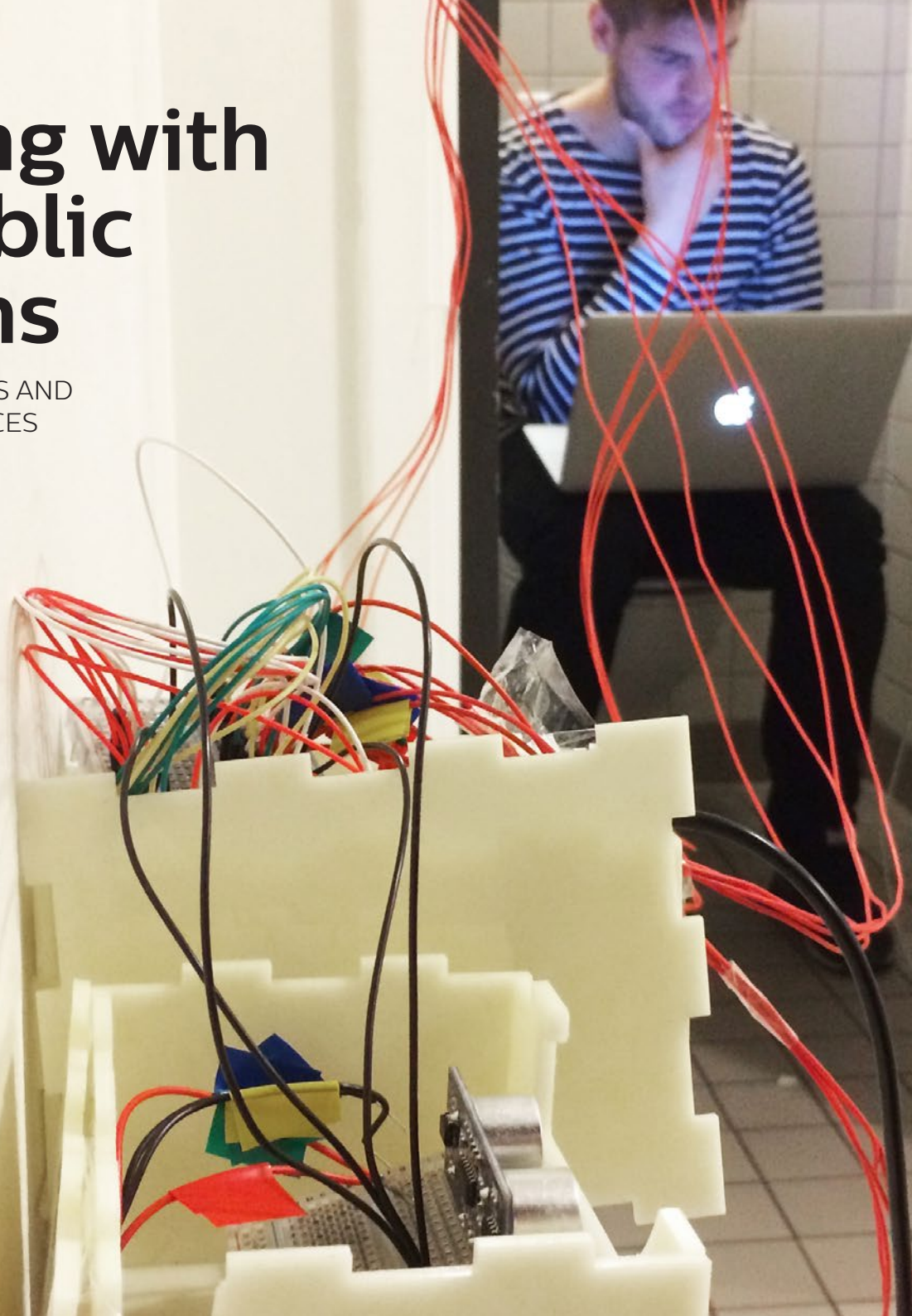


Interacting with Large Public Restrooms

- RESEARCHING TRANSITIONS AND DESIGNING FOR EXPERIENCES



THESIS IN DIGITAL DESIGN AND COMMUNICATION

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WRITTEN BY

Andreas Sikjær Sørensen

Jesper Hjorth

SUPERVISED BY

Erik Grønvall

Laurens Boer

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Abstract

I dette speciale undersøger vi ud fra et *interaktionsdesign*-perspektiv hvordan mennesker interagerer med offentlige toiletter. Vi er interesserede i at forstå hvilke aspekter der knytter sig til brugeroplevelsen i *transitions* (overgange) mellem fysiske rum på offentlige toiletter. Dette er interessant, fordi vi mener, at denne kontekst rummer et uudnyttet potentiale for at gøre brug af digital teknologi i forhold til research og design.

Vi anvender digital teknologi til at undersøge faktorer i den eksisterende praksis af offentlige toiletter ved at designe en interaktiv installation i fuld skala, der primært adresserer *privacy* (privathed) i forhold til eksponering. Vores designkoncept Tune Toilet har til formål at maskere brugeres uønskede lyde og hjælpe dem med at gennemskue andre brugeres aktuelle eller tidligere brug af toilettet. Installationen fungerer som et *ambient information system* der anvender lyd som den semiotiske modalitet. Udover at adressere aspekter af eksponering demonstrerer vi hvordan et interaktivt digitalt system til offentlige toiletter kan designes.

På baggrund af etnografiske undersøgelser identificeres fem fysiske overgange på offentlige toiletter: *Entering, choosing a stall, leaving stall, cleaning* og *exiting*. Gennem en analyse af overgangene udledes fem aspekter: *Distance, sound, hygiene, exposure* og *availability*. Disse aspekter har forskellig indflydelse på brugeroplevelsen samtidig med, at de er forbundne i komplekse relationer. På baggrund af analysen fremsættes syv indsigter om brugen af offentlige toiletter,

som danner grundlag for vores efterfølgende designfase. Formålet med designprocessen er at berige brugeroplevelsen samt, at anvende viden fra de identificerede aspekter til at informere vores research.

I vores metodiske tilgang kombineres *ethnografi* og *constructive design research* med det formål at genere ny viden gennem design af en konstruktion på grundlag af feltarbejde. Denne kombination resulterer i en ekstensiv design research process, hvor fokus både er på undersøgelse af menneskelig adfærd, design konstruktion og test. Vi argumenterer for at kombinationen har hjulpet os med at generere viden, der ikke ville have været mulig gennem en isoleret metodisk tilgang.

Viden genereret i dette speciale er brugbart i flere henseender. Ved at diskutere design for privathed på offentlige toiletter foreslår vi begrebet *involuntary exposure*. Vi argumenterer for at ufrivillig eksponering indfanger den paradoksale følelse brugere oplever når de anvender offentlige toiletter til private gøremål. Ved at diskutere vores design af et *ambient information system* foreslår vi at definitionen af et sådant system skal udvides til at inkludere *intangible ambient information systems that uses sound*. Til at støtte fremtidigt design af sådanne systemer præsenteres fem anbefalinger baseret på vores erfaringer.

Keywords: Public restrooms, transitions, privacy, ambient information system, UX, ethnography, constructive design research

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1 – Introduction

Digital technology have become an embedded part of the physical infrastructure in western countries post millennium. As technology has become smaller the potential for digital solutions have become bigger. Physical environments are increasingly being altered with digital solutions that influence people's experience of the environment. However, some physical environments seem to be pristine to the digital alteration, e.g. public restrooms.

We are intrigued by the lacking presence of digital technology in public restrooms because it is our impression that this context contains paradoxes that are worth exploring in detail, e.g. doing private things in a public space. Specifically we seek to explore how users interact with public restrooms to understand the underlying factors of the interaction. Building on that understanding we strive to design an interactive digital systems for public restrooms that enriches the experience of transitions.

The term *transition* is used for many purposes depending on the context it is used in. In medical terms it is for example used to describe the “*passage from one condition to another*”

(Transition [Def. 1]). In music it describes the “*change from one key or tonality to another*” (Transition [Def. 2]). In physics it is defined as an “*alteration of a physical system from one state to another*” (Transition [Def. 3]). The definitions provides synonyms that can help us grasp the notion of transition as a passage, a change, or an alteration from one to another. They do however differ in what the transition refers to e.g. condition, key, tonality, or state. Our field of research (large public restrooms) manifest itself as being a physical space, where users performs actions through physical movement over time. Thereby we understand a transition as a *physical movement from doing one action to another*. This definition center around the physical movement of the body causing a change.

Research question

How do aspects of transitions influence people's experience in use of large public restrooms?

The research question can be divided into two separate questions i.e. *what are the aspects of transitions of large public restrooms* and *how do these aspects influence people's experience?*

Motivation and background

As graduate students with a specialization in *interaction design* from the IT University of Copenhagen (ITU), we are educated to solve problems in the world using digital solutions. In order to do that successfully, it requires an understanding of both human needs and technology. We often see it as our task to build the bridge between people and technology. This is not an easy task because human needs change, and technology designed to accommodate those needs potentially create new needs or problems. This means that a design and its impact can only fully be understood after it is created and introduced to the world.

This complex interplay between new technology and human needs is the main reason we in this thesis prioritize designing, building and testing. We have often concluded educational projects with an unfulfilled curiosity about how the final concept or prototype would have impacted the world. We are convinced that a process, including both research, design, and test, is an ideal way to create knowledge.

Due to our specialization in interaction design we position our approach in relation to many different academic disciplines, design practices, and interdisciplinary fields. We use Rogers et al.'s (2011) figure of *Interdisciplinary Overlapping Fields* to offer an introductory overview of interaction design's relation to other areas (Figure 1.1).

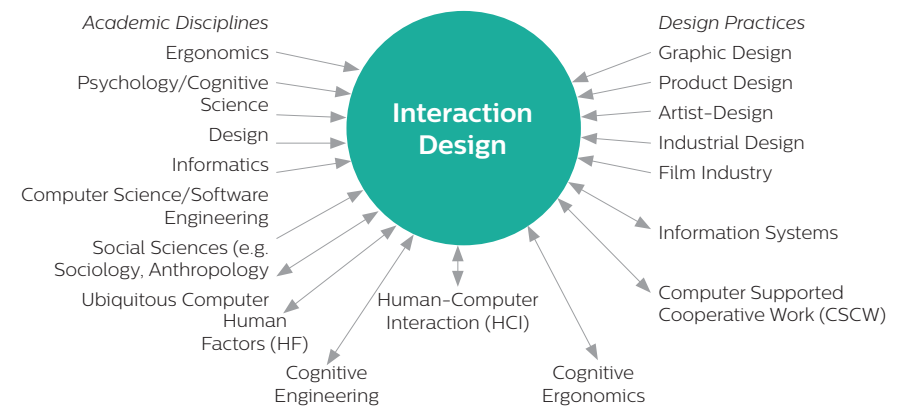
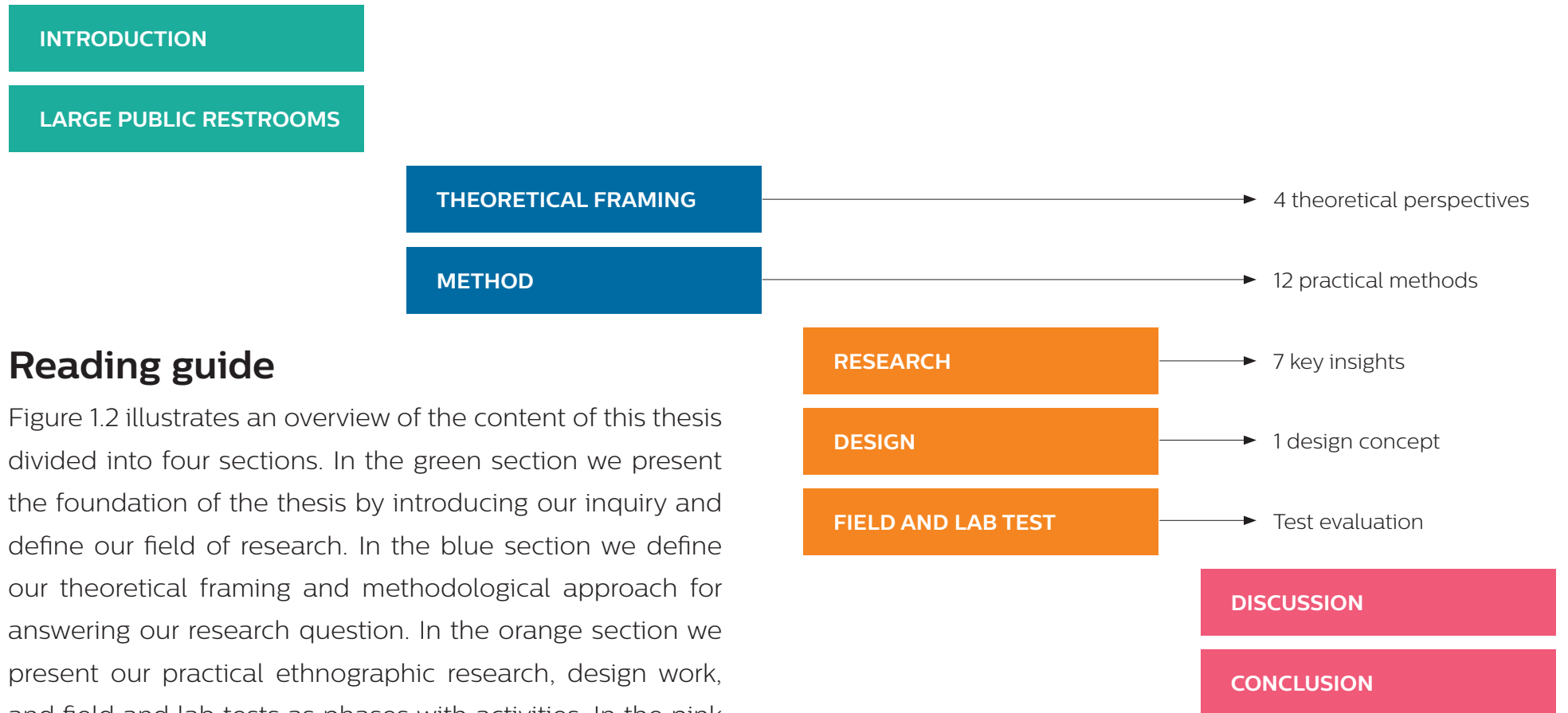


