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The Effect of the Meaning and Experience of Place on Mapping Behaviour

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In loving memory of
Siep Schaafsma

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Abstract

This thesis researches the role of platial connection and personal demographic and geographic characteristics on an individual's mapping behaviour. Recently, individuals increasingly use their geographic voice by participating in crowd-sourced and voluntary geographic data collection and visualisation. Simultaneously, there is a demand for better understanding places and how the meaning of place can be portrayed in maps. By investigating the connection of mapping behaviour as influenced by the extent to which people feel a platial relationship, the understanding of individual influences on mapping initiatives can be understood better, together with gaining insights in how to research mapping behaviour.

A self-administered online questionnaire including interactive mapping exercises was carried out. Participants performed mapping exercises of five secondary schools (of which they attended one; three schools inside Eindhoven, two outside Eindhoven) by tracing the geometry on aerial images of the area they saw as belonging to that place. The mapped area size, number of placed nodes and time spent on the exercise constitute the variable 'mapping behaviour'. Questions relating to the personal relationship with those places were also included, together with personal demographic and cartographic questions. The data was analysed quantitatively through linear mixed effect models and qualitatively. Schools were chosen to portray 'locational familiarity', places that cause relationships based on the location instead of their thematic function.

This study showed that the personal platial relationships with specific places do affect the way individuals map these places, both quantitatively (in ways of included areas, time spent on mapping and the usage of nodes) and qualitatively through used language. The personal demographic and geographic characteristics are of less impact and require further study to rule out their significance. Due to the limitations of the available cartographic research tools for designing mapping experiments and the limited data sample, future research can add on this exploratory study by looking into additional mapping behaviour variables and the inclusion of different types of places that allow for parametric sampling.

Keywords: Platial, Places, Mapping Behaviour, Place Attachment, Cartographic Experiment, Eindhoven

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Abbreviations

The included secondary schools:

SCE	**Stedelijk College Eindhoven, location Henegouwenlaan**
ECK	**Eckartcollege**
SJC	**Sint-Joris College**
SGN	**Stedelijk Gymnasium Nijmegen**
JWG	**Johan de Witt Gymnasium**
sce	Stedelijk College Eindhoven, loc. Henegouwenlaan as attended school
eck	Eckartcollege as attended school
sjc	Sint-Joris College as attended school

Other abbreviations:

CFA	Confirmatory Factor Analysis
EFA	Exploratory Factor Analysis
Ex.	Exercise/Experiment
GIS	Geographic Information System
GIScience	Geographic Information Science
PRS	Platial Relationship Score
VGI	Volunteered Geographic Information

Note on the Language

To improve the comprehensibility of the text, specific combinations of abbreviations were adapted in the results section to differentiate between the analysed mapping experiment and the attended school of the participant. For example, 'SCE-eck', where the first abbreviation in capital letters always refers to the mapping experiment in question (i.e., the school for which questions were answered). The second uncapitalised abbreviation always refers to the school the participant has attended. 'SCE-eck' thus refers to the mapping experiment of SCE (Stedelijk College Eindhoven), for a participant that has attended ECK (Eckartcollege). 'ECK-eck' would then refer to the mapping experiment of ECK for someone that has also attended this school. Please see the list of abbreviations above for the meaning of the abbreviations. When schools are being referred to on themselves, the capitalised abbreviation is used.

Another differentiation is made between 'mapping experiment' and 'mapping exercise'. The mapping experiment always refers to the entire block of questions in the questionnaire referring to a specific place, whereas the 'mapping exercise' specifically refers to the interactive mapping task.

1. Introduction

1.1 Problem Context

The phenomena of 'Volunteered Geographic Information' (VGI) have in recent years frequently been discussed and observed in action (Haworth, 2017; Goodchild & Li, 2012; Forati & Ghose, 2019), indicating that individuals increasingly gather and communicate geographic data in a crowd-sourced and voluntary manner, thus giving a geographic voice to the individual. These contributors have diverse backgrounds—whether in terms of age, gender, ethnicity, or other personal characteristics—as VGI mapping interfaces like OpenStreetMap and Wikimapia operate all over the world. It is commonly reasoned that these personal characteristics, i.e., the lived experience, influences someone's cognitive interpretation and conceptualisation of space and place (Lowrie, Jorgensen, Logan & Harris, 2021; Montello, 2009). This might therefore influence the way individuals map and contribute to VGI.

Paying attention to understanding map users and contributors is not new (Van Elzakker & Ooms, 2018), although the context in which those are to be understood can shift over time. An example is the movement of 'critical cartography', which emphasises 'the idea that maps [...] are not (and cannot be) value-free or neutral' (Perkins, 2018, p. 80), thus focussing on the context, creation, and interpretation of maps. Within this narrative there is an increased call for understanding and mapping the meaning of places, as illustrated by Poplin (2015), Pearce (2008) and Kim (2015). Where Poplin argues for more research on understanding sense-making of place, Pearce argues for understanding the mapping of space in relation to its experience. Kim states: 'overlooked phenomena can be reclaimed, different perspectives can be made apparent and new knowledge constructed' (p. 215). In other words, the personal experience with place must be closely considered to make map creation and interpretation more meaningful. Blaschke and Piralilou (2018) also stress the novelty of 'human-centred and philosophical notions of place' (p. 29) in Geographic Information Science (GIScience), as probably less than 0,1 per cent of literature deal with these topics. More commonly, Geographic Information Systems (GIS) are used to map more distinct, locational and environmental phenomena, whether these are discrete (e.g., number of buildings) or continuous (e.g., temperature). This thus calls for more research into how individuals portray these human-centred conceptions of place in their produced maps and how interpretations of place might influence the mapping itself.

This however raises the question, what is place and how can experience with or feelings towards a place be defined? A 'place' is not just a set of geographical coordinates that encompass a certain space, it is not one thing. A place can be explained by being 'about a relationship between people and the world' (Wood, 2018, p. 403), or about meaning attached to locations (Westerholt, Mocnik & Comber, 2020). The concept of place is thus rather 'vague' without universally defined boundaries and includes an individual part: the relationship of the individual with certain locations. As

Westerholt et al. (2020) argue, 'place' is difficult to operationalise both in words and in GIS, as the latter often relies on a specific set of coordinates to show locations.

To sum, the concept of place is abstract, and the type of connection or degree of attachment to a place depends on the individual. This entails that where one person might have a close bond to a certain place, another person may not feel anything al all for the same place. The 'platial relationship characteristics' of someone like feelings of familiarity, affinity, attachment and platial experience can thus differ from person to person and from place to place. As stated above, someone's lived experience might already influence the way they contribute to mapping processes, including these platial relationship characteristics.

1.2 Relevance

From the above, it becomes clear that there is a knowledge gap in the relationship between a map contributor and the places they map. To increase the quality of understanding VGI-initiatives, it is beneficial to have a good awareness and understanding of this mapping behaviour. The rest of this research thus focusses on identifying the possible differences in mapping behaviour depending on the personal platial relationship individuals have with specific places and their personal geographic and demographic characteristics. This can be of interest to other researchers in the field of cartography, people working with VGI-initiatives who are aiming to better understand mapping behaviour and to other map contributors looking to reflect on their own mapping behaviour. The research is therefore relevant by aiming to increase awareness on mapping behaviour and how this might be influenced by the individual's lived experience and relationship to place. In the future, this might allow research in this area to be more focussed through considering how people from different locations and levels of familiarity operate. Additionally, as the research is conducted through a self-administered online questionnaire that includes a mapping exercise, reflections on how to conduct such experiments may also be of relevance to researchers that want to carry out similar studies and/or experiments. This is relevant because similar studies on place or mapping behaviour are often performed with pencil-on-paper methods, even though VGI initiatives or other cartographic products often executed digitally.

1.3 Objective and Research Questions

The overall research objective is to examine the potential differences in individual's mapping behaviour regarding their personal relationship with certain places and to investigate how online mapping experiments can test mapping behaviour and personal relationships to places. In response to the above, the following research questions have been developed:

What effect does an individual's Platial Relationship Score, Personal Demographic, and Geographic Characteristics have on their Mapping Behaviour towards places they know of and do not know of?

- *How to define and operationalise the personal relationship to place, such as through the Platial Relationship Score, Personal Demographic Characteristics and Personal Geographic Characteristics?*
- *How to design a mapping experiment to test the individual's mapping behaviour and personal relationship to a place?*
- *What is the relationship between a Platial Relationship Score, Personal Demographic, and Geographic Characteristics and Mapping Behaviour?*

To answer these questions, a cartographic questionnaire combining quantitative and qualitative questions and including an interactive mapping exercise, was used to create understanding in how people map and feel towards these places. Using statistical and qualitative analyses, the mapped geometry, levels of platial relationship with the places and associated attributes were tested to determine whether people showed different mapping tendencies depending on their platial relationship scores or other personal characteristics.

1.4 Reading Guide

The report is structured as followed: the next chapter reviews and discusses relevant literature on understanding the concept of place and mapping behaviour. Chapter three explains the adapted methodology and describes how the studied places were chosen and how the questionnaire and mapping exercises were designed and analysed. Chapter four shows the results from the empirical study and Chapter five discusses and concludes these. Appendix A contains illustrations of the statistical model assumptions and Appendix B includes an overview of the questionnaire.

2. Literature Review

This chapter provides an overview and discussion of the existing literature on place and mapping behaviour.

2.1 The Meaning of Place

As evident from the introduction and the multitude of existing theories, 'place' is a multifaceted concept, which allows for different interpretations. This section aspires to give an overview of the different views on the concept of place.

2.1.1 Definitions of Place

That the noun 'place' has numerous meanings and applications becomes irrefutable when consulting the dictionary. With more than twelve definitions and even more sub-definitions in English language dictionaries like the Oxford English Dictionary and Merriam-Webster (Oxford English Dictionary, n.d., Merriam-Webster, n.d.), 'place' has many applications in modern language and takes up a prominent spot in daily vocabulary (Mocnik & Westerholt, 2021). Not surprisingly, most definitions reference a specific spatial entity, even taking up the first spot in the three 'essential meanings of place' provided by Merriam-Webster (n.d.): (1) 'place: a specific area or region of the world: a particular city, country, etc.'. However, the other two essential meanings provide a different outlook on place, with (2) 'place: a building or area that is used for a particular purpose' and (3) 'place: a building, part of a building, or area that is used for shelter'. As will become clear in the next sections, these definitions broadly refer to the notion of place as a function and as a home, which are common views in literature on place. Even with just these three examples of definitions of place, it becomes unmistakable that place does not have a single definition but instead depends on the context of conversation what meaning is insinuated.

However, when writing academically about place, used concepts of place differ from the ones provided in the dictionary. Instead, additional terms are used, like relative or absolute 'location' and 'point of interest' (POI) to distinguish between different concepts. Still, the boundaries between these words are often vague and definitions partly overlap. In turn, it is not always clear what definition is adapted or implied by the author and how this influences the content. Cresswell (2014, 2008) finds problem in the unknowingness many have towards different connotations of place and argues for a more philosophical understanding, embracing, and acknowledging different understandings of place.

The geographical concept of place is complex, and the remainder of this section will provide a more detailed view on some of the facets of this concept. In general, academic writings interpret place as a subjective, relational and non-discrete concept, in contrast to a 'location with meaning' or specific POIs, which can often be indicated by a specific set of coordinates and consequently be pinpointed on a map. This does not mean that locations are stationary, but rather encompassed by clear boundaries (Cresswell, 2008). Additionally, Cresswell argues that a place is a location with a

past and meaning. Others also address the relational component of place, emphasising the active role people have in shaping place, namely 'place-making' and 'places as spaces of social relations' (Comber, Butler, Malleson & Schafran, 2018, p. 7). This underlines the active side of place, as human activity is at the foundation of creating place. This view is supported by Thrift (2008) who argues that space and place emerge from 'hard work' by groups of people that construct their surroundings. To synthesise, place is defined through the perspective of humans; humans give meaning to locations, turning them into places. Through active human behaviour—place-making—meaning is created and places are shaped. Place can be understood from human relationships with the environment, which carry on from the past into the present and future.

2.1.2 Relationships with Place

It can be argued that place is often understood from an individualistic perspective, even though its meaning impacts the lives of more than one person. This becomes clear from the arguments made by multiple authors, stating that for example an 'apartment', 'neighbourhood' or 'city' change meaning completely when adding a possessive pronoun like 'my', 'yours', or 'ours'. This addition changes our perception of the word and turns a generic word into one with meaning and applications for one's individual life—it creates a sense of place that only people included in the 'my', 'yours' or 'ours' can understand (Wood, 2018; Davies, 2018; Cresswell, 2014). In this sense, place is about the relationship individuals have with their world and goes beyond just the location of a generic apartment building or neighbourhood. The emotions connected to this relationship, however, can be both positive and negative (Wood, 2018; Comber et al., 2018).

These emotions are also closely related to arguments of place as home. As Cresswell (2014) argues, many people have strong feelings of attachment and familiarity to their home. However, the way in which 'home' can be portrayed as the ideal sense of place for people can be problematic, as the understanding of home is more complex than that. This becomes evident from the way in which Cresswell (2014) initially describes home, as a place where 'you can be yourself' and a 'field of care' (p. 39). This is not a perspective applicable to everyone and should not be neglected. For many (marginalised) groups of people, the place of home is a contested place in constant need of validation. Wood (2018) for example discusses a case study on Indigenous people in Canada, showing how they use mapping to convince other people of the worth of the space they consider a place of home. A different example is about the position of women in the home, which was (and in some cases still is) not necessarily a place of self-expression, as argued by feminist geographers (Blunt & Rose, 1994). Home, in this case, might still be a 'place', but not necessarily in the positive nature of 'care' and 'self-expression' as mentioned before. Whether this is because outsiders do not recognise a space as a place of home for specific groups, or because the home is not a positive place, which might cause people to think of other, less traditional, places as home.

Furthermore, place is not just personal but political as well, as argued in the critical geography discourse. This manifests itself through the process of 'place-making' (Cresswell, 2014), an active process in which people shape the space around them, resulting in places with which they have

meaningful connections. These place-making activities also have the power to shape the physical space of places. Therefore, people with more resources in a specific area might have more power to change and shape place itself too, thus affecting how people interpret that as place. An example could be how a group of people might come together to plant flowerbeds, thus changing the environment to their liking. This is reflected in the critical geography discourse, which emphasises the importance of critical social theory.

Anthropogenic Place

Many of the aforementioned arguments of place share a common perspective—an anthropogenic one. Most definitions of place share the notion that 'space becomes a place' when human meaning is established. Whether this is through highlighting the relational aspect of place (Comber et al., 2018; Wood, 2018); of human prescribed functions to place (Wood, 2018); as a social construct established through meaning and materiality (Cresswell, 2014); or as a sense of kinship with place (Comber et al., 2018). These views share the implicit notion that space only changes into place when humans interact with an area. To add to this view, the opposite of place may then be seen as complete wilderness, untouched by humans as theoretically, humans would have no connections with these spaces. It is important to notice that there are also researchers that disagree with this notion, arguing that there are human 'non-places' and areas of 'placelessness' (Augé, 1992; Relph, 1976). These concepts are further discussed in the next section. Seeing wilderness as opposing to human-made places, interesting questions can be raised, for example about the position of nature and animals in platial discussions. There are many borderlands where humans and wild animals and nature cross-over in each other's territory (Emel, Wilbert & Wolch, 2002), where are boundaries of 'human' places drawn? Subjects like these were addressed by animal geographers, who focus on the relationship between humans, animals and conceptions of place and space (Emel et al., 2002). Although Cresswell (2014) argues that animal geography is not often practiced anymore, in our globalising world that faces a climate catastrophe, these topics might be interesting again as true 'wild' spaces are becoming rarer in urbanising countries.

2.1.3 Changing Natures of Place

The End or Beginning of Place?

To add to the discussion of place in geographic discourse, there is also a body of work signalling and discussing the 'end of place'—that is, the world becoming a homogenous place without distinct places, typified by unique characteristics. This argument has been around for a while and originated as a reaction on increasing trends of globalisation (Castree, 2009; Dymnicka, 2010; Graham, 1998). This becomes evident from the following quote from Castell (1996), as referenced by Castree (2009, p. 153): 'The fundamental fact is that [...] places [...] become diluted and diffused in the [... new] logic of a space of flows'. In other words, territorial boundaries are becoming vaguer where interaction between regions increases, negating distinct characteristics of places in exchange for a homogenous personality; it is the 'end' of traditional geography. Examples of this can be found in

the theory about 'non-places', 'pseudo-places' and 'placelessness', as introduced by Relph (1976) and Augé (1992). These types of non-places are separate from their surroundings and have no distinct character. Due to globalisation, these types of places are often similar in nature, independent of where they are located and thus have no clear relationship with their environment. Relph (1976) argues that mobility specifically is an act of placelessness, as it does not develop place, but leads people away from a specific location and therefore do not form meaningful relationships to turn it into a rooted place. Other examples of non-places are hotels, fast food restaurants and shopping malls and airports (Relph, 1976; Cresswell, 2014, p. 77)

Interestingly, there are also indications of places of mobility that result in strong reactions of attachment and meaning. In 2007 for example, a local train station in Houten (the Netherlands), was saved from destruction by residents of the town, which lead to the entire building being lifted and being relocated to a location 150 meters away (Van der Linden, 2020). The building now has a new function, serving as a restaurant and meeting place. This shows that places of mobility might still have a history, created by people who share the local environment and thus create a place worth saving. It therefore seems that if a place of mobility is embedded in a larger environment of place, these mobility hubs can still impact the way the surrounding place is perceived by locals.

Nowadays, geographers more commonly argue against these views of 'the end of place', stating that place does not 'end' but merely changes identity. Accordingly, Castree (2009) synthesises that human geographers have changed their perspective on place and call for a discourse that recognises both differences and interdependencies of places: 'places are conceived as being unique rather than singular' (p. 169). It can thus be argued that place is not 'ending', but rather that a new conceptualisation of place is 'beginning'.

GIS and Place

Looking more specifically at how place is represented digitally in a GIS, there are some interesting arguments that suggest that a GIS is not necessarily all that compatible with social studies on place (Mocnik, 2022; Comber et al., 2018; Westerholt et al., 2020). Generally, a GIS is about quantifiable things in spatial form, i.e., measurable concepts with a specific location in space (Cresswell, 2014). This could thus somewhat be seen as the opposite of place, as place itself is not quantifiable, or connected to specific geographical coordinates (like POIs are for example). Comber et al. (2018, p. 9) reinforces this, as they argue that places with social meaning are often fuzzy and situational and not as specific as a pair of coordinates in a GIS. This makes it difficult for the concept of place to be operationalised in a GIS. The PLATIAL symposium series was formed as a reaction to this and aims to show data and research that are more than just visual representations of locational data (PLATIAL'X, n.d.). By involving social, cultural, behavioural, and cognitive aspects, a new GIScience paradigm is pursued. To achieve this however, effort should be placed in interdisciplinary research which stands at the core of PLATIAL proceedings (Westerholt, Mocnik & Comber, 2018; Mocnik & Westerholt, 2020; Mocnik & Westerholt, 2021; Westerholt, Mocnik & Zipf, 2018).

2.2 Relationships with Place: Place Attachment and Experience

Whereas the previous section focussed on defining the concept of place, this section aims to discuss the ways personal relationships with place can be defined, through concepts of place attachment and place experience.

2.2.1 Emotional Connections to Place: Place Attachment

There are various theories that discuss how people perceive and feel connected to places. These will be discussed below.

Research Field Development

'Place attachment' and 'sense of place' are just two examples of terms that discuss human connection to places, that is, what emotions are involved in these connections? This area of place research has been long-ongoing, as Lewicka (2011) shows by providing a thorough analysis of the field over the last 40 years, but still is as relevant as ever.

Often, increased place attachment is seen as something positive. Nevertheless, some studies point out the potential negative consequences of a high place attachment. This might entail that people have less mobility (which is either the cause or result of place attachment) and thus might not be able to move away from their place of residency in search for new life experiences, or to flee from potential (physical or social) harmful surroundings, like war (Lewicka, 2011).

Lewicka (2011) mentions the importance of research on diverse aspects and approaches to place attachment. For example, a distinction between three main components of place attachment can be made: people, place, and process (Scannell & Gifford, 2010; Lewicka, 2011). The 'people' perspective is frequently represented in research, focussing on understanding 'who' feels attached to places, but not necessarily what processes cause this attachment or what makes a place more likely to become attachable. Furthermore, another important distinction can be made between social and physical (environmental) attachment. Most research focusses on the social dimensions of place attachment, for example determined by residence length and neighbourhood ties. However, the environmental dimension is more underrepresented, i.e., how the physical environment might increase levels of attachment (for example through the presence of specific natural structures; Lewicka, 2011). In other words, there are many different dimensions to place attachment, all relating to who, why and how people form emotional connections to their environment and care should be given to making sure these are all explored.

Different Views on Place Attachment

One of the most influential typologies regarding place attachment has been introduced by Relph (1976), who argues in dichotomies of 'insidedness' vs. 'outsidedness' and 'place' vs. 'placelessness' (as briefly mentioned in Sections 2.1.2 and 2.1.3). This theory is characterised by a phenomenological approach, meaning it focusses on the individual human experience *with* and *of* place. In other words, it is about both the unique identity *of* a place and the human experience *with* a place. The latter scale

of insidedness and outsidedness is therefore adjustable to a specific individual, as a certain location can score differently on this scale depending on the person and their connection to the place. 'Insidedness' categorises place along 'the degree of attachment, involvement, and concern that a person or group has for a particular place' (Seamon & Sowers, 2008, p. 45). Whereas 'outsidedness' is defined by how 'people feel some sort of lived division or separation between themselves and the world' (Seamon & Sowers, 2008, p. 45). 'Existential insidedness' and 'existential outsidedness' both typify the ends of the spectrum, where the former raises feelings of 'deep, unself-conscious immersions in place' and the latter 'a sense of strangeness and alienation' (p. 45). From these definitions it becomes clear that human, emotional experiences have a substantial impact on how places are perceived. This theory of insidedness and outsidedness is therefore another way in which emotional connections to place (i.e., place attachment) can be analysed.

The scale of 'place' vs. 'placelessness' refers to the identity of a specific location and to what extent a place is authentic and unique (Relph, 1976; Seamon & Sowers, 2008). This relates to the end of place discussion, as Relph argues that areas of placelessness begin to dominate authentic places. These areas of placelessness are distinguished by their 'standardized landscapes' (Seamon & Sowers, 2008, p. 46).

Factors Determining Place Attachment

Now that the concept and definition of place attachment have been discussed, this paragraph addresses the factors determining place attachment.

In general, two distinct types of factors can be determined: dimensions and predictors of place attachment (Lewicka, 2011). The former provides information on the types and reasons of place attachment. The latter focusses on separate indicators that can influence place attachment indirectly. The latter are therefore studied through independent measurements, for which the respondent does not have to be conscious of the relationship between the predictor and place attachment (Lewicka, 2011). These indicators can be divided into multiple categories, from social to physical. The most important indicators for place attachment are summed up below, as mainly discussed by Lewicka (2011):

- *Socio-demographic predictors*: many socio-demographic indicators have been studied relating to place attachment, however with varying results. Depending on the study, factors like age, education and economic resources show both a negative and/or positive relationship with place attachment.

  A strong relationship with place attachment can be found in residence length, which shows increased positive attachment to both the place of residence and areas of recreation. Residence length also has an indirect influence on place attachment, as it may increase the number of social relationships an individual has, therefore contributing to place attachment (see social predictors). This positive trend seems to slow down after some years of residence, but due to its strong nature overall, residence length is sometimes considered as a sole parameter to measure place attachment (Lewicka, 2011). Other factors are that of

home ownership and mobility, which can increase place attachment. An example of mobility is the experience of 'homesickness', which can make an individual become aware of their attachment to a certain place. However, frequent moving might also limit the amount of attachment one might feel to a place, it is therefore closely related to residence length.

- *Social predictors*: the presence of 'community ties', together with residence length, is another dominant factor in establishing place attachment. As Mesch & Manor (1998) state: 'The higher the number of close friends and neighbors that are known and live nearby, the higher the attachment to the neighborhood' (p. 227).
- *Physical predictors*: as mentioned above, the physical dimension and factors relating to place attachment are hard to determine and not often included in place attachment research. Although these physical predictors are not fully operationalised, it appears that the presence of physical features like quiet, aesthetically pleasing areas and green areas positively influence place attachment. This relationship might also indirectly lead to more place attachment through the encouraging better social contacts, as for example green areas can operate as social meeting areas.

2.2.2 Place as Experience

Another perspective on place is by viewing place as an experience. There are multiple ways to interpret this viewpoint, some overlapping with the earlier interpretation of emotional place through place attachment. Viewing place from an experience perspective can take two directions that of active and passive experience.

Passive experience seems most represented in articles that talk about experience as things that happen to you, or as memories from the past, thus prior 'experiences' (Bonaiuto & Fornara, 2017). This perspective may overlap most with the perspective of place attachment, as meaning is mostly subtracted from those experiences by the emotions that they create—how people change opinion on place by means of these prior experiences. Tuan (2001) for example mentions experience as passive. He mostly talks of experiences in the past tense, as things someone has 'undergone' or 'suffered', being experienced is thus about having had things happen to you (Tuan, 2001 p. 9; Pearce, 2008). In addition, Scannell and Gifford (2010), argue that experiences in certain locations add meaning to certain places, so not only the (physical) characteristics of places are decisive. These all refer to experience as—often individual—memories, influencing space perception after experiences occur.

Opposing to this, the concept of experience can also be approached from an active perspective, meaning that experience is actively shaping place in the present through interactions of individuals. This notion is most famously represented by Seamon's work on place-ballet (Seamon, 1980), which states that place is actively formed by the way humans move their bodies through space and create certain patterns and routines specific to certain places. Before constructing the notion of place-ballet, Seamon builds on the concepts of 'body-ballet' and 'space-time routines'. Whereas body-ballet

focusses purely on 'a set of integrated behaviors which sustain a particular task or aim' (Seamon, 1980, p. 157) and focus mostly on the individual's body movement, separate from space. An example is doing the dishes, which is routine for many people that does not require much conscious thought. Space-time routines are then the 'habitual bodily behaviors which extends through a considerable portion of time' (p. 158), thus adding the concept of time, but leaving the geographical aspect rather generic. The theory of 'place-ballet' changes this, as it combines both prior concepts, and 'joins people, time and place in an organic whole and portrays place as a distinct and authentic entity' (Seamon, 1980, p. 163). By frequent human activity and thus 'experiencing' places, strong space-time routines and familiarity with places is created, which evolve into place-ballets. It is thus through activities—particular actions that create the sense of an active 'experience' of the surroundings that place is defined. Examples of places where this occurs is in areas with an active market or parks where people can go jogging or read on a bench (Seamon & Nordin, 1980; Van Eck & Pijpers, 2016). Place-ballets are therefore not solitary or individual happenings, but also adopt a holistic perspective on how people experience a place collectively and give opportunity for people to meet and form connections (Seamon, 1980).

2.3 Mapping Places and Mapping Behaviour

This section focusses on the cartographic aspect of places and aims to provide an overview of how places can be mapped and the mapping behaviour of individuals.

2.3.1 Mapping Places

After defining the concept of place in the previous sections, the question remains how these concepts can be represented cartographically. As previously established, the concept of place is rather fuzzy and non-discrete, making if difficult to translate the concept to maps. Traditional GIS methods are usually less suitable in portraying concepts that have no direct locational and measurable qualities, unlike most environmental phenomena (see Section 2.1.3). An example of this is provided by Mocnik and Fairbairn (2018) where they explain that text is better at communicating stories (and thereby places that are part of a story) than maps. To illustrate, they compare the function of a tourist guidebook to a map, where the guidebook using text is more likely to portray a feeling of place by describing 'experiences—physical, social, emotional and mental—which previous travellers encountered; it would give vivid and recognizable descriptions of the terrain and landscape in narrative form [...]' (Mocnik & Fairbairn, 2018, p. 36) than a standard map would, even though the descriptions are spatial in nature.

However, as Gerlach (2018) mentions, cartographic methods have gone through an evolution over the years, most notably shifting from purely analogue maps to digital renditions. Cartographic methods within digital mapmaking have also evolved. Maps like sketch maps and mental maps are increasingly popular, together with other art-leaning methods that focus on 'expression' (Gerlach, 2018).

Besides these cartographic methods, there are also cartographic movements that focus on mapping place that have gained attention or could do so in the future. Examples are the critical cartography movement (already briefly discussed in Section 1.1) and others, like feminist cartography and countermapping (Dolma, 2022; Perkins, 2018; Cidell, 2008). These movements focus on the effects that maps can have, as evident from the critical cartography movement which focusses on how maps hold power and cannot be value neutral. Therefore, maps can have (political) influence on (local) groups, while also highlighting that the lived experience of individuals can differ from what is actually portrayed on a map (Cidell, 2008).

But how to portray a place on a map? Wood (2018) argues that not much detail is needed to accurately portray a place and spark a sense of recognition in the map-user. As soon as a location is recognisable as having a personal function to the map-user, it can be successful in conveying a sense of place for the map-user. This does not necessarily need to be a full-detailed, elaborate map, but a distinction can be made between accidentally and deliberately portraying place. The latter specifically focusses on representing place as interpreted by an individual, for example through sketch maps. However, it is thus not necessary to deliberately portray a 'place' to also invoke a sense of place in the map interpreter. A map does not have to be created for a specific person to also depict some version of a place.

Other cartographic movements put more emphasis on cartography methods, instead of an emphasis on how maps should be interpreted. Nardi (2014) emphasises both the method and outcome of cartographic methods, with a focus on collaborative experiential mapping—where locals and researchers work together on map creation, with a focus on representing platial experience. By highlighting personal emotions and narratives through pictures and descriptions within the map, they want to create a sense of place and 'living heritage' in their maps. An example is shown in Figure 2.1, where the map includes pictures and text boxes alongside more traditional cartographic means to reflect the lived experience for that place, challenging the notion of 'dusty displays or inaccessible tomes' that can be associated with traditional descriptions of landscapes and local heritage (Nardi, 2014, p. 18). Thus, through both the collaboration between researchers and local inhabitants of the area the map showcases and the use of non-traditional cartographic means, the map aimed to provide a sense of place to the map interpreter.

Dolma (2022) researches similar cartographic methods, focussing on visualising the narratives of marginalised groups about place, comparing both traditional and more unconventional, feminist visualising techniques. Traditionally, experiences are most often conveyed through text separately

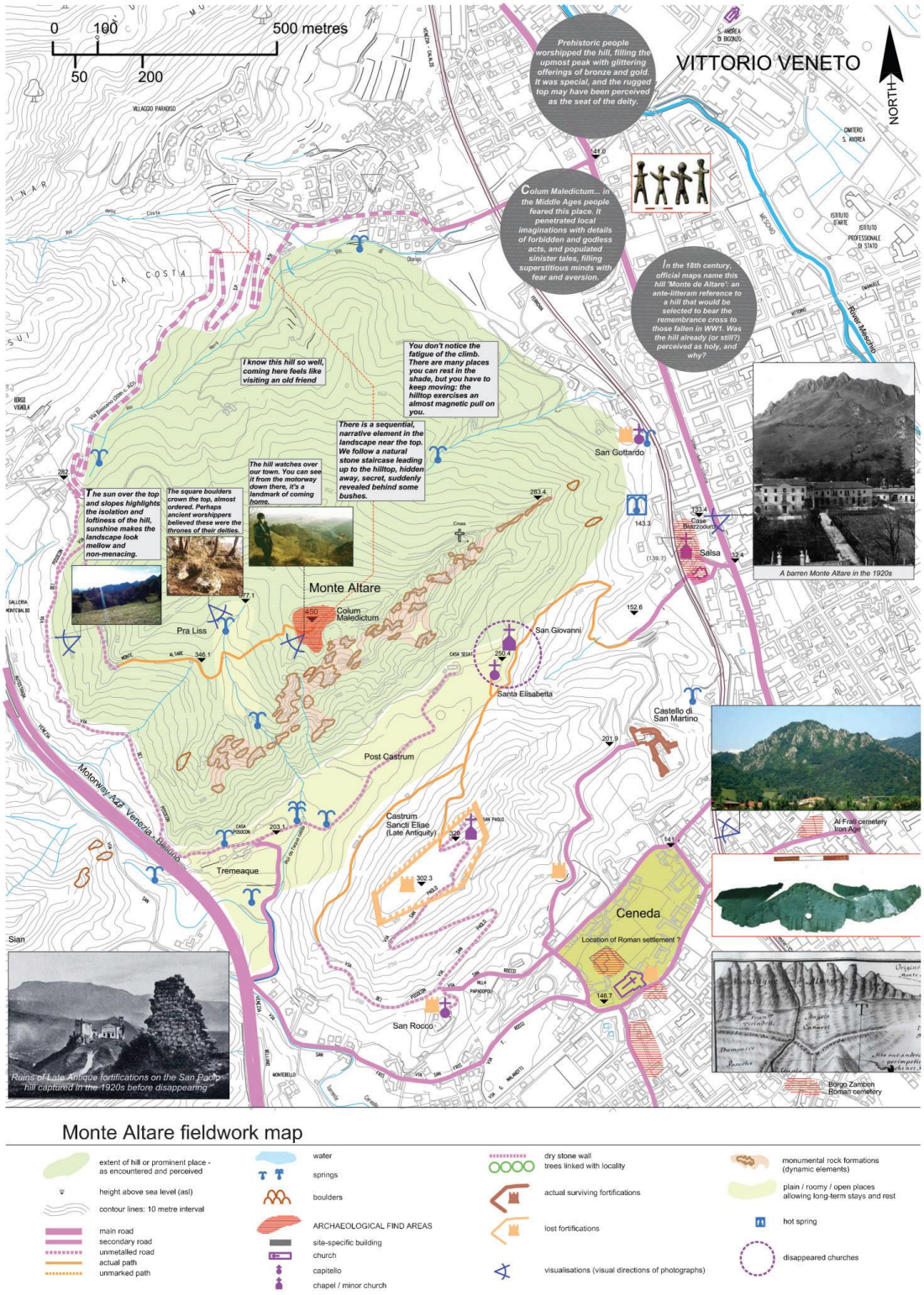
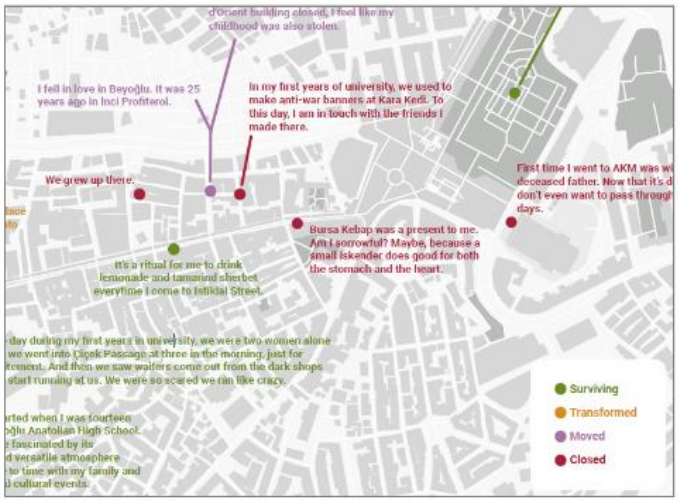


Figure 2.1 From Nardi (2014), 'The fieldwork map of Monte Altare: a communal effort' (p. 16)

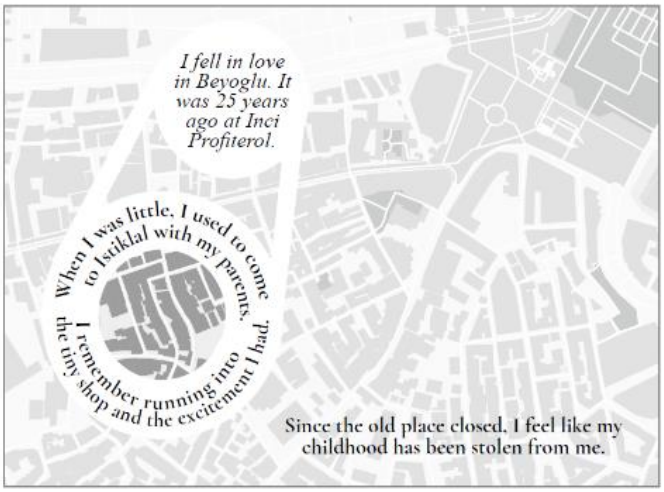
attached to the map and not by incorporating the spatial aspects of place experience through cartographic techniques. Especially aspects like ambiguity and emotion may be lost through traditional GIScience depictions. The feminist principles of cartography and data visualisation issued by D'Ignazio and Klein (2016) therefore try to counter this. They have constructed six principles that focus on visualisation, but are at its core always linked with data collection, use, etc. As adapted from D'Ignazio and Klein (2016, pp. 1–5) there are the following six rules:

1. *Rethink binaries*: adopt multiplicity in viewing concepts and data;
2. *Embrace pluralism*: embody subjectivity and the role of the researcher/map-maker;
3. *Examine power and aspire to empowerment*: the map-interpreter is an active agent in knowledge creation; accept the shared nature of knowledge between user and creator;
4. *Consider context*: situated knowledge and the lived experience can influence map creation and interpretation;
5. *Legitimise embodiment and affect*: consider what methods of data visualisation is most effective, for example to create an emotional bond with the map-interpreter;
6. *Make labour visible*: recognise everyone involved in the process to get to the final end-result, increasing validity.

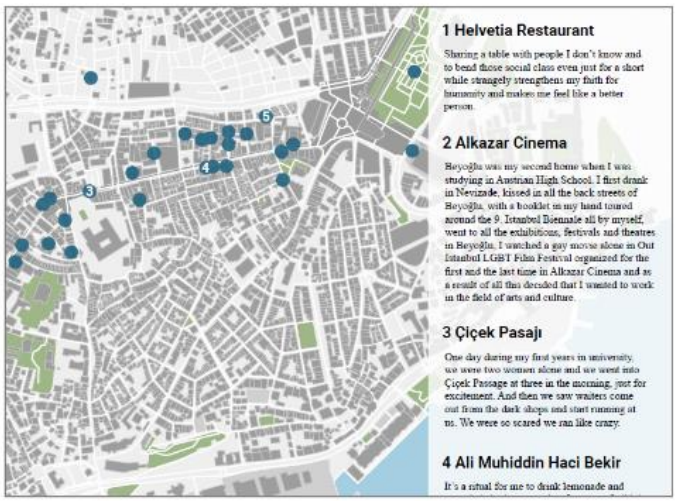
These principles do not suggest specific cartographic methods but focus more on the underlying assumptions related to data visualisation which in turn can benefit the visualisation of places. Dolma (2022) has compared maps portraying places using both cartographic methods aligning with these feminist principles and using more traditional methods. Examples can be found in Figure 2.2. The figures portray 'memory places' and aim to visualise specific memories people have had on particular locations. The figures on the left use the more traditional visualisation techniques and are deemed more 'objective' (Maps 2A and 3A) by participants, while the figures on the right apply the feminist principles of 'elevate emotion and affect' (Map 2B3) and 'challenge power and aspire to empowerment' (Map 3B). These are considered being better at portraying individual consequences for people and showing their perspectives (Maps 2B3 and 3B). By comparing these, Dolma (2022) concludes that while the unconventional maps may not always be the easiest to understand or the most aesthetically pleasing, they might be the best to portray the intended message. It therefore remains crucial to always consider the aim of the map before deciding upon certain mapping strategies.



(a) Map 2A



(d) Map 2B3



(a) Map 3A

(b) Map 3B

Figure 2.2 From Dolma (2021), 'Content of the memories and memory places' (pp. 38–39)

2.3.2 Mapping Behaviour

A distinction can be made between conscious mapping decisions and unconscious, cognitive processes that occur while handling geographic data. Deliberate decisions made by an expert user about which visualisation methods to employ are an example of the former, while the cognitive processes that lead to preference and unconscious choices are an example of the latter (Tommasi & Laeng, 2012). This section hence aims to differentiate between conscious and unconscious mapping interactions.

Mapping Behaviour: VGI

This section aims to provide an interview of how Volunteered Geographic Information (VGI) can contribute to insights in mapping behaviour. As a relatively new phenomenon within GIScience, the content and creators of VGI are widely studied. Even though this group of 'produsers' (referring to

individuals that both add to and use a service/product) is only a small percentage of people interacting with geographic content overall, the analysis of their behaviour can still provide interesting insights into why and how people produce geographic content.

Coleman, Georgiadou and Labonte (2009) provide a thorough analysis of the types of people involved in VGI. They categorise their experience profiles, the context in which they collect VGI and their personal reasons for contribution. The groups of people involved in VGI can be classified from 'neophyte' ('someone with no formal background in a subject, but possessing the interest, time, and willingness to offer an opinion on a subject'; p. 337) to 'expert authority' ('someone who has widely studied and long practiced a subject [...] and stands to lose [their] reputation and perhaps their livelihood if that credibility is lost even temporarily'; p. 338), with other levels in between, like 'interested' and 'expert' amateur (p. 338). Furthermore, the reasons for people to contribute may be myriad, varying from 'altruism' to 'intellectual stimulation', 'creativity' and 'pride of place' (Coleman et al., 2009, pp. 343–344), the latter indicates a sense of connection with the place of interest. In this way, a feeling of place attachment can be a direct reason to voluntarily contribute geographic information of said place.

Besides looking at the characteristics of involved creators in VGI, the way they produce content—their mapping behaviour—can be analysed, as is done by Bégin, Devillers and Roche (2013). They analyse the nature of VGI as presented in OpenStreetMap and argue that personal characteristics like interests and mapping methods are highly influential for the way data is mapped. Especially on platforms like OpenStreetMap this has a large impact, as just a small percentage of users generate most data (about 90 percent of data; Bégin et al., 2013, p. 150). This implies that the choices and preferences of people can directly impact the results on the platform. In their further research, it is shown that individuals are indeed impacted by their interests, 'feature type preferences' are defined 'as the inclination of a contributor to capture most instances of a specific feature type [...] before capturing features of lower priority [...] within the same mapping area' (Bégin et al., 2013, p. 150). In other words, people do not just map arbitrarily, but they often start with what they prefer and rely on spatial adjacency from there (Bégin et al., 2013).

It is also important to note that acts of 'mapping behaviour' do not necessarily have to consist of adding new geometry to a map. Especially on OpenStreetMap, contributions can also include edits to the ontology or taxology of the data. For example, contributors can add information about a certain location by adding tags to a place (even resulting in a 'folksonomy'), thereby adding personality to the map and possibly influencing interpretation of others for the mapped places (Mocnik, Zipf & Raifer, 2017).

Capineri (2016) further emphasises the personal nature of VGI, stating that participating in VGI generation can cause feelings of sense of place, as 'VGI contributors are engaged in knowledge production processes which are grounded in social structures and sets of values, and in turn, physical place' (p. 24). In other words, by interacting with certain locations through VGI, feelings of attachment can be enhanced, resulting in a stronger feeling of sense of place. Every transaction thus incorporates the lived experience of the VGI contributors.

Separate from VGI, Mocnik and Kühl (2022) addresses the way in which *mapping behaviour* vs. *what is mapped* is difficult to distinguish, as for example the semantic description and geometric boundaries provided to aspects on the map may very per individual's mapping behaviour, which in turn can influence the manner in which different individuals interpret these places on the map.

Map Interaction

In addition to focussing on how the content and creation of maps influences map interpretation, the used medium for portraying maps might also influence map interpretation. Poplin (2015) focusses on this by investigating the user-friendliness of digital, interactive maps. Nowadays, digital maps are widely used by almost all groups in society. This means that not just people with geographic or cartographic experience handle map content anymore. This highlights the importance of user-friendliness, because otherwise people might not gain the right information or come to wrong conclusions (Poplin, 2015; Ooms, De Maeyer & Fack, 2015). They conclude that within these interactive maps that are manipulable by the user, it is especially important to focus on interface design and cognition, as most usability problems relate to, among others, crowded interfaces, wrong or unclear colour usage, and for example difficult to use search features (Poplin, 2015). To make sure that the interactive maps reach their potential and individuals have the intended response to them, these aspects should be taken seriously and tested beforehand for their effect on the users. Elzakker and Ooms (2018) reinforce this argument, as they stress the importance of knowing the target audience and their characteristics, which would allow personalisation of mapping interfaces.

The Influence of Map Content

Besides the influence individuals have in shaping and visualising a map, the map content itself can also influence the map interpreter. Lewicka (2010) argues that the geographical shapes portrayed on a map influences the way individuals interpret that content. They provide an example of locations with more continuous versus discrete boundaries and shapes, enabling more identification and attachment in case of clearer shapes and boundaries. Lowrie et al. (2021) argues in a similar direction, but instead focusses on map production by stating that the shape of the environment itself can affect how people map cognitively, whether this is through physical characteristics, or cultural ones. These examples thus show that the characteristics of areas portrayed on a map can affect both map interpretation and creation and by result can impact the portrayal and experience of place on a map.

Furthermore, the daily lives experiences of individuals also translate to the maps they create, but also mainly to how they interpret maps already created. Cidell (2008) underline the difficulties in portraying the lived experiences of local individuals, but often use these experiences to address map content.

Spatial Perception through Spatial Cognition

How people perceive spatial information and replicate it through maps, is highly dependent on complicated, individual cognitive processes. However, as Griffin (2018) argues, there is an increasing amount of attention focussed on these processes. The discipline of cartography therefore shares interests and theories with (amongst others) psychology by centring the concepts of perception and cognition (Griffin, 2018). Despite the attention on these subjects from various disciplines, it is still not straightforward to capture these mental processes with accurate physical laws (Uttal, 2008). In his research on laws in physics versus psychology, Uttal (2008) calls for a better understanding on how environmental stimuli cause measurable reactions in individuals, thus making psychological processes more tangible.

