known as a category-based text analysis based on Mayring's report (2000), whose coding aspects are derived directly from the content itself, thus, also follow the rules of interpretation.

This qualitative oriented analysis comprehends two approaches – inductive and deductive. In most cases, the *inductive approach* is applied to qualitative data, administered by research questions, and, thus, it formulates a theory according to the patterns in the results. On the contrary, the *deductive approach* is used for quantitative data, puts forward a theory, and checks the validity of the hypothesis.

Figure 4.8

Step model of inductive and deductive category development



Note. Left figure: inductive approach; *Right figure*: deductive method. Adapted from "Qualitative Content Analysis" by Ph. Mayring, 2000, *Forum Qualitative Sozialforschung / Forum: Qualitative Social*

Hence, this part of the experiment will use the complementary, or hybrid approach for the interpretation of the results: deductive approach showed more relevance for **Q2.1.1, Q2.1.2,** and **Q2.1.3** and inductive – for **Q2.2.1, Q2.2.2, Q2.2.3, Q2.2.4,** and **Q2.2.5.** The interpretation of qualitative measurements´ results proceeds following the steps outlined below.

4.3.1 Deductive approach

The main hypothesis that will administer the results´ interpretation of qualitative ranking measurements is:

H_1: Participants will highly assess the map based on their experience and familiarity.

Several psychological phenomena might explain the origin of this theory:

- the ***mere exposure effect*** describes the tendency to make preferences and to like things based on subjective familiarity. Zajonc (1968) discovered that the more often one sign was shown to the stimulus, the more an individual liked it although if he even cannot interpret this sign. Moreover, the mere exposure effect can proceed without conscious cognition, and, thus, the preferences are not supported by inferences;
- the mere exposure effect is characterized by ***perceptual fluency*** (Jacoby, Kelley, & Dywan, as cited in Lee, 2001) and the ***modified two-factor model*** (Bornstein, as cited in Lee, 2001). Joye et al. (2015) confirmed that the repetition of the information increases the perceptual fluency and semantic memory retrieval. The modified two-factor model posits that an individual prefers something familiar, and thus, it reflects the process of learning. This was confirmed in Zajonc's study (2003), which demonstrated that prior exposure positively influences the processing speed and fluency, which leads to higher rankings.

Based on it, we assume that Group I representing European countries would assess Map I higher than Map II, and Group II would demonstrate the vice-versa attitude. Further steps of the deductive approach will proceed with statistical hypothesis analysis by groups.

GROUP I

- **Hypotheses:**

Given that *Q2.1.1 Ugly – Attractive* conforms to identification and evocation hedonic dimensions, *Q2.1.2 Discouragement – Motivation* is expressed by stimulation dimension, and *Q2.1.3 Confusion – Clarity* reports on the pragmatic quality. In the initial stage of the rating values interpretation, we propose null and alternative hypotheses considering the aforementioned dimensions of the observation.

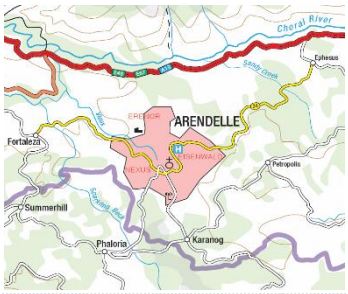
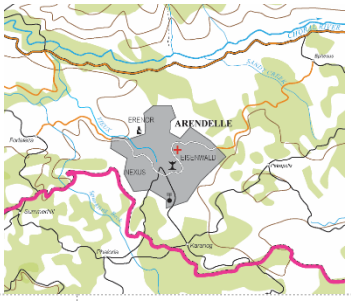
H_0 *– the is no significant difference between the for "Ugly – Attractive" dimensions in the sample set to the sample size;*
H_a *– the is a significant difference between the records for "Ugly – Attractive" dimensions in the sample set to the sample size;*
H_0 *– the is no significant difference between the records for "Discouragement – Motivation" dimensions in the sample set to the sample size;*
H_a *– the is a significant difference between the records for "Discouragement – Motivation" dimensions in the sample set to the sample size;*
H_0 *– the is no significant difference between the records for "Confusion – Clarity" dimensions in the sample set to the sample size;*
H_a *– the is a significant difference between the records for "Confusion – Clarity" dimensions in the sample set to the sample size;*

- **Collecting categories in coding agenda:**

The attributes were derived directly from the ranking dimensions of the questions **Q2.1.1, Q2.1.2,** and **Q2.1.3:** *Ugly – Attractive, Discouragement – Motivation,* and *Confusion – Clarity*. The ranking values on the ascending 5-point scale were aggregated and compiled in the following table:

Table 4.1

Map design assessment results by Group 1

Map I			Map II		
					
Attributes	**x̄**	**σ**	**σ**	**x̄**	**Attributes**
Ugly - Attractive	3.96	0.84	0.94	2.84	*Ugly - Attractive*
Discouragement - Motivation	4.04	0.88	0.89	2.72	*Discouragement -Motivation*
Confusion - Clarity	4.4	0.7	0.85	2.32	*Confusion Clarity*

Note. "x̄" - arithmetic mean;
"σ" - standard deviation.

- **Checking the hypotheses:**

For checking the validity of theories, we will apply an *Equal Variance T-distribution or Student´s T-test* (Gosset, 1908).

Step 1: By substituting into the general equation, we get a specific one relevant to our sample size:

$$t_\varepsilon = \frac{|\overline{x_1} - \overline{x_2}|}{\sqrt{\frac{(n_1-1)s_1^2 + (n_2-1)s_2^2}{n_1+n_2-2}} \cdot \sqrt{\frac{1}{n_1}+\frac{1}{n_2}}} = \frac{|\overline{x_1} - \overline{x_2}|}{\sqrt{\frac{24s_1^2 + 24s_2^2}{48}} \cdot \sqrt{\frac{1}{25}+\frac{1}{25}}} = \frac{|\overline{x_1} - \overline{x_2}|}{\sqrt{\frac{s_1^2 + s_2^2}{5}}} = \frac{5|\overline{x_1} - \overline{x_2}|}{\sqrt{s_1^2 + s_2^2}}$$

where:

$\overline{x_1}$ – mean values of the sample set Map I, $\overline{x_2}$ – mean values of the sample set Map II;
n_1 – number or records in a sample set for Map I, n_2 – in a number of records in a sample set for Map II;
s_1 – standard deviation of Map I, s_2 – standard deviation of Map II.

Step 2: For proceeding further we need to define the Degrees of Freedom for our case study which shows the number of values in the sample set that are free to vary:

$$D_f = n_1 + n_2 - 2 = 25 + 25 - 2 = 48$$

where:

D_f – the Degree of Freedom;

n_1 – number or records in a sample set for Map I, n_2 – in a number of records in a sample set for Map II.

Step 3: With these key values, we are able to calculate a t-score:

Ugly – Attractive: $t_1 = \frac{5(3.96-2.84)}{\sqrt{0.84^2+0.94^2}} = \frac{5.6}{1.26} = 4.44$

Discouragement – Motivation: $t_2 = \frac{5(4.04-2.72)}{\sqrt{0.88^2+0.89^2}} = \frac{6.6}{1.25} = 5.27$

Confusion – Clarity: $t_3 = \frac{5(4.4-2.32)}{\sqrt{0.85^2+0.7^2}} = \frac{10.4}{1.10} = 9.44$

Step 4: Next, we need to specify the level of probability (level of significance, *p*) as a criterion for validation. A 5% value is assumed to be the p-value in our case. Using the value of the Degree of Freedom as 48 and the level of significance as 5%, we check the table of the percentage points of the t score distribution (Table 4.2):

Table 4.2

A shortened table for critical values for one-tailed t score distribution

df	*.25*	*.10*	*.05*	*.025*	*.01*
1	1.000	3.078	6.314	12.706	31.821
10	.700	1.372	1.812	2.228	2.764
20	.687	1.325	1.725	2.086	2.528
30	.683	1.310	1.697	2.042	2.457
40	.681	1.303	1.684	2.021	2.423
45	.680	1.301	1.679	2.014	2.412
48	.680	1.299	**1.677**	2.011	2.407

Note. Adapted from Student's t-Distribution, 2020 by Wikipedia. (https://en.wikipedia.org/wiki/Student%27s_t-distribution). In the public domain.

