

Measuring Perceptual Spatial Quality in Virtual Environments: A Case for the Canal Revitalisation of Historic Gedempte Zuiderdiep, Groningen



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Abstract

Employing a multi-method approach, the study combines qualitative and quantitative analyses to explain how participants perceive and evaluate urban spaces represented in 3D virtual environments. This thesis focuses on five essential urban design qualities derived from urban design theory —imageability, enclosure, human scale, transparency, and complexity—each contributing to the perceived experience of streetscapes. *Gedempte Zuiderdiep*, Groningen, with the city’s plans for canal revitalisation, is used as a case study to generate streetscape designs depicting green and blue spaces. Using 3D models, this discourse navigates the complexities of environmental perceptions, revealing how cultural contexts intertwine with urban design elements, ultimately shaping the ways individuals experience and interpret urban spaces.

Furthermore, this academic exploration extends beyond the realms of mere observation, by providing quantifiable attributes for urban design implementation through the use of Visual Assessment Surveys completed by participants. And, through a qualitative lens, participants engaged in semi-structured focus groups describing their perceptual insight. Using both quantitative and qualitative analysis, this research suggests urban designers concentrate on developing spaces characterized by high-rated design qualities, specifically emphasizing imageability and human scale. It underscores the importance of comprehending the dynamic relationship between complexity, enclosure, and transparency, as these factors significantly impact the overall perceptions of safety and mobility, as well as the activities conducted in urban spaces. Moreover, this thesis determined participants were able to effectively navigate 3D Virtual Environments to evaluate the perceptual design qualities of four different 3D models, proposing further research into the use of Virtual Reality in urban design communication. Finally, the research aims to contribute valuable insights to the field of urban design by bridging the gap between theoretical frameworks and practical Virtual Reality applications.

Key concepts: Urban design; perceptual design qualities; 3D virtual environments; canal revitalisation.

Table of Contents

1 Introduction	4
1.1 The Advent of Urban Design	4
1.3 Research Framework and Outline	6
1.2 The Case Study	8
2 Theoretical Framework	9
2.1 Urban Design Theory	9
2.1.1 Sense of Place	10
2.1.2 Urban Form	11
2.1.3 Human-Environment Interaction	12
2.2 Defining Spatial Quality in Urban Environments	13
2.3 Perceptual Urban Design Qualities	14
2.3.1 Visual Quality Analysis of Urban Space	15
2.3.2 The Physical Quality Analysis	17
2.3.3 Structure Analysis of Urban Space	18
2.4 Green and Blue Spaces in Urban Design	19
2.4.1 Green Spaces	19
2.4.2 Blue Spaces	20
2.5 Visual communication	22
2.5.1 The 3 rd Dimension	24
2.5.2 Virtual Reality	25
2.5.3 Virtual Reality in Urban Design	26
2.6 The Gap - Urban Design Theory and Practice	27
2.6.1 Measuring Perceptual Urban Design Qualities	28
2.7 Conceptual Model	31
3 Methodology	33
3.1 Research Design	33
3.2 Research Approach	34
3.2.1 Spatial Quality Metrics in the Context of this Research	34
3.3 Creating Virtual Environments	39
3.3.1 3D Modelling	39
3.3.2 Four Virtual Environments	41
3.4 Methods of Data Collection	45
3.4.1 Finding and Approaching Panel experts	45
3.4.2 Visual Assessment Survey	46
3.4.3 Semi-structured Interviews	47
3.5 Ethical Considerations	48

3.6 COVID-19 Restrictions	49
4 Results	50
4.1 Qualitative Results.....	50
4.1.1 Organising and Coding Panel Discussions	50
4.1.2 The Code Tree.....	51
4.1.3 Environmental Perceptions	51
4.2 Quantitative Results	57
4.2.1 Average Rating of Each Design Quality by Model	58
4.2.2 Average Rating by Professionals vs Students.....	59
4.2.3 Average Rating by Planners vs Architects	60
4.2.4 Correlations Between Design Qualities	61
5 Discussion	63
5.1 Discussing on the Research Findings.....	63
5.1.1 Spatial Qualities Communicated Through 3D Models	63
5.1.2 Participant Attributes	65
5.2 Contributions to Growing Research in Urban Design	67
6 Limitations and Future Research Opportunities	70
6.1 Sample Size and participants	70
6.2 3D modelling	71
6.2 Virtual Reality Opportunities.....	72
8 Reference List	73
9 Appendices.....	80
Appendix I - Literature Table.....	80
Appendix II - Visual Assessment Surveys	81
Appendix III - Code Tables	84
Appendix III – Transcripts	104
Focus Group 1.....	104
Focus Group 2.....	122
Focus Group 3.....	142
Focus Group 4.....	168

List of Figures and Tables

Figure 1: Gedempte Zuiderdiep, Groningen	8
Figure 2: List of Perceptual Design Qualities.....	15
Figure 3: Aesthetic Response to Building Attributes.....	16
Figure 4: Scientific Visualisation.....	23
Figure 5: Streetscape Example Image.....	29
Figure 6: Example Images of Architectural Styles	30
Figure 7: Example of a Floor Plan Presented to the Participants	31
Figure 8: Conceptual Model	32
Figure 9: Mixed Methods-case Study Conceptual Model	33
Figure 10: Imageability: Left (High Quality); Right (Low Quality).....	35
Figure 11: Enclosure: Left (High Quality); Right (Low Quality)	35
Figure 12: Transparency: Left (High Quality); Right (Low Quality).....	36
Figure 13: Human Scale: Left (High Quality); Right (Low Quality).....	37
Figure 14: Complexity: Left (High Quality); Right (Low Quality)	38
Figure 15: Process of Creating 3D Models (By Author)	39
Figure 16: Building Facades.....	40
Figure 17: Model 1	41
Figure 18: Model 2	42
Figure 19: Model 3	43
Figure 20: Model 4	44
Figure 21: List of Perceptual Design Qualities.....	50
Figure 22: Imageability Code Tree	52
Figure 23: Enclosure Code Tree	53
Figure 24: Transparency Code Tree	54
Figure 25: Human Scale Code Tree	55
Figure 26: Complexity Code Tree.....	56
Table 1: Breakdown of Participants by Attribute.....	46
Table 2: Visual Assessment Survey Format	47
Table 3: Audit Quality Criteria	51
Table 4: Themes Derived from the Code Trees	57
Table 5: Average Ratings for Each Design Quality and Model.....	58
Table 6: Average Ratings of Design Qualities: Professionals & Students	59
Table 7: Average Ratings of Design Qualities: Planners & Architects.....	60
Table 8: Correlations Among Urban Design Qualities.....	61

1 | Introduction

1.1 | The Advent of Urban Design

Designing cities dates back thousands of years to the earliest civilisations of Mesopotamia, the meticulously planned streets and public spaces of classical Greek and Roman cities, the narrow winding streets and fortifications of medieval Europe, and the Renaissance, with the discovery of mathematical perspective, and a period of rebirth in planning and design (Broadbent, 1990). This rebirth created an elite class of designers which cities became dependent on “the personal filters of designers at specific geographic locations and moments in time” (Larice & Macdonald, 2013, p. 5). Shortly thereafter, the Industrial Revolution brought about new technological advancements and rapid urbanisation, thus designers were tasked with creating visions of cities which addressed the issues of overcrowding, poor sanitation, and pollution (Broadbent, 1990; Hall, 1996; Leavy, 2017).

Today contemporary urban design principles are a direct response to the failures of urban renewal projects of the late 20th century, with the obsession with the automobile which led to demolishing integral communities (Southworth, 1989). As a direct result of engineering as the approach to planning, by the 1960s, early Modernist writers and designers such as: Jane Jacobs, Kevin Lynch, Gordon Cullen, Christopher Alexander, Lewis Mumford, Aldo Rossi, Ian McHarg, and Jan Gehl, would become influential in the urban design movement. However, it wasn’t until 1956, when Jose Sert officially coined the discipline of urban design during an international conference at Harvard University. Sert was able to reveal two working definitions (Larice & Macdonald, 2013, p. 587).

Urban Design

“...is that part of the city which deals with the physical form of the city”

And

“...the most creative phase of city planning, in which imagination and artistic capacities play the important part”

The subject of urban design has been on the rise in the mainstream since the 1980s (Madanipour, 2006). To understand why, it is important to acknowledge the cities have

gone through immense structural changes, now with over half of the world's population living in cities. The economic role of cities has also changed, especially in the west where urban centers have moved from manufacturing to the service sector, leading to transformations in the social and spatial organisations of cities (Madanipour, 2006). These spatial organisations are continuing to shift. Many studies have been conducted in order to understand specific aspects of spatial quality such as sustainability, walkability, safety, or social aspects of design. These aspects can be studied using methods such as; walkability assessments, public space assessments, street design analysis, environmental impact studies, safety audits, or social surveys to name a few. In order to gain credibility in the scientific field, urban design is being measured, tested, and validated scientifically at multiple scales. Studies in literature show quantitative metrics for urban form (Clifton et al. 2008; Schwarz 2010), complexity and connectivity (Boeing, 2018), density, diversity and design (Cervero and Kockelman, 1997), urban sprawl (Song and Knaap, 2004); Tsai, 2005), mobility (Ewing and Cervero, 2010), walkability (Ewing et al., 2013), and land use (Song et al., 2013). Additionally, urban design has increasingly been incorporating "the spatial interests of social science, geography, cultural studies, economics, architecture, art history" (Cuthbert, 2006, p. 17), and sustainability, through the intersectionality of feminism, race, and class, further legitimising the field in scientific study (Lacey et al., 2013).

Urban design, positioned at the intersection of planning and architecture, embodies a discipline that transforms policy, outlined in comprehensive plans, into tangible, three-dimensional physical forms. Steiner et al. (2012) succinctly define the role of urban design in shaping the built environment. This transformative process has been facilitated by the widening scope of methods for presenting and communicating urban design and planning. The accessibility and affordability of design technologies, coupled with rapid processing times, have ushered in an era where the tools of the trade are more available than ever. Notably, Virtual Reality (VR), Augmented Reality (AR), and Virtual Worlds stand at the forefront of design and planning, particularly in academic settings, offering avenues for thorough testing. However, Moudon (1992) aptly points out the partial nature of research and theories in urban design, as they address some but not all issues faced by designers, necessitating a comprehensive consideration to yield a complete set of information. Delving into historical context, the groundwork laid by Modernist designers provided insights into how urban form influences people's

perceptions and interactions within spaces (Forsyth, 2007). Building upon this foundation, contemporary urban designers have an extensive reservoir of experience, design theory, and urban form precedents to draw upon (Larice & MacDonald, 2013). This rich background enables urban designers to engage with both the process and products of development, aiming to enhance the quality of urban environments (Carmona, 2010). Furthermore, urban design offers a platform for creative problem-solving, fostering imagination without the constraints typically imposed by professional categories (Cuthbert, 2006; Kasprisin, 2019).

1.3 | Research Framework and Outline

This thesis aims to expand upon the growing knowledge and understanding of perceptual urban design qualities, and how to communicate urban design quality through the medium of 3D Virtual Environments. This research will look at five specific design qualities - Imageability, Transparency, Enclosure, Human Scale, and Complexity, following the methodologies outlined in the study *'Measuring Urban Design: Metrics for Livable Cities'* conducted by Ewing and Clemente (2013). These five specific design qualities were chosen with respect to their importance assigned to them in urban design literature. Furthermore, these qualities were tested based on the results of the study by Ewing and Clemente (2013), and where they found that these five design qualities were the most reliable to test using visual assessment surveys.

The study conducted by Ewing & Clemente used experts in the fields of urban planning, urban design and architecture in order to understand the perceptual qualities of urban design related to walkability. The participants of the study conducted a visual assessment survey and watched videos of a camera-person walking down streets, characterised as urban, in various cities across the United States. The participants then rated each street based on the predetermined design qualities (such as imageability, enclosure or human scale) as either low or high. Overall, the study found that "walkability was directly related to each urban design quality individually" (Ewing and Clemente, 2013, p. 35). Using this study by Ewing & Clemente as a foundation, this thesis aims to expand on some unanswered questions. These questions relate to individual perceptual preferences based on individual attributes, such as culture, gender, and education or professional background. Furthermore, this thesis will use a different digital

medium, so rather than videos of a street, this research uses 3D modelling as a way to view streetscapes in a digital form. This medium was chosen for two reasons.

The original proposal for this thesis aimed to explore Virtual Reality (VR) as a way of communicating urban design and engaging with the public. Unfortunately, the pandemic restrictions put in place by the Dutch government prohibited in-person meetings, which would have been necessary for this approach. As the 3D models were already constructed prior to the restrictions taking place, the 3D models by themselves were used instead because these models could be easily shared using virtual environments in any web browser. This meant that these meetings could be done virtually, adhering to the Dutch government Covid-19 protocol. Second, digital formats such as VR are gaining popularity in planning, design and architecture, as a way of showcasing, communicating, and collaborating with the public. This thesis aims to answer the following questions:

How can 3D modelling be utilised to determine and communicate the spatial quality of streetscapes?

1. *How can spatial qualities such as imageability, enclosure, transparency, human scale, and complexity be communicated through 3D models?*
2. *What are the preferred physical features that improve the spatial quality metrics as perceived through 3D models?*
3. *How do different groups, such as academic field, nationality, and gender, perceive spatial qualities differently in a 3D virtual environment?*

Therefore, the structure of this thesis includes the following chapters; *Chapter 2* introduces the theoretical framework and academic literature fundamental to understanding perceptual design qualities, *Chapter 3* introduces the methodologies that are used to conduct the research included how the 3D models and virtual environments were created, and how the data from the conducted focus groups will be analysis, *Chapter 4* presents the results and findings of the qualitative and quantitative data, *Chapter 5* answers the research questions and outlines proposed guidelines for how practitioners can improve spatial quality, and *Chapter 6* provides critiques and analyses the study as a whole in order to provide insight into opportunities for further research on the topic.

1.2 | The Case Study

The case study used for this research is the *Gedempte Zuiderdiep* in Groningen, which will examine the potential for spatial quality using semantic 3D modelling. First established in 1040, the city of Groningen is located in the north of the Netherlands, in the province of Groningen. This popular university city has a population of 230,000 making it the sixth largest city in the Netherlands (Statista, 2023). Over the past couple of decades, Dutch cities, including Groningen, have been admired for their bike friendliness, walkability and culturally rich urban planning practices. One only has to look at the context of urban form to understand how history is nested in contemporary urban structure and design. Groningen is a culturally rich case to study how resurrecting historic canal networks can enhance urban spatial quality.

The *Gedempte Zuiderdiep* canal once belonged to the inner canal ring of medieval Groningen. However, a principal street is currently paved where the historic canal once resided (*figure 1*). In 1880, the canal was filled in to accommodate motor vehicle transportation circulation (Tsubohara & Voogd, 2004). This objective is understood in the context of the 1880s when vehicle transport became a widely prioritised in urban planning as the optimal mode of transportation.



Figure 1: Gedempte Zuiderdiep, Groningen

2 | Theoretical Framework

The following chapter will provide the theoretical framework and build the foundations for the key themes explored throughout this research. The key themes, discussed in this chapter include: (1) Urban design theory, (2) perceptual spatial quality, (3) blue and green spaces, (4) visual communication & Virtual Reality (5) the current research methodologies for measuring perceptual urban design qualities.

This research explores urban design theory in order to understand how perceptual qualities of the urban form can be communicated and measured. Planners and designers use a variety of tools to communicate their plans to the public. Visualisations, in essence, are made to convince the public that their plans will enhance the spatial quality of an area. But what is spatial quality? And, what determines “good” spatial quality? How can spatial quality be measured? And how can urban design be communicated? These questions need to be answered before we can ask how 3D visualisation can be used to understand how spatial quality will be met in practice.

2.1 | Urban Design Theory

Moving forward it will help to break down the terms *urban*, *design*, and *theory*. Urban comes from the Latin word *urbs*, meaning city. However, *urbanism* is much more than just the built environment, nor is it truly based on size; it is a form of social organisation and community building (Wirth, 1938). To *Design* is the process of planning, sketching, arranging, problem-solving, and delivering physical outcomes (Carmona, 2010). *Design* differentiates urban design from other urban fields of study, and “it was understood that *design* is not purely *deductive* or analytical, but tends to be mostly *inductive* or of synthetic reasoning” (Ghosh et al., 2015, p. 81). And, *Theory* is a system of ideas, seen as more descriptive than prescriptive. And still, there is no agreed-upon definition of urban design, but rather a multitude of working definitions. Many definitions of urban design focus on the urban form. For example, Cuthbert (2007) defines urban design as “the production and reproduction of urban forms” (Cuthbert, 2007, p. 185). And, Marshall (2012) defined it as “any kind of design of the built environment at varied scales, from the design of manhole covers to grade-separated freeway intersections” (Marshall, 2012,

p. 400). While, others define urban design with the distinction between public and private space (Dovey & Wood, 2015; Sternberg, 2000).

Consequently, there are many subcategories of theories which encompass urban design. In Araabi's topology of urban design theories, Araabi describes three types of theories: (1) theories about subjects within urban design, (2) theories about the object of urban design, and (3) theories about the knowledge of urban design (Araabi, 2016). Type one theory focuses on the subjects within urban design, literature in this type tends to only focus on one aspect of real urban life, or ways to solve a specific urban problem. We can think of type one as the first layer of urban design theories as urban design began to develop as a field of study. However, as these theories only address specific aspects of urban design, they do not provide a comprehensive overview of urban design. Type one theories in Araabi's typology are numerous, but they can be categorised. Into, for example; *Sense of place* (placemaking, imageability, meaning, & history), *urban form* (aesthetics, legibility, & composition), and *human-environment interaction* (safety, social interactions, & perceptions). The second type focuses on providing an overview and analysis of individual urban design elements presented in type one. This type includes both a comprehensive view of what urban design object is about (descriptive emphasis), and how to improve the object of urban design (prescriptive emphasis) (Araabi, 2016). Lastly, type three theories "consider the actual *knowledge* of urban design," and are "intellectual studies of the theories falling into the categories of type one or two" (Araabi, 2016, p. 15). These theories include; theorising urban design knowledge from the perspective of other disciplines, and theorising urban design knowledge from within (Araabi, 2016). As a result of this wealth of knowledge in urban design, which takes into account the form of cities, the physical environment and aesthetics, the individual and cultural meanings placed on urban spaces, and how people interact with the urban environment, designers are able to understand what makes urban spaces attractive, vibrant, and places where people want to live and visit.

2.1.1 | *Sense of Place*

The use of the word *places* rather than spaces or environments is important to distinguish as, "the concept of *place* integrates the social, economic, physical and historical aspects of a location" (Bell, 2021, p. 71). Lynch (1984) defines a sense of place as "the degree to which

the settlement can be clearly perceived and mentally differentiated and structured in time and space by its residents, and the degree to which that mental structure connects with their values and concepts – the match between environment, or sensory and mental capabilities, and our cultural constructs” (Lynch, 1984, p. 118). *Placemaking* was first conceptualised in the 1960’s by journalist Jane Jacobs and American urbanist William Whyte. The movement advocated for citizens to become involved in the planning and decision-making of cities, and by doing this, urban spaces become, first and foremost, built for people. Walkable streets and lively neighbourhoods become places with collective meaning and shared stewardship (Jacobs, 1961). Additionally, a place which has meaning and identity is a highly imageable place. According to Lynch (*The Image of the City* (1964)), the design and form of cities should evoke strong mental images which are memorable, and legible layouts of cities help to build clear mind maps. Placemaking and imageability are also derived from historical elements of cities, Kostof (*The City Shaped* (1999)), describes how cities are repositories of collective memory through street layouts, architectural styles, and monuments.

2.1.2 | *Urban Form*

Urban form is defined as the spatial configuration of fixed elements. In the early history of urban design, architects were especially interested in urban form. Ebenezer Howard’s Garden City, Frank Lloyd Wright’s Broadacre City, and Le Corbusier’s Radiant City, are examples of early architects tackling 19th century urban problems through design and urban form (Hall, 1996). Theories of *Urban form* ask the questions: How do cities form? And, “How does it work” Lynch (1984). To answer these questions, Lynch describes three branches of urban form theory; (1) *planning theory*, “asserts how complex public decisions about city development are or should be made.” (2) *functional theory*, “attempts to explain why they [cities] take the form they do and how that form functions”, and (4), *normative theory* “deals with the generalizable connections between human values and settlement form” (Lynch, 1984, p. 37).

Fundamentally, urban form can be broken down into **nodes**, **paths**, **edges**, **districts**, and **landmarks** (Lynch, 1960). This describes the physical elements of cities; buildings, plazas, streets, and the connections between them. **Nodes** are defined as critical points within an urban area that serve as focal points, and centers of activity.

According to Krier, (1979), the square was probably the first use of urban public space, as a centre for community, market and court. Then, if the population outgrows the square, the natural organisation is to form linear streets (**paths**) extended from the square (Gehl, 1987). Berry (1965) argues that “the central business district is a point of focus about which land uses and densities, the spatial patterning of the urban population, subsidiary retail and service locations, transportation and commuting patterns, and the like, have evolved. When other specialized activities are performed, they create supplementary or additional nodes” (Berry, 1965 p. 112). Gehl defined **districts** as “medium-to-large sections of the city, conceived of as having two-dimensional extent, which the observer mentally enters “inside of,” and which are recognisable as having some common, identifying character” (Gehl, 1987, p. 41). Additionally, urban form is categorised into *hard spaces* and *soft spaces*. “*Hard spaces* are those principally bound by architectural walls; often these are intended to function as major gathering places for social activity” (Tranicik, 1991, p.61). These spaces are a particularly important factor in creating *enclosure*, as Sitte states; “the ideal street must form a completely enclosed unit. The more one’s impressions are confined within it, the more perfect will be its tableau: one feels at ease in a space where the gaze cannot be lost in infinity” (Sitte, 1965, p. 61). “*Soft spaces* are those dominated by the natural environment” (Trancik, 1991, p. 61), the physical distinction between hard and soft spaces are **edges**.

2.1.3 | *Human-Environment Interaction*

The human-environment interaction is defined by how the urban form and physical environmental elements, facilitate community safety, accessibility, social inclusion, social interaction, a variety of urban activities, and mobility. Urbanists such as Jane Jacobs, have been advocating for urban planners and designers to pay more attention to space and the social interactions in everyday life. High-quality built environments increase the overall sense of place through usage, accessibility, social interactions, enjoyment, and relaxation (Vaeztavakoli, 2018). Gehl (1987), categorises these activities into necessary, optional, and social activities. Spontaneous social activities depend on the presence of other people moving about in a public space (Gehl, 1987). “Opportunities for meetings and daily activities in the public spaces of a city or residential area enable one to be among, to see, and to hear others, to experience other people functioning in various situations” (Gehl, 1987, p. 15). Furthermore, specific physical urban design elements such as sloping curbs,

lighting, and auditory and visual information all help to create accessible and safe spaces (Evans, 2015). Blue and green landscapes within urban centres also increase social interactions as these spaces create places of activity, both physical and social.

2.2 | Defining Spatial Quality in Urban Environments

This research focuses on both the perceived *spatial quality* and the physical characteristics of design quality. Urban designers agree that *Spatial quality* is a difficult concept to define, yet it is the central principle for urban design and planning (Khan et al., 2014; Moudon, 1992). The earliest expression of design quality can be found in Roman antiquity, architect and engineer Marcus Vitruvius Pollio (known as Vitruvius) formulates design quality in his treatise *De architectura* as: *utilitas* (function), *firmitas* (firmness or solidity) and *venustas* (beauty or attractiveness) (Bianco, 2023; Cowan, 2021; Klijn et al., 2013). Which in its simplicity, expresses that buildings must stand, be functional, and be beautiful.

Space can be defined in a multitude of ways: physically, geographically, mathematically, philosophically, culturally, or socially. Therefore, the difficulty lies in deciding the definition of space that suits this research. Architects and designers traditionally perceive space in physical and mathematical terms. However, in urban planning and design, space is often defined socially, in terms of *public* and *private* space. This is important as environmental perceptions and behaviour of individuals are often determined by sociocultural characteristics. While an architect's focus is on closed, private spaces such as buildings, urban designers focus on open spaces and public spaces, which are the spaces between buildings: the square and the street (Gehl, 1987; Krier, 1979). Streets and squares tend to be lined with commercial places such as cafés and shops, which encourage connectivity and interaction (Gehl, 1987).

And *quality*, as Tang & Long state, “generally refers to a degree of excellence in something” (Tang & Long, 2019, p. 2). However, this definition lends itself to being quite subjective, stated by individual perceptions and preferences. Consequently, an official definition of spatial quality does not exist, this is due to the complexity associated with the social, physiological (sensory), cognitive and behavioural aspects that are attached to specific spatial contexts. Therefore, *spatial quality* requires some kind of defined agreed-upon metric assessed through a combination of quantitative, qualitative, and

observational methods. There are many studies which use urban design theory in order to determine what qualities need metrics to determine good spatial quality in different aspects of urban design. Such as, urban form (Clifton et al. 2008; Schwarz 2010), complexity and connectivity (Boeing, 2018), density, diversity and design (Cervero and Kockelman 1997), urban sprawl (Song and Knaap 2004; Tsai 2005), mobility (Ewing and Cervero, 2010), walkability (Ewing & Clemente 2013), and land use (Song et al. 2013). And, while there is still contention about how to define spatial quality, urban designers agree that the quality of urban design is inexorably linked to the quality of life and livability of urban areas (Cities Alliance, 2007).

2.3 | Perceptual Urban Design Qualities

The perceptual qualities that are widely used in urban design literature are visual, aesthetic, auditory, tactile, olfactory, as well as, emotional, cultural and spiritual, which are qualitative measures belonging to the pre-cognitive stage (Abusaada & Elshater, 2020). “*Perception* is the process by which we utilise external sensory information in combination with other internal conscious and unconscious workings of the brain to make sense of the world” (Barry, 2002, p.91). Besides the physical sensing of information, perception uses past experiences (real and genetically acquired) in order to process visual information (Barry, 2002). These qualities describe how individuals perceive and value their environments. *Figure 2* includes a comprehensive overview of individual qualities outlined by Ewing & Handy (Ewing & Handy, 2009, p. 66). Zhang et al. (2004), categorise these into three evaluation principles: The visual quality analysis, the physical quality analysis, and the structure analysis. (Zhang et al., 2004).

adaptability	distinctiveness	intricacy	richness
ambiguity	diversity	legibility	sensuousness
centrality	dominance	linkage	singularity
Clarity	enclosure	meaning	spaciousness
coherence	expectancy	mystery	territoriality
compatibility	focality.	naturalness	texture
comfort	formality	novelty	transparency
complementarity	human scale	openness	unity
complexity	identifiability	ornateness	upkeep
continuity	imageability	prospect	variety
contrast	intelligibility	refuge	visibility
deflection	interest	regularity	vividness
Depth	intimacy	rhythm	

Figure 2: List of Perceptual Design Qualities

2.3.1 | Visual Quality Analysis of Urban Space

Perceptual design qualities related to the visual and aesthetic aspects of urban spaces have been the most common metric used to determine spatial quality. The basis for this research is in perceptual landscape aesthetics, in which there are several theories that attempt to explain commonly perceived preferences: Evolutionary theories and cultural theories. The first widely cited evolutionary theory, the prospect-refuge theory (Appleton, 1975), explains aesthetic stimulus through the biological association of human fitness and survival - 'see without being seen'. Landscapes which offer both prospects and refuge tend to be more evolutionarily advantageous and, therefore, these aesthetic preferences are engrained in humans (Tveit, 2006). Second, the information processing theory (Kaplan & Kaplan, 1982, 1989), addresses the "adaptive need to make sense of the environment and also be stimulated by it" (Zube, 1982, p. 7). Environments which are easy to read, are an advantage, as information is quick to obtain and process (Tveit, 2006).

On the other hand, cultural theories are more subjective, and argue that landscape perception is both cultural, and based on the individual's attributes and experiences (Tveit, 2006). Cultural theories include; the *topophilia hypothesis* (Tuan, 1974), *ecological aesthetics* (Carlson, 2001; Gobster, 1999), *symbolic aesthetics* (Lang, 1987), *formal aesthetics* (Arler, 2000; Bell, 1999; Nasar 1994), and *schematic aesthetics* (1999; Nasar 1994). "Topophilia is the affective bond between people and place or setting" (Tuan, 1974, p. 4) which is formed by personal attributes such as; "age, gender, occupation, hobbies, academic

background, and familiarity” (Tveit, 2006, p. 232). Second, *ecological aesthetics* addresses the non-material advantages of ecosystem services through sound natural landscapes. Carlson (2001) argues that ecological aesthetics have particularly influenced the “clean up the environment” movement which is concerned with the environmental ethics and ecologically sound landscapes. *Symbolic aesthetics* is the study of human responses to the meaning of environments (Lang, 1987). This can be an individual assigning meaning to an object beyond instrumental use, culturally assigned meanings that differ from group to group, or the architect or designer, of a space or object, establishing meaning through patterns and symbols (Lang, 1987). *Formal aesthetics* is the “study of the structure of forms” (Nasar, 1994), and pulls heavily from the arts mimicking form and patterns in nature (Bell, 1999). This theory argues (shown in *Figure 3*) that “aesthetic response has probabilistic relationships to building properties. Perception of the physical properties has probabilistic relationships with physical properties present. Cognition has probabilistic relationships to perception” (Nasar, 1994, p. 380).

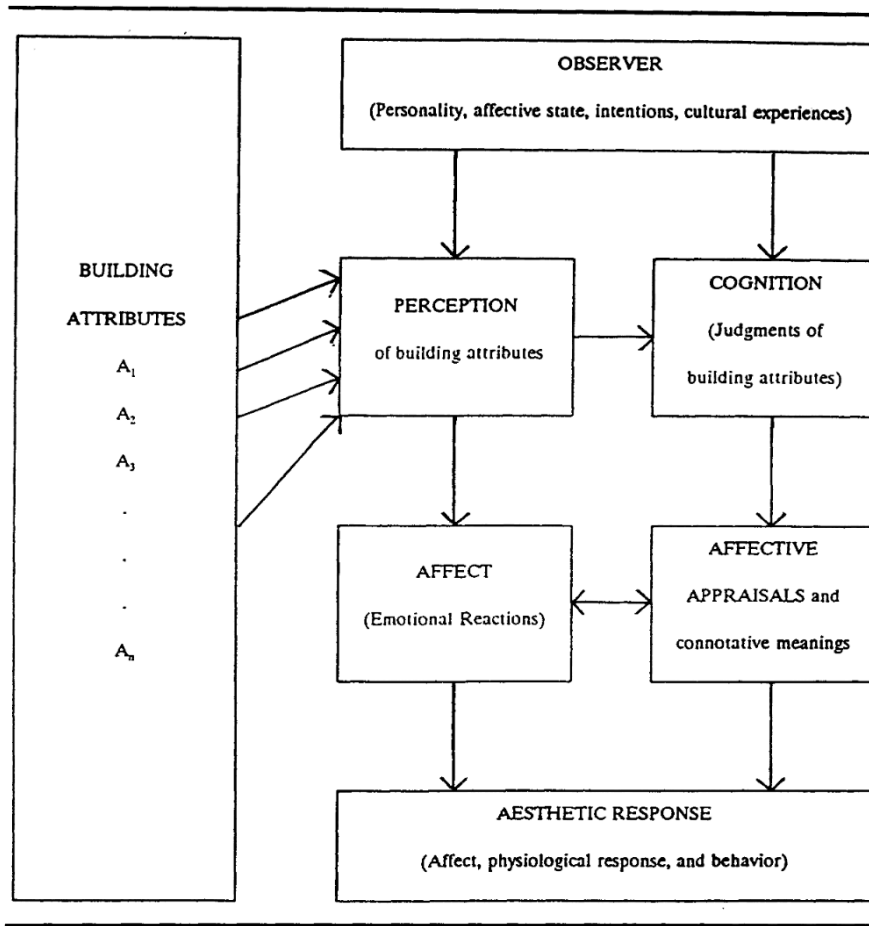


Figure 3: Aesthetic Response to Building Attributes

In *formal aesthetics*, the perception of the complexity of the environment, and the elements within the environment, tend to take an “inverted U-shape: buildings with an intermediate level of complexity tend to be favoured over those with the most and least complexity” (Steg & Groot, 2019, p. 89). However, Arler (2000) argues that landscape aesthetics and the quality of nature should be judged by those who possess the experience, as well as virtues such as “sensitivity, diligence and imagination” (Arler, 2000, p. 294). Lastly, *schematic aesthetics* refers to a “design’s goodness-of-example or typicality for its functional category (e.g., restaurants, shops)” (Steg & Groot, 2019, p. 89).

2.3.2 | *The Physical Quality Analysis*

Physical quality “refers to how pleasant the spaces are” (Zhang et al., 2004, p.83). Besides the visual qualities of urban spaces, tactile qualities are equally, if not more important. Touch is the primary sense with the skin as the primary receptor of temperature, pain and pressure. Not only that, but the body is the centre of the individual’s perceptual world and in which length and width dimensions are measured (Palasma, 2009). Deep kinetic and depth receptors can receive detailed information about the form and size of objects providing environmental awareness (Naghizade & Ostadi, 2014). Heat and coldness, dry and wetness, softness and hardness, static and mobile, light and heavy, porous and resistant, are all perceptual sensory states of emotions and comfortability (Lucas & Romice, 2010). Perceptual tactile qualities include comprehensiveness, interactivity, comfortability, way-finding, and human scale.

“Acoustic Ecology or ‘soundscape studies’ is an exploration of how living beings react to their inhabited environments through the mediation of sound” (Edge, n.d, p. 6). In urban environments, designers often overlook the importance of acoustic ambience, typically addressing it only in the context of mitigating noise pollution from traffic. And, while European legislation (Sustainable Development Goals 3 & 11) does establish the relationship between sound and quality of living, only one-third of academic research surrounding urban design focuses on sound as an urban design quality (Maag et al., 2021). Consequently, traffic and vehicle noises are so engrained into the urban fabric, that urban dwellers often subconsciously ignore the sonic environment (Edge, n.d). Intentionally designing spaces that introduce sound or reflect sound can help to better understand the full nature of the space such as; materials, size, depth, and emptiness,

which evidently affect the mood of the space - whether it's a happy vibrant place, or an empty echo. Acoustics can enrich environments by amplifying the combinations of voices, music, water, or bird songs, and enhance spatial diversity and complexity (Naghizade & Ostadi, 2014).

2.3.3 | Structure Analysis of Urban Space

The structural analysis of urban space refers to “the structure and function of places and whether these functions are situated in the proper places (urban morphology)” (Zhang et al., 2004, p.83). This perceptual analysis deals with complex topics in a holistic way, such as housing availability and affordability, density, mobility, walkability, transportation, and the functionality of spaces at various scales. All of these attributes determine where people live, where they congregate, how they travel, how space is used, and overall “shape the experience of the city residence” (Noseir et al., 2023, p. 3). In the past couple of years post-pandemic, urban designers and planners have had to reimagine the form of cities. Now, in 2023, most people are back to their regular commutes to work, however in 2020, streets were largely void of traffic with some cities opening up entire streets to pedestrians. The “15-minute city” was conceptualised by “Carlos Moreno, and accelerated during the COVID-19 pandemic” (Moreno et al., 2021, p. 94). The idea of the 15-minute city is to increase the livability of cities by having everything citizens need to live within a fifteen-minute walking distance; shops, work, schools, activities, etc. (Moreno et al., 2021). The urban form has an effect on perceptual qualities such as imageability and legibility, as a sense of familiarity helps the traveller navigate seamlessly through the urban space. Additionally, these qualities help to increase the sense of safety. Jane Jacobs (1961) explains how urban design elements such as lighting and transparency boost the number of “eyes on the street”, which ultimately improves safety (Jacobs, 1961).

2.4 | Green and Blue Spaces in Urban Design

2.4.1 | *Green Spaces*

The concept of 'green' has been incredibly influential in urban planning and design. Green space is simply defined as open space, at least partly, covered by vegetation or natural features, such as parks. This also includes green space elements such as trees, small gardens, green parks and green surfaces on buildings (Virtudes,2016). There are several benefits to urban green spaces including socioeconomic, cultural, aesthetic and environmental. Although, most of the literature surrounding green spaces focuses on physical and mental health qualities. The positive effects of green spaces can be seen in the following ways: by offering places for citizens to interact with nature, by creating places of social interaction and connectivity, to create aesthetically pleasing and comfortable places to enjoy, to promote ecological diversity and sustainability, to combat the warming of urban climates (also known as heat islands), and also to increase property value.

The idea of green spaces for human health began during the Industrial Revolution in order to help people escape the pollution of the industrial city. Major urban renewal projects became popular at this time. For example, from 1853 through 1870, Paris underwent large-scale public works projects headed by George Eugene Haussman, who implemented "wide boulevard systems through the dense medieval city center," and throughout the peripheral areas, large new public parks were established in order to promote urban development (Larice & Macdonald, 2013, p. 25). The American Parks Movement spurred by Frederick Law Olmsted (1822-1903), and the City Beautiful Movement as a result of Ebenezer Howard's Garden City, brought about New York's Central Park, the Golden Gate Park in San Francisco, and many more systems of parks throughout the United States (Larice & Macdonald, 2013).

Contemporary urban greening is not only concerned with the health of people, but a response to climate change, an effort to improve the sustainability of cities, and protect ecological diversity. A study in the Netherlands was able to connect urban green spaces to improve comfort in both physical and psychological terms, and that "people's perception of thermal comfort could be increased by creating urban green spaces"

(Klemm et al., 2015, p.7). Additionally, the importance of public outdoor recreational spaces became particularly evident during the COVID-19 pandemic. As city dwellers “flocked to public spaces as soon as restrictions [had] lifted, balancing the risk of infection with the physical and mental benefits these spaces expected to confer” (Bereitschaft & Scheller, 2020, p. 4).

2.4.2 | *Blue Spaces*

Blue spaces are defined as “all forms of natural and manmade surface water”, such as; coasts, rivers, lakes, canals, ponds, and fountains (Smith et al., 2021, p. 1). “The water space, the limit between land and water, is a strategic space, often protected, where it is recognised as a strong landscape with environmental value, but is also a strategic space for the cities’ transformation” (Errigo, 2019, p. 98). However, in urban planning literature, blue spaces are rarely thought about independently from green spaces, this is because blue spaces are often integrated into green space environments. In the literary research by Smith et al., they argue that blue spaces on their own do have mental and physical health benefits comparable to green spaces (Smith et al., 2021). Bell et al. (2021), refer to this type of ecosystem service as cultural services encompassing “non-material ways in which people benefit from ecosystems” (Bell, 2021, p. 67). Not only do blue spaces positively impact the health of individuals, but also offer environmental and climatic benefits to the urban landscape. In terms of ecosystem services, this is referred to as *regulating services* (Bell, 2021). Urban heat islands have been gaining attention in the past decade due to the combination of rapid urbanisation and climate change. The use of blue space in urban design helps with cooling by providing heat capacity, as well as reflectance, lowering surface temperatures overall more effectively than green spaces (Lin et al., 2020).