Nevertheless, even though it is recognised that cognition plays an influential role in how spatial data and maps are perceived from person to person (Keskin, Ooms, Dogru & De Maeyer, 2018), there is only a limited understanding of how cognition works (Stedman, 2002). Stedman (2002) argues that due to the subjective nature of platial experience—thus creating a sense of place—it is difficult to find the 'source of cognition' (p. 577). Furthermore, spatial cognition is complex, as it exists in both the presence and absence of direct environmental impulses (Tommasi & Laeng, 2012). In general, this refers to 'how organisms compute where things are with respect to themselves, and vice versa' (p. 566) and 'computing where things are with respect to each other' (p. 566). An example by Tommasi and Laeng (2012) is the manner in which many people have mental images of a spatial nature while interpreting fictional worlds or thinking about past (real-life) events. To add to that, Tang, Falomir, Freska, Sheng & Lyu (2020) also reason that space is not approached quantitatively, 'preferring to prioritize what is visibly, semantically or emotionally significant for them' (Tang et al., 2020, p. 903).

Overall, it is apparent that spatial cognition is not easily explained. Keskin et al. (2018) have researched the cognitive processes present while participants work with (studying) digital maps. Alongside these results, they present an overview of the spatial cognitive processes present while working with geographic information. This theory is summarised in Figure 2.3 (Keskin et al., 2018). They approach the cognitive theories from several two-folded concepts, starting at the differentiation between 'control processes' and 'memorial processes'. These control processes mainly refer to how individuals pair their knowledge of previous, similar situations to the map at hand. Therefore, this concept is split-up into 'maplikeness', which refers to the extent to which the situation resembles a familiar/classic map. The other concept, 'expertise', acts on the presumption that professionals find it easier to work with or recollect spatial information than individuals without experience. The concept of 'memorial processes' focusses on the individual's manner in which spatial information in their cognitive map is stored and accessed during a spatial task. As illustrated in Figure 2.3, this concept is also split into two categories, namely 'primary knowledge'—referring to direct spatial observations—and 'secondary knowledge'—referring to both map features (e.g., colour) and structural information (e.g., geometry). These last concepts are also highlighted in Tommasi and Laeng's (2012) description of human cognition, in which they address the importance of landmarks—similar to primary knowledge—and of 'working memory', similar to the overall me-

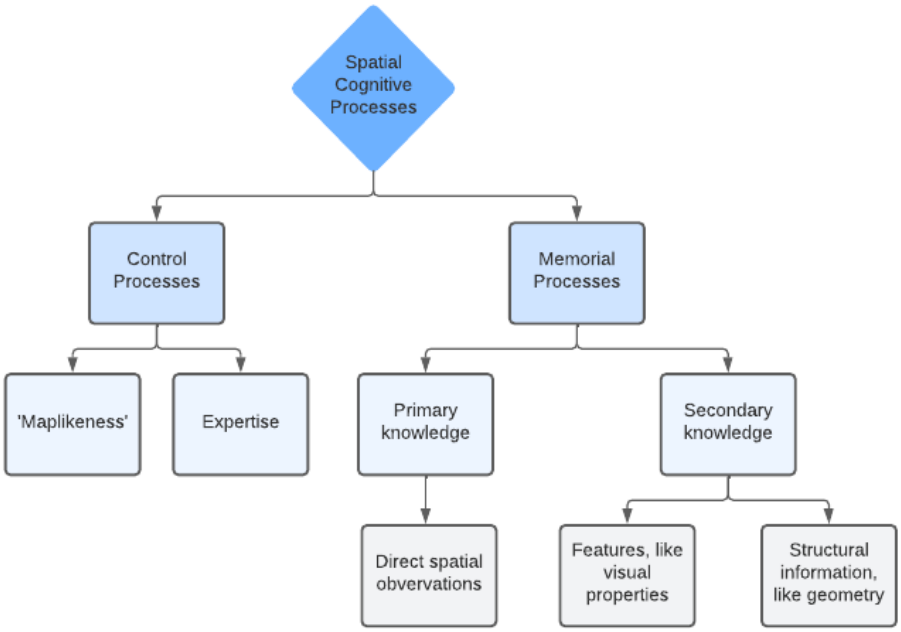


Figure 2.3 Summary of theory presented in Keskin et al. (2018; pp. 1–20)

morial process of processing aspects in the 'real-world' and 'virtual reality'. Together, this shapes how individuals process spatial information. As a person can score differently on each concept and this scoring itself can be difficult to make tangible due to other influences, it is no surprise that spatial cognitive processes are argued to be challenging.

Sketch Maps

A common method of revealing a person's spatial perception and cognitive map is through having them make 'sketch maps' or 'mental maps' in which people draw—either digitally or physically—a geographical area from memory. By drawing from memory, the way in which individuals perceive an area is represented. By analysing what people do or do not include, it can be derived what they find memorable and important in an area, resulting in conceptualisations of the places around them (Tang et al., 2020; Boschmann & Cubbon, 2013; Keskin et al., 2018). Tang et al. (2020) describe the way in which these sketch maps can reflect cognitive place perception; as the sketches 'are often simplified, rotated, and even omitted according to the person's perception' (p. 904).

There is some discussion on the usage of the terms sketch map, mental map and cognitive map, as these and similar concepts are often used interchangeably. Boschmann and Cubbon (2013) argues for a clear distinction between sketch maps and mental maps, where mental maps are mainly used as (geographical) decision making tools and sketch maps are specifically used for GIS research, thus being spatially referenced to research lived experiences (Boschmann & Cubbon, 2013). Although the results of both mental and sketch maps may be similar, the intention for each is different.

The method with which the sketch maps can be collected can also differ, from physical pen-and-paper methods to the collection of digital sketch maps. Many researchers use pen-and-paper

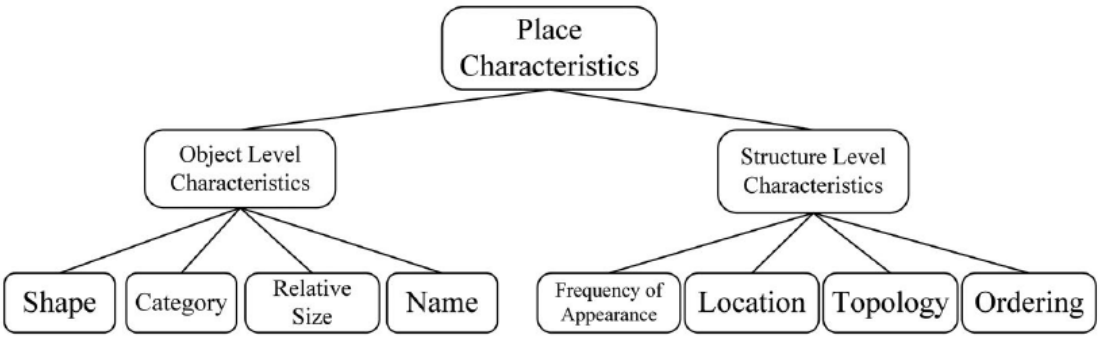


Figure 2.4 From Tang et al. (2020), 'Multi-level characteristics of a sketched place' (p. 908)

methods for collecting the sketch maps, but also call for increased attention for digital or internet-mapping methods (Boschmann & Cubbon, 2013; Ooms et al., 2015), as these results can vary greatly from on-paper methods. Both options can cause limitations or biases, and thus have their own (dis)advantages. For example, Ooms et al. (2015) mention the importance of taking into account screen resolution. Additionally, the ease of changing, for example shapes or colours digitally needs to be considered. This cannot only change the research outcome, but also influence the cognitive processes itself (Ooms et al., 2015).

The content of a sketch map can be analysed in different ways, for example trough measuring the variance in relative object placement, accuracy with the real world, colour usage, shapes, sizes or the order features are drawn in (Keskin et al., 2018; Tang et al., 2020). Figure 2.4 (extracted from Tang et al., 2020, p. 908) illustrates the characteristics of a classic sketch map that might be analysed (depending on the study design). The order in which features are drawn by a participant are often analysed digitally and thus provides an advantage for digitally drawn sketch maps. From research on the drawing order, it was evident that many people draw roads first, followed by landmarks (Ooms et al., 2015; Huyn & Doherty, 2007), of which it is presumed that the landmarks important to an individual are drawn first, as mentioned above in the section about VGI mapping behaviour.

2.3.3 Personal Demographic and Geographical Characteristics Influencing Mapping

Different spatial studies show that differences in mapping and interacting with maps exist between individuals with different personal characteristics, like age, gender and mapping experience. This section discusses these differences related to mapping behaviour.

Gender

Gender might be one of the most discussed personal characteristics. It has often been claimed that there are significant differences between how women and men handle spatial information (Lapon, Ooms, De Wit, Vanhaeren & De Maeyer, 2020). Multiple studies show this effect, like Coluccia, Iosue and Brandimonte (2007) and Lapon et al. (2020), with the exception of Keskin et al. (2018) who perceived no difference. Where Coluccia et al. (2007) ask the respondents to draw a sketch map of

an area, Lapon et al. (2020) focus on how accurately participants estimate country and continent sizes. However, both conclude a significant difference in how men and women navigate the spatial tasks. Lapon et al. (2020) conclude that men are better in accurately estimating area sizes. Coluccia et al. (2007) conclude similarly, stating that men were quicker in performing the task, but also focussed more on accurately placing roads in their sketch map, while women focussed more on landmarks. It therefore seems like men approach a map more holistically, while women tend to focus on specific areas with landmarks (Coluccia et al., 2007). Nevertheless, when both men and women had more time for the task, these differences became smaller. Overall, they concluded that men are not necessarily 'better' at spatial tasks, but rather adopt a more useful method, thus resulting in more efficiency and accurate results than women. This information is in turn useful when developing learning strategies (Coluccia et al., 2007).

Age

The effect of age on mapping is more contested, with some research finding a significant effect, while others do not. Lapon et al. (2020) state that the specific spatial tasks determine the extent to which age has an effect. For example, they mention that elderly are often slower and less accurate and thus score lower on certain tests (p. 551). Nevertheless, despite finding that the older participants often scored lower on cognitive map accuracy, no significant relation could be found on age. They explain that this might be caused instead by how people are educated, as the results on age varied by country (Lapon et al., 2020). It can thus be argued that age has no causal effect on map cognition, but rather other external factors, like education or surroundings. This latter example ties in with Lowrie et al.'s (2021) research, who found that children performed better at locating their homes on maps when they were used to walking to school. Besides this, no other significant age results could be found (p. 3).

Mapping Experience

The extent to which people are experienced with map-making or map-using could also influence their mapping behaviour, as found by Lapon et al. (2020) who state that users with a high map use frequency got better at accurately judging region sizes.

Keskin et al. (2018) and Ooms et al. (2015) have done extensive research on the topic of 'novices vs. experts' in the realm of cognitive mapping through sketch maps. In general, Keskin et al. (2018) found no significant disparities in sketch map accuracy, between experienced and unexperienced map users (Keskin et al., 2018). However, this does not mean that both groups interact in exactly the same manner regarding sketch maps. For example, Ooms et al. (2015) have concluded that there are differences in how efficiently the long-term memory is used to recollect spatial information together with applying deductive reasoning skills, which they found is easier for more experienced map users, as novices are not able to 'store this "extra information" ' (p. 18).

Additionally, Ooms et al. (2015) have analysed mapping behaviour of novices vs. experts via a 'thinking aloud' strategy, which encourages participants to share all their thoughts during the

mapping exercise. These words were recorded and analysed, which has shown clear differences in how the experts and novices approached and described the task. For example, novices tended to use more descriptive words for what they were doing, while experts had the extended vocabulary to use more specific words. This also goes for describing the location of objects on the map, which were described by their shape by novices, but called out by name by experts. Additionally, they found that the experts allotted more time on reviewing the result of their task, while novices needed more time to perform their task (Ooms et al., 2015, p. 12). Conclusions of Keskin et al. (2018) align, as they saw that in general experts took longer than novices to complete their task, which they coupled with the amount of detail present in the result (p. 9). These observations therefore not only show how more specific knowledge allows for better verbalisation of geographic tasks, but also shows how approaches to tasks might differ between varying levels of experience.

Overall, there may not be significant differences in how accurately individuals with varying levels of experience execute sketch maps (Keskin at al., 2018), how the actual task is processed, executed or described does vary. Experts are often more efficient and quicker in handling spatial data and have more tools to describe what they are doing.

Education

As Lowrie et al. (2021) presented, differences in geographical skills may be assigned to for example geographic education instead of strictly to age. In this way, it is thus expected for education to play a role in mapping behaviour. However, the concept of 'education' remains rather vague and undefined. Local, lived experiences may also influence the development of spatial skills, together with education (Lowrie et al., 2021). Moreover, the quality and content of 'education' is not the same for everyone. For example, in the Netherlands, not all high school children are obligated to take geography courses past a certain point in their studies.

Place of Residency

It was already mentioned before that actively walking through a neighbourhood (in other words 'experiencing the place') affects the ability of children to accurately locate places on a map (Lowrie et al., 2021). In a sense, this proximity to a place might thus influence an individual's spatial abilities. A similar conclusion is drawn by Boschmann and Cubbon (2013), who state that having increased 'urban mobility largely determines spatial decision making' (p. 240). Lapon et al. (2020) concur, having found that having a migration background (changed place of residency) positively impacts the accurateness of their global cognitive map, especially on the continental level. Presumably, it can be hypothesised that this is largely due to individuals becoming more familiar with other places and expanding and diversifying their cognitive images of places. This might thus also be applied to smaller-scale scenarios, where the time spent in proximity to a place can influence the spatial ability of mapping said place.

3. Methodology

This chapter discusses all the methodological decisions that were made during the study. First, the research design and methods are discussed, including a detailed description of how the questionnaire was designed. Then, the choices made during place and case study selection are explained, before going onto the ways data was sampled and analysed. The chapter ends with a discussion of reliability, validity and ethics in the research.

3.1 Research Design

A quantitative research approach was adopted, following an observational study type, as data was collected through a self-administered online questionnaire and mainly analysed through statistical tests. The questionnaire also included some qualitative questions, where participants could fill in an (optional) open-ended question through a textbox. These were analysed qualitatively, by coding and grouping the responses.

The study can also be qualified as a cross-sectional correlation case study, as it followed a repeated measures design 'since the difference that is analysed is that between two performances *within* each participant' (Coolican, 2019, p. 89), although in this case five performances were analysed for each participant. Participants were thus researched at a single point in time for data they contributed on five different places through a questionnaire that was filled out once. The questionnaire was the same for every participant, meaning that everyone was exposed to the same conditions (albeit in a randomised order). This resulted in a single, dependent sample. The focus was therefore on the possible differences within a participant's performance, hence the repeated measures design. The cross-sectional aspect of the study was represented through the comparative nature of the research, in which different sub-groups were compared and measured for a single point in time (Coolican, 2019).

3.2 Research Methods

This section discusses the applied methods in the study, namely that of a self-administered online questionnaire. The performed pre-study is also reviewed.

3.2.1 Questionnaire Design: Self-Administered Online Questionnaires

This section focusses on how the questionnaire was designed. The aim of the study was to research how people map places, based on their mapping behaviour, platial relationship characteristics (e.g., affinity and familiarity to specific places) and personal characteristics (e.g., age, gender, and education). To study this, a self-administered online questionnaire was used that consisted of questions and interactive mapping exercises.

The self-administered online questionnaire method was chosen instead of in-person experiments for multiple reasons: it helped minimising researcher bias in the study, together with allowing a greater range of respondents to fill in the questionnaire within the available resources of

this study (Bryman, 2016). Additionally, by using online questionnaires instead of on-paper methods, the precision of measured data is higher. For cartographic experiments, this meant that online mapping tools can measure aspects of geometry in more detail, unlike paper sketch maps or mental maps. Also, participants might already have been familiar with online (mapping) activities, for example through services like OpenStreetMap and/or Google Maps. This familiarity might have increased the precision through which they have communicated their visions on place and increased the number of high-quality responses. However, there are also some disadvantages to using online questionnaires that were considered. For example, it is not possible to adjust questions based on respondents' answers and the response rate for online questionnaires is generally much lower (Bryman, 2016). To account for this, open-ended questions were included, so that participants could include any type of additional information they would like to share. Although this is different from having an interview, it did leave more room for unexpected responses and background information. To help negate the low response rate, the questionnaire was tested excessively, to make sure that it was as clear as possible and had a fair length.

The questionnaire was ordered in blocks and included mapping experiments for five different places. Screenshots of the questionnaire can be viewed in Appendix B. The structure was as follows:

> Introduction → personal characteristics questions → explanation of the mapping exercise → [pictures of the place → questions about the place → mapping exercise] (repeated five times) → place for comments/feedback → optional lottery participation → conclusion of the questionnaire.

First, the introduction informed the participant about the contents of the questionnaire and asked for their informed consent about participation. Next, questions about personal characteristics were asked, like age, education and prior mapping experience. These were asked at the beginning, so that the data would also be collected for people that did not complete the entire questionnaire.

The mapping experiments were designed as followed; before the actual start of the mapping experiments, a page was shown that included explanations on how to conduct the exercises, accompanied by a video that showed an example of how to do this (of a place not included in the study as to not bias the participant; see Appendix B). On the actual first page of the mapping experiment, participants were introduced to the place by seeing the name and two pictures of it. On the next page, these were followed by questions about the place regarding their familiarity with it, personal ties, how often they have visited the place etc. On the last page of the experiment, they were asked to map the place in question. Satellite imagery was shown on an interactive map, where participants could trace the geometry of the place by placing nodes connected by straight lines. They were explicitly asked to trace the image to the extent of what they considered as being part of the place. The goal of the questionnaire was to allow people with and without mapping experience to

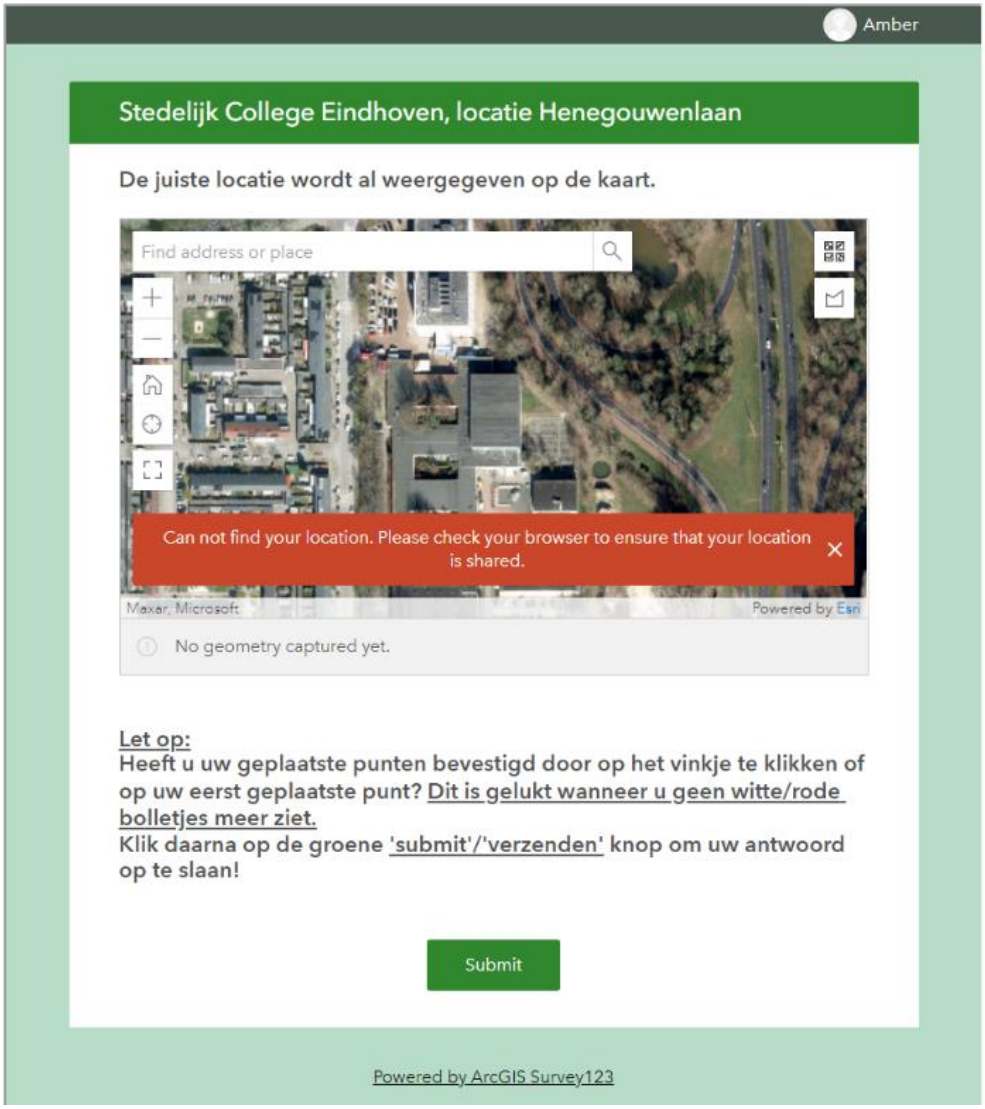


Figure 3.1 Example of a mapping exercise (SCE shown)

map the places they saw on the aerial imagery intuitively, while providing room to give addition context on their choices. An example of what the mapping exercise looked like can be seen in Figure 3.1.

The order of the mapping experiments was randomised, to account for bias from either boredom/fatigue or from practice (i.e., an order effect; Coolican, 2019). To illustrate, as people may have become tired and/or bored with the questionnaire, they may have become less precise in their answers the longer the questionnaire went on. It was therefore key to make the length of the questionnaire reasonable, which was tested during the pre-study. Simultaneously, an opposite effect may have been at play, where participants became more precise, as they gained experience with online mapping from the previous places they mapped in the questionnaire and thus possibly made less mistakes caused by the inability to work with the program. By randomising the order it is assumed that these effects have cancelled each other out and decreased bias.

The questionnaire was created using two online platforms: SoSciSurvey and ArcGIS's Survey123 (SoSciSurvey, n.d.; ESRI, n.d.a). SoSciSurvey was used to create the questionnaire itself (the body and

all questions), while Survey123 was used to create the mapping exercises for each place, as SoSciSurvey does not support these. The mapping exercises were created via separate Survey123 questionnaires that were then implemented in the SoSciSurvey questionnaire using an html embedded iframe.

3.2.2 Pre-study

Before data collection was started, a small pre-study was executed to test the questionnaire and mapping exercises, the findings and changes resulting from this pre-study are discussed next.

Several focus points were identified before the start of the pre-study, the length of the questionnaire had to be assessed, together with if the intention of the mapping exercises were clear and if the results were stored correctly, especially due to the embedded nature of the mapping exercises.

The pre-study was performed by seven participants, known to the researcher so their experience and feedback could be discussed in person. This resulted in some helpful observations and changes to the questionnaire. For one, it was agreed that the questionnaire was too long in length, which led to the decision to delete one of the originally six mapping experiments. Further, some explanations on the mapping exercises were not yet clear enough. The explanations were adjusted, for example, by providing a clearer hierarchy of importance of the mapping button explanation. It also became clear that the way in which the mapping exercise results have to be saved was quite specific (again, due to the embedded nature of the Survey123 form within the general SoSciSurvey questionnaire). Extra emphasis was thus placed on this process as well. Other implemented changes were about placing extra emphasis on the fact that the participants does not need to know of the place they are making the experiment of, and to the order of the questionnaire blocks, where one pre-study participant suggested to bring the personal background questions forward, so they would also be collected for people that did not finish the entire questionnaire.

3.3 Case Study and Research Location Selection

This section first discusses the choice for the type of studied places, before discussing the choice for the specific research locations of these places.

3.3.1 Place Selection

As the focus of the research is about how people map certain places with a sense of (personal) meaning attached to them, it was critical to carefully consider what type of places best serve this purpose. However, as the chosen mapping locations are not researched on themselves—rather the perception by participants of them—the chosen locations should be recognisable for all participants and create none, to few biases in the research sample based on the location alone. Therefore, it was first considered what type of biases could appear based on location selection and then a list of criteria was constructed that the chosen place and case study location should adhere to.

Two main types of platial familiarity were identified: thematic familiarity and locational familiarity. 'Thematic familiarity' is about the function of a place, unrelated to its geographic location. 'Locational familiarity' is about familiarity with geographical location, unrelated to the actual function of a place. Therefore, it was decided to negate the effect of thematic familiarity as much as possible by designing specific criteria that the places should obey. In particular, the places should:

- have a local character, encouraging feelings of attachment to the site nearest to you, while not being due to the thematic function of the location. However, the places should still have a semi-large service area, so respondents are easier to reach;
- have a strong sense of personal meaning attached to them;
- have a well-defined territory, preferably a detached building;
- not change location/shape too frequently, allowing the development of a strong local character;
- have enough independent instances spread over the city, that preferably create differentiation in feelings of familiarity.

Only one type of thematic location was researched in this study, namely secondary schools (also known as high schools, and as 'middelbare scholen' in Dutch). Secondary schools adhere to the above-mentioned criteria, because firstly schools have a local character, where it was estimated that people often only have a strong connection to the school(s) that they have personally attended and few others. This would limit the effect previously described as thematic familiarity bias. Especially because Eindhoven is a larger city, attachment to schools geographically further away was hypothesised to be smaller, which thus allowed the research to focus on locational familiarity.

Secondly, schools allow a strong sense of personal meaning, as almost every person has attended a secondary school in their life. Schools can be experienced by attending them, might evoke affinity due to either negative or positive associated emotions and can be familiar in recognising/knowing things about specific schools. They thus fit the framework used in this research. Moreover, as attending secondary school (up to a certain grade) is mandatory in the Netherlands, people with all sorts of diverse backgrounds and personal characteristics can be familiar with schools, without excluding a certain group.

Thirdly, schools often have a well-defined territory, with detached buildings, as opposed to for example restaurants or movie theatres that can share a building with other establishments. The detached buildings made the mapping exercises clearer and allowed for better analysis of mapped geometry.

Fourthly, the places should be stable, and not change too frequently, as this might impact the level of locational familiarity. Not all schools adhere to this requirement, so their history was investigated to determine how long they have been located at a certain location.

Lastly, there should be enough independent instances spread over the city. Ideally, this would allow diverse levels of familiarity by respondents in the same city and allow responses from people

with varying backgrounds. These separate places should remain similar in its function, which schools often are, even though the content and level of education might be different (e.g., 'vwo' vs. 'mavo').

There are a few possible drawbacks of using secondary schools as a research unit: there is the ability for them to have been relocated or demolished since people of a specific age group have attended that school. In case the school is relocated since a person went there, they likely experience no locational familiarity with the new location unless they are familiar with the location due to other reasons. This was taken into account while selecting the specific places. Next, another bias could be created towards younger people in the research, as it would be less long ago that they attended secondary school, possibly making (emotional) experiences more vivid in their recollection. Lastly, the possibility of thematic familiarity bias might appear when respondents with a particular affinity for (secondary) schools and/or education participate in the questionnaire. This was checked by an added question, which asked the participant whether they have worked or are currently employed by a secondary school.

3.3.2 City Selection

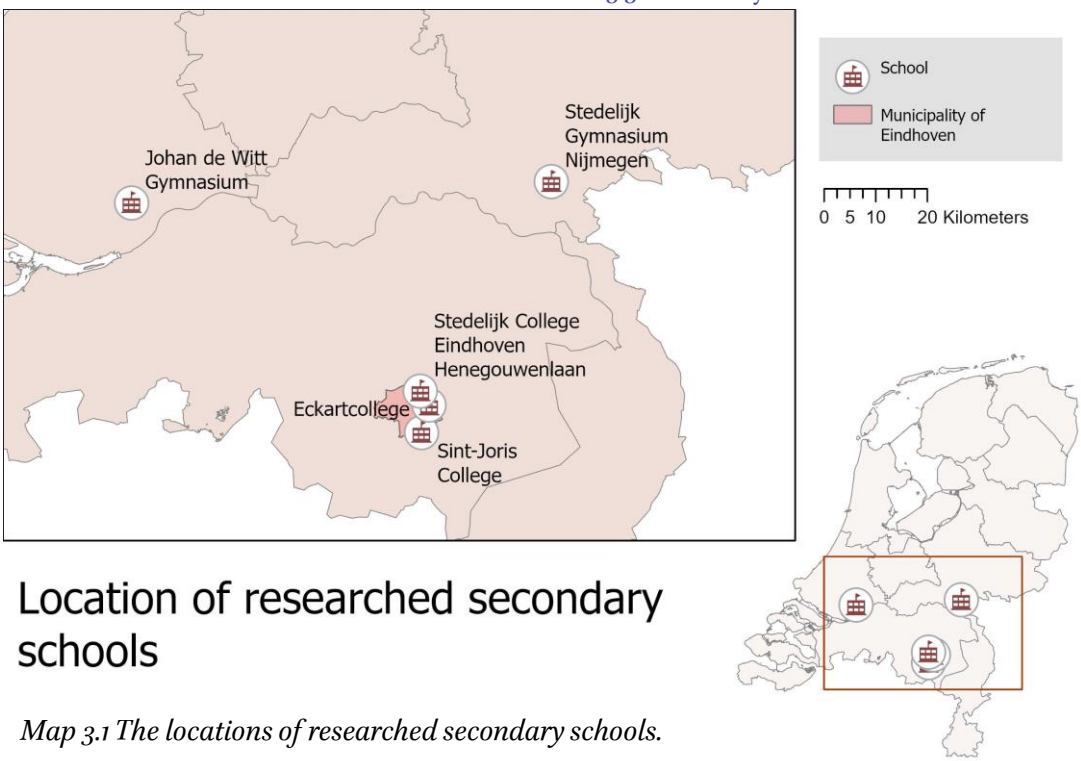
Due to the limitation of available resources, one city was selected as the prime focus of the research. This allowed more time for gathering a greater number of respondents, as opposed to having to gather sufficient respondents for multiple cities. The chosen city has to adhere to multiple criteria: (1) it has to be a larger city where variation of familiarity between locations is expected; (2) the city needs to have a diverse culture, consisting of people with varying backgrounds and personal characteristics; (3) the city needs to be compatible with the selected 'locations to be mapped', which should be manifold and in different locations spread over the city.

The city of Eindhoven is compatible with aforementioned criteria and was thus selected as the main research location. Eindhoven is the fifth largest city of the Netherlands, with a total population of over 234.000 in 2020. Also, Eindhoven is accessible to the researcher, making it possible to target enough respondents. This would become increasingly difficult if smaller villages or multiple cities would be included. Eindhoven is therefore also compatible with the available resources of this research.

Overall, Eindhoven has 28 secondary schools. The schools vary in size regarding the number of enrolled students, from 13 tot 1650 (Scholen op de kaart, n.d.). For selecting the schools to partake in the study, several characteristics were analysed and compared. Their number of enrolled students, founding year and if they have relocated in the past or have had their main building demolished. These are discussed in the next section.

3.3.3 School Selection

Within Eindhoven, initially four schools were selected to be included in the questionnaire. However, as mentioned in Section 3.2.2 about the pre-study, it quickly became clear that one of these schools



Map 3.1 The locations of researched secondary schools.

needed to be omitted from the research due to the length of the questionnaire. Which school was omitted will be discussed below. In selecting the schools to include in the study, precedence was given to larger schools that have not relocated and still have an older building—allowing people of varying ages to recognise the building and environment on the aerial imagery during the mapping exercise. The following schools were initially included:

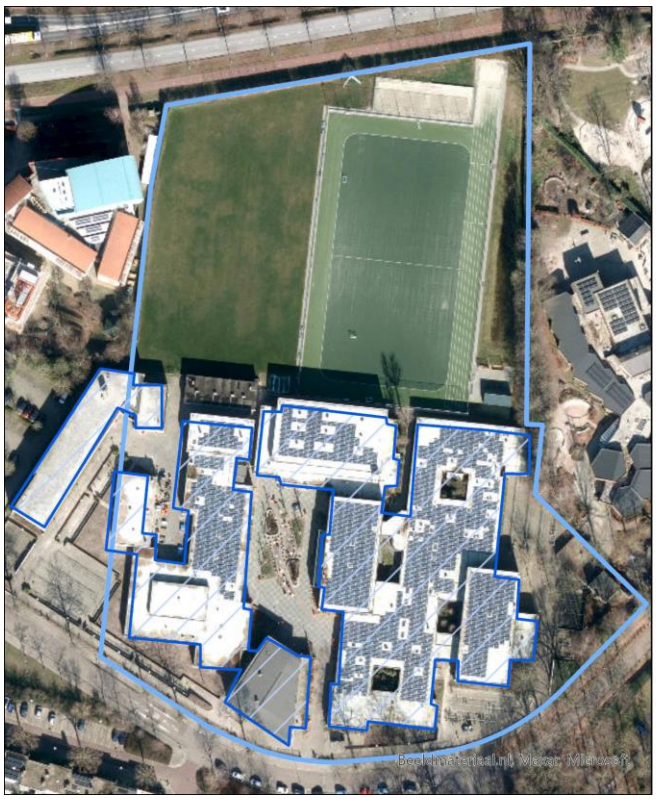
- Stedelijk College Eindhoven: Locatie Henegouwenlaan (Stedelijk College Eindhoven, n.d.)
- Eckartcollege (Eckartcollege, n.d.)
- Sint-Joris College (Sint-Joris College, n.d.)
- Lorentz Casimir Lyceum (Lorentz Casimir Lyceum, n.d.)

The school 'Lorentz Casimir Lyceum' was removed from the questionnaire after the pre-study, as it was the only school from these four that offered one educational level less than the others. The three chosen schools in Eindhoven are respectively the 2nd, 3rd and 4th largest schools in Eindhoven with between approximately 1360–1460 enrolled students (Scholen op de Kaart, n.d.) The largest secondary school in Eindhoven was not included, because it recently changed locations.

In addition to the selected schools in Eindhoven, two schools in different cities were also included in the questionnaire as a control measure, to ensure that some locations were fully unfamiliar to the participants. This allowed comparison based on places that are more and less familiar to the participant. It does not matter where these schools are located, but to ensure unfamiliarity they are drawn from two different cities in the Netherlands, not too close to Eindhoven. As it was not the goal to target people that have attended these schools, these schools did not have to adhere to the conditions mentioned above, except for the need for a clear aerial image. The following two schools were included:

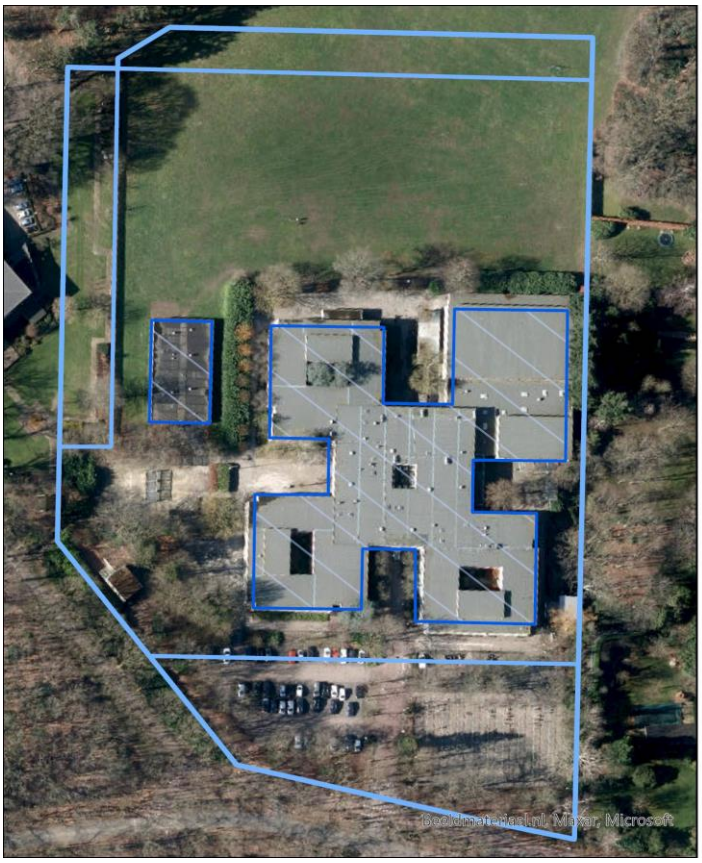
- Stedelijk Gymnasium Nijmegen (Nijmegen; Stedelijk Gymnasium Nijmegen, n.d.)
- Johan de Witt Gymnasium (Dordrecht; Johan de Witt Gymnasium, n.d.)

Map 3.2 Overview of Stedelijk College Eindhoven loc. Henegouwenlaan

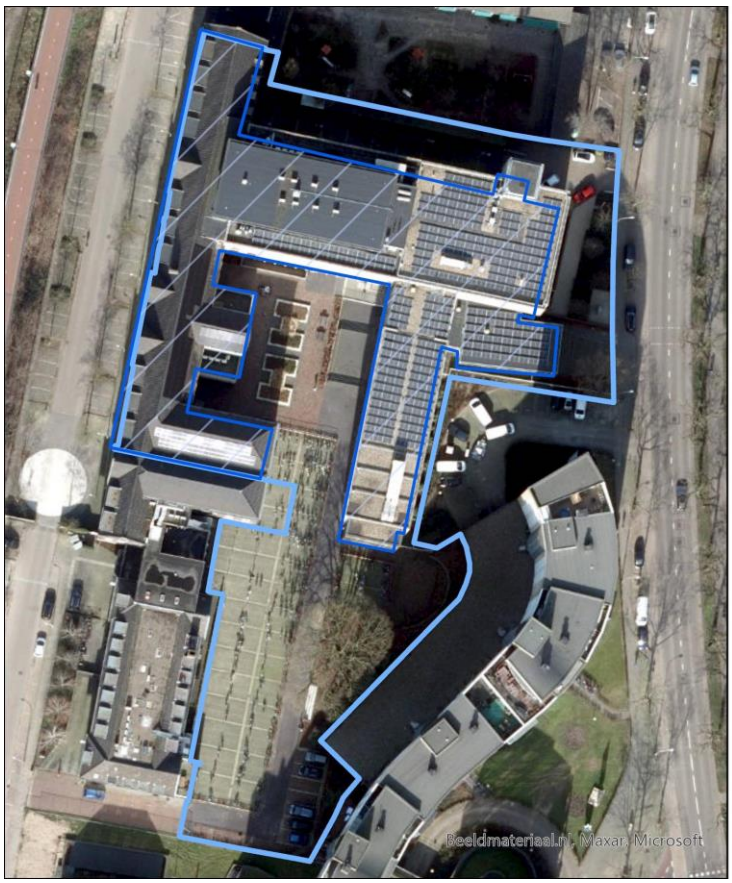


Map 3.3 Overview of Eckartcollege

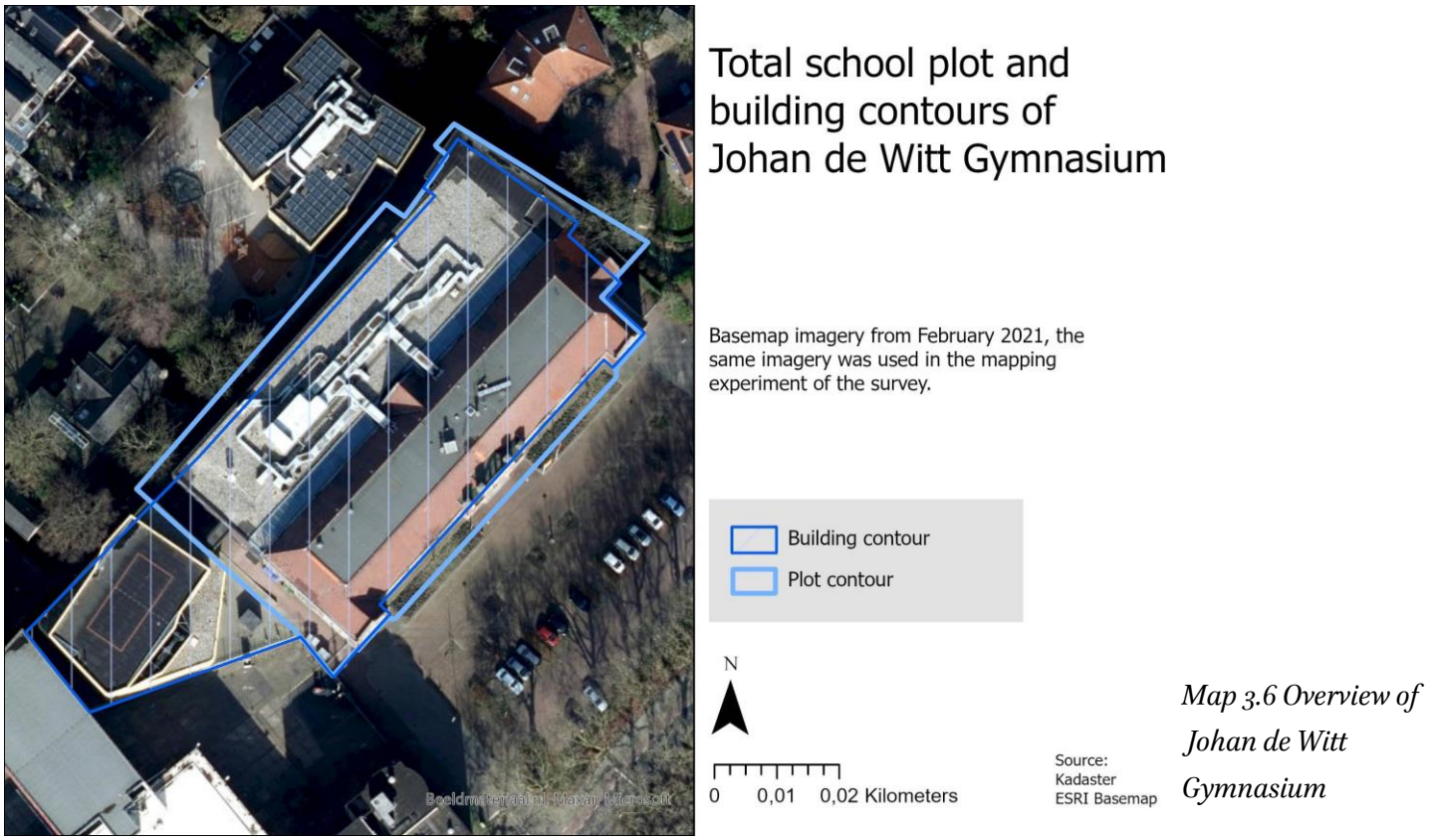
Map 3.2 to Map 3.6 show aerial imagery of the places included in the questionnaire. The maps use the same aerial imagery as the mapping exercises, albeit in a slightly different scale and rotation (in case of the Sint-Joris College). The maps also show the building contours and plot contours of the area that belongs to the secondary schools, as registered by Kadaster.



Map 3.4 Overview of Sint-Joris College.



Map 3.5 Overview of Stedelijk Gymnasium Nijmegen



Map 3.6 Overview of Johan de Witt Gymnasium

3.3.4 Target Population

The target population of the study was defined as people over 18 years-old that have attended (or are attending, if over 18 years-old) one of the three secondary schools in Eindhoven included in the questionnaire (i.e., Stedelijk College Eindhoven loc. Henegouwenlaan, Eckartcollege or Sint-Joris College). It did not matter if this was in the past and/or if the person has moved away from Eindhoven since then.

People were excluded from the research if they were under 18-years old, in that case they should not have approved the opening question in the questionnaire that asked if they agree to the terms and conditions of the questionnaire. Although there was a specific target population, the questionnaire did not automatically exclude participants that did not adhere to the conditions. Based on the questions asked, it was easy to filter out participants that did not belong to the target population during the data analysis.

3.4 Data Sampling

A true randomised sample of the target population was not possible, as an exhaustive list to draw the sample from was not available, which would have consisted of a database of (past) secondary school attendees. The study therefore applied multiple non-parametric sampling strategies, in combination with a version of random sampling based on geographic location.

The main sampling methods used were that of snowball sampling, convenience sampling and a systematic, clustered sample drawn from addresses in Eindhoven. These methods were not chosen

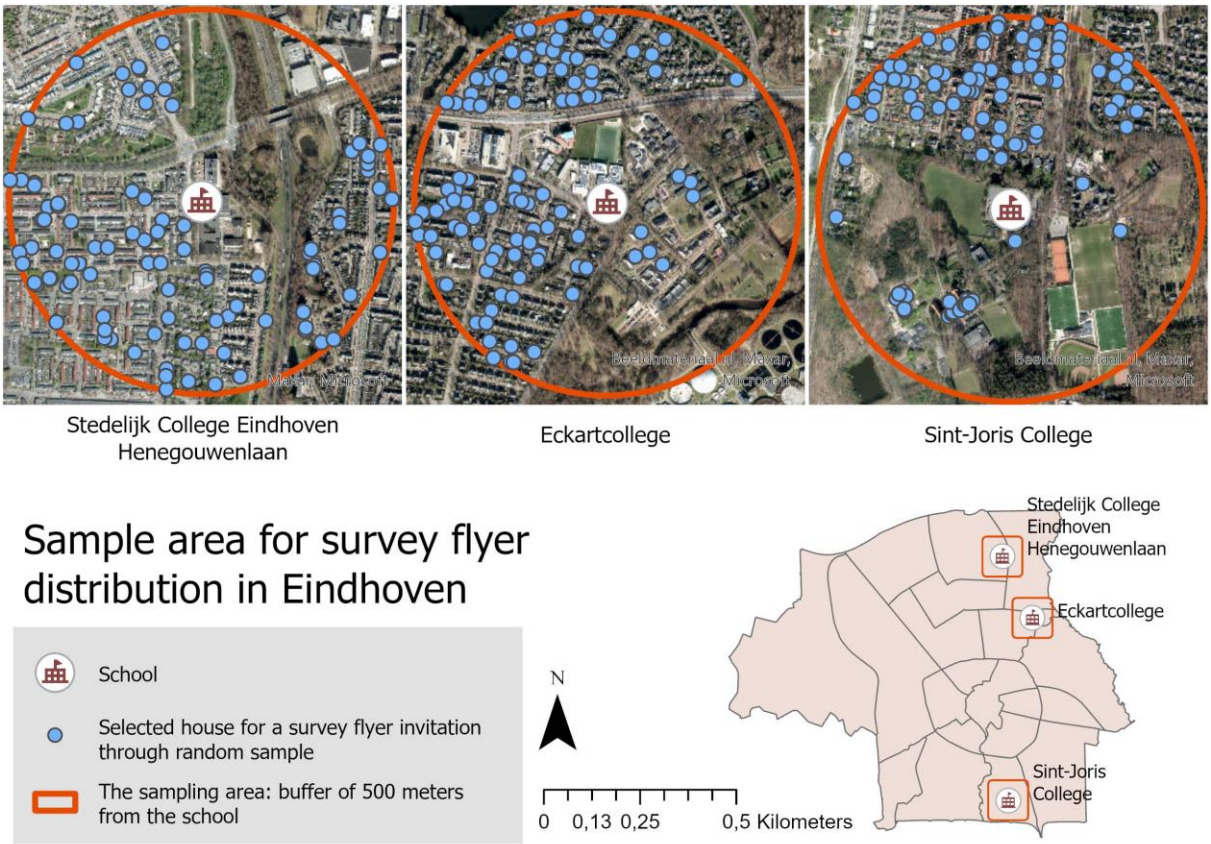
because the were easier or 'convenient', but rather because they best aligned with the subject and aim of the research, as well as with the available resources. Snowball sampling was applied by asking participants to share the questionnaire with acquaintances that they knew might have attended one of the included schools. The other applied method is that of convenience sampling. This method was chosen for its efficiency in approaching people that fall within the target population, as there were no other resources available to reach them. This method was executed in multiple ways. For instance, some people already known to the researcher to fall within the target population were approached directly. But mostly, people were targeted using (social) media. This was done in several ways:

- LinkedIn/Facebook: people that had one of the three participating secondary schools listed on their profile were messaged with basic information about the research and a link to the questionnaire, a general post on the timeline was shared (and reshared by mutuals) as well;
- Reddit: a message was posted on the r/Eindhoven forum with basic information about the research and a link to the questionnaire;
- WhatsApp: people were approached directly with information and a link to the questionnaire and the question to share that message with anyone they knew had attended one of the three participating schools;
- Yammer: the online yammer environment of the ASML company (located near Eindhoven) was used to share a message and link to the questionnaire as well.