Step 5: This provides three equations based on which we can make the conclusions:

$t_1\ (4.44) > t\ (1.677)$, so that we reject H_0 and accept H_a.
$t_2\ (5.27) > t\ (1.677)$, so that we reject H_0 and accept H_a.
$t_3\ (9.44) > t\ (1.677)$, so that we reject H_0 and accept H_a.

The findings show that there is a significant difference between the values for both maps on all given categories. Thus, it means that the participants from Group I ranked Map I on all dimensions higher than Map II.

Taken as a whole, the resulting outcomes corroborate with the main hypothesis for 100% (n = 25) that the level of familiarity plays a crucial role in such types of ratings as evaluation of attractiveness and usability (Bornstein, as cited in Lee, 2001). Most of them affirmed that Map I was similar to the maps that they have been seeing and using although there were minor discrepancies (the reasoning behind their choice is presented and discussed in the next subchapter *4.3.2 Inductive approach*).

GROUP 2

- **Hypotheses:**

The theories for this group remains the same as for Group I:

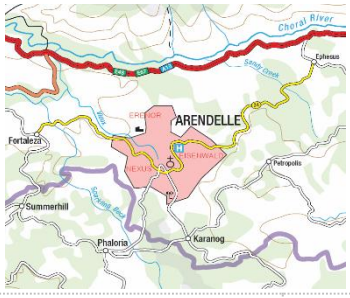
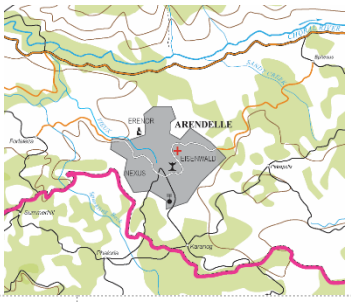
H_0 – the is no significant difference between the records for "Ugly – Attractive" dimensions in the sample set to the sample size;
H_a – the is a significant difference between the records for "Ugly – Attractive" dimensions in the sample set to the sample size;
H_0 – the is no significant difference between the records for "Discouragement – Motivation" dimensions in the sample set to the sample size;
H_a – the is a significant difference between the records for "Discouragement – Motivation" dimensions in the sample set to the sample size;
H_0 – the is no significant difference between the records for "Confusion – Clarity" dimensions in the sample set to the sample size;
H_a – the is a significant difference between the records for "Confusion – Clarity" dimensions in the sample set to the sample size;

- **Collecting categories in coding agenda:**

The derivation of categories for this group followed the same procedure as for Group I and is illustrated in Table 4.3:

Table 4.3

Map design assessment results by Group 2

Map I			Map II		
					
Attributes	**$\bar{x}$**	**σ**	**σ**	**$\bar{x}$**	**Attributes**
Ugly - Attractive	3.6	1.08	1.15	3.4	*Ugly - Attractive*
Discouragement - Motivation	3.4	1.08	1.29	3.4	*Discouragement -Motivation*
Confusion - Clarity	1.8	0.76	0.81	3.9	*Confusion Clarity*

Note. "$\bar{x}$" - arithmetic mean;
"σ" - standard deviation.

- **Checking the hypothesis:**

A similar procedure was carried out for Group II too**. Step 1, Step 2,** and **Step 4** are universal for both groups since the number of records in the sample set, the sample size itself are equal to 25, and, thus, the Degree of Freedom, the level of significance are the same as for Group II. Two stages of the analysis will be depicted here.

Step 3: Calculating a t-score:

Ugly – Attractive: $$t_1 = \frac{5(3.6-3.4)}{\sqrt{1.08^2+1.15^2}} = \frac{1}{1.58} = 0.63$$

Discouragement – Motivation: $$t_2 = \frac{5(3.4-3.4)}{\sqrt{1.08^2+1.29^2}} = \frac{0}{1.68} = 0.0$$

Confusion – Clarity: $$t_3 = \frac{5(1.8-3.9)}{\sqrt{0.76^2+0.81^2}} = \frac{10.5}{1.11} = 9.45$$

Step 5: This provides three equations based on which we can make the conclusions:

$t_1\ (0.63) < t\ (1.677)$, so that we accept H_0.
$t_2\ (0.0) < t\ (1.677)$, so that we accept H_0.
$t_3\ (9.45) > t\ (1.677)$, so that we reject H_0 and accept H_a.

The third set of analysis accepted an alternative hypothesis stating that there is a significant difference in given numeric values. It also verified the main theory "*the more familiar to the user the map is, the higher it will be assessed*". The respondents asserted that Map I confuses them or creates biases due to the *pale colour scheme* so that the attention was lost and did not capture the attention of the whole scene, the *complexity of road network* provoked by several levels and categories, and to its *high visual attention* in overall composition caused by the thickness of lines and several colour hues.

However, the assessment of two dimensions, viz, *Ugly – Attractive* and *Discouragement – Motivation*, is heterogeneous; ergo, needs more scrutiny. The evaluation of the attractiveness of Map I *(M = 3.6, SD = 1.08)* and Map II *(M = 3.4, SD = 1.15)* did not differ significantly from each other but anyway was below the expectations. Meanwhile, the ranking of hedonic dimension showed equal values but with a higher spread in the sample set: Map I (*M = 3.4, SD = 1.08*) and Map II (*M = 3.4, SD = 1.28*). Furthermore, none of these differences was statistically significant.

The overall picture supported the current hypothesis for 67%. It was expected that Group II would give higher ranking values, particularly for Map II. But the Group II split in their assessment so that they equally evaluated the attractiveness and hedonic qualities of both maps but appraised the usability of Map II.

We could take the results as it comes but by taking into account some circumstances it appears contradicting. The discrepancy in the results is visible in a comparative form (Table 4.4). The results outlined by red boxes show which of the participants evaluated Map I higher than Map II. This may have occurred because of low or medium level of map experience, and probably because of the sequence of map assessment: all participants had to provide feedback on Map II, and then Map I. Thus, after thinking aloud procedure on Map II, where specific open-ended questions highlighted the map variables that are important here, during the experiment some of the respondents (n = 6) rethought their criteria and realized that some map variables are better represented on Map I rather than on a previous map. A possible explanation behind the choice of *P. 11, P. 14,* and *P. 18* is still not completely clear.

Table 4.4

Subjective measurements on map design assessment

GROUP 2						
№	*Ugly – Attractive*		*Discouragement – Motivation*		*Confusion – Clarity*	
	Map I	Map II	Map I	Map II	Map I	Map II
P. 1	4	3	4	3	2	4
P. 2	4	3	5	3	2	3
P. 3	3	4	3	4	3	4
P. 4	2	3	2	3	I	4
P. 5	4	2	5	2	3	4
P. 6	2	4	3	4	2	4
P. 7	4	3	3	2	2	3
P. 8	5	2	4	2	2	4
P. 9	4	4	3	4	I	3
P. 10	5	3	3	2	I	3
P. 11	3	2	3	4	I	4
P. 12	4	I	4	I	I	2
P. 13	4	2	4	2	I	4
P. 14	5	5	5	4	2	3
P. 15	3	5	3	5	2	5
P. 16	4	2	4	2	I	3
P. 17	5	3	4	2	3	5
P. 18	5	4	3	5	3	4
P. 19	4	3	5	2	3	4
P. 20	3	4	2	5	2	5
P. 21	2	4	2	4	I	4
P. 22	3	4	3	4	2	4
P. 23	I	5	I	5	I	5
P. 24	3	5	5	5	I	5
P. 25	3	5	3	5	2	5

Note. Green boxes for Novices; Yellow - for Competent users; Red - for Experts.

4.3.2 Inductive approach

The answers to the following questions provided an accurate panorama of all strong and weak points of the map samples´ design:

Q2.2.1 What particularly caught the eye on this map?
Q2.2.2 What did you like most on this map? (what was aesthetically appealing and pleasing)
Q2.2.3 What did not you like on this map? (what was irritating, creating conflicts and confusions)
Q2.2.4 Which of the maps is familiar particularly for you and why?