Blue spaces are especially integral to the urban form of Dutch cities, as water is the prominent feature of the landscape. “Nederland literally means “low country”; because of the geomorphological conformation that places the country, on average, five meters below sea level (with peaks of 7 meters), at the mouth of three major European rivers” (Reno, Meuse and Schelde), “has 451 kilometres of coastline”, and “2,969 kilometres of rivers and canals” (Errigo, 2019, p. 98). This combination of low-lying coastal land, delta formation, and dense urbanisation, means that the country is incredibly susceptible to

both pluvial and fluvial flooding affecting the majority of urban areas. Studies of blue spaces in the Netherlands predominantly stem from the need for flood mitigation strategies, and water sensitive-planning and engineering. However, that doesn't mean that the Dutch have not incorporated urban design into hydro-engineering projects. For example, the 'Room for the River' programme, part of the national Delta Works project, had two main objectives: first, to improve safety from flooding, and second, to improve the spatial quality of the riverine areas (Rijke et al., 2012). Spatial quality, in this case, was defined by the importance of "agriculture, recreation, cultural-historic values and existing residences" (Rijke et al., 2012, p.377). The project was a major deviation from the traditional robust water management in the Netherlands. As a result, the project received positive outcomes and is a step in the right direction for integrated water-sensitive planning and spatial quality.

Moreover, 35 Dutch municipalities (such as Utrecht (2020), Meppel (2008), Drachten (2015), and Zaandam (2001)) have embraced and revitalised historic water features (Platform Stadsgracht Wageningen, 2008). For example, Utrecht celebrated the "return of water in the Catharijnesingel and the completion of the old canal" in 2020 (van Egmond, 2021, p. 107). This project revitalised the cities' historic defensive moat, which was filled in in the 1960's in order to accommodate vehicle traffic - An unfortunate twentieth-century trend worldwide. Fortunately, this trend is slowly being reversed in order to improve the spatial quality of Dutch urban centres, and help to mitigate the effects of climate change. Canal revitalisation projects recognise the importance of historic urban form as a way to generate a sense of place and improve imageability. These places also provide areas for recreation – both water-based and along the edges. In the case of Utrecht, the project was awarded the 2022 European Prize for Urban Public Space, as it "prioritises pedestrian mobility and social interaction, as well as porous surfaces and a rich biodiversity. As, "these aspects are what make our cities healthy, sustainable and enjoyable" (CCBD, 2020, p. 2).

2.5 | Visual communication

Smith et al. (1998), argue that visualisation as well as communication are “at the heart of the planning system” (Smith et al., 1998, p. 2). In general terms visualisation can be defined as “the representation of complex issues by visual means as a tool for exploration and communication” (Warren-Kretzschmar, & Tiedtke, 2005, p. 2). In the Book *Visualization in Landscape and Environmental Planning: Technology and Applications*, Lange & Bishop lead the reader through the history of visualisation. They conclude with three reasons why visualisation is the dominant human sensory characteristic (Lange & Bishop, 2005, p.3).

- We want visualisation to give us the opportunity to see, experience and understand environmental changes before they occur.
- Through the ability to share this experience and potential for exploration, visualisation will help communities (of whatever size) to build consensus and make decisions about their future.
- The relationship of people to their environment is a key contributor to environmental decisions and visualisation can help us learn more about that relationship (Lange & Bishop, 2005, p.3).

Figure 4 shows the interrelation between cartography and scientific visualisation by Cartwright et al., (2004), which is based on Kraak’s (1995) understanding of the ways in which visualisation is used. Although cartographic and architectural visualisation have been used for centuries of urban development, there is no universally accepted standard for geographical communication (Ghosh et al., 2015). This depiction can be used in order to understand when specific visualisations should be used and at what stage of the planning process. Batty (2000), refers to this as forward and backwards communication. Forward, refers to citizens and stakeholders, and backwards refers to professionals in the fields of planning and design (Batty, 2000).

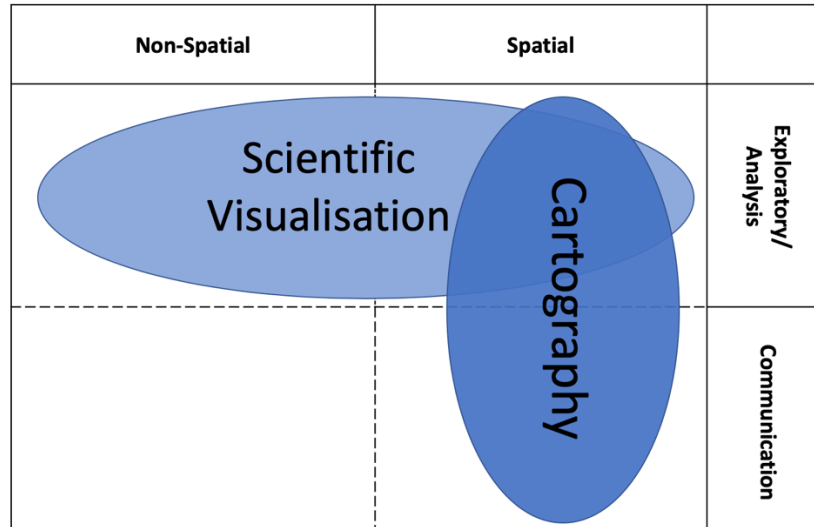


Figure 4: Scientific Visualisation

For example, backwards communication may use analytical tools such as GIS applications, 2D or 2.5D maps, 3D CAD graphics, or collections of maps such as master plans, local plans, or even the conventional spreadsheet, which are sufficient for communication between professionals in the field (Pettit et al., 2006). Planners may even switch between data visualisation techniques depending on what stage of the planning process they are working on. Bishop and Lange argue that visualisations with more abstract displays are better suited for an audience of experts (Lange & Bishop, 2005). And, as planning is an iterative process, abstract visualisations may be more cost-effective as plans are drawn and revised from problem definition to the evaluation of implemented designs.

On the other hand, forward communication, to stakeholders and citizens, relies on visualisation for the minimal expertise in order for any layperson to comprehend the data or design representations they have observed. This is what Lange & Bishop (2005) refers to as the expert-layperson paradigm (Lange & Bishop, 2005), and it requires planners to have the right set of communication ‘tools’ in their ‘toolbox’ (Pettit et al., 2006). Traditional computerised and non-computerised tools used by planners, are often too abstract for the layperson to have a meaningful interaction with and extract data from. In their study on communication methods in development planning, Appleton & Lovett (2015) found that an overwhelming number of participants struggled to visualise 2D maps as 3D mental images. They found that participants had difficulty in orienting themselves as well as imagining ‘the wider picture’ (Appleton & Lovett, 2015, p. 328). For

this reason, 3D visualisations offer the public more understanding which, in turn, generates well-informed citizenry (Al-Kodmany, 2001; Appleton & Lovett, 2015).

Studies have shown that high levels of detail are the most effective for a lay audience (Al-Kodmany, 2001), visual communication such as renderings, 3D models, box models, and even Virtual Reality (VR), have often been used in order to show plans in practice. The traditional block models have been the standard for visual communication in urban planning, design and architecture. Yet, in the realm of digitisation, 3D digital models are more flexible. However, even these visualisations need some kind of moderator in order to describe the associated relationships between representation and function. This is where semantic 3D GIS becomes increasingly more relevant, and planners need to take full advantage of the communicative aspect of 3D visualisation. Nevertheless, this type of communication must be prepared with caution and care, as any communication, written or spoken, will influence how the visual information is perceived (Lange, & Bisho, 2005). The question then is, how do planners and designers communicate more than just building structures and street layouts? How can urban designers communicate important data associated with spatial quality? The types of visual communication used in urban planning and design have traditionally included: cartography and physical models, however more recently, this has expanded to digital mediums such as videos, virtual 3D models, and even, Virtual Reality (VR). In this way communication has moved from 2D platforms into 3D Virtual environments.

2.5.1 | *The 3rd Dimension*

In recent years architecture, planning, and urban design have “experienced a major cultural shift in visual communication” (Bates-Brkljac, 2012, p. 187). Since the 1990s, computer processing has become more powerful, accessible, and affordable, year over year (Nevescanin, 2017). An incredible amount of 3D software has recently exploded on the market for engineering, architecture, and design, such as Autodesk, Solid Works, AutoCAD and SketchUp, as well as for video games and 3D animation including software like Autodesk 3ds Max or Houdini. 3D software for GIS applications, such as ESRI’s ArcGIS 3D analyst and CityEngine, allows the user to view Digital Elevation Models (DEM) and civil data in ArcScene and Scene Viewer 3D environment. Some software is even free to use, such as Blender, which allows for widespread access and

adoption across disciplines. This has led to a variety of methods and workflows facilitated by new software for producing 3D visualisations. Though, the common approach for urban planning and design is to first compile CAD and GIS spatial data of a particular study area, and then create 3D outputs (Lovett et al., 2015).

Possibilities for digital representation are numerous, and workflows are becoming more streamlined as many CAD software now support GIS data, and likewise, GIS mapping software is integrating 3D geometry functionalities. Previously, 3D attribute analysis in 2D environments had to be described in descriptive text, now truly being able to accurately view Z values has proved to be enormously beneficial for practitioners. The amalgamation of GIS and CAD software functionalities foster a holistic approach to planning and design, as detailed design elements can now be seamlessly integrated with accurate geographical information. This application is especially integral for utility networks where utility depths can be viewed in 3D environments. But equally useful for transportation planning, optimising green spaces, visualising potential developments, and overall, promoting sustainability and facilitating well-informed decision-making.

According to Appleton et al. (2002), there are three main types of 3D visualisation outputs: *Image draping* (images draped over a 3D representation of the terrain) which are usually still images from a single vantage point, *photorealistic* rendering (with detailed vegetation and other landscape features) which can be still images or fly-through animations, and *virtual worlds* “which allow the user to interactively explore an environment” (Appleton et al., 2002, p. 146-147). The main advantage of using *virtual worlds* is that “humans can observe objects and scenes from different angles to acquire a better understanding of the geometry” such as layout, location and depth perception (Lai et al., 2012, p.2). This is also optimal for exploratory planning and design. *Virtual worlds* in this case are analogous to the concept of Virtual Reality.

2.5.2 | *Virtual Reality*

When talking about 3D environments, nothing surpasses Virtual Reality (VR) in its ability to be dynamic, interactive, and experiential to users. While there is no standard definition for VR, these systems and their features are often determined by the “3 I’s” - “Immersion, Interaction and Imagination” – imagination referring to “the mind’s capacity to perceive

nonexistent things” (Burdea & Coiffet, 2003, p. 3). Moreover, VR can be classified into three categories: Fully-immersive, non-immersive and semi-immersive systems. Fully-immersive requires cutting out all outside information, and fully encasing the user with audio, visual, and even haptic devices. However, fully-immersive systems can be quite costly, which hasn’t led to widespread accessibility. Non-immersive, also known as desktop virtual reality, uses standard computer monitors to display virtual worlds. This application is inexpensive to produce and can still offer adequate imagery and interaction within a 3D Virtual Environment. Lastly, semi-immersive refers to overlaying transparent computer graphics onto the real world, this is also known as *augmented reality* (AR). Semi-immersive systems have become extremely popular due to its accessibility, only requiring the use of a phone or tablet to display the VR.

2.5.3 | *Virtual Reality in Urban Design*

The use of VR in urban design is not a new technology, the concept has been evolving since the 1980’s, although primarily explored in academia. VR is especially relevant to the fields of urban design and planning as it offers the ability to represent, model, evaluate changes to the built environment, and communicate. The success of VR implementation can be measured by, (1) “the ability to convince the client (ie. the public, regulating bodies, and lobby groups), that the proposed urban guidelines can be successfully implemented.” And (2), “its ability to convince the urban designers that models and simulations are realistic and accurate, and that VR can be used as a powerful and useful tool in urban design” (Araby, 2002, p. 457). As mentioned previously, the high cost of computing power and the time it takes to create the digital environment, as well as building a user interface to go along with the presentation, is an inevitable downside to most municipalities adopting the technology in practice.

As VR starts to move from the academic realm into municipal planning and design procedures, sound methodologies are needed in order to quickly build, adjust, and maintain VR programmes. A quick Google Scholar search shows VR has been used to analyse and measure urban design approaches (Chowdhury & Schnabel, 2019), as well as perceptual urban design qualities such as; landscape aesthetics & visual perceptions (Zhang 2004; Boz et al., 2022; Johnson & Thompson, 2010; Scorpio, et al., 2020; Kim & Kim, 2019; Lu et al., 2021), ecological aesthetics (Pitt & Nassauer, 1992; Xu et al., 2022),

climate perceptions (Vigier & Siret, 2015), public perception (Zheng, 2014), density & overcrowding (Fisher-Gewirtzman, 2018), navigation (Chen et al., 2021), architectural styles (Mouratidis & Hassan, 2020), and soundscapes (Lindquist et al., 2020; Jo & Jeon, 2022). Complementing this growing wealth of knowledge in urban design and VR, this thesis aims to use 3D modelling in a virtual world as a tool to measure perceptual urban design qualities using variations of streetscapes.

2.6 | The Gap - Urban Design Theory and Practice

Yet there is still a question about how urban design theory and perceptual design qualities are used in practice. As Forsyth argues, “urban design is still solving specific problems using design and not research methods” which “may not extend the knowledge base of a field.” (Forsyth, 2007, p. 465). Much of the research on urban design mentions there is this gap between *theory* and *practice*, with the actual *practice* of urban design being just as ambiguous as the *theory*. The fact that this gap is mentioned repeatedly is a testament to how ambiguously defined urban design really is, but in reality, they both inform and form one another (Araabi, 2018).

We can differentiate between theory and practice as *substantive-descriptive* knowledge and *normative-prescriptive* information. *Theory* is described as *substantive-descriptive*, referring to ‘what is’ and ‘why’. And practice being *normative-prescriptive*, referring to ‘what should be’, through *prescriptive* guidelines or methods (Lang, 1987; Moudon, 1992). Faludi and Cuthbert refer to theories as being *of* or *about* planning (or design), and understanding how planning operates. And practice being *for* planning (or design), what is actually trying to be achieved in the process (Faludi, 1973; Cuthbert, 2006). As mentioned previously, urban design practice pulls knowledge from both architecture and planning, just as these fields have formed the role of contemporary urban design. Rowley states that there are two main problems with urban design practice: One is the breadth of work under the designation urban design, and the other is that definitions vary based on an individual’s or group’s perspective (Rowley, 1994). Madanipour (1997), gives designers three dimensions: aesthetics of the urban environment, spatial form, and social-spatial connections. Yet these dimensions also depend on whether a designer is working at a micro- or macro-scale, on visual or spatial management, or in the public or private sectors. The breadth of urban design is in part

due to the change of roles over time. Urban designers write policies and guidance, draw up master plans and design codes, review the quality of building proposals, and design development schemes and spaces. They can work at varying scales from a single building to an entire region (Cowan, 2021).

Yet, as Madanipour states, “We need to address two tendencies: one which sees urban design as an exercise in producing ‘nice’ images, and another which sees urban design as only attending the aesthetics of the urban environment” (Madanipour, 1997, pg. 368). And, there is still a third, more direct, problem: How academics acquire knowledge, “does not exactly fit what is needed in practice” (Araabi, 2018, p. 6). As Edwards & Bates state: “Academics are accused of being too removed from the realities of practice and professionals of maintaining the status quo without a wider view” (Edwards & Bates, 2011, p. 175). Moudon argues that for a practitioner of urban design to be successful they must pull from the existing knowledge and theories of urban design and adjacent disciplines (Moudon, 1992).

2.6.1 | *Measuring Perceptual Urban Design Qualities*

Jordi Honey-Rosés argues that experimental methods are particularly useful in understanding the causal relationships between “how the built environment influences behavioural choices or how public participation processes may influence planning outcomes” (Honey-Rosés, 2019). “Perception is the process of attaining awareness or understanding of sensory information” (Ewing & Handy, 2009). In the past decade there has been an insurgence of experimental field research in the urban environment, identified as *living labs* or *urban laboratories*, which tend to focus on the areas of “climate change, sustainability, transport, creative industries, new technologies, and innovation” (Caprotti & Cowley, 2017, p. 1442). However, within urban design fields, controlled experiments are not widely employed. Properly conducting scientific studies is extremely difficult in urban settings, cities are too complex and lack a controlled group to run controlled experiments. On the other hand, if controlled experiments were properly executed, “they would be an important complementary resource that could make urban design theory and practice more robust” (Kim & Kim, 2019, p. 1). This section outlines some studies which are integral to this research on measuring perceptual qualities. These studies are examples of using multimedia, such as images and videos, in order to measure various perceptual metrics.

Studies which aim to measure the perceptual attitudes towards urban design traditionally use visual quality assessments, which are “conducted using subjective tests in which human subjects are asked to rate the perceived visual quality of the displayed media according to a provided quality scale, with or without the presence of a reference visual medium, and based on specified criteria and conditions” (Karam et al., 2009, p. 189). Numerical scores are assigned to each individual’s rating, then scores are pooled together to calculate a single rating for that test case (Karam et al., 2009). For example, Gjerde (2010), uses visual assessment surveys, and asks participants to rate their overall preferences for images of six urban streetscapes (an example of one image from the study is shown in *Figure 5*) in order to determine five urban design qualities: visual interest, order, human scale, human activity, and maintenance. Gjerde, first used formal surveys, displaying the images on a public street for passersby to evaluate. Later, focus groups were held in order to get longer-form answers about the participant’s perceptions and ratings. The study concluded that people do “have discerning tastes in respect of the built environment”, and people do care and “have strong preferential views” (Gjerde, 2010, p. 9). Furthermore, “people seek to project themselves into a scene to understand how they themselves would use the buildings and spaces” (Gjerde, 2010, p. 10).



Figure 5: Streetscape Example Image

In similar studies, Ghomeshi et al. (2012) use 36 architectural elements of buildings in 9 categories (overall form, wall appearance, wall texture, wall patterns, windows, balcony, amenities, ornaments, and context) in order to understand how architects compare to non-architects in design preferences. The study aimed to help designers and architects identify elements which are most aesthetically important to the general user of everyday architecture (circular windows are a universally agreed upon dislike, according to this study) (Ghomeshi et al., 2012). Casakin & Mastandrea (2009) use a visual assessment survey to understand aesthetic emotions and their relationship to

architectural styles (Casakin & Mastandrea, 2009, p. 1). They used eleven bipolar appraisal metrics (*figurative/abstract, classical/modern, simple/complex, easy/difficult, familiar/not familiar, typical/not typical, positive/negative, I like/I don't like, relaxing/arousing, interesting/not interesting, and beautiful/ugly*) and ten pictures presented randomly to participants to rate. This study found that “predicting how people may react or develop emotional bonds with respect to certain design styles will enable a better control of the design process” (Casakin & Mastandrea, 2009, p. 5). In *Figure 6* there are two examples of architectural styles, Renaissance and contemporary, used in this study.



Figure 6: Example Images of Architectural Styles

Duffy et al. (1986) used visual assessment surveys in order to explore discrepancies in design preference among designers, nursing home residents and administrators, for the design of nursing home floor plans and lounge room layouts (example of floor a plan in *Figure 7*) (Duff et al., 1986). Understanding how the design of spaces affects mental health and well-being was the main objective of the study. They concluded that the nursing home residents preferred layouts and floor plans which facilitated more privacy, as “isolation and social withdrawal among some nursing home residents may be a predictable response to environments that “overload” on social interaction (Duffy et al., 1986, p. 255).

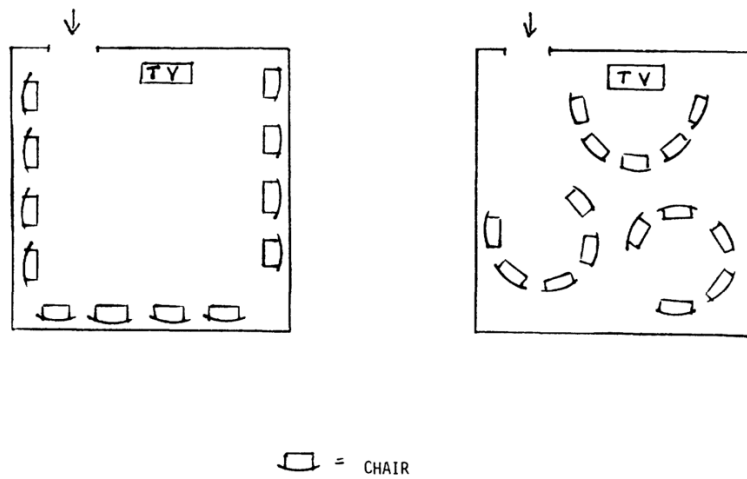


Figure 7: Example of a Floor Plan Presented to the Participants

Lastly, Ewing & Clemente (2013) use visual assessment surveys in order to measure perceptual urban design qualities related to walkability. In this study, an expert panel was asked to rate 32 video clips of an individual walking down urban streets. Urban design qualities measured included: Imageability, enclosure, human scale, transparency, complexity, coherence, legibility, linkage, and tidiness (however coherence, linkage, legibility and tidiness were dropped due to the unreliability of testing these qualities). Walkability was used as the dependent variable and the participant's ratings of each urban design quality as independent variables (Ewing & Clemente, 2013). In order to make this study as objective as possible, the perceptual ratings were tested against physical features in the clips, such as; the number of courtyards, landmarks, distinctive signage, number of street connections, number of land uses, number of visible doors etc. This study concluded that "imageability had the highest reliability, closely followed by complexity and transparency" (Ewing & Clemente, 2013, p. 62).

2.7 | Conceptual Model

After a full elaboration of the theoretical concepts that lie at the basis of the study, a conceptual model is presented (Figure 8). The conceptual model is a visual representation of the theoretical concepts connected to the objective of the study. This model outlines how 3D modelling can theoretically be used to communicate spatial qualities and the

diagram moves left to right, from the objective physical elements to the subjective perceptions of urban design.

It starts with the context, what physical features are added to the 3D models? Streets, buildings, and trees are all examples of physical elements in the real world that can be visualised in a 3D environment. These are objective elements, and give the environment spatial context. These physical elements, and how they are placed in a model, allow us to interpret urban design qualities. Through, not only the planning of the virtual space, but also the attention to detail in the textures used and elements chosen. This in essence is visual communication. But how we evaluate these elements is weighted by our individual perceptions, preferences, cultural background, academic background, the activities we enjoy, and even our gender. By having individuals rate 3D models' design qualities based on the physical elements visualised within those models, perhaps a conclusion can be made as to which physical elements contribute to the overall quality of spaces as perceived through 3D modelling.

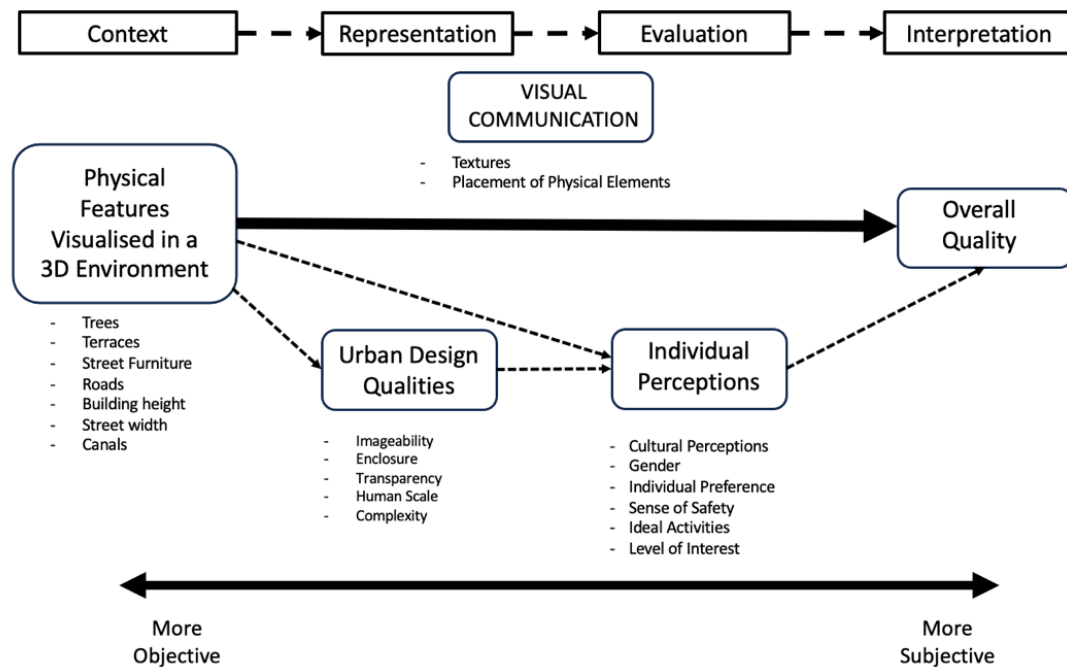


Figure 8: Conceptual Model

3 | Methodology

The following chapter examines the methodologies used in order to answer the research questions determined in Chapter One. This study, therefore, aims to examine the various visual components of 3D modelling and determine how these visualisations can be used in urban planning & design to communicate with citizens and evaluate spatial quality in urban landscapes. This chapter starts with explaining the research design, then the research approach, how the 3D models were created, the methods for data collection, ethical considerations, and lastly COVID-19 restrictions.

3.1 | Research Design

This research attempts to employ a controlled experiment using 3D modelling and following Ewing & Clemente’s (2013) methodology for measuring urban design. In doing so, a particular case study has been selected, and rather than visuals being presented in video format, this research will take on the case study within a digital 3D environment allowing for digital alterations to the physical environment. Therefore, as suggested, the procedures used to answer the main and subsequent research questions take on a *mixed methods-case study* approach.

Mixed Methods-Case Study Approach

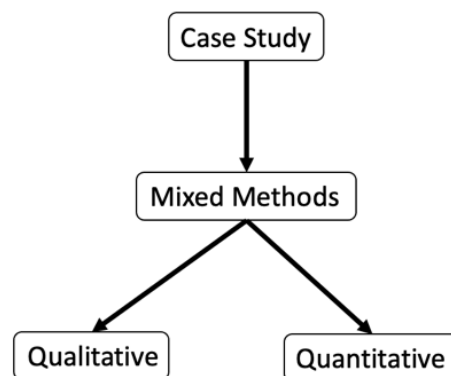


Figure 9: Mixed Methods-case Study Conceptual Model

3.2 | Research Approach

As this thesis follows the research of Ewing & Clemente (2013), their methodologies called for a panel of urban design and planning experts. Expert panels, or *focus groups*, allow for detailed and in-depth information from participating experts, which is important when looking at perceptual influences on spatial quality and design. Focus groups are first and foremost a cultural experience, they allow participants to share and compare personal experiences, while the informal structure allows for spontaneity (Krueger, 2014). As Breen (2006) states, focus groups are “appropriate for the generation of new ideas formed within a social context” (Breen, 2006, p. 466).

This section of the methodology takes an in-depth look at the research approach and breaks it down into the sequential steps needed to produce results in this study. First, how the 3D models were created. Second, details of the focus groups will be outlined with the methods used to conduct and code the focus groups. The quantitative analysis is determined by the number of features present in the 3D models.

3.2.1 | *Spatial Quality Metrics in the Context of this Research*

3.2.1.1 | Imageability

Imageability is “that quality in a physical object which gives it a high probability of evoking a strong image in any given observer” (Lynch, 1960. p. 8). In terms of the quality of space, “imageability makes it distinct, recognisable, and memorable” (Ewing & Clemente, 2013, p. 5). This may not be solely one physical or perceptual element such as a landmark, but a combination of various physical and perceptual components which are presented in a particular way to evoke feelings (Ewing & Clemente, 2013). In urban geography this is often called ‘placemaking,’ as Derek Thomas explains, in order to formulate the process of placemaking, designers must first identify the attributes of urban space (Thomas, 2016).



Figure 10: Imageability: Left (High Quality); Right (Low Quality)

3.2.1.2 | Enclosure

“Enclosure refers to the degree to which streets and other public spaces are visually defined by buildings, walls, trees, and other vertical elements” (Ewing & Clemente, 2013, p. 6). This design quality creates a sense of position and orientation by using vertical elements to enclose space. This is done by ensuring that “the height of vertical elements is proportionally related to the width of the space between them” (Ewing & Clemente, 2013, p. 6). It is quite likely that enclosure is a crucial environmental feature, as environmental psychology has indicated that there is a specific region of the brain which directly responds to images of rooms where floors and walls enclose a space (Holden, 2000).



Figure 11: Enclosure: Left (High Quality); Right (Low Quality)

Trancik (1991) divides urban spaces into two categories “soft spaces” and “hard spaces.” Soft spaces are shaped by the natural environment and provide spaces for recreational activities such as parks, gardens, and linear greenways (Trancik, 1991 p.61). Hard spaces function as major gathering spaces, and are principally bound by architectural walls to create *enclosure* (Trancik, 1991 p.61). Hard spaces that are enclosed don’t tend to be found in modern planning, although ancient spaces, such as piazzas, are important and offer places of solitude and protection within the urban form (Sitte, 1979).

3.2.1.3 | Transparency

“Transparency refers to the degree to which people can see or perceive what lies beyond the edges of the street, or other public space” (Ewing & Clemente, 2013, p. 11). Lynch describes transparency through visual scope which includes transparencies, overlaps, vistas and panoramas (which increase the depth of vision), articulating elements (which visually explain a space), connectivity (which exposes farther objects to view), and clues (which speak of an element otherwise invisible) (Lynch, 1960, p. 106). This includes windows facing the street, and the ability to see, inviting passers-by to look through and enter the space (Gehl, 1987).

The importance of transparency lies in the public gaze, with the ability to see human activity beyond the edges of a defined space (Dovey, 2016; Erkartal & Uzunkaya, 2019). Gehl, uses the example of children, if they can “see the street or playground from their homes, they also can follow what is happening and see who is outside playing” (Gehl, 1987, p. 113). And, Jane Jacob’s uses the concept of the “street ballet” to infer social cohesion on the streets and public squares (Jacobs, 1961).



Figure 12: Transparency: Left (High Quality); Right (Low Quality)

3.2.1.4 | Human scale

“Human scale refers to the size, texture, and articulation of physical elements that match the size and proportions of humans and, equally important, correspond to the speed at which humans walk” (Ewing & Clemente, 2013, p. 9). Crucially, perceptions of human scale by the individual are related to building heights, (Boeing, 2018, p. 7), horizontal space (Trancik, 1991), and neighbourhood scale (Moughtin & Mertens, 2003).

The importance of proportions dates back to Roman architecture, as Vitruvius states well-designed buildings adhere to symmetry and proportion, which is necessary to the beauty of a building. Human proportions, therefore should be used to take into account (Vitruvius Pollio, 2015). According to Alexander (1977), buildings should not exceed four stories, and parking lots contribute to the destruction of human scale, by creating unpleasant places (Alexander, 1977, p. 504). Additionally, “streets that suggest extremes of either width or narrowness attracted attention” (Lynch, 1960, pg. 51). The width of streets corresponds to the function, is the street plan to the scale of the human being, horse and carriage, or is it designed for the flow of motorized traffic? (Krier, 1979). “When buildings are narrow, the street length is shortened, the walking distances are reduced, and street life is enhanced” (Gehl, 1987, p. 94). Other elements that contribute to human scale include textures, patterns, and architectural details (Trancik, 1991).



Figure 13: Human Scale: Left (High Quality); Right (Low Quality)

3.2.1.5 | Complexity

“Complexity refers to the visual richness of a place. The complexity of a place depends on the variety of physical environment, specifically the numbers and kinds of buildings, architectural diversity and ornamentation, landscape elements, street furniture, signage and human activity” (Ewing & Clemente, 2013, p. 13). However, Boeing (2018) argues that highly complex urban environments can be overwhelming to the senses, while urban design elements that are too few, too similar, or too disordered to be comprehended, leads to poor complexity (Boeing, 2018 p. 7).



Figure 14: Complexity: Left (High Quality); Right (Low Quality)

3.3 | Creating Virtual Environments

3.3.1 | 3D Modelling

The first stage in this approach is geospatial, focusing on 3D modelling by connecting the science of projecting geographic space into a computer-generated 3D model and the art of visualisation. The 3D visualisation approach taken was combining photorealism and virtual worlds. This is partially done by first creating digital replicas of each building within the study area in SketchUp, which are then exported into CityEngine, and finally viewed in ESRI Scene Viewer – a virtual world that can be viewed in any web browser.

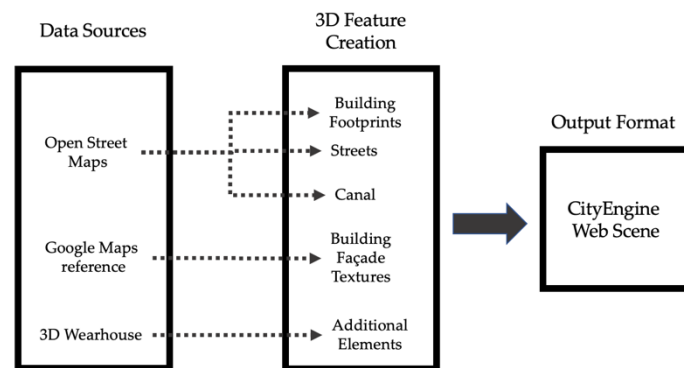


Figure 15: Process of Creating 3D Models (By Author)

First, the building footprints and road network data were sourced from Open Street Map (OSM), and satellite and Digital Terrain Model (DTM) data was sourced from Google Maps. These are both open-source spatial data platforms. It was important to obtain the building footprints, building height, and street width data in order to replicate the street to exact measurements. Using OSM, the portion of *Gedempte Zuiderdiep* chosen, was exported as a shapefile into SketchUp. SketchUp is a CAD software, that uses *geometry*, which are *edges* and *faces*, in order to make up shapes, forms and objects in a virtual 3D environment (Tai, 2010). The metadata from OSM for each building footprint provided the height of the buildings which helped to create the basic box of the buildings.

In Google Maps Street View, the shapes of the roofs could be distinguished and screenshots of the buildings in Street View were taken in order to create the facades textures which were placed on the building faces in SketchUp. Additional elements such as balconies, steps, door niches, and elaborate roof architectural details, such as corbie

steps, dormers, or windows that are setback with ledges, were all meticulously modelled, in order to provide accuracy and realism.



Figure 16: Building Facades

Textures for roofs, pavement, roads, and grass, as well as the models for trees, bikes, bike racks, signage, tables, chairs, benches, umbrellas, and garbage bins, were all sourced from 3D Warehouse, an opensource platform for 3D modellers. These elements were also

added to the 3D environment in SketchUp before being exported to CityEngine. CityEngine is an advanced 3D modelling software designed by ESRI used for creating interactive and immersive urban environments (ESRI). In this case, CityEngine was used to seamlessly display the models as scenes in Scene Viewer, an online interactive interface which supports CityEngine scenes. This is a great way to share 3D environments with people over the internet. When the scenes are made public, anyone can use the URL to access and view the 3D scene in their web browser and are able to pan around the scene, zoom in and out, and look at the environment from any angle.

3.3.2 | *Four Virtual Environments*

3.3.2.1 | **Model 1**

Four models were created with varying levels of detail. The first scene depicts the current situation of the study area seen in *Figure 17*. This includes the main *Gedempte Zuiderdiep* street with bus turnouts, lined trees, bike paths and wide sidewalks on either side. Some terraces outside the bars and cafes were depicted, as well as some street signage and bike racks. Textures were chosen to closely resemble the street in the real world, this included various colours of brick for the cycle paths and sidewalks, and dark pavement for the traffic street.



Figure 17: Model 1

3.3.2.2 | Model 2

The second model (*Figure 18*) depicts the street with a green space in the middle, with the main road now split into two on either side of a large green space. This greenspace now has trees scattered in the middle with benches placed along the edges. the bike paths are replaced with shared space one-way roads with slightly different pavement textures. The sidewalks are of similar proportions to the original model and are accompanied by an increase in individual elements, such as terraces with umbrellas, chairs, tables, bike racks (with bikes parked), and garbage bins.

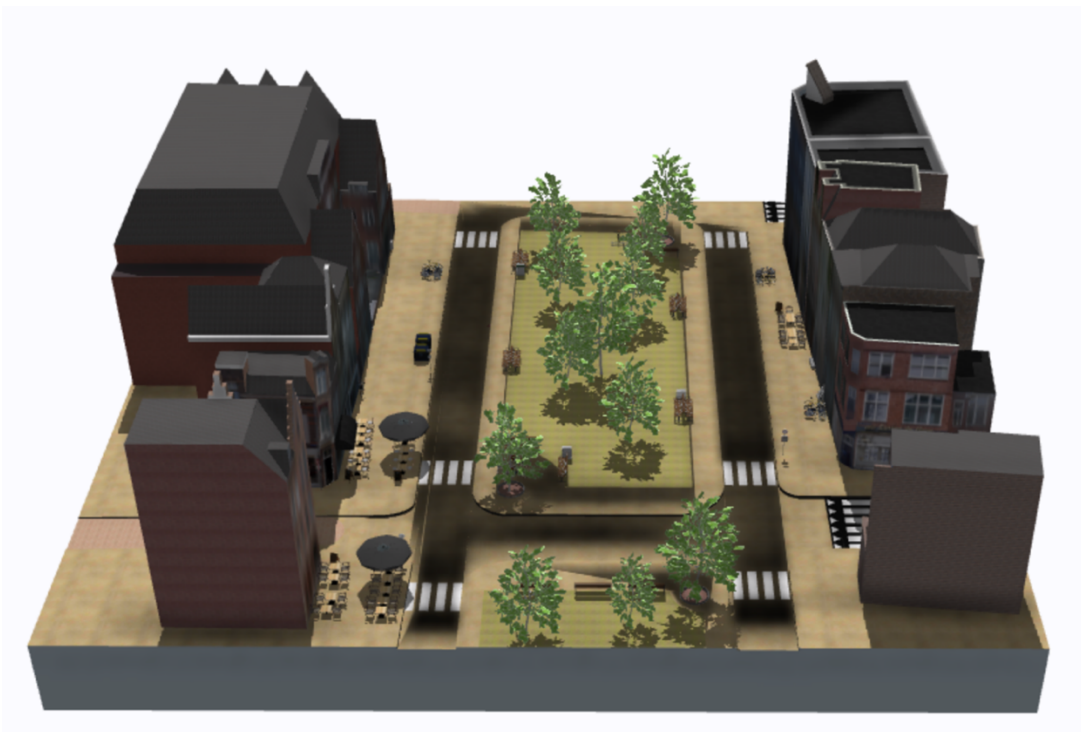


Figure 18: Model 2

3.3.2.3 | Model 3

The third model (*Figure 19*) depicts a bluescape with the proposed canal restoration replacing the main street, with a shared space for bikes and cars on one side and a street on the other. The trees now become linear once again alongside the canal. The street that intersects with the canal features a bridge. Terraces, bikes, bike racks, street signs, garbage bins, benches and now four street lamps are placed throughout the model.



Figure 19: Model 3

3.3.2.4 | Model 4

Model four (*Figure 20*) also depicts the canal restoration, however this time the textures of the streets, grass, sidewalks, and the tree models themselves depart from realism, with a softer colour palate and whimsical tall trees with large leaves. The streets running alongside the canal in the previous model are now replaced with bike paths, and the only motor vehicle access is using the street which bridges the canal. The building facades are kept the same, this is because if this canal restoration project came into being, the buildings would be untouched as most of these buildings are historically designated.