Additionally, a form of randomised sampling was used to further diversify the data collection methods, through executing a clustered, systematic sample. The aim was to limit the biased nature of convenience sampling and to reach a sufficient number of respondents. Although this was based on a method of random sampling, the sample itself was not truly random as it will not be drawn from the exact target population.

The sample was drawn from a list of addresses in Eindhoven, which the researcher approached with flyers including information and an invitation to the questionnaire. The sample was drawn as followed:

- The BAG (official registration of buildings in the Netherlands) was used to select all buildings with a 'housing function' in Eindhoven.
- A radius around the three included schools of 500 meters was drawn and all houses within this radius were selected.
- A random number generator was used to draw the sample from the list of addresses (so that every nth house was selected for the sample).



Map 3.7 Overview of the sample area for flyer distribution. Data source: Kadaster.

After creating the sample, the houses were approached by the researcher on three Saturdays in January during the day and a flyer with information on the research and an invitation link with QR-code was delivered in their mailbox. The immediate vicinity of the three schools were chosen as the research location to narrow down the size of Eindhoven. But as the three schools have some distance between them, a larger area of Eindhoven was included. Map 3.7 shows the distribution of sampled addresses and where the flyers were thus distributed.

There were also some downsides to using this approach. For example, the addresses were selected in Eindhoven, although living in Eindhoven is no requirement for participating in the study. Having attended one of the three included schools in the questionnaire is, which is not related to living in a certain part of Eindhoven. The actual response rate of this method is therefore estimated to be low. Also, by including people that have returned or stayed in Eindhoven after attending secondary school in Eindhoven, a type of bias could be created in the results. This is however accepted, as this is not the only type of data collection, and it will be registered what responses have been collected this way. All links to the questionnaire carry an identifier in the URL, which makes it possible during data analysis to reflect on what data records came from what recruitment source. This allows for reflection on potential bias due to the recruitment source.

Payment for participation

A monetary incentive was offered for participation in the form of a Bol.com gift voucher that is randomly allocated to a questionnaire participant that opted-in for the lottery.

3.5 Data Analysis

This section goes over the studied variables and the type of data analyses applied. It ends with a list of hypotheses that were tested.

3.5.1 Measured Variables and Operationalisation

Figure 3.2 shows an overview of all measured variables in the research by means of a conceptual model of the research. Next, the individual variables are briefly shown, together with the way they were measured in the questionnaire. See appendix B or the next chapter for the full overview of the categorical answer options.

Mapping behaviour

- **Number of placed nodes**: calculated through 'Feature Vertices to Points' and then added together for every mapping exercise for each participant (ESRI, n.d.c.).
- **Mapped area in square meters**: automatically generated by Survey123.
- **Time in seconds**: the start and finish time of the mapping exercise is automatically generated by Survey123, these times are converted to seconds. Just the time from the start of the mapping exercise to the moment the exercise is submitted is considered.

Platial Relationship Characteristics

- **Number of visits to the place**: 'How often have you been in the area of [place]?', measured categorically. Based on theory presented by Lowrie et al. (2021), Lapon et al. (2020) and by Boschmann and Cubbon (2013) in Section 2.3.
- Familiarity, Affinity, Experience, Attachment, Social Relationships:

  'Indicate on the scales below to what extent you identify with the statements regarding…:'

  - **Familiarity**: I am familiar with this place; I recognise this place;
  - **Emotion**: This place evokes emotions in me (positive or negative);
  - **Experience**: I know how it feels to be in this place;
  - **Attachment**: I feel attached to this place;
  - **Relationships**: I have social relationships originating from/related to this place.

Measured on separate slider scales with (invisible) values from 1–100. Based on the theory presented in Section 2.2, including Lewicka (2008).

- **Description of the place**: 'With what words would you describe this place?' An open-ended question.
- **Description of personal relationship with the place**: 'How would you describe your relationship with the place?' An open-ended question.

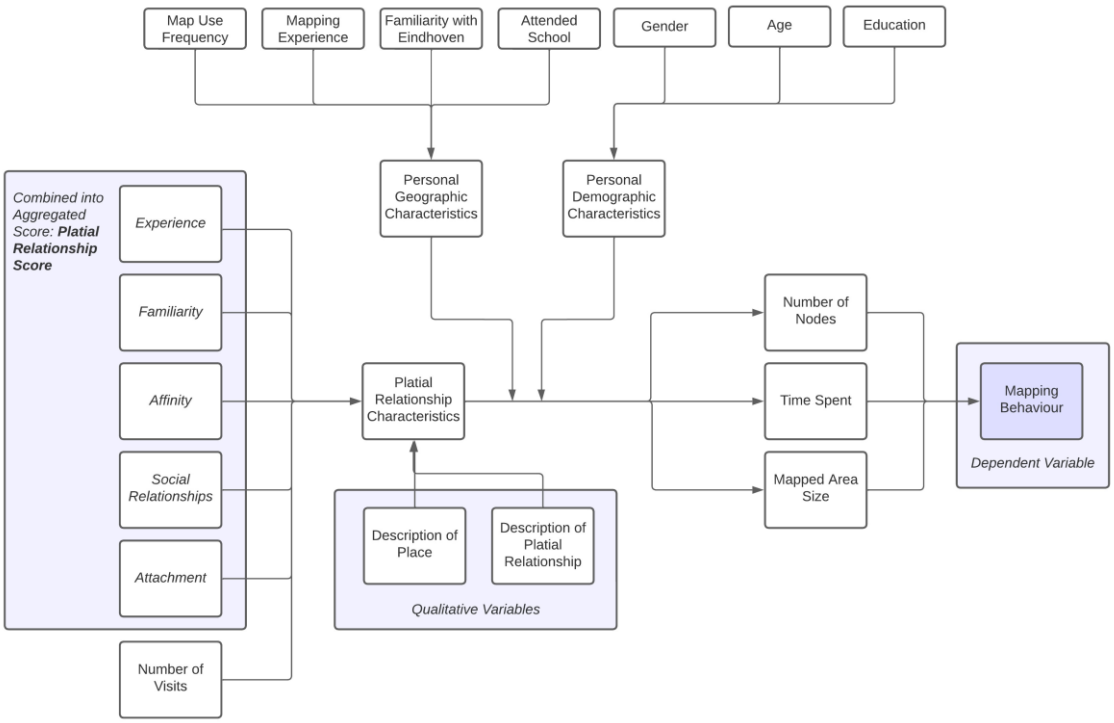


Figure 3.2 Overview of researched variables in conceptual model

Personal Demographic Characteristics

Several personal, demographic characteristics were measured, namely: **age, gender, and education** through categorical questions.

Personal Geographic Characteristics

- **Frequency of map use**: 'How often do you use maps?' Categorical question. Based on the theory of Lapon et al., 2020 from Section 2.3.
- **Experience with maps**: 'How much experience do you have with the use of maps?' Slider scale ranging from 1–100. Based on the theory of Lapon et al., 2020 from Section 2.3.
- **Familiarity with Eindhoven**: 'How familiar are you with Eindhoven?' Slider scale ranging from 1–100. Based on theory presented by Lowrie et al. (2021), Lapon et al. (2020) and by Boschmann and Cubbon (2013) in Section 2.3.
- **Attended secondary school**: categorical. Contains a list of secondary schools in Eindhoven, including a write-in option for 'other'. This variable is used to create two dummy coded variables:
  - **Mapping experiment in Eindhoven**: yes/no.
  - **Attended the school of the experiment**: yes/no.

Quality Control

- **Type of device used for questionnaire**: categorical question.
- **Employment at a secondary school**: categorical question with write-in option to specify the location of the school if outside Eindhoven.

3.5.2 Data Analysis

All data analysed in the research is collected through the online questionnaire, the data from the pre-study is not included in this. In the next sections, the used statistical analyses are discussed, together with the applied qualitative analysis strategies.

Data preparation

Before data analysis began, the data was checked on quality. This meant checked the data for duplicate mapping exercise entries by the same participant and to screen for obvious faulty mapping entries. More on the specifics of this can be read in Section 4.1. Descriptive statistics were run for all variables, including the two variables that were added for quality control: device used and (previous) employment at a secondary school. The pre-registration mentioned that the participants that worked on a secondary school had to be filtered out. However, due to the limited response, this was not viable. Therefore, it was analysed whether this group differed from the others and included in the further analyses. The same went for device used.

Statistical analysis

All statistical procedures were performed using R and R Studio (R Core Team, 2021; RStudio Team, 2021), all used packages are referenced in the bibliography.

The variables under the 'Platial Relationship Characteristics' concept were first analysed using an Exploratory Factor Analysis (EFA). It is important to note that this differs from the approach mentioned in the pre-registration, as there it was stated that a Confirmatory Factor Analysis (CFA) would be used. However, it was decided to use an EFA instead, as this is used when a specific question scale has not yet been tested. As this was not the case for the variables under PRC, an EFA was better suited. The purpose of the EFA is to assess whether the included statements that measure the Platial Relationship Characteristics correlate and can be combined into an aggregated score, the Platial Relationship Score (PRS).

The other main type of statistical test used is the 'mixed linear effect model', also simply known as 'mixed model' analysis. This type of statistical test is suitable for data with a repeated measures design and thus a dependent sample, which was the case for this study. By defining a cluster variable in the model, the test compensates for the non-independent nature of the data. Another benefit of this type of statistical test is the possibility of adding predictors to the models, similar to regression models.

First, a baseline model was defined for each of the three dependent variables for Mapping Behaviour (Number of Nodes, Mapped Area and Time Spent). This meant no predictors were added into the model. Then, all variables were tested separately as a predictor in pairs with the Mapping Behaviour variables. Using model comparison functions these models are then compared against the baseline to further look at their impact on the dependent variables. After these single model analyses, multiple predictors are added at once, to further analyse the relationship between combinations of predictors with mapping behaviour.

Qualitative analysis

There were two types of qualitative data analysis performed. The first looked at the visual ways participants had mapped the geometry of the places. Although their mapping behaviour has also been analysed statistically, it was interesting to also include visual representations of what specific areas they included in their mappings and if there were any obvious differences based on the comparison of past attendees and non-attendees of the places. Using ArcGIS Pro (ESRI, n.d.b), these geometries were visualised in maps of each place and then discussed in Section 4.5.

The second type of qualitative analysis is applied to the answers to the open-ended questions that were present in the questionnaire. The answers were coded and grouped based on themes and categories that could be identified from the words used.

3.5.3 Hypotheses

Table 3.2 below provides an overview of the variable relationships that were tested, together with the associated hypotheses.

Table 3.2 Overview of the tested variable pairs and hypotheses

RESEARCH HYPOTHESES OVERVIEW

Hypothesis	Interpretation	Statistical Measure
Platial Relationship Characteristics		
*H*1	The variables 'familiarity', 'affinity', 'experience', 'attachment' and 'social relationships' can be combined into one aggregated index score, to help portray the latent variable 'Platial Relationship Score'.	Exploratory Factor Analysis
*H*2	A relationship exists between the PRS for each location and the total Number of used Nodes/Mapped Area Size/Time Spent per location's mapping exercise.	Mixed Linear Model
*H*3	A relationship exists between the Number of Visits to each location and the total Number of used Nodes/Mapped Area Size/Time Spent per location's mapping exercise.	Mixed Linear Model
Personal Demographic Characteristics		
*H*4	A relationship exists between the respondent's age and the total Number of used Nodes/Mapped Area Size/Time Spent per location's mapping exercise.	Mixed Linear Model
*H*5	No relationship exists between the gender of respondents and the total Number of used Nodes/Mapped Area Size/Time Spent per location's mapping exercise.	Mixed Linear Model
*H*6	A relationship exists between the level of completed education and the total Number of used Nodes/Mapped Area Size/Time Spent used per location's mapping exercise.	Mixed Linear Model
Personal Geographic Characteristics		
*H*7	A relationship exists between the level of Familiarity with Eindhoven and the total Number of used Nodes/Mapped Area Size/Time Spent per location's mapping exercise in Eindhoven; this relationship does not exist for the locations not in Eindhoven.	Mixed Linear Model

Table 3.2 (cont.) Overview of the tested variable pairs and hypotheses

Hypothesis	Interpretation	Statistical Measure
Personal Geographic Characteristics		
*H*8	If a respondent has attended the high school that they are performing the mapping exercise of, the total Number of used Nodes/Mapped Area Size/Time Spent for this location differs from respondents that have not attended the high school in this mapping exercise.	Mixed Linear Model
*H*9	A relationship exists between the level of experience with mapping and the total Number of used Nodes/Mapped Area Size/Time Spent per mapping exercise.	Mixed Linear Model
*H*10	A relationship exists between the frequency of map use and the total Number of used Nodes/Mapped Area Size/Time Spent per mapping exercise.	Mixed Linear Model
Quality Control		
*H*11	A relationship exists between the type of device used and the total Number of used Nodes/Mapped Area Size/Time Spent per mapping exercise.	Descriptive Statistics
*H*12	A relationship exists between the participants that are or were employed at a secondary school and the total Number of used Nodes/Mapped Area Size/Time Spent per mapping exercise.	Descriptive Statistics

3.6 Reliability and Validity

The following sections discuss the reliability and validity of the research, and the measures taken to improve these. Also, the role of the researcher is discussed, together with the pre-registration that was submitted.

3.6.1 Reliability

The reliability of the research can be defined as the consistency of measures and results (Bryman, 2016; Middleton, 2019; Scheepers, Tobi & Boeije, 2016). There are several ways to assess and improve the reliability of research, which will be discussed below.

In short, reliability is about the reproducibility and consistency of research. The 'test-retest' method is therefore often applied to assess the reliability of research, meaning that every time the research methods could be repeated, similar conclusions should appear. Thus, the applied research steps were documented as transparently as possible, making it possible for others to reproduce the research in the future if wanted.

Additionally, by keeping the conditions in which the empirical data was gathered as similar as possible between different moments of data gathering, chances of inconsistencies were eliminated as much as possible. Also, by making the questionnaire as clear as possible—by testing the questionnaire in the pre-study—this was hopefully acquired. It should however be noted that the nature of online questionnaires often makes it difficult to have full control over the conditions in which individuals take part in the research. It is impossible to know whether they were helped by others, or for example used the internet to look up additional information.

3.6.2 Validity

Validity is determined by the extent to which the results measure what they are intended to measure (Bryman, 2016; Scheepers et al., 2016). To make the research more valid, it is important to base it on existing research, which was done by first executing a literature review and basing the content of the questionnaire on the researched constructs discussed there. Additionally, it was aimed to improve the internal validity by adapting a single blind study approach, where participants were not aware of the conditions on which they were being assessed. The main theme of the research was shared with the participant (experiencing places), but the hypotheses and researched variables (mapping behaviour/personal platial characteristics) were not mentioned until the end of the questionnaire. A double-blind study was not applicable, because the researcher was aware of all conditions the participants were exposed to, or to what category the participants belong during data analysis. The concept of generalisability is further discussed in the discussion and conclusion.

3.6.3 Role of the Researcher

Lastly, it is important to be aware of the role of the researcher, as their lived experience influences how they view and interpret the world, which in turn might influence how they conduct and interpret research (Rose, 1997). To verify the integrity of the research and the position of the researcher, before the empirical research was conducted, the drafted study design (including hypotheses and planned analyses), was uploaded to the Open Science Framework's database of registered research by ways of a pre-registration. This pre-registration ensures that any changes from the at beforehand planned research are detectable, thus ensuring the quality of research. The pre-registration can be accessed at: osf.io/kd7fz (van de Kerkhof, 2022).

3.7 Ethics

To ensure the well-being of the research participant and the quality of the research, the four requirements for an ethical study as defined by Bryman (2012, p. 135) were followed. These are applied as follows:

1. *The research should harm no participants*. There were no indications for harmful reactions to the research upfront. However, as the questionnaire asked personal questions about emotional experiences this could trigger certain (negative) memories or emotions within the participant. This could be considered unwanted by the participant. Therefore, it was clearly stated that the participant can quit at any time and the end of the questionnaire contains a guide to local general practitioners, in case the participant wants help with their well-being.
2. *There should always be informed consent*. Participants were explicitly asked whether they agree to participate in the study. The questionnaire also started with information on how to stop and delete the participants records as well as general expectations about the content of the questionnaire.
3. *Privacy should not be invaded*. The guidelines of the General Data Protection Regulation (GDPR) were followed (Autoriteit Persoonsgegevens, n.d.). Participants were informed on

data handling before participation. In general, no personal information was collected during the researcher. An exception was the optional collection of email addresses if the participant wanted to take part in the lottery. These email addresses were in turn stored in a separate database (a function of SoSciSurvey), so they could in no way be linked to specific questionnaire responses and easily deleted after the draw of the winner.

4. *There should be no deception.* To prevent (accidental) feelings of deception, the questionnaire was designed to be as transparent as possible. Information about the length, privacy regulations and objectives etc. were shared. Furthermore, contact with the researcher was encouraged by including contact information on every page of the questionnaire.

To further ensure all above points are met, the ITC Ethics questionnaire was also submitted and approved before data collection started. Changed made to the questionnaire based on this process was for example that ages were asked in a range, instead of as a numerical value, that the optional nature of open-ended questions was emphasised and that information about well-begin and help was added to the end of the questionnaire.

4. Results

This chapter is divided into five sections. First, the recruitment process and outlier handling are discussed. Second, the demographic characteristics of the participants are shown. Third, the descriptive statistics of the remaining variables are described. Fourth, the linear mixed model analysis is shown and last, the results of the qualitative analysis are presented. Please note that page ix includes a list of abbreviations and a Note on the Language that explains the (structure of) abbreviations used in the results chapter. All used R packages are references in the bibliography.

4.1 Recruitment Process and Outlier Handling

4.1.1 Recruitment Process

Online data collection was executed from 22nd November 2022 until 9th February 2023, where three additional Saturdays in January were spent distributing flyers during the afternoon. The results of different recruitment methods can be seen in the flowchart in Figure 4.1. During this time, 1209 people were directly contacted, either through flyers at home or by sending direct messages on social media. Other methods of distributing the questionnaire were also applied, but the reach of these could not be quantified. From the approached people, 224 answered the first question in SoSciSurvey (i.e., agreed to the terms and conditions). From these, 184 (82,1%) were part of target population.

For the distribution of flyers, 100 were distributed in each school's vicinity, as described in Section 3.4. The other 90 were randomly distributed to houses elsewhere in Eindhoven. From the 390 distributed flyers, approximately 20 were used to fill in the first question of the questionnaire (5,13% of total distributed flyers). Only 11 of these have also successfully completed at least one mapping exercise (2,82%). It is impossible to know the exact number of respondents recruited through the flyers, as they did not contain a reference in the URL to keep the URL easy to copy.

Sending direct messages to individuals who have attended one of the three schools in Eindhoven via LinkedIn proved most beneficial, as 21,47% of sent messages resulted in the first question of the questionnaire being answered. For Facebook individual messages, this was 9,38%. It was not possible to calculate these results for the other recruitment methods applied, as it is unknown how many people have seen these messages. In the end, there were 80 respondents who answered the mapping questions in SoSciSurvey and also successfully completed one or more of the mapping exercises. 72 of these belong to the target population and could be included in data analysis. The distribution of how they were recruited can be viewed in Table 4.1.

Attrition was mainly caused by the limitations of the online platforms used to reach respondents (Facebook and LinkedIn). An unforeseen problem was that both websites got blocked when too many messages were sent. Facebook and LinkedIn both had a temporary ban of a day after sending approximately 50 messages on Facebook and 80 on LinkedIn, while LinkedIn also warned of a permanent ban if messages kept being sent. This occurred after sending approximately 550 messages and indicated the end of data collection through LinkedIn, which also explains the skew in distributed messages to people who attended Stedelijk College Eindhoven (23,6%), Sint-Joris Col-

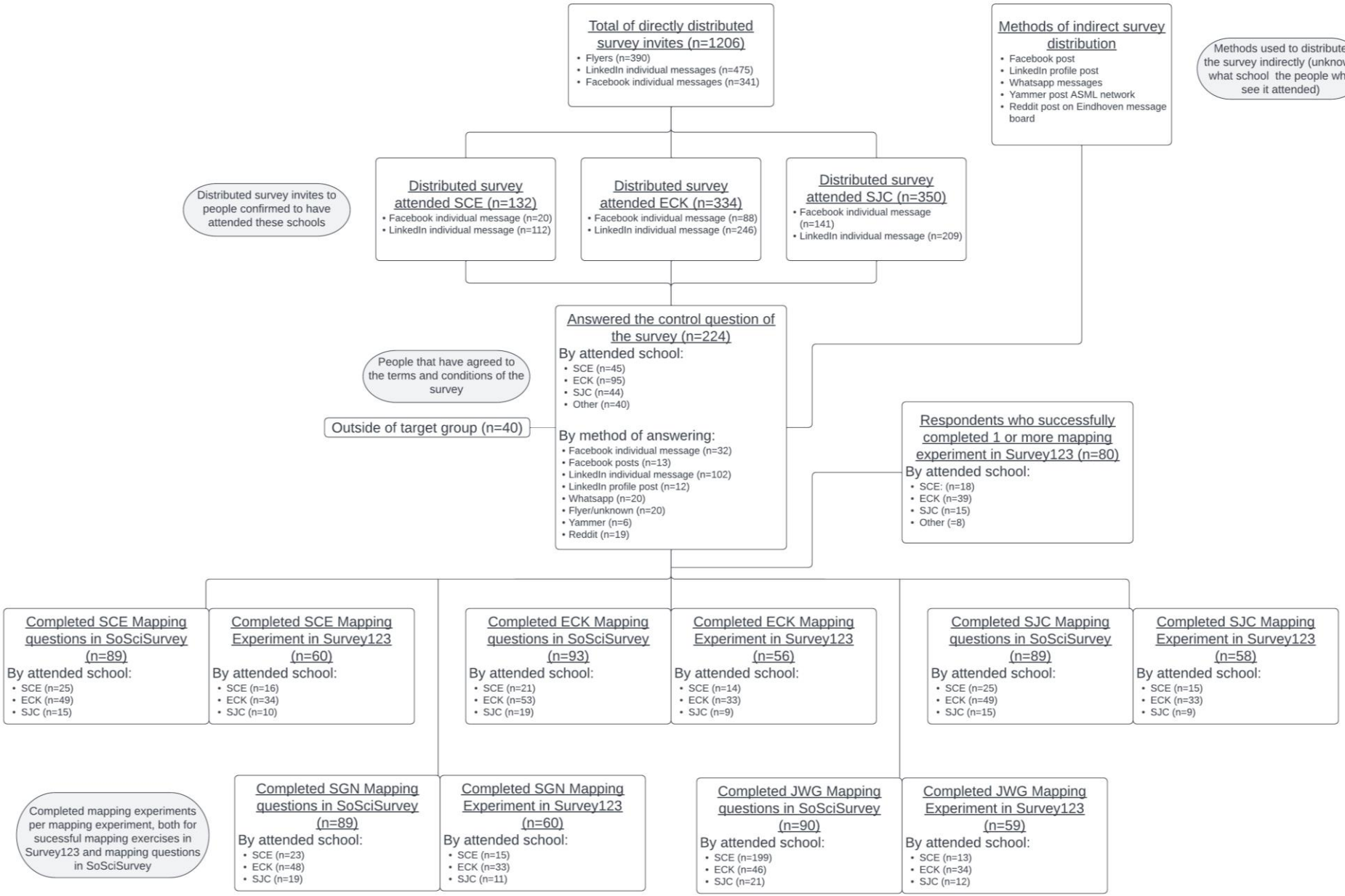


Figure 4.1 Overview of recruitment methods

Table 4.1 Overview of participant's recruitment method

OVERVIEW OF PARTICIPANT'S RECRUITMENT METHOD		
Recruitment method	**Number of participants who completed 1 or more mapping exercises**	**Percentage of total number of participants who completed 1 or more mapping exercises (n=80)**
Facebook individual message	12	15 %
Facebook post	2	2,5 %
LinkedIn individual message	31	38,8 %
LinkedIn profile post	3	3,8 %
WhatsApp message	14	17,5 %
Flyer/Unknown	11	13,8 %
Yammer (ASML environment)	4	5,0 %
Reddit Eindhoven message board	3	3,8 %

lege (44,0%), and Eckart College (51,8%), which was not possible to even out before being blocked. For Facebook (besides being able to send less messages a day), attrition mainly occurred due to hitting the end of the search results for people of each attended school.

4.1.2 Excluded Data and Outliers

To ensure data quality, some cases have been excluded from analysis. All collected cases were checked on quality and completeness. Especially data collected through the mapping exercises were checked for slivers, empty responses, duplicates or weird shapes that seemed caused by mapping mistakes. The following sections describe the decisions made during this process.

Cases from Non-target Population Individuals

There were some instances where people outside the target population (i.e., did not attend either SCE, ECK or SJC) have filled out the questionnaire and were thus removed from the data set. This was most common for SJC, as it became clear that some people (n=9, seven people between the age of 65–79 years old, two people between 45–64 years old) have attended this school in a different location than represented in the questionnaire. It appears that the school had a different location during the years these people attended SJC. This was unforeseen, as previous research led to believe that this school had not moved locations. In the end, seven cases were dropped from the data set that also had valid mapping exercise data stored. Five for the aforementioned reason, two because they attended the school that was dropped during data collection (Lorentz Casimir Lyceum, see Sections 3.3.2 and 3.3.3).

There was one case where the participant had attended two of the three (SCE and SJC) schools presented in the questionnaire. This case was removed, as it was not possible to accurately account for this difference in the analysis groupings.

Finally, there were two participants that deleted their data from SoSciSurvey during their participation. However, as they completed one or more of the mapping exercises in Survey123, their data was not automatically deleted from that data set. To honour their wish to be deleted from the study, their records were deleted there as well.

Cases with No Data for the Mapping Exercises

When first investigating the mapping exercise data through Survey123, it became clear that not all cases were successfully submitted. In other words, people completed all questions about the mapping experiment in SoSciSurvey and possibly also completed the practical mapping exercises but failed to submit their responses or decided to skip these questions. In total, this occurred for 19 cases (3 for the SCE ex., 2 for the ECK ex., 6 for the SJC ex., 4 for the SGN ex., 4 the for the JWG ex.), coming from 12 different participants.

As these numbers only make up a small portion of each subgroup's valid mapping responses, it was decided to replace the empty values with their attended school's subgroup median for each missing mapping variable (Number of Nodes, Time Spent and Mapped Area). By doing this, the mapping questions that they did answer, like the Platial Relationship Characteristics, could still be used for analysis. The median was used as it is less susceptible to extreme values in the data. Important to note is that the affected participants each had one or more other successfully completed mapping exercise, which was an additional criterion to be kept inside the data set.

Duplicate Mapping Exercise Data

In some cases, multiple entries of one participant's mapping exercise data were registered, possibly because a respondent either thought it was not yet saved, or because they wanted to start over and thus redid the exercise. Here, a choice was made for which data to include in analysis. The following rules were constructed to guide this process and to make sure the retained cases were chosen on comparable grounds:

- If all entries followed the same mapping pattern (similar in both size and shape), the first entry was included in the data analysis based on the assumption that the participant wanted to recreate this first try.
- If all entries had a different mapping pattern (varied sizes and/or shapes), the last entry was included in the data analysis based on the assumption that the participant wanted to start over the exercise.
- If one entry was clearly faulty (e.g., just a sliver), the entry that is more complete was included in the data analysis.

Overall, 16 cases had duplicate entries—either two or three entries per case. By mapping exercise: the SCE exercise had four occurrences, the ECK ex. 2, SJC ex. 5, SGN ex. 2 and JWG ex. 3. Of these cases, 11 of the duplicate sets were mapped identically, while two cases had an obvious faulty entry (sliver) and the last three entries had differing shapes/area sizes, where the respondent had included different areas on their second try.

Respondent Knows Either SGN or JWG

The schools in Nijmegen (SGN) and Dordrecht (JWG) were brought into the questionnaire to act as a place that none of the respondents would be familiar with. Therefore, all respondents who indicated that they knew of the school in Nijmegen and/or Dordrecht by having visited that place before (see the question 'How often have you been in the vicinity of X school?'), were considered as being outside of the target group and removed for that specific experiment. This was done for eight cases for the SGN experiment and did not occur for the JWG experiment.

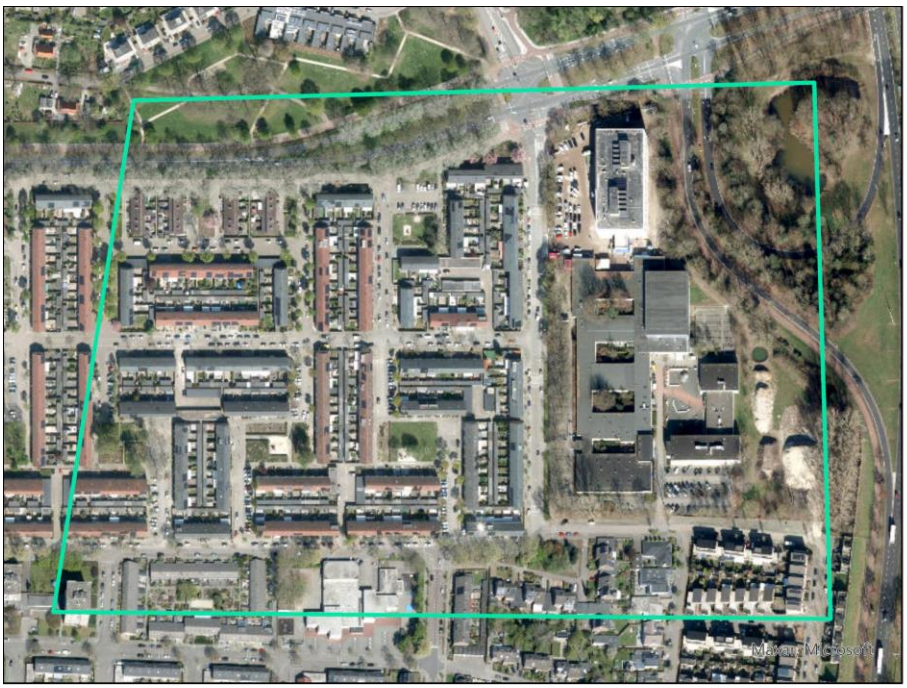
Faulty Mapping Entries

Before constructing the data set, each stored mapping exercise entry from Survey123 was individually checked for 'mistakes', i.e., they were checked whether what is mapped is realistic in the context of the place. The observed issues include: the mapped area was either way too big (e.g., including entire neighbourhoods or being almost the exact shape of the mapping extent window), way too small (e.g., only being a small sliver), mapped area was away from the intended school, or the mapped area was oddly shaped, giving the impression it was unintentional.

In total, nine cases were interpreted as mapping mistakes (1 for the SCE ex., 1 for ECK, 3 for SJC, 2 for SGN and 3 for JWG). Of these, three were just a sliver, three were larger than credible and included part of a neighbourhood, one case included an entirely different location. The last two cases were of participants who have attended SJC, who decided to include an additional building in the SJC mapping exercise. This in itself is a very interesting decision, but as no other respondents have made this decision, it makes their results incomparable and were thus adjusted and instead analysed qualitatively. For these cases, the mapping variables 'Mapped Area' and 'Number of Nodes' were replaced with the median, so that the other data can be kept in the analysis. The variable 'Time Spent' was not changed, as these values will be analysed for outliers separately (see the section below) and do not necessarily have to be impacted by the described situations.

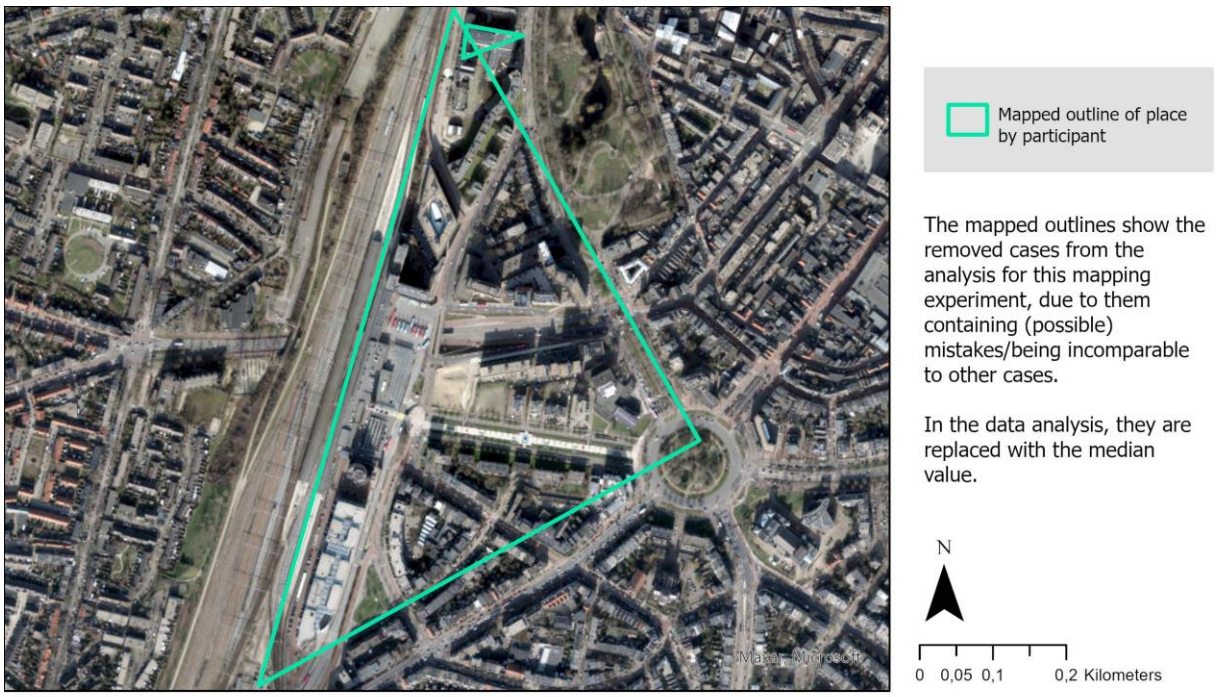
There were three other cases with slight mapping oddities (2 for the ECK ex., 1 for the SGN ex.), but these were minor in comparison with the others and are not expected to impact the analysis. For example, one of them included part of a neighbourhood, but was in comparison with the others very carefully mapped and not just the same size of the mapping extent. Another had just a tiny sliver added to a more general mapping shape.

Examples of faulty mapping entries are depicted in Maps 4.1 to 4.4.



Map 4.1 Overview of SCE removed mapping result

Map 4.2 Overview of SCE removed mapping results



Stedelijk Gymnasium Nijmegen Mapping Experiment Removed Results

Map 4.3 Overview of SCE removed mapping result

Johan de Witt Mapping Experiment Removed Results

Map 4.4 Overview of SCE removed mapping results

Outlier Identification with the Interquartile Range

The interquartile range (IQR) method for outlier detection was applied to the mapping variables. By calculating the IQR, all values that were 3 IQRs removed from either the 1st or 3rd quartile were flagged as outliers and inspected. This method works well for data that is not normally distributed (Bedre, 2022). A threshold of 3 instead of 1.5 was chosen to only select the extreme outliers.

The 'Time Spent' mapping variable was analysed differently for outliers than the 'Number of Nodes' and 'Mapped Area' variables. In contrast, time spent on each mapping exercise is difficult to check for errors, as deviations in time can originate from misunderstanding the task, interest in the task, or from distractions in real-life. Therefore, these values were analysed solely using the IQR. In total, five outliers were flagged (2 for the SCE experiment, and 1 for each the ECK, SJC and SGN experiment). All these cases took longer to complete the mapping exercises. These values were replaced with the median of the participant's attended school subgroup. This way, the other mapping variables can still be analysed.

The mapping variables 'Number of Nodes' and 'Mapped Area' were also analysed via the IQR method. However, when investigating the identified outliers, it was noticeable that the cases were not 'faulty' but for example the result of someone using more nodes because they mapped with more detail than others. Deviations in mapped area size were mostly caused by respondents deciding to map different areas (for example by including neighbouring buildings or greenery). In the end, all identified outliers using the IQR method were retained in the data set, as they all seemed to contain valuable insights into someone's mapping behaviour. Only the cases that overlapped with the identified 'faulty' entries discussed above were adjusted. Another reason for keeping the flagged outliers, is that some of these have multiple similarly mapped entries from other respondents, indicating a similar interpretation.

4.1.3 NA-analysis

A brief NA-analysis (missing value analysis) was performed to show possible patterns in non-response. In total, there were 127 participants that answered the personal geographic/demographic characteristics questions at the beginning of the questionnaire. Table 4.2 shows the distribution per attended school of these participants and how many of them have registered an answer in zero or more of the mapping exercises. Although there were many participants that were unable to register mapping exercise data, some did still register useful answers to the open-ended questions that were analysed qualitatively. Regarding the demographics of the NA-group, most data was similar to the demographics of the overall group of participants. However, there were some differences for the variables of map use frequency and device used for the questionnaire. The map use frequency had several occurrences (n=4) in the 'yearly' category, which was not present for the non-NA group. Furthermore, the type of device used during the questionnaire was in 60,6% of NA-cases a mobile phone, even though this was discouraged. For non-NA cases, only 4,2% of participants (n=3) had used a mobile phone (and were successful in the mapping exercise).

Table 4.2 Frequency distribution of demographic characteristics NA-analysis

NA ANALYSIS					
Descriptive Statistics	**Attended SCE**	**Attended ECK**	**Attended SJC**	**Attended SJC Other location**	**Attended Other**
n	27	56	28	9	7
# of completed experiments (but no mapping exercises)					
0 mapping exp.	12	17	10	1	3
1 mapping exp.	9	30	12	2	2
2 mapping exp.		2	3		
3 mapping exp.	1	2	1	1	
4 mapping exp.					
5 mapping exp.	5	5	2	5	2
Gender					
Man	10	15	11	7	5
Woman	17	41	17	2	2
Age					
18-19	2	2	1		
20-24	7	15	8		1
25-44	17	19	12		5
45-64	1	17	7	2	1
65-79		3		7	
Education					
Vmbo		1			
Havo	1	2	3		
Vwo	3			1	
Mbo	4	6	7		2
Hbo	12	27	11	6	1
University	7	19	7	2	4
Not answered		1			
Mapping Experience					
Mean	74,15	73,38	82,07	81,00	71,86
Map Use Frequency					
Daily	5	20	12	4	1
Weekly	19	29	15	1	5
Monthly	3	4	1	3	1
Yearly		3		1	
Device					
Mobile phone	19	31	21	1	5
Tablet	3	5	2	2	1
Laptop/Computer	5	20	5	6	1

Table 4.3 Age frequency distribution

AGE

Frequencies and percentages by total and split total by respondent's attended school

	Total		Attended SCE		Attended ECK		Attended SJC	
Age	Total Frequency	Total Percentage	Frequency	%	Frequency	%	Frequency	%
< 18 years								
18–19 years								
20–24 years	23	31,9%	4	22,2%	15	38,5%	4	26,7%
25–44 years	31	43,1%	11	61,1%	14	35,9%	6	40,0%
45–64 years	18	25,0%	3	16,7%	10	25,6%	5	33,3%
65–79 years								
> 79 years								
Not answered								
Total	72	100%	18	100%	39	100%	15	100%

4.2 Demographic Analysis and Composite Measure Reliability

The collected demographic data can be categorised in two groups; personal demographic characteristics and personal geographic characteristics. An overview of the included variables will be given in this section by both a table containing descriptive statistics and a figure that gives a visual overview of the data distribution.

4.2.1 Personal Demographic Characteristics

The following sections discuss the demographic make-up for the variables age, gender, and education.

Age

All participants were between the ages of 20 and 64, the distribution can be seen in Table 4.3. The group of 25–44-year-olds was the largest, with 43%. The group of 20–24-year-olds followed with 32% and lastly 45–64-year-olds with 25%. For participants who attended either ECK or SJC, the distribution between the three age groups was almost equal, but the SCE sample had a peak in the 25–44-year-old category. As mentioned in Section 4.1.2, there was some data collected for people in the 65-79 group (n=7), but these people did not belong in the target group due to having attended SJC in a different building than represented in the study.

Gender

Table 4.4 shows the distribution of gender within the sample, split by the attended school of the participant. The total sample had a slightly larger group of women (58%) than men (39%). 3% was non-binary (two people in the ECK sample). This pattern was also reflected in the ECK sample, which had 15 more women (67% total) than men. The SCE and SJC subgroup in contrast had an almost equal distribution between men and women.

Table 4.4 Gender frequency distribution

GENDER

Frequencies and percentages by total and split total by respondent's attended school

	Total		Attended SCE		Attended ECK		Attended SJC	
Gender	Total Frequency	Total Percentage	Frequency	%	Frequency	%	Frequency	%
Man	28	38,9%	9	50,0%	11	28,2%	8	53,3%
Woman	42	58,3%	9	50,0%	26	66,7%	7	46,7%
Non-Binary	2	2,8%			2	5,1%		
Other								
Not answered								
Total	72	100%	18	100%	39	100%	15	100%

Table 4.5 Level of Education frequency distribution

LEVEL OF EDUCATION

Frequencies and percentages by total and split total by respondent's attended school

	Total		Attended SCE		Attended ECK		Attended SJC	
Level of Education	Total Frequency	Total Percentage	Frequency	%	Frequency	%	Frequency	%
Basisschool								
Lbo								
Vmbo								
Havo	6	8,3%			4	10,3%	2	13,3%
Vwo	6	8,3%	3	16,7%	3	7,7%		
Mbo	3	4,2%			2	5,1%	1	6,7%
Hbo	26	36,1%	5	27,8%	13	33,3%	8	53,3%
Wo/University	31	43,1%	10	55,5%	17	43,6%	4	26,7%
Not answered								
Total	72	100%	18	100%	39	100%	15	100%

Level of Education

Table 4.5 reflects the distribution of the level of education. Participants were asked about their achieved level of education, where it can be viewed that not every category was represented. It is important to note that these results show their finished education, not current level of education. All respondents have finished secondary school, but 'pre-vocational secondary education' (Vmbo) was not represented. The consecutive vocational education was represented by three respondents (4%), which was the smallest category in the data. In contrast, the secondary school levels that lead to higher education made up approximately 17% of the data set (Havo/Vwo), and the higher education levels (Hbo/University) 79,2%. Overall, there were more respondents that already finished higher education (Mbo, Hbo, University; n=60) vs. that only finished secondary education (n=12).

4.2.2 Personal Geographic Characteristics

The following sections discuss the geographic make-up for the variables 'frequency of map use', 'experience with maps' and 'familiarity with Eindhoven'.

Table 4.6 Map use frequency distribution

MAP USE FREQUENCY

Frequencies and percentages by total and split total by respondent's attended school

	Total		Attended SCE		Attended ECK		Attended SJC	
Map Use Frequency	Total Frequency	Total Percentage	Frequency	%	Frequency	%	Frequency	%
Daily	18	25,0%	5	27,8%	8	20,5%	5	33,3%
Weekly	47	65,3%	13	72,2%	24	61,5%	10	66,7%
Monthly	7	9,7%			7	17,9%		
Yearly								
Never								
Not answered								
Total	72	100%	18	100%	39	100%	15	100%

Table 4.7 Descriptive statistics map experience

EXPERIENCE WITH MAPS

Descriptive Statistics

Descriptive Statistics	Total	Attended SCE	Attended ECK	Attended SJC
N	72	18	39	15
Mean	74,88	80,72	71,44	76,80
Standard Deviation	20,88	20,80	21,51	18,66
Median	77	87,50	74	77
Minimum	26	29	26	37
Maximum	100	100	100	100
Skew	-0,53	-0,88	-0,36	-0,43
Kurtosis	-0,68	-0,18	-0,95	-0,79
Standard Error	2,46	4,9	3,44	4,82

Map Use Frequency

Participants were asked how often they use maps in their daily lives, with examples given of Google maps, traditional maps, GIS etc. Most used maps either daily or weekly (25% vs. 65%). Only seven respondents from the ECK sample indicated to use maps monthly (10% total). For each sample, the weekly map use category was largest (see Table 4.6).