- **Determination of criterion of selection:**

In agreement with the thesis´ purpose and research questions, we can formulate a specific question on that stage: *Which map design Group I/Group II liked most and why?*

- **Step-by-step formulation of categories out of the results:**

Afterwards, the procedure of parsing the written narratives and looking for patterns has resulted in such categories as "*colour scheme*", "*font-style*", "*font-size*", "*relief representation*", "*road network*", "*depiction of settlement areas*", "*graphical symbols*". The filtered data are compiled and presented in the following tables:

Table 4.5

Thinking aloud protocols for both map samples (Group 1)

GROUP I

categories	**MAP I**
colour scheme	· is well-balanced, uniform, and harmonized; · has neutral, muted, pastel-tone, soft colour tone; · looks nice, visually attractive and aesthetically pleasing for the eyes; · has "speaking" colours, label colours are linked to the map elements (green for valleys, brown for mountains) · eases the orientation, navigation and reading; · it seems like it follows some standards or guidelines and, thus, it looks correct; · looks recognizable, familiar; · is similar to German, French, Spanish, Czech, Polish topographic maps´ colour scheme;
font-style	· is harmonized and consistent because of one font style; · is readable and legible; · is self-explanatory, especially for natural objects; · eases the map reading process; it seems like it follows some standards or guidelines and, thus, it looks correct;
font-size	· is distinct, eye-catching, visible; · has good legibility but it is hard to "feel" on a digital format of the map; · self-explanatory and logical so that it is possible to notice hierarchy levels in labelling; · it seems like it follows some standards or guidelines and, thus, it looks correct;
relief representation	· mountainous areas have a kind of 3D effect; · mountain peaks with rock depiction are well visualized; · rock depiction makes more sense than on Map II;
road network	· is detailed; · is well-categorized, and straightforward since it is illustrated by the thickness of the line, colour hues, and road intersections; · is distinguishable, prominent, and dominating; · is well-balanced and efficient for navigation purposes; · the thick red line is too strong and distracting; · road categories and types are clear;

	· it seems like it follows some standards or guidelines and, thus, it looks correct;
depiction of settlement areas	· the outline of large settlements makes more sense than Map II; · pink colour for large residential areas is familiar and no confusion occurs here; · label placement is logical and follows the direction of an object on a map; · city district names in reddish colour are irritating; · it seems like it follows some standards or guidelines and, thus, it looks correct;
graphical symbols	· are unambiguous and straightforward; · hospital sign sometimes was messed with a bus stop sign in Germany at first sight.

categories	**MAP II**
colour scheme	· is very bright, and saturated; · has a high contrast of colour hues; · looks nostalgic, similar to Hungarian, Albanian, Georgian old maps; · yellowish colour as a background (i.e. white space) looks old-fashioned; · yellowish colour as a background (i.e. white space) looks unusual;
font-style	· a mix of serif and sans serif fonts is not good; · seems like randomly chosen, inconsistent; · looks retro, old-fashioned and not typical for a topographic map; · labels for natural objects and relief does not serve the purpose of a map;
font-size	· too small, especially for natural objects; · not readable and visible in comparison to Map I; · does not stand out easily; · difficult to understand the hierarchy from the font size;
relief representation	· isolines are prominent and visible; · yellowish, light green, brown colours represent the relief well;
road network	· lines are too thin so that everything looks like a big mess, redundant; · the whole network looks empty from the perspective of knowledge; · has no real information for navigation; · is not visually appealing; · is a bit illogical in the case when the road changes its style when it enters the city area;
depiction of settlement areas	· representation of cities in two distinct colours (grey and orange) does not make makes; · grey colour for cities gives an impression of the "industrial area"
graphical symbols	· are puzzling, especially for beacon, religious places, factory, TV, radio station; · only symbolization of hospital, aerodrome, and mining site was easy to interpret;

Table 4.6

Thinking aloud protocols for both map samples (Group 2)

GROUP II

categories	**MAP I**
colour scheme	· is too pale, so that the objects on a map are not clearly visible and even lost; · the colour hues are not facilitating an easy map reading; · does not invite a map user because of low contrast and light colour hues; · looks very harmonized and homogeneous; · looks as a "gold standard", follows some rules for better visual perception;
font-style	· very clear and legible; · nothing special; · it seems like it follows some standards or guidelines and, thus, it looks correct;
font-size	· facilitates good findability and readability; · are straightforward especially when it comes to natural objects; · the hierarchy of labels is distinctive;
relief representation	· is not visible and eye-catching; · isolines (horizontals) are not aesthetically appealing, lost for eyes;
road network	· is eye-catching and outstanding; · is too detailed, dense, distracting, · is "too much" like a ball of yarn; · requires more attention and unravelling the situation; · gives pressure and confusion; · has too many categories for road hierarchy, which is needless information;
depiction of settlement areas	· the pink colour makes cities very prominent but does not make sense to show cities in this colour;
graphical symbols	· some of them are clear and understandable but the majority is unknown or does not make sense; · hospital sign was unclear (hotel or hospital?); · beacon sign reminded an oil-, gas field like on Kazakhstan thematic maps in atlases.

categories	**MAP II**
colour scheme	· is very familiar and native; · reminds maps from books used in childhood; · is aesthetically attractive, illustrative, and fancy; · invites to explore the content of the map; · is similar to retro-style; · it seems like it follows some standards or guidelines and, thus, it looks correct;
font-style	· is simple and understandable;

	· fits the overall composition; · is highly legible and readable;
font-size	· could be bigger but is not critical; · too small for reading or navigating on a map;
relief representation	· is bright, clear, illustrative, outstanding, self-explaining; · natural objects´ colour is saturated and, thus, depicts it at its best (lakes, forests); · too crude and bright colour tones;
road network	· the complexity is just right; · is muted for eyes; · is simple and clear;
depiction of settlement areas	· is familiar and intuitive, used to see them before; · is clear-cut and depicts the places better than on Map 1; · is clear and self-explaining: brown colour reminds brick structures, grey colour represents residential buildings;
graphical symbols	· are familiar and „correct" (how a good map should look like); · symbolization of beacon and religious places is unclear.

- **Hypotheses:**

The aforestated findings lead to the theory:

H_1: Participants tend to like the map based on their experience and familiarity.

The theory was exemplified by the case study of Group I and Group II (except five people, who recognized the familiarity with Map II but neglected this fact).

Group I that comprise participants with expert-level knowledge in cartography (n = 24) provided a detailed review and unanimously preferred Map I. They showed coherence and critical thinking while sharing their opinions on both maps (Table 4.5 and Table 4.6). Generally speaking, there was a significant positive correlation between given feedback on map samples´ design and ranking values. Furthermore, participants also found similarities between the design of Map I and the maps that they have experienced. For instance, the light shades of green and blue, unobtrusive light strokes of contour lines, pink-coloured polygons for residential areas, multilevel transportation network, serif font style, self-explaining font colours, the placement of text labels repeating the direction of an object (mountains, valleys, rivers), the common symbolization of the railway road, graphic symbols looked familiar and as a "gold standard" design decisions. Three participants from Hungary, Albania, and Georgia recognized the design style of Map II but asserted that they had no real attachment or the experience of communication with this type of maps since. The reason was that those maps were considered as old versions of their current topographic maps. And therefore, we can conclude that all narratives fit their chosen option.

As regards to **Group 2**, over half of the participants (n = 13) reported that Map II looks more attractive and correct and Map I is divergent, incorrect, and ineffective for the use

(e.g. "*I don´t like Map I because the colour scheme is too pale, the road network is too advanced, dense, and outstanding so that I feel discouraged to explore it; Map II is very fancy and visually appealing, natural features are visible and perfectly visualized, the road lines are muted for the eyes, the brownish colour of settlement areas makes sense so that I feel confident with this map*"). Among them were two participants (P. 19 and P. 21) having an academic background in Cartography and GIS who spent 2 to 7 years in the EU countries and the US, respectively.

Some of the respondents (n = 7) provided argumentative feedback on two map samples. They were pointing out that the design style of Map I was more effective in terms of readability and legibility (characterized by font style and font size), was correct from the cartographic perspective, was more harmonized in terms of visual appearance (defined by the colour scheme). But unexpectedly chose the map which was contradicting to their statements – Map II (e.g. "*Map I has legible font size and looks harmonized and probably is designed according to some guidelines; Map II has saturated and crude colours but it seem so familiar to me/remind me school atlases or old geography books*"). The evidence of that was explained and justified by statistical hypothesis test in the previous subchapter.

Interestingly, five people from Group II (P. 8, P. 12., P. 16, P. 17, P. 19, *see Table 4.4*) provided both positive rating values and comments on Map I. Their age varies from 24 to 32. All of them obtained their graduate degrees in the Western states (England, the U.S., Scotland, Austria) and lived abroad only for 1 or 2 years. All of them identified themselves as individuals with Kazakhstan mentality: their relevance to the group with a holistic mindset and interdependent social orientation was conforming to the Central Asian mentality (refer to the Table 2.2 and Table 2.3). Nevertheless, they inclined to Map I ("*I would prefer and use Map I because it seems to me that it follows well-established cartographic standards, effectively meets my goals as a map user, invites to explore the content; Map II looks as conventional but old-fashioned, the colour scheme is very familiar but I think that it was a bad decision to use exactly these colour hues and a mixture of fonts"*).