Figure 1.1 – Interdisciplinary Overlapping Fields from Rogers et al. (2011), p. 10

Our overall goal of studying and practicing *interaction design* is to design digital solutions that improves human lives by “[...] creating user experiences that enhance and augment the way people work, communicate, and interact.” (Rogers et al., 2011, p. 9).



Reading guide

Figure 1.2 illustrates an overview of the content of this thesis divided into four sections. In the green section we present the foundation of the thesis by introducing our inquiry and define our field of research. In the blue section we define our theoretical framing and methodological approach for answering our research question. In the orange section we present our practical ethnographic research, design work, and field and lab tests as phases with activities. In the pink section we discuss implication for design and theory, discuss methodological reflections and finally conclude the thesis by answering our research question. The structure is linear; meaning that the information in each section build on the previous sections. The structure does not entirely reflect our thesis process. Instead it is organized with readability in mind.

Figure 1.2 - Reading overview

2 – Large Public Restrooms

The field of research in this thesis is large public restrooms. In this chapter we define our understanding of large public restrooms by drawing on academic literature, online resources, and our own perception based on experience from a Danish point of view. Afterwards, design examples and relevant literature is presented to give an overview of the research related to large public restrooms and to highlight the relevance of the herein reported project.

Type of room

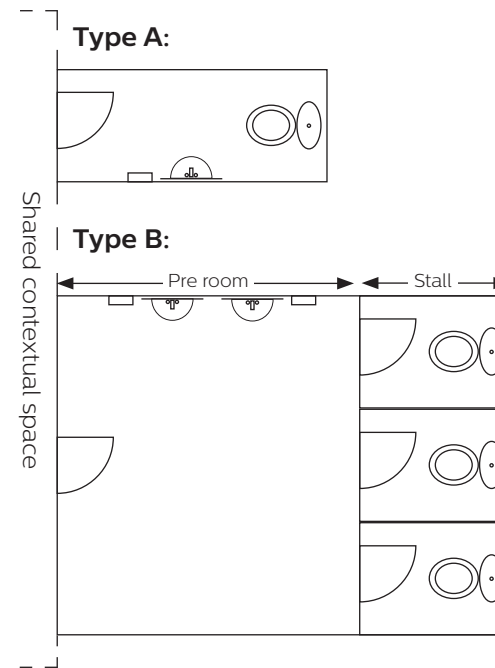
If we break down the word restroom into its linguistic origin we must understand the meaning of the words rest and room. The former referring to a state of mind in between sleeping and activity associated with e.g. refreshing ease, relief, and freedom from disturbance, (Rest [Def. 4]). The latter referring to the physical space associated with e.g. a portion of space in a building or structure, and a space occupied by or available for someone or something (Room [Def. 5]). These definitions are very general and point to the unclarity of the merged word rest-room. According to the online dictionary Merriam Webster, a restroom is in Western culture: “a room in a public place with a sink and toilet” (Restroom [Def. 6]). Public in a general sense refers to a facility that is shared with people in a society. A characteristic of public restrooms is that they

typically are segregated by gender, encouraging men and women to use different restrooms. However, gender-neutral restrooms have recently been implemented in Western societies (Bergum, 2014).

There is no universal design of public restrooms. The shape of restrooms differs primarily in relation to the architectural structure of buildings. We are using Berry et al.'s (2012) classification of two main types of restrooms because we have identified these two restroom layouts in our initial research (Figure 2.1).

Figure 2.1 -Types of public restrooms (a schematic overview) with example of type B

- A. Single user restroom: Where the restroom is directly connected to the shared contextual space.
- B. Multi user restroom: Where a shared pre room distributes access to multiple stalls. These restrooms are by definition larger than separated restrooms because there is an extra room in between the shared contextual space and the multiple stalls.



Type B example:



In this thesis we are focusing on **large public restrooms** that have a shared pre room (type B). We identify a greater potential in multi user restrooms, because the pre room extends the physical movement from the shared contextual space to the individually used stall, which presumably makes the aspects of the transition more apparent. The pre room also creates a temporal social situation, which we find interesting due to our own experience of the social interplay between users, e.g. awkward, embarrassing, or fun moments.

STANDARDIZATION

In Denmark, building regulations and the labour inspectorate have established a set of requirements for larger institutions and workplaces, e.g. determining that a pre room in the transition from the WC-room to the shared- or office areas is required (Bygningsreglementet, 2015). These requirements also determine quantitative information about size, distance, and number of specific fixtures inside the restrooms based on the presumed use (Arbejdstilsynet, 2005; Bygningsreglementet, 2015). The function of legislation and requirements is to standardize how public restrooms in general are being designed.

GUIDELINES

In the United States, The American Restroom Association communicates knowledge of how to design great public restrooms by identifying problems, present design guidelines and mediate legislation and regulations. It is a resource for seeking inspiration and detect potential problematic aspects of a design. Among the wide range of guidelines they suggest using door-less *Labyrinth entrances*, because it avoids surface contamination and has proved to minimize criminal activity, because it is more likely to be detected if no doors exist. Also they suggest background music inside the restroom, because it, besides improving the ambience, also provides a level of acoustic privacy (The American Restroom Association, 2016). The function of these guidelines is to suggest and improve restroom design.

Cultural differences

Besides the difference of public restrooms due to architectural considerations, public restrooms also differ depending on culture and geography. In our own experience when travelling, we have learned at first hand that toilet going is done differently around the world. Generally speaking a separation between Western-style and Eastern-style toilets can be made (The American Restroom Association, 2016;

Sargunaraj, 2010). Where the former can be characterised as a sitting toilet with a flushing cistern accompanied with paper flushed into a sewer system. These are most common in the western countries, such as the United States, Japan and European countries. The latter can be characterized as a squatting latrine without paper. These are more common in Middle Eastern countries, such as Pakistan and India. The use of restrooms is logically tied to the structural composition of the physical space, for instance, if there is no toilet paper available, you cannot use paper. Likewise, if there is no lock on the door, you will have a harder time communicating that the toilet is occupied. These possibilities and constraints are given by the culture which the public restroom is located in. This thesis is rooted in western culture, centered around the Western-style toilet. It means that we limit ourselves to focus on westerners' use of public restrooms and the transitional aspects of western-style restrooms.

Literature review

In this section we review literature and design examples related to public restrooms. We highlight research focused on conditions for disabled users, hygienic aspects, technology aspects, and aesthetics and entertainment in public restrooms. Additionally we include literature concerning doors to include the transitional aspect of restrooms.

In the literature related to public restrooms researchers have used different perspectives to focus on users with disabilities. Molenbroek et al. (2011) supports the tradition of *Inclusive Design* by designing and testing a “*Friendly Rest Room for older people and persons with a disability, enabling them to gain greater autonomy, independence, self-esteem, dignity, safety, improved self-care and thereby enjoy a better quality of life*” (Molenbroek et al., 2011, p. x). Mamee and Sahachaisaeree (2010) are seeking to establish *universal design* criteria for users with walking disabilities. Kitchin and Law (2001) bring the discussion of disabled people to a social level by providing a *critical analysis* of the provision of accessible public toilets in Ireland. They address

the consequences of badly designed public restrooms for disabled users and suggest improvements in the legislation to change the attitude of design professionals and the general public. The literature on this area points to the need for universality of design solutions in the context of public restrooms. Even though we do not seek to contribute directly to the tradition of Inclusive Design, Kitchin and Law's critical review highlights the importance of making sure that our design solution does not exclude users from a public facility that is considered to be essential and accessible to everyone.

Another well-researched area of public restrooms, and restrooms in general, is the topic of hygiene. Most design work in this area is built upon research on hand hygiene, social norms, and fear of contamination. Judah et al. (2009) gains knowledge of social norms by testing 18 interventions in public restrooms. They confirm previous studies by observing a significant increase of hand wash if there is visual presence of other people, especially in the men's room (Judah et al., 2009). Olatunji & Armstrong have studied *contamination fear* in public restrooms as a theme in obsessive compulsive

disorder (OCD). Besides mapping thresholds in different users' fear, they argue that mood induction is a key factor for the perceived contamination fear. Meaning that if a user is aware (as opposed to being neutral) of the potential exposure to sources of contagion, the higher the fear will be (Olatunji & Armstrong, 2009). Berry et al. (2012) contribute to the literature on hand wash behaviour and routines of the general public by exploring 48 fast food restaurants in the United States. By linking environmental characteristics, e.g. restroom designs, facilities, and appliances, to impressions and behaviour, through a detailed mapping of touch points, the authors are able to break the routines of users into pieces and afterwards engage in a dialogue with users through evidence based scenario testing. Their findings are meant to improve intervention strategies for restroom designers and improve hygiene politics. The literature in this area emphasizes the social embeddedness in this context as direct or indirect exposure. It is important to understand that hygiene shapes users' behaviour in relation to others via overlapping contact or as traces.

As technology becomes an integrated part of our daily lives

our surroundings are changing. The potential for enhancing otherwise mundane situations can be explained with the term *Internet of Things* as devices become connected to the Internet and analogue artefacts are being put to digital use (Chui et al., 2010). Philips Research have among others been conceptualizing products for the *Intelligent Bathroom*, like the *The Interactive Mirror* – a digital augmented interface where users can interact with their health data (Lashina, 2004). Design examples like interactive mirrors suggest a redesign of our surroundings, because there is a potential for enrichment using technology. Lyytinen and Yoo (2002) explained *pervasive computing* as a dimension of *ubiquitous computing*. In these terms the idea is that environments can become “intelligent”, by handling human behaviour through “invisible” sensors, and thereby become a meaningful part of people's lives in specific environments (Lyytinen & Yoo, 2002). The literature stresses the importance of understanding human behaviour in order to design solutions that are appropriate for users in specific situations, otherwise technology has the potential to do more harm than good (Lyytinen & Yoo, 2002). An example of a clever and simple technology solution is the Eco Otomo; a technology gadget

that simulates the sound of flushing and thereby deals with Japanese women's shyness and goal to avoid unpleasant noises. The Eco Otomo gadget was quickly sold out and toilet manufacturers later included the fake flushing as a function on the toilet, and thereby reduced the water use enormously (Matsukawa, 2009). Another design example is Boer et al.'s attempt to make a toilet brush that should provide joy, and if necessary, stimulate toilet goers to use the brush. Unfortunately participants from field trials experienced “*the brush as undesirable, predominantly because the sounds produced by the brush would make private toilet room activities publicly perceivable*” (Boer et al., 2015, p. 151). These two examples emphasize the importance of understanding the situation where technology is being added; meaning that it is crucial to understand norms and values by investigating people's behaviour and attitudes when designing technology to public restrooms.

Research on public restrooms as places for aesthetic expression and visual communication have also been made. Cast (2009) approaches male toilets as a cultural scene for post-modern art. She examines a wide pallet of urinals.