Experience with Maps

People were asked to rate their experience with maps on a scale of 1–100 (on a slider scale), where 'no experience' was on one side of the scale and 'much experience' on the other (see Table 4.7). The distributions of how respondents rate their experience with maps per attended school were similar, with slight peaks around the 100 for all subgroups, indicating much mapping experience. The ECK

Table 4.8 Descriptive statistics familiarity with Eindhoven

FAMILIARITY WITH EINDHOVEN

Descriptive Statistics

Descriptive Statistics	Total	Attended SCE	Attended ECK	Attended SJC
N	72	18	39	15
Mean	78,94	80,94	77,59	80,07
Standard Deviation	18,84	18,41	18,07	22,15
Median	81	78,50	80	87
Minimum	30	33	30	33
Maximum	100	100	100	100
Skew	-0,61	-0,76	-0,46	-0,67
Kurtosis	-0,46	0,11	-0,68	-1
Standard Error	2,22	4,34	2,89	5,72

sample also showed a peak around the 60 mark, which would mean the marker was placed around the middle of the scale between 'no experience' and 'much experience'.

Looking at the descriptive statistics, the minimum value varied between 26 and 37, indicating that no participant has put the slider scale at the extreme side of 'no experience'. The mean was similar for all samples (SCE: M=80, SD=20,8; ECK: M=71,4, SD=21,5; SJC: M= 76,8, SD=18,7) and the similar standard deviations indicated a similar variability of data, where the SJC sample was slightly more concentrated around the mean. Each sample had a negative skew and kurtosis, which is visualised through the peaks around the 100 score and the flat pattern of observations. For SCE the skew was highest, while ECK had the highest level of kurtosis. The mean and median for each sample were similar, indicating that the data was not highly influenced by outliers.

Familiarity with Eindhoven

Participant's familiarity with Eindhoven was also asked on a scale of 1–100 ('entirely unfamiliar' vs. 'entirely familiar'; see Table 4.8).

For all three samples, there were clear peaks around the 100 value, indicating agreement to the statement 'entirely familiar with Eindhoven'. The ECK sample also showed a clear peak in the middle, around the marks of 50/60. Each sample contained lower values with a minimum of 30 for ECK and 33 for SCE and SJC. The mean and standard deviations were similar for the samples (SCE: M=81, SD=18,4; ECK: M=77,6, SD=18,1; SJC: M=80,1, SD=22,2), with a higher standard deviation for SJC indicating a larger spread in variability of values. Each sample had a negative skew, in total varying between -0,76 and -0,46, which is considered acceptable. They could be viewed in the clustering around the 100 score. The kurtosis for SJC and ECK (SCE: K=0,11; ECK: K=-0,68; SJC=-1) were more negative, indicating a flatter curve.

4.2.3 Composite Measure Reliability: Exploratory Factor Analysis

The questionnaire included several questions that aim to describe one construct, namely the Platial Relationship Score (PRS). Before creating this construct, the internal and external validity of the separate measures were analysed, to assess whether it was justified to create the combined index score. An Exploratory Factor Analysis (EFA) was performed for this purpose, documented below.

Based on the theory presented in Section two, five statements per mapping exercise (and thus 25 in total) were presented in the questionnaire that relate to an individual's Platial Relationship for that place. These could be answered on a slider scale of 1–100 (fully disagree vs. fully agree). Translated from Dutch (with their category name in front, which will be used to refer to them) there were the following statements:

- *Familiarity*: I am familiar with this place; I recognise this place;
- *Emotion*: This place evokes emotions in me (positive or negative);
- *Experience*: I know how it feels to be in this place;
- *Attachment*: I feel attached to this place;
- *Relationships*: I have social relationships originating from/related to this place.

Missing values are not accepted in EFA analysis, and to analyse all five mapping exercises simultaneously, all cases with missing values for any of the PRC statements had to be omitted. Additionally, the corrected data set after outlier removal discussed in Section 4.1.2 was used for this analysis. Thus, only cases which have values for all the mapping exercises were included in the EFA, which means that some data was left out of the analysis. The assumption was therefore made that all results that come out of the EFA were also applicable for the data that had one or more missing values. It was also not possible to group the variables by attended school in the EFA, as the sample sizes would become too small. It is therefore also important to be aware that this might influence the results.

Exploratory Factor Analysis Results

For the EFA, all 25 Platial Relationship Characteristics variables (five for each mapping exercise) were fed into the analysis, with 51 observations that had no missing values for any of these 25 statements. First, a Kaiser-Meyer-Olkin (KMO) test was executed to measure the sampling adequacy (MSA). The overall MSA score was 0,72, which is 'middling' according to Kaiser's interpretation scale (Glen, n.d.), which is a fine score. Next, Bartlett's test for sphericity was highly significant ($p<0{,}001$), indicating that there was indeed correlation between variables, a prerequisite for EFA.

To determine the number of factors to extract, the eigenvalues larger than one were counted, which indicated the need for at least five factors (see Table 4.9). However, when running the full EFA with five factors, the model returns highly significant ($p<0{,}001$), which indicates that the model rejects the null hypothesis that five factors were sufficient to explain the occurring variance in data. Implementing more factors, the model does not accept the null hypothesis until eight factors were defined ($p=0{,}105$). The remainder of the EFA was thus calculated for eight factors.

When looking at the results below (see Table 4.10), it was notable that the items for each mapping experiment remained grouped together. This was also the case while changing from the model with five factors, to the model with eight factors. Between these, most changes occurred in how the SGN and JWG items were loaded onto separate factors.

Before analysing the individual factor loadings, the method of rotation has to be determined. To start, the oblique rotation method 'promax' was applied, as it works under the assumption that the factors were not independent, which was not expected for the variables in Eindhoven. This was confirmed by the factor correlations, which has an r>|0,40| for the relationship between the third (SCE) and fourth (SJC) factor. There were also high correlations between the first (SGN/JWG) factor and third (SCE) and fourth (SJC) factors. Therefore, the oblique rotation method was kept as final.

Table 4.9 Distribution of eigenvalues per

EIGENVALUES			
Factor	**Eigenvalue**	**Factor**	**Eigenvalue**
1	7,670	16	0,159
2	5,317	17	0,111
3	4,461	18	0,094
4	1,612	19	0,085
5	1,325	20	0,063
6	0,876	21	0,057
7	0,617	22	0,048
8	0,511	23	0,036
9	0,393	24	0,022
10	0,338	25	0,017
11	0,291		
12	0,283		
13	0,225		
14	0,209		
15	0,180		

When looking at the individual factor loadings, all loadings larger than 0,3 have been included in the table, so factors 5–8 would not appear empty. However, the reasoning of Field (2005) was followed that a reliable factor 'has four or more loadings of at least 0,6 regardless of sample size' (MRC Cognition and Brain Sciences Unit, 2013; Hair, Tatham, Anderson & Black, 1998; Junt, Gi Seo & Park, 2020). This means that the loadings onto the last four factors would not be reliable, as these only consist of a maximum of two items and generally have low loading values. These four factors also consist mostly of cross-loadings, indicating that the same item was already loaded onto another factor with a higher value. The exception was the SGN-Experience item, which was actually stronger in the fifth factor. The last four factors were therefore disregarded, including the items that were solely loaded onto them. The remaining factors 1 to 4 all adhere to this requirement, with the exception of two items that have a loading of 0,59 (SJC – Relationships) and 0,31 (SGN – Experience). The former was part of four other item loadings larger than 0,60 and was retained, the latter was deemed too low and removed from the factor.

Deeming the factor loadings for each factor a good fit, the factors can be named. As briefly mentioned before, each factor seems to group the items based on the mapping experiment. The slight exception seems to be the first factor, which includes seven factor loadings from both the SGN and JWG mapping experiment whom both contain places unknown to the participants. Each factor was named after the place it represents, e.g., the SCE PRS factor, ECK PRS factor etc. The cumulative variance of these four factors shows that 70% of total variance was explained within the variables for these factors, a remaining 13% would have been explained by the four factors that do not have enough item loadings. This means that another 16% of total variance remains unexplained by the original eight identified factors.

Table 4.10 Exploratory factor analysis results

Exploratory Factor Analysis Results using 'promax' rotation

n = 51

Uniquenesses

SCE - Familiarity	SCE - Emotion	SCE - Experience	SCE - Attachment	SCE - Relationships
0,21	0,12	0,08	0,17	0,20
ECK - Familiarity	ECK - Emotion	ECK - Experience	ECK - Attachment	ECK - Relationships
0,22	0,04	0,00	0,00	0,19
SJC - Familiarity	SJC - Emotion	SJC - Experience	SJC - Attachment	SJC - Relationships
0,29	0,18	0,00	0,29	0,48
SGN - Familiarity	SGN - Emotion	SGN - Experience	SGN - Attachment	SGN - Relationships
0,11	0,47	0,04	0,13	0,00
JWG - Familiarity	JWG - Emotion	JWG - Experience	JWG - Attachment	JWG - Relationships
0,23	0,35	0,22	0,08	0,09

Loadings*

	Factor 1 - SGN/JWG PRS	Factor 2 - ECK PRS	Factor 3 - SCE PRS	Factor 4 - SJC PRS	F. 5	F. 6	F. 7	F. 8
SCE - Familiarity			**0,90**					
SCE - Emotion			**0,93**					
SCE - Experience			**0,98**					
SCE - Attachment			**0,86**					
SCE - Relationships			**0,84**					
ECK - Familiarity		**0,69**						
ECK - Emotion		**1,04**						
ECK - Experience		**0,87**						-0,32
ECK - Attachment		**1,06**						0,47
ECK - Relationships		**0,81**						
SJC - Familiarity				**0,88**				
SJC - Emotion				**0,89**				
SJC - Experience				**1,02**				
SJC - Attachment				**0,72**				
SJC - Relationships				**0,59**				
SGN - Familiarity	**0,94**							
SGN - Emotion					0,57	0,36		
SGN - Experience	0,31				0,86			
SGN - Attachment	**0,83**							
SGN - Relationships	**0,94**						0,49	
JWG - Familiarity	**0,96**							
JWG - Emotion						0,79		
JWG - Experience	0,75							
JWG - Attachment	**0,81**							
JWG - Relationships	**0,89**							

* The values in bold are deemed a good fit and included in the aggregation into index scores.

	Factor 1 - SGN/JWG PRS	Factor 2 - ECK PRS	Factor 3 - SCE PRS	Factor 4 - SJC PRS	F. 5	F. 6	F. 7	F. 8
SS loadings	5,55	4,24	4,16	3,60	1,37	1,03	0,49	0,47
Proportion Var	0,22	0,17	0,17	0,14	0,05	0,04	0,02	0,02
Cumulative Var	0,22	0,39	0,56	0,70	0,76	0,8	0,82	0,84

Factor Correlations

	Factor 1 - SGN/JWG PRS	Factor 2 - ECK PRS	Factor 3 - SCE PRS	Factor 4 - SJC PRS	F. 5	F. 6	F. 7	F. 8
Factor 1 - SGN/JWG PRS	1							
Factor 2 - ECK PRS	-0,054	1						
Factor 3 - SCE PRS	-0,496	0,249	1					
Factor 4 - SJC PRS	-0,375	0,017	0,470	1				
Factor 5	0,037	-0,021	0,390	0,227	1			
Factor 6	0,033	-0,356	-0,240	-0,107	0,173	1		
Factor 7	-0,323	-0,127	0,310	0,184	0,133	-0,058	1	
Factor 8	-0,310	0,149	0,130	0,219	-0,105	-0,209	0,203	1

Test of the hypothesis that 8 factors are sufficient.
The chi square statistic is 148.36 on 128 degrees of freedom.
The p-value is 0.105

Cronbach's Alpha

Before being able to conclude whether the variables can be grouped into index scores, the internal consistency was assessed using Cronbach's Alpha. The raw alpha score for the SCE PRS factor was α=0,95, for the ECK PRS this was α=0,94 and for the SJC PRS factor this was α=0,92. These scores cannot be improved by removing an individual item and any alpha score ≥ 0,9 is deemed 'excellent' (Vocht, 2016). For the SGN/JWG PRS factor, the raw alpha was α=0,72, and deemed 'acceptable'. However, by removing the JWG – Experience item, the internal reliability can be improved and become α=0,93. This item was dropped for two reasons: first, it makes the alpha score more comparable to the other three factors, and second, the 'SGN – Experience' item was also not included in this factor, making it more comparable. Overall, the remaining items that were loaded onto the four factors can be combined into a single score. Factor-based scores were generated based on the average of the included items. This conclusion answers the first hypothesis as listed in Section 3.5.3:

> ***H1.*** *The variables 'familiarity', 'affinity', 'experience', 'attachment' and 'social relationships' can be combined into one aggregated index score, to help portray the latent variable 'Platial Relationship Score.*

The hypothesis is accepted, although it should be noted that for the factor explaining the mapping experiments outside of Eindhoven, the variables 'emotion' and 'experience' were not included. For the factors explaining each school in Eindhoven, all mentioned variables were included to portray the latent variable 'Platial Relationship Score' and both their internal and external validity were deemed good.

4.3 Descriptive Statistics

The following sections assess the descriptive statistics for all remaining variables.

4.3.1 Number of Nodes

Table 4.11 shows the descriptive statistics for the number of placed nodes in each mapping exercise, split by the attended school of the participant; Figure 4.2 contains the accompanying distribution's histograms and plotted density lines.

For all mapping exercise entries, the number of used nodes were calculated through the 'Feature Vertices to Points (Data Management)' tool in ArcGIS Pro (ESRI, n.d.c), which generated a new feature layer containing point data on the locations where survey participants had placed vertices in the mapping exercise. These were then summed for each participant separately and used for further calculations.

The histograms looked similar, where most distributions showed their peak slightly to the left of the range of values. There were some instances with higher peaks in density and instances that showed possible outliers, e.g., for the SCE-sce and ECK-sce subsamples. The presence of outliers could be confirmed by the high Kurtosis values for some of the subsamples, where the Kurtosis was >2 for six of the 15 subsamples, indicating large tails in the distribution most likely caused by outliers (Kenton, 2023).

Table 4.11 Descriptive statistics number of placed nodes

NUMBER OF PLACED NODES

Descriptive Statistics

	EX. SCE			EX. ECK			EX. SJC		
ptive Statistics	Attended SCE	Attended ECK	Attended SJC	Attended SCE	Attended ECK	Attended SJC	Attended SCE	Attended ECK	Attended SJC
N	17	36	10	14	35	11	15	37	12
Mean	9,71	7,75	9,30	9,29	9,80	13,27	7,60	8,54	11,92
Standard Deviation	4,13	2,23	3,06	3,87	3,47	2,53	4,57	4,57	2,87
Median	8	7	8	9	9	12	7	7	12
Minimum	5	5	7	6	5	10	5	5	7
Maximum	23	14	14	21	22	19	23	23	17
Skew	1,80	0,96	0,71	1,83	1,41	0,93	1,73	1,73	0,08
Kurtosis	3,49	0,52	-1,53	3,16	2,64	-0,20	2,12	2,12	-0,81
Standard Error	1	0,37	0,97	1,03	0,59	0,76	0,70	0,75	0,83

	EX. SGN			EX. JWG		
ptive Statistics	Attended SCE	Attended ECK	Attended SJC	Attended SCE	Attended ECK	Attended SJC
N	14	31	11	14	36	13
Mean	7,50	8,03	9,36	7,50	8,25	9,46
Standard Deviation	2,18	3,31	3,85	3,06	3,66	3,84
Median	7	7	8	7	7	9
Minimum	5	5	5	5	5	5
Maximum	12	20	17	16	20	18
Skew	0,98	1,75	0,96	1,51	1,54	0,62
Kurtosis	-0,08	3,27	-0,59	1,56	1,96	-0,60
Standard Error	0,58	0,59	1,16	0,82	0,61	1,07

The descriptive statistics also showed a slight difference between the mean and median values, which tended to differ by approximately one node. Considering the median, there did not seem to be any large differences between the different mapping exercises and to what subsample participants belonged. However, an exception seemed to be the SJC attendees that placed more nodes on average for the mapping exercises in Eindhoven. This was reflected by a higher mean (four times), median (also four times) and Minimum (three times) value for almost all mapping exercises. The same pattern was not present for their Maximum values. The difference in median value for the SCE, SGN and JWG exercise was low (either the same number or difference of one node), but for the other exercises the difference was either two, three or five nodes.

Lastly, regarding the SGN and JWG mapping exercises, there seemed to be almost no differences in the numbers of nodes used. The median was the same for the SCE and ECK subsamples for both exercises, while SJC differed with one and two nodes. The standard deviations were also similar, ranging between 2,18–3,85 for SGN and 3,06–3,84 for JWG. The minimum number of nodes used for each exercise and subsample was the same (five nodes), but the maximum number of nodes showed more variation, ranging from 12 to 20.

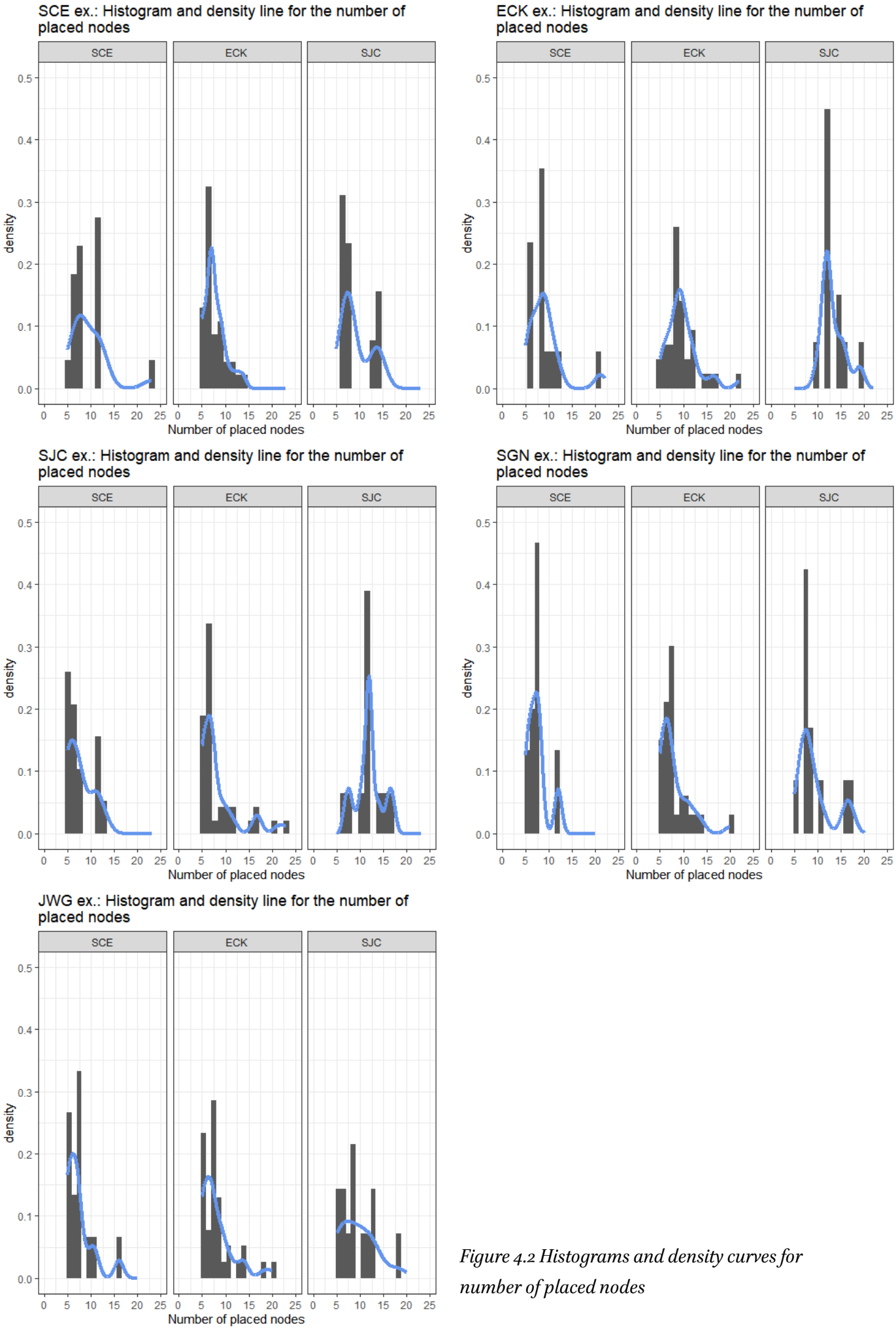


Figure 4.2 Histograms and density curves for number of placed nodes

Table 4.12 Descriptive statistics for time spent on mapping exercises in seconds

TIME SPENT ON MAPPING EXERCISE (SECONDS)

Descriptive Statistics

	EX. SCE			EX. ECK			EX. SJC		
ptive Statistics	Attended SCE	Attended ECK	Attended SJC	Attended SCE	Attended ECK	Attended SJC	Attended SCE	Attended ECK	Attended SJC
N	17	36	10	14	34	11	15	37	12
Mean	85,97	72,47	80,30	61,79	99,97	101,18	53	68	171,50
Standard Deviation	44,49	46,88	65,15	35,45	60,07	58,37	45,06	49,83	79,71
Median	81,50	60	62,50	63,00	87,50	95	35,00	53	152
Minimum	27	14	24	25	27	21	18	15	59
Maximum	167	200	240	157	298	206	160	236	324
Skew	0,45	1,18	1,33	1,16	1,15	0,60	1,60	1,60	0,49
Kurtosis	-0,97	0,62	0,77	1,04	1,31	-0,77	1,09	2,29	-0,88
Standard Error	10,79	7,81	20,60	9,47	10,30	17,60	11,63	8,19	23,01

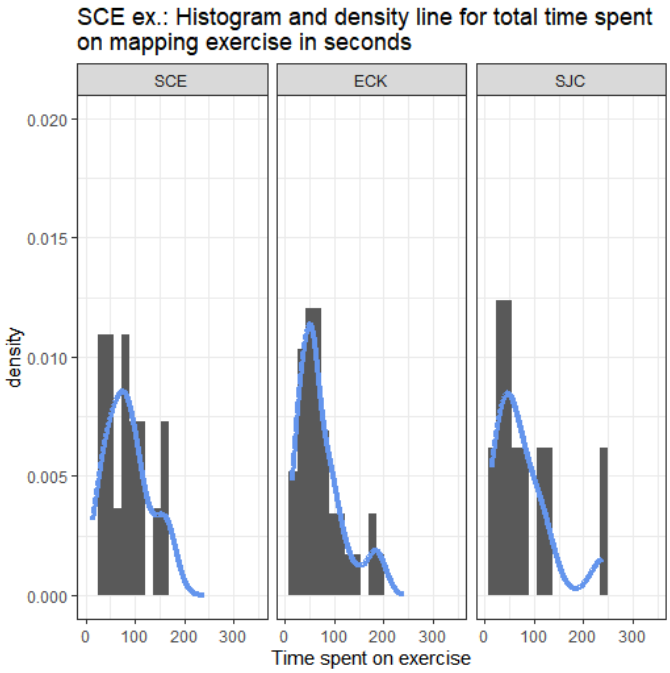
	EX. SGN			EX. JWG		
ptive Statistics	Attended SCE	Attended ECK	Attended SJC	Attended SCE	Attended ECK	Attended SJC
N	14	31	11	14	36	13
Mean	86,07	68,52	60,45	79,00	95,58	96,54
Standard Deviation	62,62	49,00	35,22	76,82	80,83	88,61
Median	62	56	55	61	63	63
Minimum	26	19	21	17	11	18
Maximum	225	247	113	314	302	284
Skew	1,06	1,98	0,39	1,97	1,32	1,04
Kurtosis	-0,19	4,08	-1,57	3,39	0,65	-0,30
Standard Error	16,74	8,80	10,62	20,53	13,47	24,58

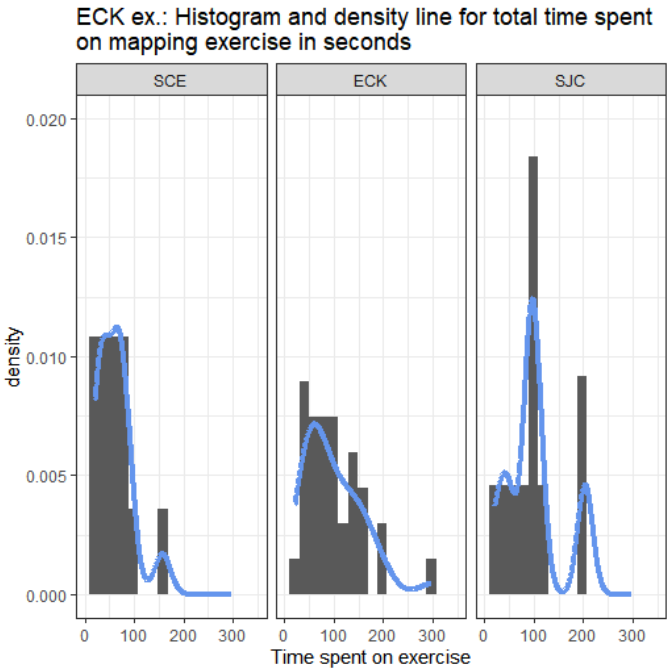
4.3.2 Time Spent

Table 4.12 and Figure 4.3 show the descriptive statistics and visual distribution through histograms and density lines for the variable time spent on each mapping exercise, grouped by the subsamples of what school the participants have attended.

In the questionnaire, the time spent on the mapping exercise was calculated by Survey123, which registered the starting time and finish time of the form, in this case a single mapping exercise. The difference in time was calculated in seconds. There seemed to be variation between the mean and median values for many of the subsamples. Four of the 15 subsamples only had a difference of less than ten seconds, but for four other groups this difference was more than 20 seconds. Seven groups thus varied between 10–20 seconds. These differences indicated the possibility of outliers in the data set, even though the extreme outliers were removed (see Section 4.1.2). There were also four cases where the Kurtosis was >2, indicating again the presence of larger tails in the distribution and thus the possibility for outliers. This was the case for SJC-eck, SGN-eck and JWG-sce.

Considering the median values for the SGN and JWG mapping exercises, their values per attended school's subsample were similar, with a slight exception for SGN-eck and SGN-sjc that differed from the other subsamples with approximately seven seconds. Between the JWG subsamples, the difference was only two seconds. This was also reflected in the histograms, which showed similar patterns.





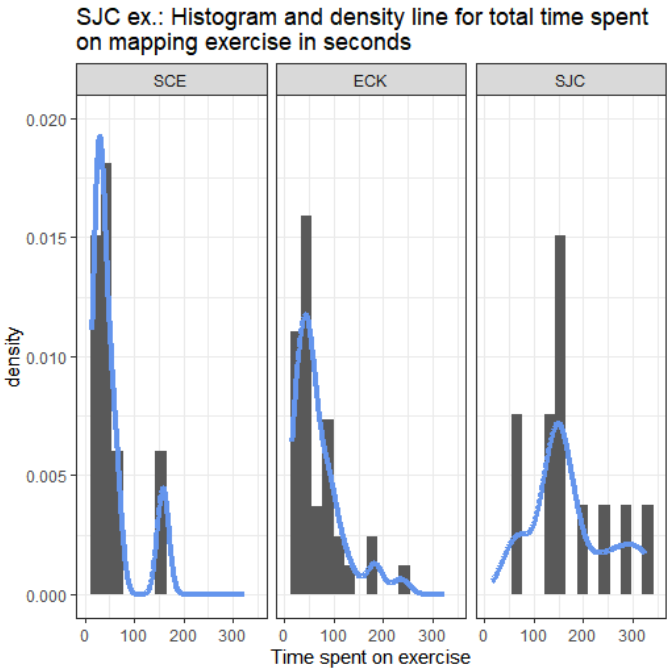


Figure 4.3 Histograms and density curves for time spent on the mapping exercise

For the three mapping exercises in Eindhoven, the differences in median values were slightly bigger between the subsamples of attended school, with differences varying between 2,5 seconds and 117 seconds, but with an average of approximately a 37 second difference for all nine subsamples of the Eindhoven mapping exercises.

Interestingly, it seemed like the SJC attendees spent more time on the mapping exercise of their own attended school, which can be viewed by both the high mean and median value, but also the high Minimum. This was observable in the histogram, where their distribution was shifted more to the right opposed to the distribution for SJC-sce and SJC-eck. The median value for ECK-sjc was also higher than for the other two subsamples. If this high value was ignored, it seemed like median values for the attended school's exercise tended to be higher than for the other groups (e.g., SCE-sce=81,5, while SCE-eck=60; ECK-eck=87.5, while ECK-sce=63; and SJC-sjc=152, while SJC-sce=35 and SJC-eck=53).

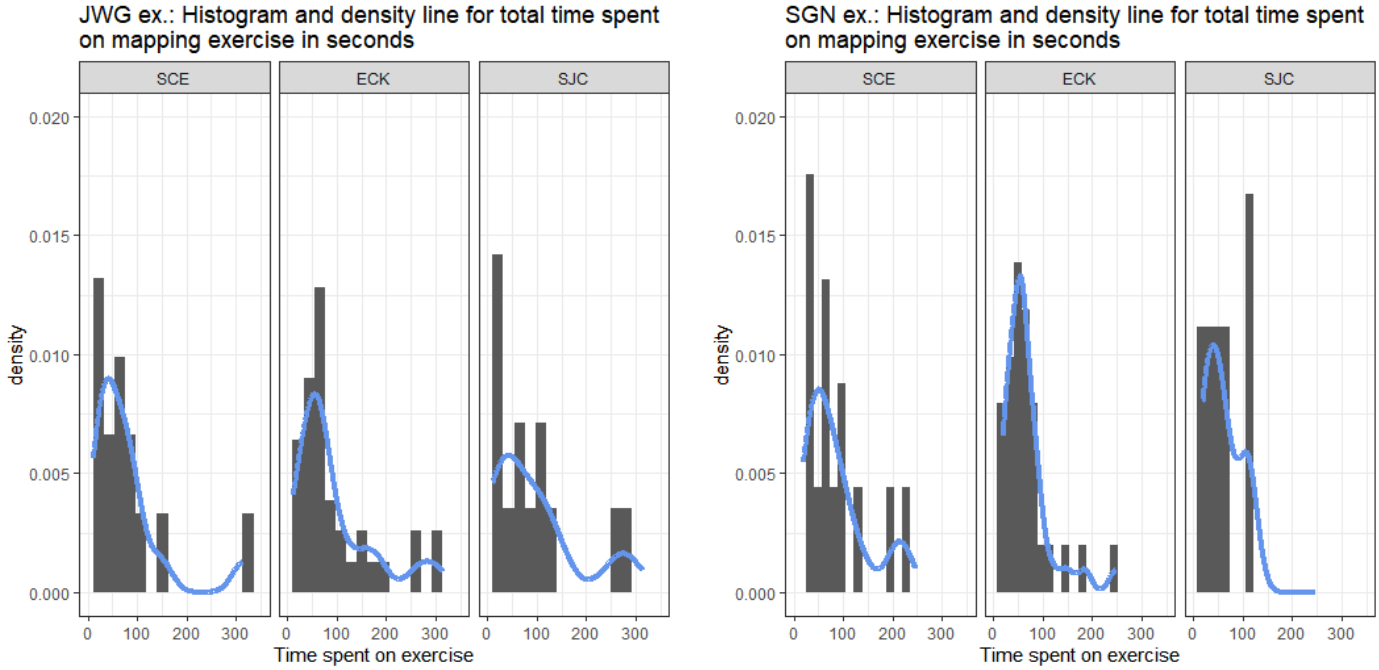


Figure 4.3 (cont.) Histograms and density curves for time spent on the mapping exercise (in seconds)

4.3.3 Mapped Area

Table 4.13 and Figure 4.4 show the descriptive statistics and histograms with density lines plotted for the Mapped Area Size variable in square meters. The data for this variable was automatically calculated for each registered polygon by Survey123.

The mean and median values for each exercise's subsample differed for most groups with approximately 1000 square meters. There were a few cases where this difference was larger, for example, for SCE-sce the difference was about 2500 sqm and for the SJC-sce and SJC-eck groups the difference was approximately 6000 sqm and 7000 sqm, where the mean had a higher value. Looking at the histograms for these two subsamples, the distribution itself seemed to be more evenly spread out in comparison with the SJC-sjc graph. Additionally, there were three subsamples that had a Kurtosis value >2 (of which one case also had a Skewness >2).

For the SCE and SJC exercise, the subsample that attended the school they were mapping, also had the highest median/mean value. This was not the case for the ECK exercise, where SJC attendees had the highest median (with a difference of approx. 2000 sqm). Comparing the histograms for the SGN and JWG exercises, the distributions looked similar, with slight differences in median per subsample of around 2000 sqm or less.

Table 4.13 Descriptive statistics for total mapped area size in square meters

MAPPED AREA SIZE (SQUARE METERS)

Descriptive Statistics

ptive Statistics	EX. SCE			EX. ECK			EX. SJC		
	Attended SCE	Attended ECK	Attended SJC	Attended SCE	Attended ECK	Attended SJC	Attended SCE	Attended ECK	Attended SJC
N	17	36	10	14	35	11	15	33	10
Mean	36.820	32.285	32.699	27.781	33.963	36.114	23.886	26.455	44.225
Standard Deviation	6.366	7.096	9.336	5.819	10.326	7.640	12.945	16.817	4.106
Median	39.353	32.448	36.132	28.690	33.360	35.472	17.905	19.394	45.407
Minimum	25.963	8.693	15.309	18.528	12.195	21.387	9.835	7.024	38.564
Maximum	47.511	41.386	46.469	34.752	83.033	49.710	45.270	71.913	51.507
Skew	-0,16	-1,09	-0,55	-0,22	2,80	0,20	0,41	0,91	0,11
Kurtosis	-1,37	1,56	-0,91	-1,70	12,41	-0,23	-1,68	-0,23	-1,32
Standard Error	1.544	1.183	2.952	1.555	1.745	2.303	3.342	2.928	1.298

ptive Statistics	EX. SGN			EX. JWG		
	Attended SCE	Attended ECK	Attended SJC	Attended SCE	Attended ECK	Attended SJC
N	14	31	11	14	36	13
Mean	13.937	10.603	12.419	6.394	8.069	7.222
Standard Deviation	5.156	5.871	5.658	3.102	4.869	4.597
Median	12.973	9.963	10.511	5.973	6.972	6.972
Minimum	6.546	1.163	4.662	1.883	1.447	1.448
Maximum	23.939	31.645	25.909	15.222	23.550	18.724
Skew	0,65	1,48	0,98	1,37	1,34	0,95
Kurtosis	-0,62	3,17	0,34	2,09	1,96	0,43
Standard Error	1.378	1.055	1.706	829	811	1.275

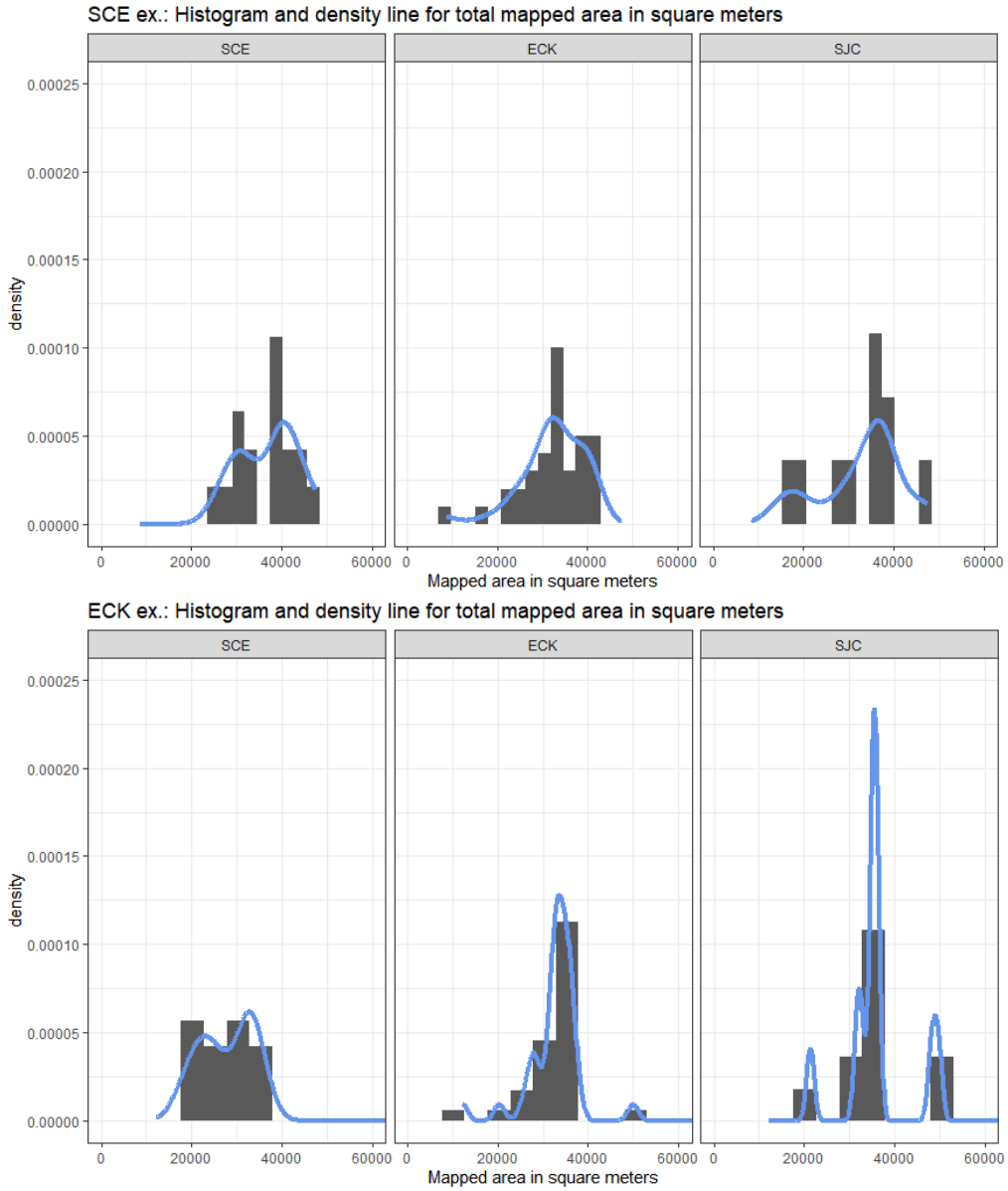
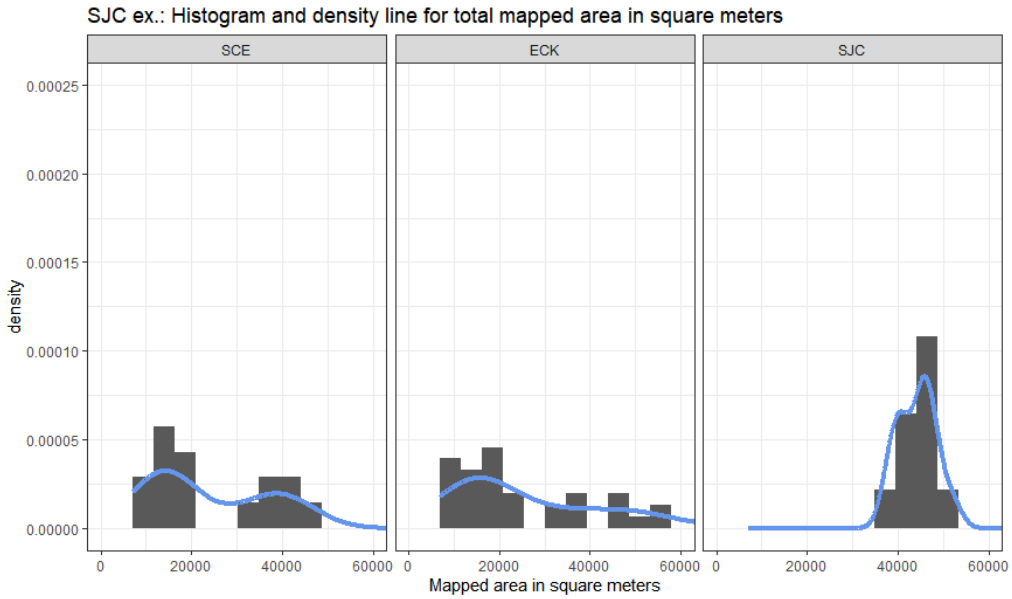
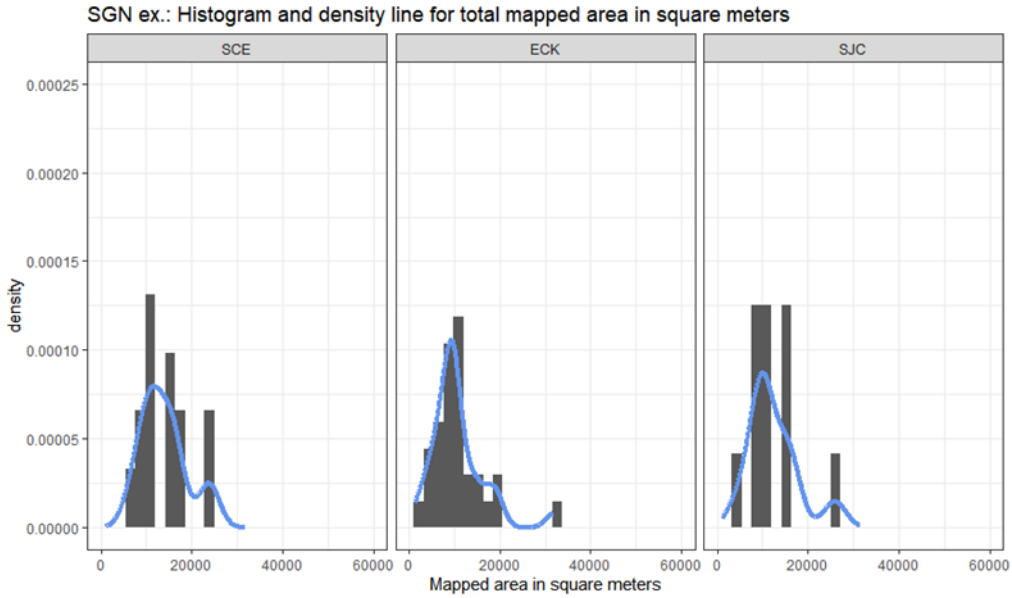


Figure 4.4 Histograms and density curves for total mapped area size in square meters





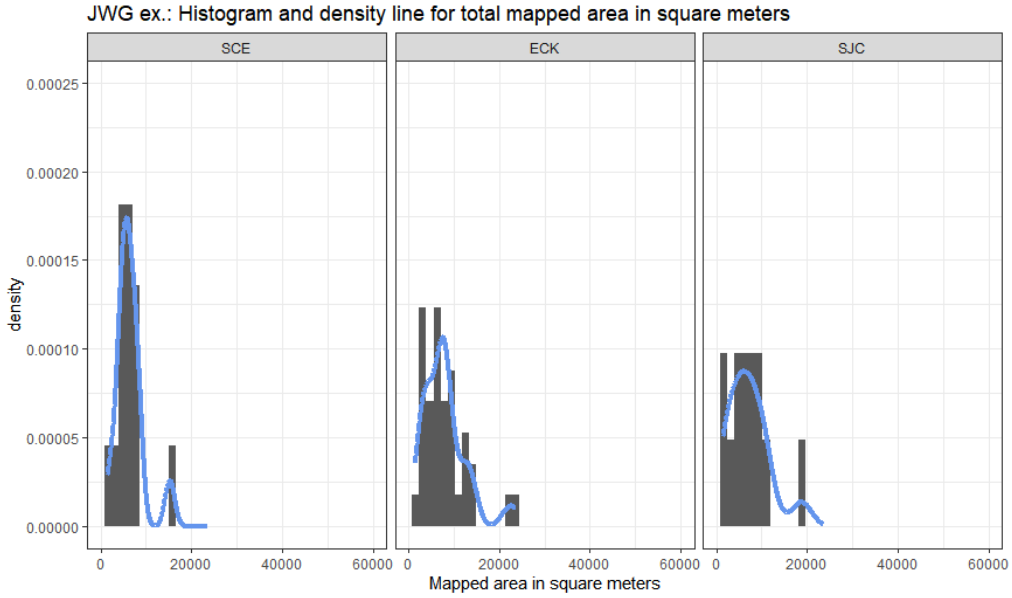


Figure 4.4 (cont.) Histograms and density curves for total mapped area size in square meters

Table 4.14 Descriptive statistics for the aggregated Platial Relationship Score (PRS)

AGGREGATED PLATIAL RELATIONSHIP SCORE

Descriptive Statistics

	EX. SCE			EX. ECK			EX. SJC			EX. SGN/JWG		
ptive Statistics	Attended SCE	Attended ECK	Attended SJC	Attended SCE	Attended ECK	Attended SJC	Attended SCE	Attended ECK	Attended SJC	Attended SCE	Attended ECK	Attended SJC
N	17	36	10	14	36	11	15	37	12	12	30	11
Mean	83,58	32,67	7,04	26,04	83,50	10,13	7,23	14,05	78,30	0,67	1,24	2,85
Standard Deviation	15,27	29,23	6	22,47	18,07	16,71	10,40	18,27	14,36	1,26	1,94	2,82
Median	86,60	29,40	6,20	21,80	86,80	5,80	2,60	8	78,90	0,00	0,33	2,33
Minimum	47	0	0,20	0	28,80	0	0	0	50,80	0	0	0
Maximum	100	90,20	20,20	72,20	100	56,40	38	78,80	97	3,83	7	7,33
Skew	0,41	0,41	0,81	0,58	-1,14	1,88	1,77	1,92	-0,47	1,57	1,76	0,37
Kurtosis	-1,23	-1,23	-0,31	-0,98	0,58	2,43	2,38	3,58	-1,04	0,91	2,12	-1,66
Standard Error	4,87	4,87	1,90	6	3,01	5,04	2,69	3	4,14	0,36	0,36	0,85

4.3.4 Platial Relationship Score

The descriptive statistics and histograms with plotted density line per participant's attended school can be viewed in Table 4.14 and Figure 4.5 for the variable Platial Relationship Score. In Section 4.2.3 it was discussed how this variable came to be from the different Platial Relationship Characteristics statements and how they were aggregated into a score by use of a factor analysis. The aggregated score was used for the following analyses and ranges from 1–100.