H_2: The participants perform better on chosen and liked maps.

According to the mere exposure effect, it is assumed that if the map is more familiar and favoured, and thus, easier to work with, then the map readers should show a better performance on it. The results of the *Quantitative method: Objective measurements (Part 1)* failed to confirm this hypothesis since both groups performed faster on Map I with only differences in speed.

5. DISCUSSION

5.1 Study Limitations

Several potential limitations need to be considered. First and foremost, *the format of the experimental study* played a crucial role while executing map-reading tasks. Due to the pandemic situation, the initial idea of facilitating a user study with paper maps in the laboratory environment and with the involvement of hardware apparatuses probably would give a more accurate result. Here, we have noticed the difficulties caused by the *physical presence/absence of the interviewer*. Some participants were not organized or attentive since then as an interviewer I had to reset the stopwatch and repeat the question. Most likely it was caused by the difference of how convenient it is to perceive and sense the new information. And as a result, it gave no feeling of "owning the situation" to some individuals.

Different *hardware components*, viz, system properties, screen size and resolution, used in the experiment was an apparent limitation even the map samples´ content, scale, features, the quality was the same. It was also significant in while executing the reading tasks. Some participants had a minimal allowed size of the computer screen (13 inches), hence, it required more zooming-clicking manipulations while seeking an answer for the task. Most of the participants sometimes were slow because of the software program's speed (PDF-readers). Nevertheless, the digital format of the think-aloud interview similar to the cognitive walkthrough session was not the worse one in given circumstances.

Another important factor was *the level of map experience.* The distribution of novice, competent, and expert user in Group I and Group II was not evenly distributed. We assume that if they had more or less homogeneous structure, then it would be more accurate.

The third limitation was related to *the exposure of technologies.* We assumed that *the* age range of both groups influences on being on a safe side, but it slightly touched Group II. We cannot rule out that the prevalence of digital devices, web-, mobile map apps and platforms are getting more practical than static paper maps with a traditional and classic view, symbolization, and the way of interaction. Also, the lack of illustrated thematic, touristic, navigational, city banner, transportation maps in a surrounding setting in Kazakhstan has created a phenomenon of being detached, away of using maps for easy spatial orientation and navigation. For that, people usually use already estimated routes in different location-based platforms such are Google Maps, 2GIS Maps, Yandex Maps for navigation and area exploration. But besides, people interact with maps only for studying or professional purposes. Thus, might be an explanation of the difficulty in taking a wild guess while judging about unknown symbolization on a map described in *Chapter 4.3 Qualitative approach (Part II)*.

5.2 Overview and conclusions

This thesis has presented a methodological and interdisciplinary analysis of significant studies in the area of cross-cultural and cognitive psychology and cartography. It helped to identify the research questions which were aimed to examine whether the cultural background is involved in the process of "map-user" interaction. For that reason, ad hoc map samples were created from scratch in Adobe Illustrator program, whose design style was following the design guidelines of two topographic maps. After that, 50 interviews with participants from the European and Central Asian countries were conducted. It resulted in qualitative and quantitative sample sets which were statistically investigated. The quantitative method of the experiment has revealed that there was a difference in the speed of the participants while performing map-reading tasks. Moreover, it was assumed that the participants from each group would recognize the topographic map design style and, thus, proceed faster. But these findings were possibly influenced by the level of experience with cartographic products and academic and professional background.

The findings of the think-aloud procedure serve as evidence of cross-cultural differences in map design perception. Particularly, consistent assessment ranking and feedback from Group I highlighted a significant level of the importance of cultural background whilst communicating the map. Even though another group only partially (67%) supported this theory because of the contradicting situation between rating evaluation and shared feedback on it. The possible cause of the discrepancy might be a consequence of diverse academic and professional background, more importantly, the map experience level.

The outcomes of the qualitative data also have revealed the presence of psychological phenomena, namely, *the mere exposure, perceptual fluency, and modified two-factor model*. According to this, our experience creates and shapes our world-view. Since the input information and content acquired from the surrounding setting varies from culture to culture, we assume that "how we perceive" to some extent is influenced by cultural circumstances.

5.3 Recommendations for future studies

The experiment demonstrated the presence of cross-cultural differences in cognitive performance through qualitative data findings. However, it partially failed to justify it in terms of statistical analysis due to the aforementioned factors. Future work should consider the limitations of the current research. Promising topics for further examination were found during this study, namely, the investigation of colour scheme, graphical symbols, the level of complexity, and visual hierarchy in terms of cross-cultural psychology and cartography.

REFERENCES

1:25,000 scale Topographic Map. (n.d.). Kingdom of Saudi Arabia - The General Commission for Survey. Retrieved September 4, 2020, from https://www.gcs.gov.sa/En/ProductsAndServices/Products/BaseMaps/Pages/Topographic-Map-25K.aspx;

Administration of the President of Russia. (2015). *Federal Law on Geodesy, Cartography and Spatial Data dated 30.12.2015 № 431-ФЗ*. Administration of the President of Russia. http://kremlin.ru/acts/bank/40372;

A.R. Luria. Cultural differences and intellectual activity: Psychology OnLine.Net. (2006, 20:30:37 UTC). Psychology OnLine.Net - Материалы По Психологии. https://www.psychology-online.net/articles/doc-613.html;

Arnheim, R. (1954). *Art and the Visual Perception: A Psychology of the Creative Eye*. University of California Press;

Ausburn, L. J., & Ausburn, F. B. (1978). Cognitive Styles: Some Information and Implications for Instructional Design. *Educational Communication and Technology*, *26*(4), 337–354. JSTOR;

Bender, A., & Beller, S. (2011). The cultural constitution of cognition: Taking the anthropological perspective. *Front. Psychology*, *2*(67). https://doi.org/bhkpg5;

Berry, J., & Dasen, P. (2019). *A. Heron and M. Simonsson (1969): Weight conservation in Zambian children: A nonverbal approach: Readings in Cross-Cultural Psychology* (pp. 335–350). https://doi.org/fbjs;

Berry, J. W. (1992). Acculturation and Adaptation in a New Society. *International Migration*, *30*(s1), 69–85. https://doi.org/c4h69j;

Berry, John W., Poortinga, Y. H., Segall, M. H., & Dasen, P. R. (2002). *Cross-Cultural Psychology: Research and Applications* (2nd ed.). Cambridge University Press;

Berry, J.W. (2019). Ecocultural Psychology. *Cultural-Historical Psychology*, *15*, 4–16. https://doi.org/fbjt;

Bertin, J. (1983). *Semiology of graphics*. University of Wisconsin Press;

Beugelsdijk, S., Maseland, R., & Hoorn, A. (2015). Are Scores on Hofstede's Dimensions of National Culture Stable over Time? A Cohort Analysis. *Global Strategy Journal*, *5*. https://doi.org/gcp2cw;

BEV. (n.d.). *Kartographisches Modell 1:250 000 (Raster KM250-R)*. Unentgeltliche Produkte des BEV - Downloads - Support - Bundesamt für Eich- und Vermessungwesen. Retrieved September 2, 2020, from https://www.bev.gv.at/portal/page?_pageid=713,2875837&_dad=portal&_schema=PORTAL;

BKG. (n.d.). *WebAtlasDE Viewer*. Bundesamt für Kartographie und Geodäsie. Retrieved September 2, 2020, from http://sg.geodatenzentrum.de/web_bkg_webmap/applications/webatlasde/webatlasde.html;

Boduroglu, A., Shah, P., & Nisbett, R. E. (2009). Cultural Differences in Allocation of Attention in Visual Information Processing. *Journal of Cross-Cultural Psychology*, *40*(3), 349–360. https://doi.org/cbthjh;

Boroditsky, L. (2001). Does Language Shape Thought?: Mandarin and English Speakers' Conceptions of Time. *Cognitive Psychology*, *43*(1), 1–22. https://doi.org/dk27d2;

Carpenter, S. (2000). Effects of cultural tightness and collectivism on self-concept and causal attributions. *Cross-Cultural Research*, *34*(38–56);

Cohen, D. (2001). Cultural variation: Considerations and implications. *Psychological Bulletin*, *127*(4), 451–471. https://doi.org/fsgq7k;