These include regular, political, artistic, inappropriate and humoristic urinals. Other examples are urinals with integrated games or urinals highly integrated in the environment or architecture of a building. Graffiti in public restrooms have also received academic attention. Green (2003) view graffiti as a unique window into the relationship between gender, language and social context. He however emphasizes the importance of language and style, which he argues have been neglected for the past century compared to the focus on topic. Besides art (legal or not) some attempts of entertainment in public restrooms have also been made. In a newly opened public restroom at Fangshan Square in Beijing, China, the government has decided to install Wi-Fi-Internet, power outlets, interactive entertainment screens etc. The restroom serves as a test to inform the design of 57.000 public restrooms which the Chinese government is going to renovate or build over the next years. So far the feedback from the users is that it causes longer lines and is a waste of money (Hernandez, 2015). These examples of aesthetic expression and entertainment highlight a public restrooms potential and limitations for supporting experiences not only related to the main functionality.

Since we are interested in understanding aspects of transitions, we find it relevant to review literature relating to doors since it is an embedded part of public restrooms. Roumen investigates, in his thesis from 2013, how surprise and curiosity can be applied in product design, particularly doors, by evaluating three theoretical frameworks for this purpose. Following the needed engagement to interact with a door, Wilde et al. address *design through movement*. They state that artefacts and experiences designed to reflect the inherent features of our embodiedness can transform normative physical awareness into surprise and knowing (Wilde et al., 2011). In a concrete example one of the authors has made the installation “deur\gang\” where a temporary hallway is created in the doorway, while the users enter the door and afterwards disappear (Klooster, 2010). Literature focusing on the engagement of the body is useful when designing experiences where movement is a natural part of it. In this perspective technology becomes a part of the world surrounding the user. The user’s engagement through movement is the key to unlock the experiences – analogue as well as digital.

3 – Theoretical framing

In this chapter we define our theoretical framing of this thesis. Theory on the *public-private* dichotomy, support the process of defining our field of investigation, and leads to the presentation of relevant theory on *privacy*. By presenting theory on *user experience* we achieve an overview and present our practical perspective on the incomprehensive nature of UX. Lastly we present a taxonomy of *ambient information systems* to define conditions for a design construction.

Public-private

The distinction of what is *public* and *private* can seem intuitive, and has been called one of the *grand dichotomies of western thought* (Weintraub, 1997). This means that society can be divided in two separate parts of public and private (spheres) with no overlaps. The result being that one element has to be public or private as Habermas (1996) have tried to categorize as public and private *spheres*. This distinction is however problematic because these concepts can have very different meanings at once, and therefore leads to confusion (Weintraub, 1997; Fraser, 1990). Weintraub have identified four different distinctions of the terms public and private. The first being the difference between *state* and *family*. The second is a distinction between the *state* and *market economy*. The third comes from political theorists, who

describe the political community as public and distinct from the economy, the household and administrative apparatus of the state. The fourth and last distinction derives from cultural critics who “*treat the public realm as the arena of sociability, a stage for appearing before others*” (Kohn, 2004, p. 8). Kohn (2004) proposes to treat the public space as a cluster concept instead of a dichotomous distinction. A cluster concept is in her description a term, which have multiple and sometimes contradictory definitions. She uses three core concepts to define a public space: *ownership*, *accessibility* and *intersubjectivity*. This creates a complex continuum from public owned and accessible squares to private owned and inaccessible homes. *Intersubjectivity* refers to the kind of encounters that a space facilitates, e.g. individuals positioned as members of an audience at a stadium, are less likely to engage in social interaction compared to individuals positioned as co-creators in a meeting room (Kohn, 2004). We build our understanding of the public space on Kohn’s three core concepts because it offers a useful framework to describe and understand a specific public space.

Privacy

The concept of *privacy* is related to the distinction between public and private, because privacy is intuitively related to the private space. We separate privacy from the private-public distinction in this thesis, as it enables us to treat the concept of privacy as desirable and perhaps obtainable in a public space, and not related to the private space alone.

Iachello and Hong (2007) divide the research on privacy in Human-Computer Interaction (HCI) in two major directions of *Data Protection* and *Personal Privacy*. Data protections refer to how governments and commercial entities manage personal identifiable information. This direction is often focused on legislative standards and policies. Personal privacy refers to how people manage their own privacy with respect to other individuals. The research on personal privacy in HCI builds on human behaviour related to privacy (Iachello & Hong, 2007), but tends to focus on communication technologies like instant messaging (Patil & Kobsa, 2004; Grinter & Palen, 2002), location-based services (Barkhuus, 2004) or on concrete IT applications like

RAVE at EuroPARC (Gaver et al., 1992). We identify a lack of research in HCI concerning how technology influence privacy issues between people, instead of between people and technology.

The following will focus on a definition of privacy that builds on the concept of personal privacy without relation to communication technologies. The goal is to frame the concept of privacy in a way that is suitable for discussions of privacy in large public restrooms. Privacy is unfortunately not easy to define even though it is considered an important right (Bellotti & Sellen, 2000). One general definition of privacy is “[...] *the claim of individuals, groups or institutions to determine themselves when, how and to what extent information about them is communicated to others.*” (Westin, 1967, p. 7). Former professor at Columbia University Alan F. Westin (1929–2013) is considered one of the creators of the concept of data protection (Iachello & Hong, 2007), but his writing on “The origins of modern claims to privacy” is related to personal privacy, and is useful to get a basic understanding of privacy (Westin, 1967). We argue that the following four expressions are all subcategories to Westin’s

definition, and might also suggest a broader idea of privacy than just the control of information. The expressions of privacy are “*to be free from physical invasion of one’s home or person*,” “*the right to make certain personal and intimate decisions free from government interference*,” “*the right to prevent commercial publicity of one’s own name and image*” and “*the control of information concerning an individual’s person*” (Murphy in Iachello & Hong, 2007, p. 4). The second and third expression are related to data protection, but the first and last are relevant to personal privacy and add physical invasion in addition to control of information. The following quote elaborates on *invasion of privacy*.

What is considered “too close” a contact and therefore an “invasion of privacy” in human society will often be an odor, a noise, a visual intrusion, or a touch; the mechanism for defining privacy in these situations is sensory (Westin, 1967, p. 9)

To clarify, we treat privacy as being free from sensory or physical invasions and the ability to control when, how and to what extent information about you is communicated to others.

It is necessary to introduce the concepts of *curiosity* and *discretion* to understand the concept of privacy to its fullest. *Curiosity* is “*a tendency on the part of individuals to invade*

the privacy of others [...]” (Westin, 1967, p. 19). It is also what motivates children to explore the environment around them, and adults to learn what is happening to others. People’s curiosity may lead to invasion of another’s privacy or just casual eavesdropping, which is a regular part of most people’s daily life. Curiosity serves a number of important functions in a society, because it helps circulate information. *Discretion* – “*the willingness of people to respect the privacy of others*.” (Westin, 1967, p. 54) is related to curiosity as it can be viewed as its counterweight.

Another way to view the opposites of privacy and curiosity, is as a dialectical process where all individuals are constantly navigating between seeking privacy and companionship. This helps individuals to control the different roles they play in a society.

The reason for the universality of this process is that individuals have conflicting roles to play in any society; to play these different roles with different personas, the individual must present a different “self” at various times. Restricting information about himself and his emotions is a crucial way of protecting the individual in the stresses and strains of this social interaction. (Westin, 1967, p. 13)

Even though curiosity, privacy and the dialectical process between privacy and companionship are generally universal, the norms of privacy are not. Anthropological studies show

large differences between different societies. Entry to the house, sexual relations, sleeping habits, religious acts and the rooms of a house are different areas where social norms differ between societies (Westin, 1967).

User experience design

‘Experience’ is the word that is most likely to express something of the felt life. It is a very rich word, discursively open and complex, and redolent of life as lived, not just as theorized. (McCarthy & Wright, 2004, p. 29)

Experience is a notion difficult to grasp and is related to personal and subjective valuations, as the opening quote for this section implies. User experience (UX) was initially introduced as a challenge to the task oriented analysis and evaluation techniques in HCI, e.g. usability testing. For the past twenty years UX have developed as a tool to approach issues beyond the task-related (Hassenzahl & Tractinsky, 2006). UX is still without a widely accepted definition despite being well known and used as a term in the interaction design community (Rogers et al., 2011). UX as a term have been criticised for being too vague by many authors (Bargas-Avila & Hornbæk, 2011; Hassenzahl & Tractinsky, 2006; Hellweger & Wang, 2015). Mike Kuniavsky gives his definition of user experience in his book *Smart Things*:

The user experience is the totality of end user’s perception as they interact with a product or service. These perceptions include effectiveness (how good is the result?), efficiency (how fast or cheap is it?), emotional satisfaction (how good does it feel?), and the quality of the relationship with the entity that created the product or service (what expectations does it create for subsequent interactions?) (Kuniavsky, 2010, p. 14)

Hassenzahl and Tractinsky try to answer the question “What is UX?” and end up with what others consider a definition (Hellweger & Wang, 2015):

UX is a consequence of a user’s internal state (predispositions, expectations, needs, motivation, mood, etc.), the characteristics of the designed system (e.g. complexity, purpose, usability, functionality, etc.) and the context (or the environment) within which the interaction occurs (e.g. organisational/social setting, meaningfulness of the activity, voluntariness of use, etc.) (Hassenzahl & Tractinsky, 2006, p. 95)

These definitions are clear examples of the complexity of UX. Especially the parentheses in the latter, exemplify some of all the variables that are relevant for the experience. The multidimensional and multifaceted nature of UX is highlighted by Hellweger and Wang’s (2015) study of 21 papers containing original definitions of UX. They found 114 UX-related terms, which they collected in a UX conceptual framework shown in Figure 3.1 (UX overview).

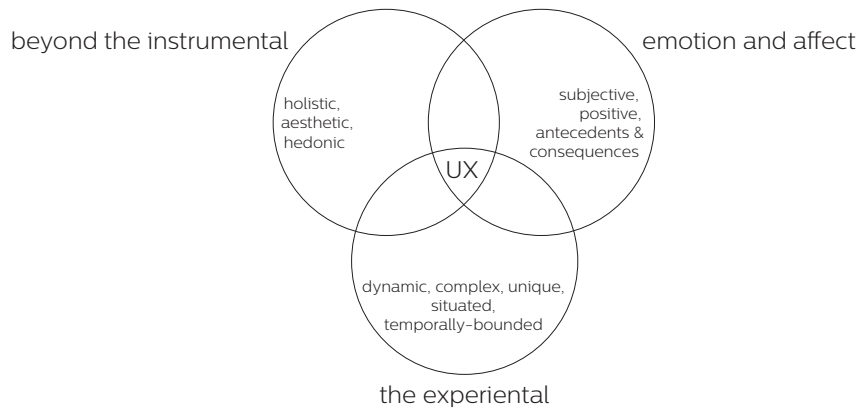


Figure 3.2 – Facets of UX from Hassenzahl & Tractinsky, 2006, p. 95

Ambient information system

Ambient sound as a channel of information is at the core of the working prototype presented later in this thesis. Pousman and Stasko (2006) presents “A Taxonomy of Ambient Information Systems” which we will draw on to describe, analyse, and discuss our design as an ambient information system.

The notion of *ambient information system* is build on multiple terms including *ambient display*, *peripheral display*, and *notification system*. Pousman and Stasko (2006) define ambient information systems as:

- Display information that is important but not critical
- Can move from the peripheral to the focus of attention and back again
- Focus on the tangible; representations in the environment.
- Provide subtle changes to reflect updates in information (should not be distracting).
- Are aesthetically pleasing and environmentally appropriate. (p. 2)

We align with Pousman and Stasko’s (2006) definition of ambient information systems (AIS) except the third line stating a system as tangible. We question Pousman and Stasko’s focus on the tangible, because of their mentioning of the project *Audio Aura* as one of inspiration sources for their terminology. The goal of *Audio Aura* is “to provide *serendipitous information, via background auditory cues, that is tied to people’s physical actions in the workplace*” (Mynatt et al., 1998, p. 566). We argue that there is a contradictory relation between focusing on tangible systems and including an example of a system that is intangible. This contradiction might suggest that Pousman and Stasko is not entirely clear on whether or not intangible auditory systems like *Audio Aura* can be treated as an AIS. We argue that AIS can be intangible, which we discuss in chapter 8.

AIS have according to Pousman and Stasko (2006) four dimensions, which can be thought of as design choices that are important when designing or building it. The four dimensions are: *information capacity*, *notification level*, *representational fidelity* and *aesthetic emphasis*. Each dimension is structured from low to high.