The mean and median values were similar for all exercises and subsamples, with slight variations that had a maximum difference of seven points. This indicated that there were not many outliers greatly influencing the mean values. There were however four subsamples that had a Kurtosis value >2, showing that the tails of these distribution were long. These can also be observed in the histograms, for example for ECK-sjc and SJC-eck.

Participants that had attended the school they did the mapping experiment of, had the highest PRS for that experiment. For the SCE experiment, attendees of ECK had a higher mean PRS score (M=32,67) for that experiment than SJC attendees (M=7,04), a difference of approx. 26. For the ECK experiment this pattern was similar, but slightly smaller. Here, SCE attendees scored M=26,04 and SJC attendees scored M=10,13; a difference of approx. 16 points. For the SJC experiment the score given by SCE and ECK attendees seemed to be more similar to each other (7,23 vs. 14,05), thus with a difference of seven. This pattern was also observable in the histograms, where the SCE-eck and ECK-sce distributions were more spread out and different from that of SJC. In contrast, the SJC-sce and SJC-eck histograms were similar to each other, possibly indicating less familiarity with SJC from both SCE and ECK attendees.

For the SGN/JWG experiment factor, where the participants were assumed to have no relationship with the place, all subsamples scored very similarly, with differences between the mean of about one or two points and differences in Maximum of around four.

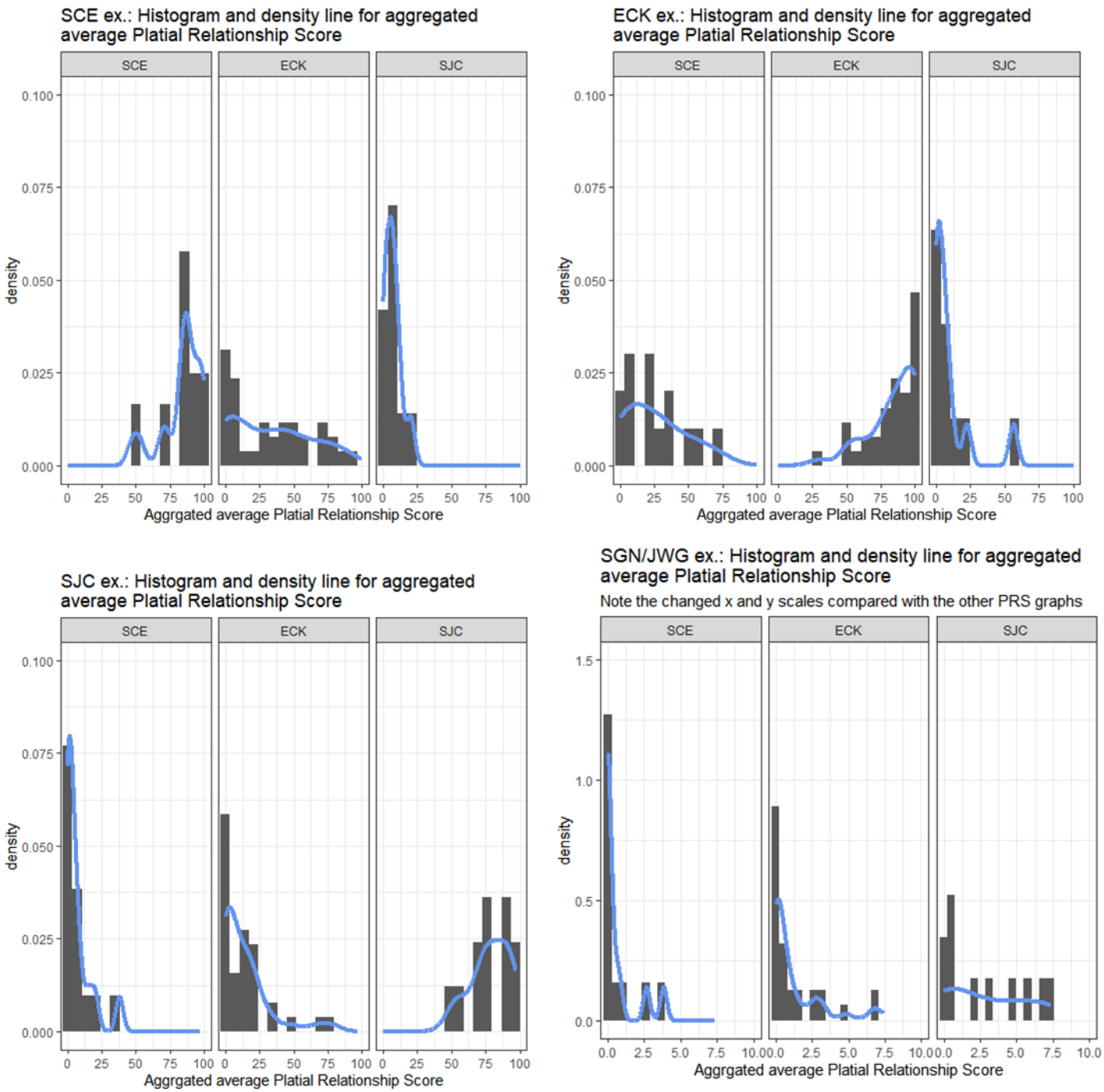


Figure 4.5 Histograms and density curves for platial relationship score

4.3.5 Number of Visits

Table 4.15 and the bar charts in Figure 4.6 show the details of the Number of Visits variable. As previously discussed in Section 4.1.2, the cases where participants answered this question for the SGN mapping experiment with anything other than 'Never (0 times)', were removed from the analysis for this experiment. However, for the table and bar chart below, they were left in to provide a clearer and more complete overview. For the JWG this did not have to be done, as none of the participants indicated to have visited this place before.

Table 4.15 Frequencies for number of visits

NUMBER OF VISITS TO PLACE

Frequencies and percentages per mapping experiment and attended school

	EX. SCE								EX. ECK							
Number of Visits	**Total**		**Attended SCE**		**Attended ECK**		**Attended SJC**		**Total**		**Attended SCE**		**Attended ECK**		**Attended SJC**	
	freq.	**%**	**freq.**	**%**	**freq.**	**%**	**freq.**	**%**	**freq.**	**%**	**freq.**	**%**	**freq.**	**%**	**freq.**	**%**
Never (0 times)	14	22,2%			10	27,8%	4	40,0%	10	16,4%	1	7,1%	1	2,9%	8	72,7%
1-9 times	16	25,4%			10	27,8%	6	60,0%	9	14,8%	8	57,1%			1	9,1%
10-49 times	7	11,1%			7	19,4%			6	9,8%	5	35,7%			1	9,1%
50-100 times	2	3,2%			2	5,6%										
> 100 times	24	38,1%	17	100%	7	19,4%			36	59,0%			35	97,2%	1	9,1%
Not answered																
Total	63	100%	17	100%	36	100%	10	100%	61	100%	14	100%	36	100%	11	100%

	EX. SJC								EX. SGN							
Number of Visits	**Total**		**Attended SCE**		**Attended ECK**		**Attended SJC**		**Total**		**Attended SCE**		**Attended ECK**		**Attended SJC**	
	freq.	**%**	**freq.**	**%**	**freq.**	**%**	**freq.**	**%**	**freq.**	**%**	**freq.**	**%**	**freq.**	**%**	**freq.**	**%**
Never (0 times)	35	54,7%	9	60,0%	26	70,3%			56	87,5%	14	87,5%	31	86,1%	11	91,7%
1-9 times	13	20,3%	4	26,7%	9	24,3%			6	9,4%	1	6,3%	4	11,1%	1	8,3%
10-49 times	5	7,8%	2	13,3%	2	5,4%	1	8,3%	2	3,1%	1	6,3%	1	2,8%		
50-100 times																
> 100 times	11	17,2%					11	91,7%								
Not answered																
Total	64	100%	15	100%	37	100%	12	100%	64	100%	16	100%	36	100%	12	100%

	EX. JWG							
Number of Visits	**Total**		**Attended SCE**		**Attended ECK**		**Attended SJC**	
	freq.	**%**	**freq.**	**%**	**freq.**	**%**	**freq.**	**%**
Never (0 times)	63	100%	14	100%	36	100%	13	100%
1-9 times								
10-49 times								
50-100 times								
> 100 times								
Not answered								
Total	63	100%	14	100%	36	100%	13	100%

Almost all people who had attended the school of the experiment, have visited that place more than 100 times. There seemed to be a few exceptions, where participants have said they attended the school, but have filled in that they have never been there. This for example occurred for ECK-eck and for SJC-sjc, where there was a case where a participant had indicated having visited the place between 10–49 times instead. The opposite has also occurred, where participants had not attended the school but have visited the place many times (see SCE-eck for example).

For all the mapping experiments in Eindhoven, the participants that attended the school represented in the exercise have also visited the place the most. However, all mapping experiments also had cases where people have visited that place while not having attended the school, mostly in the 1–9 times range. For example, in case of the SCE experiment, many people that attended ECK have visited the place of SCE—44,4 % visited more than ten times. For the place of ECK, the percentage of people who attended SCE was a bit less—35,7 visited between 10–49 times. No participant who has attended SJC has visited the place of SCE more than ten times, but for ECK-sjc two participants have visited ECK more than ten times. In turn for the SJC place, 13,3 % of SCE attendees visited this place more than ten times, this was 5,4 % for ECK attendees.

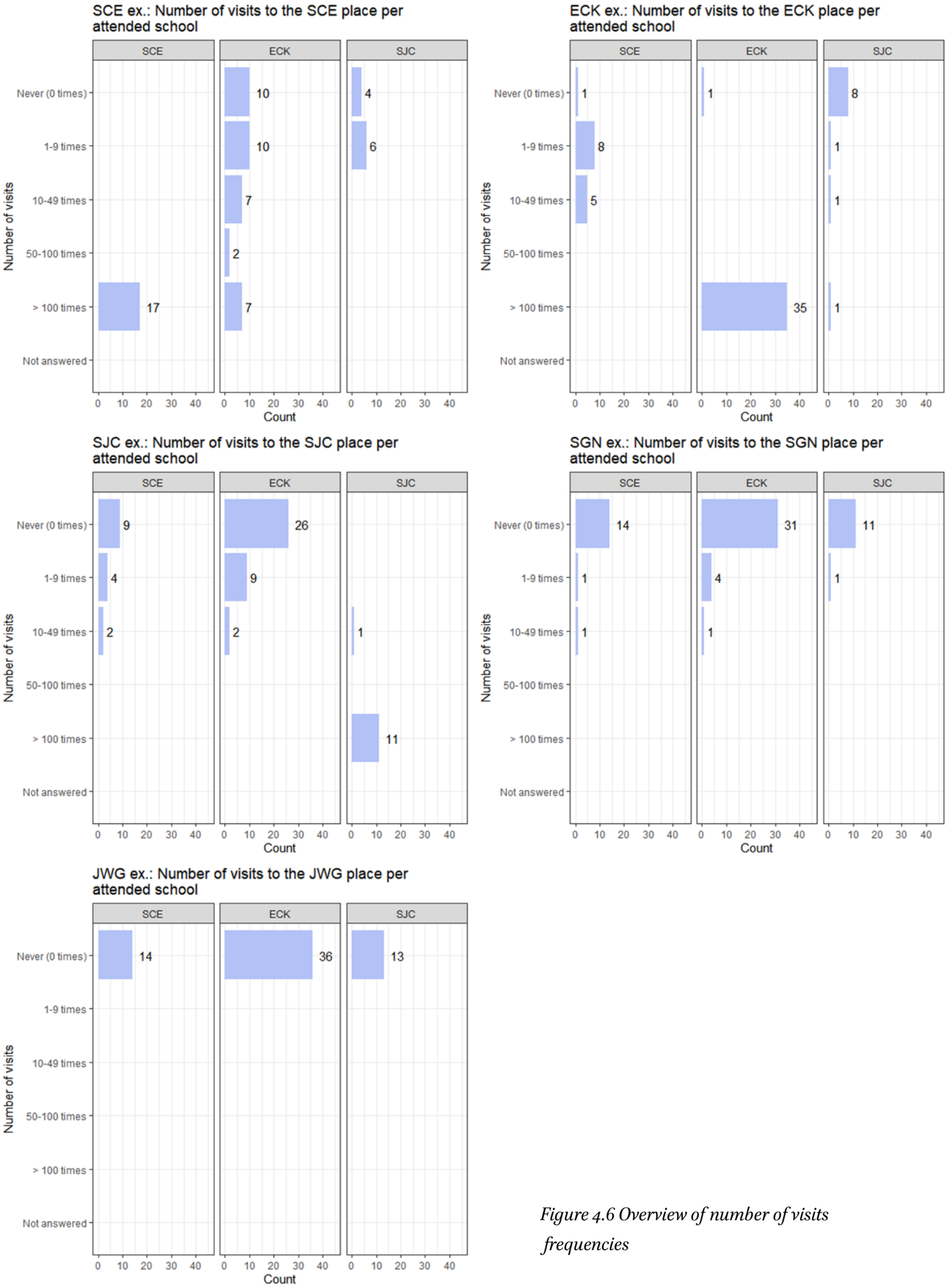


Figure 4.6 Overview of number of visits frequencies

4.3.6 Work on a Secondary School and Device Used

Most people filled in the questionnaire on their laptop/computer, as illustrated in Figure 4.7, with one person per school's sub-group having used a mobile phone successfully for the mapping exercises. This differs widely from the distribution discussed in the NA-analysis in Section 4.1.3, where most participants who had incomplete mapping exercises filled in the questionnaire on their mobile phone.

Figure 4.8 illustrates the distribution of participants that have previously or currently worked for a secondary school, either in Eindhoven or elsewhere. Only three participants have worked for a secondary school in Eindhoven, while five have worked for a secondary school outside of Eindhoven.

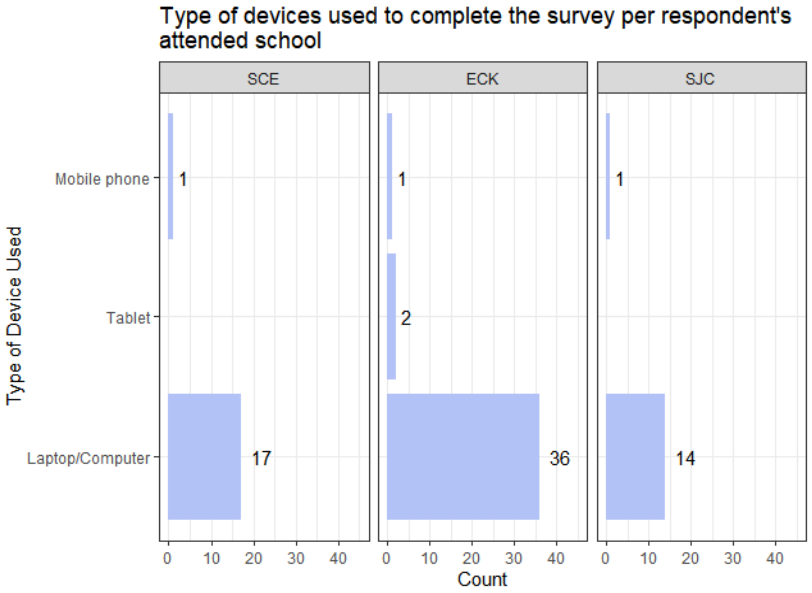


Figure 4.7 Overview of used devices for the questionnaire

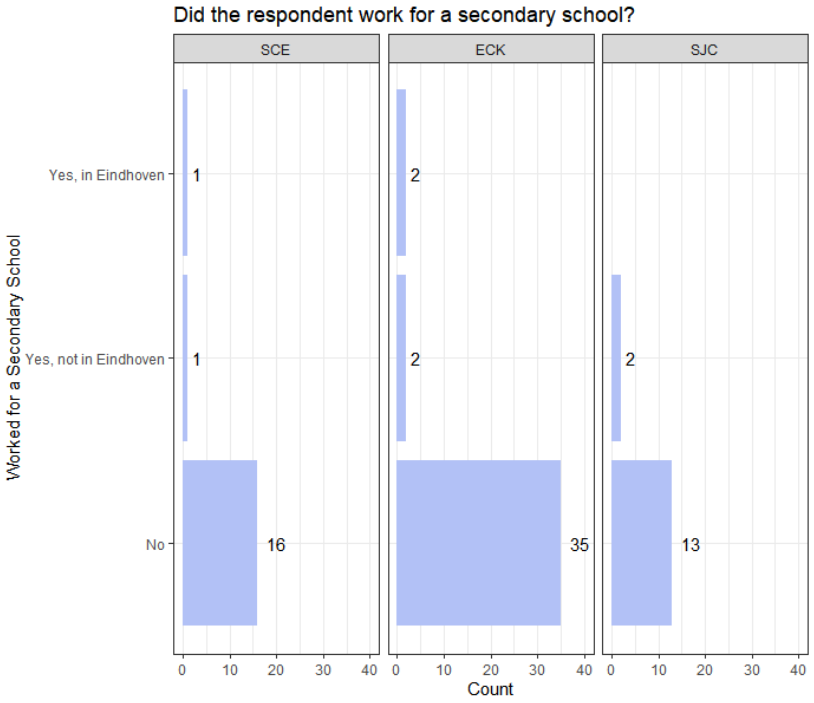


Figure 4.8 Overview of work for a secondary school

4.4 Linear Mixed Model Analysis

This section tests the relationships between the dependent variables of mapping behaviour (Number of Nodes, Time Spent and Mapped Area) and the various independent variables through the use of linear mixed models. First, baseline models were generated that included no predictors. Next, 'optimal fit models' were fitted and lastly the hypotheses from Section 4.4.2 were tested.

Unless otherwise stated, all statistical models discussed in this section shared model characteristics. All models are linear mixed models and were calculated using the 'lmer' function from the 'lme4' R package (Bates, Maechler, Bolker, & Walker, 2015). They were estimated through maximum likelihood and 'nloptwrap'. The p-values were calculated with Satterthwaite degrees of freedom and judged on significance on a 95% confidence level (α=0,05). The restricted maximum likelihood (REML) was disabled, so that the models sharing a dependent value could be compared to one another. All models were random intercept, fixed slope models (the variables that were eligible for inclusion as a random intercept were tested for model fit, but this did not lead to better model fit for any of the variables). The Participant's questionnaire ID was used as the cluster variable for all models. Lastly, the 'report' function in R from the report package was used for the statistical reports (Makowski, Lüdecke, Patil, Thériault, Ben-Shachar & Wiernik, 2023).

4.4.1 The Baseline Models

The following subsections briefly discuss the statistical results of the baseline models that were used throughout the chapter to compare the fitted models to. These baseline models do not include any predictor variables and purely show the results for the dependent mapping behaviour variable and the cluster variable, participant ID. Additionally, the model assumptions were checked for each dependent variable (see Appendix A). These results were deemed acceptable.

Number of Nodes: Baseline

An intercept only linear mixed model was fitted for the variable 'Number of Nodes' where the participant ID was included as the random effect cluster variable. The model's intercept was at 8,84 nodes (95% CI [8,21; 9,48], SE=0,32, p<0.001). The total conditional R^2 was 0,42 with AIC=1588,2 and BIC=1599,4. The ICC was 0,42, indicating that 42% of the variance was due to the grouping variable (Participant's ID). In other words, the variance for the number of used nodes can in a moderate fashion be explained by an individual participant's repeated behaviour. It is therefore crucial that linear mixed models were used that account for this grouping effect.

Time Spent: Baseline

An intercept only linear mixed model was fitted for the variable 'Time Spent' (measured in seconds) where the participant ID was included as the random effect cluster variable. The model's intercept was at 83,7 seconds (95% CI [75,0; 92,3], SE=4,4, p<0.001). The total Pseudo-R^2=0,15 with AIC=3396,2 and BIC=3407,4. The ICC was 0,15, a fairly low score, meaning that the time spent by participants on

their various mapping exercises varied and was more dissimilar and varied for the different mapping exercises.

Mapped Area: Baseline

An intercept only linear mixed model was fitted for the variable 'Mapped Area' (measured in square meters) where the participant ID was included as the random effect cluster variable. The model's intercept was at 23093 sqm (95% CI [21463; 24723], SE=828, p<0.001). The AIC equals 6738,1 and BIC equals 6749,2. It was important to note that this specific model gave a 'singular fit' warning message, as this was the simplest form of the model, the warning was dismissed (more complex models with this dependent variable do not give the same warning). This however meant that the R^2 and ICC could not accurately be computed.

4.4.2 Optimal Fit Model Testing

A process of individual variable elimination was applied to find the optimal fit model. Starting with a model including all variables, each variable was individually removed and compared for the lowest AIC and BIC. That variable was then removed, and the process repeated until the AIC and BIC could not be improved anymore (Shinaberger, 2017). The individual optimal fit models for each of the three dependent mapping behaviour variables are discussed below and are split by an optimal model for the AIC and for the BIC, as these often disagreed on what variables to include for the best fit. The optimal AIC was reached by eliminating less variables than for the optimal fit regarding the BIC.

Number of Nodes: Optimal Fit Model

The AIC and BIC did not fully agree on the best fit model, with one variable difference (see the illustration to the right and Table 4.16). Regarding the AIC, the full model (without any rounds of elimination) already fitted the data better than the baseline model. Consulting the BIC, the model fit better than the baseline model when the variables 'Number of Visits', 'Gender', 'Map Use Frequency' and 'Mapping Experience' were removed.

The best AIC fit was reached by eliminating variables 1 until 7 as listed in the illustration to the right. The lowest AIC was thus achieved by retaining the PRS, age and level of education in the model (AIC=1549,0; BIC=1586,2). The total explanatory power of the model was 0,48 (conditional R^2), of which 0,19 was due to the fixed effects (marginal R^2). Not all included categories in the model had a significant effect on the number of nodes. Only the PRS, 25–44-year-olds and educational level Havo had a

Order of variable elimination for Number of Nodes Optimal Fit Model

1. Number of Visits
2. Gender
3. Map Use Frequency
4. Experience with Maps
5. Map. Ex. in Eindhoven
6. Familiarity with Eindhoven
7. Attended School of the Ex.
8. Age

(1 variable difference between best AIC and best BIC)

Table 4.16 'Number of Nodes' Optimal Fit Model by AIC and BIC

OPTIMAL FIT MODEL NUMBER OF NODES				
	Estimate	**Standard Error**	**p-value**	**95% CI**
Number of Nodes (optimal for AIC)				
Intercept (20-24 y/o, university, PRS=0)	5,87	0,86	0,00	4,17 - 7,56
PRS	0,02	0,01	0,00	0,00 - 0,03
Age: 25-44 y/o	2,42	0,85	0,01	0,75 - 4,09
Age: 45-64 y/o	1,58	0,89	0,08	-0,17 - 3,33
Education: Havo	5,78	1,22	0,00	3,37 - 8,18
Education: Vwo	1,98	1,34	0,15	-0,66 - 4,62
Education: Mbo	-0,48	1,53	0,75	-3,49 - 2,53
Education: Hbo	1,23	0,68	0,08	-0,12 - 2,57
Number of Nodes (optimal for BIC)				
Intercept (20-24 y/o, university, PRS=0)	8,37	0,35	0,00	7,68 - 9,06
PRS	0,02	0,01	0,00	0,01 - 0,03

significant and positive effect. From these, the effect of Havo graduates were highest, with a positive beta of +5,78 in addition to the intercept. It should however be noted that this category did not have many participants (n=6). The effect of 25–44-year-olds was also substantial, with a significant beta of +2,42 added to the intercept when a participant belonged to this group. The ICC=0,36, which decreased compared to the baseline model, indicating that some of the similarities in the used number of nodes between mapping exercises of the same participant were explained through the included fixed effects.

The best BIC fit was reached by also eliminating the variable of 'age' (AIC=1558,6; BIC=1573,4). Here, the model had substantial explanatory power, with a conditional R^2 of 0,47. 0,04 was due to the included fixed effects of the PRS. Only 'PRS' had a significant relationship with the intercept (that assumed PRS=0), for every increase in PRS, +0,02 nodes were placed, only a small increase.

Time Spent: Optimal Fit Model

The AIC and BIC did not agree on the best fit model, with four variables difference (see the illustration to the right and Table 4.17). The model with one round of elimination (Number of Visits) fit the data better than the baseline model based on the AIC, whereas the model needed two rounds of elimination to fit better based on the BIC (Number of Visits and Map Use Frequency).

The best AIC fit was reached by eliminating 'Number of Visits', 'Map Use Frequency' and 'Familiarity with Eindhoven'

Order of variable elimination for Time Spent Optimal Fit Model

1. Number of Visits
2. Map Use Frequency
3. Familiarity with Eindhoven

4. Level of Education
5. Age
6. Map. Ex. in Eindhoven
7. Experience with Maps

(4 variables difference between best AIC and best BIC)

Table 4.17 'Time Spent' Optimal Fit Model by AIC and BIC

OPTIMAL FIT MODEL TIME SPENT				
	Estimate	Standard Error	p-value	95% CI
Time Spent (optimal for AIC)				
Intercept (PRS=0, experience maps=0, woman, university, 20-24 y/o, ex. in Eindhoven, ex. not attended)	65,38	17,54	0,00	30,86 - 99,90
PRS	0,08	0,20	0,68	-0,31 - 0,48
Gender: Man	-0,64	8,00	0,94	-16,39 - 15,11
Gender: Non-Binary	111,51	22,11	0,00	67,99 - 155,02
Education: Havo	49,29	15,16	0,00	19,45 - 79,13
Education: Vwo	7,50	16,70	0,66	-25,37 - 40,36
Education: Mbo	-12,23	19,77	0,54	-51,14 - 26,69
Education: Hbo	15,13	8,51	0,08	-1,61 - 31,87
Age: 25-44 y/o	17,87	10,58	0,10	-2,95 - 38,69
Age: 45-64 y/o	25,42	11,36	0,03	3,06 - 47,77
Experience with maps	-0,32	0,19	0,09	-0,68 - 0,05
Mapping ex. not in Eindhoven	14,28	8,04	0,08	4,59 - 64,99
Attended school of the ex.	34,79	15,34	0,02	-1,54 - 30,09
Time Spent (optimal for BIC)				
Intercept (PRS=0, experience maps=0, woman, university, 20-24 y/o, ex. in Eindhoven, ex. not attended)	74,81	5,64	0,00	63,72 - 85,91
PRS	-0,1	0,18	0,60	-0,46 - 0,26
Gender: Man	-0,66	8,30	0,94	-16,99 - 15,66
Gender: Non-Binary	101,09	24,43	0,00	53,02 - 149,17
Attended school of the ex.	41,11	15,39	0,01	10,82 - 71,39

(AIC=3336,4; BIC=3392,1). The total explanatory power of the model was moderate (conditional R^2=0,22), where 0,19 was due to the fixed effects (marginal R^2). Interestingly, none of the removed variables for the AIC model consisted of personal demographic characteristics, which thus contributed more towards the final best AIC/BIC score. The final optimal fit model included seven different variables, of which four categories had a significant effect on the time spent intercept. The largest, positive, effect came from 'Gender: Non-Binary', with a beta of +111,51 seconds. It should however be noted that this category only consisted of two participants. Next, participants that graduated from Havo education had a significant, positive beta of +49,29 seconds. There were no significant negative relationships. When the participant thus belonged to one of the significant categories (or with an increase of one for PRS), they tended to spend more time on the mapping exercises, which also applies to past attendees.

The lowest BIC was reached by eliminating the variables 'Level of Education', 'Age', 'Mapping Experiment in Eindhoven' and 'Experience with Maps' (AIC=3341,1; BIC=3367,1). The model had a total explanatory power of 0,20 (conditional R^2), where 0,11 was due to the fixed effects only. The variables 'PRS', 'Gender' and 'Attended School of the Exercise' were the only variables left in the model. From these, only the categories of non-Binary participants and participants that attended the school of the mapping experiment were significant. Similar to the other optimal fit models (except for 'Mapped Area: Optimal Fit Model [BIC]) the relationship with PRS was not significant, even though this variable negatively impacted the AIC and BIC when left out.

OPTIMAL FIT MODEL MAPPED AREA				
	Estimate	**Standard Error**	**p-value**	**95% CI**
Mapped Area (optimal for AIC)				
Intercept (PRS=0, visited 0 times, familiarity Eindhoven=0, experience maps=0, ex. in Eindhoven, daily map use)	31840,81	3435,45	0,00	25079 - 38602
PRS	11,97	36,66	0,74	-60 - 84
Number of Visits: 1-9 times	390,10	1866,85	0,84	-3284 - 4064
Number of Visits: 10-49 times	6668,92	2621,80	0,01	1508 - 11829
Number of Visits: 50-100 times	10573,90	6215,97	0,09	-1660 - 22808
Number of Visits: 100+ times	8267,96	3089,01	0,01	2188 - 14348
Familiarity with Eindhoven	78,59	33,00	0,02	14 - 144
Experience with maps	-97,32	32,08	0,00	-160 - -34
Mapping ex. not in Eindhoven	-17616,3	1360,84	0,00	-20595 - -15238
Map use frequency: weekly	-4791,28	1468,70	0,00	-7682 - -1901
Map use frequency: monthly	-4679,26	2305,82	0,05	-9218 - -141
Maped Area (optimal for BIC)				
Intercept (PRS=0, mapping ex. in Eindhoven)	27410,98	1036,43	0,00	25371 - 29451
PRS	105,36	17,10	0,00	72 - 139
Mapping ex. not in Eindhoven	-18233,4	1200,42	0,00	-20596 - -15871

Table 4.18 'Mapped Area' Optimal Fit Model by AIC and BIC

Mapped Area: Optimal Fit Model

The AIC and BIC did not agree on the best fit model, with four variables difference (see the illustration to the right and Table 4.18). The full model without any rounds of elimination already fit the data better than the baseline model, as indicated by a lower AIC and BIC.

Order of variable elimination for Mapped Area Optimal Fit Model

1. Level of Education
2. Age
3. Gender
4. Attended School of the Ex.

5. Number of Visits
6. Familiarity with Eindhoven
7. Map Use Frequency
8. Experience with Maps

(4 variables difference between best AIC and best BIC)

The best AIC fit was reached by eliminating 'Level of Education', 'Age', 'Gender' and 'Attended School of the Exercise' (AIC=6375,4; BIC=6423.7). The total explanatory power of the model was substantial, with a conditional R^2 of 0,68. 0,65 was due to the included fixed effects alone. Interestingly, the three demographics variables had to be removed first, followed by more of the personal geographic characteristics variables. The final optimal fit model for explaining the mapped area size based on the AIC thus included the variables: 'PRS', 'Number of Visits', 'Familiarity with Eindhoven', 'Experience with Maps', 'Mapping exercise in Eindhoven', 'Map use Frequency'. Besides the variables 'PRS', 'Number of Visits: 1–9 times' and 'Number of Visits: 50–100 times', all categories had a significant ($p \leq 0,05$) effect on the Mapped Area that differed from the intercept (that assumed PRS=0, visited 0 times, familiarity Eindhoven=0, experience with maps=0, the exercise was in Eindhoven and map use frequency was daily). From the model input, the 'mapping exercise is not located in Eindhoven' had the largest significant effect with a beta of -17616

sqm, indicating that participants mapped the exercises not located in Eindhoven (SGN and JWG) significantly smaller. The map use frequency and level of mapping experience also had significant, negative relationships with the mapped area intercept, where the mapped area sizes decreased with the change in mapping frequency and increased mapping experience. Interestingly, the 'PRS' variable had a non-significant relationship, as it was observed that this variable had the most effect on improving the AIC and BIC during model fitting.

The lowest BIC was reached by also eliminating the variables 'Number of Visits', 'Familiarity with Eindhoven', 'Map Use Frequency' and 'Experience with Maps' (AIC=6385,5; BIC=6404,1). The model had a total explanatory power of 0,67 (conditional R^2), where 0,61 was due to the fixed effects only. The variables 'PRS', and 'Mapping Exercise in Eindhoven' were the only variables left in the optimal fit model. Both of these had a significant effect on the intercept (that assumed PRS=0 and that the mapping experiment was located in Eindhoven). For every increase in PRS, the mapped area size also increased, whereas when the mapping exercise was not located in Eindhoven, the total mapped area size decreased.

Model Summary

Comparing the optimal fit models for each mapping behaviour variable, it was noticeable that each model had a different best fit based on the AIC and BIC, twice consisting of a four variables difference and once by a one variable difference. Overall, the AIC best fit models included more variables and had higher total explained variance. Of the model pairs for each mapping behaviour variable, each pair included at least one variable that was excluded by both other model pairs (e.g., 'Gender' and 'Attended School of the Ex.' included for Time Spent model, 'Education' only included for 'Number of Nodes' and 'Mapping ex. in Eindhoven' included only for Mapped Area. Not all models exclude the variables in the same order, but positions were often comparable. Interestingly, 'PRS' was the only variable that was never excluded from the optimal fit models. During the model fitting, it was noticed that excluding this variable often led to the most negative change in AIC/BIC fit. Regardless, PRS returned non-significant in the optimal fit models, except for the Mapped Area optimal BIC model.

4.4.3 Hypothesis Testing

Section 3.5.3 has introduced an overview of hypotheses, which will be statistically tested next through the application of linear mixed models. Please note that hypothesis one was already discussed in Section 4.2.3.

> ***H2.*** *A relationship exists between the PRS for each location and the total Number of used Nodes/Mapped Area Size/Time Spent per location's mapping exercise.*

For the following models using PRS as the predictor, PRS was not included as a random effect. Based on the AIC and BIC, this made the model fit less well for all three dependent variables in comparison with including it solely as a fixed effect.

Number of Nodes: PRS

The variable 'Number of Nodes' was predicted using the PRS. The total explanatory power of the model was substantial (conditional R^2=0,47), but increased little over the baseline model. The marginal R^2 for the fixed effects was only 0,03. The intercept (assumed PRS=0) estimate was 8,37 nodes (95% CI [7,7; 9,1], SE=0,35, p<0,001). The effect of PRS on Number of Nodes was statistically significant and positive, with a small beta estimate of 0,02 nodes (95% CI [0,01, 0,03], SE=5,2, p<0,001). Indicating that participants tended to use more nodes when PRS increased. The model fit improved somewhat, with AIC=1558,6 and BIC=1573,4, which was lower than the baseline model and thus preferred.

Time Spent: PRS

'Time Spent' was predicted using PRS. The model moderately explained the total variance (conditional R^2=0,20), while the fixed effect marginal R^2 was small (marginal R^2=0,03). The model intercept (assumed PRS=0) was 75,3 seconds (95% CI [65,1; 85,5], SE=5,19, p<0,001). The effect of PRS was statistically significant and positive (beta=0,33, 95% CI [0,1; 0,5], SE=0,10, p<0,001). The model fit was better than that of the baseline model, with AIC=3356,3 and BIC=3371,2.

Mapped Area: PRS

The variable 'Mapped Area' was predicted using PRS. The model explained a substantial 36% of total variance (conditional R^2=0,36), with the fixed effects contributing 0,36 of this value (marginal R^2=0,35). The model intercept (with PRS=0) was 16812 sqm (95% CI [15103; 18521], SE=868, p<0,001). The effect of PRS was statistically significant and positive (beta=247, 95% CI [209; 285], SE=19, p<0,001). The model fit was better than for the baseline, as favoured by the lower AIC of 6548 and lower BIC of 6563.

Hypothesis Summary: PRS

The above models have provided evidence for a relationship between the three mapping behaviour variables: number of used nodes, the time spent on the mapping exercise and the total mapped area size. The hypothesis is thus accepted. Overall, the models have shown that for every increase in PRS, the number of nodes, time spent on the exercise and mapped area size also increased.

> ***H3.*** *A relationship exists between the Number of Visits to each location and the total Number of used Nodes/Mapped Area Size/Time Spent per location's mapping exercise.*

The variable 'Number of Visits' was included solely as a fixed effect, as the AIC and BIC indicated a better model fit than when it was also included as a random effect. The output of the models is illustrated in Table 4.19.

NUMBER OF VISITS				
	Estimate	Standard Error	p-value	95% CI
Number of Nodes				
Intercept (visited 0 times)	8,44	0,35	0,00	7,75 - 9,12
Visited 1-9 times	0,02	0,50	0,96	-0,96 - 1,01
Visited 10-49 times	0,31	0,71	0,66	-1,09 - 1,71
Visited 50-100 times	-1,03	2,03	0,61	-5,03 - 2,97
Visted 100+ times	1,64	0,38	0,00	0,89 - 2,39
Time Spent (sec)				
Intercept (visited 0 times)	78,71	5,18	0,00	68,51 - 88,90
Visited 1-9 times	-10,39	10,38	0,32	-30,82 - 10,03
Visited 10-49 times	-10,24	14,56	0,48	-38,89 - 18,42
Visited 50-100 times	6,45	41,76	0,88	-75,72 - 88,63
Visted 100+ times	29,13	7,99	0,00	13,40 - 44,86
Mapped Area (sqm)				
Intercept (visited 0 times)	15308	855	0,00	13625 - 16990
Visited 1-9 times	12920	1947	0,00	9089 - 16751
Visited 10-49 times	19465	2707	0,00	14138 - 24791
Visited 50-100 times	22717	7778	0,00	7411 - 38023
Visted 100+ times	21371	1523	0,00	18374 - 24368

Table 4.19 Overview of the linear mixed model output with 'Number of Visits' as the predictor

Number of Nodes: Number of Visits

'Number of nodes' was predicted through the 'Number of Visits' variable. The total variance explained was substantial (conditional R^2=0,46), but only 0,04 was added through the fixed effect of number of visits. The model's intercept (where number of visits equals 'never visited') equalled 8,44 nodes. Within the model, three of the remaining four levels of 'number of visits' were non-significant, while only the category for 'visited 100+ times' was significant and positive. Thus, the placed number of nodes when a participant visited the place of the mapping exercise 100+ times differed significantly from when they never visited the place by +1,64 nodes compared to the intercept. However, comparing the model fit with the baseline model, it was ambiguous which model was favoured with a slight decrease in the AIC (AIC=1576,9) and increase in the BIC (BIC=1602,9).

Time Spent: Number of Visits

'Time Spent' on the mapping exercise was also predicted through 'Number of Visits' to the place of the mapping experiment. The model's explanatory power was moderate (conditional R^2=0,20), while the part related to the fixed effects alone (marginal R^2) was 0,05. The model's intercept (assumed the participant never visited the place of the mapping experiment) was 78,71 seconds. Similar to the 'Number of Nodes: Number of Visits' model, only one category was statistically significant and positive, that of 100+ visits. Here, participants took +29,13 seconds longer to complete the mapping exercise then when they had never visited the place. However, similar to the previous model, when comparing the model fit to the baseline model, it remained ambiguous which model was preferred.

With a slightly decreased AIC (AIC=3386,66) and a slightly increased BIC (BIC=3412,72) for the Number of Visits model.

Mapped Area: Number of Visits

Mapped area was predicted through 'Number of Visits', with substantial explanatory power (conditional R^2=0,45). 0,43 of the explained variance was due to the fixed effect of Number of Visits (marginal R^2). The model's intercept (where the participant never visited the place) was at 15308 sqm and was significant. Within the model, all other categories for 'number of visits' were also significant, indicating that every category of Number of Visits differed from the 'never visited' category in the mapped area size. The confidence intervals were however quite large, which might indicate that these results were less trustworthy and more likely due to chance. This model was clearly favoured over the baseline model based on the AIC (AIC=6575,5) and BIC (BIC=6601,6).

Hypothesis Summary

For the mapping behaviour variables 'Number of Nodes' and 'Time Spent', there was evidence that suggested a significant relationship when the participant had visited the place in question 100+ times, but not when they visited the place less. The relationships in question were positive in both cases, meaning that the number of placed nodes and time spent on the exercise increased compared to never having visited the place. However, the model fit for these models was ambiguous, indicating that leaving out 'Number of Visits' as a predictor made the model fit the data better. For the 'Mapped Area' variable this was different, where every category of 'Number of Visits' differed in the mapped area size from the reference category of 'never visited'. This model fit suggested that including the Number of Visits variable improved the model fit, as opposed to the previous two models for Number of Visits. The hypothesis can thus (partly) be accepted.

H4. *A relationship exists between the respondent's age and the total Number of used Nodes/Mapped Area Size/Time Spent per location's mapping exercise.*

The variable 'age' was included as a fixed effect only. The output of the models is illustrated in Table 4.20.

Number of Nodes: Age

'Number of Nodes' was predicted using the participant's age, which explained 0,42 of the total variance (conditional R^2=0,42), only 0,01 was due to the fixed effect of age (marginal R^2). The model's intercept assumed that the age category was 20–24 years old and had an estimate of 8,61 nodes. As reflected in Table 4.20, no other age category in the model had a statistically significant effect on the number of placed nodes. The model fit the data less well than the baseline model, as shown by the higher AIC (AIC=1591,3) and BIC (BIC=1609,9).

AGE				
	Estimate	Standard Error	p-value	95% CI
Number of Nodes				
Intercept (20-24 y/o)	8,61	0,56	0,00	7,50 - 9,72
25-44 y/o	0,57	1,74	0,45	-0,90 - 2,03
45-64 y/o	-0,08	0,87	0,93	-1,78 - 1,62
Time Spent (sec)				
Intercept (20-24 y/o)	81,35	7,79	0,00	66,02 - 96,69
25-44 y/o	1,86	10,21	0,86	-18,22 - 21,95
45-64 y/o	6,22	11,93	0,60	-17,26 - 29,69
Mapped Area (sqm)				
Intercept (20-24 y/o)	23378	1478	0,00	20470 - 26286
25-44 y/o	58	1924	0,98	-3728 - 3845
45-64 y/o	-1326	2257	0,56	-5767 - 3116

Table 4.20 Overview of the linear mixed model output with 'age' as a predictor

Time Spent: Age

The 'Time Spent' variable was predicted through using age and only had moderate explanatory power (conditional R^2=0,14), of which 0,01 due to the fixed effect of age (marginal R^2). The intercept assumed the age category of 20–24 years old and had an estimate of 81,35 seconds. No other age category had a significant effect on time spent. This model using age as a predictor fit the data less well than the baseline model, with a higher AIC of 3399,9 and BIC of 3418,5.

Mapped Area: Age

For the mapped area size model predicted through age, it is important to note that the model returned a singularity warning. This means that the R^2 could not be computed. Just like the other two models predicted with age, no additional age category within the model returned significant. Comparing the model fit to the baseline model, the AIC and BIC prefer the latter. These were higher for the Age model (AIC=6741,6; BIC=6760,2).

Hypothesis Summary

The above models provided no evidence of a relationship between the age categories present in the data and the mapping behaviour through the number of placed nodes, time spent on the exercise and mapped area size. Also, the model fit for each of the three models proved better without adding age as a sole predictor in the model. The hypothesis is thus refuted.

H5. *No relationship exists between the gender of respondents and the total Number of used Nodes/Mapped Area Size/Time Spent per location's mapping exercise.*

The variable 'gender' was included as a fixed effect only. The model output is illustrated in Table 4.21.

Table 4.21 Overview of the linear mixed model output with 'Gender' as a predictor

GENDER				
	Estimate	Standard Error	p-value	95% CI
Number of Nodes				
Intercept (Woman)	8,81	0,42	0,00	7,99 - 9,64
Man	0,14	0,67	0,83	-1,17 - 1,46
Non-Binary	-0,92	1,96	0,64	-4,78 - 2,94
Time Spent (sec)				
Intercept (Woman)	81,19	5,09	0,00	71,17 - 91,21
Man	-0,80	8,30	0,92	-17,13 - 15,52
Non-Binary	97,83	24,70	0,00	49,23 - 146,43
Mapped Area (sqm)				
Intercept (Woman)	23004	1058	0,00	20923 - 25086
Man	-125	1733	0,94	-3536 - 3285
Non-Binary	5116	5223	0,33	-5161 - 15394

Number of Nodes: Gender

Gender was used to predict the number of placed nodes. The total explained variance was 0,42, (conditional R^2) of which zero was explained through the fixed effect of gender (marginal R^2). The model's intercept assumed 'woman' as the reference category and had an estimate of 8,81 nodes. No other gender category had a significant effect on the Number of Nodes. Based on the AIC and BIC, the baseline model was preferred and fit the data better than when gender was included as a predictor, the AIC and BIC were both higher for the model including gender (AIC=1591,3; BIC=1609,9).

Time Spent: Gender

Gender was used to predict the time spent on the mapping exercise. The total explained variance was 0,14 (conditional R^2) of which 0,06 was explained through the fixed effect of gender (marginal R^2). The model's intercept assumed that the participant is a woman and had an estimate of 81,19 seconds. Only the non-binary category had a significant effect, but as this category only consisted of two people, this result was not sufficiently valid and therefore ignored. Based on the AIC and BIC, the baseline model was preferred and fit the data better than when gender was included as a predictor (AIC=3399,9; BIC=3418,5).

Mapped Area: Gender

For the mapped area size model predicted through gender, it is important to note that the model returned a singularity warning, there was thus no variance explained (and ICC) computed. The model's intercept assumed that the participant is a woman and had an estimate of 22799 sqm. No other gender category had a significant effect. Based on the AIC and BIC, the baseline model was preferred and fit the data better than when gender was included as a predictor (AIC=6741,6; BIC=6760,2).