ČÚZK. (2020). *Geoprohlížeč*. Mapová aplikace pro prohlížení produktů ČÚZK. https://ags.cuzk.cz/geoprohlizec/?id=8910c49c4e1049f382140db266682a7c_1w;

Dasen, P. (1977). Cross-cultural cognitive development: The cultural aspects of Piaget's theory. *Annals of the New York Academy of Sciences*, *285*, 332–337;

Dasen, P. R., & Heron, A. (1981). Cross-cultural tests of Piaget's theory. In H. C. Triandis & A. Heron (Eds.). In *Handbook of cross-cultural psychology* (Vol. 4, pp. 295–342). Allyn & Bacon;

Ember, C., & Ember, M. (2009). *Cross-Cultural Research Methods* (Vol. 2). AltaMira Press;

Encyclopedia Britannica. (n.d.). *Topographic map | cartography | Britannica*. Encyclopedia Britannica. Retrieved September 2, 2020, from https://www.britannica.com/science/topographic-map;

Frink, D., & Klimoski, R. (1998). Toward a Theory of Accountability in Organizations and Human Resources Management. *Research in Personnel and Human Resources Management*, *16*;

Geert Hofstede. (2016, June 14). *Dimension data matrix*. Geert Hofstede. https://geerthofstede.com/research-and-vsm/dimension-data-matrix/;

Geertz, C. (1973). *The Interpretation of Cultures*. Basic Books;

Gelfand, M. J., Nishii, L., & Raver, J. L. (2006). On the nature and importance of cultural tightness–looseness. *Journal of Applied Psychology*, *91*(1225–1244);

Gelfand, M., Raver, J., Nishii, L., Leslie, L., Lun, J., Lim, B., Duan, L., Almaliach, A., Ang, S., Arnadottir, J., Aycan, Z., Boehnke, K., Boski, P., Cabecinhas, R., Chan, D., Chhokar, J., D'Amato, A., Ferrer, M., Fischlmayr, I., & Yamaguchi, S. (2011). Differences Between Tight and Loose Cultures: A 33-Nation Study. *Science (New York, N.Y.)*, *332*, 1100–1104. https://doi.org/dzt3n2;

Geoscience Australia. (2012). *1:250 000 Scale Topographic Map*. Australian Government - Geosciences Australia. http://geoscience-au.maps.arcgis.com/apps/opsdashboard/index.html#/7e8e72ea0cc042f588d1883d0e57d855;

Goldsberry, K. P. (2007). *Real-Time Traffic Maps*;

Gosset, W. S. (1908). Student. In *Biometrika* (Vol. 6). University Press;

Grossmann, I., & Varnum, M. E. W. (2011). Social class, culture, and cognition. *Social Psychological and Personality Science*, *2*(1), 81–89. https://doi.org/d7nswr;

Hampton, R. S., & Varnum, M. E. W. (2017). Individualism-Collectivism. In V. Zeigler-Hill & T. K. Shackelford (Eds.), *Encyclopedia of Personality and Individual Differences* (pp. 1–8). Springer International Publishing. https://doi.org/fbjv;

Hassenzahl, M. (2003). The Thing and I: Understanding the Relationship Between User and Product. In *Funology. Human-Computer Interaction Series. Blythe M.A., Overbeeke K., Monk A.F., Wright P.C. (eds)* (Vol. 3). Springer, Dordrecht. https://doi.org/frhhgq;

Hassenzahl, Marc. (2005). The Thing and I: Understanding the Relationship Between User and Product. In *Funology: From Usability to Enjoyment* (Vol. 3, pp. 31–42);

Hassi, A., & Storti, G. (2012). *Globalization and Culture: The Three H Scenarios*. https://doi.org/fbjw;

Higgins, E. T. (1996). The "self digest": Self-knowledge serving self-regulatory functions. *Journal of Personality and Social Psychology*, *71*(6), 1062–1083. https://doi.org/cctmjh;

Hills, M. (2002). Kluckhohn and Strodtbeck's Values Orientation Theory. *Online Readings in Psychology and Culture*, *4*. https://doi.org/gfsnks;

Hofstede, G. (1980). *Culture's Consequences: International Differences in Work-Related Values*. SAGE Publications. https://books.google.kz/books?id=hW6AAAAAMAAJ;

Hofstede, G. H. (1996). *Cultures and organizations: Software of the mind* (1st ed.). McGraw-Hill;

Hofstede, G. H., Hofstede, G. Jan., & Minkov, Michael. (2010). *Cultures and organizations: Software of the mind.* McGraw-Hill;

Hofstede, Geert. (1991). *Cultures and organizations: Software of the mind*. McGraw-Hill; /z-wcorg/;

Hofstede, Geert. (2011). Dimensionalizing Cultures: The Hofstede Model in Context. *Online Readings in Psychology and Culture*, *2*(1). https://doi.org/cbjq;

Holland, R. P. (1982). Learner Characteristics and Learner Performance: Implications for Instructional Placement Decisions. *The Journal of Special Education*, *16*(1), 7–20. https://doi.org/c3c3bg;

Holmes, J. (2001). Sociolinguistics. In N. J. Smelser & P. B. Baltes (Eds.), *International Encyclopedia of the Social & Behavioral Sciences* (pp. 14562–14569). Pergamon. https://doi.org/b5qsrk;

Holton, R. (2000). Globalization's Cultural Consequences. *The ANNALS of the American Academy of Political and Social Science*, *570*(1), 140–152. https://doi.org/fbjx;

Imhof, E. (1972). *Thematische Kartographie* (1st edition). De Gruyter Oldenbourg;

Instituto Geográfico Nacional. (2017). *Mapa Topográfico Nacional 1:25.000*. Búsqueda General. http://contenido.ign.es/web/biblioteca_cartoteca/abnetcl.cgi/O7540/ID06105f71/NT1?TITN=31987&FORM=1;

Instituto Geografico Nacional Tommy Guardia. (n.d.). *DESCARGA EL MAPA 1:25 000*. Retrieved September 3, 2020, from https://sigigntg.anati.gob.pa/portal/apps/webappviewer/index.html?id=96c46429e3c349b9b4a987096e1e1a5c;

Istituto Geografico Militare. (n.d.). *Carta Topografica d'Italia alla scala 1:25.000*. Retrieved September 3, 2020, from https://www.igmi.org/;

Joye, Y., Steg, L., Unal, A., & Pals, R. (2015). When Complex Is Easy on the Mind: Internal Repetition of Visual Information in Complex Objects Is a Source of Perceptual Fluency. *Journal of Experimental Psychology Human Perception & Performance*, *42*. https://doi.org/f3f5vw;

Kaasa, A., & Minkov, M. (2020). Are the World's National Cultures Becoming More Similar? *Journal of Cross-Cultural Psychology*, 0022022112093367. https://doi.org/fbjz;

Kent, A. J. (2009). Topographic Maps: Methodological Approaches for Analyzing Cartographic Style. *Journal of Map & Geography Libraries*, *5*, 131–156. https://doi.org/dxpts3;

Kingdom of Saudi Arabia - The General Commission for Survey. (n.d.). *Kingdom of Saudi Arabia—The General Commission for Survey*. Kingdom of Saudi Arabia - The General Commission for Survey. Retrieved September 3, 2020, from https://www.gcs.gov.sa/En/ProductsAndServices/Products/BaseMaps/Pages/Topographic-Map-25K.aspx;

Kitayama, S., Duffy, S., Kawamura, T., & Larsen, J. T. (2003). Perceiving an Object and Its Context in Different Cultures: A Cultural Look at New Look. *Psychological Science*, *14*(3), 201–206. https://doi.org/djvkd5;

Kitayama, S., Ishii, K., Imada, T., Takemura, K., & Ramaswamy, J. (2006). Voluntary settlement and the spirit of independence: Evidence from Japan's "northern frontier." *Journal of Personality and Social Psychology*, *91*(3), 369–384. https://doi.org/d2t3c3;

Kitayama, S., Park, H., Sevincer, A. T., Karasawa, M., & Uskul, A. (2009). A Cultural Task Analysis of Implicit Independence: Comparing North America, Western Europe, and East Asia. *Journal of Personality and Social Psychology*, *97*, 236–255. https://doi.org/cfw9bz;

Kluckhohn, F. R., & Strodtbeck, F. L. (1961). *Variations in value orientations*. Evanston, Ill., Row, Peterson;