Information capacity represents the number of discrete information sources that a system represents. When measuring the dimension of information capacity one needs to count the information elements which are discrete information “nuggets”. A day schedule for a class that contains the elements of time, room and teacher is an example of a system that contains three information elements.

Notification level is the degree to which a system interrupts a user. Notification level consists of five categories: *user poll*, *change blind*, *make aware*, *interrupt*, and *demand attention*. User poll refers to lowest notification level, because users need to call information themselves. Change blind refers to information available without the user noticing it. Make aware makes information available to the user in a subtle way. Systems that have the two highest notification levels (interrupts and demand attention) are not considered AIS. Change blind and make aware notifications are at the core of AIS, because information at these levels is available without the need of interaction and does not disrupt or require attention of the user (Pousman & Stasko, 2006).

Representational fidelity describes how a system displays data from the world encoded into patterns, pictures, words, or sounds. This can be described in the language of semiotics.

*A semiotic **sign** is made up of three parts. The object is called the **signified**; it is the physical thing or idea that the sign stands for. The **signifier** is the representation of the object, which could be a word, a picture, or a sound. The **sense** is the understanding that an observer gets from seeing or experiencing either the signified or its signifier.* (Pousman & Stasko, 2006, p. 5 [highlighted as in the original text])

Signs can be *symbolic*, *iconic* or *indexical*. Symbolic signs are arbitrary. Iconic signs have an intermediate degree of transparency to the signified object, which means that they have some similarities or resemblance to the object or essential parts of the object. Indexical signs are directly connected to the signified (Pousman & Stasko, 2006).

The aesthetic emphasis is the relative importance of the aesthetics of the system. To clarify, aesthetic emphasis is not an aesthetic evaluation of the beauty of a system. It is the importance given to aesthetics in a system by designers (Pousman & Stasko, 2006).

4 – Method

In this chapter we present methods used in this thesis. Our approach is a combination of ethnographic research and constructive design research (CDR). Ethnographic field studies is rooted in social sciences. CDR comes from different traditions, primarily inspired by industrial design and interaction design as design disciplines. We argue that the strength of the combination is the potential of CDR to generate additional knowledge from a design that have been informed by research on human behaviour through ethnographic methods.

We unfold our understanding of ethnography and CDR in the next section along with our approach for using them. Later in this chapter we give a detailed description of concrete practical methods, and our use of them.

Figure 4.1 illustrates our methodological process. The green line indicates how knowledge, gained through traditional ethnographic field studies informs the following design phase (orange loop). By intervening with the current practice of using a public restrooms with our design construction we gain additional knowledge of how users experience transitions in large public restrooms. This phase is what we call lab and field test (the blue line). The research phase is unfolded in chapter 5, the design phase in chapter 6, the tests in chapter 7, and the following discussion in chapter 8.

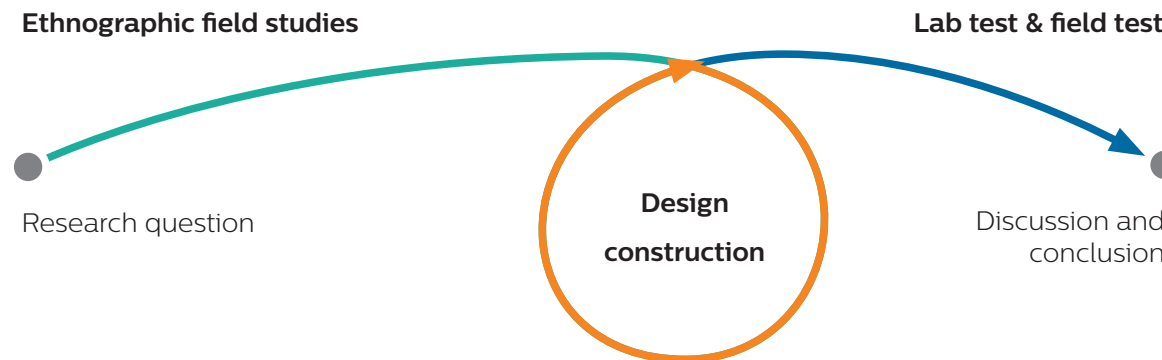


Figure 4.1 – Method overview

Approach

Here we explain our understanding of ethnography and CDR before we present the practical methods being used. These are the main methodological areas in which we position ourselves.

ETHNOGRAPHY

Our approach for studying human behaviour is rooted in the social sciences specifically the tradition of anthropology. We study human behaviour and the ways people construct and make meaning of the world. Ethnography differs from other social and behavioural sciences by assuming that we first must discover what people actually do and the reasons they give for doing so, before we can suggest interpretations based on our own personal or professional understanding (Andersen et al., 1999; Atkinson et al., 2001; Konopinski, 2013; LeCompte & Schensul, 1999).

By using ethnography we seek to get as close as possible to people's understanding of the world in order to understand their behaviour. By using this approach we, as researchers, become a tool for data collection since we immerse ourselves into the context in order to present an accurate reflection of

participants' perspective and behaviours using ethnographic methods. In Willis and Trondman's words ethnography:

Is a family of methods involving direct and sustained social contact with agents, and of richly writing up the encounter, respecting, recording, representing at least partly in its own terms, the irreducibility of human experience. (Willis & Trondman, 2000, p. 5)

In this quote it is worth pointing out the phrase "*richly writing up*" as a way to keep the complexity and depth of the reality in the documentation. Geertz's (1973) present the notion of *thick descriptions* (borrowed from Gilbert Ryle) as a tool to create descriptions that meets the criteria of depth by emphasizing the complex and meaningful structures human behaviour express itself in. We are inspired by this notion in our use of visual methods as descriptive tools.

Ethnographic studies often brings up ethical questions, and our context of large public restrooms is no exception. In our research phase we encountered issues such as: Are we allowed to take pictures of people using restrooms? Can we use video surveillance as documentation? Are we pushing people's boundaries when asking about their restroom visit?

By drawing on literature and guidance from our supervisors, we have learned that there is no right or wrong answers to these questions (Konopinski, 2013). Therefore researcher must be creative and flexible in the way they approach the field. In that sense research becomes a learning process (Andersen et al., 1999) where ethical dilemmas are solved by respecting the situation and adjusting to it. Ethical consideration influenced the decision to use drawings of people's movement on floor plans instead of video documentation while doing our field studies. Ethics was also an important factor when we decided not to interview people right after they have used a restroom.

Literature in ethnography clearly states that multiple data sources are needed to successfully do ethnography; meaning both qualitative and quantitative data (LeCompte & Schensul, 1999; Konopinski, 2013). Konopinski (2013) in particular point out that due to the time-consuming nature of what she identify as *primary ethnographic fieldwork methods*, researchers should supplement these methods with other *secondary research methods*. Later in this chapter we explain our practical ethnographic methods for doing

our field study and analysis. The methods include *informal conversation*, *participant observation*, *visual methods*, *anonymous online questionnaire as elicitation*, and *focus group*.

CONSTRUCTIVE DESIGN RESEARCH

CDR offers experience in how to integrate design and research. Koskinen et al. (2011) present the concept of CDR in their book "Design Research: Through Practice", drawing on three approaches for doing design research: *lab*, *field* and *showroom*. Later in this chapter we present concrete practical methods related to these approaches. CDR mostly builds on work carried out in *industrial design* and *interaction design*. The two traditions differ in many ways:

The most notable differences are in tradition and technology: industrial design has roots producing material goods, and interaction design is based on computer science, film, and Web design. Industrial design is product-oriented, three-dimensional, and relies heavily on sketches, mock-ups, models, and physical prototypes. Interaction design is time-oriented and relies on personas, scenarios, narratives, and software prototypes. (Koskinen et al., 2011, p. 8)

We argue that our design draws on these two traditions because we build a physical prototype and design the interaction using software. What is important from a methodological perspective is how construction can lead to new knowledge. By using the approach of CDR we seek to gain knowledge, beyond what we can get using only an ethnographic approach. The following quote explains the essence of it.

When researchers actually construct something, they find problems and discover things that would otherwise go unnoticed. These observations unleash wisdom, countering a typical academic tendency to value thinking and discourse over doing. (Koskinen et al., 2011, p. 2)

Design is complex but CDR gives us as an overall approach for our design process, and a way to gather knowledge by construction and not just thinking. We utilize methods from both interaction design and product design such as sketching, physical prototyping, experience prototyping, and field and lab testing.

Practical methods

In this section we present concrete research methods for doing ethnographic fieldwork, and doing CDR. We introduce the methods, explain how we use them, and present the extend of which they are being used.

INFORMAL CONVERSATION

Informal conversation is a an unstructured ethnographic research method that offers an invaluable way for researchers to more or less knowingly get an idea of what is important to investigate and what is not (Konopinski, 2013).

We have used informal conversation in the initial stages of our research (r.phase 0 and r.phase 1) to navigate and shape our focus. We have sought informal conversations with colleagues, friends, family, employees at the public restroom at Amager Torv (a public square in the heart of Copenhagen), and volunteers at Valby Kino (a large cinema).

PARTICIPANT OBSERVATION

Participant observation is especially appropriate for exploratory studies with a special interest in human behaviour and interaction as viewed from the perspective of users (Jorgensen, 1989; DeWalt & DeWalt, 2010). This intensive ethnographic method is time consuming and researchers

explain that this activity in the early stages sometimes blurs the researchers overview because the complexity of situations usually reveals itself. Nonetheless researchers agrees that combination of participation and observation is crucial when doing ethnographic fieldwork (Andersen et al., 1999; Jorgensen, 1989) because it enhances the quality of the data obtained during fieldwork, and it enhances the quality of the interpretation of the data, making it both a data collection and an analytical tool (DeWalt & DeWalt, 2010). The combination is however a paradox because the presence of a researcher will affect the situation. The goal of capturing the situation neutrally is utopian, and the involvement creates a higher risk of being biased from the specific situation one took part of. To deal with these challenges researchers needs to be aware and reflective of their presence in the situation and do participant observation over longer periods of time (Konopinski, 2013).

By observing public restrooms we discovered that our initial idea of documenting people's behaviour and movement on an individual level did not make sense. The reason was that users' decisions and movement was influenced by the presence of other users (including us). This fact made it apparent that the social interplay between users was a topic of interest. We therefore changed the strategy to draw

and document scenarios of multiple users instead of single users. We define a restroom scenario as: *the period from when a user enters an empty restroom, to the restroom is empty again*. We documented 16 scenarios over a divided period of three hours at the restroom at Amager Torv.

VISUAL METHODS

Visual communication is an invaluable source of non-verbal information about the ethnographic setting. Capturing images and videos and mapping actions visually makes the researcher able to analyse the behaviour and attitudes in a richer sense than verbal because these data forms are not subjectively communicated (Konopinski, 2013). We use visual methods for three purposes: 1) For documenting the irreducible nature of situations by using images, drawings of scenarios, audio, and video. 2) As a mapping strategy for materializing our fieldwork for further explorations by using animating scenarios, re-enacting actions in video. 3) As a way of documenting our own research and design process by using images, figures, and illustrations. Visual methods are used specifically in research phase 1, 2, and 3, as a mean for capturing complexity of human behaviour in the field as thick description. Moreover visual methods was used to externalize and document our analytical work. In the design

phase visual methods are key for both constructional and communicative purposes, which is explained in greater details in the design methods.

ANONYMOUS ONLINE QUESTIONNAIRE AS ELICITATION

There is an embedded distance in the situation of going to the restroom. The sensitivity of the actions performed and the physical blocking by a door and a lock creates the distance. The ethical dilemma in confronting users' intimate experiences made us search for a method that would suit the situation and hopefully encourage people to participate. The online questionnaire offers a structure where respondents can explain their experiences anonymously as a form of elicitation (Konopinski, 2013). This method is however mediated through technology and the user's subjectivity; meaning that we should be careful in concluding the data as valid.

We launched a campaign "Restroom Secrets", in the form of an anonymous online form submission, to gain knowledge of how users perceive and interact with, and within public restrooms. We asked people to share weird experiences, thoughts or assumptions related to the use of restrooms. At ITU the campaign contained a poster (Figure 4.2) with a digital entry inside every toilet stall in the building.



Figure 4.2 - "Restroom secrets" campaign

The campaign ran for two weeks where we encouraged students, colleagues and friends at ITU to contribute to the form anonymously. Info screens placed on each floor advertised for the campaign with the iconic smiling poop emoji and a text saying “*Can we gather empirical research from the toilets at ITU? – Help us by telling your restroom secret next time you visit the loo*”.

We collected stories from 34 respondents. 22 entries are classified as relevant. In these 22 entries a total of 70 statements are made. 52 of those statements are classified as relevant.