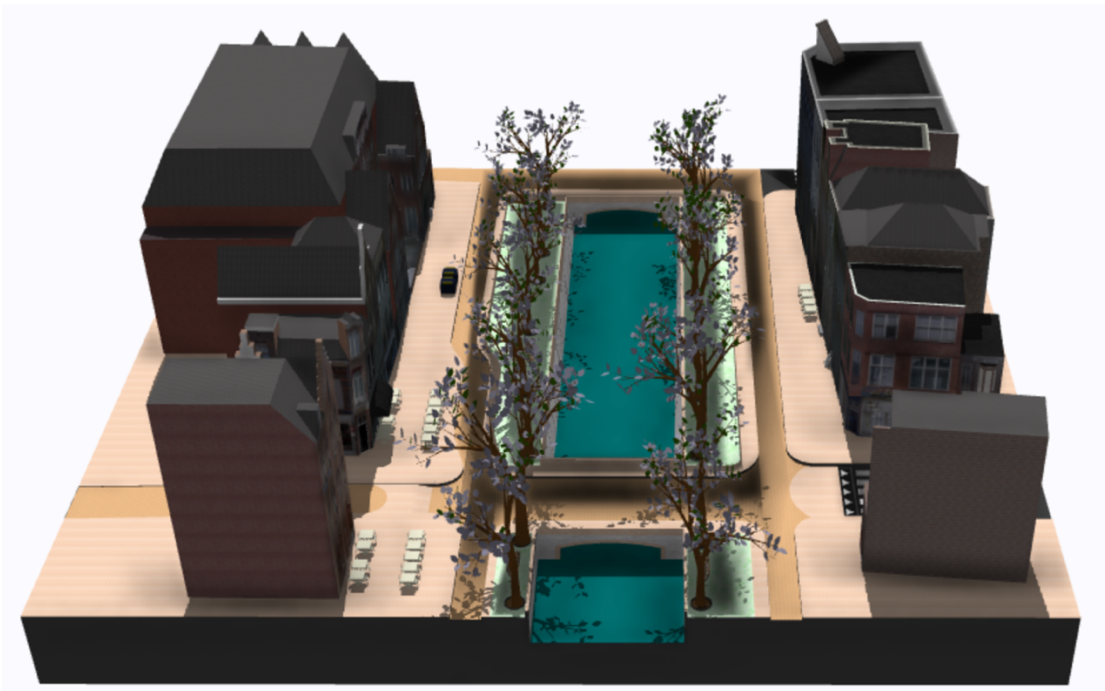


Figure 20: Model 4

3.4 | Methods of Data Collection

3.4.1 | *Finding and Approaching Panel experts*

The criteria for the expert panellist include: First, having knowledge in the planning or design fields in order to be able to support their subjective perceptions. And second, would bring a variety of different perspectives within the fields of urban planning and design. For this reason, experts in the faculty of spatial sciences and architecture at the University of Groningen were recruited. The four expert panels were divided into two groups, with two panels of three appointed faculty academic staff who were experts in urban planning and design through their academic research and their work as professionals in their fields. And, two expert panels were recruited Master's students within the faculty of Spatial Science who, decidedly for this research, are classified as experts in the planning field and were recruited based on their voluntary interest in the research topic. Following Ewing & Clemente's example of making an effort to achieve a balance between urban designers and planning professionals, this study aimed to balance between professions and students (*Table 1*).

Professionals

Faculty staff panellists were selected based on the aforementioned criteria and were sent an invitation to join the focus groups. Ten emails were sent out to faculty staff on Monday the 21st of September 2020, with a brief description of the research topic and a Google Forms poll to see which dates and times would be the most convenient for the participants. Of these ten emails, six experts were able to participate with two groups being formed.

Students

Students on the other hand, were recruited based on past and previous enrolment in the faculty of spatial sciences and an open invitation and a poll was sent out via email, the university's online system called "Nestor" which an online form was created to reach out to students in the faculty, and WhatsApp to reach a wide range of potential participants. Only two students replied directly to the poll, and it was clear that a more direct approach needed to be taken. Eight direct messages were sent out to those students who were

known to still be living in Groningen. Three of these students agreed to join and were able to suggest other potential participants that they knew, and that if directly messaged these students would be willing to join. By doing this, two student panels were finally confirmed on the 30th of October 2020.

Variables	Data Coding	Reference Category
Gender	Male [6] Female [6]	Female
Educator/education	Faculty Professor/ researcher [5] PhD Student [1] Student [6]	Faculty Professor/researcher
Faculty Programme	Environmental & Infrastructure Planning [8] Socio-spatial Planning [1]	Environmental & Infrastructure Planning
Professional Field	Urban Planning [10] Architecture [2]	Urban Planner

Table 1: Breakdown of Participants by Attribute

3.4.2 | Visual Assessment Survey

Once the participants confirmed their willingness to participate in this research, a document was sent to each individual participant which was titled “*Visual Assessment Survey*” (can be found in *Appendix I*), this document describes the five design qualities that are used in this study, in order for all the participants to have an understanding of what criteria they are rating the models by. The document provided a description of the design qualities as outlined by Ewing & Clemente, and photos were provided for each design quality showing both an example of high quality and low quality, as determined through the theoretical research into spatial qualities. Included in this document is a table (*Table 2*), where each model is numbered and each design quality indicated. The participants would record their ratings individually using this table while the focus groups were being conducted. The completed tables were emailed back to the researcher after the focus group was concluded.

Participant:				Date:	
Model #	Imageability	Enclosure	Human Scale	Transparency	Complexity
Model 1					
Model 2					
Model 3					
Model 4					

Table 2: Visual Assessment Survey Format

3.4.3 | Semi-structured Interviews

The focus groups were conducted using semi-structured interviews. A semi-structured interview is a qualitative technique that requires the researcher to have a schedule of questions, but implements them flexibly allowing the participants to guide the direction of the interview (Dempsey et al., 2016). In this case, although unorthodox, an interview guide was not developed, this is because the process was incredibly straightforward. The expert panels are conducted as informal discussions in which participants can share and compare their experiences and thoughts in regard to urban design through 3D modelling. As Ewing & Clemente (2013) state in their research, “The panel members helped define perceptual qualities of urban scenes” and “rated different models with respect to these qualities” (Ewing & Clemente, 2013, p. 25). Participants were asked to rate each design quality based on their initial perceptions of the model, and subsequently discuss why they rated the models as such. This kind of flexibility allowed participants to freely express their personal perceptions unrestrained by the researcher’s theoretical background on urban design and spatial quality. The first ten minutes began with an introduction to the focus group itinerary and reiterating the topic as described in the emails sent to each participant. Each participant was then given the opportunity to introduce themselves, their experience in the urban planning or design fields, and their familiarity with the topic of urban design.

For this visual assessment survey, the participants were shown the four 3D models in a random order. Within the chat in Google Meet, the URL was provided for each of the models using ESRI Web Scene Viewer. The participants were able to use their mouse to zoom in and out, and pan around the 3D models. Based on their immediate reactions, each participant filled out the survey sheet provided and rate each scene from low to high (1 to 10) based on the design quality indicator (imageability, enclosure, human scale,

transparency and complexity). This took about fifteen to twenty minutes, and participants were able to ask questions about the scenes and the design quality indicators. Finally, the remaining time was divided equally between each scene to ensure that they each deserved quality discussion. Participants were then able to discuss the reasoning behind the ratings they gave each design quality indicator for each modelled scene. The discussions looked at the perceptions each participant initially had for each scene, as well as how participants viewed others' choices in ratings.

3.5 | Ethical Considerations

Throughout this study, it is imperative that this research is conducted responsibly and ethically in order to reflect the Dutch code of conduct for research integrity. In the social sciences and human geography, practising ethical behaviour means protecting the “rights of individuals, communities and environments” as well as ensuring “a favourable climate for the continued conduct of scientific enquiry” (Clifford, et al., 2016, p. 36). Therefore, throughout the course of this research, the five NWO (2018) principles of *honesty, scrupulousness, transparency, independence and responsibility* were adopted (NOW, 2018).

Furthermore, as outlined in the National Ethics Council for Social and Behavioural Sciences (2018), researchers are to be able to communicate their intended, scientifically valid, research and ethical reflection. This means that the week before each focus group, the participants were forwarded a reminder of the meeting, as well as an overview of how the groups will be conducted. Furthermore, at the beginning of each focus group, the participants will again be informed that the discussion will be videotaped for quality of information provided. Interviews will be conducted with openness, transparency and honesty, and questions will be conducted without steering or exploitation. Respect for the privacy of participants is ensured through anonymity and confidentiality as data for the focus groups will not include information by which the participant can be directly identified.

3.6 | COVID-19 Restrictions

According to Hollis et al. (2002), the recommended group size for discussions is between six and ten. However, due to the novel COVID-19 pandemic, these group sizes needed to be reduced to just three participants in order to comply with physical distancing measures set out by the government, and followed by the University of Groningen. Once the focus groups had been confirmed, the government unfortunately announced a total lockdown of the university, and the focus groups were no longer able to meet in person. In order to continue with this research and comply with the government lockdowns and university restrictions, the focus groups were moved onto the virtual platform Google Meet. *Chapter 5* further discusses the limitations encountered during the data collection process.

4 | Results

4.1 | Qualitative Results

4.1.1 | Organising and Coding Panel Discussions

Each focus group was recorded, which was used to transcribe each group discussion manually documented in a Microsoft Word document (*Appendix III*). When transcribing, each participant is indicated by participant number (1 through 12), followed by their comment. For example, the moderator’s name with the question asked is subsequently followed by each participant and their comments.

The programme ATLAS.ti is used to code the focus group transcript using a thematic content analysis. This programme has a built-in *focus group* coding tool. First, each speaker is coded according to faculty programme, field of planning, education level, and professional experience. According to Friese et al. (2018), “Codes help in organizing, structuring, and retrieving data and they support the identification of themes, but rarely is a code also a theme.” (Friese et al., 2018, p. 8). Thus, the next step is to label the topic mentioned by the participants presented in the transcripts. *Figure 21* shows the inductive coding table based on the predicted outcomes based on Ewing & Handy’s 2009 study, and potential topics discussed with themes attached to each outcome. This is followed by deductive codes and themes (*Figure 21*) derived from the discussions themselves.

adaptability	distinctiveness	intricacy	richness
ambiguity	diversity	legibility	sensuousness
centrality	dominance	linkage	singularity
Clarity	enclosure	meaning	spaciousness
coherence	expectancy	mystery	territoriality
compatibility	focality.	naturalness	texture
comfort	formality	novelty	transparency
complementarity	human scale	openness	unity
complexity	identifiability	ornateness	upkeep
continuity	imageability	prospect	variety
contrast	intelligibility	refuge	visibility
deflection	interest	regularity	vividness
Depth	intimacy	rhythm	

Figure 21: List of Perceptual Design Qualities

4.1.2 | *The Code Tree*

This code tree is based on the results of transcribing each focus group and creating tables for each participant (*Appendix II*). The main themes of the coding were sorted into the urban design qualities that are attempting to measure: imageability, enclosure, human scale, transparency, and complexity. From these design qualities, perceptions by the participants about the space are inferred, such as cultural perspectives, activities perceived in that space, proportions of spaces, sightlines, perspectives, and details. These perceptions are then classified starting with larger categories such as environment, structures, seating, activities, or physical elements. Finally, individual physical elements that show up in the 3D models such as trees, buildings, streets, sidewalks, windows, bikes etc.

4.1.3 | *Environmental Perceptions*

The qualitative results bring together the inductive codes provided by Ewing & Handy (2009), and the deductive codes derived from the four focus groups (*Appendix II*). Below is a table (*Table 3*) showing the themes derived from the qualitative coding analysis.

Audit Quality Criteria	Descriptors
Imageability	Capturing attention / sense of place / distinct / memorable / vernacular architecture
Enclosure	Streets / definition through buildings, walls, trees / heights, widths and proportions
Human scale	Size / articulation of physical elements in relation to humans / building and street detail
Transparency	Degree to which people see and perceive what lies beyond / human activity
Complexity	Visual richness of a place – architectural / landscape / streets / signage / human activity

Table 3: Audit Quality Criteria

4.1.3.1 | Imageability

The code tree in *Figure 22* shows how imageability is linked to specific physical elements in the models. For some participants, the imageability was dependent on the details in a model including the textures used, the colours, and details such as trees. In this case, not necessarily trees as they represent a physical element, but the types of trees, or artistic representations of trees, chosen to be used in the model. For example, the trees used in Model 4, which have large stems and leaves showing a more artistic representation of a tree, enhanced the imageability of the model itself.

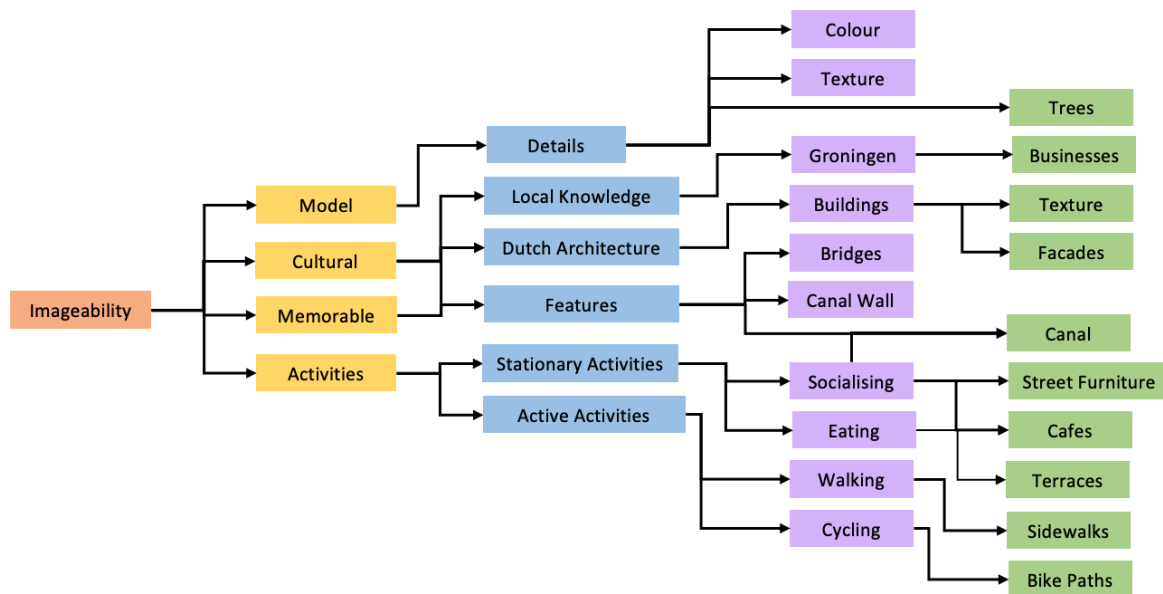


Figure 22: Imageability Code Tree

Culture & Memorability

The cultural and memorability aspects of the models include the participant's local knowledge of the study area and the Dutch architecture. All except two participants were of Dutch nationality, which had a major effect on imageability in particular. For example, Dutch students and professionals both expressed how the models were un-imageable or not memorable because they looked like any other street in the Netherlands. Even those who rated the models highly communicated how unimageable the streetscapes were. Memorability is also linked to these cultural aspects features that are memorable were

those that were surprising or unexpected, such as the trees and textures in Model 4, as well as the canal wall, which is unusual for Dutch urban design. Imageability for Model 4 was rated the highest out of the four models. This could be linked to the whimsical, cartoonish and unrealistic textures used. However, not all participants used this as a justification for their higher ratings.

Activities

How imageable the models are, also depends on the types of activities presented in the models through the physical elements. Stationary activities such as socialising and eating depend on the availability of cafés, terraces and street furniture. But also, stationary activity is observed when the physical space is deemed suitable and pleasing, such as sitting next to a canal, or in a park. Activities, such as walking and cycling, require the appropriate infrastructure such as sidewalks and bicycle paths.

4.1.3.2 | Enclosure

The code tree in *Figure 23* shows how enclosure is linked to many linear elements in the 3D models, as well as textures, proportions, linear elements, and in general well-defined spaces.

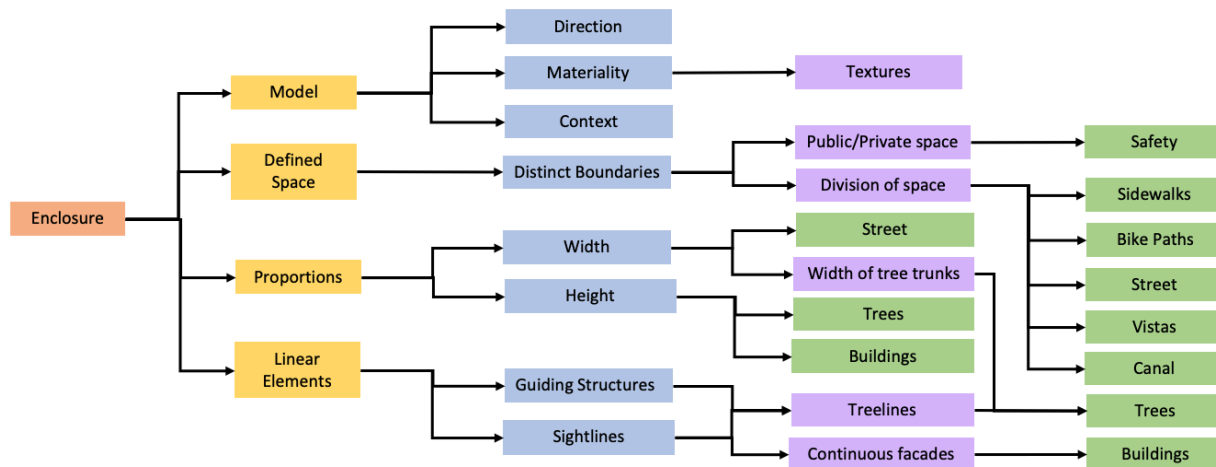


Figure 23: Enclosure Code Tree

Defined Spaces, Linear Elements, Textures & Proportions

Elements such as the canal, streets, sidewalks, bicycle lanes, buildings, and vistas, show how defined spaces improve the perception of enclosure. In urban design literature, tall trees with canopies are described as providing a sense of shelter or a roof covering a public space. The heights of buildings in proportion to the street also act as walls improving the sense of enclosure. All these linear elements help to define space, create guiding structures or sightlines, and break up what would be a large street. Additionally, textures help to define spaces such as street pavement, the use of bricks for sidewalks and bicycle paths, green grass textures, and water. Proportions are also important, if a space is perceived as too wide compared to its “edges,” enclosure is low. If the same width, in this case the original street in the models, is broken up into distinct linear spaces such as streets, canals, greenspace, or bicycle lanes, the sense of proportionality increases leading to higher ratings of enclosure.

4.1.3.3 | Transparency

The code tree in *Figure 24* shows how transparency is linked to textures, sightlines, trees, and windows. Transparency as an environmental perception is also linked to cultural perceptions.

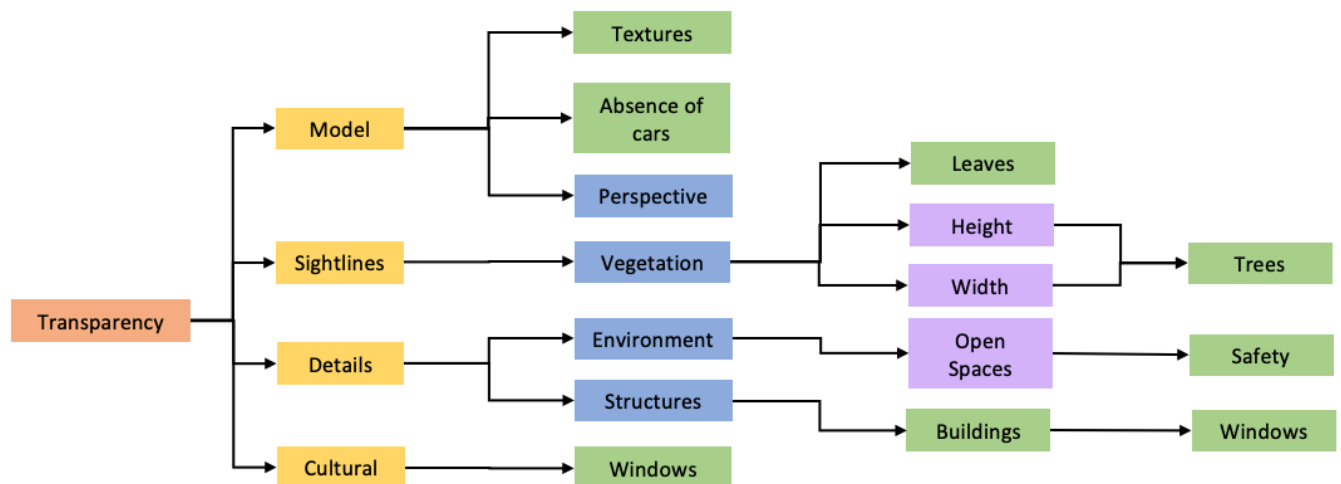


Figure 24: Transparency Code Tree

The 3D Model, Details, Sightlines, and Culture

Based on the participant's perceptions of the 3D models, transparency is linked to the amount of vegetation and types of trees depicted in the model. For example, tall trees or trees with small steps and the least amount of foliage, add a sense of transparency to the model. Additionally, the absence of cars and traffic in the model would increase a pedestrian's sightlines, which could add to a sense of safety while walking or cycling. Additionally, a cultural aspect of these models that was raised repeatedly by participants, was the sense of transparency that was felt due to the large windows which are typical of Dutch architecture. These large windows allow pedestrians to view into the windows of shops and cafés lining the street, as well as provide reflections of the surrounding street adding to a sense of safety and openness.

4.1.3.4 | Human Scale

The code tree in *Figure 25* shows how human scale is linked to almost all of the elements within the 3D models, the details of street furniture, architecture, and vegetation, as well as the textures used, and the way that spaces are divided.

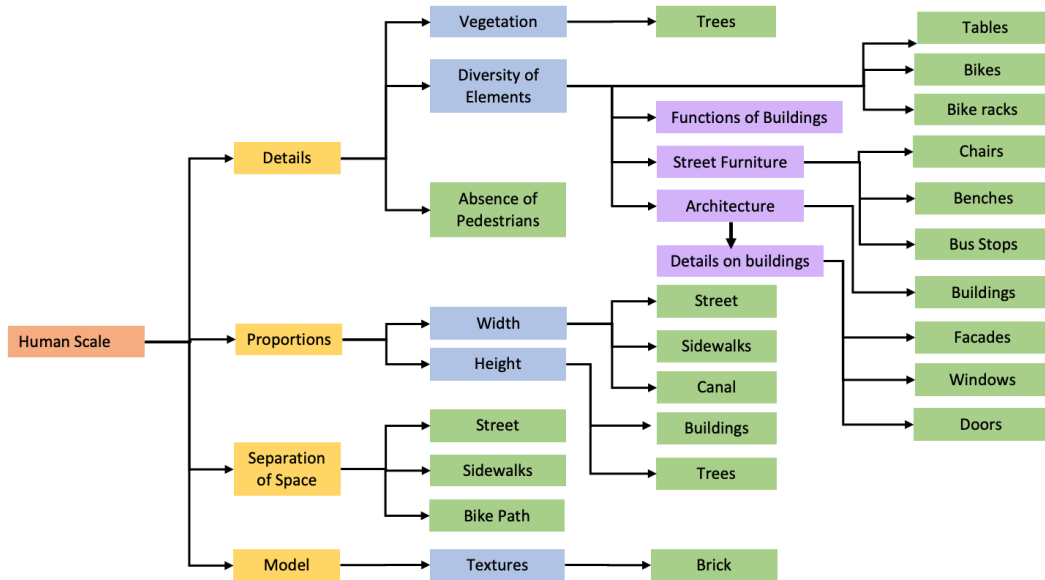


Figure 25: Human Scale Code Tree

Details & Proportions

The diversity of elements in the models, such as street furniture, trees, building facades, windows, doors, bike racks, the canal, streets, and textures all add to a sense of human scale. Being able to automatically understand how human proportions would fit into these models without having to place a model of a person into the scene, is a testament to the quality of the design. For example, if the brick textures were too big, or models of the trees were too small, all the other “to scale” elements would make those specific elements feel rightfully out of place. Participants also noted that by having the buildings the same in each model, they became an anchor for how the other elements in the models fit with the facades. So, if a tree felt too tall or if a road felt too wide, it was compared to the height of the buildings.

4.1.3.5 | Complexity

The code tree in *Figure 26* shows how complexity is linked to details present in the models as well as the absence of details. Architectural styles, vegetation, textures and individual model elements all made up the complexity within the model. However, the absence of some sensory elements should also be noted. Noise and motion of traffic and people, make up a huge downside of static models. These elements add tremendously to the way people perceive spaces as lively or attractive.

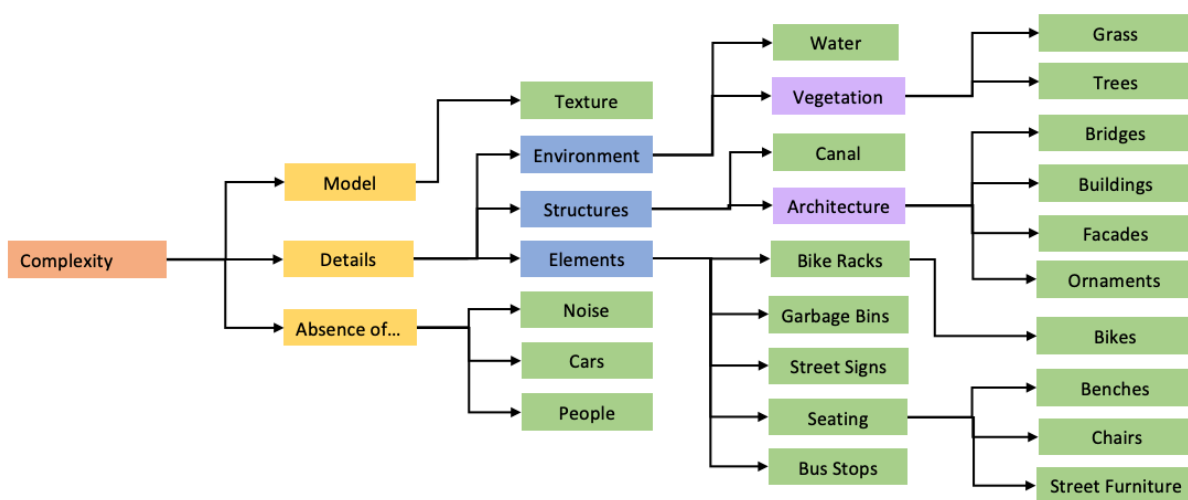


Figure 26: Complexity Code Tree

Table 4 shows themes that were derived from the codes referring to the design qualities, physical features, and individual perceptions of urban design. Perceptions about space and physical elements help to identify what kinds of activities would be taking place in the space, one’s sense of safety in the public realm, and the cultural aspects of how to identify with a space.

Design qualities	Activities	Safety	Culture
Imageability	- Play - Sit - Eat - Socialise	- “Eyes on the street” - Sense of community and place	- Architecture - Canals - Street width
Enclosure	- Socialise in an enclosed space	- Sense of safety in isolation	- Street width - Tree-lined streets - Canals
Human Scale	- Types of mobility: vehicle, bicycle, and pedestrian	- Width of a street and sense of scale	
Transparency	- Socialising in an open space - Space for playful activities - People watching	- Higher transparency leads to less visual obstruction	- Dutch architecture: large windows
Complexity	- Increase areas of seating	- Possibly more obstruction of visible lines	- Textures such as brick adds complexity

Table 4: Themes Derived from the Code Trees

4.2 | Quantitative Results

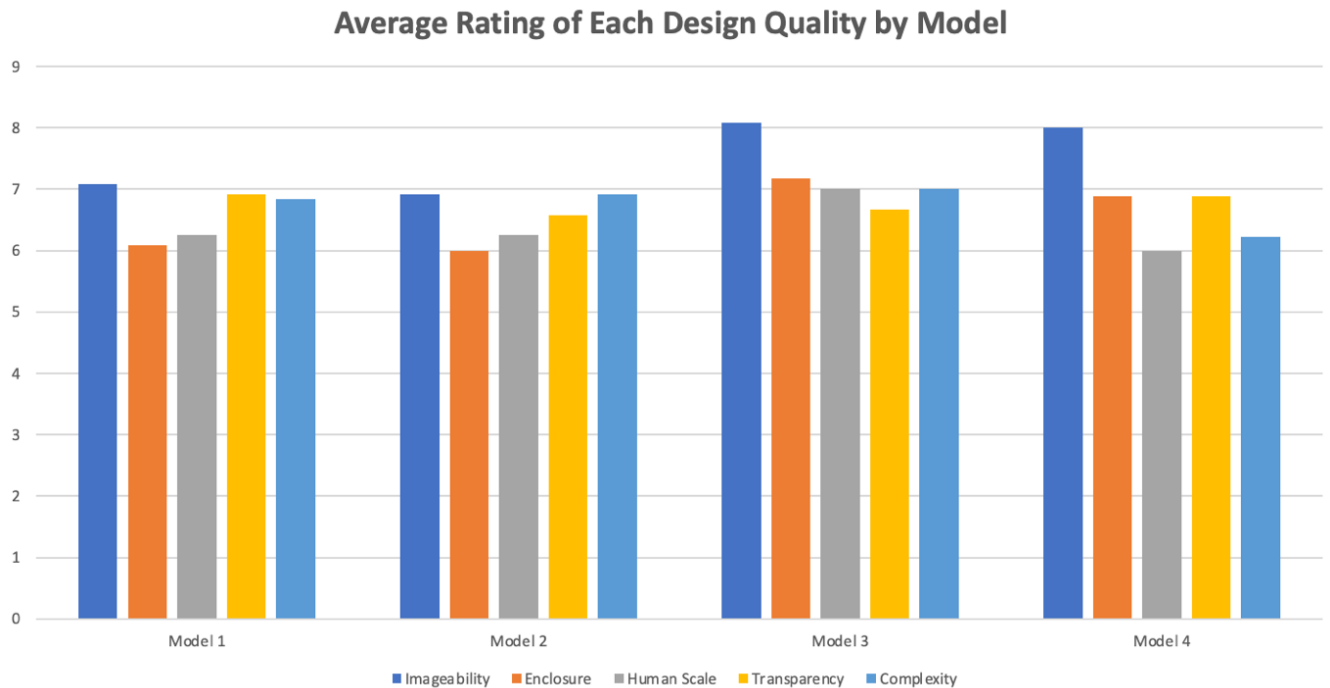
In order to objectively measure the subjective and perceptual, this study aims to measure the specific design qualities by having participants rate each spatial quality for each 3D model shown. The rating system ranged from one to ten, one being low quality and ten being the highest quality. This will help to answer the research questions: What physical features determine good spatial quality, and how do different groups of academics perceive spatial qualities through the medium of 3D virtual environments? This rating system can also help to understand the correlations between the design qualities and what individual elements help to increase the perceptual ratings of the participants.

4.2.1 | Average Rating of Each Design Quality by Model

Table 5 and subsequently Graph 1 demonstrate the average ratings by all twelve participants for each of the five design qualities throughout each model. The only trend that can be concluded between the models is the increase in imageability ratings between models one and two to models three and four, which increased on average by about one point. It is important to note here that the first model depicted a streetscape, the second an open greenspace with two roads on either side, and the third and fourth models depicted a Bluescape showing the proposed canal restoration.

	Imageability	Enclosure	Human Scale	Transparency	Complexity
Model 1	7.08	6.08	6.25	6.92	6.83
Model 2	6.92	6	6.25	6.58	6.92
Model 3	8.08	7.17	7	6.67	7
Model 4	8	6.89	6	6.89	6.22

Table 5: Average Ratings for Each Design Quality and Model



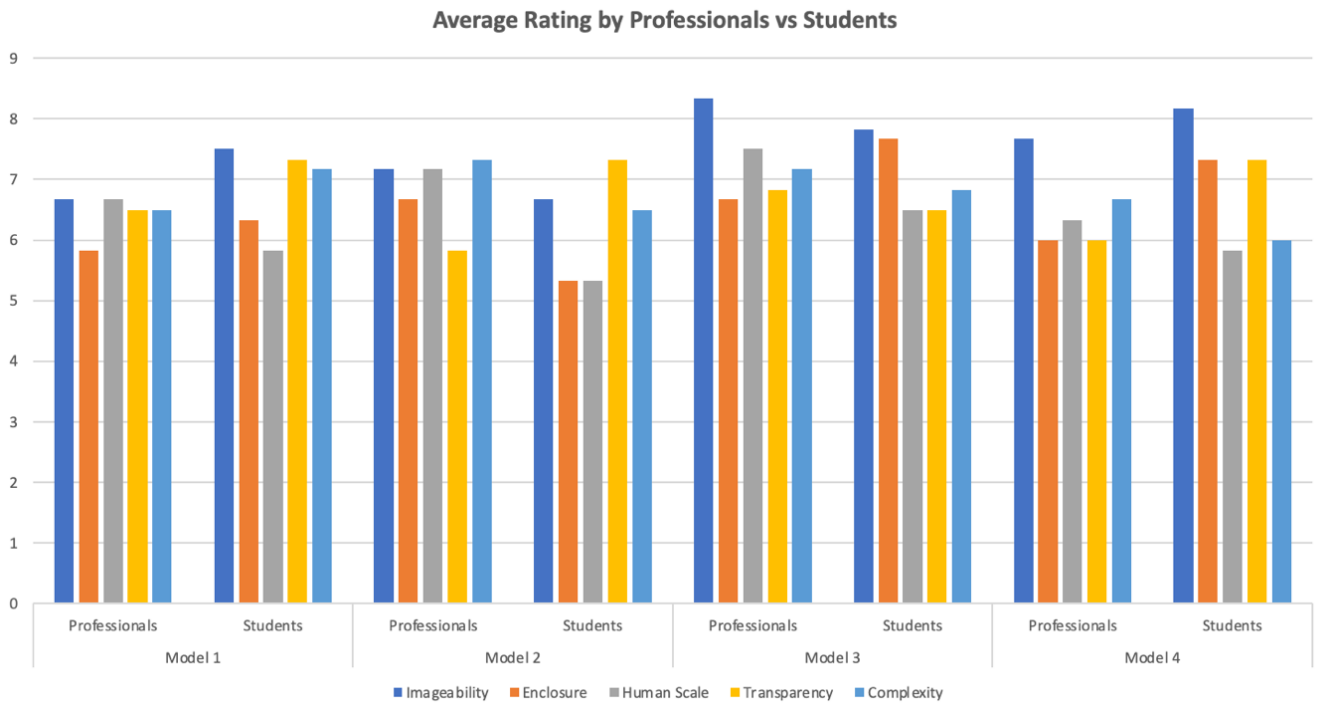
Graph 1: Average Rating for Each Design Quality by Model

4.2.2 | Average Rating by Professionals vs Students

Table 6 and subsequently Graph 2 shows the average ratings of design qualities between the two groups of professionals and students for each model. The twelve focus group participants are equally split between professionals and students. No significant trends appear between these two groups of participants, although on average the design quality of human scale tends to be rated higher by the professionals for all models.

	Model 1		Model 2		Model 3		Model 4	
	Professionals	Students	Professionals	Students	Professionals	Students	Professionals	Students
Imageability	6.67	7.50	7.17	6.67	8.33	7.83	7.67	8.17
Enclosure	5.83	6.33	6.67	5.33	6.67	7.67	6	7.33
Human Scale	6.67	5.83	7.17	5.33	7.5	6.5	6.33	5.83
Transparency	6.5	7.33	5.83	7.33	6.83	6.5	6	7.33
Complexity	6.5	7.17	7.33	6.5	7.17	6.83	6.67	6

Table 6: Average Ratings of Design Qualities: Professionals & Students



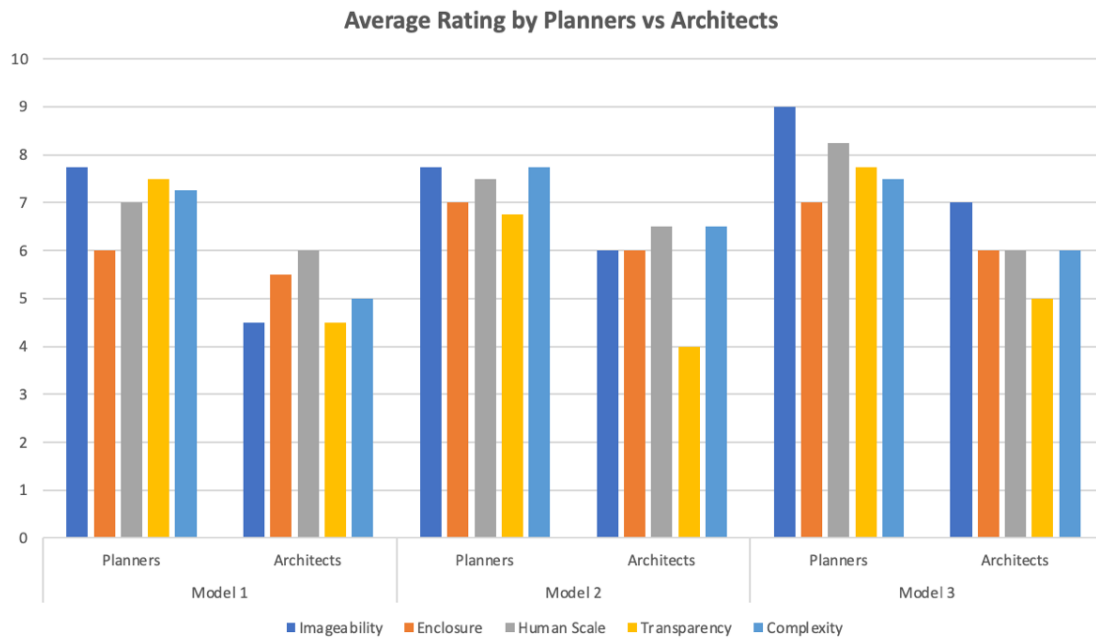
Graph 2: Average Ratings of Design Qualities: Professionals & Students

4.2.3 | Average Rating by Planners vs Architects

Table 7 and subsequently Graph 3 shows the average ratings of design qualities between the two groups of professionals, planners and architects. In total, there are four planners and two architects. On average the architects rated the design qualities lower than the planners. A t-test was conducted and determined that there is a significant difference between the two groups for the design qualities of imageability, human scale, transparency and complexity. However, enclosure was not shown to be rated significantly differently between the two groups.

	Model 1		Model 2		Model 3	
	Planners	Architects	Planners	Architects	Planners	Architects
Imageability	7.75	4.5	7.75	6	9	7
Enclosure	6	5.5	7	6	7	6
Human Scale	7	6	7.5	6.5	8.25	6
Transparency	7.5	4.5	6.75	4	7.75	5
Complexity	7.25	5	7.75	6.5	7.5	6

Table 7: Average Ratings of Design Qualities: Planners & Architects



Graph 3: Average Ratings of Design Qualities: Planners & Architects

4.2.4 | Correlations Between Design Qualities

A Pearson correlation was conducted between the independent design qualities to determine if there were any correlations between the ratings given by the participants between these design qualities. All correlations are positive and are separated into strongly (>0.5) and moderately (>0.3) correlated. The test concluded that there are strong correlations between the design qualities of imageability and transparency (0.596), imageability and complexity (0.547), complexity and transparency (0.513), and complexity and human scale (0.598). While there are moderately positive correlations between imageability and human scale (0.385), enclosure and imageability (0.301), enclosure and transparency (0.344), complexity and enclosure (0.302), human scale and imageability (0.385), and transparency and human scale (0.336).