LEVEL OF EDUCATION				
	Estimate	Standard Error	p-value	95% CI
Number of Nodes				
Intercept (University)	8,37	0,44	0,00	7,50 - 9,24
Havo	4,12	1,08	0,00	1,99 - 6,25
Vwo	-0,02	1,11	0,99	-2,20 - 2,17
Mbo	-1,49	1,50	0,32	-4,43 - 1,46
Hbo	0,50	0,66	0,44	-0,79 - 1,80
Time Spent (sec)				
Intercept (University)	77,98	6,37	0,00	65,43 - 90,52
Havo	34,14	15,53	0,03	3,58 - 64,71
Vwo	-11,51	16,15	0,48	-43,29 - 20,28
Mbo	-19,09	21,90	0,39	-62,18 - 24,00
Hbo	11,95	9,45	0,21	-6,64 - 30,54
Mapped Area (sqm)				
Intercept (University)	22799	1252	0,00	20334 - 25264
Havo	1875	3039	0,54	-4106 - 7856
Vwo	-696	3193	0,83	-6979 - 5588
Mbo	-7207	4338	0,10	-15745 - 1330
Hbo	1283	1853	0,49	-2364 - 4930

Table 4.22 Overview of the linear mixed model output with 'Level of Education' as a predictor

Hypothesis Summary

There was no significant evidence that gender affected the mapping behaviours through the number of placed nodes, time spent and mapped area size. The baseline models fit the data better than when gender was included as a predictor. The hypothesis is therefore accepted.

H6. *A relationship exists between the level of completed education and the total Number of used Nodes/Mapped Area Size/Time Spent used per location's mapping exercise.*

'Level of Education' was included as a fixed effect only. The model output can be viewed in Table 4.22.

Number of Nodes: Level of Education

'Number of Nodes' was predicted with the participant's completed level of education. Using this predictor, the total explanatory power of the model was substantial (conditional R^2=0,43), of which 0,11 was due to the fixed effects (marginal R^2). The model's intercept (assumed the level of education was 'university') was at 8,37 nodes. Only the level of education 'havo' was significant in this model, which had a positive effect of +4,12 nodes in comparison with the group of university graduates. Comparing the model fit to the baseline model, it was ambiguous which model was preferred. The AIC for the Education model was lower (AIC=1580,9), while the BIC was higher (BIC=1607,0).

Time Spent: Level of Education

'Time Spent' was predicted with the participant's completed level of education. Using this predictor, the total explanatory power of the model was only moderate (conditional R^2=0,15), of which 0,04 was due to the fixed effects (marginal R^2). The model's intercept (assumed the level of education was 'university') was at 77,98 seconds. Only the level of education 'havo' was significant in this model, which had a positive effect of +34,14 seconds in comparison with the group of university graduates. Comparing the model fit to the baseline model, the baseline model was favoured by the BIC, which was higher for the education model (BIC=3422,3). The AIC was the same for both models (AIC=3396,2).

Mapped Area: Level of Education

Like the other 'Mapped Area' models including a demographic variable, this model that predicts mapped area through level of education, also had a singularity warning; the explained variance and ICC can thus not accurately be computed. The model's intercept (assumed level of education was university) was at 22799 sqm. In contrast to the models for 'Number of Nodes' and 'Time Spent', no other educational category was significant. Assessing the model fit, the baseline model was preferred by the AIC and BIC, which were both higher for the Education model (AIC=6741,8; BIC=6767,9).

Hypothesis Summary

Overall, there seemed to be a lack of evidence to accept the hypothesis that there was a relation between mapping behaviour (as measured through number of placed nodes, time spent on the mapping exercise and mapped area size) and level of education for the educational categories present in the data. There was a slight suggestion for a significant effect and relationship for 'havo' graduates on the number of placed nodes and time spent on the exercises, but this was also contested due to the lacking model fit when using Education as a sole predictor.

H7. *A relationship exists between the level of Familiarity with Eindhoven and the total Number of used Nodes/Mapped Area Size/Time Spent per location's mapping exercise in Eindhoven; this relationship does not exist for the locations not in Eindhoven.*

The 'Familiarity with Eindhoven' variable was included as a fixed effect only.

Number of Nodes: Familiarity with Eindhoven

'Number of Nodes' was predicted using 'Familiarity with Eindhoven'. Together this explained 0,42 of the total variance (conditional R^2), while only 0,01 was explained through the fixed effect of familiarity with Eindhoven (marginal R^2). The model's intercept assumed the familiarity with Eindhoven was zero and was at 9,95 nodes (95% CI [7,24; 12,66], SE=1,38, p<0,001). The effect of familiarity with Eindhoven was non-significant (beta=-0,01, 95% CI [-0,05; 0,02], SE=0,02, p=0,41). Comparing the model fit to the baseline model, it was somewhat ambiguous which model better fit

the data. The AIC for the familiarity with Eindhoven model was slightly lower (AIC=1583,9), while the BIC was somewhat higher (BIC=1602,5).

Time Spent: Familiarity with Eindhoven

Time spent on the mapping exercise was predicted using 'Familiarity with Eindhoven'. Together, this explained 0,15 of the total variance (conditional R^2), while only 0,01 was explained through the fixed effect of familiarity with Eindhoven (marginal R^2). The model intercept assumed the familiarity with Eindhoven was zero and was at 112,0 seconds (95% CI [75,29; 148,79], SE=18,68, p<0,001). The effect of familiarity with Eindhoven was non-significant (beta=-0,36, 95% CI [-0,81; 0,09], SE=0,23, p=0,12). Comparing the model fit to the baseline model, it was ambiguous which model better fit the data. The AIC for the familiarity with Eindhoven model was slightly lower (AIC=3395,8), while the BIC was higher (BIC=3410,7).

Mapped Area: Familiarity with Eindhoven

The mapped area size was predicted using 'Familiarity with Eindhoven'. This model had a singularity warning, making it impossible to accurately calculate the variance and ICC. The model's intercept assumed Familiarity with Eindhoven equals zero and was at 18453 sqm (95% CI [11440; 25466], SE=3564, p<0,001). The effect of familiarity with Eindhoven was non-significant (beta=58,44, 95% CI [-27,49; 144,38], SE=44, p=0,18). Comparing the model fit to the baseline model, it remained ambiguous which model better fit the data. The AIC for the Familiarity with Eindhoven model was similar (AIC=6738,3), while the BIC was somewhat higher (BIC=6753,2).

Hypothesis Summary

The discussed models did not provide evidence to accept a relationship between the mapping behaviour variables and the level of familiarity with Eindhoven. Additionally, the model fit results also showed that there was often no added accuracy in model fit by just including 'Familiarity with Eindhoven' as a sole predictor. The hypothesis is thus not accepted.

H8. *If a respondent has attended the high school that they are performing the mapping exercise of, the total Number of used Nodes/Mapped Area Size/Time Spent for this location differs from respondents that have not attended the high school in this mapping exercise.*

The information about which mapping experiment was performed and on which school the participant has attended, were recoded into dummy variables. These variables 'Attended the school of the mapping experiment' (yes/no) and 'mapping experiment is located in Eindhoven' (yes: SCE, ECK, SJC; no: SGN, JWG) were tested for the three dependent variables on the best model fit and already provided better model fit than when the non-recoded information was used (categorical for attended school and location of the mapping experiment). For 'Number of Nodes' and 'Time Spent', the best model fit was achieved by only including the 'attended the school of the mapping experiment', while for 'Mapped Area' the combination of that variable plus the variable of 'mapping

experiment is located in Eindhoven' provided the best fit for the data. These best fit models are discussed below. They were all modelled as fixed effects only.

Number of Nodes: Attended School

'Number of Nodes' was predicted with the dummy coded variable 'attended the school of the mapping experiment'. Using this predictor, the total explanatory power of the model was substantial (conditional R^2=0,46), but only 0,03 was due to the fixed effect of attending the school of the experiment (marginal R^2). The model's intercept (assumed that the participant did not attend the school of the experiment) was at 8,49 nodes (95% CI [7,84; 9,14], SE=0,33, p<0,001). When the variable 'attended the school of the mapping experiment' assumed yes, the relationship was positive and significant (beta=1,63, 95% CI [0,89; 2,37], SE=0,38, p<0,001). Comparing the model fit to the baseline model, the fitted model was preferred by the lower AIC and BIC (AIC=1572,0; BIC=1586,9).

Time Spent: Attended School

'Time Spent' was predicted with the dummy coded variable 'attended the school of the mapping experiment'. Using this predictor, the total explanatory power of the model was moderate (conditional R^2=0,20), but only 0,05 was due to the fixed effect of attending the school of the experiment (marginal R^2). The model's intercept (assumed that the participant did not attend the school of the experiment) was at 76,67 seconds (95% CI [67,41; 85,94], SE=4,71, p<0,001). When the variable 'attended the school of the mapping experiment' assumed yes, the relationship was positive and significant (beta=33,13, 95% CI [17,60; 48,67], SE=7,90, p<0,001). Comparing the model fit to the baseline model, the fitted model was preferred by the lower AIC and BIC (AIC=3381,2; BIC=3396,1).

Mapped Area: Attended School and Location of the School

'Mapped Area' was predicted with the dummy coded variables 'attended the school of the mapping experiment' and 'mapping experiment in Eindhoven'. Using these predictors, the total explanatory power of the model was substantial (conditional R^2=0,66) and 0,60 was due to the fixed effect of attending the school of the experiment (marginal R^2). The model's intercept (assumed that the participant did not attend the school of the experiment and the location of the mapping experiment was in Eindhoven [i.e., SCE, ECK & SJC) was at 29175 sqm (95% CI [27422; 30929], SE=891,10, p<0,001). When the variable 'attended the school of the mapping experiment' was set to yes and the location was still in Eindhoven, the relationship was positive and significant (beta=7487, 95% CI [4920; 10054], SE=1304, p<0,001). When the model assumed that the participant did not attend the school of the experiment and that the location of the experiment was not in Eindhoven (i.e., SGN & JWG) the relationship with mapped area size was negative and significant (beta=-19658, 95% CI [-21801; -17515], SE=1089, p<0,001). Comparing the model fit to the baseline model, the fitted model was preferred by the lower AIC and BIC (AIC=6452,9; BIC=6471,5).

Hypothesis Summary

There was evidence for a significant relationship between whether participants have or have not attended the school of the mapping experiment and their mapping behaviour as measured through the number of used nodes and the time spent on the exercise. For these variables the relationship with past attendees was positive, meaning that their number of used nodes and time spent on the exercise increased based on the fact that they attended the school they were performing the mapping exercise of. For the mapping behaviour variable 'Mapped Area' this was also the case, but the model fit the data better by including the second predictor variable of whether the place of the mapping experiment was located in Eindhoven or not. Here, a significant relationship was found when the location of the exercise was kept constant (in Eindhoven); past attendees mapped the area size differently from non-attendees in a positive way (the included area size increased). Additionally, when the mapping exercise was not located in Eindhoven (and participants did not attend these schools, thus SGN and JWG), the relationship was negative and significant. The total mapped area size for these locations was smaller than for those in Eindhoven. The hypothesis is thus accepted.

H9. *A relationship exists between the level of experience with mapping and the total Number of used Nodes/Mapped Area Size/Time Spent per mapping exercise.*

Number of Nodes: Mapping Experience

'Number of Nodes' was predicted through the level of mapping experience. This explained 0,42 of the total variance (conditional R^2), but only 0,003 was due to the fixed effect of mapping experience. The model's intercept (where mapping experience equalled zero) was at 9,65 nodes (95% CI [7,30; 12,01], SE=1,20, p<0,001). The effect of the level of mapping experience was non-significant (beta=-0,01, 95% CI [-0,04; 0,02], SE= 0,02, p=0,48). Comparing the model fit to the baseline model, the AIC and BIC preferred the latter. The AIC (AIC=1589,7) and BIC (BIC=1604,6) were both higher for the fitted model.

Time Spent: Mapping Experience

Time spent on the mapping exercise was predicted through the level of mapping experience. This explained 0,15 of the total variance (conditional R^2), but only 0,01 was due to the fixed effect of mapping experience. The model's intercept (where mapping experience equalled zero) was at 109,45 seconds (95% CI [77,47; 141,43], SE=16,25, p<0,001). The effect of the level of mapping experience was non-significant (beta=-0,35, 95% CI [-0,76; 0,07], SE= 0,21, p=0,10). Comparing the model fit to the baseline model, the preference was ambiguous. The AIC was lower for the mapping experience model (AIC=3395,5), while the BIC was somewhat higher (BIC=3410,4).

FREQUENCY OF MAP USE				
	Estimate	**Standard Error**	**p-value**	**95% CI**
Number of Nodes				
Intercept (Daily)	9,03	0,63	0,00	7,79 - 10,27
Weekly	-0,02	0,74	0,97	-1,48 - 1,44
Monthly	-1,63	1,16	0,16	-3,91 - 0,65
Time Spent (sec)				
Intercept (Daily)	80,67	8,77	0,00	63,41 - 97,94
Weekly	4,78	10,37	0,65	-15,62 - 25,18
Monthly	-0,59	15,92	0,97	-31,92 - 30,74
Mapped Area (sqm)				
Intercept (Daily)	25770	1641	0,00	22541 - 28998
Weekly	-3847	1939	0,05	-7663 - -32
Monthly	-2080	2935	0,48	-7855 - 3695

Table 4.23 Overview of the linear mixed model output with 'Frequency of Map Use' as a predictor

Mapped Area: Mapping Experience

Again, the model for mapped area had a singular boundary warning, so the variance and ICC was not computed. The model's intercept (assumed mapping experience was zero) was at 25792 sqm (95% CI [19727; 31858], SE=3082, p<0,001). The effect of mapping experience was non-significant (beta=-36,33, 95% CI [-115; 42], SE=40,0, p=0,36). Comparing the model fit to the baseline model, the AIC and BIC favoured the latter, the last two were both larger in the mapping experience model (AIC=6739,2; BIC=6754,1).

Hypothesis Summary

The discussed models did not provide evidence to accept a relationship between the mapping behaviour variables and the level of mapping experience. Additionally, the model fit results also showed that there was (almost) no added accuracy in model fit by just including mapping experience as a sole predictor. The hypothesis is thus not accepted.

> ***H10.*** *A relationship exists between the frequency of map use and the total Number of used Nodes/Mapped Area Size/Time Spent per mapping exercise.*

'Map Use Frequency' was modelled as a fixed effect. The model output can be viewed in Table 4.23.

Number of Nodes: Map Use Frequency

'Number of Nodes' was predicted with the participant's frequency of map use. Using this predictor, the total explanatory power of the model was substantial (conditional R^2=0,42), but only 0,02 was due to the fixed effect of map use frequency (marginal R^2). The model's intercept (assumed the map use frequency as 'daily') was at 9,03 nodes. None of the other frequency categories present in the data were significant. Comparing the model to the baseline model, the AIC and BIC favoured the latter. The AIC of 1589,8 and BIC of 1608,4 for the map use frequency model were larger than for the baseline model.

Time Spent: Map Use Frequency

'Time Spent' was predicted with the participant's frequency of map use. Using this predictor, the total explanatory power of the model was only moderate (conditional R^2=0,15), of which zero was due to the fixed effect of map use frequency (marginal R^2). The model's intercept (assumed the map use frequency as 'daily') was at 80,67 seconds. None of the other frequency categories present in the data were significant. Comparing the model to the baseline model, the AIC and BIC favoured the latter. The AIC of 3399,9 and BIC of 3418,5 for the map use frequency model were larger than for the baseline model.

Mapped Area: Map Use Frequency

The mapped area size was predicted through the map use frequency variable. Due to a singularity warning the variance and ICC could not accurately be computed. The model's intercept (assumed daily map use) was at 25770 sqm. The category of weekly map use was significant and negative (p=0,048). Indicating a significant difference in how participants that use maps weekly opposed to daily, mapped the area size. Again, the baseline model was favoured by the AIC and BIC, which were higher for the map use frequency model (AIC=6738,1; BIC=6756,7).

Hypothesis Summary

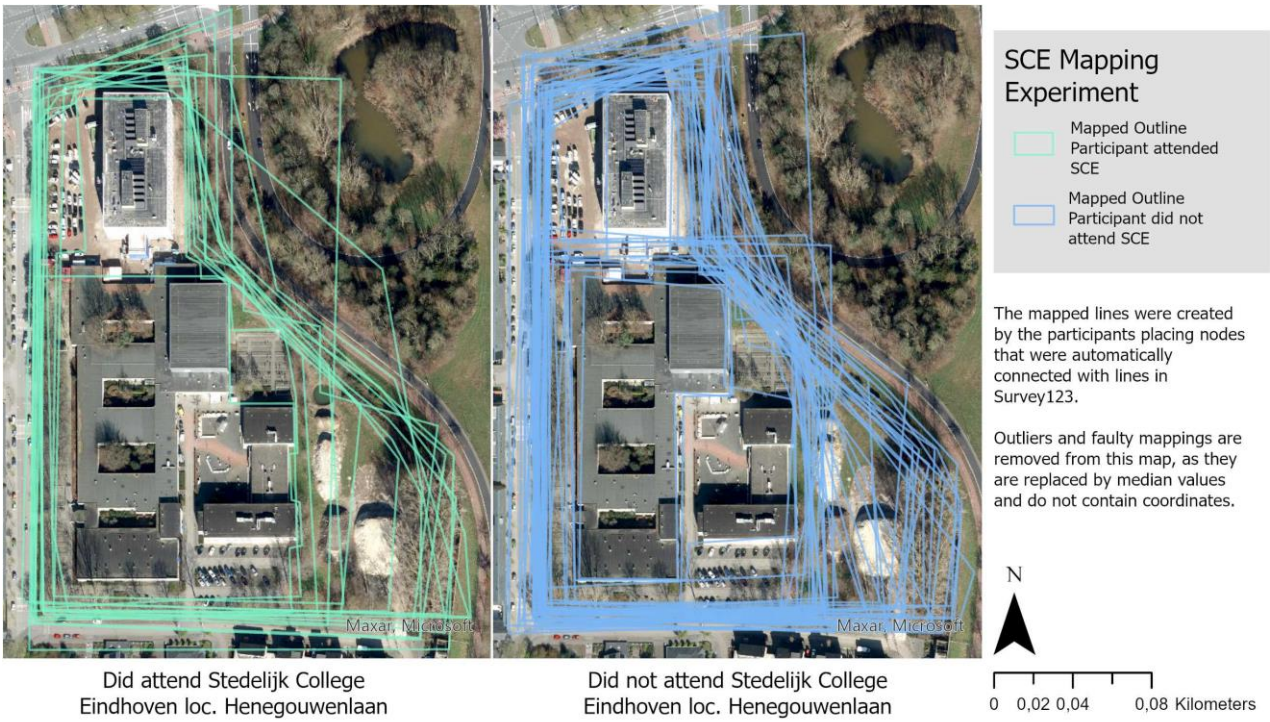
Again, no sufficient evidence was found for a relationship between the categories of map use frequency and the variables for mapping behaviour. The model fit assessment also suggested that not including map use frequency as the sole predictor provides a better fitted model. The hypothesis is thus not accepted.

H11. *A relationship exists between the type of device used and the total Number of used Nodes/Mapped Area Size/Time Spent per mapping exercise.*

There was not enough variance in the data to test this hypothesis using linear mixed models, but as discussed in Sections 4.1.3 and 4.3.6, people that wanted to participate in the mapping exercises via their mobile phone were often incapable of successfully submitting their data. This result was expected, although the warning at the beginning of the questionnaire to prevent people from participating through their mobile phone was anticipated to have a larger effect in preventing the faulty and non-responses. Based on these observations made by the NA-analysis and descriptive statistics, the hypothesis is accepted.

H12. *A relationship exists between the participants that are or were employed at a secondary school and the total Number of used Nodes/Mapped Area Size/Time Spent per mapping exercise.*

There was not enough variance in the data to accurately test this hypothesis using linear mixed models, complicating statistical assessment of the hypothesis. However, as seen in Section 4.3.6, the group of participants that has worked on a secondary school was small, and thus assumed to not affect the data set. The hypothesis can thus not fully be answered.



Map 4.5 Mapped Geometries SCE mapping exercise

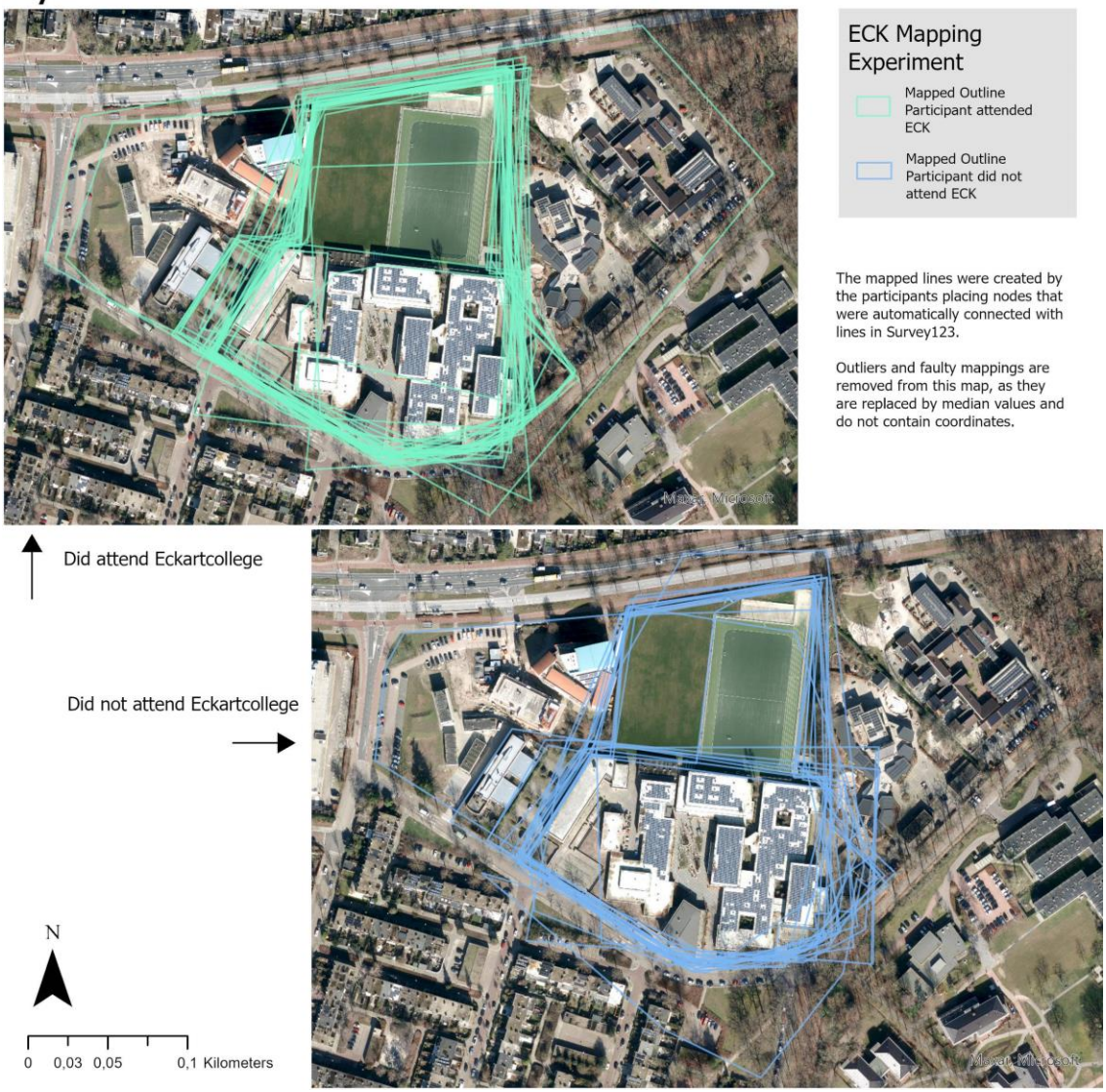
4.5 Qualitative Analysis

This section first discusses the mapped geometries of the mapping exercises and then analyses the descriptive text answers from the questionnaire.

4.5.1 Analysis of Mapped Geometry

Stedelijk College Eindhoven, location Henegouwenlaan

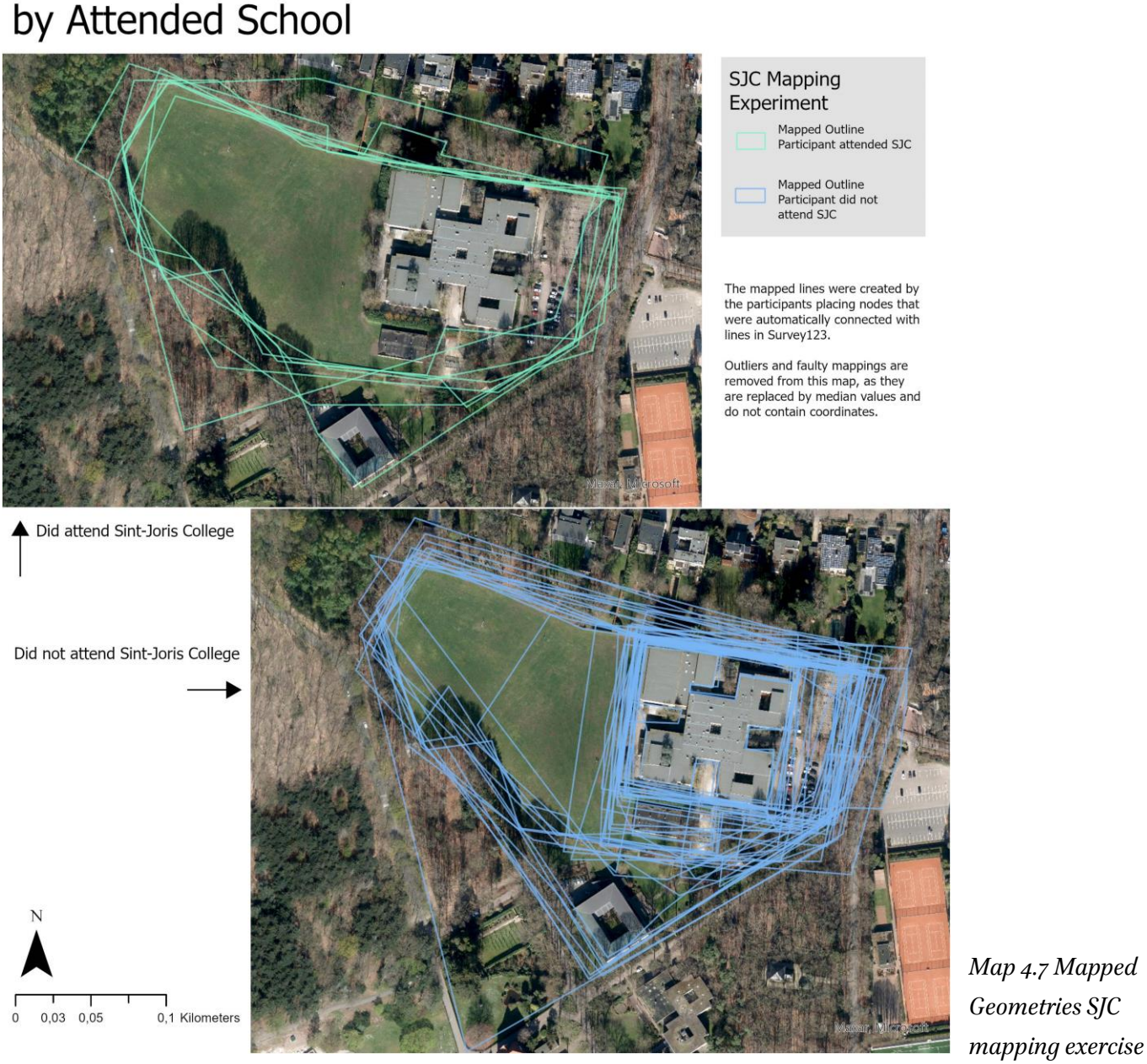
Map 4.5 shows the mapped geometry of the SCE mapping exercise, grouped by past attendees and non-attendees of SCE. Comparing these groups, it becomes apparent that there were similarities in how participants have decided to map the place of SCE. At first glance, it seems that most participants seem to follow the geometry of the plot itself, defined by the surrounding roads which split the school plot from the surrounding greenery and neighbourhood. There were also participants that mapped more closely to the building outlines. This occurred in both groups, however in the group of past attendees, they also included the detached building to the right of the map. Some participants in the non-attended group have excluded this building. Other distinct areas like the bicycle storage area to the right, the area of greenery to the bottom-right, or the detached building to the top of the map have also been included or excluded by different participants in both groups, although the group of past attendees seem to include the top building more often. There were also some participants that mapped the place via a rectangle, which occurred more often for the non-attendees.



Map 4.6 Mapped Geometries ECK mapping exercise

Eckartcollege

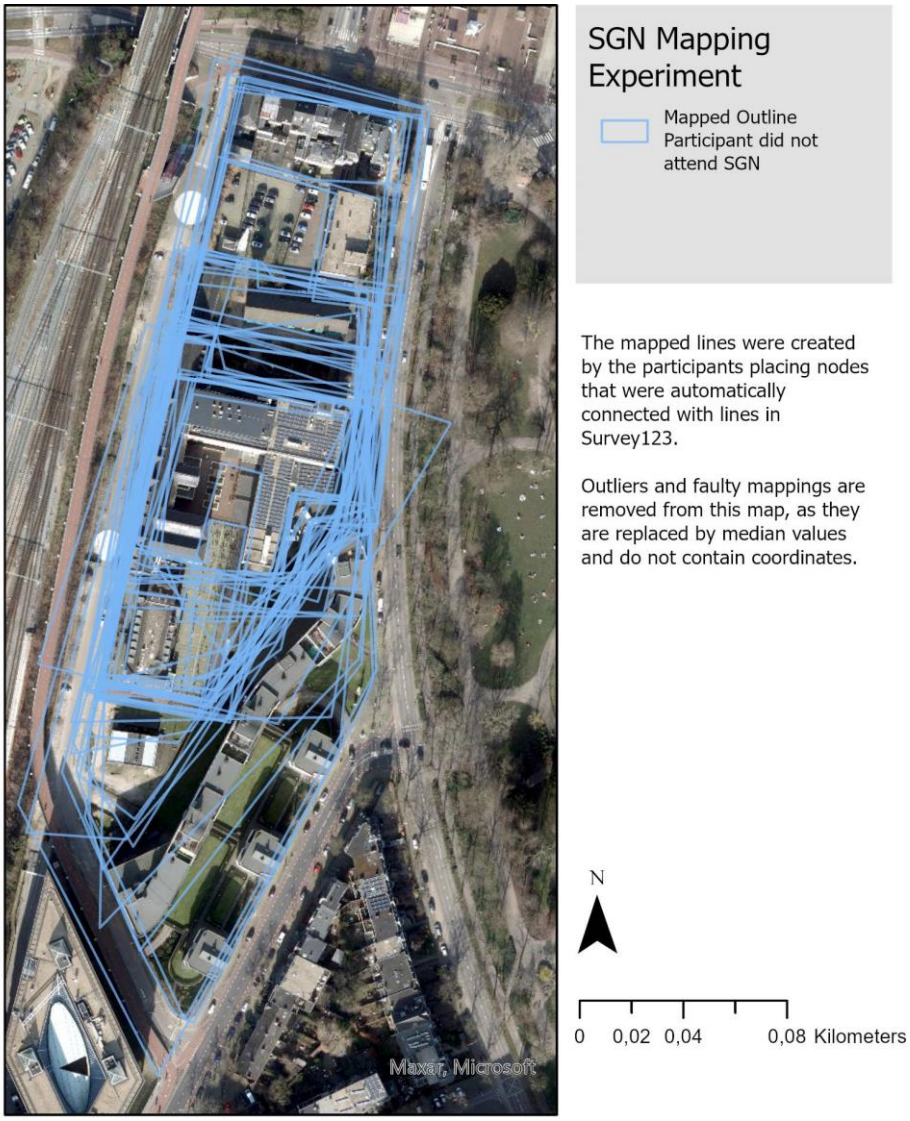
Map 4.6 shows the results for the ECK mapping exercise, grouped by participants who are past attendees of the school and non-attendees. Although there are many similarities between the two groups, there appears to be a clear difference in the choice to either include or exclude the sport fields to the north of the map. The group of non-attendees, appear to have more often excluded this area, following the contour of the buildings instead. Within the group of past attendees, there appear to be just two instances of excluding the sport fields, even though the larger sample size of this group. A similar area showing differences between the groups is the small area to the left of the main cluster of school buildings, which shows a small bicycle parking place. Only some of the non-attendees have included this area in their mapping, whereas past attendees included it more often. Both groups also include a participant that mapped a large part of the surrounding neighbourhood, including another school building and houses. Another interesting observation is that many participants, regardless of past attendance, seem to know what the bulk of the buildings belonging to the school is. That is, not many have included the buildings not belonging to the school (like the small clusters of buildings to the left and right of the sport fields), unless they have included the entire area extending to the roads.



Map 4.7 Mapped Geometries SJC mapping exercise

Sint-Joris College

Although the sample size for past SJC attendees is limited, Map 4.7 indicates some differences in how both groups have mapped the place of SJC. A noticeable difference is the way non-attendees more often only include the main building and exclude the area of greenery to the left on the map, whether this is an exact outline of building contours or a more general tracing following the paved area. Comparing this to past attendees, none of them have excluded this area of greenery. Furthermore, there are some differences regarding the inclusion or exclusion of the small building to the bottom of the map, which is more often included by non-attendees. As mentioned in Section 4.1.3, there was another interesting occurrence, where two past attendees of SJC have also included a building that does not directly border the school plot shown above. For these instances, see Map 4.7. None of the other past attendees have included this building, but for the two people who went out of their way to include this section, it was important to include in the mapping of SJC as a place.

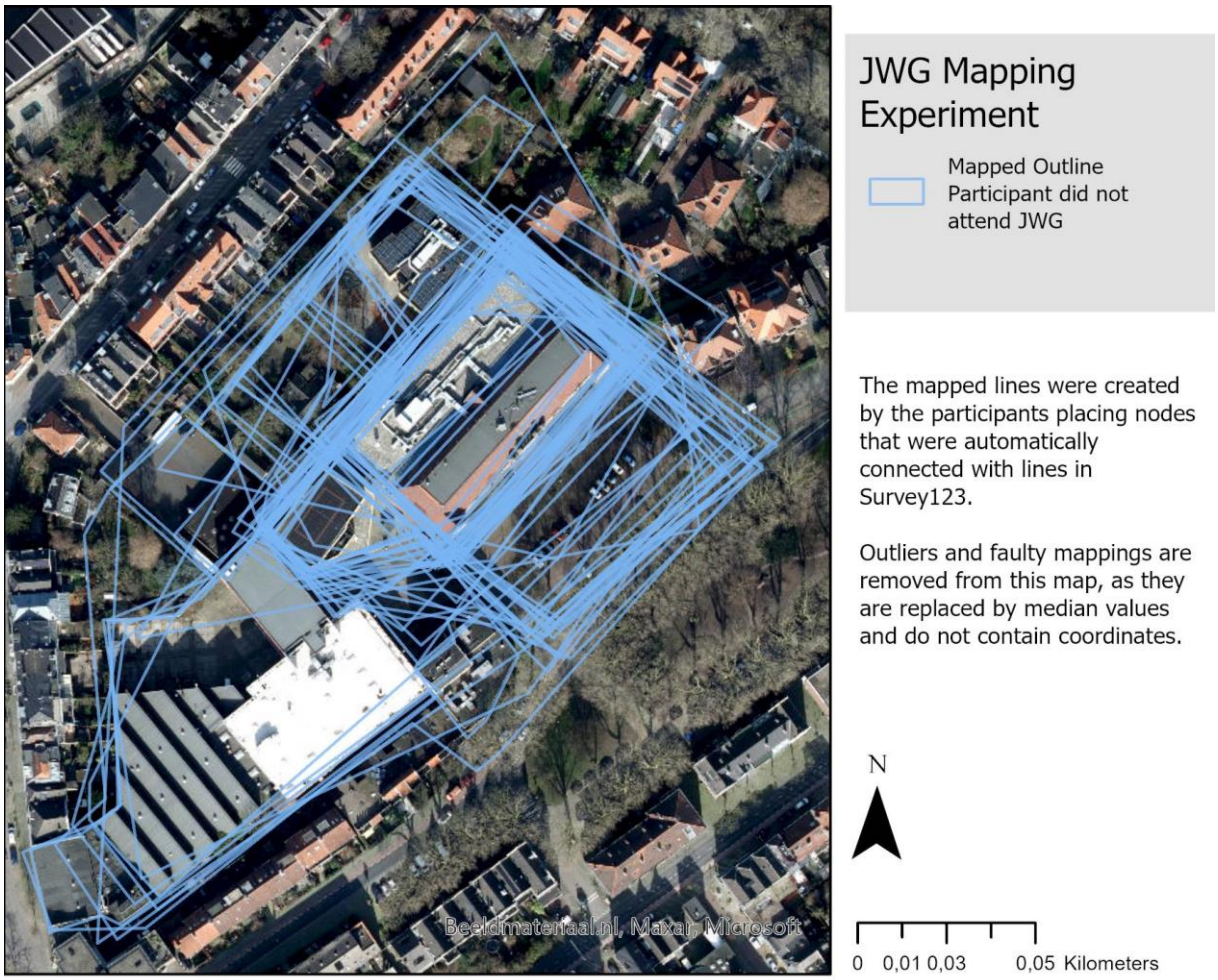


Stedelijk Gymnasium Nijmegen Mapping Experiment Results

Map 4.8 Mapped Geometries SGN mapping exercise

Stedelijk Gymnasium Nijmegen and Johan de Witt Gymnasium

Maps 4.8 and 4.9 show the results for the SGN and JWG mapping exercises, the two schools from whom no past attendees have participated in the questionnaire. The results from both exercises seem to follow a similar pattern, where in both maps, it can be observed that there were different interpretations of what consist of the places of SGN and JWG, as many different areas are included in the mappings. There are therefore larger deviations in size and what area was included, although many participants seem to have followed the outline of buildings or the entire plot defined by the surrounding roads as boundaries. In both maps it can also be observed that the inclusion of parking lots is sometimes differently interpreted, where some focus special attention on including these areas, while others leave it out.



Map 4.9 Mapped Geometries JWG mapping exercise

4.5.2 Qualitative Questionnaire Questions Analysis: Platial (Relationship) Bond

In the questionnaire there were two (optional) open ended questions included per mapping experiment, asking the participant to describe the place and to describe their relationship with the place. Through analysing and coding these text answers, several constructs and themes have been identified. They provide a lens to view and group the responses through. But first the general responses and findings of the answers are discussed. Please note that all quotes have been translated from Dutch to English and any comments between square brackets are added by the researcher to provide context to the quote.

For the 72 participants of the mapping exercises, only four did not answer any of the text questions. All other participants have answered at least one open ended question. In total, there were 438 recorded text answers, spread over the ten questions. The distribution per mapping experiment was as follows:

- SCE: 87 responses, of which 32 by past attendees;
- ECK: 97 responses, of which 60 by past attendees;
- SJC: 90 responses, of which 19 by past attendees;

- SGN: 84 responses;
- JWG: 80 responses.

However, many of these answers consisted of 'empty responses', i.e., they did include text, but the text itself indicated that the respondent either had no relationship, knowledge and/or opinion about the place in question. Examples of these answers are 'not applicable', 'none', 'unknown', 'no relationship', 'I have never been there', '–', etc. Overall, there were 118 cases of these type of answers, distributed as follows:

- SCE: 11 empty answers;
- ECK: 7 empty answers;
- SJC: 21 empty answers;
- SGN: 38 empty answers;
- JWG: 41 empty answers.

Notably, the 'unknown' places SGN and JWG had more empty responses. Also, for the SCE, ECK and SJC experiments, none of these empty answers were by participants who had previously attended the school they were answering the questions of.

Looking at the content of the remaining, non-empty answers, participants seemed to answer the questions differently. Some had a single word response, like 'school', 'nice', or 'boring', while others listed multiple words, like 'proper, changed, modern, thrilling', or 'historic, monumental, strict'. A third category consisted of more lengthy responses of either one or more sentences, often anecdotal or descriptive in nature. These differences could also be observed per mapped place, where the responses to the 'unknown' places of SGN and JWG more often fell into the first and second categories, with short responses and also more 'empty answers'. Although the questions for SCE, ECK and SJC also included answers of these types, they also had more lengthy and personal answers.

The following subsections will now discuss the various identified themes in the text responses, through which they are grouped. Although many of the presented quotes could fit into more than one of the identified themes, they were used as examples for the theme they seem to represent most.

Personal Relationships

The theme of personal relationships often occurred in the answers, which was indicated by mentions of acquired friendships, relatives, or other references to connections with people tied to the place in question. These types of answers can be grouped in two categories, which also follow the division of past attendees and non-attendees. That is, when past attendees mentioned human connections in their answers (occurred 9 times), they did so in a way that indicated they have created these relationships by attending the school and experiences they have had there. In contrast, when non-attendees mentioned personal relationships (also occurred nine times), they were mostly referring to other people that they know have attended the specific school in question, or referred to the proximity of the place to someone they know. The following three quotes were from participants who emphasised friendships that were made in the place they previously attended:

'Positive. I went to this school for six years. I have fun memories of this. Retained good friends.' (SCE-sce)

'Nostalgic, carefree, youth, friendships, ugly.' (SCE-sce)

'School, conflict, friendships, skipping class, youth, 90s.' (SJC-sjc)

In contrast, the following three quotes show the connection to the place through people they know. The first quote even explicitly indicated that familiarity with the place somewhat increased because of their sister that attended the place:

'My sister went to this school, so I am somewhat familiar with it.' (ECK-sce)

'School that friends attended.' (ECK-sjc)

'Around the corner from my father. My mother went to this school. It was one of my options to go to, but did not.' (ECK-sce)

Interestingly, there was also a participant from the SGN experiment that described knowledge of the school through having friends that went there:

'School where many of my current friends went to, even though I am not from Nijmegen.' (SGN-eck)

Next, the theme of proximity and geographic location is discussed.

Location and Proximity

The answers often mentioned topics of location and proximity, whether this was through mentioning the participants' proximity to the place they were mapping or the geographic location of the place itself. Some patterns may be identified within these answers. For example, there were instances of answers that primarily focussed on the geographic location of the place and often mentioned little else:

'Eindhoven South.' (SJC-sce)

'School in Woensel? [area in Eindhoven]' (SCE-sjc)

'(...) other side of Eindhoven.' (SJC-sce)

'A secondary school in Eindhoven.' (SCE-eck)

In the previous examples, the location of the place itself was mentioned without reference to another place. There were also responses that put the place in relation to the location of another place or point of interest:

'Safe, close to home, familiar.' (SCE-sce)

'Nearby my parental home.' (SCE-eck)

'Close to the IKEA.' (SCE-sjc)

The above quotes mentioned more static examples of proximity and location, but there were also instances that referenced passing by the place or having been inside the place in the past:

> 'I was there a long time ago for an open day, but never after that.' (SCE-eck)
>
> 'I drive by it frequently, it is familiar.' (SCE-eck)
>
> 'I was there once for an open day and bike past it quite frequently, but it does not have a special connection for me.' (ECK-sce)

As mentioned twice in the previous quotes, some participants already remarked on their level of platial connection in relation to their proximity to the place. For example, linking their time away from the place to a decreased connection with it now, as in the following quotes:

> 'I have nothing with this [place] anymore since I am gone.' (ECK-eck)
>
> 'My old school, slightly nostalgic, curious how it is there now, but no strong bond, because it has been a long time since I was there.' (ECK-eck)
>
> 'I went to this school for years, so I have a somewhat close bond with it. Not that I care that much, because it has been a long time since I have been there.' (SCE-sce)

However, there were also some responses that signal a somewhat contradictory view, mentioning a certain level of familiarity with the place even though they were only rarely, or never in the area:

> 'The place is familiar, however, I am rarely in the area of this school.' (SJC-eck)
>
> 'A recognisable place for me where I have never been.' (SJC-eck)

Similarly, to the quotes discussed in the previous section about relationships, there were also some responses for the SGN experiment that indicated that the participant's proximity to the place of SGN resulted in knowledge about the place:

> 'A school building on the street where I bike past on the way to the supermarket. There is an old cloister between the buildings where students live now.' (SGN-eck)

Additionally, a participant states that being exposed to the place of SGN also triggered emotions about what can be seen as the place of Nijmegen as a whole, regardless of having been in the proximity of SGN specifically:

> 'I think Nijmegen is a beautiful city, but I can't remember if I have been to this exact place. But it does trigger nice memories of Nijmegen.' (SGN-sjc)

The connection between a participant's proximity to the place and their time away from the place has already briefly been mentioned in some quotes above. This concept of time will now be discussed further.

Time

Having read some of the answers above, it has become clear that the concept of time was also present in participants' responses and often intertwined with their mentions of proximity. This was illustrated by the above quotes that indicated that not having been in the proximity of the mapped place can lead to a lesser amount of connection with the place for some. This was however not the only way in which participants used time indications in their answers. Many also highlighted the total amount of time spent attending the school, just on its own or in connection with other information.

> 'Six years vwo.' (ECK-eck)
>
> 'Very familiar and a place where five years of my life took place.' (ECK-eck)
>
> 'I spent seven years on this school, so this place holds much nostalgia for me. I have had a fun time [there] and still talk to friends that I have made there.' (ECK-eck)

Whereas the above quotes were either neutral or positive about the time the participant spent in the place and their familiarity/nostalgia with the place, another participant indicated that their relationship with the place did not really exist anymore because they have only spent two years there:

> 'Not really anymore, was only there for two years havo 4+5.' (SJC-sjc)

The following quote of a past ECK attendee also called their bond with the place of SCE strong due to them having spent six years there. They also mentioned that even though they have left school over seven years ago, they still experience the bond as somewhat strong (perhaps indicating that the bond decreased a little but did not disappear) and mentioned the proximity to their home. However, they remarked instead that their bond with the place is more complicated now, due to the (partly) replaced buildings:

> 'You could call the bond strong, because I have spent six years there. Still a bit, because it is close to my home (even though I have left the school more than seven years ago…). But, the fact that the old building is demolished and a new building has replaced it, makes it a bit complicated ;).' (SCE-sce)

For the questions about SGN and JWG, time was not mentioned in a way similar to the discussed quotes above. Instead, time was only connected to the appearance of the buildings and place, which was often described as 'old' and 'historic' (occurred 14 times).