EXPERIENCE FLOW AS AN ANALYTICAL TOOL

A wide range of visual tools are developed for creating overview of ethnographic field studies and achieve a useful understanding of people, their experiences, and identify possibilities for interventions, improvements, or more radical innovative solutions center around the user's experience. The global design and innovation firm Frog are structuring their work around *Customer Journey Maps* (Richardson, 2010), where purchasing of a product is central to the visual

mapping. Several visual tools have been developed within Service Design to map different layers of a service by focusing on touch points and stakeholders, e.g. *Service Blueprint* (Bitner et al., 2008) and *Service Ecology* (Polaine et al., 2013). The above mentioned tools center around the capitalistic aspect of the experience (seeing the user as the customer), which means that the goal is set to be of economic value for a company rather than improving the experience itself even though the goal is to do both. Philips Design have developed their *Experience Flow tool* with less emphasis on the users as customers, and instead focused on the experiences the user encounters (Swaminathan, 2014).

We are using Philips Design's experience flow tool as a visual map to overview and identify transitions in large public restrooms. We do that by externalizing findings from the ethnographic field study (i.e. findings, quotes, components, senses), and structure them in a flow diagram organized from the perspective of user experience. It helps us identify relationships between activities, context (environments/spaces), people, and experiences over time (Swaminathan, 2014). The experience flow offers us an overview, similar

to how Berry et al. (2012) created a touch-path model for mapping out hand-wash behaviour and routines in public restrooms. The visual illustration of the experience flow can be found in Figure 5.4, in the next chapter.

FOCUS GROUP

Using focus groups to address findings in a social setting engages users in dialogues and discussions because it is inherent in the format. It helps researchers understand a group's *interpretations*, *interactions* and *norms* in a cultural sense (Halkier, 2009). As opposed to participant observations and the online questionnaire the focus group takes place outside the context, resulting in data being based on the user's subjective interpretation of their behaviour. Nonetheless, the goal is to establish a comfortable situation where participants can discuss intimate personal behaviour in relation to the social norms. This goal cannot be taken for granted since there is a risk that users will engage in the conversation from a normative perspective where generalizations are made. The constructed situation of the focus group allows us as researchers to engage and collaborate with informants using visual communication.

We use the focus group in research phase 2 to understand our findings from research phase 1 in depth. The focus group consisted of six participants and was structured in four activities. In the first two activities the users engaged physically by using visual materials as a way to upon up the discussion. In the last two activities users participated by discussing scenarios and paradoxes. The focus group resulted in a combined graph explaining the user's feeling of privacy, five floor plans visualising the user's preference when choosing stalls in our constructed dilemmas, and 31 written elaborations as quotes, opinions or general views from all four activities.

AFFINITY CLUSTERING

Kuniavsky (2012) present different methods for structuring and analysing data. He distinguish between a *deductive top-down grouping* using predetermined categories, and an *inductive bottom-up grouping* as a product of an immersive process where the data over time reveals new patterns through clustering. The two approaches does not exclude each other. Instead the author suggest that they can complement each other, and stresses that the process

of playing around with different ways to categorize is of great value to the researcher.

Whether inductive or deductive, the goal of this grouping activity is to give each group a short, descriptive label, or code, that characterizes the group. (Kuniavsky, 2012, p. 428)

In the analysis in our research phase we use both inductive and deductive grouping. At first by using the transitions (identified in the experience flow) as a structure for organising the finding as top-down. Afterwards we clustered the findings looking for patterns and themes. We categorise this bottom-up structure through multiple iterations. This method is called *affinity clustering* (Kuniavsky, 2012) and is used as an analytical tool. In our analysis we succeed in combining the inductive and deductive structures in a matrix diagram containing 5 themes, 4 transitions, and 34 findings. We also used affinity clustering to analyse data gained from the lab test. Here 72 statement was structured into seven clusters.

BRAINSTORM

Brainstorming is mistakenly often thought of as an everyday idea generating activity. This is not only a statement by Kelly in his article “The perfect brainstorm” (2000), it is also something we have encountered numerous times in study groups or at work. We try to follow his guidelines to the extent it makes sense for our project. Kelly (2000) present seven guidelines (which he call secrets) for a perfect brainstorm.

We considered the guidelines when we brainstormed ideas in the design phase. We found the following four useful: *sharpen the focus, playful rules, number your ideas*, and *get physical* (Kelly, 2000). We sharpened our focus by defining the following question: “*how can we maximize/minimize the exposure of [variable term]*”. Initially the variable terms originated from the themes analysed in our research such as: distance, sound, hygiene and availability. We realized that limiting the variable term to complex themes was too constraining. Instead we broadly applied any encounters from our research to the question, such as: temporality, use of body, consciousness, transitions, social norms, other users and so forth. Variable question functioned as playful

rules that resulted in a myriad of sketches and ideas drawn on paper or described on post-it's. We worked without critiquing ideas and encouraged each other to come up with wild ideas drawing on the ideas already made. We numbered and named the ideas. All our ideas was sketched out as drawings with short explanatory text, which made it easy to collaborate on together later on. The sketching process is what Kelly (2000) refers to as *getting physical*. We use Buxton's notion of *sketching* as a method for having a *conversation* with the design situation, where a sketch is created as a representation that is read by the mind and knowledge is shaped or reshaped (Buxton, 2007). By brainstorming with sketching we created 42 different sketches. By combining these methods we were able to keep a steady flow of ideas because the manifestation of ideas led to new ideas as an iterative process.

PROTOTYPING

In this thesis we are seeking to construct knowledge through design practice; meaning a construction (Koskinen et al., 2011). We mainly define this construction as a *prototype*, due to the flexible and powerful nature of such a design object.

Our understanding of prototypes stems from Lim et al. (2008) conceptualization of prototypes in their article "The anatomy of prototypes: Prototypes as filters, prototypes as manifestations of design ideas":

Prototypes are the means by which designers organically and evolutionarily learn, discover, generate, and refine designs. They are design-thinking enablers deeply embedded and immersed in design practice and not just tools for evaluating or proving successes or failures of design outcomes. (Lim et al., 2008, p. 2)

By emphasizing prototyping as a way of bringing the design forward and not using it as tool for evaluation, the authors align with Schön's thoughts of the *reflective practitioner*, as it explains how the designer gains design knowledge by starting a *reflective conversation* with the materials of the situation. The designers ability to *see-move-see* forms design knowledge by *knowing-in-action* (Schön, 1983). Because *sketch* and *prototype* could be understood as the same thing, we must point out that we do not view them as such. They are both instantiations of a design concept but they serve different purposes and support the process differently. In Buxton's terms sketches *suggest* rather than *describe*, *explore* rather than *refine*, are *tentative* rather

than *specific*, *propose* rather than *test*, and so on (Buxton, 2007). In that sense *sketching* is particularly useful in the divergent part of a design process (the brainstorm) to open up the design space by suggesting and exploring tentative proposals with low-fidelity because it is fast, cheap and pushes the boundaries for the solutions. In the convergent part of the design phase we shift from *sketching* to *prototyping* by refining and testing specific conceptual ideas in a higher fidelity. This shift is useful because it allows the us to address the research question with a tight coupling to the field through the design.

In the article “The anatomy of prototypes: Prototypes as filters, prototypes as manifestations of design ideas” Lim et al. (2008) presents an anatomy of prototypes to support designers in being reflective about how they work with prototypes. The anatomy seeks to understand what prototypes *are* instead of just what they *do*. The anatomy involves at framework containing two fundamental dimensions of prototypes:

1. *Filters*. The incompleteness of a prototype allows the designer to unpack certain interesting qualities of the design space without distorting an understanding of the whole. The presented dimensions of filtering are: *appearance*, *data*, *functionality*, *interactivity*, and *spatial structure*.
2. *Manifestation of design ideas*. The externalization of the ideas in prototypes results in a materialization representing design ideas that calls for configuration through iterations due to the reflective practice of the design conversation. The presented dimensions of this manifestation are: *materials*, *resolution*, and *scope*.

We use these two dimensions to de-construct our prototypes as a way of getting of grip of what our prototypes actually are prototyping, to compare our two prototypes, and to be able to focus on certain aspects without prototyping everything at the same time (Lim et al, 2008).

We distinguish the terms *prototype* and *prototyping* in alignment with the authors:

Prototypes are representative and manifested forms of design ideas. Prototyping is the activity of making and utilizing prototypes in design (Lim et al, 2008, p. 12)

By prototyping constructively throughout the design process we are able to take advantage of our ability to get surprised and inspired in the situation to explore new design possibilities.

TINKERING AS PROTOTYPING

We use digital technology when designing the interactive prototypes. Micro-controllers and software environment are used as digital materials in this process. Alessandrini (2015) presents practices, technologies, and challenges of constructing and programming physical interactive prototypes. He describes current digital prototyping tools, e.g. Arduino, Raspberry Pi, and Littlebits, as useful when tinkering creatively in physical prototyping. Based on his experience from teaching interaction design in a university setting, he argues that these technologies does not fully support the process of experimentation and design-thinking skills. *“Prototyping tools should permit smooth transitions between different solutions, thus enabling easy and fluid rearrangements of components and behaviours according to the system’s requirements.”* (Alessandrini, 2015, p. 9) However, he argues that the current tools does not yet fully support designers and calls for a development of better tools for prototyping using physical computing tools.

EXPERIENCE PROTOTYPING

We do not only use prototyping to physically manifest design ideas. We combine practice of physical materialisation (product design) with the practice of prototyping experiences (interaction design). Buchenau and Suri (2000) present the method of *experience prototyping* as an *“attitude, allowing the designer to think of the design problem in terms of designing an integrated experience, rather than one or more specific artefacts.”* (Buchenau & Suri, 2000, p. 2). Their focus is on the experience rather than the artefact itself. Therefore *“an Experience Prototype is any kind of representation, in any medium, that is designed to understand, explore or communicate what it might be like to engage with the product, space or system we are designing.”* (Buchenau & Suri, 2000, p. 2). We utilize this method of experience prototyping by using scenarios centered around the experience flow of single users and the general flow of public restrooms containing multiple users. The scenarios was structured as stop motion and documented in videos that can be accessed from Appendix A – Online material.

TEST

The approaches of the lab, the field and showroom (explained under CDR) comes from different areas and have their roots in different traditions. In the showroom approach research meets design and art as a way of suggesting critical questions through design. The lab approach offers a solution to deal the complexity of a real world in a laboratory setting that allow us to focus on isolated aspects, one at a time. Where the lab approach is de-contextualizing the field approach is contextualizing. Field researchers seek to understand the meaning of the system by understanding people and how they make sense of their surroundings (Koskinen et al., 2011). During this thesis we do not utilize the showroom as we do not seek to open a critical discussion of using technology in public restrooms or to change people's behaviour. Instead we make use of the contextualized setting by installing our concept in a large public restroom and testing it with the everyday users of the restroom. This helps us understand the underlying aspects of using a large public restroom by intervening with it, which is a strength of the field approach.