Koffka, K. (1922). Perception: An introduction to the Gestalt-Theorie. *Psychological Bulletin*, *19*(10), 531–585. https://doi.org/ckb5vv;

Köhler, W. (1929). *Gestalt psychology*. H. Liveright;

Köhler, W., & Pratt, C. C. (1969). *The task of Gestalt psychology*;

Kozhevnikov, M. (2007). Cognitive Styles in the Context of Modern Psychology: Toward an Integrated Framework of Cognitive Style. *Psychological Bulletin*, *133*, 464–481. https://doi.org/fhk5t4;

Kroeber, A. L., & Kluckhohn, C. (1952). Culture: A critical review of concepts and definitions. *Papers. Peabody Museum of Archaeology & Ethnology, Harvard University*, *47*(1), viii, 223–viii, 223;

Krygier, J. B. (1995). Cartography as an art and a science? *The Cartographic Journal*, *32*(1), 3–10. https://doi.org/fzcxzq;

Lacko, D., Šašinka, Č., Cenek, J., Stachoň, Z., & Lu, W.-L. (2020). Cross-Cultural Differences in Cognitive Style, Individualism/Collectivism and Map Reading between Central European and East Asian University Students. *Studia Psychologica*, *62(1):23-43*. https://doi.org/d7rr;

Lederach, J. P. (1995). *Preparing for peace: Conflict transformation across cultures*. Syracuse University Press;

Lee, A. Y. (2001). The Mere Exposure Effect: An Uncertainty Reduction Explanation Revisited. *Personality and Social Psychology Bulletin*, *27*(10), 1255–1266. https://doi.org/cr8n5p;

L'Institut national de l'information géographique et forestière. (2019). *Géoportail (IGN)*. https://www.geoportail.gouv.fr/;

Lu, L., & Gilmour, R. (2007). Developing a new measure of independent and interdependent views of the self. *Journal of Research in Personality - J RES PERSONAL*, *41*, 249–257. https://doi.org/b4pm7p;

Lucy, J. A. (2001). Sapir–Whorf Hypothesis. In N. J. Smelser & P. B. Baltes (Eds.), *International Encyclopedia of the Social & Behavioral Sciences* (pp. 13486–13490). Pergamon. https://doi.org/dr45ph;

Luria, A. R. (1931). Psychological expedition to Central Asia. *Science*, *74*, 383–384;

Lustig, M. W., & Koester, J. (1999). *Intercultural competence*. New York: Addison-Wesley Longman;

Mapa topográfico escala 1:25 000. (2011). Instituto Geografico Nacional Tommy Guardia. https://sigigntg.anati.gob.pa/portal/apps/webappviewer/index.html?id=96c46429e3c349b9b4a987096e1e1a5c;

Matsumoto, D. (1996). *Culture and psychology*. Brooks/Cole;

Matsumoto, D., & Juang, L. (2012). *Culture and Psychology*. Cengage Learning;

Mayring, P. (2000). Qualitative Content Analysis. *Forum Qualitative Sozialforschung / Forum: Qualitative Social Research*, *20*(3). https://doi.org/ggfn74;

McLuhan, M. (1964). *Understanding media: The extensions of man*;

Ministry of Justice of the Kyrgyz Republic. (2013). *Instructions for Determining and Ensuring the Secrecy of Topographic and Geodetic, Cartographic, Gravimetric, Aerial Photography and Space Survey Materials on the Territory of the Kyrgyz Republic (Decree № 622 from 11,Novermber, 2013)*. http://cbd.minjust.gov.kg/act/view/ru-ru/94821/10?mode=tekst;

Ministry of Justice of the Republic of Kazakhstan. (1999). *Law of the Republic of Kazakhstan dated March 15, 1999 No. 349-I About state secrets*. //online.zakon.kz/Document/?doc_id=1012633;

Minkov, M. (2017). A revision of Hofstede's model of national culture: Old evidence and new data from 56 countries. *Cross Cultural & Strategic Management*, *25*. https://doi.org/gddtz4;

Miyamoto, Y., Nisbett, R., & Masuda, T. (2006). Culture and the Physical Environment Holistic Versus Analytic Perceptual Affordances. *Psychological Science*, *17*, 113–119. https://doi.org/cck9h6;

Monmonier, M. (1996). *How to Lie with Maps*. University of Chicago Press;

Montello, D. R. (2004). Cognition of Geographic Information. In *A Research Agenda for Geographic Information Science Edited by Robert B.McMaster, E.Lynn Usery* (1st ed., pp. 61–91). CRC Press;

Natural Resources Canada. (2014). *Topographic maps: The basics*. https://doi.org/fbj3;

Navon, D. (1977). Forest before trees: The precedence of global features in visual perception. *Cognitive Psychology*, *9*(3), 353–383. https://doi.org/fn234h;

Nisbett, R. (2004). *The Geography of Thought: How Asians and Westerners Think Differently...and Why*. Free Press; Reprint edition;

Nisbett, R. E. (2003). *The geography of thought: How Asians and Westerners think differently ... And why.* (pp. xxiii, 263). Free Press;

Nisbett, R. E., Peng, K., Choi, I., & Norenzayan, A. (2001). Culture and systems of thought: Holistic versus analytic cognition. *Psychological Review*, *108*(2), 291–310. https://doi.org/fqdnc6;

Nisbett, R. E., Peng, K., Choi, I., & Norenzayan, A. (2008). Culture and Systems of Thought: Holistic versus Analytic Cognition. In J. E. Adler & L. J. Rips (Eds.), *Reasoning: Studies of Human Inference and its Foundations* (pp. 956–985). Cambridge University Press; Cambridge Core. https://doi.org/fbj4;

Nisbett, R., & Masuda, T. (2003). Culture and point of view. *Proceedings of the National Academy of Sciences*. https://doi.org/d6tz6c;

Norenzayan, A., Choi, I., & Peng, K. (2007). Perception and cognition. In *Handbook of cultural psychology*. (pp. 569–594). The Guilford Press;

Ordnance Survey. (n.d.). *Products | Specific GIS Mapping Tools | Free & Premium Data*. Ordnance Survey. Retrieved September 3, 2020, from https://www.ordnancesurvey.co.uk/business-government/products;

Ortag, F. (2009). Variables of Aesthetics in Maps. In *Cartography and Art*. Springer;

Ory, J., Christophe, S., & Fabrikant, S. I. (2013, August). *Identification of Styles in Topographic Maps*. ICC - The 26th International Cartographic Conference, Dresden (Germany). https://doi.org/fbj5;

Ory, J., Christophe, S., Fabrikant, S. I., & Bucher, B. (2015). How Do Map Readers Recognize a Topographic Mapping Style? *The Cartographic Journal*, *52, 2015*(2), 193–203. https://doi.org/f722qq;

Oyserman, D. (2011). Culture as situated cognition: Cultural mindsets, cultural fluency, and meaning making. *European Review of Social Psychology*, *22*(1), 164–214. https://doi.org/dn362t;

Oyserman, D., & Lee, S. W. S. (2008). Does Culture Influence What and How We Think? Effects of Priming Individualism and Collectivism. *Psychological Bulletin*, *134(2)*(311–42). https://doi.org/ctgvpm;

Oyserman, D., & Sorensen, N. (2009). *Understanding Cultural Syndrome Effects on What and How We Think: A Situated Cognition Model*;

Pelto, P. J. (1968). The differences between "tight" and "loose" societies. *Trans-Action*, *5*(5), 37–40. https://doi.org/dk3qsk;

Phinney, J. S. (1996). *Understanding Ethnic Diversity: The Role of Ethnic Identity*. https://doi.org/dn46q6;

Piaget, J. (1936). *Origins of intelligence in the child*. Routledge & Kegan Paul;

Piaget, J. (1952). *The origins of intelligence in children*;

Piaget, J. (1964). Cognitive development in children: Piaget development and learning. *Journal of Research in Science Teaching*, *2*, 176–186;

Rushton, M. (2004). Tyler Cowen: 2002, Creative Destruction: How Globalization is Changing the World's Cultures. *Journal of Cultural Economics*, *28*, 81–83. https://doi.org/fgvhnx;

Sapir, E. (1929). *The Status of Linguistics as a Science*. *5*(4), 207–214;

Segall, M. H., Campbell, D. T., & Herskovits, M. J. (1963). Cultural Differences in the Perception of Geometric Illusions. *Science*, *139*(3556), 769. https://doi.org/bdv4pf;