The above quotes already acknowledged the physical appearance of the place, which will be discussed next.

Appearance

When asked to describe the place of the experiment, many participants included the appearance of the place in their answer. These answers were most often formulated by listing several keywords,

which ranged from having neutral to positive and negative connotations about the appearance of the place.

Participants included descriptions about the appearance of both the building and the surrounding area. Some of these were positive and/or neutral in nature, for example focussing on the size of the place/building, or on purely descriptive characteristics, like the number of tiles:

'Forested, big.' (SJC-eck)

'Secondary school with a lot of space.' (SJC-sce)

'Big, many tiles, quiet neighbourhood.' (ECK-eck)

'The shape of the building always made me think of a castle with four towers, although this is only visible from above. The location feels a bit like a quiet corner of Eindhoven, with a lot of space around it.' (SJC-sjc)

However, other's descriptions could also be interpreted as more negative towards either the appearance of the place or the feeling the place instigates, regardless of whether they attended the place or not:

'Dark, not a fun place.' (SCE-eck)

'Boring.' (ECK-sce)

'Ugly, greenery, cheap, old fashioned.' (SJC-eck)

'Not mother's prettiest.' (SCE-sce)

'Messy, ugly, claustrophobic, cold.' (SCE-eck)

Another example shows a past attendee of ECK describing the place in a way that can only be done with prior knowledge or memories about the place, as they described the inside of the hallways (that were not pictured in the questionnaire):

'Prettier courtyard than in the past, not such a beautiful school, ugly colours in the hallways.' (ECK-eck)

Interestingly, some participants also mentioned the appearance of the mapped place through recent renovations that took place. One participant (non-attendee) explicitly mentioned that they do not really recognise the place anymore because of this, others just mention the change more passively or insinuated that the change is positive:

'There is a completely new building now, so I do not really recognise it anymore.' (SCE-eck)

'Familiar, big, old building and new building, modern.' (SCE-sce)

'Safe, used to be ugly, renovation (newbuilding), big.' (SCE-sce)

The questions about the places of SGN and JWG were often answered with descriptions of the appearance of the places and the general feeling they invoked in the participant, like 'strict' or 'boring'. The descriptions focussed most on the appearance of the buildings and remained more objective. As mentioned in the section about time, many descriptions focussed on the old and historic nature of the buildings for both SGN and JWG, or talked about changes from old to new or

the importance of keeping older buildings up-to-date with current needs, as expressed in the following quote where the participant shared their history and opinions about older buildings:

> 'Again, a school with multiple floors like the one in Nijmegen. Older buildings than the schools in Eindhoven. I have attended a primary school in a similar building in Eindhoven (de Talisman). As long as the rooms inside are good and there is enough space outside, then the older style does not really matter.' (JWG-eck)
>
> 'Characteristic building makes place for newer buildings (that seems a bit boring…).' (SGN-eck)

Other descriptions pointed out the following:

> 'It looks like an office building.' (SGN)
>
> 'Old, beautiful, fancy, rich, school.' (SGN)
>
> 'Beautiful, educational.' (JWG)
>
> 'School, rich, fancy.' (JWG)
>
> 'Stately, big, dark coloured.' (JWG)

The following section discusses the topics of memories and emotions present in the recorded answers.

Memories and Emotions

Looking at the responses to the two questions, it becomes clear that many of them included indications of past memories and/or words relating to emotions and feelings. Often, the memories and/or emotions are not fully spelled out, the participant only stating that they exist, or indicating the nature of the bond as positive, negative or neutral. The following quote mentioned the concepts of memories and emotions, in both positive and negative fashion:

> 'Quite good [the platial relationship]. I have positive and negative emotions if I think of this place/school. I did not like most children in school and also not all teachers. However, I also have good memories, including theatre and my best friend.'

The above quote explicitly mentioned memories and emotions about the place, but other participants often mentioned these aspects separately. The following examples included the word 'memories', which was used for a total of 10 times. The first example indicates the existence of both good and bad memories, but also states that this did not affect the relationship with the school in a way that it would not feel like 'their' school anymore.

> 'I spent almost everyday here for five years. I have both good as bad memories of my time at 't Joris, but above all, it still feels like 'my' school. Then I did not yet live in Eindhoven, but funny enough I now live very close.' (SJC-sjc)
>
> 'Good memories, new friends' (ECK-eck)
>
> 'The bond is very familiar and it brings up fun memories.' (ECK-eck)

'A place that I still have many memories of.' (ECK-eck)

'Positive. I have spent six years at this school. I have fun memories of this. Retained good friends.' (SCE-sce)

The concept of 'emotions' was less directly noticeable in the answers, where the word 'emotion' only appeared six times, of which two times referring to non-existent emotional bonds. However, other words that were used could also be interpreted as referring to emotions, like 'thrilling':

'I grew up here, so I have an emotional connection with this school.' (SCE-sce)

'Emotional, good.' (ECK-eck)

'thrilling' (SCE-eck, ECK-eck)

Interestingly, the word 'emotion' was also used to indicate that there was no emotional bond present:

'No emotion, tall building.' (SGN-eck)

'I especially often passed by this place by bike. I was inside the school a few times for open days or school information nights, but I definitely don't have an emotional connection with it.' (SCE-eck)

Or the answer included indications of emotions/feelings that were not just positive, but also did not state why this was the case.

'Mixed feelings.' (SJC-sjc)

'Indifferent.' (SJC-sjc)

'Emotional, teenage-like, familiar, fun but also less fun.' (ECK-eck)

Another example of a term that indicates a type of emotion is 'nostalgia'. The concept of nostalgia was mentioned frequently, nine times in total, but only for the three schools located in Eindhoven.

'I am curious about this place, but I do not recognise a lot anymore. Regardless, there remains a somewhat nostalgic bond.' (ECK-eck)

'nostalgic' (SCE-sce,)

'I spent seven years at this school, so there is a lot of nostalgia with this place for me. I have had a fun time and still talk to the friends that I made there.' (ECK-eck)

Another often mentioned word (seven times in total) was 'youth', which could be linked to the concept of memories. The two quotes below illustrate how the mapped place is part of someone's personal history, or even encompasses it by indicating that the described place was their youth.

'Part of my youth' (SCE-sce)

'My youth' (SJC-sjc)

There were some other responses as well that seemed to insinuate a link between the place and their sense of identity or personal sense of belonging, either by comparing the place to their self-growth, or to the personal concept of 'home':

'I really enjoyed going here. I have gotten to know myself better at this school, like any teenager.' (ECK-eck)

'Big school, but felt like home.' (SJC-sjc)

'Feels like coming home.' (ECK-eck)

'In the area and familiar, but did not feel like 'home', so I went to a different secondary school.' (ECK-sce)

As illustrated by the last example above, relating the concept of 'home' to the described place does not necessarily indicate that that place felt like home. This participant used the concept to explicitly mention that the described place (ECK) did not feel like home, regardless of it being close to their actual home.

For SGN and JWG, the concept of memories and/or emotions is less present in the answers, except for some descriptive words like 'grey' and 'cold', that can be interpreted as an invoked feeling upon the participant triggered by the appearance of the place. The section about proximity and location already briefly discussed the concept of memories relating to the SGN place by showing a quote by a participant that had no specific memory of having been in the proximity of SGN, but that the mapping experiment did trigger nice memories about the city of Nijmegen. Lastly, some other mentions of 'emotions' in the SGN and JWG responses referred to not having any emotions about the place:

'No emotion, tall building.' (SGN)

Lastly, the concept of 'function' will be discussed.

Function

Many participants mentioned the word (secondary) school when asked to describe the place they are mapping, thus putting emphasis on the function of the place. In total, the word 'school' was used 139 times, sometimes also in combination with a possessive pronoun, like 'my' for the school they attended:

'Secondary School' (SCE-sce)

'My secondary school' (ECK-eck)

'My old school' (SCE-sce)

Many responses also included a more specific type of function, for example mentioning something the school used to provide. Participants also mentioned these functions when they did not attend the school and in one case even mentioned that this was the reason they did not attend the school. Some mentioned educational functions as well:

'School, technasium [type of education].' (ECK-eck)

'Quite a good school I believe, but they did not have gymnasium [a level of education] (so I did not go there).' (ECK-sce)

While others focussed on the availability of extracurricular activities at the school:

> 'School with dual language program, a place to play indoor football.' (SCE-eck)
>
> 'A school that has a special program for professional athletes etc. Beyond that no idea what kind of school it is.' (SJC-eck)
>
> 'Secondary school, sports, theatre.' (SJC-eck)

For the places of SGN and JWG together, the word 'school' was mentioned 34 times, often on its own or with descriptive words about the appearance of the place. There was no additional information provided about other types of functions of the places, like for the three places in Eindhoven.

Summary

The previous sections highlighted responses to the questions that had participants describe the places of the various experiments as well as their relationship with these places. Many participants have answered these questions, with responses ranging from short and descriptive, to lengthy and anecdotal responses. However, there were also 'empty' responses, where the participant did type something, but the response itself indicated no specific relationship, knowledge, or bond with the place, like 'unknown' or 'not familiar'. Many responses shared overarching themes, namely: personal relationships, proximity and location, time, appearance, memories and emotions, and function. Although many answers fit into more than one of these categories, these themes helped to analyse the nature of the responses.

When analysing for differences in the type of responses to each place, the largest difference found was between responses to places inside Eindhoven (SCE, ECK and SJC) versus outside Eindhoven (SGN and JWG). The responses for the latter group were shorter and more impersonal, and mainly focussed on describing the appearance or the function of the place and stayed rather neutral in tone. Moreover, there were less responses in general for these 'unknown' places and more often consisted of the identified 'empty answers' compared with the places located in Eindhoven. These were in turn answered in more detail and often included personal stories and indications of relationships, passing of time, or proximity to the places. These answers varied in tone and content, varying from more negative to positive views of the places; the same place could be described as both 'boring' by one participant and 'thrilling' by another. These views did not necessarily correspond with past attendance of the participant, it became clear that non-attendees were also familiar with the other places in Eindhoven to an extent that they could describe opinions about the place, relate it to prior proximity to the place or other acquaintances that attended the place. There seemed to be a difference however between ECK and SCE past attendees in the way they described SJC. It seemed like these participants gave the questions regarding SJC shorter responses (similar to those of SGN and JWG) or 'empty answers'. This could be explained by the closer geographic proximity of SCE with ECK, while SJC is located on the other side of Eindhoven. It therefore, seemed like the nature of the responses were mostly influenced by familiarity with the place, where more unfamiliar places (like SGN, JWG or even SJC) evoked more neutral responses.

5. Discussion and Conclusion

This final chapter discusses the results and connects them to the literature. The limitations of the study and opportunities for future research are considered before concluding the research.

5.1 Summary of the Results

The aim of the research was to investigate the role of platial connection and personal demographic and geographic characteristics on an individual's mapping behaviour, to better understand mapping initiatives. The results indicate a positive relationship between an individual's mapping behaviour with the Platial Relationship Score and the secondary school they attended, although this effect is negated when other variables were included in the Optimal Fit Models (except for the Mapped Area model for optimal BIC). The included demographic and geographic characteristics provided no evidence of an effect on the mapping behaviour, except for a significant effect for the 'Havo' educational level and the non-Binary subgroup. However, due to the low number of participants in these groups, these findings should be viewed critically.

Additionally, the mapped geometries from the mapping exercises were analysed qualitatively. Here, both differences and similarities were noticeable between past attendees and non-attendees in how they mapped the geometries of the different mapping exercises. Two groups of mappers could be distinguished: one that mapped the outline of the entire school plot by following visual boundaries (like roads, or the transition from pavement to greenery), and a second that traced building outlines. Both past attendees and non-attendees applied these methods. Larger differences were found by the decisions to include or exclude specific areas of the places. For example, some distinct areas that were more often included by past attendees are bicycle storages, specific detached buildings, or areas of greener (such as the sports field of ECK). Again, this was not a hard rule, as non-attendees sometimes included the same areas. For SGN and JWG, the included areas were more susceptible to different interpretations of what should be included in the mapped geometry.

Lastly, the open-ended questions that had participants describe the places of the various experiments as well as their relationship with these places were analysed. The responses varied, some consisting purely of descriptive keywords, while others were more anecdotal. Participant's opinions on the places were mixed, where differences in answer-type were found between the places located in Eindhoven, versus the places outside of Eindhoven. The SGN/JWG places were described more impersonal and less detailed, while also having less answers in general. The main topics that were identified in the answers were that of personal relationships, proximity and location, time, appearance, memories and emotions, and function.

5.2 Interpretations and Implications

The following section further discusses the results presented in the previous chapter by interpreting them and connecting them to the existing literature analysed in chapter two.

5.2.1 Platial Relationship Characteristics

An exploratory factor analysis confirmed that the platial relationship statements about familiarity, attachment, experience, social relationships, and affinity with the place of the mapping experiment were combinable into a single score: the Platial Relationship Score (PRS), thus confirming the first hypothesis. The PRS showed clear differences in values based on the location of the mapping experiment and whether the participant attended the school of the mapping experiment. If the mapping experiment was located outside of Eindhoven (i.e., either SGN or JWG), the PRS score was close to zero. In contrast, the score was close to 100 (the maximum) when the participant has attended the school of the experiment. The scores for the other experiments in Eindhoven that the participant did not attend received lower scores, but higher than for the experiments outside of Eindhoven. This indicates some level of platial relationship with the school and place in question regardless of having attended the school.

During the statistical testing of the variable PRS with the three dependent mapping behaviour variables, when PRS was included as the sole predictor in the model it returned highly significant ($p<0{,}001$) for all three models. All relationships were positive in nature, indicating that an increase in PRS also leads to an increase in the used number of nodes, time spent on the exercise and included mapped area size. Especially for the 'Mapped Area' model, PRS had a large effect on the explained variance, where 36% of the total explained variance was due to the inclusion of PRS. For the 'Number of Nodes' and 'Time Spent' model this was both only 3%. An explanation could be that a higher PRS indicates more knowledge of the place and thus more consensus between participants about what areas to include (leading to more similar mapped area sizes). These results are in line with expectations on platial relationship predictors as discussed by for example Seamon (1980) about place experience and Lewicka (2011) on the importance of social relationships.

However, there were also some inconsistencies measured in the performance of PRS as a predictor for the mapping behaviour variables. Although the individual relationship of PRS on these was significant and positive, during the optimal model fit testing PRS sometimes no longer had a significant effect. For the six optimal fit models (two for each dependent variable, for the optimal fit according to the AIC or BIC), only three measured a significant effect for PRS: the two Number of Nodes models and the BIC Mapped Area model. Although the effect of PRS on 'Time Spent' was significant when included on its own, this was no longer the case when other variables were added. The reason for this is unknown, but a possibility could be that the other added variables explain the effect of time spent on the exercise better or interferes with the effect of PRS.

5.2.2 Personal Demographic Characteristics

The following paragraphs discuss the results of the personal demographic characteristics variables: age, gender, and level of education.

Age

Regarding age, not all age categories present in the questionnaire were represented in the data. Participant's age ranged from 20–64 years old. The 25–44-year-olds category occurred most. There were ten participants belonging to the 65–79-years-old category, but they were filtered out of the research due to not belonging to the target group or not having submitted any mapping data.

The hypothesis about age expected a relationship between age and mapping behaviour. Based on the models that implemented age as the sole model predictor, this hypothesis was rejected. None of the age categories had a significant effect on any of the three dependent mapping behaviour variables. However, two of the optimal fit models did include an age category with a significant effect, namely for the 'Number of Nodes' optimal fit AIC model and the 'Time Spent' optimal fit AIC model. The former included a significant relationship for the 25–44-year-olds, while the latter model for the 45–64-year-olds. No other optimal fit model included age as a predictor. For the 'Time Spent' model, the 45–64-year-olds group had a positive relationship. This is somewhat in line with the comment by Lapon et al. (2020), who mention that 'elderly' can be slower and less accurate in performing spatial tasks. Although this age category cannot truly be defined as being 'elderly', it could indicate confirmation towards this theory, especially if it could have been compared with the following category of 65–79-year-olds. Unfortunately, this category was not present in the data, which in itself could also indicate confirmation towards the theory that older people have more trouble with spatial/digital tasks. Furthermore, Lapon et al. (2020) also state that no further evidence for age related differences were found in their research. This again aligns with the non-significant effects when age is analysed on its own. Lastly, it remains unclear why some of these were not able to submit their mapping results. It also remains unclear whether these age groups were not reached during data collection, or whether they decided not to take part in the questionnaire.

Gender

The hypothesis for gender predicted that no relationship would be found with the mapping behaviour variables, which was accepted. When analysing gender as the only model predictor, only the group of non-binary people had a significant effect on 'Time Spent'. For the optimal fit models, gender was also only included for the two 'Time Spent' models, where the non-binary group was also significant. However, as this group only consisted of two people, the result cannot be seen as reliable. Therefore, it was concluded that there is no relationship between gender and mapping behaviour. This is somewhat inline with existing theories, although these often differ on their conclusions whether gender does or does not impact geographical skills. For example, Keskin et al. (2018) state that there is no difference, but Lapon et al. (2020) briefly mention that there is a difference in how men and women approach certain spatial tasks and design sketch maps. Coluccia et al. (2007) also stated that men are often quicker in performing tasks, no evidence of that was found in this research. Also, the mentioned research compare gender more with cognitive mapping task capabilities, which is not necessarily researched in this study.

Level of Education

Not all levels of education were present in the data set. 'Hbo'/University groups were represented most, which might be due to a sampling bias caused by LinkedIn being the most successful applied sampling strategy. When tested on its own, only the 'Havo' category returns positive and significant for the 'Number of Nodes' and 'Time Spent' model. Similarly for the optimal fit models, 'level of education' was only included in the AIC version of the 'Number of Nodes' and 'Time Spent' models, where also only the 'Havo' category had a positive and significant effect, indicating that participant's belonging to this group use more nodes and spent longer on the exercises. It is however important to note that only six people make-up the Havo group, which could distort the results and limit its reliability. The hypothesis that there is a relationship between level of education and the mapping behaviour variables is therefore rejected, although there are some indications for a relationship with 'Havo' graduates. This finding is contradictory to the theory of Lowrie et al. (2021), who state that education instead of age could be more important in explaining geographical skills. However, this could still be the case if instead of level of education the content of education was studied. A general level of education does not necessarily correspond with the quantity and quality of (digital) geographical educational programs and might thus explain the non-significance of the level of education in this research.

Additionally, no evidence for interactions between the variables 'Age' and 'Level of Education' was found. Naturally, it can be expected that for example 'Mavo', 'Havo' or 'Vwo' graduates are younger, as they are likely to still partake in further education. However, including variable interactions led to a worse model fit and did not provide other results.

5.2.3 Personal Geographical Characteristics

The following paragraphs discuss the results of the personal geographical characteristics variables: attended school and location of the mapping experiment, number of visits, familiarity with Eindhoven, and mapping experience and map use frequency.

Attended School and Location of the Mapping Experiment

The variable 'attended school of the mapping experiment' was also tested as a predictor for the three mapping behaviour variables, on its own for the 'Number of Nodes' and 'Time Spent' models, and with the predictor 'mapping experiment located in Eindhoven' for the 'Mapped Area' model, as this generated a better model fit. All three models indicated a significant and positive effect when a participant has attended the school they were performing the mapping exercise of. For the mapped area size model, the relationship between having attended the school of the exercise is also positive and significant and when the mapping exercise is outside of Eindhoven (and the participant has thus not attended this place; either SGN or JWG), the relationship is negative and significant. These differences in the estimates per exercise can be explained due to the general sizes of places, which are smaller for the locations outside of Eindhoven, thus establishing a negative effect. Overall, the

participants tended to use more nodes, spent longer on the exercise, and included a larger area when they are mapping the school they attended.

For the optimal fit models, the variable of having attended the school is only included for the optimal AIC and BIC 'Time Spent' model, of which the former also included the variable of 'mapping experiment located in Eindhoven'. Having attended the school of the exercise had a positive effect in both 'Time Spent' models, also indicating that past attendees spent more time on those exercises. However, in the AIC model, when the participant did not attend the school of the exercise and the exercise was not located in Eindhoven, there was no significant relationship found. Therefore, only the difference between having attended the schools in Eindhoven provided a significant difference in the time spent on them. For the 'Mapped Area' optimal fit models, only the 'experiment located in Eindhoven' variable was included. Here, the included mapped area size differed significantly and negatively with the exercises that were located in Eindhoven. In other words, participants tended to map the locations outside of Eindhoven smaller, which again can be due to their general size. The difference between past attendees and non-attendees for the locations in Eindhoven cannot be explained this way, and instead could be explained by the increased level of familiarity and knowledge of the place when having attended the place. For the time spent model, it might be possible that when someone has attended the school in the past, they might take extra time to map the place to be more exact or to reminisce about the place.

Number of Visits

The 'Number of Visits' variable more often included significant relationships with the mapping behaviour variables, although the variable was only included in the AIC optimal model for the mapped area size. Here, the category of 10–49 visits and 100+ visits were significant and had a positive effect on the mapped area size. For the models that only included the number of visits as a model predictor, the '100+ visits' category was the only significant group for the 'Number of Nodes' and 'Time Spent' models. This group almost entirely consists of past attendees, meaning that the result is in line with the relationships found for the 'attended school' variable, together with a high PRS. Here, the relationship was positive (similar to past attendance and PRS) where the used number of nodes and time spent on the exercise increased. Interestingly, the effects for the 'Mapped Area' model differed greatly. Here, all categories had a significant effect on the mapped area size, meaning that participants belonging to any group differed significantly from the category of 'never visited' (the intercept). All effects were positive in nature too, indicating an increased mapped area size additional to the intercept. The confidence intervals were however quite large, which could indicate that these found effects were less reliable. Just like familiarity with Eindhoven, the theory proposed by Lowrie et al. (2021), Lapon et al. (2020) and Boschmann and Cubbon (2013), might offer an explanation for the relationships found, especially with the '100+ visits' category. The increased number of visits, more than an estimation of familiarity with Eindhoven as a whole, indicates more active experiencing of the place, which is proposed by them to influence spatial abilities. For this variable, the theory thus largely aligns with the findings.

Familiarity with Eindhoven

The variable 'Level of familiarity with Eindhoven' was only included in one optimal fit model, that of the AIC mapped area model. The relationship was positive and significant, indicating that mapped area size tended to increase with every increase in familiarity with Eindhoven. However, for the models that included 'familiarity with Eindhoven' as the sole predictor, none of the relationships were significant, neither when the predictor of 'mapping experiment in Eindhoven' was added. The hypothesis that there would be an effect was therefore rejected. This hypothesis was based on the interpretation of the theory by Lowrie et al. (2021), Lapon et al. (2020) and Boschmann and Cubbon (2013), that proximity to a place might influence an individual's spatial abilities. There was no evidence found that this is the case when paired to 'familiarity with Eindhoven' as perhaps Eindhoven is too large for such a generalisation of locational familiarity. This theory was therefore also tested with the 'Number of Visits' variable, which tested the proximity to the mapping experiment places on a smaller scale.

Mapping Experience and Map Use Frequency

The two variables 'Mapping Experience' and 'Map Use Frequency' both addressed the familiarity of participants with maps. The responses to both variables indicated that participants deemed their mapping experience highly (M=74,88) and use maps frequently (the 'weekly' category occurs most, then 'daily'). The 'yearly' and 'never' category of map use frequency does not occur at all, except for four participants in the NA-analysis that indicated only yearly map use. It remains unclear whether there is a relationship between them not being able to submit their mapping answers and the fact that they only use maps yearly.

When tested as the sole predictor, both 'Map Use Frequency' and 'Mapping Experience' did not result in any significant effects on any of the three mapping behaviour variables. Indicating no relationship between these and the number of used nodes, time spent on the exercise and mapped area size. This changed somewhat for the optimal fit models, where the level of mapping experience was included in the optimal AIC model for 'Time Spent' and 'Mapped Area', while the map use frequency was only included in the latter model. For the mapped area size model, the categories 'weekly' and 'monthly' map use had a negative and significant effect on mapped area size, indicating that when a participant uses maps either weekly or monthly, they tend to map a smaller area. For the same model, 'level of mapping experience' was also significant with a negative effect (for the 'Time Spent' model, there was no significant effect found). Thus, when mapping experience increased, participants also tended to map a smaller area. A possible explanation for the latter effect could be that when people have more experience with maps, they can map more precisely, which can result into a smaller size. However, this higher level of control over the exercise would then likely also lead to more used nodes, which was not the case.

Consulting the theory, Keskin et al. (2018) have also stated that there seemed to be no significant differences in how experienced vs. non-experienced people execute sketch maps, only that the process of making the map varies. This might explain the results in this study. Additionally, Lapon et

al. (2020) have argued that the difference between people with a higher map use frequency got better at estimating region sizes. However, there is no 'objective truth' to the mapped area sizes measured in this study, which could also explain the results. The division of Coleman et al. (2009) between experts and non-experts in the VGI field was not recognised in this study, as there was a clear skew in the data present towards being 'very' experienced with maps. A possible distinction between professional experts and casual map users was thus not possible to distinguish.

5.2.4 Qualitative Analysis

The following paragraphs discuss the results of the qualitative analyses: the mapped geometries and the responses to the open-ended text questions.

Mapped Geometries

There were differences noticeable in how past attendees and non-attendees mapped the geometry of the mapping exercises. The choices made of including specific areas therefore seemed guided by knowledge of the place (as for example illustrated by the specific action of including bicycle parking areas or the inclusion of the sports fields). This did not apply to everyone, as there are mapping similarities between past attendees and non-attendees. The reason some past attendees did not agree on the inclusion of specific places (like the sport fields in the ECK exercise) is unclear and perhaps lies in the historic timeline of a place or a participant's unique platial experiences. Concerning the SGN and JWG mapped geometries, there seemed to be less consensus on how to draw the geometries. This could have multiple reasons, these schools are in a more urban area, meaning that they have more buildings surrounding them. It could therefore be harder for participants to decide what the boundaries of the school based on visual cues. Also, due to the places being unknown, the participant is not guided by their 'sense of place'. As shown by the disagreement within the group of past attendees on how they mapped geometry differently, it is further confirmed that a 'place' is not just one identifiable 'shape' and might thus be difficult to portray in a GIS. This reinforces arguments made before (Mocnik, 2022; Comber et al., 2018; Westerholt et al., 2020). Furthermore, it was discussed how two main mapping approaches were defined, that of mapping plot outlines or building outlines. An explanation for this could be in accordance with Lowrie et al. (2021), who mention the possibility of map production to be influenced by the shape of the environment itself, and how this can influence map producers cognitively. This might steer people into mapping concrete, visible, boundaries, instead of the platial boundaries they might 'feel' when being in the area.

Qualitative Questionnaire Questions: Platial (Relationship) Descriptions

The myriad of answers collected through the open-ended questions about describing the place and the participant's bond with the place provided valuable insights. Many different themes were distinguished from these answers (namely: personal relationships, proximity and location, time, appearance, memories and emotions, and function) that reflected themes identified during the

literature review, like community ties, proximity and appearance (Lewicka, 2011; Lapon et al., 2020; Lowrie et al., 2021). Answers were never related to how participant's map a place. However, this is likely explained by the placement of the questions, which came before the mapping exercise. Interestingly, the concept of appearance occurred frequently, which might indicate a link to the theory about 'physical predictors' of place attachment (Lewicka, 2011). Although it was not tested if the physical appearance of the included places had any effect on for example the PRS or mapping behaviour, the recurring nature of this concept might indicate a relationship there and would be an interesting topic for future research.

In the responses, a difference could be noted between answers form past attendees and non-attendees for the places in Eindhoven. However, this difference was exaggerated for the responses for locations outside Eindhoven. The responses for the SGN and JWG experiments were more brief, factual and tended to be enumerations of keywords. The answers for places inside Eindhoven were more detailed and often anecdotal, regardless of past attendance. Also, the number of non-responses or 'empty responses' increased for the places outside of Eindhoven. However, these differences should be treated carefully, as a bias might be present. As these open-ended questions were optional, people that had nothing specific to say might also have skipped them.

5.3 Limitations of the Study

The next part reflects on limitations identified in the study and ways these might have impacted the research.

5.3.1 The Sample

There were some issues regarding the final sample, mainly regarding the limited response and underrepresentation of some subgroups in the questionnaire. Although the questionnaire was directly distributed to more than 1200 individuals (and to even more indirectly), the actual response rate was limited. This lack of response was enhanced by the number of participants that had invalid mapping exercise data, which made their contribution invalid. Additionally, due to the limitations imposed by Facebook and LinkedIn (being blocked from sending a certain number of messages), it was not possible to even out the number of approached individuals per included school, causing an uneven distribution in the three subsamples. With the extra unforeseen detail that certain older participants attended a different SJC location, this subsample included less participants than the others.

Small sample sizes in the subcategories of variables were recognised as a limitation too. For the categorical variables, not every category is well populated. This might result in a (subconscious) bias in the results and the data. To reflect, a bias could have been created towards younger people in the research, as it would be less long ago that they attended the school in question. As there are more younger people present than elderly, this might be the case. However, no strong relationships for the variable 'Age' were found regardless so this bias is estimated to be limited.

Before starting data collection, it was argued that the addition of distributing flyers to a random selection of addresses in Eindhoven would help balance the possible bias that could occur from using non-parametric sampling techniques. However, this did not have the expected result, as response through this method was extremely low (approximately 11 on 390 distributed flyers, 2,8% response). Before, it was a concern that the targeting of people still living in Eindhoven might create a bias, as they might feel stronger attachment to Eindhoven/the included places as they are geographically closer to them. However, due to the small percentage of recruited participants through flyers, the effect of this is deemed small. It is however still possible that a (small) bias exists, as it is unknown what percentage of the data set currently still lives in Eindhoven. Still, the effect is estimated to be limited, as the variable 'Familiarity with Eindhoven' had almost no impact.

To conclude, it is important to treat the sample of this research with caution. The specific target group paired with the used non-parametric sampling strategies make generalisation of the research difficult. Nevertheless, the results can still be interpreted with great value as an exploratory study, testing the waters for future research.

5.3.2 The Questionnaire and Mapping Exercise Design

The biggest challenges and limitations of the research were met during the design stage of the questionnaire and mapping exercises. The main goal beforehand was to create an interactive mapping questionnaire that allows participation regardless of prior mapping experience. However, during the design phase it quickly became clear that there are not many platforms that allow both intricate question types and the inclusion of multiple maps that people can draw on. Before, it was expected that the entire questionnaire could be made in ESRI's Survey123, but this only supported one map extent per survey. This forced the use of another survey platform (that in turn does not offer interactive mapping questions; SoSciSurvey) with use of embedded versions of separate Survey123 questionnaires with the mapping exercises. This however caused the final questionnaire to be more convoluted and dependent on specific actions by the participant to successfully complete a mapping exercise. For example, as the mapping exercises are loaded as an embed, it had to be submitted separately, failing to do so would mean the mapping results would be lost. Additionally, due to the nature of how interactive geometry mapping works on Survey123, a careful order of steps had to be followed to save the placed nodes. There would be no warning if they were not saved before submitting the embedded questionnaire. This likely contributed to the empty submitted forms that were unusable for the research. A result of these complicated and non-intuitive, but important steps was the need for written explanations, which made the questionnaire less attractive and more time costly. To negate part of this, an instruction video was added showing the necessary steps.

Another limit was the inability to participate in the questionnaire via a mobile phone, made impossible by the embedded nature of the mapping exercises. This was likely a cause of the low response rate, as also indicated by the high percentage of phone users in the NA-analysis that were unable to save their mapping results (or had to skip the exercises due to the inability to perform them). Moreover, due to the mapping difficulties people might have experienced, it remains unclear

whether these people felt like they could accurately portray the place as they wanted and intended to, the type of mapping options might have restricted them in their expression. Which would therefore be an interesting point for future research as well.

The specific difficulties encountered were unexpected, but also represented in the literature by Boschmann and Cubbon (2013) and Ooms et al. (2015), who call for increased attention for digital or internet-mapping methods as the results and interpretations of these may vary from on-paper methods. Even though these arguments are from 8–10 years ago, it seems like the message is still needed. This is also highlighted by Poplin (2015) and Elzakker and Ooms (2018), who found that the user-friendliness impacts the way people draw conclusions or handle the map content. They emphasise the need for testing, which was followed in this research during the pre-study. Nevertheless, many of the final results analysed in the research were of good quality, indicating that there are still people that understand the type of mapping exercises presented in the questionnaire, but more people could likely have been reached if available platforms supported more cartographic options.

Still, it was helpful to use digital mapping exercises opposed to on-paper methods, as it helped reveal limitations in currently available tools. As VGI-initiatives and other cartographic maps are usually made digitally, using digital tools to help assess mapping behaviour helped gain insights that translate more directly to how such behaviour would occur in regular circumstances. Future research could thus benefit from an added focus on incorporating classic sketch-like 'on-paper' qualities (adding colour, more freedom in creating natural shapes etc.) into a digital tool to compare the results of such a tool to both 'traditional' GIS and on-paper methods.

5.4 Recommendations

Future research is needed to establish whether the found relationships in this research hold up against different samples and different types of places. The chosen research locations of secondary schools were deemed a good fit for platial research but are in the end only one manifestation of how people perceive and experience place. Preferably, further research includes places that allow parametric sampling strategies, so insecurities towards sampling and generalisation can be limited.

Furthermore, there seems to be a lack of a service that allows more intuitive, approachable, and accessible tools that allow the combination of interactive mapping exercises and other types of questions. Further research could benefit from an added focus on the development of such a tool, which stimulates and enables both geographic and cartographic research, but also the possibilities for more interdisciplinary research. Due to the limited availability of tools in digital cartographic research tools, the expression of creativity and the 'personality' of place remains difficult. An added focus on researching and developing new tools could allow for the integration of more sketch-like tools or other forms of feminist visualisation principles (D'Ignazio and Klein, 2016).

5.5 Conclusion

This research aimed to investigate an individual's mapping behaviour based on their platial relationship with various (un)known places and their personal demographic and geographic characteristics. The following research questions guided this:

What effect does an individual's Platial Relationship Score, Personal Demographic, and Geographic Characteristics have on their Mapping Behaviour towards places they know of and do not know of?

- *How to define and operationalise the personal relationship to place, such as through the Platial Relationship Score, Personal Demographic Characteristics and Personal Geographic Characteristics?*
- *How to design a mapping experiment to test the personal relationship to a place?*
- *What is the relationship between a Platial Relationship Score, Personal Demographic, and Geographic Characteristics and Mapping Behaviour?*

By executing a self-administered online questionnaire including interactive mapping exercises, data was collected and analysed both quantitatively and qualitatively. The research followed a repeated measures design, where each participant contributed towards multiple mapping exercises. Three secondary schools in Eindhoven and two schools outside of Eindhoven were included as the subject of the mapping exercises, where the participants mapped the geometry of what they saw constituting to the place of that school and answered questions about their relationship with the places. The choice for secondary schools to portray 'locational familiarity' was deemed a good fit, as indicated by the high scores on the PRS for past attendees and lower scores for non-attendees.

Using linear mixed models, the relationship between the three identified variables of mapping behaviour and the PRS, personal demographic and geographic characteristics were analysed. The results indicated significant effects between the mapping behaviour and the PRS and past attendance of the place in question. These relationships were positive in nature, indicating more nodes placed (which could indicate more detailed mapping), more time spent on the mapping and a larger mapped area. These results were contested when other variables were added for the 'Time Spent' model, where PRS lost its significant effect. Overall, it was noticed that not all three mapping behaviour variables responded the same to the added variables. The 'Number of Nodes' and 'Time Spent' models often behaved similarly, with 'Mapped Area' differing. It could therefore be argued that the used number of nodes and time spent on mapping exercises are part of an individual's overall personal mapping style, while the mapped area size (and also choice for certain included regions) is more influenced by their individual knowledge of, and relationship with a place. This was supported by the visual comparisons of mapped geometries, where it appeared that knowledge of the place influenced what areas were included in the mapped geometry.

Furthermore, although the responses to the open-ended questions did not relate to their mapping behaviour, the way in which the places inside versus outside of Eindhoven were described differently might relate to how individuals would describe and label (un-)familiar places when participating in VGI-initiatives. Here, it was observed that shorter and more descriptive language was

used for the unknown places, opposed to more personal, emotional, and lengthy anecdotal answers for the more familiar places inside Eindhoven.

Moreover, the designing of the interactive mapping questionnaire proved more challenging than anticipated, leading to a surprising insight that there are not many accessible geographic research tools available that allow the combination of cartographic and statistical research. This can limit the amount of interdisciplinary research conducted on cartography and would thus be an interesting area for future research.

Although it has been repeatedly argued that mapping the non-discrete concept of place is difficult to do in geographical information systems, certain aspects of place occur in finished maps regardless of conscious efforts to map 'place'. A distinction can therefore be made between conscious and unconscious mapping of place. For conscious mapping of place, communicating a 'sense of place' is the map's purpose and all cartographic choices are based on reaching this. Unconscious mapping of place instead occurs when effects of platial familiarity seep through in the final mapped product. Where Wood (2018) already argued that place does not have to be mapped deliberately for map readers to interpret something as a place, the same can be said for map creators themselves. They do not need the intention to portray platial aspects for those aspects to enter a map. This research has shown that mapping behaviour can be influenced by a personal platial relationship, where certain aspects of mapping behaviour, and thus final map results, changed when familiarity with a place increased. Regarding the popular Volunteered Geographic Information initiatives, it is worthwhile to be aware of this. Not only in the final visual representation, but also by what words and tags are used to talk about and describe the mapped place. This links back to the discussion of a 'folksonomy' that can occur in mapping initiatives where words are also used (Mocnik, Zipf & Raifer, 2017). Awareness of how an individual's platial relationship with a place can influence mapmaking can benefit map interpretation and can be used to further boost the potential of creating maps. As discussed before, communicating a deliberate sense of place through vibrant platial descriptions or non-traditional mapping methods (see Dolma, 2022; Nardi, 2014) can add a lot of new information to a map. This can shape opportunities for a new implementation and understanding of platial mapping in the future.

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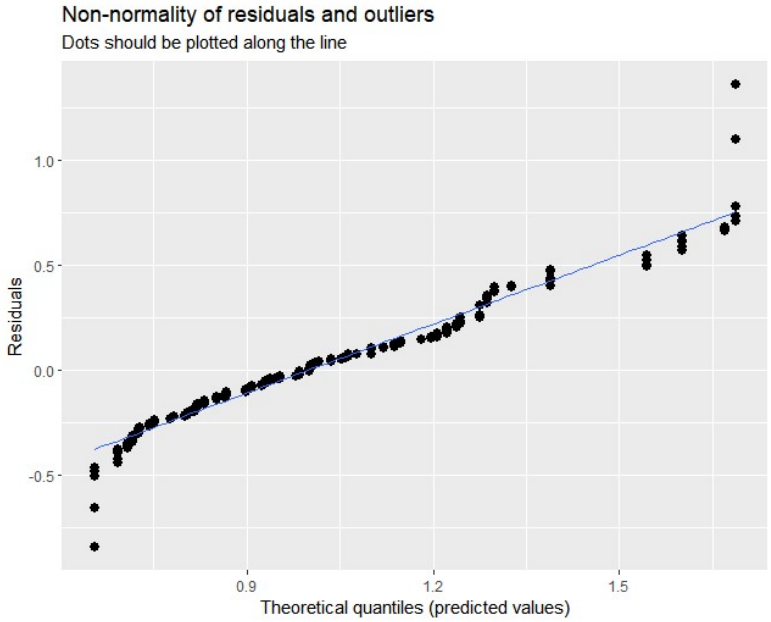
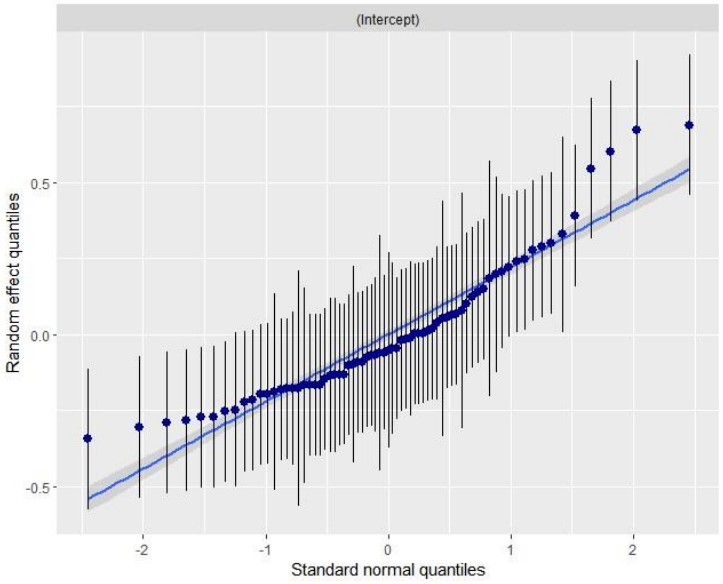
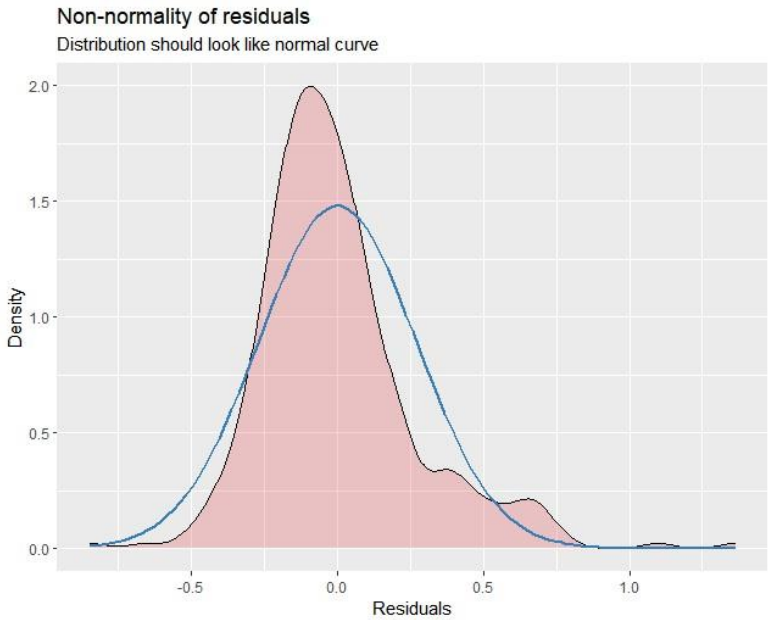
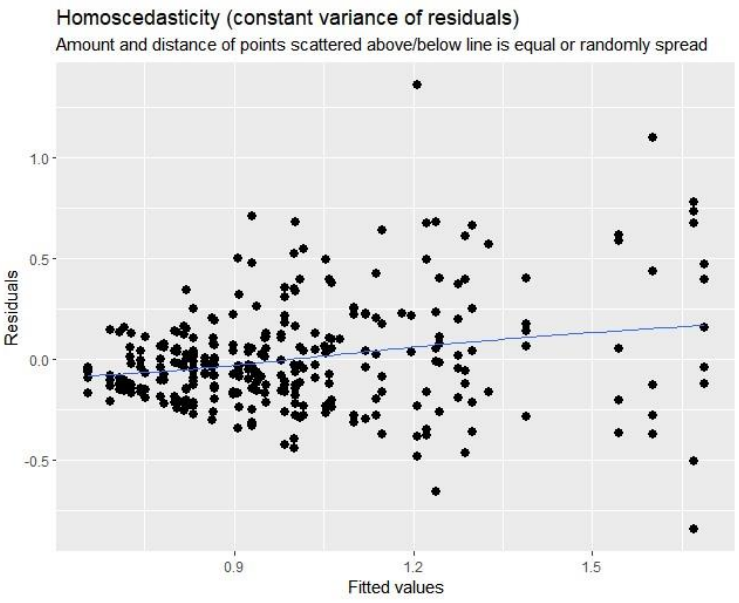
Appendix A: Statistical Model Assumptions