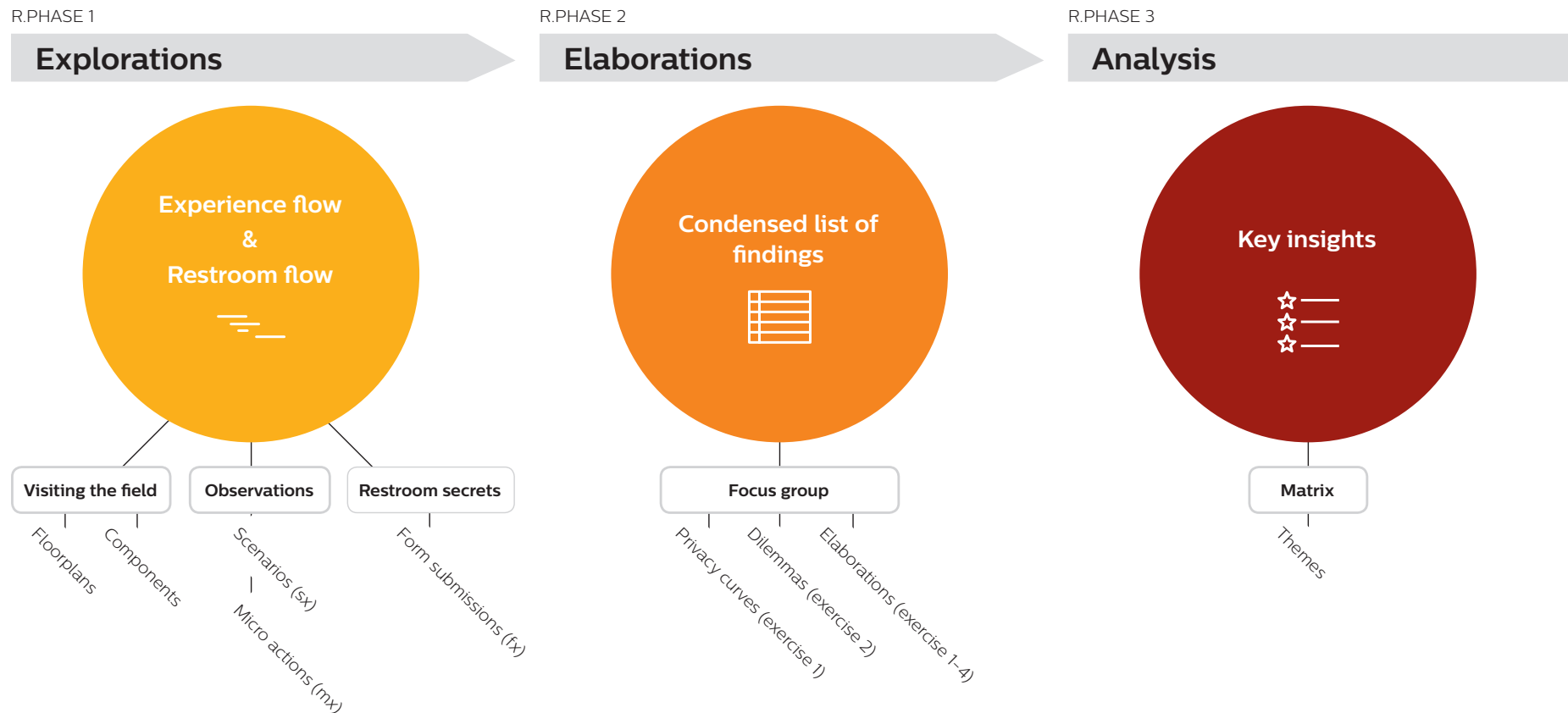
We use a voluntary questionnaire as a method for collecting quantitative data regarding the perception of the system. During the period of time, when the installation was accessible in the public context, we de-contextualized the installation by closing it and convert it into a lab setting. Here our design was tested through three rounds of simulation containing both men and women at the same time. We did this to focus on the experience and the interaction in detail instead of the installation as a whole, which is a strength of the lab approach. The method for doing the simulation is similar to the focus group. Here four users participated by simulating use and engaging in discussions facilitated by us. The details of our lab and field test can be found in chapter 7.

5 – Research

In this chapter we present our ethnographic research and deduce key insights to inform and guide the following design phase. The chapter is divided into four research phases (labelled *r.phases*). These phases are the chronological steps of our research and covers everything from the initial pre-study in *r.phase 0* to the key findings in *r.phase 3*. Each phase builds on knowledge gained in the previous phase. *R.phase 0* is a pre-study that serves to explore the notion of transitions and find potential fields for further research. *R.phase 1* covers the exploration of the field through interviews, observations and an anonymous online

form submission. *R.phase 2* is an elaboration of the findings in *r.phase 1* through a focus group. The combined data from *r.phase 1* and *2* is analysed in *r.phase 3*, where seven key insights are presented. The key insights conclude this chapter, and serve as the foundation of the design phase in the next chapter. Figure 5.1 offers for an visual overview of our research phase. The circles represents the outcome of each *r.phase*. Underneath are the activities illustrated as boxes, and the different data sources are connected to the activity which they emanated from.

Figure 5.1 - Empirical overview



R.phase 0 – Initial research

The initial research conducted in this phase is used to settle on a subject for this thesis. It is a pre study that serves as a source of inspiration; meaning that the goal is not to gather empirical data for analysis. In this phase we are using methods of informal conversation and visual documentation.

DOORS AND TRANSITIONS

Our initial curiosity for this thesis originates from bodily interactions that is activated and experienced by bodily movement. We realized that we needed a specific context to explore this very general and unspecific topic. We were intrigued by the function of unnoticed interactions of doors and doorways. The reason for this fascination originates from the idea of doors as the interface between two rooms. We identified a underutilized potential for working with the issues and possibilities in the connection between two rooms. If you imagine that a door could tell you what or who is in the room behind it, you might have an idea of our initial speculations. To open up this field we adjusted the perspective from focusing on doors to the concept of transitions instead. Our understanding and definition of

transitions is explained in the introduction. To find a context that offered interesting transitions for research and design, we documented transitions in our everyday lives by taking photos of them. The result was 26 photos which included 14 different transitions. 4 of these are shown in Figure 5.2.

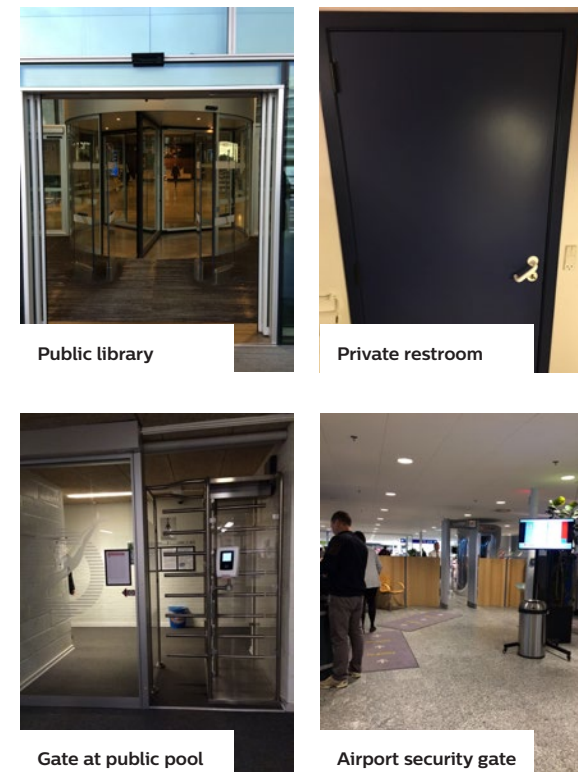


Figure 5.2 - Examples of general transitions

The following early insights from the initial research are very general, yet they proved to be very helpful when narrowing the scope of this thesis. The research showed that transitions

- can be one way, two way and round ways.
- gives access for different types of people (personal, general, group specified)
- is made accessible by body, cognitive ability or artefact (fingerprint, code or key)
- builds excitement because of lack of overview
- can be linked in order of levels of access (from public to shared to private)
- can be linked to an overall structure

CHOOSING LARGE PUBLIC RESTROOMS

Based on the list of early insights on transitions we decided to focus on the context of public restrooms. This choice especially derived from our experienced tension in the transition between spaces with different levels of access. The transitions related to movement from a public setting into a private setting within the public setting became an interesting paradox.

We listed a number of public restrooms and identified some differences in the contexts. Based on our own experiences

we argue that there is a considerable difference between a public restroom at a university and at a public square in the city. The difference is not only in the surroundings but also in your expectations, relation to other users, components, etc.. By drawing on Kohn's (2004) distinctions of public and private spaces (*accessibility* and *intersubjectivity*) we divide the context of public restrooms into three categories: *Public context*, *collective context* and *mixed context*.

Restrooms in public squares, train stations, shopping malls, libraries etc. are considered fully public, because they are generally accessible to everyone and the relationship between users will most likely not encourage to interpersonal interaction.

If a public restroom is shared by a large and related group of people we call it collective because users will be interconnected by the organisational structure; meaning that there is a larger chance for users to know or recognize each other. Examples of these contexts are: Workplaces, universities, community locations, and public institutions.

The third category combines the former two where the collective cohesiveness is temporally constructed. The context that normally can be categorized as public, due to the accessibility, can be perceived as collective temporally because of users interconnectedness by relation to the activities in the context, e.g. concerts, venues, sports events, cinemas and restaurants.

The size of the restroom matters since we are interested in the transitional aspect of the public restrooms. As explained in chapter 2, a typical Danish public restroom contains a pre room, where stalls can be accessed from. Therefore we seek to explore large public restrooms with a pre room and minimum two stalls in the above mentioned different contexts.

GETTING ACCESS TO THE FIELD

The categorization served as a framework for identifying potential places for further research. In Figure 5.3 we present a list of the institutions and companies we contacted. All places were contacted by email.

PUBLIC	COLLECTIVE	MIXED
The municipality of Copenhagen - Amager Torv Copenhagen central station Imperial (cinema) Frederiksberg Centeret (mall) Magasin (mall)	ITU University of Copenhagen Danmarks Radio	Valby Kino (cinema) Vega (concert hall) Danish Agency for Labour Market and Recruitment Den Sorte Diamant (library)

Figure 5.3 - Potential fields

We received positive feedback from The Municipality of Copenhagen, ITU and Valby Kino, who all welcomed us to come and collect data. These locations differ in the type of context. Amager Torv, as a public square in the heart of Copenhagen, was assumed to have a steady flow of users, whereas ITU and Valby Kino was expected to have peak moments in the use before and after lectures and movies. We also expected the different contexts to have different groups of users.

R.phase 1 – Explorations

In this phase we explain our practical activities and present the data gathered using methods of informal conversation, participant observation, visual methods, anonymous online form submission as elicitation, and experience flow. The scope of research during this phase is exploratory and broad. The raw empirical data gathered in this phase will only be referred to as Appendixes, as the analysis is postponed to r.phase 3 where findings from this phase is elaborated. We will conclude r.phase 1 with a section that outline how the research in r.phase 1 pose questions we pursue answers for in r.phase 2.

EARLY ACTIVITIES

In this phase we gather data by visiting the public restrooms at Amager Torv and Valby Kino. We sought to get closer to an understanding of how a public restroom is being used on both a macro and a micro level.

We used visual methods at both locations to document the overall structure of the two locations and map out the structural components on a macro level. Informal conversations gave focus to our participant observation. Due to low activity at Valby Kino we decided to fully focus our participant observations at the public restroom at the public square Amager Torv. Here the initial documentation visit and informal conversation with the employee at work promised a steady activity during the day. Here we did participant

observations for three hours: 11:30AM – 1:00PM and 3:00PM – 4:30PM. We participated in the situation as employees wearing uniforms and was sitting in a partly hidden corner. From here we mapped scenarios and noted micro actions such as gestures and specific movements. As a supplement to the observations we launched the “Restroom Secret” campaign to collect otherwise inaccessible information of the field. In the anonymous online questionnaire we collected 52 useful statements related to user’s’ experiences, thoughts or assumptions.

INFORMATION SOURCES

COMPONENTS

A list of all components spotted while visiting the fields can be found in Appendix B – List of components. The list include 14 different types of components found in the restrooms. Some components were found in various types like disposable soap dispensers and wall mounted soap dispensers. Some varied between being automatic or manual like the paper dispenser and the water tab. The restrooms at Valby Kino and Amager Torv are very similar as they share almost all components (except for a sliding door at urinals and a mirror). We argue that the components of these two public

restrooms can be categorized as normal because they fit with our general understanding of a typical Danish public restroom.

SCENARIOS AND MICRO ACTIONS

Our participant observations at Amager Torv resulted in 16 scenarios, where more than one person was present in the restroom, containing a total of 51 users. Scenarios and micro actions are labelled with the identifier sx (scenarios) and mx (micro actions) and can be accessed in Appendix A - Online material. For analytical reasons and to make the physical mapping of users' journey meaningful in a timely sense, we animated scenario two (s2) as video on a timeline where the interplay between user's actions are visually captured. Relevant observations are described with other findings in the extensive list of findings (Appendix C - Condensed list of findings), which we will analyse later in this chapter. Due to a lack of permission to videotape the users, we re-enacted ten interesting micro actions based on our notes from observing users, these videos can also be found in the online material (Appendix A - Online material).