Correlations Among Urban Design Qualities					
	Imageability	Enclosure	Human Scale	Transparency	Complexity
Imageability	1.0000				
Enclosure	0.301	1.0000			
Human Scale	0.385	0.297	1.0000		
Transparency	0.596	0.344	0.336	1.0000	
Complexity	0.547	0.302	0.598	0.513	1.0000

Table 8: Correlations Among Urban Design Qualities

4.2.4.1 | Imageability and Transparency

Based on the conversation with non-Dutch participants, the correlation between imageability and transparency could be tied to the cultural aspects of Dutch architecture and the presence of the canal in the fourth scene. In the case of imageability, participants who were not Dutch explained how such large windows on buildings are part of the Dutch architectural cultural experience. As the details in the buildings did not change, the large windows provided the participants with the perception of high transparency throughout all four models. Additionally, the presence of the canal in the fourth model increased the transparency for many participants, as this element added a vertical dimension of transparency below street level. Participants also increased their imageability scores when the canal was introduced leading to a strong cultural correlation between imageability and transparency.

4.2.4.2 | Imageability and Complexity

There is a statistical correlation between imageability and complexity, although it is not necessarily straightforward. Imageability is more subjective in this study because it not only relates to the depiction of the model as a representation of the real world such as the street layout. Also, the way the models were constructed, the program which was used, the choices in textures, tree models, and specific elements in the models such as street furniture or signs. All these elements were design choices, and design is subjective. The more elements depicted in the models such as streets, trees, textures, signs, street furniture, bicycles, bike racks, or water, the higher the complexity. However, this does not necessarily translate to higher imageability, as some participants pointed out, the complexity can distract from a place being perceived as imageable, as in - one can't imagine themselves in that space because of the sense of visual clutter. On the other hand, imageability also corresponds to understanding of what activities take place in a specific space, and the complexity of elements can help identify the function. For example, the abundance of street furniture or café furniture indicates the activity designated to that particular space is stationary and social. In this way, complexity does correlate positively to imageability.

4.2.4.3 | Complexity and Transparency

If imageability and complexity are correlated and imageability and transparency are correlated, then it is logical that complexity and transparency would also have a correlation. In this case, the less complexity that is depicted the more transparent the model was perceived by the participants. This has to do with visual sightlines unobstructed by visual clutter. One example of this is trees with low canopies and more detailed leaves obstruct the view of the streetscape in the models leading to less transparency.

5 | Discussion

This chapter discusses the results in-depth and brings together the theoretical framework, the qualitative, and the quantitative results in order to answer the research questions for which this thesis aims to answer. First, the findings are discussed in further detail with references to the present academic research, after which a discussion on how this research contributes to the growing understanding of measuring perceptual urban design, and methodologies in virtual environments. Finally, opportunities for further research will be discussed.

5.1 | Discussing on the Research Findings

5.1.1 | *Spatial Qualities Communicated Through 3D Models*

The five perceptual spatial design qualities included in this research are imageability, transparency, enclosure, complexity and human scale. These qualities were used because of previous studies on this topic, mainly Ewing & Clemente, who concluded that these qualities were the most reliably tested (Ewing & Clemente, 2013). These perceptual spatial qualities also have robust theoretical backings in urban design, and take inspiration from the fields of architecture, environmental perceptions, and behavioural studies. To reiterate, "*Perception* is the process by which we utilise external sensory information in combination with other internal conscious and unconscious workings of the brain to make sense of the world" (Barry, 2002, p.91).

Based on the visual assessment surveys, there was no indication from any of the participants that the perceptual qualities could not be deduced from the 3D models. Much like the study conducted by Gjerde (2010), the participants were able to project themselves into the scene and perceive the spatial quality. In fact, some participants voiced how their experience was improved with the ability to move around the virtual world just with a mouse, and were able to get their eye level all the way down to street view. This is an obvious advantage to other similar studies using traditional means of media such as images and videos. 3D virtual worlds and VR are not new to the field of urban design; however, using virtual environments to measure these specific design qualities has not yet been tested. Through the use of virtual environments, the perceptual design qualities have been easily linked to the physical elements within the models.

The “How” part of the research question was addressed through the methodologies used to create the 3D models and the use of ESRI’s Scene Viewer online platform. The models were created using ESRI’s CityEngine software, where accurate GIS data was sourced from Open Street Maps, this was used to create the accurate georeferenced 3D models. The data was then transferred to a popular 3D rendering software called SketchUp. Next, the realistic textures were sourced by taking screenshots of buildings using Google Street View and draping them over the 3D models. Other textures such as brick textures and tree models were sourced from open data found online. This was an effective way to create realistic 3D models of the street, which the participants were able to view in a browser on their computer. The ability to interact and move around the models increased the immersive experience adding to the ability to perceive space, and therefore spatial quality as a whole.

Preferred Physical Features

The models provided the participants with three distinct streetscapes with a variety of individual physical elements throughout. Preferred elements such as trees, textures, greenspace and blue space (the canal), were evident as the survey moved from one model to the next. The model with the canal bluescape was by far the highest rated for imageability – a preferred element of the built environment. However, taking into account the literary research conducted in *Chapter 2*, this is not a surprising revelation. Blue spaces are notably imageable, even for the Dutch participants who stated this model looks like any other street in the Netherlands. However, it was somewhat surprising that all other ratings increased overall. For example, when transparency is high, according to the correlations analysis, enclosure should be lower as well as complexity. This was not the case for the canal model. However, more analysis needs to be conducted in this area, possibly with multiple canal designs to understand this phenomenon.

Model 3 was used specifically to see how individual preferences would change if the model used unrealistic textures. Colour schemes, cartoonish textures, and whimsical unrealistic trees sparked a discussion about the urban planning process and communication. When a model is hyper-realistic with the trees and textures, it adds a perception of finality in the design and planning process. While unrealistic images and

models lead the viewer to think that the plan is not finalised and that citizens might have a say in the design process. Not only do photorealistic models and images show an air of finality in the design, but these images can also be manipulative. Highly polished images and design representations are associated with luxury and exclusivity, instead of the urban reality of everyday social and public issues (Minkjan, 2016). These images are meant to sell an ideal way of life. However, other than the architects, most of the participants stated that they preferred the photo-realistic renderings.

5.1.2 | *Participant Attributes*

Additional attributes of the participants in this study such as gender, nationality, academic background, and professional background has been shown to influence the perceptions of the spatial qualities in the 3D models. Four themes were derived from these attributes: Knowledge of urban design and the study place, perceptions, individual preferences, and culture.

Knowledge of Urban Design

The difference between the professionals in the fields of architecture and planning versus the students did not yield any conclusive results between the perceptions of design qualities, or their ability to understand design concepts. Both groups were able to articulate their understanding of urban design and voice their opinions when it came to their perceptions of the designs. It was interesting that even though the Environmental and Infrastructure Planning students did not specifically take courses on urban design, they were able to make judgements on what their perceptions of what “good design” is, and navigate the digital environments understanding the principles of urban design theory. This study loosely follows the research conducted by Ewing & Clemente, who used panels of experts in the fields of urban design and architecture. They state that by having knowledge of the field, participants would be better able to “support their subjective judgements” and their opinions would “carry weight in the field” (Ewing & Clemente, 2013, p. 25). In the study, the professionals in architecture and planning were able to explain how the design qualities held up urban design theory. For example, Participant 1 cited urban theorist Jane Jacobs. And, the other professionals explained concepts such as public and private spaces, shared space, functional space, safety, and

the importance of activities in the space. Students on the other hand may not have had as much knowledge in urban design theory. And, while they did not quote urban theory, most were able to explain their perceptions of the virtual environment and give examples in urban planning. For example, *participant 12* argued that the green space depicted in Model 2 would not be found in any Dutch city centre, where *Gedempte Zuiderdiep* Street is situated. But rather, would be found on the outskirts of the city. This observation makes it much more likely that if this survey were to be done on the general public, a short explanation of urban design qualities might be sufficient to replicate this study.

Second, the differences between the professionals who were architects and those who practised in the field of planning did show that overall, the planners were more likely to rate each design quality higher for every model shown. This might not be a surprise as the architects have spent their careers designing, creating models and renderings, and perfecting their eye for good design. They might be more critical of the models and representation of design in the use of textures and model elements chosen. This has created a divide in how architects' critique can be to this kind of project. Whereas, the planners might only be looking at the street layout or individual elements, but no necessarily the stylistic approaches such as tree models chosen or choices of textures used. This evaluation perfectly explains the difference between the fields of planning and architecture in practice, while architects focus on the presentation, planners are more concentrated on the representations of urban form.

Knowledge of the Case Study Place & Culture

While Ewing & Clemente (2013) used video footage from various cities in the United States, this study modelled just one case study employing various streetscapes. This one case study used a portion of the *Gedempte Zuiderdiep* street in the city of Groningen. All of the participants were currently living, studying, and working in Groningen, and had experience walking or cycling this street. Many of the participants were able to draw from their knowledge of the space and project their perceptions of the space onto the models, especially Model 1. Street width was especially talked about by all participants in some manner. Participants were even able to name businesses and other buildings they knew about along *Gedempte Zuiderdiep*, and they were able to compare this street to other streets in Groningen and the Netherlands.

Very little research has been conducted into cultural perceptions and cultural preferences when it comes to urban design metrics. Urban design literature often cites culture as a factor in urban design preferences, however never goes into detail about the how or why. Cultural determinants include cultural activity, cultural experiences, and cultural historical value. “Cultural activities provide people with a greater sense of purpose for using public spaces and frequenting the wider area” (Pugalis, 2009, p. 20). Cultural experiences are the collective individual experiences brought about by social norms and the history of a particular built environment. Perspectives about cultural historical value also play a role in perceptions of a specific place and built environment. For example, those who were not Dutch expressed how they find transparency much higher in the Netherlands compared to other places. This is due mostly to how large Dutch windows on buildings typically are, especially windows on the ground level of buildings. Furthermore, as *Participant 1* pointed out, the Dutch typically are not concerned about privacy and do not close window curtains, adding to the overall transparency.

5.2 | Contributions to Growing Research in Urban Design

This thesis brought to light the difficulties in classifying and quantifying perceptual preferences. Urban design, much like architecture, falls in between science and art. In the field of urban design, designers inherently know what “good” design is. It incorporates function, form, aesthetics, and a strong sense of place. Using Araabi’s (2016) topology of urban design theories, this research falls into type two, theories about the object of urban design. This thesis looked at a specific urban design problem and how urban design can be improved based on the outcomes.

Through the process of conducting focus groups, three main lessons can be implemented into urban design practice. First, when to use 3D virtual environments as a tool for urban design communication and public participation. As Forsyth argues, the problem in practice is design is used to try and solve specific problems, and not solved through research (Forsyth, 2007, p. 465). By using the methodologies in this study, research can be implemented into the planning practice. Batty (2000), refers to forward and backwards communication. Forward, refers to citizens and stakeholders, and

backwards refers to professionals in the fields of planning and design (Batty, 2000). 3D models, and visual assessment survey methodology, in practice, are more geared towards forward communication, by involving the public in the design process and understanding how the current design proposal will be perceived.

Second, what specific perceptual urban design qualities should be focused on? Design qualities and how they can be portrayed in real life, set an example for what kind of score municipalities need to achieve in their urban design processes. Through this research, it is evident that high imageability ratings set the tone for how the model would be rated overall. High imageability scores (>6) indicated overall spatial quality. Imageability was also shown to be strongly correlated to transparency and complexity. However, a high complexity score and low imageability would indicate overstimulation. Steg & Groot (2019), explains complexity as an ‘inverted U-shape,’ where buildings with an intermediate level of complexity tend to be favoured over those with the most and least complexity” (Steg & Groot, 2019, p. 89). This was re-affirmed through the qualitative analysis in this thesis about streetscapes as a whole. Medium complexity also increases transparency in 3D models, without the obstruction of people, cars, and other elements. Transparency should be recorded highly as this design quality directly influences the safety of a street. More visual sightlines and windows increase the ‘eyes on the street’ phenomenon coined by Jane Jacobs. Therefore, municipalities should aim for high scores in transparency. Scores for human scale should also aim to be high, however, this was not proven to be as important of a spatial quality as imageability, complexity or transparency. However, the overall scale does affect the sense of comfortability of a space, as the width of a street in respect to the height of buildings creates a better sense of enclosure. Enclosure, and human scale, may provide a perceptual sense of comfort in a space and, therefore, should be rated fairly high.

Lastly, this thesis incorporated the Dutch experience using canal revitalisation as a catalyst for understanding perceptual urban design quality. Through the visual assessment survey, it is evident that the re-introduction of the *Gedempte Zuiderdiep* canal would increase the overall sense of place and imageability. Furthermore, introducing canals into urban environments helps to reduce the heat island effect, which is only being exacerbated by climate change. The perceptual qualities of hot/cold are important to the comfort felt by urban residents. This comfortability also leads to an increase in activities

both static and dynamic. Sitting at the edge of a canal and socialising, or running, cycling, as well as water-based activities, leads to increased livability within cities. This trend of canal revitalisation in the Netherlands is a testament to the positive direction municipalities are moving in to incorporate spatial quality into their planning and design practices. The optimal design of these spaces, to ensure high levels of spatial quality, can be reliably tested before implementation, using visual assessment surveys. And 3D virtual environments take the immersive experience one step closer to VR without the added cost.

6 | Limitations and Future Research Opportunities

This thesis delved extensively into the somewhat ambiguous realm of urban design theory, and perceptual urban design qualities. However, there lies an opportunity for the re-evaluation of urban design as both a subject of research and a practical field, considering its current challenges. Primarily, a notable disparity exists between urban design theory and its practical implementation, a gap consistently acknowledged by practitioners (Araabi, 2018; Forsyth, 2007). Empirical and observational reasoning can only take urban designers so far, and at the end of the day urban designers must follow the controlled policy implementations outlined by urban planners and strict budgets set out for projects. This gap serves as a compelling reason to explore urban design through more comprehensive studies. This last chapter aims to acknowledge the limitations of this research and provide avenues for additional research opportunities.

6.1 | Sample Size and participants

The first major limitation of this research is the sample size of participants. As stated in *Chapter 3*, the sample size used for this study was a total of twelve participants. This limited sample size was due to the COVID-19 restrictions at the time of conducting focus groups. Typically for student research, it is difficult to amass large sample sizes without a team of researchers. Although there are no definite guidelines for how big a sample should be for any particular study, sample sizes should be over-exaggerated in order to be confident that the results accurately reflect the wider population (Mustafa, 2023; Lindsay, 2006). Therefore, the quantitative results of this research cannot be generalised to a wider population.

In future studies, broadening the participant pool by including participants who are lay people, as well as architects, urban designers, and planners (or planning students), could create a wider variety of opinions and perceptions about the built environment. While the insight from the experts was instrumental in the qualitative results of this study, it may have been self-fulfilling in nature, as urban planners and designers can rely on urban design theory to justify their perceptions, rather than their perceptions upholding, or disproving, urban design theory. Additionally, it would be interesting to expand upon the cultural significance of how participants perceive urban design qualities

and the built environment. However, the majority of the participants were Dutch, and the Dutch perspective heavily outweighed those from different cultural backgrounds. Though the comments made by those who were not Dutch, were incredibly insightful, especially when commenting on imageability and transparency, the case study chosen is a well-known street in Groningen, which all participants had first-hand knowledge of. This may have affected the way participants perceived the virtual environment, as participants made multiple comparisons to the case study site. Therefore, using a larger sample size with a wider variety of participants from various backgrounds, either cultural or those who are lay-people to the topic of urban design, would be advantageous to measuring urban design perceptions using the methodologies in this research.

6.2 | 3D modelling

Second, in the study conducted by Ewing & Clemente (2013), participants were exposed to 16 video clips showcasing diverse streets from various cities. In contrast, this study presented participants with four 3D models. This is not enough models, especially since the models depict only one specific case study site. Furthermore, the differences between models were not enough in terms of modelling elements such as trees, street furniture, tables, garbage bins, bikes, bike racks, and street signage. Additionally, finding the textures and individual elements is a matter of personal preference, which influences other perceptions of the design itself. And, while these elements were moved around between the models as the streetscape changed, there was not enough variation in the elements used. For example, a model completely devoid of elements and trees would have sparked interesting discussions. Therefore, in future studies following these methodologies, the recommendation would be to create multiple models of various streetscapes, in different locations around the world, or possibly models which do not correspond to a particular place, in order to create a variety of conditions and physical elements that can be tested. To combat bias, create a library of individually modeled elements which can be chosen at random to integrate into the models, this would reduce the impulse to only select elements which are pleasing to the model-maker.

However, having photorealistic renderings in a 3D environment sounds like the optimal format for expressing creativity and design. In reality, models in this context take an incredible amount of time to construct. First, creating spatial data such as streets and buildings, as well as their attributes such as building heights and street widths and

mapping these elements using GIS software is time-consuming. Moreover, virtual environments are contingent on computational resources, including graphics cards for optimal frame rates and visual clarity, rendering times that rely on computer processing power, and, given that these models were accessed via a web browser, internet speed posed a challenge for some participants. Luckily, with the current trajectory in VR and rendering technology, this will only get better and cheaper with time.

6.2 | Virtual Reality Opportunities

Finally, further research on this topic is an exciting prospect, fully immersive VR and AR, are the logical progression in measuring perceptions of urban environments. Testing perceptual urban design goes beyond the visual sensitivities, perception also includes smell, touch, and auditory senses. For example, by using 3D virtual environments the participants noted the lack of additional sensory elements – noise, traffic, and people. Thus, fully immersive VR, while costly, would immensely benefit the fields of urban design, planning, and behavioural studies. Furthermore, VR is not limited to static images; animations, auditory soundscapes, and haptic implementations, are all within the realm of possibilities, and should be explored further.

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9 | Appendices

Appendix I - Literature Table

Typology	Author	Origin	Titles	Explanation
Imageability	Kevin Lynch	American	"The Image of the City" (1960)	Mental image (mental mapping and cognitive legibility) City legibility (understanding, experience and enjoyment), Imageability (quality of the physical city and evoking a strong image).
Urban Form	Kevin Lynch	American	"A Theory of Good city Form" (1984)	Interrelation of human purpose and city form. Normative theory (vital, sensible, well-fitted, accessible, and well controlled).
Urban Sphere	Jane Jacobs	American	"The Death and Life of Great American Cities" (1961)	A response to post-war American urban renewal and failures of Modernist planning Livable cities originate from close observation of city life Inductive and empirical reasoning (ordinary people relying on their observations)
Visual Aesthetics	Gordon Cullen	British	"Townscape" (1961)	Visual art of the arrangement of buildings, roads, trees, nature, and urban environment that decorate space. Townscape supports the functions of human activity. Serial vision (visual images captured), place (emotions captured at a specific place and time), content (colour, texture, scale, style, character, personality, and uniqueness), and the function tradition (quality in of elements in the physical space) Visual stimulation, emotional levels of response by observer
Urban Sphere	Jan Gehl	Danish	"Life Between Buildings: Using Public Space" (1987)	Optimal and social activities – both moving and stationary activities Physical properties of human senses (smell, hearing, sight) such as building heights, orientation of entrances, multifunction areas and active frontages, density, modes of transportation, accessibility and visibility. Gehl's theories are based on systematic and empirical observations
Urban Sphere			"Cities for People" (2010)	Sustainability, shared spaces, mixed use, sense of security, usability, and levels of pedestrian comfort. Public spaces should be urban meeting places, places for social cohesion and interaction. Based on systematic and empirical observations

Appendix II - Visual Assessment Surveys

Focus Group 1:

Participant 1				Date: 21-10-2020	
Model #	Imageability	Enclosure	Human Scale	Transparency	Complexity
<i>Model 1</i>	4	7	7	7	7
<i>Model 2</i>	7	6	7	5	8
<i>Model 3</i>	8	8	7	6	8
<i>Model 4</i>					

Participant 2				Date: 21-10-2020	
Model #	Imageability	Enclosure	Human Scale	Transparency	Complexity
<i>Model 1</i>	7	5	7	7	5
<i>Model 2</i>	8	5	8	7	6
<i>Model 3</i>	8	7	8	7	7
<i>Model 4</i>					

Participant 3				Date: 21-10-2020	
Model #	Imageability	Enclosure	Human Scale	Transparency	Complexity
<i>Model 1</i>	8	5	8	8	8
<i>Model 2</i>	8	7	8	6	8
<i>Model 3</i>	9	6	8	7	8
<i>Model 4</i>					

Focus Group 2:

Participant 4				Date: Date: 22-10-2020	
Model #	Imageability	Enclosure	Human Scale	Transparency	Complexity
<i>Model 1</i>	8	7	7	9	8
<i>Model 2</i>	9	8	7	9	8
<i>Model 3</i>	10	7	9	10	8
<i>Model 4</i>	10	7	8	9	8

Participant 5				Date: 22-10-2020	
Model #	Imageability	Enclosure	Human Scale	Transparency	Complexity
<i>Model 1</i>	8	7	6	6	8
<i>Model 2</i>	6	8	7	5	9
<i>Model 3</i>	9	8	8	7	7
<i>Model 4</i>	8	6	7	6	8

Participant 6				Date: Date: 22-10-2020	
Model #	Imageability	Enclosure	Human Scale	Transparency	Complexity
<i>Model 1</i>	5	4	5	2	3
<i>Model 2</i>	5	6	6	3	5
<i>Model 3</i>	6	4	5	4	4
<i>Model 4</i>	5	5	4	3	4

Focus Group 3:

Participant 7				Date: 23-10-2020	
Model #	Imageability	Enclosure	Human Scale	Transparency	Complexity
<i>Model 1</i>	8	6	3	8	6
<i>Model 2</i>	4	7	6	7	5
<i>Model 3</i>	7	8	7	6	4
<i>Model 4</i>	7	8	5	6	4

Participant 8				Date: 23-10-2020	
Model #	Imageability	Enclosure	Human Scale	Transparency	Complexity
<i>Model 1</i>	9	6	6	7	8
<i>Model 2</i>	7	4	5	7	7
<i>Model 3</i>	8	7	7	7	8
<i>Model 4</i>	9	7	7	7	7

Participant 9				Date: 23-10-2020	
Model #	Imageability	Enclosure	Human Scale	Transparency	Complexity
<i>Model 1</i>	7	5	5	4	6
<i>Model 2</i>	5	4	5	5	6
<i>Model 3</i>	7	7	5	5	4
<i>Model 4</i>	7	8	3	8	3

Focus Group 4:

Participant 10				Date: 22-10-2020	
Model #	Imageability	Enclosure	Human Scale	Transparency	Complexity
<i>Model 1</i>	7	6	6	8	8
<i>Model 2</i>	7	6	5	8	7
<i>Model 3</i>	8	8	7	8	9
<i>Model 4</i>	9	7	6	8	8

Participant 11				Date: 22-10-2020	
Model #	Imageability	Enclosure	Human Scale	Transparency	Complexity
<i>Model 1</i>	6	8	8	8	7
<i>Model 2</i>	8	6	6	8	8
<i>Model 3</i>	8	8	6	7	8
<i>Model 4</i>	9	8	6	7	7

Participant 12				Date: 22-10-2020	
Model #	Imageability	Enclosure	Human Scale	Transparency	Complexity
<i>Model 1</i>	8	7	7	9	8
<i>Model 2</i>	9	5	5	9	6
<i>Model 3</i>	9	8	7	6	8
<i>Model 4</i>	8	6	8	8	7

Appendix III - Code Tables

Participant 1

Theme	Sub Coding	Example
Imageability	<ul style="list-style-type: none"> - Cultural perceptions - Relational Information - Context - Trees as landmarks - Water feature - Recognisable - Distinct 	<ul style="list-style-type: none"> - This might be linked to my cultural background because I'm not Dutch, so for me in this scene it looks very similar in other parts of Zuiderdiep. - I though oh ya if I would have had this relational information to the shopping street then I would have a very high recognisable and memorable thing - The trees make it more distinguished; you know you can distinguish better. I think the trees are acting a bit like landmarks. - the water feature, you know it's more distinct so it's more memorable/recognisable for me - Beautiful decorative bridges as landmarks
Enclosure	<ul style="list-style-type: none"> - Well defined - Façades - Trees - Guiding structures - Bus stops - Sidewalks - Materiality - Continuous facades - Cultural perceptions of width and enclosure - Vista - Public/private space - Distinct boundaries 	<ul style="list-style-type: none"> - Because I think it's very well defined relatively speaking. - You have the façades, you have the trees as guiding structures, even the street, the bus stops, the sidewalks. So you have a lot of materiality that is also guiding, so it's visually very well defined - Also with this closure of the façades, you know there are no holes, there are not a lot of jumps in the facades. You have this very pure almost directionality in a way so that's why my enclosure is high - It's really interesting because culturally for me well yes it's a wide street but it's not a super wide street. - I think it's also really important to put in your work that you have this cultural difference in the perception - The trees are also blocking the vista, so you have more enclosure in terms of vista and more plumaged - On the other hand when you have this stationary activity and you can sit and you have all these benches next to the tree you see and be more scene. - But when we talk really about public and private space and vista then it blocks a little bit - It has more district boundaries
Transparency	<ul style="list-style-type: none"> - Look inside buildings - Cultural perceptions of privacy - Arrangement of Trees - Canal - Stationary activities - Public space - Seen and be seen - Safety - Jane Jacobs - Seating - Cafes - Vistas go up - Intervisibility 	<ul style="list-style-type: none"> - I think in general Zuiderdiep is very transparent. You have the cafes, you can look inside even the Albert Hein. So I think it's really very high in transparency. - in Vienna nobody would sit without curtains and let people look into your privacy - I think because of the arrangement of the trees actually this transparency goes down. - more transparent because of the water feature. When you stand on one side of the canal you can look to the other side. But honestly I don't really have a rational explanation. Here it's more intuitive I have to be very honest. It's just like imagine me in that space, would I feel it's a higher transparency? - I feel like with the water feature you get more functional public space and more stationary activity. People always like to sit around water features, they attract a lot of the stationary functions. - it's more transparent in the sense of see and be seen. Because it's about active walls, and then we had the discussion about public and private space. So for me the quality of the public space goes up in terms of stationary activity - urban seating and little cafes having that outdoor seating around water features. It's very attractive for stationary activity. And then when we put it in context with the idea of Jane Jacobs, eyes on the street and safety

Human Scale	<ul style="list-style-type: none"> - Width - Textures - Facades - Ornaments on buildings - Human body in relation - Details - Trees - Buildings 	<ul style="list-style-type: none"> - I think yes it's a wide street, but still with all that you just mentioned, the textures, the kind of different scales, the facades, all the detail sometimes you have these ornaments (on buildings) - The scale related very much to the human scale and the body, how you perceive your body in relation to that, so for me that's actually quite high because of all the details and different scales imbedded. And of course the facades are very important here for me. - They were lines up and for me it did not change a lot. It's the same like in the previous model just in different locations. And you can sit down but we had a lot of urban furniture in the previous model as well and trees so it's just relocation of urban furniture and vegetation. - the element of the water does not change for me how you refer to the built environment because from the beginning you have this very detailed façade, the trees, the urban furniture, which I think are already very important for reference for your body-ness and how you perceive yourself in the built environment. So the water does not fundamentally change it for me compared to the previous model - The important elements here are the buildings and the facades and the street texture. I think the facades are the dominant element for the human scale including of course the textures of the street.
Complexity	<ul style="list-style-type: none"> - Dutch architecture - Facades - Physical elements - Trees - Vegetation - Bus stops - Chairs - Outside seating - Proportions - Width of street loses some complexity - Local knowledge of the place 	<ul style="list-style-type: none"> - it's visually very rich, because of the Dutch architecture, the facades etc, and all the physical elements, the trees, the bus stops, the chairs, the outside seating etc. - On the other hand because of the former Zuiderdiep canal and the width of the street I think it also loses a bit of this visual richness because of the proportions. You know, if this would be a very narrow street, it even would appear and even be perceived with higher visual richness for me. In terms of how it was defined as complexity. - Because the vegetation and the way you arranged it looks more complex, it's less ordered. Before it was lined up, and now you put them all over the place which for me also increase visually when you walk or sit there or walk through that space. The way you perceive it's complexity, it's kind of relational between the vegetation and the built up space, the facades and everything - For me the water feature adds and does not add for me complexity somehow. I mean if I know that is has the brick walls, the bridges and all this more detailed features it stays for me the same.

Participant 2

Theme	Sub Coding	Example
Imageability	<ul style="list-style-type: none"> - Facades - Sizes - Structures - Distinctive - Ratio height of houses and street width are distinct - Specific vegetation - Street elements - Bus stops - Typical to Groningen - Textures of roads and sidewalks - Imageability as a comparison 	<ul style="list-style-type: none"> - The façades, walls, the buildings that you can see there are very different. Different sizes, all kinds of different structures that are distinctive. And also the size of the street in relation to the houses is also kind of typical, you don't see that everywhere in Groningen. - There you have a specific ratio between height of houses and the width of the street. And of course you see also benches or tables outside you see bus stops, you see specific vegetation. So these are all elements that in some streets you don't have that which makes it also typical. It's also typical to Groningen of course the texture of the roads and the sidewalks - if you compare Groningen to other locations, cities or villages. So that makes it also more imageable. So it also depends how you relate imageability to other parts of the street, other parts of the city, or to other parts of the country. So that also helps to explain those values.

	<ul style="list-style-type: none"> - Benches - Trees 	<ul style="list-style-type: none"> - Having a place where you can stay as well, that's what it's meant for, the benches, and the trees makes it higher imageability than the previous model.
Enclosure	<ul style="list-style-type: none"> - Width of the street - Space - Sight - Tree line - Spacious - Park is enclosed - Depends where you are staying in the model - Height of buildings - Define space - Subdivisions 	<ul style="list-style-type: none"> - So I compare it with other streets in Groningen, and this is very wide and quite a huge space. And you were saying, is it correct what I did because there is a lot of space. So you go from one wall to the other wall and there are a lot of things to see. Although there are tree lines in there. And the buildings are not that high. Well it is all relative. But I know about this street and how I perceived it and it is very spacious, so there is not so much enclosure to my view. - The trees are now in a different location but it really depends on where and how you navigate through this model to see if it's more enclosed or less enclosed. The park is more enclosed, and I think that parts where you would stay stationary. But it depends and that is why I would keep it the same. - for enclosure I would say that is the major measurement is the size of the building. And the second in the hierarchy, the second would be the trees and they have an effect of course but because they are still trees they depend on the way they are. - I recognise the brick small walls around the canal, they really help to define the spaces which is strengthened with the treeline and also the different functions going with those subdivisions. They also somehow have a different perception of enclosure in my view, and this model really helps to visualise that.
Transparency	<ul style="list-style-type: none"> - Textures used in the model - Outside reference - Changing perspectives less transparency because the trees are not linear 	<ul style="list-style-type: none"> - I think here it might also affect that there are pictures, the model makes it not so transparent in some ways. So if I just look at the model it might even be lower because I know this place I can kind of fill in what it should be so then it's very recognisable what is a shop or what is a café etc. But in this model, by having pictures that are not very crisp it becomes a façade that is more anonymous. So but it helps that you also model some of those tables and chairs outside, that helps I think. But it is still a transparent environment I would say. - visibility goes up at each point of view right. If you are on the street you have bigger vistas. But with the previous model you would have different types of vistas because the trees are arranged in different ways. So you would have a variation of vistas there would be in some ways more dynamic I would say. And that translates into less transparency because it's a kind of changing perspective all the time. Then you could say it is increasing transparency in this model.
Human Scale	<ul style="list-style-type: none"> - Proportions - Details - Texture - Elements - Chairs - Benches - Bus stop - Bikes - Windows - Doors - Activities - Tables - Seats - Separation of spaces - Roads - Sidewalks - Park - Distinct Subspaces 	<ul style="list-style-type: none"> - I think there's quite a human scale if you look at proportions, if you look at details and texture. What you could add to models is a human to know about the scale here. That could make a difference, but the nice thing is that here there are many elements that are so much related to humans, so if you have chairs and benches and you have a bus stop you know the sizes of these things as well. And you have a lot of windows and doors, so that makes it easy to kind of see what the human scale is and also how it relates to the space in a general sense. So I think that's kind of an indicator that the human scale deserves a high rank. So if you are in a space where you say "I need a human" to know if it's human scale then you know that the human scale is not very high ranked. - There are more benches, there is more space for humans to do an activity, there are more tables and seats, there is a garbage thing, which is also kind of a human thing – you know how big these are. And just the separation of the spaces and the roads, the sidewalks and the park, they make distinct subspaces. Which I would say increased the human scale. - There are a few more bikes

<p>Complexity</p>	<ul style="list-style-type: none"> - Repetitive textures make it not complex - No humans - Features add complexity - Water moving in real life would add complexity - Different materials - Types of trees 	<ul style="list-style-type: none"> - If I go to the perception of street level and if I would walk here and I see the scene of some trees. But there is quite a big empty space with some tiny elements. And I think about what I normally would rate something high complexity, there would be much more going on. I think also the façade is kind of one kind of line. Although you modelled some stairs and some little elements there which make it a little bit different - The textures that are in the models are not pictures, so the bricks are not very complex because it is the same everywhere. Here I felt that through the model I rate the complexity low, while I would normally be on the street – and with humans, there are no humans here. And then when you have a lot of different things going on it would make the complexity much higher. So I think the place as it is high complexity where as the model I would say five. - Feature adds to the complexity. Also knowing that water is moving all the time, of course in the model it's not. But I can invasion the movement as well, so it's really a different material added to the scene and also the walls as well but the water especially, I thought it would be going up. - I think with having those models especially with imageability and complexity they are really changing because of the type of model you choose, or the elements or the detail, they make it really unique and add a unique element and very often with modeling you use things for example the trees, you don't know what type of tree it is. And having those kinds of things really increase those values I would say. In modeling it is very difficult to present that in a way that is the real stuff. So if you would go to a place, and we would walk there, there is so much going on, of course with all the senses and water flowing etc. that really increases imageability and complexity.
	<ul style="list-style-type: none"> - Perspective - Pedestrian vs automobile perspective - Separation of perceptions of the model and real street 	<ul style="list-style-type: none"> - You might not use the middle of the street. Now I refer to you taking pictures in respect to having this model, they both have advantages and disadvantages. An advantage is that you can look from different perspectives that you would normally not use. For example we don't drive busses or drive taxis so we don't perceive this from that angle from that street. And the same with when you come to enclosure, human scale or complexity, well now we can look from a birds eye perspective, well that can give you all kinds of information that you would normally not perceive. So it would change my grades for maybe human scale or for complexity or legibility so, now we have the advantage so we can do everything as we have been a pedestrian, driving a bus or flying around and that makes our perception and how we value things different as well. - The context you see now that it is a small snippet. What you normally do is you have all these layers when you perceive an environment that are very useful. So another thing is what you normally would do, especially with the next one enclosure, you would look at how much sky would I see? Well it depends a bit how your mouse is to find the sky. So it has advantages and disadvantages. - Ya but if you want to measure just the model that would be easier to pick a place we all don't know. Here it is very difficult to separate our perceptions.

Participant 3

Theme	Sub Coding	Example
Imageability	<ul style="list-style-type: none"> - Building Style - Landmarks 	<ul style="list-style-type: none"> - And the entire Zuiderdiep zone, which is none of your business here, but there are only, I think, two major landmarks. That is the main building of the planning department which is an expressionist building,

	<ul style="list-style-type: none"> - Street as the shape of a canal - Human scale 	<ul style="list-style-type: none"> - and then the art academy, which more or less closes it off. But It is recognisable and I think it deserves an eight. - It looks like a rendering by a municipal planning office. It makes sense too because it has trees, it has a park but it also has the shape of what used to be a canal. Because it's a bit lower than the streets surrounding it. - You can imagine if you work for the municipality and you have a plan and you have to sell the plan you can almost right a text to refer us to the original canal and the human scale... And that in a sense, which sounds a bit stupid, brings us to a high level of imageability.
Enclosure	<ul style="list-style-type: none"> - Width - Direction - Canal - Straight lines - Trees 	<ul style="list-style-type: none"> - Like all filled in canals it is too wide. And like all filled in canals it has a very strong direction. Because these canals, they don't meander a lot, they are just straight lines. And this is a straight boulevard that just follows the shape of the city model. So the enclosure is not very high. Which is not a big problem - also based on the knowledge of this place, the street is slightly bent, not much but a bit. If you include trees in the middle it automatically becomes a bit more enclosed. And trees themselves will help to minimise the effect of this thing (street) being very wide, relatively speaking. So in my view it increases the level of enclosure. Adding trees to it. - now we add a linear motive in this street I decided to make it a six. But it is a difficult thing, because if you are not actually swimming in this canal but walking along wide the shops, then enclosure actually increases.
Transparency	<ul style="list-style-type: none"> - open ended - view to exits blocked - linier elements - when exposure is high transparency is low 	<ul style="list-style-type: none"> - it's an open ended thing because it's blocked on one end but on the other end it's open. And it's characteristic for this type of urban phenomenon – the filled in canal - The views to the exits, the main exits which are in line with the street get blocked a bit. Also because the street is slightly bent. Which you cannot see in the model. - The addition of this more linier element. And I think there is well- if enclosure goes up then transparency goes down and vice versa in my chart. I'm not sure if this is true for everybody. There is a correlation between the two in my brain.
Human Scale	<ul style="list-style-type: none"> - Scale - Architecture quality - Brick textures - Heights of buildings - Functions of buildings - Canal - Proportions - Furniture - But too much furniture doesn't make sense 	<ul style="list-style-type: none"> - If you replace the black stripe with water as it used to be then the scale all of a sudden is totally right. - largely based on the quality of the architecture which is quite interesting and quite ok. On the entire Zuiderdiep there is only one building that is clearly out of scale that is the cinema. Also this H&M this is also out of scale, but since it is brick, and since it have these different facades in one building you hardly notice. It is a very well designed thing. And the entire street I think derives its quality largely to, especially this little corner, to the quality of the architecture, which is in my view totally geared to what the human scale makes pleasant. - Different architectures, different heights, different styles, different functions, different everything which makes in my view an eight. But that is based on knowing where it is - That this (canal) helps to make it more imageable. You also see that the proportions of this thing are all of a sudden ok again. Right? This is a perfect street. - the furniture of course gives you an impression of what human scale is like as a reference point, but if in real life you fill all the streets with millions of benches and couches and whatever well it doesn't make much sense.