A.1 Number of Nodes: Baseline Model Assumptions

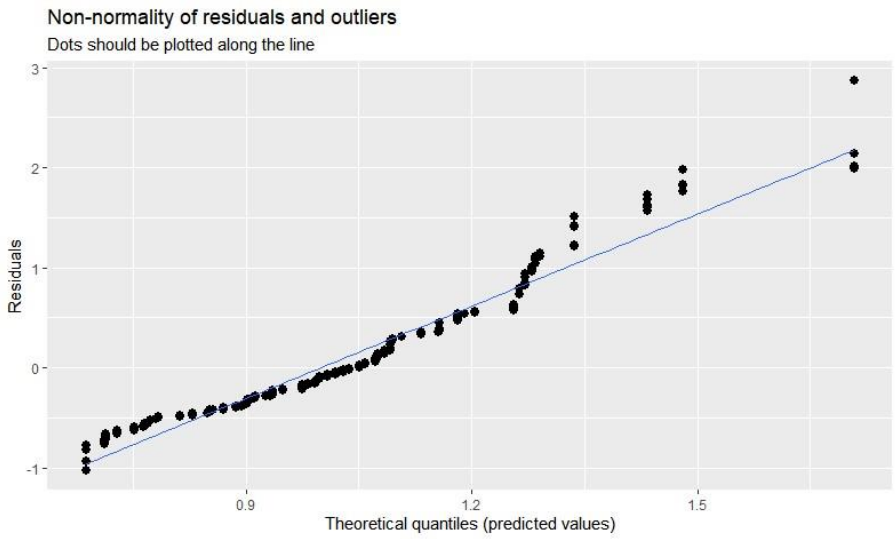


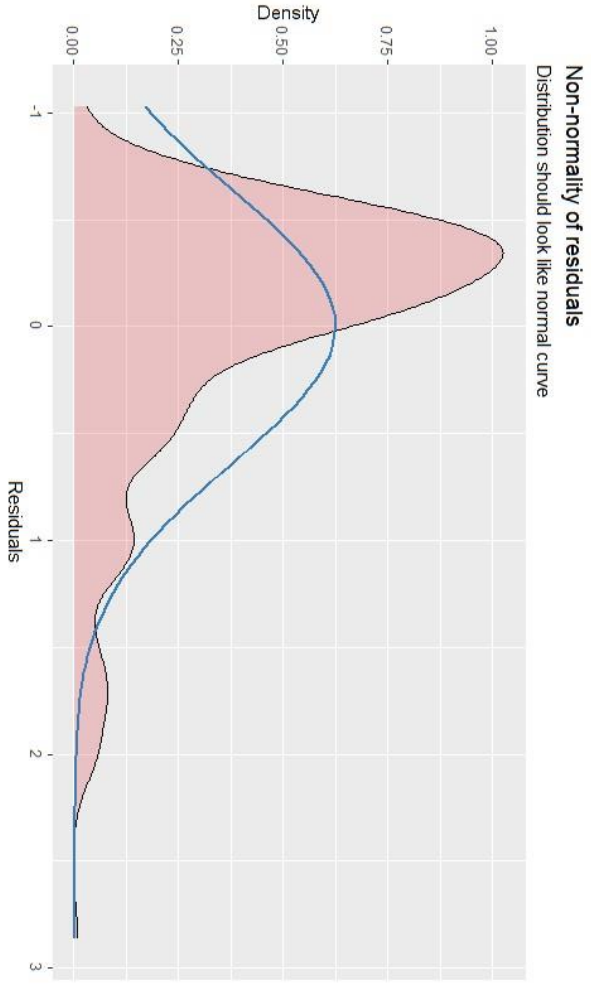


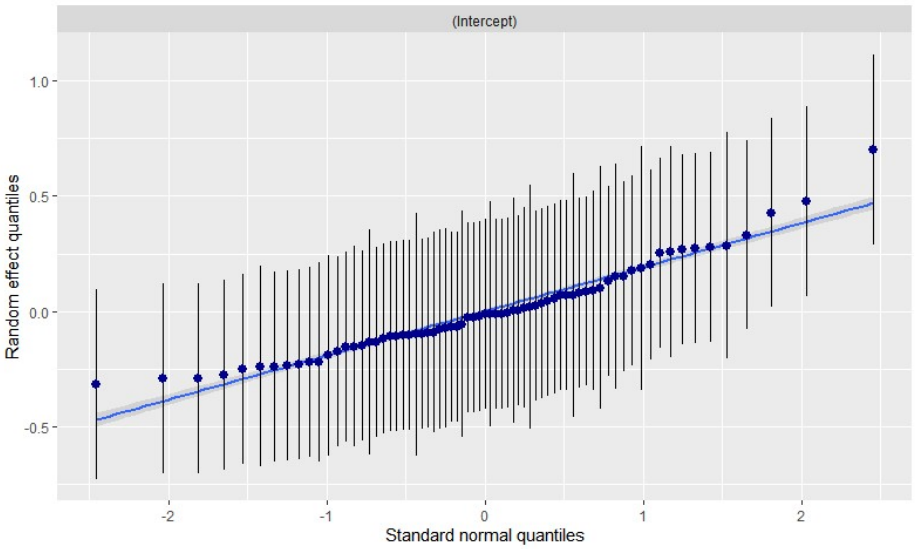


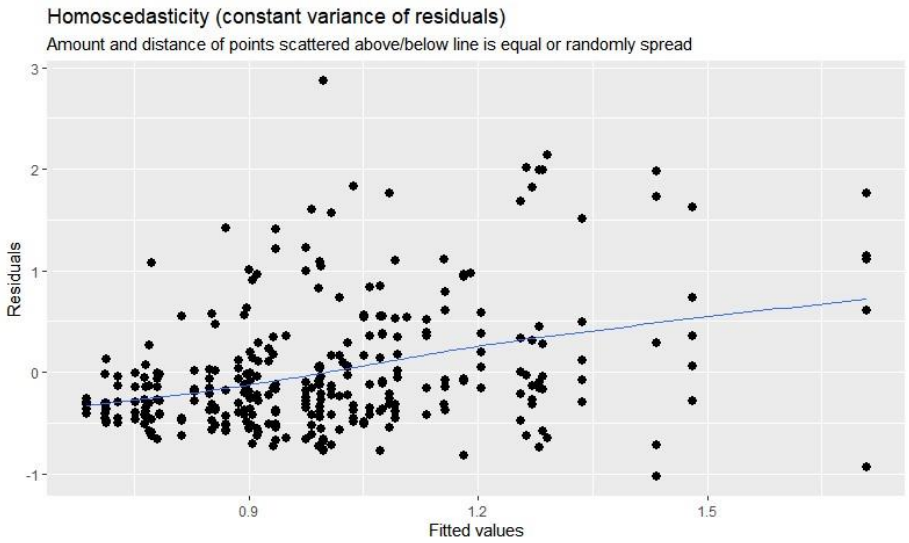


A.2 Time Spent: Baseline Model Assumptions

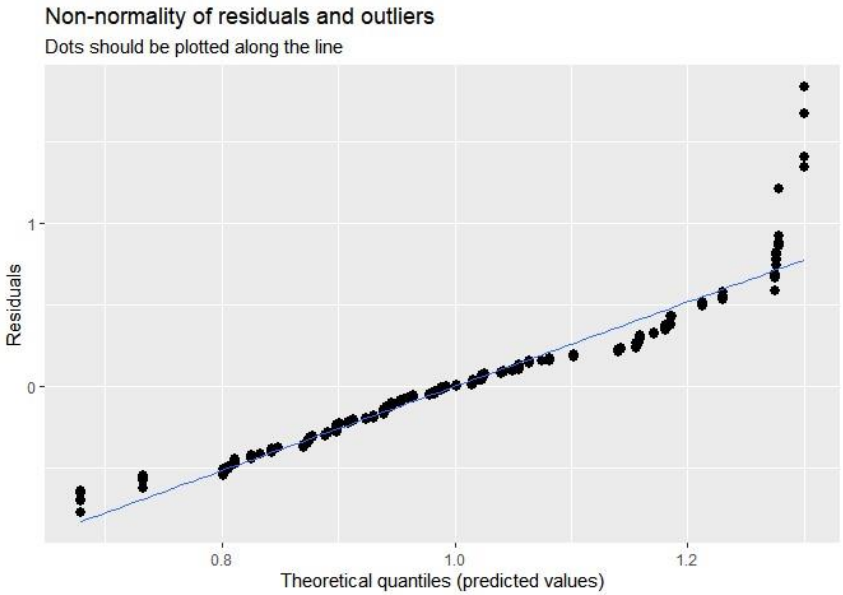


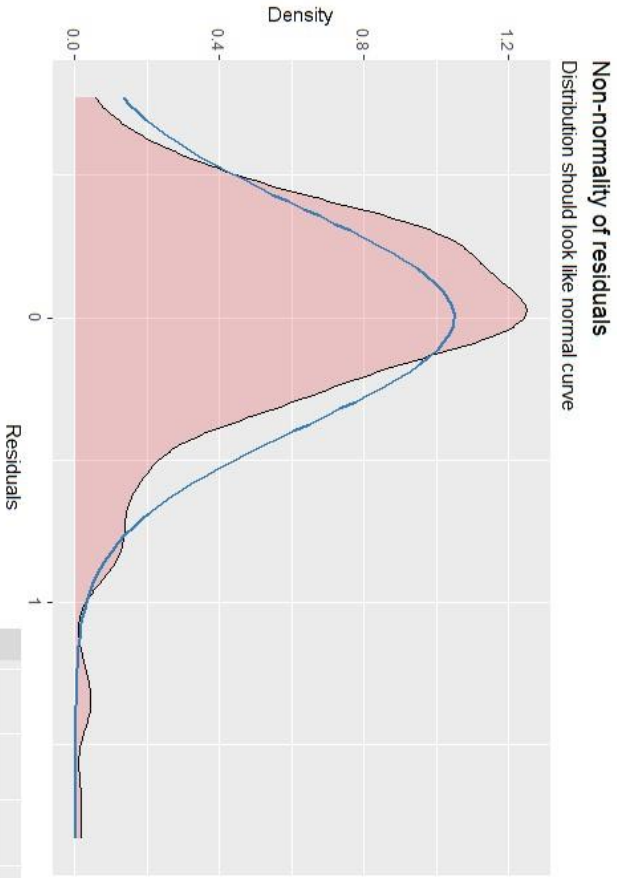


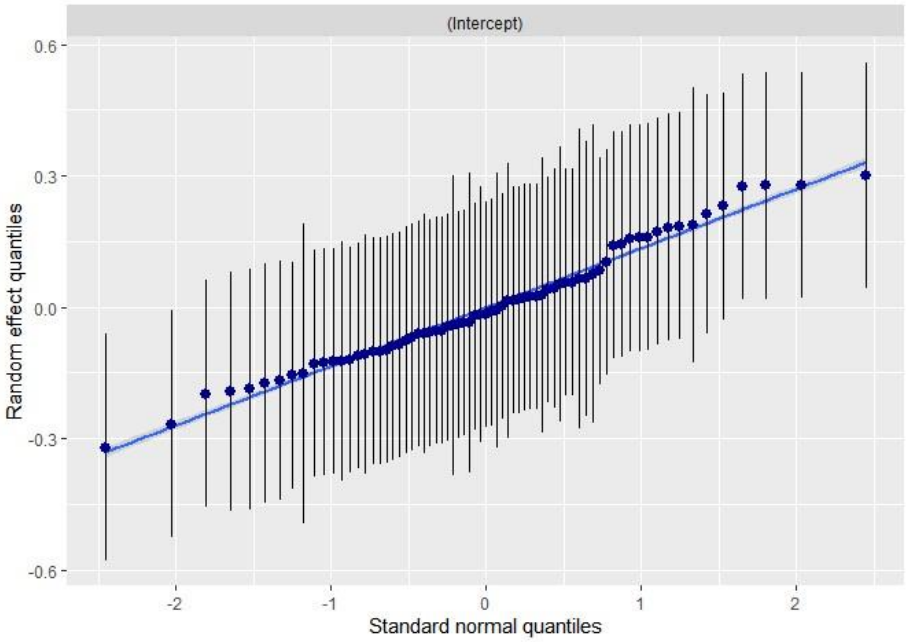


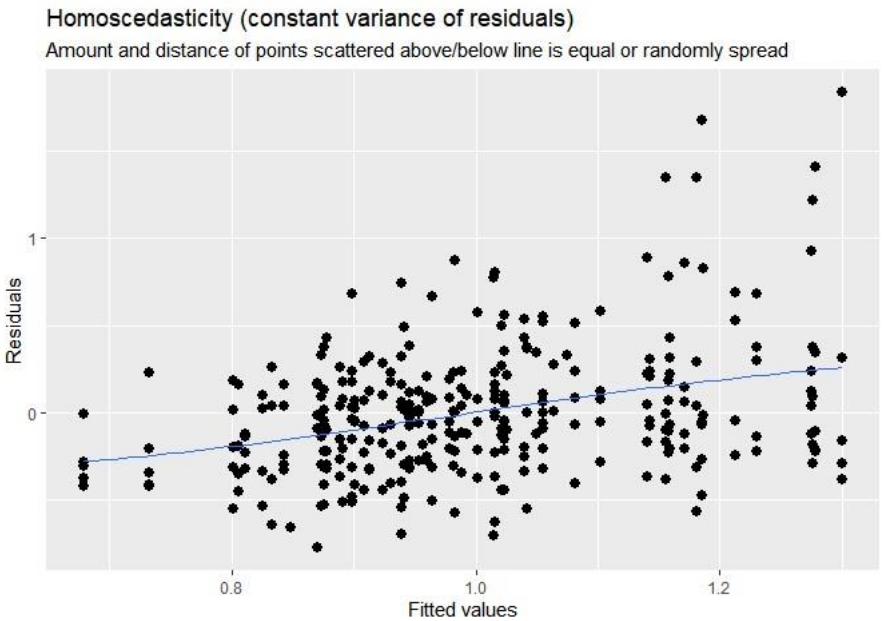


A.3 Mapped Area: Baseline Model Assumptions



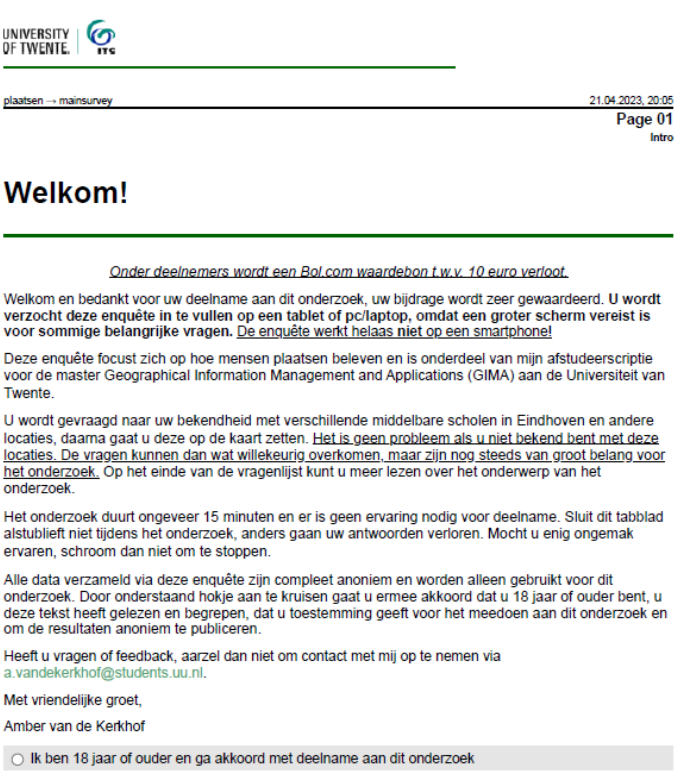






Appendix B: The Questionnaire

The following images show screenshots of a PDF extraction of the questionnaire. Please note that due to the embedded nature of the Survey123 mapping exercises, these are not included in the following images. For a look at these, please refer to Figure 3.1 and Maps 3.2–3.5.



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plaatsen → mainsurvey 21.04.2023, 20:05

Page 01
Intro

Welkom!

Onder deelnemers wordt een Bol.com waardebon t.w.v. 10 euro verloot.

Welkom en bedankt voor uw deelname aan dit onderzoek, uw bijdrage wordt zeer gewaardeerd. **U wordt verzocht deze enquête in te vullen op een tablet of pc/laptop, omdat een groter scherm vereist is voor sommige belangrijke vragen.** De enquête werkt helaas niet op een smartphone!

Deze enquête focust zich op hoe mensen plaatsen beleven en is onderdeel van mijn afstudeerscriptie voor de master Geographical Information Management and Applications (GIMA) aan de Universiteit van Twente.

U wordt gevraagd naar uw bekendheid met verschillende middelbare scholen in Eindhoven en andere locaties, daarna gaat u deze op de kaart zetten. Het is geen probleem als u niet bekend bent met deze locaties. De vragen kunnen dan wat willekeurig overkomen, maar zijn nog steeds van groot belang voor het onderzoek. Op het einde van de vragenlijst kunt u meer lezen over het onderwerp van het onderzoek.

Het onderzoek duurt ongeveer 15 minuten en er is geen ervaring nodig voor deelname. Sluit dit tabblad alstublieft niet tijdens het onderzoek, anders gaan uw antwoorden verloren. Mocht u enig ongemak ervaren, schroom dan niet om te stoppen.

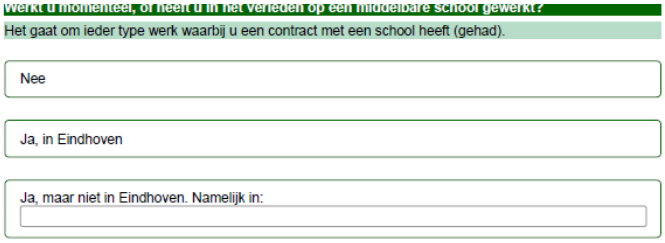
Alle data verzameld via deze enquête zijn compleet anoniem en worden alleen gebruikt voor dit onderzoek. Door onderstaand hokje aan te kruisen gaat u ermee akkoord dat u 18 jaar of ouder bent, u deze tekst heeft gelezen en begrepen, dat u toestemming geeft voor het meedoen aan dit onderzoek en om de resultaten anoniem te publiceren.

Heeft u vragen of feedback, aarzel dan niet om contact met mij op te nemen via a.vandekerkhof@students.uu.nl.

Met vriendelijke groet,

Amber van de Kerkhof

○ Ik ben 18 jaar of ouder en ga akkoord met deelname aan dit onderzoek



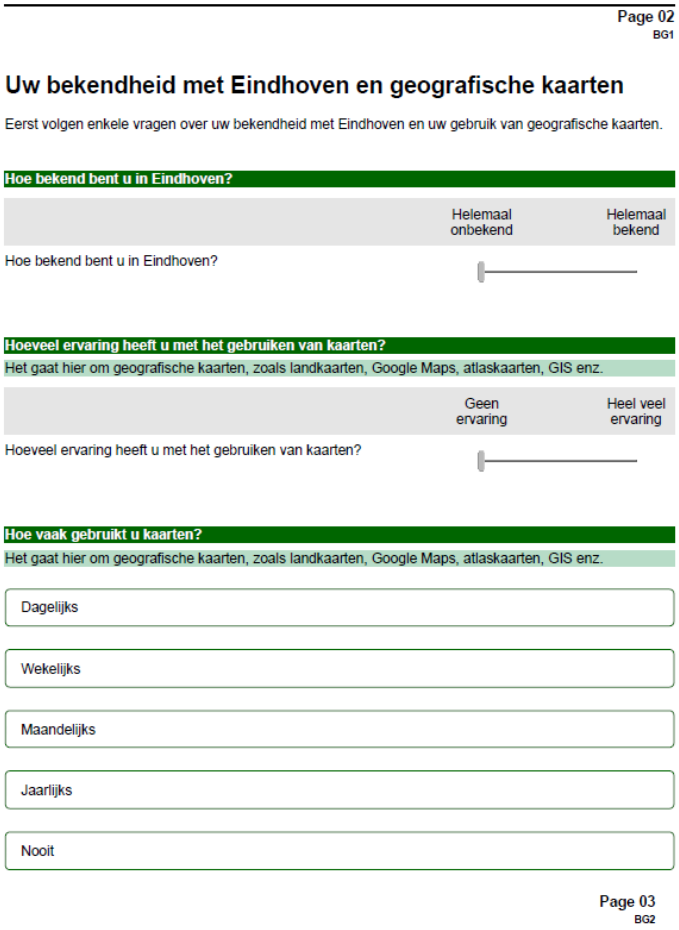
Werkt u momenteel, of heeft u in het verleden op een middelbare school gewerkt?

Het gaat om ieder type werk waarbij u een contract met een school heeft (gehad).

Nee

Ja, in Eindhoven

Ja, maar niet in Eindhoven. Namelijk in:



Page 02
BG1

Uw bekendheid met Eindhoven en geografische kaarten

Eerst volgen enkele vragen over uw bekendheid met Eindhoven en uw gebruik van geografische kaarten.

Hoe bekend bent u in Eindhoven?

	Helemaal onbekend	Helemaal bekend
Hoe bekend bent u in Eindhoven?		

Hoeveel ervaring heeft u met het gebruiken van kaarten?

Het gaat hier om geografische kaarten, zoals landkaarten, Google Maps, atlaskaarten, GIS enz.

	Geen ervaring	Heel veel ervaring
Hoeveel ervaring heeft u met het gebruiken van kaarten?		

Hoe vaak gebruikt u kaarten?

Het gaat hier om geografische kaarten, zoals landkaarten, Google Maps, atlaskaarten, GIS enz.

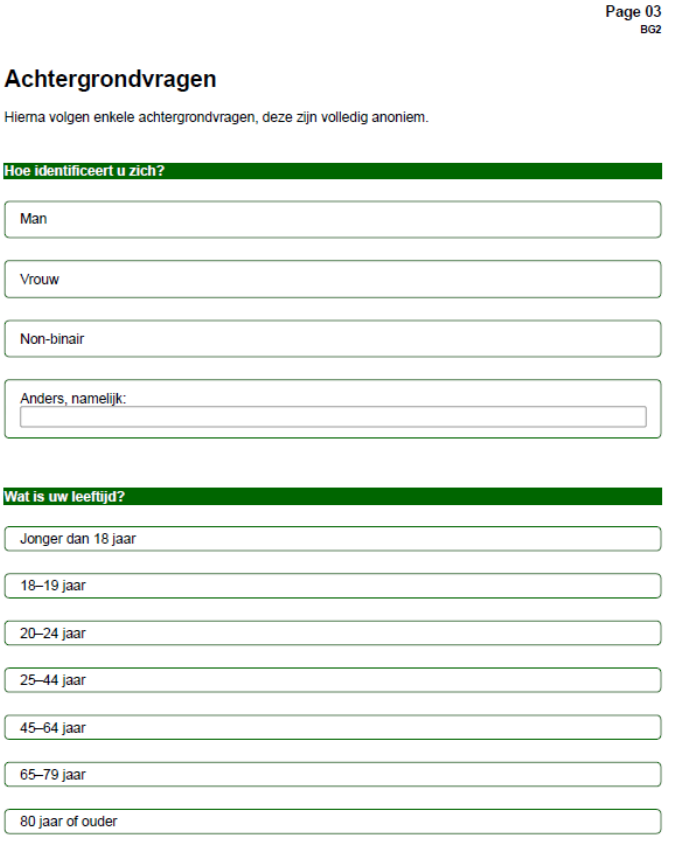
Dagelijks

Wekelijks

Maandelijks

Jaarlijks

Nooit



Page 03
BG2

Achtergrondvragen

Hierna volgen enkele achtergrondvragen, deze zijn volledig anoniem.

Hoe identificeert u zich?

Man

Vrouw

Non-binair

Anders, namelijk:

Wat is uw leeftijd?

Jonger dan 18 jaar

18–19 jaar

20–24 jaar

25–44 jaar

45–64 jaar

65–79 jaar

80 jaar of ouder

Wat is uw hoogst afgeronde opleiding?

- Basisschool of lager
- Lbo (vbo, ambachtsschool)
- Vmbo (mavo, ulo, mulo, groenschool)
- Havo (vhbo)
- Vwo (hbs, mms, lyceum)
- Mbo (leerlingwezen, bve)
- Hbo (bachelor, post-hbo, propedeuse universitaire opleiding)
- Wo/Universiteit (master, post-doc)

Op welk apparaat vult u deze vragenlijst in?

- Mobiele telefoon
- Tablet
- Laptop/Computer
- Anders, namelijk:

Page 04
SEHVa

Uw middelbare school opleiding

Heeft u uw middelbare school opleiding in Eindhoven gevolgd?

- Ja
- Nee

Page 05
SEHb

Selecteer uit de lijst hieronder op welke middelbare school (of scholen) in Eindhoven u uw opleiding heeft gevolgd.

- Eckartcollege
- Sint-Joriscollege, locatie Roostenlaan
- Sint-Joriscollege, overige locatie
- Stedelijk College Eindhoven Henegouwenlaan
- Stedelijk College Eindhoven Oude Bossche Baan
- Aloysius De Roosten
- Augustinianum
- Christiaan Huygens College, Huygens Lyceum
- De Korenaer Eindhoven
- Frits Philips lyceum-mavo
- International School Eindhoven Secondary Department
- Lorentz Casimir Lyceum
- Luzac Eindhoven
- Luzac Lyceum Eindhoven
- Montessori College Eindhoven

Novalis College

Olympia vmbo Eindhoven

SG De Rooi Pannen

SintLucas

Vakcollege Eindhoven

Van Maerlantlyceum

Yuverta vmbo Eindhoven

Anders, namelijk:

Op welke middelbare school heeft u uw opleiding gevolgd?

Op welke middelbare school (of scholen) heeft u uw opleiding gevolgd?

En in welke plaats (of plaatsen) was dat?

De video heeft geen geluid

question("$206")

Page 06
Expl

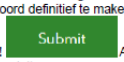
Enquête Uitleg

De enquête bestaat uit vijf blokken van drie pagina's. U ziet eerst foto's van een plaats, daarna vragen over uw bekendheid met deze plaats. Ieder blok eindigt met een opdracht waarbij u de plaats in kaart gaat brengen.

De vragen kunnen misschien repetitief overkomen, maar zijn alsnog erg belangrijk voor het onderzoek. Ik zou uw geduld dan ook enorm waarderen.

Voor deze laatste opdracht is de uitleg hieronder alvast te lezen en bekijken, deze is ook te zien op de pagina van de opdracht zelf.

Uitleg voor de kaartenopdracht later in de enquête:

1. Klik op  om de volledige kaart te zien.
2. U kunt op  klikken wanneer u de startlocatie kwijt bent.
3. Om te beginnen met de opdracht, klik op:  Het is de bedoeling dat u het gebied in kaart brengt dat u ziet als onderdeel van de weergegeven plaats. Dit doet u door de grens van dit gebied te markeren.
4. U begint door een punt te plaatsen en vervolgens in een cirkelbeweging andere punten te plaatsen op de omtrek van het gebied. U kunt zoveel punten plaatsen als u wilt.
5. **Belangrijk 1:** Om uw gemaakte markering te bevestigen, moet u op uw **eerst geplaatste punt klikken** (het witte bolletje), of op het **vinkje klikken**  Dit is gelukt wanneer u geen witte/rode bolletjes meer ziet! U kunt hiervoor ook dubbelklikken bij het zetten van het laatste punt.
6. Hierna kunt u via  of  het grote scherm sluiten.
7. **Belangrijk 2:** Om uw antwoord definitief te maken, moet u nog op de **groene 'submit' of 'verzenden' knop klikken!** 

Anders gaat uw antwoord verloren. Deze ziet u wanneer u het grote scherm sluit.
8. U kunt nu de enquête vervolgen onderaan de pagina.

Tip: Twee gemaakte punten worden verbonden met een rechte lijn, zet daarom overal punten waar een lijn op de kaart niet recht is.

Voorbeeld video van de kaartenopdracht:

Page 07
$1a

Stedelijk College Eindhoven, locatie Henegouwenlaan

Onderstaande foto's laten de huidige middelbare school het Stedelijk College Eindhoven, locatie Henegouwenlaan zien, ofwel het voormalige Gemeentelijke Scholengemeenschap Woensel (GSW). De vragen op de volgende twee pagina's gaan over deze plaats.

Neemt u een moment om de foto's te bekijken voordat u doorgaat naar de volgende pagina.

Bron: Google Streetview

Bron: Willem Suden

Page 08
S1c

Uw bekendheid met de plaats: Stedelijk College Eindhoven, locatie Henegouwenlaan

Onderstaande vragen gaan over de plaats die u zojuist op de foto's heeft gezien: het Stedelijk College Eindhoven, locatie Henegouwenlaan/voormalige GSW. Het maakt voor de vragen niet uit in welk jaar u iets met deze plaats heeft gehad of welke naam het toen had, het gaat om de locatie aan de **Henegouwenlaan**.

Probeert u alstublieft ook antwoord op de vragen te geven wanneer u niet of minder bekend bent met deze plaats, deze antwoorden zijn erg waardevol.

Om de foto's van de vorige pagina opnieuw te bekijken, klikt u op onderstaande links:

Foto 1, Foto 2

Geef op onderstaande schuifbalken aan in welke mate u zich identificeert met de stellingen met betrekking tot het Stedelijk College Eindhoven: Henegouwenlaan.

Hierbij is 0% (links) helemaal oneens met de stelling en 100% (rechts) helemaal eens met de stelling.
(Ook wanneer u met 0% wilt antwoorden moet u een keertje klikken op het schuifje).

	Helemaal oneens	Helemaal eens
Ik ben bekend met deze plaats; ik herken deze plaats.		
Deze plaats roept emoties in mij op (positief of negatief).		
Ik weet hoe het voelt om in deze plaats te zijn.		
Ik voel me gehecht aan deze plaats.		
Ik heb sociale relaties voortkomend uit en/of gerelateerd aan deze plaats.		

Hoe vaak bent u in de buurt van Het Stedelijk College Eindhoven: Henegouwenlaan geweest?

Hiermee wordt bedoelt dat u op, of direct langs het terrein bent gekomen.

- Nog nooit (0 keer)
- 1–9 keer
- 10–49 keer
- 50–100 keer
- meer dan 100 keer

Met welke woorden zou u deze plaats omschrijven?

Hoe zou u uw band met deze plaats omschrijven?

Optioneel

Page 09
S1b

In kaart brengen van de plaats: Stedelijk College Eindhoven locatie Henegouwenlaan

In onderstaande opdracht gaat u het gebied van de plaats het Stedelijk College Eindhoven: Henegouwenlaan / voormalige GSW in kaart brengen. **Dit doet u door de grens af te bakenen van wat u ziet als onderdeel van de plaats.** Er zijn hierbij geen goede of foute antwoorden, het gaat om uw interpretatie van de plaats.

Hieronder kunt u de instructies lezen en bekijken via een video.

- ▸ **Klik hier om de uitleg te lezen!**
- ▸ **Klik hier om de voorbeeld video te bekijken.**

Klik op de afbeelding voor een grotere weergave.

Belangrijk

Om uw markering definitief te maken, moet u eerst op uw **eerst geplaatste punt** klikken (het witte bolletje), of op het **vinkje** klikken ( ). Dit is gelukt wanneer u geen witte/rode bolletjes meer ziet!
Daarna klikt u op de **groene verzenden/submit knop**. Om deze te zien, is het belangrijk dat u het **grote scherm sluit** ( ), soms moet u ook iets **scrollen**.

- ○ Ik heb in bovenstaande opdracht mijn geplaatste punten bevestigd door te klikken op het **vinkje** en vervolgens mijn antwoorden opgeslagen via de **groene 'Verzenden' / 'Submit' knop**.

Page 10
S2a

Eckartcollege in Eindhoven

Onderstaande foto's laten de middelbare school het Eckartcollege in Eindhoven zien. De vragen op de volgende twee pagina's gaan over deze plaats.

Neemt u een moment om de foto's te bekijken voordat u doorgaat naar de volgende pagina.

Bron: Eckart College, Rossumedia

Bron: Wikipedia, Rosemoon

Page 11
S2c

Uw bekendheid met de plaats: Eckartcollege in Eindhoven

Onderstaande vragen gaan over de plaats die u zojuist op de foto's heeft gezien: het Eckartcollege in Eindhoven. Het maakt voor de vragen niet uit in welk jaar u iets met deze plaats heeft gehad of welke naam de plaats toen had, het gaat om de locatie aan de Damocleslaan.

Probeert u alstublieft ook antwoord op de vragen te geven wanneer u niet of minder bekend bent met deze plaats, deze antwoorden zijn erg waardevol.

Om de foto's van de vorige pagina opnieuw te bekijken, klikt u op onderstaande links:

Foto 1, Foto 2

Geef op onderstaande schuifbalken aan in welke mate u zich identificeert met de stellingen met betrekking tot het Eckart College.

Hierbij is 0% (links) helemaal oneens met de stelling en 100% (rechts) helemaal eens met de stelling.
(Ook wanneer u met 0% wilt antwoorden moet u een keertje klikken op het schuifje).

	Helemaal oneens	Helemaal eens
Ik ben bekend met deze plaats; ik herken deze plaats.		
Deze plaats roept emoties in mij op (positief of negatief).		
Ik weet hoe het voelt om in deze plaats te zijn.		
Ik voel me gehecht aan deze plaats.		
Ik heb sociale relaties voortkomend uit en/of gerelateerd aan deze plaats.		

Hoe vaak bent u in de buurt van het Eckart College geweest?

Hiermee wordt bedoelt dat u op, of direct langs het terrein bent gekomen.

- Nog nooit (0 keer)
- 1–9 keer
- 10–49 keer
- 50–100 keer
- meer dan 100 keer

Met welke woorden zou u deze plaats omschrijven?

Hoe zou u uw band met deze plaats omschrijven?

Optioneel

Page 12
S2b

In kaart brengen van de plaats: Eckartcollege in Eindhoven

In onderstaande opdracht gaat u het gebied van de plaats het Eckartcollege in kaart brengen. **Dit doet u door de grens af te bakenen van wat u ziet als onderdeel van de plaats.** Er zijn hierbij geen goede of foute antwoorden, het gaat om uw interpretatie van de plaats.

Hieronder kunt u de instructies lezen en bekijken via een video.

- ▸ **Klik hier om de uitleg te lezen!**
- ▸ **Klik hier om de voorbeeld video te bekijken.**

Klik op de afbeelding voor een grotere weergave.

Belangrijk

Om uw markering definitief te maken, moet u eerst op uw **eerst geplaatste punt** klikken (het witte bolletje), of op het **vinkje** klikken ( ). Dit is gelukt wanneer u geen witte/rode bolletjes meer ziet!
Daarna klikt u op de **groene verzenden/submit knop**. Om deze te zien, is het belangrijk dat u het **grote scherm sluit** ( ), soms moet u ook iets **scrollen**.

○ Ik heb in bovenstaande opdracht mijn geplaatste punten bevestigd door te klikken op het **vinkje** en vervolgens mijn antwoorden opgeslagen via de **groene 'Verzenden' / 'Submit' knop**.

Page 13
S3a

Sint-Joris College in Eindhoven

Onderstaande foto's laten de middelbare school het Sint-Joris College in Eindhoven zien. De vragen op de volgende twee pagina's gaan over deze plaats.

Neemt u een moment om de foto's te bekijken voordat u doorgaat naar de volgende pagina.

Bron: Eindhovens Dagblad, Fotomeulenhof

Bron: Scholen op de Kaart

Page 14
S3c

Uw bekendheid met de plaats: Sint-Joris College in Eindhoven

Onderstaande vragen gaan over de plaats die u zojuist op de foto's heeft gezien: het Sint-Joris College in Eindhoven. Het maakt voor de vragen niet uit in welk jaar u iets met deze plaats heeft gehad of welke naam de plaats toen had, het gaat om de locatie aan de **Roostenlaan**.

Probeert u alstublieft ook antwoord op de vragen te geven wanneer u niet of minder bekend bent met deze plaats, deze antwoorden zijn erg waardevol.

Om de foto's van de vorige pagina opnieuw te bekijken, kunt u deze links gebruiken:

Foto 1, Foto 2

Geef op onderstaande schuifbalken aan in welke mate u zich identificeert met de stellingen met betrekking tot het Sint-Joris College.

Hierbij is 0% (links) helemaal oneens met de stelling en 100% (rechts) helemaal eens met de stelling. (Ook wanneer u met 0% wilt antwoorden moet u een keertje klikken op het schuifje).

	Helemaal oneens	Helemaal eens
Ik ben bekend met deze plaats; ik herken deze plaats.		
Deze plaats roept emoties in mij op (positief of negatief).		
Ik weet hoe het voelt om in deze plaats te zijn.		
Ik voel me gehecht aan deze plaats.		
Ik heb sociale relaties voortkomend uit en/of gerelateerd aan deze plaats.		

Hoe vaak bent u in de buurt van het Sint-Joris College geweest?

Hiermee wordt bedoelt dat u op, of direct langs het terrein bent gekomen.

- Nog nooit (0 keer)
- 1–9 keer
- 10–49 keer
- 50–100 keer
- meer dan 100 keer

Met welke woorden zou u deze plaats omschrijven?

Hoe zou u uw band met deze plaats omschrijven?

Optioneel

Page 15
$3b

In kaart brengen van de plaats: Sint-Joris College in Eindhoven

In onderstaande opdracht gaat u het gebied van de plaats het Sint-Joris College in kaart brengen. **Dit doet u door de grens af te bakenen van wat u ziet als onderdeel van de plaats.** Er zijn hierbij geen goede of foute antwoorden, het gaat om uw interpretatie van de plaats.

Hieronder kunt u de instructies lezen en bekijken via een video.

- ▸ **Klik hier om de uitleg te lezen!**
- ▸ **Klik hier om de voorbeeld video te bekijken.**

Klik op de afbeelding voor een grotere weergave.

Belangrijk

Om uw markering definitief te maken, moet u eerst op uw **eerst geplaatste punt** klikken (het witte bolletje), of op het **vinkje** klikken ( ). Dit is gelukt wanneer u geen witte/rode bolletjes meer ziet!
Daarna klikt u op de **groene verzenden/submit knop**. Om deze te zien, is het belangrijk dat u het **grote scherm sluit** ( ), soms moet u ook iets **scrollen**.

○ Ik heb in bovenstaande opdracht mijn geplaatste punten bevestigd door te klikken op het **vinkje** en vervolgens mijn antwoorden opgeslagen via de **groene 'Verzenden' / 'Submit' knop**.

Page 16
$5a

Stedelijk Gymnasium Nijmegen

Onderstaande foto's laten de middelbare school het Stedelijk Gymnasium Nijmegen zien. De vragen op de volgende twee pagina's gaan over deze plaats.

Neemt u een moment om de foto's te bekijken voordat u doorgaat naar de volgende pagina.

Bron: Google Streetview

Bron: De Gelderlander, Google Streetview

Page 17
$5c

Uw bekendheid met de plaats: Stedelijk Gymnasium Nijmegen.

Onderstaande vragen gaan over de plaats die u zojuist op de foto's heeft gezien: het Stedelijk Gymnasium Nijmegen. Het maakt voor de vragen niet uit in welk jaar u iets met deze plaats heeft gehad of welke naam de plaats toen had, het gaat om de locatie aan de **Kronenburgersingel**.

Probeert u alstublieft ook antwoord op de vragen te geven wanneer u niet of minder bekend bent met deze plaats, deze antwoorden zijn erg waardevol.

Om de foto's van de vorige pagina opnieuw te bekijken, klikt u op onderstaande links:

Foto 1, Foto 2

Geef op onderstaande schuifbalken aan in welke mate u zich identificeert met de stellingen met betrekking tot het Stedelijk Gymnasium Nijmegen.

Hierbij is 0% (links) helemaal oneens met de stelling en 100% (rechts) helemaal eens met de stelling.
(Ook wanneer u met 0% wilt antwoorden moet u een keertje klikken op het schuifje).

	Helemaal oneens	Helemaal eens
Ik ben bekend met deze plaats; ik herken deze plaats.		
Deze plaats roept emoties in mij op (positief of negatief).		
Ik weet hoe het voelt om in deze plaats te zijn.		
Ik voel me gehecht aan deze plaats.		
Ik heb sociale relaties voortkomend uit en/of gerelateerd aan deze plaats.		

Hoe vaak bent u in de buurt van het Stedelijk Gymnasium Nijmegen geweest?

Hiermee wordt bedoelt dat u op, of direct langs het terrein bent gekomen.

- Nog nooit (0 keer)
- 1–9 keer
- 10–49 keer
- 50–100 keer
- meer dan 100 keer

Met welke woorden zou u deze plaats omschrijven?

Hoe zou u uw band met deze plaats omschrijven?

Optioneel

Page 18
S5b

In kaart brengen van de plaats: Stedelijk Gymnasium Nijmegen

In onderstaande opdracht gaat u het gebied van de plaats het Stedelijk Gymnasium Nijmegen in kaart brengen. **Dit doet u door de grens af te bakenen van wat u ziet als onderdeel van de plaats.** Er zijn hierbij geen goede of foute antwoorden, het gaat om uw interpretatie van de plaats.

Hieronder kunt u de instructies lezen en bekijken via een video.

- ▸ **Klik hier om de uitleg te lezen!**
- ▸ **Klik hier om de voorbeeld video te bekijken.**

Klik op de afbeelding voor een grotere weergave.

Belangrijk

Om uw markering definitief te maken, moet u eerst op uw **eerst geplaatste punt** klikken (het witte bolletje), of op het **vinkje** klikken ( ). Dit is gelukt wanneer u geen witte/rode bolletjes meer ziet!
Daarna klikt u op de **groene verzenden/submit knop**. Om deze te zien, is het belangrijk dat u het **grote scherm sluit** ( ), soms moet u ook iets **scrollen**.

Ik heb in bovenstaande opdracht mijn geplaatste punten bevestigd door te klikken op het **vinkje** en vervolgens mijn antwoorden opgeslagen via de **groene 'Verzenden' / 'Submit' knop**.

Page 19
S6a

Johan de Witt Gymnasium in Dordrecht

Onderstaande foto's laten de middelbare school het Johan de Witt Gymnasium in Dordrecht zien. De vragen op de volgende twee pagina's gaan over deze plaats.

Neemt u een moment om de foto's te bekijken voordat u doorgaat naar de volgende pagina.

Bron: Google Streetview, Jeanot van Dort

Bron: Scholen op de Kaart

Page 20
S6c

Uw bekendheid met de plaats: Johan de Witt Gymnasium in Dordrecht

Onderstaande vragen gaan over de plaats die u zojuist op de foto's heeft gezien: het Johan de Witt Gymnasium in Dordrecht. Het maakt voor de vragen niet uit in welk jaar u iets met deze plaats heeft gehad of welke naam de plaats toen had, het gaat om de locatie aan het Oranjepark.

Probeert u alstublieft ook antwoord op de vragen te geven wanneer u niet of minder bekend bent met deze plaats, deze antwoorden zijn erg waardevol.

Om de foto's van de vorige pagina opnieuw te bekijken, klikt u op onderstaande links:

Foto 1, Foto 2

Geef op onderstaande schuifbalken aan in welke mate u zich identificeert met de stellingen met betrekking tot het Johan de Witt Gymnasium.

Hierbij is 0% (links) helemaal oneens met de stelling en 100% (rechts) helemaal eens met de stelling.
(Ook wanneer u met 0% wilt antwoorden moet u een keertje klikken op het schuifje).

	Helemaal oneens	Helemaal eens
Ik ben bekend met deze plaats; ik herken deze plaats.		
Deze plaats roept emoties in mij op (positief of negatief).		
Ik weet hoe het voelt om in deze plaats te zijn.		
Ik voel me gehecht aan deze plaats.		
Ik heb sociale relaties voortkomend uit en/of gerelateerd aan deze plaats.		

Hoe vaak bent u in de buurt van het Johan de Witt Gymnasium geweest?

Hiermee wordt bedoelt dat u op, of direct langs het terrein bent gekomen.

- Nog nooit (0 keer)
- 1–9 keer
- 10–49 keer
- 50–100 keer
- meer dan 100 keer

Met welke woorden zou u deze plaats omschrijven?

Hoe zou u uw band met deze plaats omschrijven?

Optioneel

Page 21
S6b

In kaart brengen van de plaats: Johan de Witt Gymnasium Dordrecht

In onderstaande opdracht gaat u het gebied van de plaats het Johan de Witt Gymnasium in Dordrecht in kaart brengen. **Dit doet u door de grens af te bakenen van wat u ziet als onderdeel van de plaats.** Er zijn hierbij geen goede of foute antwoorden, het gaat om uw interpretatie van de plaats.

Hieronder kunt u de instructies lezen en bekijken via een video.

- ▸ **Klik hier om de uitleg te lezen!**
- ▸ **Klik hier om de voorbeeld video te bekijken.**

Klik op de afbeelding voor een grotere weergave.

Belangrijk

Om uw markering definitief te maken, moet u eerst op uw **eerst geplaatste punt** klikken (het witte bolletje), of op het **vinkje** klikken ( ). Dit is gelukt wanneer u geen witte/rode bolletjes meer ziet!
Daarna klikt u op de **groene verzenden/submit knop**. Om deze te zien, is het belangrijk dat u het **grote scherm sluit** ( ), soms moet u ook iets **scrollen**.

- ○ Ik heb in bovenstaande opdracht mijn geplaatste punten bevestigd door te klikken op het vinkje en vervolgens mijn antwoorden opgeslagen via de groene 'Verzenden' / 'Submit' knop.

Page 22
Prize

Ten slotte...

(klik onderaan de pagina alstublieft nog een keer op 'verder' om uw antwoorden op te slaan)

Wilt u nog iets delen dat niet aan bod is gekomen in de vragenlijst? U kunt hier ook feedback en opmerkingen delen.

Voor vragen kunt u mailen naar a.vandekerkhof@students.uu.nl, anders is een antwoord krijgen niet mogelijk.

Een Bol.com waardebon t.w.v. 10 euro wordt verloot onder de deelnemers van deze enquête. Indien u mee wilt doen, kunt u hieronder uw e-mailadres invullen. Deze vraag kan worden overgeslagen als u niet mee wilt doen.

E-mailadressen worden enkel gebruikt om de winnaar te contacteren en worden daarna vernietigd. Ook is het niet mogelijk om enquête antwoorden te koppelen aan e-mailadressen, deze blijven volledig anoniem.

- ☐ Ik wil meedoen aan de wedstrijd. Ik ga ermee akkoord dat mijn e-mailadres wordt bewaard totdat de winnaars zijn getrokken. Deze overeenkomst kan te allen tijde worden herroepen. Mijn gegevens in deze enquête blijven anoniem, mijn e-mailadres wordt niet doorgegeven aan derden.

Last Page

U bent aan het einde van deze enquête gekomen. Nogmaals hartelijk bedankt voor uw deelname, uw antwoorden worden enorm gewaardeerd. *Via deze enquête wordt onderzocht of de mate van bekendheid met plaatsen invloed heeft op hoe mensen deze plaatsen in kaart brengen.*

Kent u anderen die op één van de in de enquête besproken scholen hebben gezeten? Dan zou ik enorm dankbaar zijn als u de volgende link met hen wilt delen om de enquête in te vullen:
https://www.soscisurvey.de/plaatsen/?r=E

Mocht u vragen of feedback hebben, aarzel dan niet om contact met mij op te nemen via a.vandekerkhof@students.uu.nl.

Met vriendelijke groet,
Amber van de Kerkhof

Indien u enige negatieve emoties heeft ervaren als gevolg van deze enquête en u daar graag begeleiding bij wilt ontvangen, neemt u dan contact op met uw huisarts. Op Zorgkaart Nederland vind u een overzicht en contactinformatie van lokale huisartsenpraktijken.

U kunt dit venster nu veilig sluiten, uw antwoorden zijn opgeslagen.

Amber van de Kerkhof, MSc GIMA student, University of Twente and Utrecht University – 2022