STORIES FROM ANONYMOUS ONLINE FORM SUBMISSION

Stories from our qualitative online questionnaire (Appendix D - Answers from "Restroom Secrets") will be referred to with the identifier fx (form submission). Each user-generated entry have been classified with a relevance parameter from 1-3. Entries marked as 1 are excluded from the project due to misinterpretations of the task, e.g. a user assumably mistaking the submission for a confessional:

Okay, so I don't actually go to this university. I come here pretty often because I can just grab a desk and do some of my work quiet easily without anyone disturbing me. [...]
- *Anonymous respondent* (f10)

Entries marked as 2 are excluded due to a lack of relevance in relation to the use of restrooms in general, e.g. a user being too context specific:

I hate the Dyson hand-dryers. Gimme back my damn paper towels.
- *Anonymous respondent* (f7)

Entries marked as 3 are being used as valid data source in the project, e.g. a user explaining his preference and experience of use:

I don't mind other people in the restrooms if i'm only peeing - otherwise it will always be embarrassing [...]
- *Anonymous respondent* (f11)

EARLY ANALYSIS

EXPERIENCE FLOW

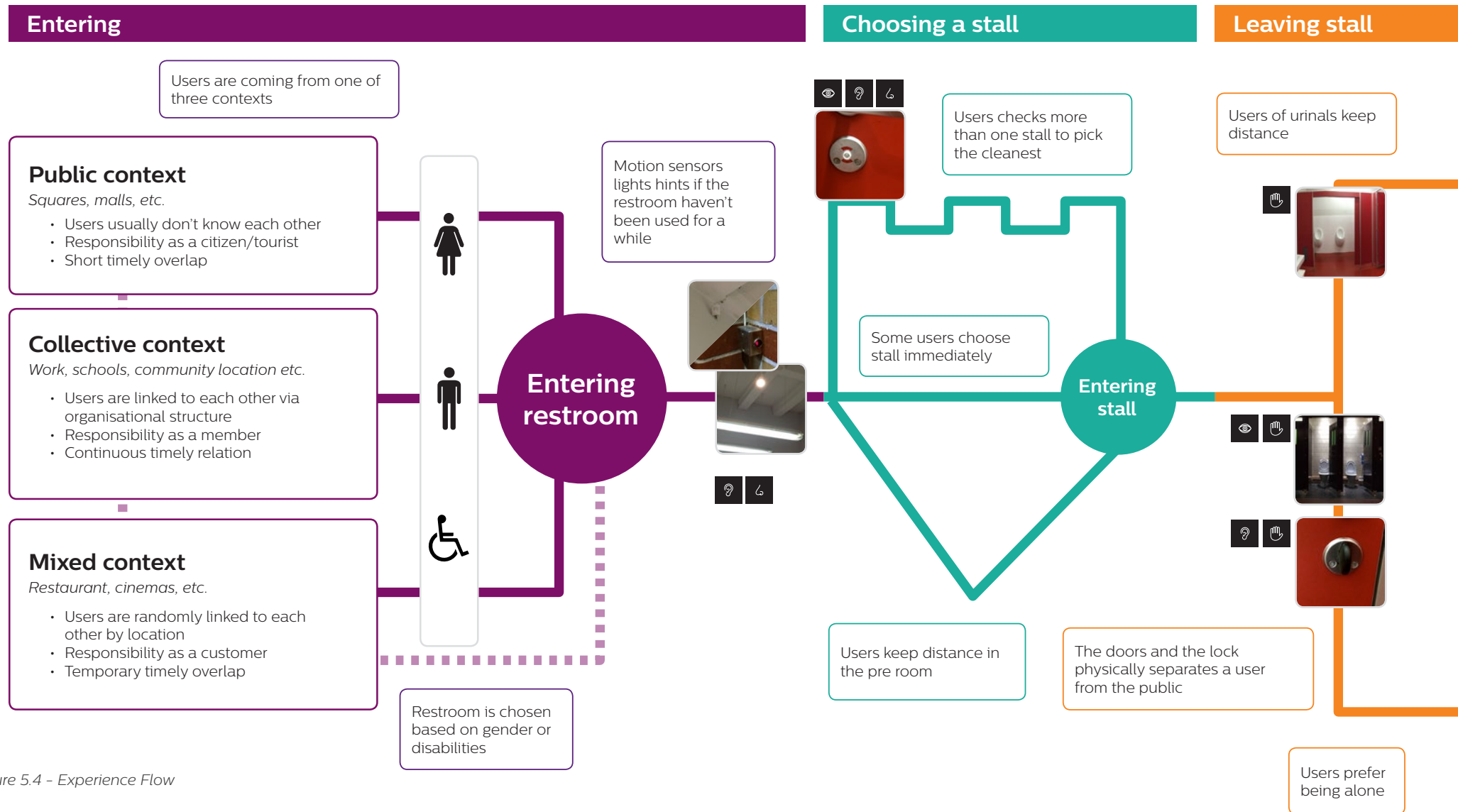
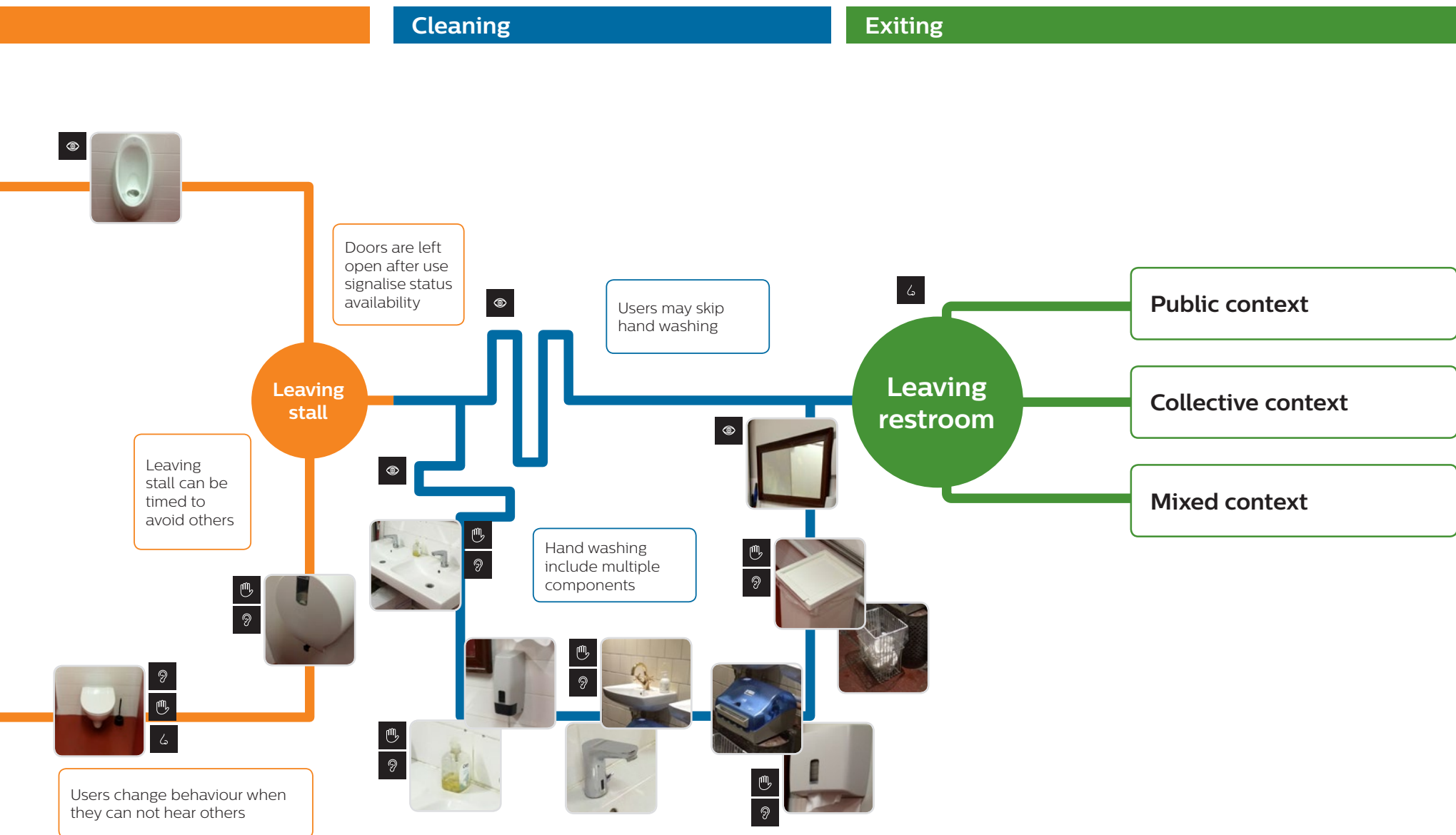


Figure 5.4 - Experience Flow



In our experience flow (Figure 5.4) we have mapped out the journey of a user coming from one of our three contexts on the left (public, collective, and mixed) and returning to the same context on the right. We identify five transitions in the experience flow: *entering*, *choosing a stall*, *leaving stall*, *cleaning* and *exiting*. We understand a transition as a *physical movement from doing one action to another* (explained in chapter 1). Entering is the transition when a user moves from the physical shared contextual space into the pre room. Choosing a stall is the transitions when a user moves from the pre room into a stall. Leaving stall is the transition when a user moves from the stall back into the pre room. Cleaning is the transitions when a user performs cleaning routines moving around in the pre room. Exiting is the transition when a user moves from the pre room the to shared contextual space. The flow is linear with a few options for deviation. Identified components (included as images) are crucial touch points to successfully complete the journey and they are linked to sensory experiences (shown as icons). In addition, findings displayed in text boxes elaborates some experiences the user encounter while interaction with components and moving through the transitions.

The illustration of the user journey as an experience flow functions as a tool for getting an immediate overview of the

situation on a macro level but at the same time it offers a level of details that calls for a deeper understanding on a micro level. It furthermore serves as a basis for teamwork, because findings constantly are put in dialogue with the experience flow through analysis; causing adjustments iteratively and result in deeper understandings.

RESTROOM FLOW

The experience flow focuses on a single user journey and the complexity of it. It does however express a zoomed in version of how a public restroom is being used. If we figuratively zoom out on the timeline, multiple user journeys will appear.

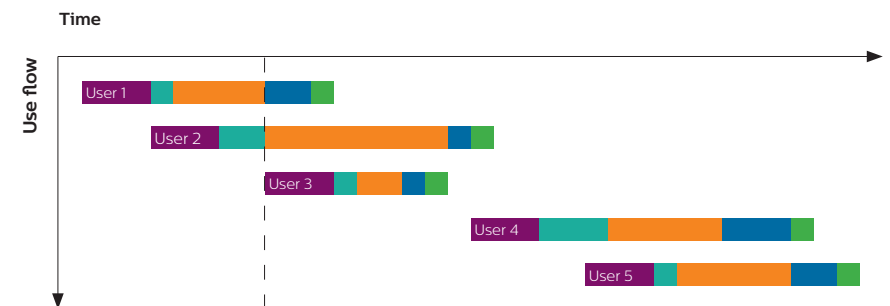


Figure 5.5 - Restroom flow

Figure 5.5 is an example of the restroom flow containing multiple users. It displays how some users overlap, and some does not. This is not surprising, since this is how humans in general live intertwined lives. Yet, it demonstrates the

temporal aspect of the situation, where overlaps are created by overlaps in the five identified transitions, e.g. user 1 starts cleaning at the same time as user 2 chooses a stall and user 3 enters the restroom. In our participant observations we found that the temporal use flow of a public restroom impacts the interplay between users; meaning that the experiences must be understood as more than just individual experiences because the temporal overlaps complexify the experiences.

TOPICS OF INTEREST

In r.phase 1 an ordinary context have revealed itself as interesting by the activities and behaviour of the user. The empirical breadth of our research is now at the widest; and thereby hard to fully comprehend. In order to focus our explorations in r.phase 2 we identify four overall themes: *Privacy*, *distance*, *sound*, and *hygiene*. In the following we demonstrate how these themes are identified as relevant due to our interpretation of the data. Examples from the raw data will be presented in the following activities.

Privacy is addressed directly or indirectly by multiple our respondents of the online form. This points to social aspect of the situation, where users are aware of the presence of people, and seek to establish some feeling of privacy in this otherwise public setting. The structural composition of public

restrooms makes it possible for people to lock themselves physically away from a public context. Yet they are not completely cut off from the context since cues display their occupation, e.g. the lock, sounds, and smell. Therefore we find the process of establishing a feeling of privacy interesting and worth to explore further.

In our participant observations at Amager Torv we immediately discovered the physical distance between users, e.g. 80% of users selecting a urinal when all 10 options are available, chose a urinal further away from our position (as observants) than midway at (Figure 5.6).

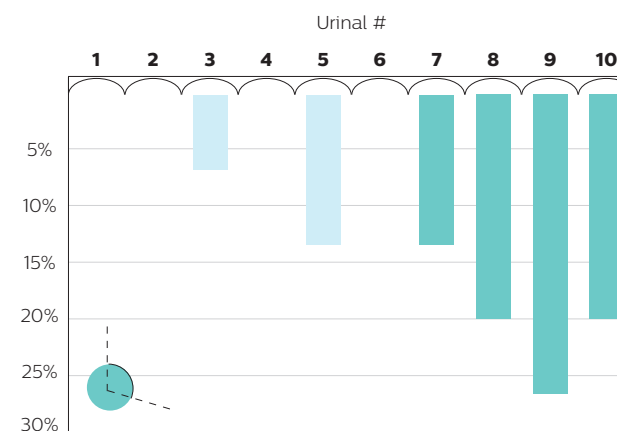


Figure 5.6 - Choosing urinal when being alone in the restroom

We also found that users selecting a urinal when there is already a person standing there does not choose a urinal next to him. We have found that distance cannot be measured

only as a physical factor. The experienced distance seems to be perceived differently by users in relation to the activities and the context of the situation. Therefore we were curious to gain a deeper understand of how distance in a public restroom works and how it can be affected.