Complexity	<ul style="list-style-type: none"> - Architecture - Bridges should be more complex 	<ul style="list-style-type: none"> - The quality of the bridges or the architecture of the bridges might have had a positive effect or at least make things more complex - I think it's almost impossible to model bridges. The most modern bridges that we have now are much more complex and artistic and exuberant even than these historical bridges. They are just a heap of brick. But now these architect they try all kinds of tricks in their bridges
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Participant 4

Theme	Sub Coding	Example
Imageability	<ul style="list-style-type: none"> - Large buildings - Distinct buildings - Trees enclosing the space - canal 	<ul style="list-style-type: none"> - The buildings are quite large, but I think the proportions of the width of the buildings and the elevation looks different for me on one side. And both sides have different buildings, and the skyline is different somehow. So that would make it imageable to me and there are some details of the buildings that make them distinct from one another. - This recession in the building makes it more imageable compared to the previous one. And also maybe these trees enclosing the space make it more imageable compared to other places. - Because of the canal which makes it a distinct element
Enclosure	<ul style="list-style-type: none"> - Trees 	<ul style="list-style-type: none"> - These trees which are somehow closing the street. - The trees in the previous one gave it more enclosure. Here it would be the same as the first one just a canal instead of the road.
Transparency	<ul style="list-style-type: none"> - Windows - Cultural perspective - High trees - No cars 	<ul style="list-style-type: none"> - Because I saw windows and for me all the streets in the Netherlands are really high in transparency compared to other countries or cities in the world so i rated it high compared to other places that i have visited. - These high trees and also the canal in the middle makes it like there are no cars here which people can see through the canal and to the other side of the street.
Human Scale	<ul style="list-style-type: none"> - Trees - Division of the width of the road - Canal - No cars - Road makes it less human scale - Bikes and pedestrians are more human scale 	<ul style="list-style-type: none"> - The trees and you have tried to divide the width of the street somehow so this makes it a little bit more human scale. Although the width of the street itself or like the total width is very high and maybe and the proportion is maybe not that much to human scale. But i thought that the trees and the division between the spaces compensates for it somehow. - The canal and there are no cars in this street just bike paths which makes it more human scale. - I thought this canal was more imageable compared to the previous ones and I though this road would influence human scale, but I guess not imageability. - Road that makes it less human scale compared to the last one where we just had pedestrian paths and cycling paths.
Complexity	<ul style="list-style-type: none"> - Facades 	<ul style="list-style-type: none"> - The complexity has something to do with the imageability and the differences between the proportions of the buildings and the skylines so ya it's all about the facades of the buildings that make it complex. - The canal is different which makes it more imageable, and also more transparent but not more complex.

Participant 5:

Theme	Sub Coding	Example
Imageability	<ul style="list-style-type: none"> - Facades - Trees 	<ul style="list-style-type: none"> - The same with the facades added with these trees, and it was also that i started considering that in case you might remove the road for a canal,

	<ul style="list-style-type: none"> - Canal - Linier pattern makes it recognisable - Main focus of the design 	<p>you have the very same kind of picture that is high quality - it would be very comparable if you have the difference here if you have a road that is a canal and I feel that I would recognize this place immediately, so that would make it reasonably high.</p> <ul style="list-style-type: none"> - The street and the linear pattern in the previous one was highlighted with the trees, and the buildings are reasonably the same. And now you miss that linear pattern and now in the middle, it feels like it could be anywhere in the world. - The canal that makes sit very recognizable. Then it is almost like picture one on the left side. And we only missed the boat, if you had that I would get to a 10. - It is now not only a canal, but it is also a street, it is on one side an open space area. So I'm trying to think what is the main focus of this design.
Enclosure	<ul style="list-style-type: none"> - Too broad - Proportions - Tall buildings help with the wide street - High trees more proportional 	<ul style="list-style-type: none"> - You might say it overall in terms of proportionality it's a bit too broad, however, the tall building a the left side down correlate with the wide space I see and also I feel that the trees do help to being the proportionality back and not to make it too big so I do consider it six-ish 7-ish to some degree sufficient something like that. - The proportionality of the trees is better - The bit higher trees further away from the facade makes it much more regular and so I consider the enclosure as high as the previous one. The height of the trees is a bit more centered in the picture makes it more proportional in a vertical manner. - The proportionality of the trees was less than the previous one. Where on one side you have a walking path and the road the trees don't fit over there. So I guess it would be better to have smaller trees over there. Or higher trees on the other side.
Transparency	<ul style="list-style-type: none"> - Windows - Direction - Corners - Trees - Safety - Canal as a barrier 	<ul style="list-style-type: none"> - The direction of the main road the transparency isn't too bad, there you have lots of windows, although you cannot really look into them so not fully transparent. In the other direction, you would not know what would be around the corner. On the right side, there is that big building and if you go in that direction you have no idea what might be there. And I would consider that low transparency. You can't see what's next to that corner. If you could look through those windows it would be better, but I can't. - I would consider the transparency already high, but now it's a bit lower as if you take one road and you want to see the other one now the trees are blocking. And with the cross road i can't see anything across the corner. So it's a lower transparency. But here it's really the trees in the middle blocking the view from one side to the other looking at it from street level. - I considered the transparency higher, from a five to a seven now because of these trees now it is more possible to see and it makes you feel safer. And you have a canal between you and the person on the other side of the canal. In this case, it might improve the social safety. The canal is a barrier and that's good.
Human Scale	<ul style="list-style-type: none"> - Width - Trees - Textures - Vegetation - Canal 	<ul style="list-style-type: none"> - This road in the middle is really attracting everything in your eye. And it's a bit too big and i would not consider it fitting in that human scale. But the trees and the street small road in between - the one that crosses the road makes it a bit more lovely to be there, and the various pavement textures you can see does contribute to some degree to what I would consider not inhuman scale. But it's not something where I would say there is no improvement possible. - It feels that the - by separating that road the differences in pavement is much more reasonable than the big black area in the middle. This pavement texture and vegetation - the height of the trees is better so that makes it a bit more human.

		- The canal makes it more human scale and the height of the trees.
Complexity	<ul style="list-style-type: none"> - Colours - Heights - Ornaments - Variation - Visual richness - Imageable 	<ul style="list-style-type: none"> - There is quite some visual richness. And the buildings are separated with multiple colours, and multiple heights - There are some ornaments over here and nice variation and complexity - The repetitive pattern is much better, therefore adding to the complexity I would argue. - I would say the visual richness is much more simple now, it's less rich but therefore more imageable and transparent but complexity goes down - The last one was higher the one road makes it less complicated.

Participant 6

Theme	Sub Coding	Example
Imageability	<ul style="list-style-type: none"> - Proportions - Material - Textures - Awkward - Details - Traffic – lack of - People – lack of - Colour scheme - Water - Diversity of elements - Human scale 	<ul style="list-style-type: none"> - I think it's proportions are right and the material is quite nicely visualized as well, on the different parts of the model. I still think it's something which i would not think of after this session. So I wouldn't really remember it. It's not something which is striking or exceptionally beautiful, it's still a bit awkward also although there are little details in there which make it something you can imagine. There's no traffic on the streets, for example, there are no people etcetera. - For me it also has to do with the colour scheme. The water makes a difference, but also the green colour and the trees are different - The diversity of the elements that you put in the model is less. So a bit similar to human scale. The one thing I'm not sure about is the size of the leaves. Which actually makes it more imageable and stands out from the other ones. So you can recognize the trees as trees but it's not really real. But that doesn't have anything to do with complexity I was just thinking back to imageability and how this one stands out.
Enclosure	<ul style="list-style-type: none"> - Cut-out model - Surroundings - Floating - Trees, height, colour, diameter 	<ul style="list-style-type: none"> - Because I had trouble because it is a cut-out model. It is hard to know the real situation. Because it is just a part of the street, and i'm not seeing the surroundings. - It's also floating in the sky, there is no other kind of suggestion that there is something else. - The trees really add to the definition of the space. - The colour of the trees really makes a dark feel to it and that makes it a little bit more defined but also - well it has something to do with the colour scheme for me, I don't know what. - Could be but the trees are just older. Like, it's like this is a situation that is older and where the trees were there for a while. Which makes the previous scenes more of a representation of designs that were just implemented more recently. That's how i interpret the difference in height in trees. - This model compared to the last one you had i think that the trees are making a difference here as well. Because they are not as high and the trunks are smaller and the first leaves are almost on eye level. And with the previous one the trunks were much higher before the branches start.
Transparency	<ul style="list-style-type: none"> - Windows - Colours and facades - Dark textures 	<ul style="list-style-type: none"> - I can see some things shimmering through because you used pictures of buildings but I can't really see in the shops so it really adds to that static picture. I don't know how you would change that but it really has to do with the model situation itself. - It also has to do with the colouring because the facades are quite dark and if you would have sort of made the windows at least on the ground level, if you had made them a little bit lighter maybe that would give the idea of transparency and be able to look in I think. That would be a lot

		<p>of work but I think that would help to give this suggestion of transparency.</p> <ul style="list-style-type: none"> - Because you have the trees in the middle and you can look underneath it you have more transparency in the model itself.
Human Scale	<ul style="list-style-type: none"> - Lack of people - Lack of units in the model - Details - Eye-level view - Diversity of elements 	<ul style="list-style-type: none"> - I can imagine at what scale I would walk through I tried to be at eye level with the model, but I don't see any people - The lack of units in the model itself. - There are more details in there in which you can relate the human size and because there are more elements in there, in the model itself, I think it's more imaginable to put yourself in there. Especially if you take an eye-level view. - The different kind of layout, and a little less diversity in the elements that you can relate to as a human. less diversity, bike racks things like that. That you had in the other model.
Complexity	<ul style="list-style-type: none"> - Facades - No traffic, humans, mobility - Elements - Detail 	<ul style="list-style-type: none"> - I think using the photos of the facades really also helped to suggest the real world, it still is a very simple model you can oversee in one look of how it's organized. And it also has a lot to do with that there is no traffic or humans, no mobility in the street. Because I think movement adds to the complexity if there are a lot of people. So to me, it's very - well as a model it is quite well done I think so. But still, I think it's a model and doesn't really add to the complexity that you have in life. So that is also looking at it as a model representing a slight section of Groningen. - There are much more elements that adds to the complexity, so it makes the absence of traffic and humans less outstanding. - The model is less detailed and complex it's even more imaginable to be able to envision people on the streets. So it's easier to add the complexity that you had in real-life situations into the model in your mind. - It's more detailed but again the trees are blocking the view which also adds to the complexity a bit it's not something you want actually in the model.

Participant 7

Theme	Sub Coding	Example
Imageability	<ul style="list-style-type: none"> - Businesses - Detailed bridges - Businesses - Memorable - Bridges usually decorated 	<ul style="list-style-type: none"> - Compared to other places in Groningen this one we can imagine pretty easily. Except that it's one thing that subtracts a few points for me is that I have no idea which businesses are where. Like the businesses and the paces are not imageable but you know the big street with busses, and you know what the sidewalks look like, but everything on the side is wishy-washy. - The middle looks like any place in Groningen – well any place anywhere really. There's so many place where you have two roads, with in the middle a little bit of green and then buildings on the side. Like the only thing that looks slightly unique is the buildings, because they are pretty high for the space they are in but everything else just looks like it could be anywhere. - It also feels like a really memorable way to go from like a city center to like on the left side to further way from the city centre which I presume is on the right side. Like on the left you see a street which feels like a shared space and cycling street that might be memorable and as soon as you exit the city you come onto this car road. - The main thing working against it is like for instance the bridges they're really generic compared to most of the bridges going over a canal. Usually they are decorated they have a statue. They have some kind of fencing on the side, where this is more of like a brick structure.

		<ul style="list-style-type: none"> - Identity wise how I would remember it I don't see a difference. If I was moving through the space on a day to day bases I think I would perceive it the same as the previous one. I think the main thing that would really catch my eye is that where the cycling path bends that would really piss me off in real life.
Enclosure	<ul style="list-style-type: none"> - Defined roads - Canal in the middle gives a sense of enclosure - Buildings - River - Trees 	<ul style="list-style-type: none"> - The street itself is well defined, but I'm thinking about Zuiderdiep as a whole again. But you know the difference between the sidewalks and the [bike] lanes right next to the road don't feel well defined? - It does look like actually things are kind of segregated. With that park in the middle with those high trees, you immediately know this is a barrier, you know I'm on this side of the road, I do not have to look at the other side. Unlike the previous one which had pretty low – you know you can always see the entire street and the other side feels like it's pretty close to you even though it's also really big. And the buildings themselves define the street pretty well it's self as well. - Having something in the middle gives me a sense of enclosure so the space I need to be aware of is smaller. - One side of the river you feel like those trees are a boundary and you feel more enclosed in one space. - It definitely feels well defined because the colours and more work being done with colours right now but just picturing myself being in the space I feel like it's kind of equal.
Transparency	<ul style="list-style-type: none"> - Trees - Buildings - Canal - Barrier 	<ul style="list-style-type: none"> - Everything that you really need to see, you can see from the floor. Like the trees, they have the thin stems, they are pretty high up, so the leaves are not really covering anything. So I think when you stand for instances next to the terrace you can see the buildings across the street, you can see pretty far into the street. If you were standing here for instance you could see [shop] which is several metres away. - I would be able to see the other side pretty well but I would have to focus on it because there is so many other things drawing my attention that I would not look to the other side the entire time like the first model you can basically see everything that happens all the time so I increased it a bit. But I still think if you want to see something in the street you can easily see it. - For the first one it felt like it was one giant open space where you could kind of see everything. The second one was limited a bit because of clutter in the middle that distracts you. But I would feel no reason to look at the other side of the canal. Like when there is a canal I usually don't look on the other side unless there is something eye catching, but that is not something I am seeing here. But having the clutter of the canal in the middle it's too much of a barrier to the other side. - It's pretty much the same thing like i feel like I'm on one side of the canal and the area i want to look at so there's not that much transparency for me I would be able to see the other side of course. But every time i try and go to one of the angles from the side walk and try and look across the canal the only think that really caught my eye were the trees.
Human Scale	<ul style="list-style-type: none"> - Gigantic street - Tall trees - Bikes - Building height 	<ul style="list-style-type: none"> - Everything in Zuiderdiep is so much bigger than you are. The street is 15 to 20 metres wide, everything these is gigantic. The trees in the middle are pretty high up. The buildings are all pretty high up. - Bit more things going on in the model that give me a sense of human scale like bikes being littered around, tables outside on both sides. I'm not sure if the tables on the left were there in the previous ones but they give me the idea that people are doing something there. It's definitely still out of proportion, like the buildings are way too high for the space but the human scale feels a bit better for me.

		<ul style="list-style-type: none"> - I also gave it a seven pretty much being enclosed on one side of the street it feels like your activity space is really limited so everything that is happening in that space is like not that high. Expect that the trees and the buildings feel massive. Also on the right side is that tree higher than that building? - I went down two points but it's mainly because of the trees. From a lot of angles, it felt like there was just this massive tree, a tree that would be in the middle of the forest rather than in the city.
Complexity	<ul style="list-style-type: none"> - Buildings look the same between models - Details - Identity - Generic - Architectural elements - Decoration - Canal - Details/ decorations - Activities 	<ul style="list-style-type: none"> - In the model I couldn't really see the differences between buildings, they all looked kind of the same. - More detail, but until a certain point. Like if it's just filled with stuff then at a certain point you are like where is the place for me? - Before it was something that had it's own identity, now it could be any neighbourhood street with buildings that are slightly out of place for a neighbourhood street. But it feels like something very generic is going on. - There is no architectural elements that really caught my eye, the buildings themselves you don't see them as much now. And when you look at the canal it's literally like a concrete slab with brick walls it doesn't have art, it doesn't have decoration, there's no variation it's literally just like a tunnel going straight. So in terms of complexity, I rank it very low. And if I think of any other canal, any other canal in Groningen or any other city, it usually draws the eye more, it's usually more architecturally defined. - I mainly just looked at architectural elements, and i don't really see any, like all of it is pretty easy to understand it's not that complex at all. - I think something very detailed, but detailed in a different way like having people interacting, having model people an activities happening, things like that decoration and stuff, I think that would really help imaging what the area's going to look like.
	<ul style="list-style-type: none"> - Purpose - Activities - Design - Planning 	<ul style="list-style-type: none"> - I think it's one of those things where it would be nice to show different models of different purposes, because this one would really let me think about how i would feel in the area, how i want different things to be, where i would actually be doing my activities, and just in general an idea of what it would be like realistically, but if you want to get ideas from stakeholders it would be better to show them less detail. I think i would end up showing them both, this is kind of where we are heading towards and how would you feel in this area. but on the other hand if you actually want to get the input you would show them the empty-er model. Like what would you place in this area that we have not thought of yet. - When you normal just start designing a place from scratch you base it already on what's there, so people already thinking about the central roads the bus roads, where the cyclists would be like it's all based on what they already know is currently there in the area. And this is pretty radically different like there's suddenly a canal, there's big trees on the side, there's this shared space area, i'm guessing, so it would let the things that are currently there flow a bit more.

Participant 8

Theme	Sub Coding	Example
Imageability	<ul style="list-style-type: none"> - Enclosed greenspace - Architecture 	<ul style="list-style-type: none"> - I think that it's quite unique that it's not that long of a street but it's like a square with the street so it's like an enclosed patch of grass that has trees. I think there is quite a architecture on the buildings it seem quite

	<ul style="list-style-type: none"> - Buildings - Colours - Cycle path 	<p>closed and then open and then closed again. I don't think that happens a lot. Like the building on the right it's two buildings and in the middle it's inwards.</p> <ul style="list-style-type: none"> - I think that combined with that it's really a square and I think it's something to remember. Not like any place in Groningen really. - I feel like mostly because of the colours I think. It really speaks more to me than the yellow and bricky and grey colours of the last one. And I also think since right now on the left of your screen, the cycle path is really formed around the side of the sidewalk and the little grass next to the canal. So it's not just a straight cycle path it's really woven into the rest of the environment. So, I think to me that would really make it memorable.
Enclosure	<ul style="list-style-type: none"> - Road width - Open space - No Barriers 	<ul style="list-style-type: none"> - For me it's the width of the road. You have the street, then the pavement, then the bike lane then the pavement again so.. - it's like because the street is in the middle and not that wide. And it would be higher enclosure than the previous one, but then again it's like there's way more open space next to the streets, that can be used. But to me it doesn't feel like barriers at all, as Participant 8 said. To me it feels very open to get from one side of the road to the other. - I think with the buildings and the trees like the atrophy canal it feels quite like barriers. So to me it's way more enclosed than the other two.
Transparency	<ul style="list-style-type: none"> - Windows - Eycline - Trees - Sightline - Barriers - Leaves 	<ul style="list-style-type: none"> - I think that's still fine because it looks like there are a lot of windows. - I think from my eyeline and the way the trees are structured I can quite well see through the trees as well because they have small stems. To me the trees aren't that obstructive to my sightline. - me if feels also the same so I rated it a seven again. I still feel like the sightlines are really clear and it's not like the trees work as a barrier but they are not visually a barrier to me. I think you can quite easily see what's going on everywhere. - the trees are way bigger but i think if you are on eye level it doesn't really make a difference. ya the other trees also had the thin stem and the leaves higher up so. When the leaves are low it really has an effect on transparency.
Human Scale	<ul style="list-style-type: none"> - Activities - Street width 	<ul style="list-style-type: none"> - When you are walking on the sidewalk next to where you can sit or eating, then it feels quite nice and not that big at all. So I think when I put myself in the model where the tables and chairs are that would feel kind of normal. But when I put myself in the middle of the street it would feel really big. When I look up to the buildings then it would feel really big. So I think it kind of depends on where I would put myself. I think where you put yourself there where a pedestrian would be I would give it a seven. - I think because you are on the sidewalk and because the trees work and the canal works as such a barrier, it feels way less wide, like the space you are in feels way less wide than in the other models so I rated the other ones a six and a five so I gave this one a seven because I think since it's smaller it all feels way more human scale to me. - for me the terraces and the benches - I feel like with the cycling roads and stuff and the little grass next to the canal with the benches, to me it feels like kind of the same as the last one.
Complexity	<ul style="list-style-type: none"> - Buildings, trees, terraces - Same elements between models - Canal dimensions - Variety 	<ul style="list-style-type: none"> - I think there is a lot going on. When you stand at the lowest point in the model you can really see that there is a lot of different buildings, and trees, and terraces, and there are the bus stops and I think there is just a lot going on - I gave it one point less than the previous model in complexity. I think the elements are pretty much the same but in the previous model there

	<ul style="list-style-type: none"> - Buildings 	<p>was the sidewalk then the bike lane then the other part of the pavement, then the big bus lane, then everything again so me that was way more to think about and watch then in this model where there are only two models.</p> <ul style="list-style-type: none"> - I think there is a lot more going on than in the previous one and you also have the dimension of the canal and activities that can happen on the water next to what happens on the road so there is much more variety in what happens in the street I think than in the previous models. - the trees feel less complex for me. That makes the most difference I think. - I think there will be a lot to take into account when there are so many different types of spaces. You go from the buildings on one side to the buildings on the other side. So that's why I still rated it quite high. - it's like when there's a lot of detail you can really think about the little things. Like when it's not detailed, I would not think about the architecture for example because it's so open still in the model. As a citizen I don't think I would really think about it if it's not really determined yet. and if it is I couldn't really state if I like it or don't like it.
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Participant 9

Theme	Sub Coding	Example
Imageability	<ul style="list-style-type: none"> - Could be anywhere in the Netherlands - Canal 	<ul style="list-style-type: none"> - I thought but with the whole concept I guess is that it can also be in the city centre of Utrecht or Amsterdam or something. So that's why I did not rate it that high. But if you are familiar with Groningen, you will probably recognise the area. - I think the canal makes it quite clear that in relation to the surrounding environment that we are in the city here. If you just look at Groningen then you probably will know where you are. But there are also other cities in the Netherlands and in the world that have this kind of structure but I'm pretty sure you know that you are in the city and when you look at the buildings and the way that things are structured and the physical environment you pretty much know that you are in the Netherlands. - I can pretty much recognise that I'm in a Dutch city. And just the way that everything is built up It can be in multiple Dutch cities so that's why it's not higher than a seven.
Enclosure	<ul style="list-style-type: none"> - Greenspace unclear in the model - Clear boundaries 	<ul style="list-style-type: none"> - If you look at the street itself then it's more clear in my opinion. Perhaps if you look at the sidewalk things are getting more blurry. - it's not like a fake line there I guess so it's a street, there are bikes on it and there is this park but it's not entirely clear what this park looks like in this model. Perhaps it's only green, perhaps there are some walking paths. - I am doubting a bit there with the bikes on sidewalks. In reality I don't think people are going to cycle on those sidewalks. Normal regular people would cycle on the streets. - when you look at the fish market for instance, there are also bike racks there so. But mainly it's because of the green space in the middle so that's why I rated it a four. Because I'm not sure what is entirely going on and how that related to the things that are going on besides that greenspace. - I think compared to the other ones it's quite clear, like in my opinion everything is quite clear like the only thing that is blurry are those sidewalks and the streets. Especially on the bridge for instance is it for pedestrians or cyclists? I guess that's why I did not rate it higher. But on the other side the rest is quite clear to me.

		<ul style="list-style-type: none"> - I think everything is more clear and also because of the question that I asked at the beginning, how I perceived the roads and the bike paths. Ya I think it's quite clear everything. It's well defined.
Transparency	<ul style="list-style-type: none"> - Windows - View of model - Greenspace - Trees - Activities - Straight lines - Sightlines 	<ul style="list-style-type: none"> - when you are at this view [straight on] when there are a lot of things in front of each other, you can't really see what is on the other side. It's the same for those windows, well I know from real life that you really have to be in front of them to see what is really going on inside. But in the model it really doesn't make that clear I think. And moreover if you are In this position you don't see the bus stop. There are the trees Infront of the bus stop. So that's why I rated it a four, you can see a lot of things of you move around [the model] but from one position to another it really differs. - well I also compared it to the previous model when you see the greenspace in the middle and the trees on top of that it's like. When you first see the model you think like this is pretty open and transparent you can see everywhere and what's going on there. But, when you look a little bit closer – those trees and also the activities will just blur you from seeing one side to the other side and what is actually going on there. You see what's going on there but you do not receive the full information about what's actually going on there. - I also think with the randomness if you do put them in straight lines perhaps you don't see the other side of the street. - Ya well I think I will get distracted but that's all so personal. - I think that's also because of my personal perception that I will focus on one side of the canal and I get distracted by that I guess and I won't see the other side of the canal. It's a little bit the same as the previous one in my opinion. - I think that's mainly because of the trees. Ya different trees and you can see a lot more now compared to the previous model - When you look at the other side you can see only the ground floor of the buildings, when you have those trees there you can see more of the buildings as well. So perhaps there is a shop at the ground floor and it's housing above and perhaps a third above.
Human Scale	<ul style="list-style-type: none"> - Field of view - Buildings height - Activities - Canal - Trees, height - Big World 	<ul style="list-style-type: none"> - I also considered it form the viewpoint of my eyes and what I can see and everything I perhaps have to see on the same height. When I see the terrace and the trees at least I see the other side of the buildings. I think it's quite human scale. I don't look to the other levels of the buildings. So I think all the activities and everything I need to see is there. - Ya there are things going on. Like what I said, you can see with your eyes but ya there are also the buildings that are high so. Going based on the activites you can observe from the human scale. Also if the tops of the buildings were a little bit lower. - I did not really know how to incorporate this with the canal. Because when you are on a boat in this position it's not really human scale. When you are here it's like wow everything is so big. And when you are in the street it's ok. So I just rated it like five just really in the middle. - because when you walk around at least when I was moving around, I really felt like wow, it's a big area or high area with high buildings and Trees are a lot higher and there is also this canal that is lower so where exactly is the human scale, it's like you are on an area afloat. - It's not lower than in the previous model that's what I was referring to. ya but it really feels like you're a small person in a big world.
Complexity	<ul style="list-style-type: none"> - Outline of buildings - Trees - Street width 	<ul style="list-style-type: none"> - I think there are many things there but still there is some general outline of the buildings in my opinion when I look into the model. Like in my opinion they [the real street and model] look not exactly similar but to a

	<ul style="list-style-type: none"> - Canal - Sidewalk 	<p>certain degree they are similar. That's why ya there are a lot of things [in the model] but you can still grasp what they represent.</p> <ul style="list-style-type: none"> - compared to the other model I don't think the complexity has changed so I rated it a six so it's like you see more trees in the greenspace but it's like the width of the street has also increased so I don't see if the complexity has really increased there. It feel like the same for me. - it did not feel like an increase of complexity so. Ya there are trees there are, there are the buildings, there are the sidewalks so it's pretty comprehensible. - I thought it was quite linked to the enclosure thing because a lot of things are pretty defined but there are a lot more things going on with this canal at the moment but I don't see if it really increases the complexity because you can expect other things at a certin location. But ya it's because of this I perceived this a one bridge but it has a sidewalk. And on the sidewalks there are mixed use but it did not feel that complex to me. - I will remember it more because of those as also mentioned. Because they are more expressive. Ya and the trees are different.
	<ul style="list-style-type: none"> - Predetermined elements - Possibilities of design - Not organic 	<ul style="list-style-type: none"> - because I think it's a little bit strange that you are already thinking about designing something that's already in place. And that's also with the models that you have shown us. Like everything is already pretty determined. So ya of course you would have a different perception of each model. But I don's really feel like i have a say in this. Like you can say what you like most but it's not like you have a say in the design process. - it's like ok these are the possibilities, there's already a different view i guess showing this is a possibility, this is a possibility, but this is an area that is not that fixed. then i think more people are going to think about it. at least i did not really think like ok these are the options, the scenarios. - I would consider it more of an edge of a city centre. just the way how things are structured. but ya i did not really think about the surrounding environment. - it really seams the way that the environment is structures it seems like the edge of a city. By the canal and the two streets it's not really like an organic thing or neighbourhood. it's more like a street where space flows.

Participant 10

Theme	Sub Coding	Example
Imageability	<ul style="list-style-type: none"> - Recognisable - detail - complexity - Separation 	<ul style="list-style-type: none"> - I had a seven it is recognisable but there are a lot of streets that look quite the same. So it's not really that special – but because of all the detail, and the complexity you will recognise it – I would recognise it directly from where it has to be. - There are a lot of places with a railing. But I like this more because it makes indeed what you said - sort of separation line or something, which I think is really cool.
Enclosure	<ul style="list-style-type: none"> - Width of street - No ambiance 	<ul style="list-style-type: none"> - I thought it was in my opinion in the model I know also from my own experience I think the street is too wide and I especially think in the winter when there are no leaves on the trees it's far too wide and it has absolutely no ambiance. So I thought the enclosure was a bit boring. - the model it looks more spacious where here it looks more like – more lines or something.

Transparency	<ul style="list-style-type: none"> - Large windows - Trees - Vertical trees - Horizontal trees - Spacious 	<ul style="list-style-type: none"> - because it's a shopping street or a bar street you can see that there are a lot of large windows and a lot of transparency into the buildings. So I think I give it an eight I think transparency is good here. - It also depends on how the trees are shaped. And these are, like really vertical trees. You also have more horizontal trees. And I think if you have more horizontal trees like the transparency is lower. But the feeling of like enclosures probably better. - I think that the last one gives you more a feeling of safety than this one. Also because you have a lot of trees and park and that sort of thing. - it's really spacious, but I don't know why but it is more spacious but because of like the vertical drop, it gives a more enclosure feeling at the same time. I think it's a really bit difficult to explain but it gives us sort of enclosure in a really spacious feeling.
Human Scale	<ul style="list-style-type: none"> - Too wide, too empty - Buildings - Enclosure - Separation - Brick texture 	<ul style="list-style-type: none"> - I still think it's too wide and too empty. I think the buildings are too large but the whole scale is too large. So what I would prefer, what you said that it was a canal before, I would make a canal again of it and I think it would look better. I think that would be good for improving the enclosure and the human scale both. Then it will all feel smaller and I think it will be far higher quality. - a human scale and enclosure and most of the time quite connected in my opinion. So what I think is that it's too wide. Actually, there is no separation. There is no separate functions. So I had a five even here because I think it's lower than the last one. And that's because I miss the separation of the parts and then why it's why it's feels too large. Not on human scale but more giant like. - I think it's nice if you don't put like the humans in because now you have to find out what the human scale is. In this model, it was far more difficult than in the last one so that's why I rate really bad on human scale. Because it's quite difficult to imagine how large human is. - the brick walls and all the benches and all the other stuff quite gives you an idea how large a human is. But it's still quite a wide street. So that's why I still think that human scale is a little bit difficult and I think you will never get it in such a street to a really high level in that sense.
Complexity	<ul style="list-style-type: none"> - Trees, - Terraces, - Street furniture - Textures - Elements - Separation of transportation - Large open space - Details 	<ul style="list-style-type: none"> - I saw a lot of elements a lot of trees, terraces, street furniture, different bricks, so I thought it was really good in complexity. - But I think there are a lot of elements but especially at the sides of the street. So the buildings are really different. You have a lot of terraces at the side. What I hate in the complexity of the street is the large tarmac thing in the middle where it's really focused on buses in this case. And I hate that sort of element. So when you break that up in a sense and hold the sides which are there right now so the middle is too wide but the sides are good in complexity. - there are quite some small details which make it a little bit more complex. But still, what I said before I miss like the - how you said the other hedges or something to separate it more. And that's why it feels for me when I see it in this model. Like a really large open space, even with all the details so that's why I give us seven - I like the amount of elements different elements. Yeah, how it's different that two sides I really like when there is like a difference between the road and the sidewalk. So I think the right side is more is better in quality than the left side in complexity. I really like how there are all the small elements and all the things.

Participant 11

Theme	Sub Coding	Example
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Imageability	<ul style="list-style-type: none"> - Not memorable - Residential 	<ul style="list-style-type: none"> - I know a lot of streets that look like this – so in that sense it’s not memorable - I don’t know many places that look like this. Except in like a really residential area. Which is not this. This is in the middle of the city center. So that there will be difference. - It’s not unique if you make this in a residential area, but it is if you make it in the middle of a city center. - I don’t know any other place well, maybe by the train station but I don’t know anything like this in like the middle of a city center. I would definitely remember this.
Enclosure	<ul style="list-style-type: none"> - Trees - Leaves - Buildings - Hedges? - Buildings 	<ul style="list-style-type: none"> - I hadn’t thought about the trees with no leaves, but I think it’s quite enclosed because the trees and the buildings they make for straight sightlines. So I think that makes it higher. - I think if you put a hedge if you put some hedges or something like on the side of the park, and then it would already like definitely more. Yeah, for example. Because right now it’s a lot of open space and I completely agree with you all the buildings feel a lot higher in this model.
Transparency	<ul style="list-style-type: none"> - Trees 	<ul style="list-style-type: none"> - The trees are still see through and you can still see the other side of the street. The big widows form the bars and shops. Ya I don’t really have anything else to add.
Human Scale	<ul style="list-style-type: none"> - Street furniture - Bike racks - Trees - lost in the space - large - Wide space 	<ul style="list-style-type: none"> - the width of the road is a good point but with the trees and I think there was some street furniture as well or some bike racks, that it’s at pretty good human scale. When I walk down the Zuiderdiep I don’t feel lost in the space or something. - benches and the tables and chairs from the restaurants, that are pretty much the only things that are to human scale. And the rest is it’s really large. - I think the benches and the tables and chairs and the garbage bins and everything that doesn’t rule out the wide space that the street is and I mean the width of the street you’re not going to get rid of that. I mean, it’s it stays the same width.
Complexity	<ul style="list-style-type: none"> - Sidewalk - Colours - Sections - Materials 	<ul style="list-style-type: none"> - there are a lot of different elements going on to the fact that the side walk is a different colour stone than the wide road is. So you can easily differentiate easily between different sections of the model and the road. - for the different materials, different colors. Also because the bricks that are used in the bridges and the wall around the canal that’s a different colour than the sidewalk so that yeah, that’s a plus for me.

Participant 12

Theme	Sub Coding	Example
Imageability	<ul style="list-style-type: none"> - complexity - leaves - Trees - Canals 	<ul style="list-style-type: none"> - I think I will remember it just because of the way all the different – for me the whole complexity part plays a role in the imageability because there’s a lot going on in there and that will make me remember - I don't think I've seen trees like that before in real life. Not because of the leaves but because of the shape that it just goes up and it just looks if I would see that in real life. I would you know, look twice I think. I'm not saying it's ugly. I like it, but it just that part of the model that just stands out to me. - And also for me what also stood out a little bit is that when you look at the canals in Groningen it normally is there's no difference with or well it just immediately the street and then there's water and here there's some kind of like little edge or something that separates the streets from

		<p>the water, gives you a little wall and that I haven't seen very often before.</p>
Enclosure	<ul style="list-style-type: none"> - Wide street - Trees, large - Straight lines - Subspaces 	<ul style="list-style-type: none"> - I kind of look at it in different sections of the model because if you are in the middle in the big wide street it's pretty open but you have the trees that kind of cover half of the big street and a little bit of the smaller streets on the side. So there is some degree of enclosure but if I look at the model as a whole I don't think it's that high. - I have an eight for that as well. Because of the straight lines from the road and the sidewalk and the trees, and the wall alongside the canal. - the trees kind of create like two usable subspaces, like the two side streets. And I think in those spaces you would feel like the high degree of enclosure.
Transparency	<ul style="list-style-type: none"> - Trees - Canopy - Safety - Traffic - Canal - Leaves - Shadows 	<ul style="list-style-type: none"> - it was quite high because you have very clear sightlines. And the trees in the model didn't have a very thick canopy you can still kind of look through the leaves and if you would theoretically be in the middle of the street and look the one side, you could see pretty far. - I should also thought if you would imagine standing like there and you would just look up and you just see all the sky. Then everything very light. - Could you also not argue that that for traffic purposes, transparency would increase like your sense of safety, because you can see a car coming from far away or a bike so you can adjust your traffic behavior. So to say. - the canal basically it blocks off or just like but yeah, blocks off the two separate streets, or bypass and street. And then with the trees you cannot really or it seems like because it's a looks like a bit a little thick layer leaves. You don't really see the other side of the street from the one side or like the one side of the canal from the other side. - Also, the shadows that it looks darker and then that's why it's less transparent.
Human Scale	<ul style="list-style-type: none"> - Wide road - Sidewalk - Trees - Buildings - Benches - Separation - Bike paths - Brick - Shared space 	<ul style="list-style-type: none"> - I try and imagine myself in there and you wouldn't be in the big wide road in the middle you'd be on the side walk. And then with the trees in there and the buildings it didn't seem or look that high I would still give it a seven for human scale and as Participant 11: said you wouldn't feel lost. - I think if you look at like a small part is like what you're looking at now is like just the benches isn't itself. It's pretty decent, like human scale. But if you look at the whole model, it's just so wide open. - there's no separation, because I think if there would be that would really improve or increase the grade for human scale. - I also look where the bike path is. It's the same material as the sidewalk like the same brick. Because it's the same material on the same texture. It makes it seem wider and therefore like less human or like a lower human scale number for me. - It's like the idea of shared space. So it almost seems and then I think the human scale gets lost a little bit.
Complexity	<ul style="list-style-type: none"> - Elements - Colour - Differentiate between sections - Materials 	<ul style="list-style-type: none"> - there are a lot of different elements going on to the fact that the side walk is a different colour stone than the wide road is. So you can easily differentiate easily between different sections of the model and the road. - really completely agree I put a six for complexity and mostly. Yes, the materials are different, but it's all very light. And that makes it look kind of similar for me. - it just there's a lot of different textures, materials going on. There's a big contrast between the sidewalk and the buildings because of the colour for me. And then with the canal. Yeah, I like this degree of complexity.