Shweder, RichardA. (1973). The Between and Within of Cross-Cultural Research. *Ethos*, *1*(4), 531–545. https://doi.org/cgfbx9;

Srull, T. K., & Wyer, R. S. (1979). The role of category accessibility in the interpretation of information about persons: Some determinants and implications. *Journal of Personality and Social Psychology*, *37*(10), 1660–1672. https://doi.org/fj8kqz;

Stachoň, Z., Šašinka, Č., Čeněk, J., Štěrba, Z., Angsuesse, S., Fabrikant, S. I., Štampach, R., & Morong, K. (2018). Cross-cultural differences in figure–ground perception of cartographic stimuli. *Cartography and Geographic Information Science*. https://doi.org/gd4tvm;

Stachoň, Z., Šašinka, Č., Sterba, Z., Zbořil, J., Březinová, Š., & Švancara, J. (2013). Influence of Graphic Design of Cartographic Symbols on Perception Structure. *Kartographische Nachrichten*, *63*(4), 216–220;

Strack, F., Schwarz, N., Bless, H., Kübler, A., & Wänke, M. (1993). Awareness of the influence as a determinant of assimilation versus contrast. *European Journal of Social Psychology*, *23*(1), 53–62. https://doi.org/fs64jw;

Student's t-distribution. (2020). In *Wikipedia*. https://en.wikipedia.org/w/index.php?title=Student%27s_t-distribution&oldid=977091384;

Survey of India. (n.d.). *Publications*. Retrieved September 2, 2020, from http://www.surveyofindia.gov.in/pages/display/246-publications;

swisstopo. (2020). *Swiss Geoportal; Federal Office of Topography swisstopo*. geo.admin.ch. https://map.geo.admin.ch;

Thomas, D. C., & Peterson, M. F. (Eds.). (2015). Chapter 3 Comparing cultures: Systematically describing cultural differences. In *Cross-cultural management: Essential concepts* (3rd ed., pp. 47–69). SAGE Publications;

Triandis, H. (1989). The self and social behavior in differing cultural contexts. *Psychological Review*, *96*, 506-520;

Triandis, H., Bontempo, R., Villareal, M. J., Asai, M., & Nydia, L. (1988). Individualism and Collectivism: Cross-Cultural Perspectives on Self-Ingroup Relationships. *Journal of Personality and Social Psycholog*, *54*(2), 323–338. https://doi.org/dh5tzq;

Triandis, Harry C. (2001). Individualism-collectivism and personality. *Journal of Personality*, *69*(6), 907–924. https://doi.org/cg4kgt;

Triandis, Harry C., & Gelfand, M. J. (2012). A theory of individualism and collectivism. In *Handbook of theories of social psychology, Vol. 2* (pp. 498–520). Sage Publications Ltd. https://doi.org/fbj9;

Triandis, Harry Charalambos. (1995). *Individualism and collectivism*. Westview Press;

Tufte, E. R. (1995). *Envisioning Information* (Version 5th, 5th ed.) [Computer software]. Graphics Press;

Tylor, E. B. (1871). *Primitive Culture: Researches Into the Development of Mythology, Philosophy, Religion, Art, and Custom* (Issue v. 1). J. Murray. https://books.google.kz/books?id=AucLAAAAIAAJ;

USGS. (2019). *TNM Download*. The National Map Data Download and Visualization Services (USGS).https://viewer.nationalmap.gov/basic/?basemap=b1&category=histtopo,ustopo&title=Map%20View#productSearch;

Uz, I. (2014). The Index of Cultural Tightness and Looseness Among 68 Countries. *Journal of Cross-Cultural Psychology*, *46*, 319–335. https://doi.org/gdh6p2;

Vandello, J. A., & Cohen, D. (1999). Patterns of individualism and collectivism across the United States. *Journal of Personality and Social Psychology*, *77*(2), 279–292. https://doi.org/ftq89f;

Varnum, M. E. W., Grossmann, I., Kitayama, S., & Nisbett, R. (2010). The Origin of Cultural Differences in Cognition: The Social Orientation Hypothesis. *Current Directions in Psychological Science*, *19(1)*(9–13). https://doi.org/cks2h8;

Veldi, M., & Bell, S. (2019). A landscape of lies: Soviet maps in Estonia. *SHS Web of Conferences*, *63*, 08002. https://doi.org/fbkb;

Vujakovic, P., & Kent, A. J. (2009). Stylistic Diversity in European State 1: 50 000 Topographic Maps. *Cartographic Journal*, *46(3):179-213*. https://doi.org/bbsjjb;

Vygotsky, L. S. (1934). *Myshlenie i Rech: Psihologicheskie issledovaniya (Cognition and Language: Psychological investigations). Edited by V. Kolbanovsky.* Gosudarstvennoe socialno-ekonomicheskoe izdatelstvo;

Vygotsky, L. S. (1960). *Razvitie vysshih psihicheskih funkcii (Developement of higher psychological functions/processes)*. APN;

Vygotsky, L. S. (1979). *Mind and Society* (2тв). Harvard University Press;

Vygotsky, L. S. (1982). *Sobranie sochineniy (The Collected Works)* (Vol. 2). Pedagogika. http://elib.gnpbu.ru/text/vygotsky_ss-v-6tt_t2_1982/go,2;fs,1/;

Wertheimer, M. (1959). *Productive thinking.* (pp. xvi, 302). Harper;

Whorf, B. L. (1940). *Science and linguistics*. Technology Review;

Wikipedia. (2020). Think aloud protocol. In *Wikipedia*. https://en.wikipedia.org/w/index.php?title=Think_aloud_protocol&oldid=943773960;

World, G. (2010, December 3). Restriction on maps in India. *Geospatial World*. https://www.geospatialworld.net/article/restriction-on-maps-in-india/;

Wright, J. K. (1942). Map Makers Are Human: Comments on the Subjective in Maps. *Geographical Review*, *32*, 527–544. https://doi.org/bxq7nx;

Zajonc, R. B. (1968). Attitudinal effects of mere exposure. *Journal of Personality and Social Psychology*, *9*(2, Pt.2), 1–27. https://doi.org/bjjgv4;

Zajonc, R. B. (2003). *The Selected Works of R.B. Zajonc*. Wiley;

Żyszkowska, W. (2015). Map perception: Theories and research in the second half of the twentieth century. *Polish Cartographical Review*, *47*. https://doi.org/fbkc.

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APPENDIX

Survey results

Quantitative method (Part I): Objective measurements

GROUP I											
№	*Q1.1 (2)*	*Q1.2 (1)*	*Q1.3 (1)*	*Q1.4 (2)*	*Q1.5 (1)*	*Q1.6 (2)*	*Q1.7 (1)*	*Q1.8 (2)*	*Q1.9 (1)*	*Q1.10 (2)*	*sum*
1	24	40	23	21	39	26	16	62	6	48	**305**
2	47	41	38	46	18	43	58	61	9	61	**422**
3	26	50	23	8	10	40	13	34	10	26	**240**
4	37	48	25	10	15	59	72	32	15	29	**342**
5	13	11	28	11	16	37	18	38	11	40	**223**
6	55	64	19	29	14	54	21	38	14	44	**352**
7	23	20	9	12	18	18	21	43	10	31	**205**
8	39	13	32	5	63	28	31	23	16	25	**275**
9	21	11	18	17	17	32	29	62	12	59	**278**
10	24	24	32	14	19	72	51	28	16	38	**318**
11	21	12	9	14	11	20	23	11	5	38	**164**
12	54	39	15	27	74	105	36	92	15	60	**517**
13	20	55	20	11	45	28	53	30	13	30	**305**
14	24	15	14	32	35	78	18	26	28	22	**292**
15	19	18	22	13	21	17	33	24	21	54	**242**
16	64	27	12	24	50	39	20	53	18	34	**341**
17	16	13	15	23	15	55	21	28	26	40	**252**
18	15	21	19	23	27	42	26	15	29	74	**291**
19	25	15	22	14	6	83	26	29	9	57	**286**
20	16	47	18	5	24	33	45	67	6	22	**283**
21	68	15	24	19	41	78	37	65	21	47	**415**
22	28	29	11	13	22	24	12	25	8	48	**220**
23	30	67	33	27	56	49	20	13	19	31	**345**
24	14	56	12	5	16	14	10	12	7	14	**160**
25	37	25	15	19	8	73	18	23	9	25	**252**

Note. The sign "№" stands for "Participant №1, Participant №2, …".