Theme	Example
Knowledge of Urban Design	<p>“Urban seating and little cafes having that outdoor seating around water features. It’s very attractive for stationary activity. And then when we put it in context with the idea of Jane Jacobs, eyes on the street and safety” – Participant 1</p> <p>“And if I think of any other canal, any other canal in Groningen or any other city, it usually draws the eye more, it’s usually more architecturally defined.” – Participant 9</p> <p>“I would consider it more of an edge of a city centre. just the way how things are structured.” – Participant 9</p> <p>“It’s like the idea of shared space. So it almost seems and then I think the human scale gets lost a little bit.” -Participant 12</p>
Knowledge of the case study place	<p>“I think in general Zuiderdiep is very transparent. You have the cafes; you can look inside even the Albert Hein. So I think it’s really very high in transparency” – Participant 1</p> <p>“So I compare it with other streets in Groningen, and this is very wide and quite a huge space” – Participant 2</p> <p>“On the entire Zuiderdiep there is only one building that is clearly out of scale that is the cinema” – Participant 3</p> <p>“The street itself is well defined, but I’m thinking about Zuiderdiep as a whole again.” – Participant 7</p> <p>“Everything in Zuiderdiep is so much bigger than you are. The street is 15 to 20 metres wide, everything these is gigantic” – Participant 7</p> <p>“I think that combined with that it’s really a square and I think it’s something to remember. Not like any place in Groningen really.” – Participant 8</p> <p>“I thought but with the whole concept I guess is that it can also be in the city centre of Utrecht or Amsterdam or something. So that’s why I did not rate it that high. But if you are familiar with Groningen, you will probably recognise the area.” -Participant 9</p> <p>“I can pretty much recognise that I’m in a Dutch city. And just the way that everything is built up It can be in multiple Dutch cities.” – Participant 9</p> <p>“I know also from my own experience I think the street is too wide and I especially think in the winter when there are no leaves on the trees it’s far too wide and it has absolutely no ambiance.” – Participant 10</p>
Perceptions	<p>“I don’t really have a rational explanation. Here it’s more intuitive I have to be very honest. It’s just like imagine me in that space” – Participant 1</p> <p>“If I go to the perception of street level and if I would walk here and I see the scene of some trees. But there is quite a big empty space with some tiny elements.” -Participant 2</p> <p>“That this (canal) helps to make it more imageable. You also see that the proportions of this thing are all of a sudden ok again. Right? This is a perfect street.” - Participant 3</p> <p>“I would say the visual richness is much more simple now, it’s less rich but therefore more imageable and transparent but complexity goes down” – Participant 5</p> <p>“Because I had trouble because it is a cut-out model. It is hard to know the real situation” – Participant 6</p>

	<p>“The model is less detailed and complex it’s even more imaginable to be able to envision people on the streets. So it’s easier to add the complexity that you had in real-life situations into the model in your mind.” – Participant 6</p> <p>“The trees and the buildings feel massive” – Participant 7</p> <p>“I think when you stand for instances next to the terrace you can see the buildings across the street, you can see pretty far into the street. If you were standing here for instance you could see [shop] which is several metres away.” – Participant 7</p> <p>“When you are walking on the sidewalk next to where you can sit or eating, then it feels quite nice and not that big at all. So I think when I put myself in the model where the tables and chairs are that would feel kind of normal.” - Participant 8</p> <p>“I think that’s also because of my personal perception that I will focus on one side of the canal and I get distracted by that I guess and I won’t see the other side of the canal.” – Participant 9</p> <p>Because right now it’s a lot of open space and I completely agree with you all the buildings feel a lot higher in this model. – Participant 11</p> <p>“I try and imagine myself in there and you wouldn’t be in the big wide road in the middle you’d be on the side walk.” – Participant 12</p>
<p>Individual preferences</p>	<p>“It’s not something which is striking or exceptionally beautiful, it’s still a bit awkward also although there are little details in there which make it something you can imagine.” Participant 6</p> <p>“For me it also has to do with the color scheme. The water makes a difference, but also the green colour and the trees are different.” - Participant 6</p> <p>“I am doubting a bit there with the bikes on sidewalks. In reality I don’t think people are going to cycle on those sidewalks. Normal regular people would cycle on the streets.” - Participant 9</p> <p>“I really like when there is like a difference between the road and the sidewalk.” – Participant 10</p> <p>“I think it’s nice if you don’t put like the humans in because now you have to find out what the human scale is.” – Participant 10</p> <p>“it just there’s a lot of different textures, materials going on. There’s a big contrast between the sidewalk and the buildings because of the colour for me. And then with the canal. Yeah, I like this degree of complexity.” – Participant 12</p>
<p>Culture</p>	<p>“This might be linked to my cultural background because I’m not Dutch, so for me in this scene it looks very similar in other parts of Zuiderdiep” – Participant 1</p> <p>“If you compare Groningen to other locations, cities or villages. So that makes it also more imageable. So it also depends how you relate imageability to other parts of the street, other parts of the city, or to other parts of the country” – Participant 2</p>

	<p>“Because I saw windows and for me all the streets in the Netherlands are really high in transparency compared to other countries or cities in the world so I rated it high compared to other places that I have visited.” – Participant 4</p> <p>“In Vienna nobody would sit without curtains and let people look into your privacy” – Participant 1</p> <p>“The middle looks like any place in Groningen – well any place anywhere really” - Participant 7</p> <p>“But there are also other cities in the Netherlands and in the world that have this kind of structure but I’m pretty sure you know that you are in the city and when you look at the buildings and the way that things are structured and the physical environment you pretty much know that you are in the Netherlands.” -Participant 9</p> <p>“I know a lot of streets that look like this – so in that sense it’s not memorable” – Participant 11</p>
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Appendix III – Transcripts

Focus Group 1

Author: So let first talk about imageability, it’s going to be interesting because I know you (participants) know this place well. So, this first scene is basically Zuiderdiep as it is in reality. So, I’ve modelled it based on satellite imagery from google maps and measures it to scale. So, you can try and take your knowledge of the real world out of the context of the model. So, what did you rate it for imageability?

Participant 1: Four

Participant 2: Seven

Participant 3: Eight

Author: Even higher, that’s really interesting. So, let’s discuss that. **Participant 1** why was your rating low?

Participant 1: Ok this might be linked to my cultural background because I’m not Dutch, so for me in this scene it looks very similar in other parts of Zuiderdiep. I do know of course there are some distinct elements. But for me not being from Groningen, I could not distinguish the place from an element that would be let’s say five hundred

metres further north or further south, or further west depending on where you stand. So, for me the elements are very repetitive and I do not have a distinguished landmark in there where I say, oh that's the spot. That's why for me not being from Groningen, the imageability is lower for this place. I could not immediately say this is this house or this is this entrance to this street. I would not be able to identify it not being from Groningen.

Author: Yes, that is maybe why the "Dutchies" rated it a bit higher.

Participant 2: So, when you (**Participant 1**) say not being from Groningen, you have been in Groningen for a long time haven't you.

Participant 1: Ya, for some time, five years. Ya five years but still.

Participant 2:

I'm not from Groningen either

Participant 1: But still for example from Vienna, which is my home town, I could immediately spot all the very local details out from seventy percent in the city.

Participant 3: But that would automatically result in a higher mark right?

Participant 1: Yes, so it is the memorability I might not have as high as other people who have been here for many years.

Author: Ya, and for you guys (**Participant 3 & Participant 2**) who rated it quite high, what makes this scene imageable?

Participant 2: Well, I think the façades, walls, the buildings that you can see there are very different. Different sizes, all kinds of different structures that are distinctive. And also, the size of the street in relation to the houses is also kind of typical, you don't see that everywhere in Groningen. You know that you have to be in specific places. There you have a specific ratio between height of houses and the width of the street. And of course, you see also benches or tables outside you see bus stops, you see specific vegetation. So, these are all elements that in some streets you don't have that which makes it also typical. It's also typical to Groningen of course the texture of the roads and the sidewalks. I mean if you compare Groningen to other locations, cities or villages. So that makes it also more imageable. So, it also depends how you relate imageability to other parts of the street, other parts of the city, or to other parts of the country. So that also helps to explain those values. And of course, it would be higher if you see a Martini

tower, because there's only one of them. So, it would show you where you are and then you might have a ten.

Author: Ya actually I was, going to ask. Because these senses are taken out of context. Sometimes imageability is not just the street itself, it can be where it is places in a city which is also part of imageability right? It is interesting to see how a very small 3D model can still be imageable, like you rated it an eight yet it is out of context completely.

Participant 3: Well, this Zuiderdiep it's a filled in canal, we don't have that many in Groningen, we have a few. Also, the ugliest square on the planet is one of them, the dumsterdiep. My students think it's super ugly. But this is one of the things that make sit quite recognisable. And this building is not exactly a landmark but there is very awkward architecture you don't see much of that in Groningen. And the entire Zuiderdiep zone, which is none of your business here, but there are only, I think, two major landmarks. That is the main building of the planning department which is an expressionist building, and then the art academy, which more or less closes it off. But It is recognisable and I think it deserves an eight.

Author: Are there any specific elements that I have put in the model that you would probably rate is higher if there was more of?

Participant 3: Well, they are going to change the entire Zuiderdiep right, so here you see this is still a race track for buses, but this will disappear. So, this entire black thing that you have in the middle for fast traffic will disappear and that is planned and will be realised but I think that at this point that is the weak part of this Zuiderdiep, this traffic thing in the middle.

Author: It was actually interesting when I was modelling it I was taking the exact satellite imagery and placing everything exactly where it needed to go. And then I stepped back and noticed that this looks way out of scale, the road looks way too wide even though I measured everything, the heights of the buildings, are from all the GIS data from the Netherlands, the street width and everything. And I was like what is this model missing missing? Because it feels so empty now, even though I modeled it to scale. And it's bikes

Participant 3: Well, it's water. If you replace the black stripe with water as it used to be then the scale all of a sudden is totally right.

Participant 1: And all the proportions then make sense.

Participant 2: So, I think also, why you might think it's also not **Participant 3**, it's because you might not use the middle of the street. Now I refer to you taking pictures in respect to having this model, they both have advantages and disadvantages. An advantage is that you can look from different perspectives that you would normally not use. For example, we don't drive busses or drive taxis so we don't perceive this from that angle from that street. And the same with when you late come to enclosure, human scale or complexity, well now we can look from a birds-eye perspective, well that can give you all kinds of information that you would normally not perceive. So, it would change my grades for maybe human scale or for complexity or legibility so, now we have the advantage so we can do everything as we have been a pedestrian, driving a bus or flying around and that makes our perception and how we value things different as well.

Author: Ya, I'm also really curious just because you are viewing a 3D model on a 2D computer screen, that also distorts the perspective as well right?

Participant 1: But I can tell you what would have increased my imageability is if for example if part of the Herrestrat would have been modelled. Because then when **Participant 3** said, "oh when this is very distinct building" I thought oh yes of course the corner of the Herrestrat. Now where the H&M is in! and I thought oh ya if I would have had this relational information to the shopping street then I would have a very high recognisable and memorable thing, so that was really interesting when **Participant 3** said this. I thought oh yes of course, you know?

Author: Ya it's actually really funny because I had one building out on each of the streets and my computer could not handle that data. It took me four hours just to render one scene.

Participant 1: Ya I believe so.

Participant 2: Ya I think the model looks great and in general it is useful, but indeed the context you see now that it is a small snippet. What you normally do is you have all these layers when you perceive an environment that are very useful. So another thing is what you normally would do, especially with the next one enclosure, you would look at how much sky would I see? Well, it depends a bit how your mouse is to find the sky. So it has advantages and disadvantages.

Participant 1: Yup I completely agree. Context is super important.

Author: Ok, let's move onto the next one: Enclosure.

Participant 1: I have a seven here. Because I think it's very well defined relatively speaking. You have the façades, you have the trees as guiding structures, even the street, the bus stops, the sidewalks. So, you have a lot of materiality that is also guiding, so it's visually very well defined. Also, with this closure of the façades, you know there are no holes, there are not a lot of jumps in the facades. You have this very pure almost directionality in a way so that's why my enclosure is high. But still I was also at the same time about thinking about what **Participant 3** said, about Paris. When you connect it to a boulevard. But for me it's a seven.

Participant 2: I had a five. So, I compare it with other streets in Groningen, and this is very wide and quite a huge space. And you were saying, is it correct what I did because there is a lot of space. So, you go from one wall to the other wall and there are a lot of things to see. Although there are tree lines in there. And the buildings are not that high. Well, it is all relative. But I know about this street and how I perceived it and it is very spacious, so there is not so much enclosure to my view. So, I had five, which is kind of average.

Participant 3: Me too, also a five. Like all filled in canals it is too wide. And like all filled in canals it has a very strong direction. Because these canals, they don't meander a lot, they are just straight lines. And this is a straight boulevard that just follows the shape of the city model. So, the enclosure is not very high. Which is not a big problem, still it's not in my opinion well five is what it is.

Participant 1: It's so interesting, it's all about reference models. It's really interesting because culturally for me well yes it's a wide street but it's not a super wide street. Because my reference model is Vienna, which of course is **not correct but** of course it is in the back of my mind somehow and I cannot get it out. Or even Paris, you know I've spent a lot of time in Paris so it's really interesting. And I think it's also really important to put in your work that you have this cultural difference in the perception. I think this would really be a strong point also in your thesis.

Participant 3: Could be even vital. Because it completely determines how you look at it.

Participant 1: And I think this is so interesting.

Author: And I can share my perspective from being from North America and then coming to the Netherlands where everything here is just so cute. I love Dutch

architecture so much it's quaint. Everywhere I go I feel cozy, and I think that is also the brick, it's the textures and having very soft textures as opposed to North America where it is either concrete or glass.

Participant 1: Postmodernist ya.

Author: Ok let's move on to human scale

Participant 1: Human scale, I have a seven. Because I think yes, it's a wide street, but still with all that you just mentioned, the textures, the kind of different scales, the facades, all the detail sometimes you have these ornaments (on buildings). So, I think the scale related very much to the human scale and the body, how you perceive your body in relation to that, so for me that's actually quite high because of all the details and different scales imbedded. And of course, the facades are very important here for me.

Author: Would it have made a difference if I used independent textures rather than images for the building textures?

Participant 1: Yes because if you don't model the textures right then it can look very artificial and awkward. Because I have seen many models where they use actual textures and sometimes somehow either the colour scheme, or I don't know, was **not correct so** it did not go well with participatory planning or other focus groups.

Participant 2: Especially for I would say visibility I would make a difference if you would model it then indeed you would think easily that this is not –

Participant 1: It's not right

Participant 2: It's not right ya something is kind of artificial ya.

Author: And what did you rate the model?

Participant 2: I had a seven too. So I actually agree with **Participant 1**. I think there's quite a human scale if you look at proportions, if you look at details and texture. What you could add to models is a human to know about the scale here. That could make a difference, but the nice thing is that here there are many elements that are so much related to humans, so if you have chairs and benches and you have a bus stop you know the sizes of these things as well. And you have a lot of windows and doors, so that makes it easy to kind of see what the human scale is and also how it relates to the space in a general sense. So I think that's kind of an indicator that the human scale

deserves a high rank. So if you are in a space where you say “I need a human” to know if it’s human scale then you know that the human scale is not very high ranked.

Author: Ya that’s a good point. And **Participant 3** what did you rate it?

Participant 3: I had an eight. So even higher, largely based on the quality of the architecture which is quite interesting and quite ok. On the entire Zuiderdiep there is only one building that is clearly out of scale that is the cinema. Also, this H&M this is also out of scale, but since it is brick, and since it have these different facades in one building you hardly notice. It is a very well-designed thing. And the entire street I think derives its quality largely to, especially this **little corner, to the** quality of the architecture, which is in my view totally geared to what the human scale makes pleasant.

Author: Ok let’s move on to transparency.

Participant 1: Transparency I was somewhere between a seven and an eight and I’m still a bit indecisive on that because I think in general Zuiderdiep is very transparent. You have the cafes; you can look inside even the Albert Hein. So, I think it’s really very high in transparency. Of course, not as high as the herrisstrat that is obvious but that is a shopping street. But for me it’s really very close to a seven/eight let’s go for the eight, no let’s go for the seven, I was really indecisive on that sorry. But in general, I think it’s very transparent in general the whole Zuiderdipe.

Author: Ya, I think culturally too the Dutch like their big windows everywhere.

Participant 1: And it’s a cultural thing, in Vienna nobody would sit without curtains and let people look into your privacy.

Author: Ya, ok **Participant 2** what did you rate it?

Participant 2: I had a seven, I think here it might also affect that there are pictures, the model makes it not so transparent in some ways. So if I just look at the model it might even be lower because I know this place I can kind of fill in what it should be so then it’s very recognisable what is a shop or what is a café etc. But in this model, by having pictures that are not very crisp it becomes a façade that is more anonymous. So but it helps that you also model some of those tables and chairs outside, that helps I think. But it is still a transparent environment I would say.

Author: I'm more looking specifically at the model not that necessarily – you are taking the outside reference in, but ya it's still interesting.

Participant 2: Ya so if I just look at the model maybe I would even grade it a little bit lower.

Author: And **Participant 3** what did you rate it?

Participant 3: I had an eight, it's an open-ended thing because it's blocked on one end but on the other end it's open. And it's characteristic for this type of urban phenomenon – the filled in canal. You can go anywhere unless somebody drops an art academy.

Author: Ya that's pretty straight forward for transparency, let move onto complexity. What did you rate it **Participant 1**?

Participant 1: Complexity is also a seven for me, I was also a bit hesitant between six and seven. Simply speaking, yes it's visually very rich, because of the Dutch architecture, the facades etc, and all the physical elements, the trees, the bus stops, the chairs, the outside seating etc. On the other hand because of the former Zuiderdiep canal and the width of the street I think it also loses a bit of this visual richness because of the proportions. You know, if this would be a very narrow street, it even would appear and even be perceived with higher visual richness for me. In terms of how it was defined as complexity. So for me it's a seven, because I think it's still very rich.

Author: Ok and **Participant 2**?

Participant 2: I actually had a five. Here it comes down to the model. I mean if I go to the perception of street level and if I would walk here and I see the scene of some trees. But there is quite a big empty space with some tiny elements. And I think about what I normally would rate something high complexity, there would be much more going on. I think also the façade is kind of one kind of line. Although you modelled some stairs and some little elements there which make it a little bit different but that's why I would rate it lower. And also the textures that are in the models are not pictures, so the bricks are not very complex because it is the same everywhere. Here I felt that through the model I rate the complexity low, while I would normally be on the street – and with humans, there are no humans here. And then when you have a lot of different things going on it would make the complexity much higher. So I think the place as it is high complexity where as the model I would say five.

Author: Ya I would say even when I was modeling it I felt like it was very empty even though I modeled exactly what I saw. And it was the people and the carnage of bikes that were missing.

Participant 2: Ya so I think there is one bike I think modelled.

Author: Ya I sprinkled a few in there for scale.

Participant 2: Ya that helps a lot to, well complexity is about that as well although of course if you compare it with for example Korreweg and you see the complexity of the façade there is much more repetitive.

Participant 1: I think now we are at a very interesting point. Also, for **Author**, do you want us to evaluate the model only or do you want us to take the contextual knowledge into consideration? Because I did exactly the opposite of what **Participant 2** now did when I evaluated it, I was just thinking about being in this place. So how would you like us to rate it then?

Author: Ya so because I'm comparing it to the objective qualities in the book, I think it's more on the model and then that's easier to compare model to model versus perspective to perspective. But I think it's still very interesting having the perspectives.

Participant 2: Ya but if you want to measure just the model that would be easier to pick a place, we all don't know. Here it is very difficult to separate our perceptions.

Participant 1: It's also very tempting just to take the local knowledge you have. Because then if I only would rate the model than I would give a six because that is also why I'm hesitant between what do I see and what do I know.

Participant 2: Are you also going to ask these questions to people who have never been to this place or been to Groningen?

Author: No everyone is from the faculty. Ya what did you rate it **Participant 3**.

Participant 3: Eight but that's based not on the model but one this place. Different architectures, different heights, different styles, different functions, different everything which makes in my view an eight. But that is based on knowing where it is. That ay complicate your mission in life a bit.

Author: So, this first model is modelled exactly like it is in real life. But I think the next models will take you away from that a little bit because I've used some artistic liberties. So, let's go to the next scene. Ok so imageability...

Participant 1: Seven.

Participant 3: Eight

Participant 2: Eight

Author: Ok and why?

Participant 1: Ya because I think the trees make it more distinguished, you know you can distinguish better. I think the trees are acting a bit like landmarks.

Author: Even though the style of the model is more like a sketch it still holds true?

Participant 1: Yes

Participant 2: Ya Having a place where you can stay as well, that's what it's meant for, the benches, and the trees makes it higher imageability than the previous model.

Participant 3: I had an eight because in terms of imageability it's a different image. But the quality of the image did not change, I think. It looks like a rendering by a municipal planning office. It makes sense too because it has trees, it has a park but it also has the shape of what used to be a canal. Because it's a bit lower than the streets surrounding it.

Participant 2: So, the modelling of the tree is a different type of model than the previous trees, is that on purpose?

Author: Ya I wanted to make a model that was not so photorealistic and had more of a sketch feel to it. Just to see if you can take away from it the same spatial qualities.

Participant 2: Interestingly it is now because we now have a reference because we referenced the first and then you see less details but. But I say well I know these are trees because I know what trees look like. And of course, you have the photos on the facades so it's kind of interesting how your brain is filling in this model. While if this would be the only model, I would say well the trees are very abstract and how should I deal with that level of information.

Author: Well, my thought process was the buildings aren't going to change even if you change the streetscape.

Participant 3: You can imagine if you work for the municipality and you have a plan and you have to sell the plan you can almost right a text to refer us to the original canal and the human scale... And that in a sense, which sounds a bit stupid, brings us to a high level of imageability.

Author: Ok so let's move on to enclosure.

Participant 1: Six, why do I have a lower enclosure than the previous model? It's simply speaking, well this is a bit of an analytical approach, but the trees are also blocking the vista, so you have more enclosure in terms of vista and more plumaged. On the other hand, when you have this stationary activity and you can sit and you have all these benches next to the tree you see and be more scene. But when we talk really about public and private space and vista then it blocks a little bit. You know the vista, and that's why I rated the enclosure a bit lower. So, it's a bit an analytical approach.

Participant 2: I had the same value as before, five. The trees are now in a different location but it really depends on where and how you navigate through this model to see if it's more enclosed or less enclosed. The park is more enclosed, and I think that parts where you would stay stationary. But it depends and that is why I would keep it the same.

Author: Well, it might be because the building alignment is the same, it has that effect.

Participant 2: Yes, for enclosure I would say that is the major measurement is the size of the building. And the second in the hierarchy, the second would be the trees and they have an effect of course but because they are still trees, they depend on the way they are. So, I would say the same.

Participant 3: I have a seven, also based on the knowledge of this place, the street is slightly bent, not much but a bit. If you include trees in the middle, it automatically becomes a bit more enclosed. And trees themselves will help to minimize the effect of this thing (street) being very wide, relatively speaking. So, in my view it increases the level of enclosure. Adding trees to it.

Author: Ok let's move on to human scale.

Participant 1: I have a seven, I had the same because we had trees in the previous model before. Yes, I know they were lines up and for me it did not change a lot. It's the same like in the previous model just in different locations. And you can sit down but we had a lot of urban furniture in the previous model as well and trees so it's just relocation of urban furniture and vegetation. So, for me it's the same in terms of human scale.

Participant 2: I had an eight, a little bit higher. There are more benches, there is more space for humans to do an activity, there are more tables and seats, there is a garbage thing, which is also kind of a human thing – you know how big these are. And just the separation of the spaces and the roads, the sidewalks and the park, they make distinct subspaces. Which I would say increased the human scale.

Participant 3: I had an eight, same as before. I don't think it makes a huge difference compared to the one you showed first. So eight.

Author: Ok, can we move on to transparency.

Participant 1: Transparency was lower. In my case I gave a five. Because I think because of the arrangement of the trees actually this transparency goes down. So, for me it's lower.

Participant 2: And for me it's the same. It didn't change that much I would say.

Participant 3: Six, two points lower. Because the views to the exits, the main exits which are in line with the street get blocked a bit. Also, because the street is slightly bent. Which you cannot see in the model.

Author: ya straight lines are easier to model. Ok Complexity.

Participant 1: Complexity increased. Again it's because of the vegetation. It's an eight for me. It's also because the vegetation and the way you arranged it looks more complex, it's less ordered. Before it was lined up, and now you put them all over the place which for me also increase visually when you walk or sit there or walk through that space. The way you perceive it's complexity, it's kind of relational between the vegetation and the built up space, the facades and everything so for me it's an increase in complexity. Also because you have more urban furniture etc, etc, you have more elements there.

Participant 2: Ya, I have a similar comment it also increased a little bit to a six now, I had a five before.

Participant 3: Eight, same story as before.

Author: Ok let's try and get through one more model. **Participant 3** I think you will be happy with it.

Participant 1: Ok imageability. I put an eight obviously because of the water feature, you know it's more distinct so it's more memorable/recognisable for me. So that's why it increased.

Participant 2: I have the same grade. But it's because it still has a feature you can see in other places so there's not one element that you can say is really remarkable. With respect to other streets because that have water as well. Although it might be a little bit higher than the previous one but still an eight.

Participant 3: Well, I had an eight, and it has to become higher so it becomes a nine. So I agree with **Participant 1** that this helps to make it more imageable. You also see that the proportions of this thing are all of a sudden ok again. Right? This is a perfect street.

Author: Logistically I'm not sure how this would work with the bus traffic.

Participant 3: Busses have to go anyways. So don't mind the fuss. The major problem in Groningen is the bike.

Author: Ok enclosure

Participant 1: Enclosure also increased for me, it's an eight now. Because this face is more defined for me visually. So, it has more distinct boundaries. So that's why the enclosure increased for me compared to the previous model.

Participant 2: Yes, for me as well, I have seven now. I recognise the brick small walls around the canal, they really help to define the spaces which is strengthened with the treeline and also the different functions going with those subdivisions. They also somehow have a different perception of enclosure in my view, and this model really helps to visualise that, so ya seven.

Participant 3: I had a seven and since now we add a linear motive in this street, I decided to make it a six. But it is a difficult thing, because if you are not actually swimming in this canal but walking along wide the shops, then enclosure actually increases. But I'm not allowed to change anything so it's a six forever.

Author: Ok, human scale.

Participant 1: It's a seven for me it stays the same because the element of the water does not change for me how you refer to the built environment because from the beginning you have this very detailed façade, the trees, the urban furniture, which I think are already very important for reference for your body-ness and how you perceive yourself in the built environment. So the water does not fundamentally change it for me compared to the previous model, that's why for me I say a seven in terms of human scale.

Participant 2: Yup same thoughts, there are elements that refer to human scale but they were in the previous models as well so it doesn't really increase. There are a few more bikes, but it's an eight for me as well.

Participant 3: Same story an eight. No changes compared to the previous ones.

Author: Is that because I'm reusing the same elements like the street furniture and not expanding the inventory. If there was more street furniture would that help with human scale?

Participant 3: It is what it is, the furniture of course gives you an impression of what human scale is like as a reference point, but if in real life you fill all the streets with millions of benches and couches and whatever well it doesn't make much sense.

Author: So even if I just had one element you would be able to take human scale from that?

Participant 1: Yes, and I think the important elements here are the buildings and the facades and the street texture. I think the facades are the dominant element for the human scale including of course the textures of the street.

Participant 2: The total picture I think, I don't think one bench would do it but it is already high, on the scale I had an eight. You would really have to change the model, the facades, the sizes, add humans etc. and then I would grade it higher. But an eight is still high and a few more benches here don't really change from eight to nine.

Author: Transparency?

Participant 1: Interestingly enough transparency increased a little bit for me even though there is not a lot of difference. Somehow it felt a little bit more transparent because of the water feature. When you stand on one side of the canal you can look to the other side. But honestly, I don't really have a rational explanation. Here it's more intuitive I have to be very honest. It's just like imagine me in that space, would I feel it's a higher transparency? Yes, and if I would see it from an analytical point of view and I would do a visual graph analysis for example, it would also give me better results. So simply speaking because of the centrality and the vistas are more focused and concentrated, so that's the whole clue if I would do like an analysis here.

Participant 2: I had the same as before. Seven. Overall, it doesn't change for my perspective.

Participant 3: Previously a six and now a seven because of the addition of this more linear element. And I think there is well- if enclosure goes up then transparency goes down and vice versa in my chart. I'm not sure if this is true for everybody. There is a **Participant 3** relation between the two in my brain.

Participant 2: So, I don't see the enclosure so much related to transparency. Of course, you can have a **Participant 3** relation.

Participant 1: I also see you know how **Author** explained it as a **Participant 3** relation between the public and the private space and I feel like with the water feature you get more functional public space and more stationary activity. People always like to sit around water features, they attract a lot of the stationary functions. So, for me that's why it goes up a little bit.

Participant 2: So, it's more transparent what the functions are?

Participant 1: No, it's more transparent in the sense of see and be seen. Because it's about active walls, and then we had the discussion about public and private space. So, for me the quality of the public space goes up in terms of stationary activity. Because in Paris you have this a lot, and in the Netherlands of course, but there is always urban seating and little cafes having that outdoor seating around water features. It's very attractive for stationary activity. And then when we put it in context with the idea of Jane Jacobs, eyes on the street and safety which we briefly discussed at the beginning. Then for me that's why it goes up. My interpretation of transparency is a bit different maybe.

Participant 2: So, if I read what was given as a definition of transparency, I don't see much about the degree to which people can see or perceive what lies beyond the street or the public space. I don't see a lot of changes there.

Author: Ya, for me I thought it would go up because the canal gives you this void going down that you can look down on, so that perspective opens up a new dimension, right?

Participant 3: I had the same idea as **Author**. I called it a linier element but what it refers to is these vistas. You can see further away.

Participant 1: True the vistas go up. And also, the intervisibility goes up.

Author: And I think you can see this more through 3d modelling versus sitting on a street, right? Because you have different perspectives.

Participant 2: Well visibility goes up at each point of view right. If you are on the street, you have bigger vistas. But with the previous model you would have different types of vistas because the trees are arranged in different ways. So, you would have a variation of vistas there would be in some ways more dynamic I would say. And that translates into less transparency because it's a kind of changing perspective all the time. Then you could say it is increasing transparency in this model.

Participant 1: Complexity stays the same like in the previous model. For me the water feature adds and does not add for me complexity somehow. I mean if I know that it has the brick walls, the bridges and all this more detailed features it stays for me the same.

Participant 2: For me it went up from six to seven. Because I think that that feature adds to the complexity. Also knowing that water is moving all the time, of course in the model it's not. But I can't envision the movement as well, so it's really a different material added to the scene and also the walls as well but the water especially, I thought it would be going up.

Author: If for example the bridges were more elaborate and had more detail would the complexity go up for you?

Participant 2: Yup.

Participant 1: For me as well.

Participant 2: Also, in general I would say, also for imageability would change as well, if you had a very distinct bridge then you know where you are. So if you were to do that and have one bridge with a very specific design that would really improve or at least increase those dimensions.

Participant 3: I also had an eight and in my thing the quality of the bridges or the architecture of the bridges might have had a positive effect or at least make things more complex. But as it is, it's an eight.

Author: Still very high.

Participant 1: Yes, for me too it was already really high, so for the previous was an eight so this is an eight as well. And I was just thinking about the example **Participant 2** gave with the bridge it just came to my mind. It's really interesting so the bridge as a landmark, you know like in Prague with the famous Calts bridge, I think that is also a very nice example how a bridge can act as a landmark. And how it really increases then the complexity because it is a pride in Prague and is very famous and attracts a lot of street artists. But that just came to my mind as a side note.

Author: Ya if this canal was in its original state, you would also have like 17th century bridge architecture. It would add to complexity because it is also a historic sight.

Participant 2: I think with having those models especially with imageability and complexity they are really changing because of the type of model you choose, or the elements or the detail, they make it really unique and add a unique element and very often with modeling you use things for example the trees, you don't know what type of tree it is. And having those kinds of things really increase those values I would say. In modeling it is very difficult to present that in a way that is the real stuff. So, if you would go to a place, and we would walk there, there is so much going on, of course with all the senses and water flowing etc. that really increases imageability and complexity.

Participant 3: Well, I think it's almost impossible to model bridges. The most modern bridges that we have now are much more complex and artistic and exuberant even than these historical bridges. They are just a heap of brick. But now these architects they try all kinds of tricks in their bridges – could write a book on that. Well, in the next life.

Author: Okay well we don't have time for the last model, but thank you so much, that was very insightful.

Participant 3: One comment that refers to this book you used. Well, I think you should expand on this – well not this, this is ok [about the focus groups] but this was only one session, you will have a few more. Well, it will be nice to learn what the final outcomes are of your thesis.

Focus Group 2

Participant 4: Yes, my name is Participant 4, I did my bachelor in Architecture, my Master's in urban design, my PhD in Urban Planning, and now I am an assistant professor in the department starting from September 1st 2020 and I've worked with - I'm familiar with the topic because I did my master's in urban design, where I was studying, urban mobility and travel behavior. I Have also looked at the influence of urban design on spatial quality, on people's travel behaviour, so this makes me somehow familiar with the topic.

Author: Yes, thanks that's great, Participant 5 would you like to go next?

Participant 5: Yes, I'm Participant 5, I am an assistant professor in environmental planning and really next door [to] Participant 4. We are both even in the faculty today. Except from that, I am an assistant professor in the core of spatial planning and design and especially with this thesis. I am dealing with the master's thesis as well. But I actually dealt with 3D models in spatial plans with wind turbines quite a lot. This is my experience regarding 3D models with spatial design comes from. To make people happy, or not so happy with a wind turbine in their backyard.

Participant 6: Generally, not so happy, I guess.

Participant 5: Ah well you can move them around so it looks better.

Author: And Participant 6

Participant 6: Hello I am Participant 6; I am also an assistant professor at the department in spatial design and water management. And my background is in landscape architecture, I graduated as a landscape architect from Wageningen university in the Netherlands somewhere in the early 1990's. I worked in practice for sixteen years in the Netherlands, predominantly. And did my PhD, later in life, at Wageningen university. And have now for a little over two years as an assistant professor, and I still feel fresh and new, but i'm not the newest. But during my professional career especially I've been in discussion on spatial quality multiple times both very concrete on specific places and specific designs but also more extra in more policy related discussions in municipalities, provinces, and even on the national level. So that's a little bit of my background on special quality.

Author: Yeah, thank you. I did pick the right people then this is great. Yeah, my interest in the topic of 3D modeling goes way back to my bachelor's. I did a lot of GIS courses

and modeling courses and just urbanism in general. For my thesis my original topic was in virtual reality, but that kind of got pushed aside with the pandemic because I couldn't do anything in person. And, the lab was down and everything so this was the second-best option for 3D modeling so ya.

So, the way that this focus group is going to go is - those were great introductions and now I want to go through the spatial qualities that we are going to be rating the models with. Just really quickly go through it first for each one and give it a short description so that everyone is on the same page so we know what exactly we are rating each of them. And after that we will get into the scenes. The Scenes, we are going to go through each of them individually and the first thing I want to do is when I open up the scene, I am actually going to share a link with you because I've uploaded them to Web Scene so you can fly around them yourself. And just take a few minutes and take a look at the scenes yourself. And the first impression is just based on your first couple minutes flying through the scene, and then you will rate each of the spatial design qualities based on the models.

Everyone was from the last focus group -everyone was from Groningen and it was a little bit hard to separate the scene from what they know in reality. So yeah, I just wanted to specify, keep in mind it's about how the model and its traits, and not the reality if that makes sense. Not necessarily like Your background it. It's really hard to separate those, which is still really interesting.

So, let's go through these design qualities really quickly. First, are you guys familiar with the Ewing & Clamete design qualities that they have?

No, I'm not.

Author: Yeah, well, I just wondered because apparently, it's a pretty famous study but it is very American-focused. So, the way that they incorporated the design qualities is pretty American - or North American streetwise. So, transferring that to Europe is actually kind of interesting as well. Let me open the document.

These are the spatial design qualities. The first one is imageability, imageability is the quality of the space that makes it very distinct and recognisable, and memorable. So, I've given two examples here. The first example on the left is what I would consider high quality. It's a very memorable space with the canal water, it can be like a meeting place. It could be people can say "oh can you meet me at this place" and you know, exactly where it is. Because it's a very memorable spot. Where is the one on the right is

just an empty parking lot. I wouldn't consider that very imageable, it's very low quality. I mean it's the Ikea parking lot, they all look the same, and it's not very distinct.

Then we can go next to enclosure. So, enclosure refers to the degree to which streets, and other public spaces are visually defined by buildings, walls trees, and other vertical elements.

So, on the left I have an image that I would consider high quality just because the street level and the buildings give it that sense of length and it gives it that very specific site line. Whereas the one on the right, I would consider low quality because - I mean there are many different sight lines and it's not a very enclosed surface, in that it doesn't focus you on one site line.

Participant 6: So, is this just really have to do with the clear marketing of this place itself? Or It's just how the vertical elements really define this space.

Author: Yes, How the vertical elements really define the space.

Participant 4: And or the ratio of the height of the buildings to the width of the space or something like that.

Author: Yeah. And it kind of leads into like that human scale element that, I'll go through a little bit like down the line. But yeah, it's, it's really about. Well, the way that I understood is really about just sight lines and how, how you feel in that space - if the proportions are right.

And then human scale is a little bit similar for me, where you have elements in a scene such as trees or even benches, street furniture, that give it that sense of scale. Where see the one on the left you have buildings that are maybe three or four stories high, and street is quite narrow and the trees give it that sense of scale where you know how you fit in the scene

Whereas on the right. You have this massive open space. There isn't really any street furniture or trees or anything that gives it that sense of human scale. The buildings are way too tall for this space. I mean, you're gonna feel really out of place in that space, you're going to feel like you're really small with these massive buildings. So, we consider that quite low quality.

And then transparency refers to degree to which people can see or perceive what lies beyond the edges of the street. I look at this really in terms of windows, one street you

can see very clearly into the shops or you can see beyond the street and you have these quite distinct sight lines where you're not feeling like you are claustrophobic really because the space kind of opens up with those windows. If the windows were to be reflective and you couldn't see through them that would make it slightly lower quality because it wouldn't give it that sense of openness whereas on the right, I would consider just a blank wall quite low quality. It doesn't really give you a sense that you can see very far.

And the last focus group did point out the difference between these in terms of public and private spaces. Whereas the private spaces are going to have less site lines or less windows, because of privacy. So that's the distinction between those.

And then the last one is complexity. So, this refers to the visual richness, it's the textures and in the scene, it's how many elements it's, it's just how much is going on in the scene? Is it vibrant? What kind of landscapes are there? What types of buildings are there? What kinds of architecture are there? Are there different styles of architecture? and that kind of thing. So, on the left, I consider this high quality because there are different architectural styles that there are lots of trees. There is lots of straight furniture and outdoor dining.

Whereas on the right, I would consider this low quality. This is my street, where I live, and honestly, every single building looks exactly the same. When I first moved there, I tried to get into other people's houses, thinking it was mine just because every single building is the same, and the doors are all the same. So, there's very low quality - the brick is almost all the same colour.

Did you have any questions about that? Pretty straight forward?

Participant 6: Straight forward, but I have lots of questions for later.

Author: Ok let's go over the first scene, I'm going to post it in the chat and you can open it.

Participant 4: Maybe I have one question before we start because it's also very relative then when we are trying to rate from 1 to 10, is this space compared to other scenes? Or is it we just have to rate that specific scene?

Author: Yeah. So, the way I'm going to show you the scenes, the first one is the current situation, so I've modeled it exactly the way it is currently, so it will be a little bit comparative just because of the way I'm setting the scenes up, I'm showing you the first

one that's the original one. And then they become more planned - or the potential for planning. So, then you can try and rate them individually. But I, it's going to be a little bit of a comparison, to be honest.

Participant 4: So, I should compare it to the first one?

Author: They will be distinct scenes. I realized from the first focus group that it ended up being a little bit comparison. But, that's ok. And so, I posted the first web scene in the chat and you could open in your web browser or I can share it on my screen as well.

Participant 5: Yeah, I see even treats bus stops and you no one on the terraces, it's really accurate.

Author: So, this first part is very individual. So, basically, just rate it, and then don't change your ratings, we'll discuss it later. You'll email me the score sheet that you have, which is the individual components.

Participant 6: So, we have to score this from your own perception?

Author: Yes, it's all about your perceptions of the model.

Participant 6: So, is it about the representation in the model or the design?

Author: the representation

Author: Let me know when you are done

Participant 5: It's amazing you even got the direction of the traffic signs correct.

Participant 4: ok I think I'm ready now.

Author: Ok this next part is just a discussion on how you rated the scenes and why you decided to rate it that way. We can go through each one individually - don't change them.

Let's start with imageability.

Participant 4: I have 8

Participant 6: I have 5

Participant 5: I scored an 8 as well

Author: That's quite high, why do you think an 8?

Participant 4: Well, I think the buildings are quite large, but I think the proportions of the width of the buildings and the elevation looks different for me on one side. And both sides have different buildings, and the skyline is different somehow. So that would make it imageable to me and there are some details of the buildings that make them distinct from one another. So, all together all the differences make it imaginable for me.

Author: so, for you, it's more about the facades of the buildings?

Participant 4: Yes.

Author: Participant 5?

Participant 5: yes it's the same with the facades added with these trees, and it was also that i started considering that in case you might remove the road for a canal, you have the very same kind of picture that is high quality - it would be very comparable if you have the difference here if you have a road that is a canal and I feel that I would recognize this place immediately, so that would make it reasonably high.

Author: Participant 6?

Participant 6: Yes, I scored a five. Although i think its proportions are right and the material is quite nicely visualized as well, on the different parts of the model. I still think it's something which i would not think of after this session. So, I wouldn't really remember it. It's not something which is striking or exceptionally beautiful, it's still a bit awkward also although there are little details in there which make it something you can imagine. There's no traffic on the streets, for example, there are no people etcetera. That's why I scored it not as high.

Author: yes, it is a very static scene. Ok, the next one is enclosure.

Participant 4: I rated it a seven

Participant 5: also, a seven

Participant 6: I had a 4-6. Only because I had trouble because it is a cut-out model. It is hard to know the real situation. Because it is just a part of the street, and I'm not seeing the surroundings. I had a four to six, not really knowing.

Author: Yes, it is tricky not having that context. If you are taking a very small study area or sample space you don't know anything about the buildings beyond that small space.

Participant 6: yes, and it's also floating in the sky, there is no other kind of suggestion that there is something else.

Author: Yup, Participant 5?

Participant 5: I would say if i had to compare it with the images in your example actually, that it is closer to the left one(higher quality) than to the right (lower quality) and if I feel this space then you might say it overall in terms of proportionality it's a bit too broad, however, the tall building a the left side down correlate with the wide space I see and also I feel that the trees do help to being the proportionality back and not to make it too big so I do consider it six-ish 7-ish to some degree sufficient something like that.

Participant 4: ya I had the same perception and the same comments, I have nothing to add.

Author: Ok then we can go to the next one which is human scale.

Participant 5: here i have 6 just

Participant 4: it was 7 for me

Participant 6: I scored a 5 on this, and that purely has to do with, although i can imagine at what scale I would walk through I tried to be at eye level with the model, but I don't see any people so that's where I question what I judge, do I judge the design its self or the model?

Author: ya the model, because I'm not a designer.

Participant 6: So, in that case it has to do with the lack of units in the model itself.

Author: And why did you rate it relatively high Participant 5 and Participant 4?

Participant 4: Well, I thought that the trees and you have tried to divide the width of the street somehow so this makes it a little bit more human scale. Although the width of the street itself or like the total width is very high and maybe and the proportion is maybe not that much to human scale. But i thought that the trees and the division between the spaces compensates for it somehow.

Author: Participant 5?

Participant 5: Ya I rated it a six so that is just sufficient. And I would also again say that this is road in the middle is really attracting everything in your eye. And it's a bit too big and i would not consider it fitting in that human scale. But the trees and the street small road in between - the one that crosses the road makes it a bit more lovely to be there, and the various pavement textures you can see does contribute to some degree to what I would consider not inhuman scale. But it's not something where I would say there is no improvement possible.

Author: Ok ya, let's move to transparency.

Participant 4: I have 9 actually for transparency

Participant 6: I have 2

Participant 5: I have 6

Author: Ok wow we have a whole range here, we are going to have to discuss this. Participant 4?

Participant 4: Well, I think it's because I saw windows and for me all the streets in the Netherlands are really high in transparency compared to other countries or cities in the world so i rated it high compared to other places that i have visited.

Author: ya this is more of a cultural comparison for you

Participant 4: Maybe

Author: Ya i feel like it was hard for me to find photos for the visual assessment survey - it was hard to find places that had low quality for my perception in Groningen. So, Participant 6 you rated it a two, right?

Participant 6: it had to do with again looking at it as a representation. But well, I can see some things shimmering through because you used pictures of buildings but I can't really see in the shops so it really adds to that static picture. I don't know how you would change that but it really has to do with the model situation itself.

Author: and if you put yourself in that space, you find it hard to imagine those windows being more transparent?

Participant 6: ya I can imagine that but it's not in the model, is it?

Author: Ya exactly, and Participant 5?

Participant 5: I would say in the direction of the main road the transparency isn't too bad, there you have lots of windows, although you cannot really look into them so not fully transparent. In the other direction, you would not know what would be around the corner. On the right side, there is that big building and if you go in that direction, you have no idea what might be there. And I would consider that low transparency. You can't see what's next to that corner. If you could look through those windows it would be better, but I can't.

Author: Interesting, so do you think if I - talking specifically about the model - if I hadn't used those facades that are image textures if I had gone in and separated those textures and put clear windows in would that have made a difference?

Participant 6: I was looking at it again it also has to do with the colouring because the facades are quite dark and if you would have sort of made the windows at least on the ground level, if you had made them a little bit lighter maybe that would give the idea of transparency and be able to look in, I think. That would be a lot of work but I think that would help to give this suggestion of transparency.

Author: interesting ok let's move onto complexity then.

Participant 6: I had 3

Participant 4: I have 8 again

Participant 5: I have an 8 as well

Author: Ok 8's why did you rate it that way.

Participant 4: well, I think the complexity has something to do with the imageability and the differences between the proportions of the buildings and the skylines so ya it's all about the facades of the buildings that make it complex.

Participant 5: Ya I also feel that there is quite some visual richness. And the buildings are separated with multiple colors, and multiple heights, and then if I compare it to the figures that we were given then I know it is similar to the left figure. But I still think ya, there are some ornaments over here and nice variation and complexity according to the examples.

Author: Ok perfect, and Participant 6?

Participant 6: ya I think it's although you have some really nice details in there like the bikes and the terraces, I think using the photos of the facades really also helped to suggest the real world, it still is a very simple model you can oversee in one look of how it's organized. And it also has a lot to do with that there is no traffic or humans, no mobility in the street. Because I think movement adds to the complexity if there are a lot of people. So, to me, it's very - well as a model it is quite well done, I think so. But still, I think it's a model and doesn't really add to the complexity that you have in life. So that is also looking at it as a model representing a slight section of Groningen.

Author: Ya exactly, perfect. So, we can move on to the second scene.

Everyone ready, ok let's go back to imageability.

Participant 4: I have 9

Participant 5: I have 6

Participant 6: I scored a five

Participant 4: so, for me, I went up because I think that this recession in the building makes it more imagable compared to the previous one. And also, maybe these trees enclosing the space make it more imagable compared to other places.

Participant 5: I would like to argue the other way around actually. For me the street and the linear pattern in the previous one was highlighted with the trees, and the buildings are reasonably the same. And now you miss that linear pattern and now in the middle, it feels like it could be anywhere in the world. So imageability goes down for me. It gets close to insufficient.

Author: and Participant 6?

Participant 6: ya for me it's more or less similar to the last model. I think it has a little bit more detail. But it didn't seem that much more than the last model. It's nicely done, and it's a good model, but I don't think it's very memorable.

Author: fair enough. Let's go to the enclosure then.

Participant 4: I have an 8

Participant 5: I also have an eight

Participant 6: I have a 6

Author: Ok

Participant 4: I had a seven for the last one. And I went up because of these trees which are somehow closing the street. Compared to the previous one. That was the only difference probably.

Participant 6: yes, same for me the trees really add to the definition of the space.

Participant 5: same, the proportionality of the trees is better. Imageability was lower but this one - the proportions are better.

Author: ya that goes back to the street itself, the street used to be a canal so it's wider than a normal street because it used to be a canal. But ok let's go to human scale then.

Participant 4: I have a similar score here a 7

Participant 6: 6 was my score

Participant 5: I also have a seven

Author: ok so why a seven

Participant 5: it feels that the - by separating that road the differences in pavement is much more reasonable than the big black area in the middle. This pavement texture and vegetation - the height of the trees is better so that makes it a bit more human.

Participant 4: I have a similar story because I don't think it's changed that much compared to the previous one, the models are more or less the same.

Participant 6: I scored a little but higher than the last one. Because I think there are more details in there in which you can relate the human size and because there are more elements in there, in the model itself, I think it's more imaginable to put yourself in there. Especially if you take an eye-level view.

Author: So, the more street furniture I put in the better human scale you can perceive from it?

Participant 6: Yes.

Author: Transparency?

Participant 6: I scored a 3, a little bit higher.

Participant 4: I have a similar score again compared to the previous one, which is a nine.

Participant 5: and I have changed from a 6 to a 5

Author: ok why did you change it Participant 5?

Participant 5: previously when you had that main road which is linear, I would consider the transparency already high, but now it's a bit lower as if you take one road and you want to see the other one now the trees are blocking. And with the cross road i can't see anything across the corner. So it's a lower transparency. But here it's really the trees in the middle blocking the view from one side to the other looking at it from street level.

Participant 6: Interesting because that is the reason why I'm a little bit higher. Because you have the trees in the middle and you can look underneath it you have more transparency in the model itself.

Participant 4: Ya I had the same perception here.

Participant 6: the walls, and the building are not that important to that transparency, you don't really have to look into the shop buildings like in the last model with the streetscape. I think that's why I scored a little bit higher.

Author: Participant 4 do you have anything to add.

Participant 4: So, my perception was similar to Participant 6's.

Author: Let's move to complexity then.

Participant 6: I had 5

Participant 4: I had 8, similar to the previous

Participant 5: I got up from 8 to 9

Author: just more elements in it?

Participant 5: ya compared to the image in the example, the structure of the reload is much more like that one. And I guess the repetitive pattern is much better, therefore adding to the complexity I would argue. And now I think if the last one was an 8 this one has to be a 9 and I was considering that I should lower the last one but that's done.

Participant 6: I think there are much more elements that adds to the complexity, so it makes the absence of traffic and humans less outstanding. Ya I think that's it.

Participant 4: I had a similar rating here even though there are more details i think this large park in the middle is somehow making it different from the previous one because in the previous model you had these different spaces, these different divisions of spaces, but now you have one large park in the middle. So that made it less complex.

Author: Ah ok that's interesting you found there were more divisions in the first model.

Are we ready to move on to the next model?

How did you rate this scene on imageability then?

Participant 6: I had a 6

Participant 4: a 10

Participant 5: I'm up to a 9

Author: So, everyone is just going up and up on these ones.

Participant 4: Ya I rated higher than the previous one because of the canal which makes it a distinct element

Participant 6: ya for me it also has to do with the color scheme. The water makes a difference, but also the green colour and the trees are different

Author: ya this one is a little less photorealistic and more like a sketch eh. And you rate this more sketch-like rendering higher than the photorealistic textures?

Participant 6: yes, I think I would remember this more than the last two. Because it's different and well i think that's how my mind works.

Author: And Participant 5 you went up as well.

Participant 5: yes, it is simply the canal that makes sit very recognizable. Then it is almost like picture one on the left side. And we only missed the boat, if you had that I would get to a 10.

Author: missed the boat. Ok let's move to enclosure then.

Participant 4: I have a 7

Participant 6: I have a 4

Participant 5: I got to an 8, same as the previous.

Author: and why would it be similar

Participant 4: I had 7 which is lower than the previous one because I thought that the trees in the previous one gave it more enclosure. Here it would be the same as the first one just a canal instead of the road.

Participant 6: same for me and I think that the colour of the trees really makes a dark feel to it and that makes it a little bit more defined but also - well it has something to do with the colour scheme for me, I don't know what.

Participant 5: I think that the bit higher trees further away from the facade makes it much more regular and so I consider the enclosure as high as the previous one. The height of the trees is a bit more centered in the picture makes it more proportional in a vertical manner.

Participant 6: ya could be but the trees are just older. Like, it's like this is a situation that is older and where the trees were there for a while. Which makes the previous scenes more of a representation of designs that were just implemented more recently. That's how i interpret the difference in height in trees.

Author: Oh, ya I like that analysis, I didn't think of that.

Participant 6: so, this one is a representation of the existing situation and the other ones would be new designs.

Author: let's move onto human scale

Participant 4: I have a 9 here

Participant 5: an 8

Participant 6: a five

Author: so, **Participant 6** last one you rated higher?

Participant 6: no lower, I think it has to do with the different kind of layout, and a little less diversity in the elements that you can relate to as a human. Ya less diversity, bike racks things like that. That you had in the other model.

Participant 4: I actually rated it two scores higher than the previous models because probably because of the canal and there are no cars in this street just bike paths which makes it more human scale.

Author: ya so the cycle paths rather than the car-oriented streets make it more human scale. Because streets for cars can be different widths but bike paths are generally human and bike width?

Participant 4: ya

Participant 5: I rated it pretty much the same the canal makes it more human scale and the height of the trees.

Author: Ok let's move on to transparency

Participant 4: I have a 10 here

Participant 6: I have a 4

Participant 5: I have a 7

Participant 4: well, I was thinking again because of these high trees and also the canal in the middle makes it like there are no cars here which people can see through the canal and to the other side of the street. And I had a 9 on the previous two models so I wanted to go one score higher.

Author: it's just because you can see from one side to the other?

Participant 4: yes, just imagining if you are walking there you can see from one side to the other compared to if there were some cars in the middle.

Participant 6: If scored a little bit lower than the previous ones because the diversity of the elements that you put in the model is less. So, a bit similar to human scale. The one thing I'm not sure about is the size of the leaves. Which actually makes it more imageable and stands out from the other ones. So, you can recognize the trees as trees but it's not really real. But that doesn't have anything to do with complexity I was just thinking back to imageability and how this one stands out.

Participant 5: And I considered the transparency higher, from a five to a seven now because of these trees now it is more possible to see and it makes you feel safer. And you have a canal between you and the person on the other side of the canal. In this case, it might improve the social safety. The canal is a barrier and that's good.

Author: ok let's go to the last one which is complexity

Participant 4: I have an 8

Participant 5: 7

Participant 6: 4

Author: Participant 5 did you go up or down from the last one?

Participant 5: down, ya I would say the visual richness is much simpler now, it's less rich but therefore more imageable and transparent but complexity goes down. Maybe a good thing?

Participant 4: for me, it's similar to the previous ones. I just thought everything was the same only the canal is different which makes it more imageable, and also more transparent but not more complex.

Author: Does the difference in the model representation like textures and different trees have any effect on how you perceive complexity?

Participant 4: no not for me

Participant 6: For me, I have the same sort of reasoning as Participant 5 had. But it's an interesting question that you had because I think it's even more because the model is less detailed and complex it's even more imaginable to be able to envision people on the streets. So, it's easier to add the complexity that you had in real-life situations into the model in your mind.

Author: Okay I think we might have time to see one last model. Let's give it a shot.

What is the imageability like on this one?

Participant 4: I have a 10 here

Participant 6: I have a five

Participant 5: I went down from a nine to an eight

Author: why did you go down?

Participant 5: it is now not only a canal, but it is also a street, it is on one side an open space area. So, I'm trying to think what is the main focus of this design. It is a bit less imaginable but compared to the previous one I prefer option three. I don't know precisely why.

Participant 4: I had a similar thought because I thought this canal was more imageable compared to the previous ones and I thought this road would influence human scale, but I guess not imageability.

Participant 6: this one has a similar colour scheme and material expression as the first two models and that's not so outstanding for me. So, I scored one point lower than the last one.

Author: So, for you for example you have this planning proposal and you want to communicate it to the public, for you having something that is more like a sketch render that would probably be more impactful for people rather than a photo-realistic model. Or is that just personal preference?

Participant 6: The thing is if you present it sketchier then people will notice immediately that it is not real and it is still under discussion and they might have a say in the details and how it is going to change and not something that is fixed. It has a role in communication to have something that is clearly not real yet. And I know I've done it myself and others do not use real-life renderings that much because of this. It puts the discussion on the wrong foot. It also depends of course on the kind of discussion you want to have. Actually, when I was doing my Ph.D. there was another Ph.D. who did his research on visualization and the communication of visualization that might be interesting for you to look at too. He researched what designers meant to communicate with visualizations but also how community groups for example will perceive the visualization. so he checked whether this assumption of the designers and what they wanted to communicate and what the community picked up.

Author: but on the flip side of that can you tell spatial quality through something that is sketchier?

Participant 6: but also do people who do not have training really interpret this sketch or real-life rendering because you don't have the sound, you don't have the smell, you don't have the real one-to-one size of reality. So that also plays a role in how models but also pictures play a role in how they are interpreted. And if you make it a sketch you communicate that it's not done yet. And you will notice that it is always sunny in models too. Even in yours.

Author: ya that's not very Dutch actually.

Participant 5: But your models are very accurate for the Corona pandemic.

Author: ok we were on enclosure

Participant 4: I have seven

Participant 5: 6

Participant 6: 5

Participant 4: Ya I had seven similar to the previous discussion, I think nothing has changed compared to the first model.

Participant 6: ya it's all similar. The thing is with this model compared to the last one you had i think that the trees are making a difference here as well. Because they are not as high and the trunks are smaller and the first leaves are almost on eye level. And with the previous one the trunks were much higher before the branches start.

Participant 5: I also felt that the proportionality of the trees was less than the previous one. Where on one side you have a walking path and the road the trees don't fit over there. So I guess it would be better to have smaller trees over there. Or higher trees on the other side.

Author: oh interesting, that changes the human scale perception.

Participant 5: Ya the difference is stressed on one side changing the proportions.

Author: We are running out of time so let's go through the last ones quickly. What did you rate human scale

Participant 4: 8

Participant 6: 4

Participant 5: 7

Author: For similar reasons to the last?

All: Yes

Participant 4: Ya, I had 8 because I thought that now we have a road that makes it less human scale compared to the last one where we just had pedestrian paths and cycling paths.

Participant 5: that's why the last one was higher the one road makes it less complicated.

Author: Ok transparency?

Participant 6: I had 3, a little lower than the last one

Participant 5: 6 also lower than the last one

Participant 4: 9 also lower than the last one

Author: Because of the trees?

Participant 6: Yes, for me it was the trees

Participant 4: yes, and the road. For me it was the road, I think.

Author: and complexity?

Participant 4: I have a similar 8 for all four models I had 8

Participant 6: I had 4 same as the last model

Participant 5: I had 8, a bit higher than the previous one, due to the road that is added. A bit but not too much adding to the complexity

Participant 6: yes, it's more detailed but again the trees are blocking the view which also adds to the complexity a bit it's not something you want actually in the model.

Author: Okay well I'm glad we got through all of them this time, and I have another focus group right after this, so I think we are going to end here. But, thanks for joining I really appreciate it.

Participant 4: Thank you, and I think you are doing a lot of interesting things, I think it has a lot of potential also to be used in other kinds of research. For example, in travel behaviour and mobility I think it has a lot of potential to be used as mobility planning for example.

Focus Group 3

Participant 7: I'm currently a sixth-year student, three years as a bachelor student in the faculty of spatial planning and design at the University of Groningen. One year Master in Oldenburg Water and Coastal Management, and currently in the second year Master in Environmental and Infrastructure planning at the University of Groningen. Besides that, I have done a little bit of consultancy, one is with a water management company and one with a social sustainability company.

Participant 8: I also did my three-year bachelor in spatial planning and design at the university of Groningen, after that started my Environmental and infrastructure planning master. I have finished it almost, I'm still doing some extracurricular courses now, then in two weeks I'm finished. I also did an internship last year at rijkswaterstaat, and I also did a minor in future planet innovation. So that's really interesting in [like] how sustainability and livability are connected in the planning of the living space.

Participant 9: Just like **Participant 8 and Participant 7** I also did the bachelor of spatial planning and design, so there's design for that, we did it in four courses. After that I did the Master in Environmental and Infrastructure Planning, I'm still doing it actually, and at the moment I am actually doing the Master Society, Sustainability and Planning as a substitute for Social Spatial Planning. And last year in June I started working for a company which is involved in more neighbourhood planning and regional planning. And then I started working with Virtual Reality to enhance the collaborative process of design and planning for a campus in that case, that's also what I'm busy with at the moment.

Author: Nice thank you, so first off, I did want to go over the spatial quality aspect first, but did you guys have any prior knowledge of these before I sent it to you? During our degree we didn't really go into any spatial design qualities.

Participant 8: Yes, I read it but I have heard the terms, but I haven't heard them in our degree. Also, not in the bachelor.

Author: and not in the bachelor either? Okay.

Participant 8: at least not to my knowledge.

Participant 9: I will look into it on my phone so you won't see me for a moment.

Author: So at the bottom of this document there is a table that you guys are going to use to rate the models. So there are five spatial qualities that basically you are going to rate each of the models on. The first one is imageability, so imageability is the quality of a space that makes it distinct, recognisable, and memorable. So I have two examples here the one on the left I would consider high imageability in terms of you know it's a very unique spot, the buildings are very unique, there is the canal and the boats on it make it very memorable. Whereas, on the right, I would consider this Ikea parking lot very low imageability. You aren't going to remember this place in any way, shape, or form. Does imageability make sense to you guys in this way? Although, my other group did not like that image for imageability for some reason, but for me that was a personal choice I guess, I find that spot very imageable.

So next is enclosure, so enclosure refers to the degree to which streets and other public spaces are visually defined by buildings, walls, trees, and other vertical elements. So on the left I would consider this street very high enclosure, because it has very distinct sightlines, so it has one straight sideline, you have walls [buildings] that are coming up on either side that makes it feel very enclosed. Whereas, on the right I would consider this low quality for enclosure because it is a big square, it's a big space, you do have buildings on the peripheral, but you just have so many different sightlines towards those buildings, so for example if you were to have trees in this space the enclosure would be a bit higher quality, but for now because those building are almost too out of scale for the size of the space it makes it quite low quality. Does enclosure make sense? Are there any questions?

The next one is pretty straight forward, it's human scale. So, it refers to the size, the texture, the articulation of the physical elements that match the size and proportions of humans. So, on the left this would be considered high human scale because you have the buildings that are only maybe three or four stories high, the trees are quite good proportion for the width of the street, you also have street furniture, some dining out here that makes it quite human scale. And if you are just looking at a photo like this you can insert yourself into that space and feel quite comfortable, I think. Whereas on the right here, I would consider this very low quality of human scale because the size of the space and the sidewalk is quite large and the buildings are at least five stories high, and for the size of the space it feels a bit awkward. You do have a few pieces of street furniture, but in all I think this space is quote low quality because of the size of the space and height of the buildings aren't in proportion to the human. Does that one makes sense?

Participant 7: Yes

Author: So, transparency is next, so transparency is the degree to which people can see or perceive what lies beyond the edges of the street or other public space. So, on the left here I have an image that shows very high transparency and it is a shopping street so you have these massive windows on these buildings that you can see into and if you go a bit further down the street it opens up into a bigger square. So quite transparent from a street to a square. I would consider this quite high quality of transparency. Whereas on the right, you just have a wall basically. And these two are very different because one is a public space and the other is a private residential street. But I think in the Netherlands it's quite hard to find examples of low transparency because buildings tend to have quite large windows. So, for me it was actually hard to find examples of low-quality transparency. But this is just one example because you would only have one sightline and you wouldn't be able to see past this brick wall. Does that one kind of make sense?

All: Yup

Author: And then the last one I have complexity. So, complexity refers to the visual richness of a space. So, it has to do with the texture, the different elements and the different architectural styles and the details in the architecture. So, on the left I would consider this high quality in that it has lots of trees, lots of patios, all the buildings are different heights and architectural styles and they have different facades with their own unique details. Whereas on the right I would consider Korreweg very low complexity, because all the buildings are the same, even the colour of the bricks are all the same. The architectural styles all the way through is all the same, same height. Same style of windows all the way along. Does complexity make sense?

All: Yup

Author: So, at the bottom of this document is the visual assessment survey. This is how we are going to rate each of the scenes. So, the first part of the rating that I'm going to show you the 3D models is a very individual part. So, you are going to take your time maybe five minutes and look through the 3D model and you are going to rate each of these spatial qualities based on the model. So, I think it's very important to have this distinction that it's not necessarily on how the model is presented, it's more on what it represents, and how you can perceive these kinds of spatial qualities within it. Does that make sense? So, it's not based on my artistic style that you are rating, please. It's how it's representing the different aspects of spatial quality. So, with the other groups what I have done is I've basically sent you the online 3D models. If your computer can't handle it then I can share my screen, and we can fly through it together. I will send the

first link in the chat, see if you can open it. So, this is scene number one and it's basically the current situation of a street that I think you will all recognise.

Participant 8: It's Zuiderdiep right?

Author: yup that's the one. So, take a look at it on your own and rate it then we will talk.

Participant 8: So, we only have to fill in whether it's high or low on the spatial quality component?

Author: Sorry, it's a scale of one to 10, one being low, 10 being high. Sorry, I forgot to explain that part. Ok the next part is the discussion. So please tell me your ratings, but don't change them while we discuss. Ok what did you rate the first on one imageability?

Participant 9: I gave it a seven

Participant 8: I gave it a nine

Participant 7: Eight here

Participant 8: Ya for me it's really a place to remember.

Participant 9: Yes, that's what I thought but with the whole concept I guess is that it can also be in the city centre of Utrecht or Amsterdam or something. So that's why I did not rate it that high. But if you are familiar with Groningen, you will probably recognise the area.

Participant 7: Ya I agree with you. I defiantly rated it within the context of Groningen. Compared to other places in Groningen this one we can imagine pretty easily. Except that it's one thing that subtracts a few points for me is that I have no idea which businesses are were. Like the businesses and the paces are not imageable but you know the big street with busses, and you know what the sidewalks look like, but everything on the side is wishy-washy.

Author: okay ya but you guys are asserting your own perceptions from the real world.

Participant 7: You are not wrong.

Author: if you were just looking at this model and not actually thinking about the real-life example. Would this model be imageable? Would the scene in the model be as imageable if you did not know the real place.

Participant 9: I think the scene in the model is recognisable. Just like **Participant 8** said immediately she recognised it. I am the same.

Participant 7: Ya same here.

Author: Okay, Ya then let's move onto enclosure then. What did you rate enclosure?

Participant 9: I gave it a five. But probably you guys are higher there.

Participant 7: Oh no I gave it a six so a little bit higher.

Participant 8: Me too I gave it a six as well.

Author: Ok why did you rate it a six for enclosure?

Participant 7: My main argument is the street itself is well defined, but I'm thinking about Zuiderdiep as a whole again. But you know the difference between the sidewalks and the [bike] lanes right next to the road don't feel well defined?

Author: Because there are only trees on one side? Or if the buildings were closer to the road maybe it would feel well defined?

Participant 7: Ya

Participant 8: For me it's the width of the road. You have the street, then the pavement, then the bike lane then the pavement again so...

Participant 9: If you look at the street itself then it's clearer in my opinion. Perhaps if you look at the sidewalk things are getting blurrier.

Author: ya I think it's also interesting, with a model like this you can look at it straight on in the middle of the street, whereas if you were a pedestrian in the street, you wouldn't be standing in the middle of it, you would be on the side walk beside it. And I think of you were in the real world and on the sidewalk, you would feel a bit more enclosure. But if you are looking at the model and flying around and looking at the middle of the street it feels really big and wide.

Participant 9: Ya agreed.

Author: Ok what about human scale?

Participant 8: I gave it a six as well

Participant 9: Five again

Participant 7: Three

Author: a three, okay, why did you rate it a three?

Participant 7: Because everything in Zuiderdiep is so much bigger than you are. The street is 15 to 20 metres wide, everything these is gigantic. The trees in the middle are pretty high up. The buildings are all pretty high up.

Author: ya that's interesting

Participant 8: When you are walking on the sidewalk next to where you can sit or eating, then it feels quite nice and not that big at all. So, I think when I put myself in the model where the tables and chairs are that would feel kind of normal. But when I put myself in the middle of the street it would feel really big. When I look up to the buildings then it would feel really big. So, I think it kind of depends on where I would put myself. I think where you put yourself there where a pedestrian would be I would give it a seven.

Participant 9: Ya I think I also considered it from the viewpoint of my eyes and what I can see and everything I perhaps have to see on the same height. When I see the terrace and the trees at least I see the other side of the buildings. I think it's quite human scale. I don't look to the other levels of the buildings. So I think all the activities and everything I need to see is there.

Author: my internet cut out can you repeat the first bit?

Participant 9: Ya I was just saying I rated it from the viewpoint of my eyes and what I can see. There are trees, there is a terrace, the sidewalks, the street, the busses in the real world the bottom of the buildings so that makes the human scale a little bit more human. And if you did not have the trees for instance the human scale would be a lot less.

Author: ya I agree. What about transparency?

Participant 9: Four

Participant 8: I gave it a seven

Participant 7: I gave it an eight

Author: again, pretty high for transparency. Why did you rate it an eight **Participant 7?**

Participant 7: Everything that you really need to see, you can see from the floor. Like the trees, they have the thin stems, they are pretty high up, so the leaves are not really covering anything. So I think when you stand for instances next to the terrace you can see the buildings across the street, you can see pretty far into the street. If you were standing here for instance you could see [shop] which is several metres away.

Author: and if you were just rating the model without think about the real-life street, would you still rate it quite high or?

Participant 7: ya I tried going to ground level and, in the model, I feel like the trees are a little bit lower than they feel in real life, but you would still be able to see everything you can see in real life.

Participant 8: ya I agree with **Participant 7**.

Author: Okay and the textures of the facades, because I put an image texture on it, you can't really see into buildings but do you get the sense that it is quite transparent? Or does that take you away from the transparency a little bit?

Participant 7: I didn't look at that at all.

Participant 8: I think that's still fine because it looks like there are a lot of windows.

Author: even though the buildings are quite dark in this model. And **Participant 9** what about you? A four?

Participant 9: Ya because when you are at this view [straight on] when there are a lot of things in front of each other, you can't really see what is on the other side. It's the same for those windows, well I know from real life that you really have to be in front of them

to see what is really going on inside. But in the model, it really doesn't make that clear I think. And moreover, if you are In this position you don't see the bus stop. There are the trees Infront of the bus stop. So that's why I rated it a four, you can see a lot of things of you move around [the model] but from one position to another it really differs.

Author: Ya I mean that's the nice thing about having a dynamic model you can fly around versus a rendering or just looking at a photo of a scene.

Participant 9: Ya

Author: ok do you have anything else to add or can we move on to complexity?

Participant 9: I think we can move on.

Author: Okay what did you rate complexity?

Participant 9: A six.

Participant 7: also, a six.

Participant 8: an eight

Author: Okay why did you rate it an eight – quite high?

Participant 8: Because I think there is a lot going on. When you stand at the lowest point in the model you can really see that there is a lot of different buildings, and trees, and terraces, and there are the bus stops and I think there is just a lot going on.

Author: and you guys rated it six's

Participant 9: ya I think there are many things there but still there is some general outline of the buildings in my opinion when I look into the model. Like in my opinion they [the real street and model] look not exactly similar but to a certain degree they are similar. That's why ya there are a lot of things [in the model] but you can still grasp what they represent.

Participant 7: ya same thing just in the model I couldn't really see the differences between buildings, they all looked kind of the same.

Author: Ya ok cool. DO you guys have any last comments on this model before we move on to the next one?

Participant 8: Mine is not working

Author: Okay we can fly through it together if I share my screen. Okay shall we start with imageability?

Participant 7: I gave it a four

Participant 8: I gave it a seven

Participant 9: I gave it a five

Author: Ok why a four?

Participant 7: I this especially the space in the middle looks like any place in Groningen – well any place anywhere really. There're so many places where you have two roads, with in the middle a little bit of green and then buildings on the side. Like the only thing that looks slightly unique is the buildings, because they are pretty high for the space, they are in but everything else just looks like it could be anywhere.

Participant 9: Ya the same thing for me for my line of reasoning.

Participant 8: I do not agree

Author: Okay **Participant 8** why don't you agree?

Participant 8: Because I think that it's quite unique that it's not that long of a street but it's like a square with the street so it's like an enclosed patch of grass that has trees. I think there is quite a architecture on the buildings it seem quite closed and then open and then closed again. I don't think that happens a lot. Like the building on the right, it's two buildings and in the middle it's inwards.

Author: Oh here, ya okay

Participant 8: Ya I think that combined with that it's really a square and I think it's something to remember. Not like any place in Groningen really.

Author: Okay ya that makes sense. Should we move onto enclosure?

Participant 8: Ya, I gave it a four

Participant 9: Ya, me two

Participant 7: I gave it a seven

Author: Seven, okay why a seven?

Participant 7: Because especially compared to the previous one it does look like actually things are kind of segregated. With that park in the middle with those high trees, you immediately know this is a barrier, you know I'm on this side of the road, I do not have to look at the other side. Unlike the previous one which had pretty low – you know you can always see the entire street and the other side feels like it's pretty close to you even though it's also really big. And the buildings themselves define the street pretty well it's self as well.

Participant 8: For me it's like because the street is in the middle and not that wide. And it would be higher enclosure than the previous one, but then again, it's like there's way more open space next to the streets, that can be used. But to me it doesn't feel like barriers at all, as **Participant 7** said. To me it feels very open to get from one side of the road to the other.

Author: Ya **Participant 9**, do you have something to add?

Participant 9: Ya it's not like a fake line there I guess so it's a street, there are bikes on it and there is this park but it's not entirely clear what this park looks like in this model. Perhaps it's only agreed, perhaps there are some walking paths.

Author: ya it's not very detailed.

Participant 9: No, and I am doubting a bit there with the bikes on sidewalks. In reality I don't think people are going to cycle on those sidewalks. Normal regular people would cycle on the streets.

Author: the bikes are in bike racks?

Participant 9: Ya I know, but that happens when you look at the fish market for instance, there are also bike racks there so. But mainly it's because of the green space in

the middle so that's why I rated it a four. Because I'm not sure what is entirely going on and how that related to the things that are going on besides that greenspace.

Author: So, say hypothetically if the trees where straight lines like they were in the first model but just on the sides of this park, would you have more enclosure?

Participant 8: Yes

Participant 9: yes, of course it would be more defined then.

Author: Yup, ok do you have anything else to add, or we can move onto human scale. What did you rate human scale.

Participant 9: A five

Participant 7: six

Participant 8: I also gave it a five

Author: Okay ya why sixes and fives?

Participant 8: I think it all feels too big

Author: It feels too big still?

Participant 9: Ya there are things going on. Like what I said, you can see with your eyes but ya there are also the buildings that are high so. Going based on the activities you can observe from the human scale. Also, if the tops of the buildings were a little bit lower.

Participant 7: Ya I would say that compared to the previous one I'm seeing a little bit more things going on in the model that give me a sense of human scale like bikes being littered around, tables outside on both sides. I'm not sure if the tables on the left were there in the previous ones but they give me the idea that people are doing something there. It's definitely still out of proportion, like the buildings are way too high for the space but the human scale feels a bit better for me.

Author: the presence of the street furniture and stuff helps with it?

Participant 7: yes

Participant 9: Yes

Author: and would more of it help or does one bench say you can insert yourself in here and say it is a scale. Or is it the more detail, the more human scale you can perceive?

Participant 9: I think the more the better ya

Participant 7: More detail but until a certain point. Like if it's just filled with stuff then at a certain point you are like where is the place for me?

Author: I think that has to do with complexity than human scale though but that might be a personal perception. What about transparency?

Participant 9: A five

Participant 8: Seven

Participant 7: Seven

Author: Okay why a five **Participant 9?**

Participant 9: Because, well I also compared it to the previous model when you see the greenspace in the middle and the trees on top of that it's like. When you first see the model, you think like this is pretty open and transparent you can see everywhere and what's going on there. But when you look a little bit closer – those trees and also the activities will just blur you from seeing one side to the other side and what is actually going on there. You see what's going on there but you do not receive the full information about what's actually going on there.

Author: So, the randomness in the placement of the trees is a little bit obstructive of your view?

Participant 9: Ya and I also think with the randomness if you do put them in straight lines perhaps you don't see the other side of the street.

Participant 8: I think from my eyeline and the way the trees are structured I can quite well see through the trees as well because they have small stems. To me the trees aren't that obstructive to my sightline.

Participant 9: Ya well I think I will get distracted but that's all so personal.

Author: Well, this is all on perception so... And **Participant 7?**

Participant 7: It's basically the same thing for me I think I would be able to see the other side pretty well but I would have to focus on it because there is so many other things drawing my attention that I would not look to the other side the entire time like the first model you can basically see everything that happens all the time so I increased it a bit. But I still think if you want to see something in the street you can easily see it.

Author: Ya I think that's a good point because enclosure has a good link to safety so how much you see has an effect on how safe you feel in the space. So, if you can't see the other side or if there is a street you need to cross and you can't see everything that is going on in the street that reduces the safety and reduces the quality of the space, right? So, something like this where you have so many trees in the middle and not being able to see right through could impact your sense of safety on the street.

Participant 7: I don't think it would for me. Having something in the middle gives me a sense of enclosure so the space I need to be aware of is smaller.

Author: Oh, okay ya. Anything else to add? Okay let's go onto the last one which is complexity.

Participant 9: Six

Participant 8: I gave it a seven

Participant 7: Five

Participant 9: ya compared to the other model I don't think the complexity has changed so I rated it a six so it's like you see more trees in the greenspace but it's like the width of the street has also increased so I don't see if the complexity has really increased there. It feels like the same for me.

Author: That's funny because the width of the street has definitely not increased. Everything is to scale. And all the models are the same scale. From building to building I measured everything so it's a perceived thing I think part of it is the viewing of the 3D model on a flat screen maybe.

Participant 9: Oh, that's funny

Author: Well, I did change the width of the sidewalks so instead of having bike lands which are about two metres not the sidewalks are three metres on each side.

Participant 9: Ok well it did not feel like an increase of complexity so. Ya there are trees there are, there are the buildings, there are the sidewalks so it's pretty comprehensible.

Participant 8: Ya I agree I gave it one point less than the previous model in complexity. I think the elements are pretty much the same but in the previous model there was the sidewalk then the bike lane then the other part of the pavement, then the big bus lane, then everything again so me that was way more to think about and watch then in this model where there are only two models.

Author: Participant 7?

Participant 7: I agree with what **Participant 8 said**, I think I also mixed it up with imageability a lot because for me they are pretty linked but it feels like it became more generic. Before it was something that had its own identity, now it could be any neighbourhood street with buildings that are slightly out of place for a neighbourhood street. But it feels like something very generic is going on.

Author: okay ya. Did you guys have anything else to add to the next one?

Participant 8: Was this a real location as well?

Author: No this is the same street, just playing around with different landscapes in the middle. Zuiderdiep is actually undergoing a canal revitalisation.

Participant 7: Are you going to show it as a canal too?

Author: maybe... maybe...

Author: Okay you are all done! What did you rate imageability?

Participant 9: a seven

Participant 8: Eight

Participant 7: I gave it a seven

Author: those are pretty high compared to the last one. What's your reasoning?

Participant 9: I think the canal makes it quite clear that in relation to the surrounding environment that we are in the city here. If you just look at Groningen then you probably will know where you are. But there are also other cities in the Netherlands and in the world that have this kind of structure but I'm pretty sure you know that you are in the city and when you look at the buildings and the way that things are structured and the physical environment you pretty much know that you are in the Netherlands.

Participant 8: I agree

Participant 7: It also feels like a really memorable way to go from like a city center to like on the left side to further way from the city centre which I presume is on the right side. Like on the left you see a street which feels like a shared space and cycling street that might be memorable and as soon as you exit the city you come onto this car road.

Author: ya this asphalt is meant to represent a one-way street and the other side is more of a bike lane/ shared space. Ya just having a cycle path on one side would be a bit memorable as a trip.

Participant 9: It's the new cycle highway.

Author: ya something like that. Well in Groningen you don't see anything where it's only a cycle path next to a canal you usually see a street.

Participant 9: Ya

Participant 7: yes definitely

Participant 9: ya when you have to cycle you most of the time go through the city centre. I don't cycle that much beside the canal.

Participant 7: And I think the main thing working against it is like for instance the bridges they're really generic compared to most of the bridges going over a canal. Usually, they are decorated they have a statue. They have some kind of fencing on the side, where this is more of like a brick structure.

Author: Well, I was not going to test my artistic skills with a fancy bridge. Did you have anything to add

Participant 8: No, I agree with what they said, ya.

Author: let's go to enclosure then.

Participant 9: I rated it a seven

Participant 8: me too

Participant 7: Eight

Participant 9: I think compared to the other ones it's quite clear, like in my opinion everything is quite clear like the only thing that is blurry are those sidewalks and the streets. Especially on the bridge for instance is it for pedestrians or cyclists? I guess that's why I did not rate it higher. But on the other side the rest is quite clear to me.

Author: ya well the bridge does have sidewalks on it but they are the same texture as the road.