Quantitative method (Part I): Objective measurements

GROUP 2											
№	*Q1.1 (2)*	*Q1.2 (1)*	*Q1.3 (1)*	*Q1.4 (2)*	*Q1.5 (1)*	*Q1.6 (2)*	*Q1.7 (1)*	*Q1.8 (2)*	*Q1.9 (1)*	*Q1.10 (2)*	*sum*
1	23	49	19	17	37	29	27	51	13	26	**292**
2	72	14	35	19	23	27	18	25	14	45	**294**
3	17	14	18	14	117	85	15	9	8	31	**331**
4	52	35	13	20	10	48	33	19	8	57	**299**
5	15	16	29	13	17	47	26	21	41	36	**266**
6	13	33	26	16	12	30	16	28	9	34	**223**
7	40	32	22	29	43	56	12	128	20	85	**474**
8	81	36	15	40	9	45	25	45	80	69	**453**
9	32	55	53	16	25	90	28	72	6	97	**483**
10	83	40	51	36	44	53	26	33	21	94	**491**
11	21	24	11	26	13	18	13	41	23	34	**235**
12	80	59	17	19	88	39	31	70	26	77	**518**
13	11	14	46	9	15	80	27	38	6	81	**340**
14	40	82	33	59	43	162	103	63	27	85	**711**
15	45	28	39	19	47	34	22	75	11	87	**422**
16	10	31	22	8	23	18	9	46	10	65	**258**
17	31	11	14	11	14	43	14	68	15	31	**269**
18	56	23	32	14	18	15	49	66	16	58	**365**
19	45	20	15	36	27	47	26	27	22	55	**339**
20	35	30	12	18	60	35	10	57	12	79	**368**
21	87	33	35	28	85	86	14	80	12	56	**537**
22	9	61	23	9	62	27	13	14	7	56	**303**
23	18	13	18	24	23	79	17	21	13	64	**313**
24	110	69	35	21	41	24	116	86	20	83	**629**
25	99	24	28	18	16	70	18	64	6	23	**391**

Note. The sign "№" stands for "Participant №1, Participant №2, …".

Qualitative method (Part II): Subjective measurements

GROUP I						
№	*Ugly – Attractive*		*Discouragement – Motivation*		*Confusion – Clarity*	
	Map I	Map II	Map I	Map II	Map I	Map II
1	4	3	4	3	5	3
2	4	4	3	4	4	2
3	2	2	2	3	4	2
4	4	3	4	4	5	3
5	5	2	4	3	4	2
6	3	2	3	3	4	2
7	4	2	4	2	4	2
8	4	2	4	3	5	3
9	4	3	5	3	5	3
10	4	3	4	2	4	3
11	5	5	5	4	5	4
12	4	4	3	3	5	4
13	4	2	4	2	3	2
14	5	2	5	I	5	2
15	5	2	5	2	5	I
16	4	4	3	4	5	2
17	5	4	5	4	5	3
18	4	2	4	2	4	I
19	4	3	5	2	4	2
20	3	3	4	3	4	3
21	3	2	3	2	3	2
22	4	2	5	I	5	I
23	2	4	3	3	3	3
24	4	4	5	3	5	2
25	5	2	5	2	5	I
$\bar{x}$	3.96	2.84	4.04	2.72	4.4	2.32

Note. The sign "№" stands for "Participant №1, Participant №2, …";

"$\bar{x}$" stands for the arithmetic mean.

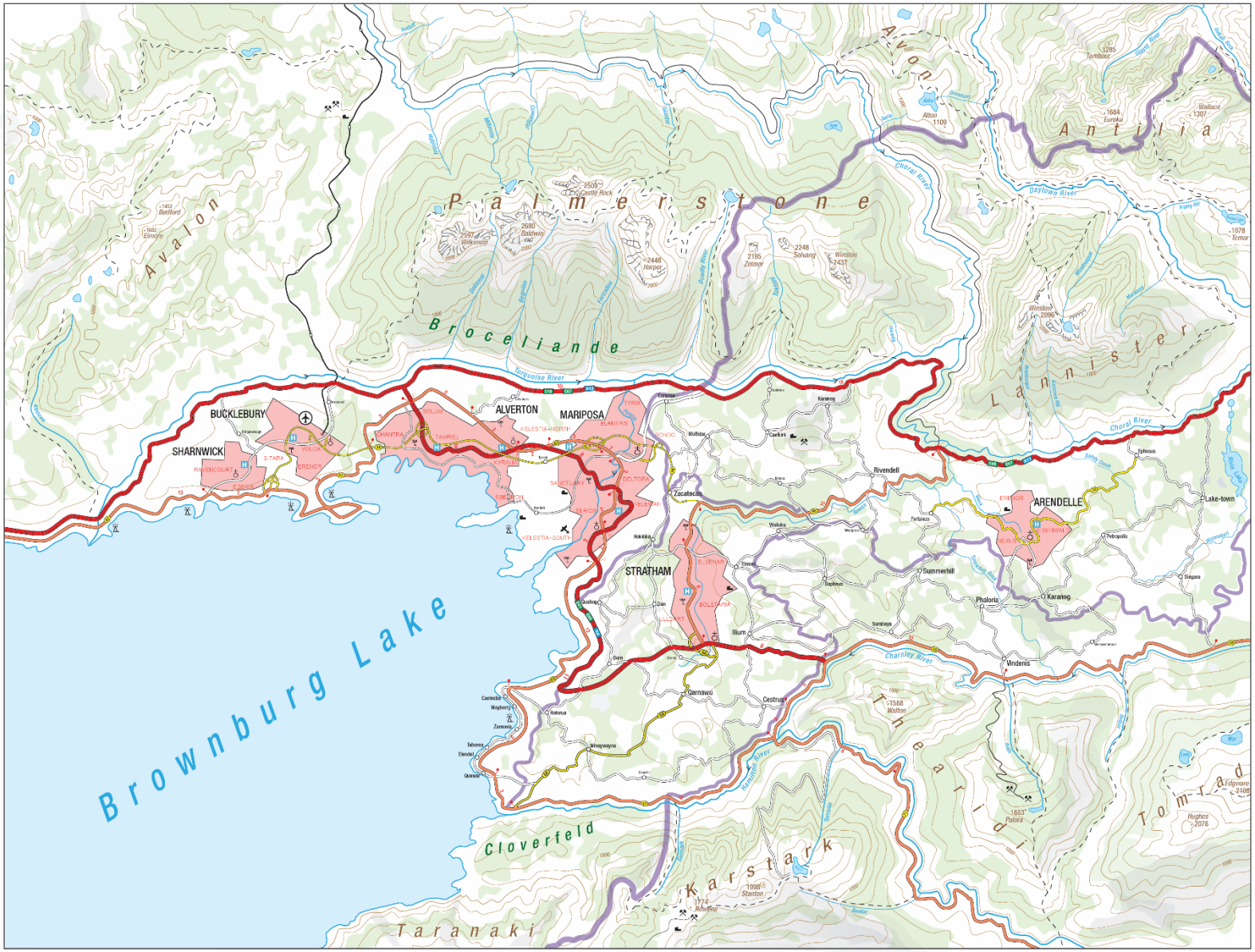
Qualitative method (Part II): Subjective measurements

GROUP 2						
№	*Ugly – Attractive*		*Discouragement – Motivation*		*Confusion – Clarity*	
	Map I	Map II	Map I	Map II	Map I	Map II
1	4	3	4	3	2	4
2	4	3	5	3	2	3
3	3	4	3	4	3	4
4	2	3	2	3	1	4
5	4	2	5	2	3	4
6	2	4	3	4	2	4
7	4	3	3	2	2	3
8	5	2	4	2	2	4
9	4	4	3	4	1	3
10	5	3	3	2	1	3
11	3	2	3	4	1	4
12	4	1	4	1	1	2
13	4	2	4	2	1	4
14	5	5	5	4	2	3
15	3	5	3	5	2	5
16	4	2	4	2	1	3
17	5	3	4	2	3	5
18	5	4	3	5	3	4
19	4	3	5	2	3	4
20	3	4	2	5	2	5
21	2	4	2	4	1	4
22	3	4	3	4	2	4
23	1	5	1	5	1	5
24	3	5	5	5	1	5
25	3	5	3	5	2	5
$\bar{x}$	3.56	3.4	3.44	3.36	1.8	3.92

Note. The sign "№" stands for "Participant №1, Participant №2, …";

"$\bar{x}$" stands for the arithmetic mean.

Map sample (Map 1)



Map sample (Map II)