Participant 9: Oh I see I didn't recognise that.

Participant 8: I think with the buildings and the trees like the atrophy canal it feels quite like barriers. So to me it's way more enclosed than the other two.

Author: Participant 7?

Participant 7: ya same thing. One side of the river you feel like those trees are a boundary and you feel more enclosed in one space.

Author: Okay what about human scale?

Participant 8: I gave it a seven

Participant 9: five, but it was a little bit difficult for me. I did not really know how to incorporate this with the canal. Because when you are on a boat in this position it's not really human scale. When you are here it's like wow everything is so big. And when you are in the street it's ok. So, I just rated it like five just really in the middle.

Author: as a side question how might you think these walls on the canal are.

Participant 9: 1.5 metres.

Author: ya exactly that's good. I just perceived them a way higher in the model but maybe that's because they are straight up and down. But ya sorry **Participant 8?**

Participant 8: I gave it a seven because I think because you are on the sidewalk and because the trees work and the canal works as such a barrier, it feels way less wide, like the space you are in feels way less wide than in the other models so I rated the other ones a six and a five so I gave this one a seven because I think since it's smaller it all feels way more human scale to me.

Participant 7: I also gave it a seven pretty much being enclosed on one side of the street it feels like your activity space is really limited so everything that is happening in that space is like not that high. Expect that the trees and the buildings feel massive. Also on the right side is that tree higher than that building?

Author: oh ya maybe... Maybe it was scaled a little too aggressively.

Participant 9: it's a very old tree.

Author: ya with a very thin trunk so... well ok what about transparency?

Participant 9: Five, ya but mainly I think that's also because of my personal perception that I will focus on one side of the canal and I get distracted by that I guess and I won't see the other side of the canal. It's a little bit the same as the previous one in my opinion.

Participant 8: ya for me it feels also the same so I rated it a seven again. I still feel like the sightlines are really clear and it's not like the trees work as a barrier but they are not visually a barrier to me. I think you can quite easily see what's going on everywhere.

Participant 7: Yes, for my grading I have been consistently going down a bit like one point each model. For the first one it felt like it was one giant open space where you could kind of see everything. The second one was limited a bit because of clutter in the middle that distracts you. But I would feel no reason to look at the other side of the canal. Like when there is a canal, I usually don't look on the other side unless there is something eye catching, but that is not something I am seeing here. But having the clutter of the canal in the middle it's too much of a barrier to the other side.

Author: what about the fact that it adds another dimension, you are not just looking straight across, you have this void you can look down into, does that add to any kind of transparency to you?

Participant 9: ya well that depends on whether you are standing next to it or curious about what is happening in the canal.

Author: but if you are just on the sidewalk, you don't have that feeling.

Participant 9: I'm not curious when I walk there, I'm only looking in the canals when I am really next to it.

Participant 7: yup.

Participant 8: yup

Author: Ok well what about complexity?

Participant 9: four

Participant 7: Also, a four

Participant 8: I rated it way higher I gave it an eight

Author: okay

Participant 9: eight?

Participant 8: ya, because I think there is a lot more going on than in the previous one and you also have the dimension of the canal and activities that can happen on the water next to what happens on the road so there is much more variety in what happens in the street, I think than in the previous models.

Participant 9: ya well I thought it was quite linked to the enclosure thing because a lot of things are pretty defined but there are a lot more things going on with this canal at the moment but I don't see if it really increases the complexity because you can expect other things at a certain location. But ya it's because of this I perceived this a one bridge but it has a sidewalk. And on the sidewalks, there are mixed use but it did not feel that complex to me.

Participant 7: For my grade I've mainly been going off of the canal itself, there is no architectural elements that really caught my eye, the buildings themselves you don't see them as much now. And when you look at the canal it's literally like a concrete slab with brick walls it doesn't have art, it doesn't have decoration, there's no variation it's literally just like a tunnel going straight. So in terms of complexity, I rank it very low. And if I think of any other canal, any other canal in Groningen or any other city, it usually draws the eye more, it's usually more architecturally defined.

Author: Cool anything else to add?

Participant 8: no am curious about the next one.

Author: So, this one is more of a conceptual model, it looks more like a rendering or a sketch that would be in the plans rather than something that is photo realistic.

Participant 8: I'm finished

Participant 9: ya me too, I'm just curious, there's this I don't know what it is in English.

Participant 7: Oh, he means these is this priority street and then it moves into the orange tiles.

Participant 9: Ya is the street going immediately through or is there a possibility to go right or left.

Author: ya I think these ones being very narrow would just be cycle paths

Participant 9: ya I guess, that's also what I perceived it so.

Participant 7: Alright I'm also done

Author: alright so what did you rate this one for imageability?

Participant 9: A seven

Participant 7: Also, a seven

Participant 8: A nine

Author: Wow that's way higher than your last one, right?

Participant 8: My last one was an eight.

Author: oh, no way higher, just higher, but you did go up. Okay why?

Participant 8: I feel like mostly because of the colours, I think. It really speaks more to me than the yellow and bricky and grey colours of the last one. And I also think since right now on the left of your screen, the cycle path is really formed around the side of the sidewalk and the little grass next to the canal. So it's not just a straight cycle path it's really woven into the rest of the environment. So, I think to me that would really make it memorable.

Author: okay and did you guys rate it higher or lower than the last one?

Participant 7: I rated it the same

Participant 9: the same

Author: the exact same, why the same?

Participant 7: I think identity wise how I would remember it I don't see a difference. If I was moving through the space on a day-to-day basis I think I would perceive it the same as the previous one. I think the main thing that would really catch my eye is that where the cycling path bends that would really piss me off in real life. Because it's two big turns and I can't –

Author: big turns, those are light -

Participant 7: Okay, annoying turns.

Author: OK, that's funny ok

Participant 9: ya I think it's the same line of reasoning that I told previously. I can pretty much recognise that I'm in a Dutch city. And just the way that everything is built up It can be in multiple Dutch cities so that's why it's not higher than a seven.

Author: In some of my other focus groups they rated it based on how memorable the actual model would be. Photo realistic vs conceptual. Would you remember this model in the way everything is exaggerated, like the trees are exaggerated.

Participant 9: ya I will remember it more because of those as **Participant 8** also mentioned. Because they are more expressive. Ya and the trees are different.

Author: okay anything else to add? Okay what about enclosure?

Participant 9: An eight

Participant 7: Also, an eight

Participant 8: seven

Author: okay are those higher or lower than your last scores?

Participant 9: Higher, I think the highest

Participant 8: Same as the last one

Author: why is it higher than the previous?

Participant 9: I think everything is clearer and also because of the question that I asked at the beginning, how I perceived the roads and the bike paths. Ya I think it's quite clear everything. It's well defined.

Participant 8: For me it feels the same as the last one

Participant 7: ya it definitely feels well defined because the colours and more work being done with colours right now but just picturing myself being in the space I feel like it's kind of equal.

Author: okay what about human scale?

Participant 9: Three

Participant 7: Five

Participant 8: Seven

Participant 7: haha, a three, a five and a seven

Author: okay why a three

Participant 9: Ya because when you walk around at least when I was moving around, I really felt like wow, it's a big area or high area with high buildings and Trees are a lot higher and there is also this canal that is lower so where exactly is the human scale, it's like you are on an area afloat.

Author: did you say the canal is lower?

Participant 8: It's the same right?

Author: it's the same

Participant 9: What really, oh I mean it's lower than the ground I mean. It's not lower than in the previous model that's what I was referring to. ya but it really feels like you're a small person in a big world.

Author: the trees are a lot older, that's for sure.

Participant 8: For me the terraces and the benches and the –

Participant 9: I would like to walk around there because you can be like ya [a lot smaller]

Participant 8: ya it's a bit the same as the last one. I feel like with the cycling roads and stuff and the little grass next to the canal with the benches, to me it feels like kind of the same as the last one.

Participant 7: My score didn't dip too far down; I went down two points' but it's mainly because of the trees. From a lot of angles, it felt like there was just this massive tree, a tree that would be in the middle of the forest rather than in the city.

Author: ya they're definitely exaggerated. Okay what about transparency then?

Participant 9: An eight

Participant 8: Seven

Participant 7: Six

Author: 8,7,6. Is it higher or lower than the last one?

Participant 9: Way higher

Participant 7: Same

Participant 8: Same as well

Author: Same. So why higher for you **Participant 9?**

Participant 9: I think that's mainly because of the trees. Ya different trees and you can see a lot more now compared to the previous model

Participant 8: I would feel like i would see the same in these models.

Author: The trees don't make a difference for you?

Participant 8: The trees are way bigger but i think if you are on eye level it doesn't really make a difference. ya the other trees also had the thin stem and the leaves higher up so. When the leaves are low it really has an effect on transparency.

Participant 9: Also, a thing that i was thinking about was. When you look at the other side you can see only the ground floor of the buildings, when you have those trees there you can see more of the buildings as well. So perhaps there is a shop at the ground floor and it's housing above and perhaps a third above.

Participant 7: ya I it's pretty much the same thing like i feel like I'm on one side of the canal and the area i want to look at so there's not that much transparency for me I would be able to see the other side of course. But every time i try and go to one of the angles from the side walk and try and look across the canal the only think that really caught my eye were the trees.

Author: Ok, the last one is complexity.

Participant 9: Three

Participant 7: Four same as the last one

Participant 8: I gave it a seven but it's one point lower than the last one.

Author: ya there are definitely less elements, that's for sure

Participant 8: Yes, and also the trees feel less complex for me. That makes the most difference, i think.

Author: Did you guys also perceive it like the change of textures are different. Like the colours? versus the more photo realistic ones? Or is that not what you were looking at?

Participant 9: No, I haven't looked that much into the textures detail of complexity. Is it just like is it difficult to comprehend? and in my opinion not that much, i pretty much expected everything was going to be there.

Participant 8: I think there will be a lot to take into account when there are so many different types of spaces. You go from the buildings on one side to the buildings on the other side. So that's why i still rated it quite high.

Participant 7: Pretty much the same thing i also didn't look at the textures too much I mainly just looked at architectural elements, and i don't really see any, like all of it is pretty easy to understand it's not that complex at all.

Author: I think also for planning purposes, if you were to show a canal restoration development to just citizens in general. Do you think that the less complexity is better? or would you say having something very detailed would be better?

Participant 7: I think something very detailed, but detailed in a different way like having people interacting, having model people an activity happening, things like that decoration and stuff, I think that would really help imaging what the area's going to look like.

Author: Ok so not necessarily the architectural details, like the bridge architecture.

Participant 7: I would also do that for sure.

Participant 8: Yes, I think that would give a certain feel for the space as well.

Author: Ok, one of the conversations we had previously was if it had too many details, it already has a sense that everything has been decided and already been planned out, and it give a sense of a little bit of manipulation if the citizens don't have a say with the planning.

Participant 9: Well, that depends if you compare different models all with equal amount of detail. Then citizens still have a say and things are determined before citizens actually have a say.

Participant 8: I also think it's like when there's a lot of detail you can really think about the little things. Like when it's not detailed, I would not think about the architecture for

example because it's so open still in the model. As a citizen i don't think i would really think about it if it's not really determined yet. and if it is i couldn't really state if i like it or don't like it.

Author: Ok that's completely opposite to the last group, they were saying that this sort of style let them put their own perceptions into it. rather than having it told to them.

Participant 8: ya I can see both ways, but i think -

Participant 7: ya I think it's one of those things where it would be nice to show different models of different purposes, because this one would really let me think about how i would feel in the area, how i want different things to be, where i would actually be doing my activities, and just in general an idea of what it would be like realistically, but if you want to get ideas from stakeholders it would be better to show them less detail. I think i would end up showing them both, this is kind of where we are heading towards and how would you feel in this area. but on the other hand, if you actually want to get the input you would show them the empty-er model. Like what would you place in this area that we have not thought of yet.

Participant 9: ya exactly because I think it's a little bit strange that you are already thinking about designing something that's already in place. And that's also with the models that you have shown us. Like everything is already pretty determined. So, ya of course you would have a different perception of each model. But I don't really feel like I have a say in this. Like you can say what you like most but it's not like you have a say in the design process.

Participant 7: I can kind of see it though because when you normal just start designing a place from scratch you base it already on what's there, so people already thinking about the central roads the bus roads, where the cyclists would be like it's all based on what they already know is currently there in the area. And this is pretty radically different like there's suddenly a canal, there's big trees on the side, there's this shared space area, I'm guessing, so it would let the things that are currently there flow a bit more.

Participant 9: ya but then it's like ok these are the possibilities, there's already a different view I guess showing this is a possibility, this is a possibility, but this is an area that is not that fixed. then I think more people are going to think about it. at least i did not really think like ok these are the options, the scenarios.

Author: I also had a question about enclosure and transparency. when you were looking at these scenes, were you looking at the edges of the study area and think how would this look continued, or does it take away from how you perceive these spatial qualities if there is just an edge to the world, and there's no context.

Participant 8: I don't mind it, i think i could quite easily imaging the street to on

Participant 7: Agreement

Participant 9: I would consider it more of an edge of a city centre. just the way how things are structured. but ya I did not really think about the surrounding environment.

Author: Ya but maybe it's because you already know the place so you took the context from the real world, right?

Participant 9: ya but it really seams the way that the environment is structures it seems like the edge of a city. By the canal and the two streets it's not really like an organic thing or neighbourhood. it's more like a street where space flows.

Author: Ok well was there anything to add? That was the last scene

Focus Group 4

Author: Okay so for imageability, what did you guys rate it?

Participant 11: six

Participant 10: I had a seven, because I think I will remember it but it's not so unique.

Participant 12: I put an eight in there because of the way – I think I will remember it just because of the way all the different – for me the whole complexity part plays a role in the imageability because there's a lot going on in there and that will make me remember

Participant 11: ya but I know a lot of streets that look like this – so in that sense it's not memorable

Participant 10: I had a seven it is recognisable but there are a lot of streets that look quite the same. So, it's not really that special – but because of all the detail, and the complexity you will recognise it – I would recognise it directly from where it has to be.

Author: Encloser? What did you rate enclosure?

Participant 12: I put a seven in there, for me you kind of look at it in different sections of the model because if you are in the middle in the big wide street, it's pretty open but you have the trees that kind of cover half of the big street and a little bit of the smaller streets on the side. So, there is some degree of enclosure but if I look at the model as a whole, I don't think it's that high.

Participant 11: but encloser doesn't necessarily have to be high

Participant 12: no but I mean the grade or the degree of enclosure

Participant 10: I had a six even, because I thought it was in my opinion in the model, I know also from my own experience I think the street is too wide and I especially think in the winter when there are no leaves on the trees it's far too wide and it has absolutely no ambiance. So, I thought the enclosure was a bit boring.

Participant 11: I have an eight, with the point that **Participant 10** made about the trees I'd knock it down to a seven. I hadn't thought about the trees with no leaves, but I think

it's quite enclosed because the trees and the buildings they make for straight sightlines. So, I think that makes it higher.

Author: Let's move onto human scale then

Participant 10: Ya for the same reason I think as enclosure I have a six again. Because I still think it's too wide and too empty. I think the buildings are too large but the whole scale is too large. So, what I would prefer, what you said that it was a canal before, I would make a canal again of it and I think it would look better. I think that would be good for improving the enclosure and the human scale both. Then it will all feel smaller and I think it will be far higher quality.

Participant 11: I have an eight. Ya the width of the road is a good point but with the trees and I think there was some street furniture as well or some bike racks, that it's at pretty good human scale. When I walk down the Zuiderdiep I don't feel lost in the space or something.

Participant 12: I put a seven in there. Also, mainly for the same thing as **Participant 11** said, I try and imagine myself in there and you wouldn't be in the big wide road in the middle you'd be on the side walk. And then with the trees in there and the buildings it didn't seem or look that high I would still give it a seven for human scale and as **Participant 11** said you wouldn't feel lost.

Participant 10: I agree with **Author** when you are when you see figure 5a it looks are better than it is in the model. In the model it looks more spacious where here it looks more like – more lines or something.

Author: Anything else to add? What did you rate transparency?

Participant 12: Ok so I had a nine for transparency. I thought it was quite high because you have very clear sightlines. And the trees in the model didn't have a very thick canopy you can still kind of look through the leaves and if you would theoretically be in the middle of the street and look the one side, you could see pretty far.

Participant 10: Ya I have the same for the same reason I have an eight, and also because it's a shopping street or a bar street you can see that there are a lot of large windows and a lot of transparency into the buildings. So, I think I give it an eight I think transparency is good here.

Participant 11: I had an eight as well. Ya kind of same reasons actually. The trees are still seen through and you can still see the other side of the street. The big widows form the bars and shops. Ya I don't really have anything else to add.

Author: Shall we move on then? So, the last one is complexity.

Participant 10: I had an eight again, I think it's already funny that you give it as an example in complexity, this is a good example.

Author: Well, it's a different part of the street. And try and just look at the model its self.

Participant 10: ya I saw a lot of elements a lot of trees, terraces, street furniture, different bricks, so I thought it was really good in complexity.

Author: Even though earlier you were saying the street was quite empty?

Participant 10: I meant the street is quite wide. But I think there are a lot of elements but especially at the sides of the street. So, the buildings are really different. You have a lot of terraces at the side. What I hate in the complexity of the street is the large tarmac thing in the middle where it's really focused on buses in this case. And I hate that sort of element. So, when you break that up in a sense and hold the sides which are there right now so the middle is too wide but the sides are good in complexity.

Participant 11: Ya I had a seven. Also because of the differences in the type of buildings brick colour from the read as well as the buildings. So ya that was the main reason for me.

Participant 12: I had an eight for complexity, and ya there are a lot of different elements going on to the fact that the side walk is a different colour stone than the wide road is. So, you can easily differentiate easily between different sections of the model and the road.

Author: anything to add before we move onto the next model?

Participant 12: Good model building, you can very easily recognise it.

Participant 10: Absolutely ya.

Author: Okay next one

Participant 10: Now I'm comparing it to the last one and I went too high and now I'm running out of numbers.

Author: Yeah, I was trying to figure out like, I kind of knew that there was going to be some comparison going on. Okay, perfect. Let's discuss Imageability, how did you guys rate it?

Participant 11: I had an eight because I don't know many places that look like this. Except in like a really residential area. Which is not this. This is in the middle of the city center. So that there will be difference.

Participant 12: I had the same thing and I put a nine. And then also mostly I don't know why but to me those trees. I don't think I've seen trees like that before in real life. Not because of the leaves but because of the shape that it just goes up and it just looks if I would see that in real life. I would you know, look twice, I think. I'm not saying it's ugly. I like it, but it just that part of the model that just stands out to me.

Participant 10: I gave it seven actually. And that's because I think it's cool. It looks cool. And it's a good idea. Only it's not so unique as you guys say because I already know five places with the same design.

Participant 11: In the middle of the city?

Participant 10: Not really in the city center, more rounded actually.

Participant 11: But that was my point. It's not unique if you make this in a residential area, but it is if you make it in the middle of a city center.

Participant 12: Yeah. The not with like sitting in the middle, right?

Participant 10: No, that's true.

Participant 12: But this is also kind of usable space.

Participant 11: Yeah, you make like a few walking paths, like from one side to the other. Kind of turn it into like a little park.

Participant 12: Yeah, exactly.

Participant 10: Yeah, so that's why I give it it's seven I think it's not so unique as you guys say actually.

Author: I think you guys all gave me your rating ratings. So enclosure.

Participant 12: I put a five because just looking at it I don't really feel enclosed. So to say it just the buildings in this model it just probably the same as the previous one, but they for some reason they see higher just in perspective. And the trees don't you know, they go mostly vertical and there's not much horizontal going on. So they also don't cover basically anything. Yeah, it just seems a little bit of like wide open space to me.

Participant 11: Yeah, I gave a six. But I completely agree with you. I think if you put a hedge if you put some hedges or something like on the side of the park, and then it would already like definitely more. Yeah, for example. Because right now it's a lot of open space and I completely agree with you all the buildings feel a lot higher in this model.

Author: And what about if the trees weren't so scrambled in the middle and they were like lines on the edge of it would that make a difference?

Participant 11: Yeah, I think so. Yeah, I would think that would make it more boring. So I'm not completely in favor of it, but it would it would like, make a higher mark for the enclosure elements, but I don't know if it would improve the overall design.

Author: enclosure isn't necessarily a bad thing; it's just how you perceive it. So sometimes low enclosure could also be a good thing to have.

Participant 10: Yeah. I had a six as well and as **Participant 11** exactly said what I was willing to say I was just thinking about as well and that's was why I already had the word in my head actually.

Author: Okay, so let's move on to human scale.

Participant 10: Yeah, I have, yeah, a human scale and enclosure and most of the time quite connected in my opinion. So, what I think is that it's too wide. Actually, there is no separation. There are no separate functions. So, I had a five even here because I think it's lower than the last one. And that's because I miss the separation of the parts and then why it's why it's feels too large. Not on human scale but more giant like.

Participant 12: Yeah, yeah, I agree. I also put a five here. And I think if you look at like a small part is like what you're looking at now is like just the benches isn't itself. It's pretty decent, like human scale. But if you look at the whole model, it's just so wide open. And yeah, like the point that **Participant 10** made that there's no separation, because I think if there would be that would really improve or increase the grade for human scale.

Participant 11: Yeah, I agree I have a six. But yeah, it could. It could also be a five but yeah you have the benches and the tables and chairs from the restaurants, that are pretty much the only things that are to human scale. And the rest is it's really large.

Author: One of the comments from the last focus group was that I didn't put any human models in.

Participant 10: I think it's nice if you don't put like the humans in because now you have to find out what the human scale is. In this model, it was far more difficult than in the last one so that's why I rate really bad on human scale. Because it's quite difficult to imagine how large human is.

Author: Yeah, exactly. Yeah.

Participant 10: It's just nice that there is no human in it.

Participant 12: Yeah, exactly. I agree.

Author: Can we move on to transparency?

Participant 10: Yeah, I vote in eight. And it's because more transparent than this is not even possible, probably.

Participant 11: That yeah, I have an eight as well. As this is even more transparent than the last model.

Participant 10: Yeah. It also depends on how the trees are shaped. And these are, like really vertical trees. You also have more horizontal trees. And I think if you have more horizontal trees like the transparency is lower. But the feeling of like enclosures probably better.

Participant 12: Yeah, yeah, I had a nine here because yeah, I should also think if you would imagine standing like there and you would just look up and you just see all the sky. Then everything very light.

Author: Yeah, and transparency and enclosure also have to do with safety is a huge part of it. So, I think like having enclosure gives you that sense of like safe space, so having just an open field while there's trees in it, but like mostly an open field isn't necessarily like giving you that sense of safety either.

Participant 10: No, I think that the last one gives you more a feeling of safety than this one. Also, because you have a lot of trees and park and that sort of thing.

Participant 12: But then again, could you also not argue that that for traffic purposes, transparency would increase like your sense of safety, because you can see a car coming from far away or a bike so you can adjust your traffic behavior. So, to say.

Author: yeah, that's classic mobility studies. Which I'm not Yeah, that's also that's like really that's like a whole other study on its own and yeah, definitely you can you can argue that. Did you guys all give your perspective? Yes. Yeah, yeah. Okay, so let's move on to complexity then.

Participant 11: I have an eight for complexity because of the difference in like asphalt and bricks and grass, on the road.

Participant 10: that's more dark bricks actually.

Participant 11: Oh, I thought it was asphalt.

Participant 10: is it a different color or is it just a shadow?

Author: This is a shadow. Yeah. It's just the way that it rendered for some reason.

Participant 11: the sidewalks are a different color than the roads, right?

Author: Those are definitely right. Yeah.

Participant 12: Okay, so I put a - really completely agree I put a six for complexity and mostly Yes, the materials are different, but it's all very light. And that makes it look kind of similar for me.

Participant 10: Yeah, I give a give a seven. I think there are quite some small details which make it a little bit more complex. But still, what I said before I miss like the - how you said the other hedges or something to separate it more. And that's why it feels for me when I see it in this model. Like a really large open space, even with all the details so that's why I give us seven. So, I agree actually with **Participant 11** and **Participant 12** both, but I'm more a little bit in the middle about this

Author: Okay, cool. Okay, so let's move on to the next model then. Okay what did you get for imageability?

Participant 11: I have an eight, because I don't know any other place well, maybe by the train station but I don't know anything like this in like the middle of a city center. I would definitely remember this.

Participant 10: Yeah, it's cool. Love it. Eight. I give him eight as well.

Participant 12: Yeah, I had a nine. And also, for me what also stood out a little bit is that when you look at the canals in Groningen it normally is there's no difference with or well it just immediately the street and then there's water and here there's some kind of like little edge or something that separates the streets from the water, gives you a little wall and that I haven't seen very often before.

Author: Well, it's to help students not falling when they're drunk.

Participant 12: It's for your safety.

Author: All I'm doing is suggesting some safety measures in this city.

Author: Some canals if they are quite high, so like the distance from like the water all the way up is about two meters. And some canals do have that quite a big difference between the water and the street, so you need something and like they'll just be like a railing or something maybe not brick wall but you'll have something maybe more transparent.

Participant 10: There are a lot of places with a railing. But I like this more because it makes indeed what you said - sort of separation line or something, which I think is really cool.

Author: We have enclosure.

Participant 11: So I have an eight for that as well. Because of the like the straight lines from the road and the sidewalk and the trees, and the wall alongside the canal. So I have that pretty high.

Participant 12: Yeah, I also had an eight and also because the trees kind of create like two usable subspaces, like the two side streets. And I think in those spaces you would feel like the high degree of enclosure.

Yeah, if you were like a pedestrian. Unlike the first one with the road where you would never just stand in the middle of the road. You could stand here.

Participant 10: I was only wondering why do you have asphalt on one side and bricks on the other.

Author: So, one is just a bike path because that's a normal bike path, which is two meters. So, you have two meters on the side and then you have three meters on the side for a road. So, like you could have, theoretically, a bit of car traffic. So that canal doesn't completely replace the road, you can still have access. You need some kind of access to these buildings for garbage collection or you know, things like utilities.

Participant 10: Where do you leave the buses? That's also a good question in this situation.

Participant 11: Yeah, I was thinking about the buses as well. Because in this scene and the last one, there were no bus stops anymore. Yeah, there were buses.

Author: That was actually part of the planning is they're going to get rid of the buses. Shall we move on to human scale?

Participant 10: I had a seven on human scale, because I think like the brick walls and all the benches and all the other stuff quite gives you an idea how large a human is. But it's still quite a wide street. So that's why I still think that human scale is a little bit difficult and I think you will never get it in such a street to a really high level in that sense.

Participant 11: Yeah, I gave it a six for human scale. Yeah, the I think the benches and the tables and chairs and the garbage bins and everything that doesn't rule out the wide space that the street is and I mean the width of the street you're not going to get rid of that. I mean, it's it stays the same width.

Participant 12: Yeah, I had a seven for human scale. And then I agree with all that's been said. And then I also look where the bike path is. It's the same material as the sidewalk like the same brick. Because it's the same material on the same texture. It makes it seem wider and therefore like less human or like a lower human scale number for me.

Participant 10: Yeah, I think that's a fault they make a lot in the city right now.

Participant 12: It's like the idea of shared space. So, it almost seems and then I think the human scale gets lost a little bit. So that's my argument for seven.

Participant 10: Transparency then I think,

Author: yeah.

Participant 10: Yeah, give it an eight again because I think it's really spacious, but I don't know why but it is more spacious but because of like the vertical drop, it gives a more enclosure feeling at the same time. I think it's a really bit difficult to explain but it gives us sort of enclosure in a really spacious feeling.

Participant 12: I agree with that a little bit. Yeah, because I put a six for transparency and I think because the canal basically it blocks off or just like but yeah, blocks off the two separate streets, or bypass and street. And then with the trees you cannot really or it seems like because it's a look like a bit a little thick layer of leaves. You don't really see the other side of the street from the one side or like the one side of the canal from the other side. And that's why I put a six.

Participant 11: maybe it also depends on how high this wall around a canal is. I have a seven. So, I'm kind of in between you two.

Author: I mean having a canal you basically have another dimension of transparency. You're not just looking straight across you're looking straight down and then across.

Participant 12: Yeah, maybe it just seems for me then personally perceive that because also of the shadows that it looks darker and then that's why it's less transparent.

Author: Right? Yeah. Okay. Interesting. Complexity?

Participant 10: I have a nine. I like the number of elements different elements. Yeah, how it's different that two sides I really like when there is like a difference between the

road and the sidewalk. So, I think the right side is more is better in quality than the left side in complexity. I really like how there are all the small elements and all the things.

Participant 12: I put an eight for complexity, I think for largely similar reasons as.

Participant 10 and yeah, it just there's a lot of different textures, materials going on. There's a big contrast between the sidewalk and the buildings because of the colour for me. And then with the canal. Yeah, I like this degree of complexity.

Participant 11: Yeah. I have an eight as well. Also, yeah, for the different materials, different colors. Also, because the bricks that are used in the bridges and the wall around the canal that's a different colour than the sidewalk so that yeah, that's a plus for me.

Author: Nice. Okay. Are we ready for the next model? Do we have time? Yeah, I think we can squeeze one more in right. No, maybe?

Participant 12: Yeah, sure. Now, I'm excited what you did with that last one?

Author: Okay, so what did you get for imageability?

Participant 10: I have a nine.

Participant 11: I have also a nine. for pretty obvious reasons. I think it's a fairy tale.

Participant 12: I put an eight in there. And I think maybe just a little lower than the other because I don't know. It's just it seems very familiar for some reason.

Participant 10: Out of your fairy tale dreams. I don't know why but the whole the idea of putting trees next to the canal. And that is just I don't know. It just seems like Yeah, so I would the other one had trees too next week. Now I know. These are like a little bit more vertical and it's a bit more open space. I don't know I just

Participant 11: Well, I I do I know where you meet because I know a street and what's it um, that is actually pretty similar to this. Besides the fact that this one only has psychopaths and the one that works for them also have like, normal roads for cars. But the thing is that that street and real to them. I know that really well. And I, I know I can just get the image in my head like right now when I'm talking about it. So, I remember it really well. So, it's it is memorable for me. Yeah. So, in that sense, I give it a high grade because it is memorable.

Participant 10: It's also kind of funny that you rated the one that looks more like a sketch like an impression more like conceptual higher than the like one that supposedly photorealistic

Author: Yeah. But like if you were if you were like in a planning meeting and you were at an open house, and they were like, oh, we have these plans for the making. This road backed into a canal. I think that based on what I've like seen in the focus groups so far, the ones that are more of a sketch would have a bigger impression. But it's one that's really committed because you can still kind of make it your own right. Have your own ideas how it would look like in real life which I'm sure all of us have also for this model. Yeah. And then for me, it's just a tad less, more or less imitability for me.

Participant 12: Yeah, that's, that's I really liked that. Because like, the fact that like having something more conceptual is like more imageable because you're putting your own spin on it. It's really interesting, I think. Yeah, I like that.

Participant 11: Yeah, I think I especially read this high, I see that you did this, like distinct, recognizable and memorable. And I think it's especially really memorable. And that's why I rated so high actually. Because I think it's this thing. It's special. And that's why I rated higher than the other ones.

Author: Yeah, but I also don't want this to be about like, like a certain artistic style because like modeling. I mean, it's sort of it's even with like cartography, it's hard. It's an art and a science, right? Like you can really like something like a map because of the artistic style, not necessarily because of the data showing, right? So it's also a little bit hard to like distinguish those two. Yeah. But yeah, anyways, let's move on to enclosure.

Participant 12: Oh, yeah, I put a six there. Just because I feel again, these trees you use it's a more like vertical lines, and it doesn't necessarily feel like covered or like the more the protected shape space idea. Yeah, that's mostly why.

Participant 11: Oh, I have to say, sorry, I have the same grade as the one before because I think they're pretty similar in in this element. Yes, with the buildings and the trees and the wall around the candle. It's yeah, it's pretty much the same.

Participant 10: Yeah, yeah. I rated the seven because I think it's more enclosure didn't have to first to first but I think the last one was more enclosure did I think that must because the trees were different. I think and there was more contrast with the wall of

the more enclosure feeling than this model because the wall around the water is blending in with like the street this

Author: right yeah. Okay. Let's go to human scale then.

Participant 11: I had a six

Participant 10: Yeah, I had a 6 too.

Participant 12: That's probably an eight Yeah. Because if you look at the sidewalks in the bike path, you know, you have like small sections of every you know, every section is like kind of small in my opinion, so like the grass area where you can sit that's like according to like human scale for me and then you have a small bike. path and the sidewalks aren't that wide. So, for me that very much contributed to like a very, like higher number for human scale.

Participant 10: Yeah, I thought the sidewalks were too wide in that sense. But of course, because this de psychopath is like it's smaller than the road was before. Yeah, I didn't know I think because everything is so white in the middle. It gives me sort of yeah, a lot more spacious feeling than I had in like the last one. And that's why I don't know exactly how large a human is when I only look through like the middle piece, per se if you're like sitting here. Well, maybe a little bit up. Like these angles where you would normally be as a pedestrian. I think that well, yeah.

Participant 11: Yeah. Yeah. I don't know. I think I had like a more feeling with the human scale in the last model than in this model. So, I work for six. Yeah.

Author: Also, one of the comments from the last one was these trees feel older, like the trunks are thicker. Like they feel like it's been planned around the trees rather than the trees just planted in?

Participant 10: Yeah, it is. Yeah. Which makes sense. I agree with that. Yeah, it's quite - it takes quite some time to get this situation in this.

Author: Yeah. Do you have anything to add to that, or should we move on to transparency?

Participant 11: I'm good to move on. Yeah. So okay,

Author: so, transparency.

Participant 11: I had a seven Yeah, you can still work like to the other side of the street through the trees or not, that leaves another like thick. So that's so good, but it's not it's not as transparent as like the second one.

Participant 10: Oh, that's true. brighter blue. Because I like something by accident. Why is it purple? Why is it blue?

Participant 12: I put an eight for transparency and I think the fact I feel like you would still have very clear like visual sidelines, especially because the trees there's not much like leaves or foliage like down below it's more directed upwards. So, you could still like in between the trees look to the other side of the canal and because I don't know for me the color also just adds like to the transparency because it's a light color like the sidewalks as well as the street.

Author: Yeah, that's like a popular comment that I did not even think about like how if it's a lighter rendering Yeah, it just yeah, the perception is slightly

Participant 10: Yeah, yeah, true. Interesting. I gave an eight again.

Author: That's okay.

Participant 10: But it's because I think all the models you created are all really spacious. You can almost always see everything in the whole street, at least when you're staying like on the edge of this model. You can see literally anything. So that were in my opinion, not really situations where you don't have a lot of transparency as you showed, like in the fake you're on your example sheet. So that's why I gave it an EIGHT again. And it's also because like the walls of the water are really low. It's not Yeah, I think there is a difference when you put like the hatches we talked about before. If you put them there were blocked far more, you're fishing your site to the end of the street. So that is far worse in transparency, I think. So, your models are really good interest in seeing. And then yeah, I'm sorry, just to add to that, is that the little wall around the canal is probably the same height as in the previous model, right?

Participant 11: Yeah. It seems lower. Yeah. Just because of the textures. I think so. Or this height to the trees. Maybe?

Participant 12: Yeah. It just it just it doesn't block your vision as much or just like catch your eye as much maybe as an imprint. Yeah, exactly. Yeah. So, the color I think again, yeah.

Author: Just based on transparency for all these models. How do you feel about the fact that there's no context like there's no you can't see to the end of a street because it's just a void. Does that affect that your perceptions of transparency as well? Or enclosure? Or do you just you just accept that that's the way it is.

Participant 10: Now, the point is that the only thing you don't know is how like the street is going because I know that in normal, I think I will give a lower grade on transparency in this because I know there is quite a I say to turn in the whole thing and the whole street. It's not a Straight Street. It's like there is a turn in it. The transparency is probably a little bit lower because of like the buildings are blocking your view in the sense where in this model I only I imagined when I see this model that this is going on for quite some time. straight direction forever.

Participant 11: No Yeah, no. That's why I read the models. I think hiring transparency then I will do when I'm there like in the real situation. But that's what the real situation and I know that there is a turn in it.

Participant 12: Which makes it then on the other side with the transparency in terms of Windows, you would probably rate this lower than the real thing because the images are quite dark but it got rendered and that's what I was in the first time when I watch to transparency and the first model. I was like, Okay, it's quite dark. So I rated really low in first place. And then I was like, okay, yeah, it's a model and you see all the windows but because the windows are not transparent in this model. If you're short, more closer feeling than it is in real time. Yeah.

Participant 11: Yeah, no, I agree with that. Yeah.

Participant 12: And all the models, all the buildings are, I think darker here than they are in real life

Participant 11: Yeah, or like it's also the contrast with the rest of the textures that I just put in versus looks really dark and far darker than it is in real life.

Author: It's really weird because when I open it up in SketchUp, which is like how I actually modeled them, the textures are really light. So, it's the way that it's been like what I transferred it from SketchUp to city engine and then exported it as a web scene. That's when the textures kind of changed. So, it makes a difference. It just kind of unfortunate because it actually looks really good in SketchUp.

Author: But, yeah. Any other comments on transparency or should we move on? I think it's complexity.

Participant 10: Yeah, I rated it lower than the last one. And that's because there is less contrast. So in therefore it looks less complex actually. And I prefer really the contrast thing and I think that will make something really official rich in that sense. So, I rated this a little bit lower than the last one. That's actually it. And I don't see a lot of more things like terraces and that sort of things, which were more in the last model, I think.

Participant 11: Yeah, the sidewalks are pretty empty. True. Yeah. Yeah, I have a seven are complexity. Also, because there's, there's less contrast. Most of the bricks are kind of the same. Well, not exactly the same color, but they're the same-colored zone or however you call it so yeah, that was for me the main reason gives us seven.

Participant 12: Yeah, I also put a seven and then within like, if you look at the big things, I still think it's pretty compared with the whole like if you look from just like right to left it's like sidewalks and it's the bike path which is slightly different material and the water and then that again, but as we always had the end with it in the little things, there's hardly anything on the sidewalk. It's still in the same kind of color tones. Yeah, I agree. I agree. Even though like I'm in real life. I like the fact that you know, these yellow pavements and stuff, but it doesn't add much to the complexity here.

Participant 10: I feel like maybe in the in a model it's also because the color of the grass here is lighter than in real life. Yeah, now it's light green. Some, some kind of like green. Well, in reality, it's darker green. Yeah, I agree. So maybe that kind of throws you off a little. Yeah.

Participant 11: It's a combination. I think of the Whitestone also the Whitestone like in the sight of the chair, the candle combined with its a lot of white a lot of light caught really light. The last one with the bright red bricks and then the more differences in colors. Yeah, this way.

Author: Yeah. Interesting. Yeah, I'm just wondering if so like for these ones, I tried to make it look more like a sketch. So, I took all like the bikes out and things that looked a little bit too like photorealistic. So, I'm wondering like, don't do that. Those kinds of things, like really add to the complexity like or? Yeah, I'm not sure.

Participant 10: I think if there's more going on than it does add to like your perception of complexity. Because that's one more complex. Yeah. I also prefer to last model

actually. Because that's more Yeah. Just concrete actually. Can clear Yeah, although I do like the, like the work. The canal like the size of the canal. Not the like a wall but this is more it's not like a straight.

Participant 11: Yeah, these ones are at an angle. Yeah. Yeah.

Participant 12: I do like it better

Participant 10: The other model also had it at an angle, but I think the darker textures it was hard to tell. No problem.