We have identified multiple sensorial experiences in public restrooms (see experience flow, Figure 5.4). Smell is a factor mentioned due to the apparent existence of undesirable scents and the relation to hygiene. Likewise touch is associated with hygiene and strategies for handling hygienic issues are many. Sight is mainly used for navigational and not social purposes; eye contact is being avoided to keep a respectful distance understood by the social norm. Findings related to the above mentioned senses align with our expectations of the sensorial experiences of the context. Hearing on the other hand seemed more surprising; sounds made in the restroom affects both distance and privacy in subtle ways. The perception of different sounds being e.g. noisy, informative, appropriate, or inappropriate emphasizes the complexity of sounds in this context. We seek to investigate the perception of sounds further because it

seems to be tapping into the social aspect of the situation where users relate and use sounds to different transitions.

We expected hygiene to be a relevant factor in public restrooms due to the vast amount of literature related to this topic. Since hygiene is so apparent and important in this context we would like to explore how hygienic considerations can be challenged by other factors in this setting.

R.phase 2 – Elaborations

The goal of r.phase 2 is to get elaborations on the findings from r.phase 1 by using the method of a focus group. We seek to refute or confirm some of the contradictions from the previous research, e.g. privacy, norms, stall picking, behaviour. The focus group was conducted at G. A. Hagemanns Kollegium a Tuesday evening. This student residence have shared restrooms and bathrooms on each floor; meaning that the participants daily uses restrooms in a collective context. The focus group consisted of six participants ranging from 22 to 27 years old. The participants consisted of one female and five males. It was structured around four activities and was done within one hour. The focus group was initiated with a short presentation of our project and the overall schedule for the four activities. We introduced the participants to the experience flow, to make sure that they had an understanding of our framing of a large public restrooms, transitions as physical movements, and were aligned with the identified user journeys.

DATA SOURCES

We gathered 31 elaborations during the focus groups by transcribing and condensing the discussions as opinions or quotes. This data is labelled with the identifier ex (elaboration) and can be found in Appendix E – Focus group elaborations. The elaborations are structured chronologically linked to the four activities explained below.

Activities

ACTIVITY 1 - FEELING OF BEING PRIVATE AND PUBLIC

The purpose of activity 1 was to explore and understand how users interpret the feeling of being public and private when using public restrooms. Each participant was handed a blank chart with the five transitions along the x-axis and the y-axis going from private to public. The participants were reminded about the relation to the experience flow and how to interpret the transitions *entering*, *choosing stall*, *leaving stall*, *cleaning* and *exiting*. They were asked to fill out the paper as a graph of how private or public they felt in the given time during a visit to a large public restroom individually. The results are presented in Figure 5.7.

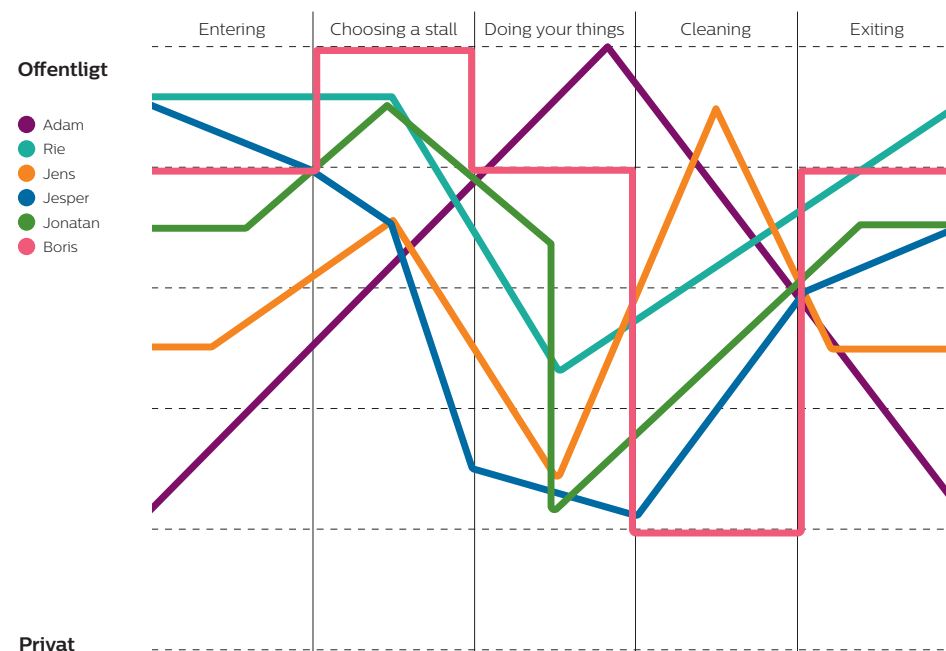


Figure 5.7 - Participants impression of public private

The six graphs were placed on a whiteboard so they were visible to everyone. Afterwards we facilitated the discussions so that the participants could elaborate their answers. The discussion was intended to be an open conversation between the participants, although we guided the discussion with prepared questions to get the conversation started.

FINDINGS FROM ACTIVITY 1

Figure 5.7 shows the results from the first activity. Four of the six participants marked the time inside the stall as the most private. One of the remaining two marked the situation inside the stall as the most public. This contradictory interpretation started a discussion about privacy in public restrooms. The main argument was, that it is when a person desires to be private, that he or she feels the publicness of the context. Other participants agreed to this view, e.g.:

Adam felt more public when doing his thing. He was more aware of being in a public place when inside the stall, and that was why he marked this as the most public. Some of the other participants recognised the feeling of being most aware of the public inside the stall (e2)

This finding addresses our general curiosity of transitional shifts in the context of public restrooms. The establishment of privacy in a public setting can be viewed as a paradox, where the feeling of privacy when being inside the stall is confronted with the fact that users feel publicly exposed due to their actions.

ACTIVITY 2 - STALL CHOOSING DILEMMAS

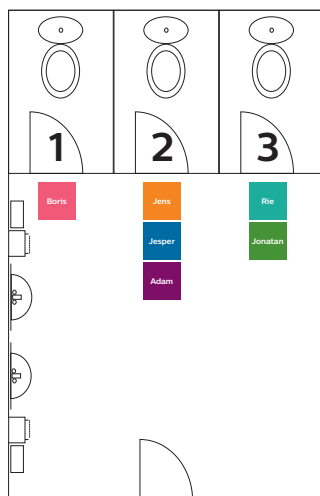
The second activity is an attempt to gain detailed explanations of consideration when choosing a stall. Findings related to choosing a stall were ambiguous in r.phase 1, but they proved useful in proposing five dilemmas. The following dilemmas are situated in a large public restroom with a typical structural composition, but varies on parameters like the presence of others, smell, cleanliness, and available stalls. A floorplan of the restroom was visible for the participants as they were instructed to write their name and the number on a post-it showing which stall they would choose for each dilemma. A discussion was initiated after each dilemma.

FINDINGS FROM ACTIVITY 2

DILEMMA 1

The light turns on, when you enter, so you know the restroom is empty. All the stalls are clean. There is no smell and you have not seen anyone leaving the restroom. (Figure 5.8)

Choosing a stall in an empty restroom was based on two things. First the assumptions of previous use, e.g. a participant having read about the first stall never being used (e4). The second important thing was considerations relating to the next users. Participants would choose a stall in one of the ends, to create the possibility for the next person to choose the stall furthest away for the comfort of both of them, e.g.:



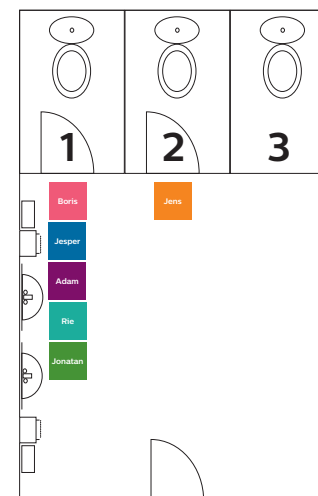
Rie says that picking a stall at one of the ends makes really good sense, because if another one enters the restroom, that person will have the opportunity to pick the one furthest away, so they don't need to be sitting next to each other. Jonatan and Boris agree with this strategy (e5)

Figure 5.8 - Dilemma 1

DILEMMA 2

Stall 3 is occupied. The two others looks clean and there is no smell. (Figure 5.9)

There is a clear relation between an occupied stall and the participants being prone to pick the stall furthest away. One participant didn't mind sitting in a stall next to another person (e9). The five others chose the stall furthest away as a direct consequence of the other person present in the restroom (e8), e.g.:



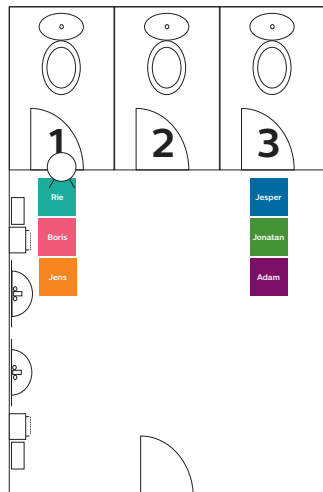
Jonatan says "there is this rule that you have to get furthest away" [...] "And if he comes out I'll like to show that 'I'm away from you'" (e7)

Figure 5.9 - Dilemma 2

DILEMMA 3

Another person steps out of stall 1 right as you enter the restroom. The smell in stall 2 is relatively bad and you see drops of liquid and some toilet paper dropped on the floor in stall 3. (Figure 5.10)

The participants preferred either stall 1, which had just been used or stall 3 that had drops of water and paper towels on the floor. No one picked the smelly stall in the middle. The smell was considered a problem for two reasons. The first being related to the risk that the next users would look at you as responsible for the bad smell (e12) and the second being related to the displeasure of being reminded of others activities, e.g.:



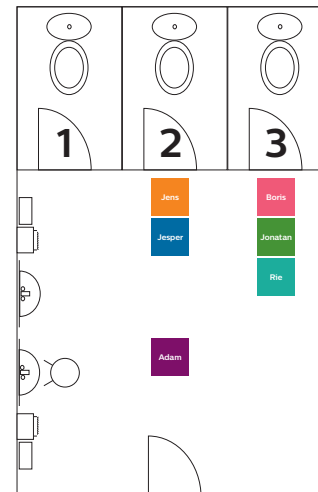
The smells is the biggest problem of the three in this scenario. Rie says that even though you know what people are doing on the toilet, you don't want to be reminded about it (e11)

Figure 5.10 - Dilemma 3

DILEMMA 4

A person is washing his hands at the sink. The stalls behind him are all free and looks fine. (Figure 5.11)

When people are using the pre room and all the stalls are available behind them new users will try to create distance by choosing the stall furthest away from the sinks (e13, e14). Another concern in this situation is to avoid using the same stall as the person at the sink, e.g.:



Adam is undecided. He would like to figure out which stall the other person have been using to avoid it. He will use around ten seconds to figure it out. He says it would be awkward to spend more time on it. This maneuver seems difficult for some of the other participants (e15)

Figure 5.11 - Dilemma 4

DILEMMA 5

Stall 1 and 2 is pretty messy. You can see traces of the previous user in both lavatories and it smells bad. Stall 3 is occupied. (Figure 5.12)

In the last dilemma there were the two available stalls with dirty lavatories. Some participants would try to clean the lavatories with a flush, and wait for the occupied stall if they were unsuccessful (e16). Others would wait for the occupied in any circumstance (e17). Compared to dilemma 2, were five participants picked the stall furthest away from the other user, this dilemma highlights the importance of hygiene because all users would rather wait then use a dirty toilet.

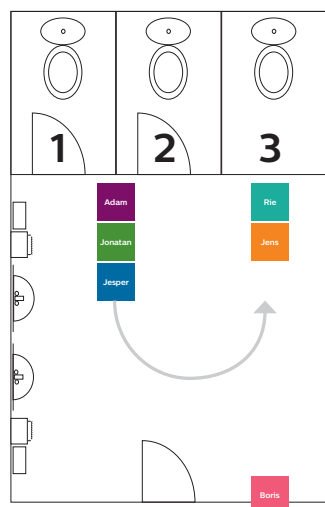


Figure 5.12 – Dilemma 5

ACTIVITY 3 - BEING INSIDE THE STALL

This activity seeks to elaborate the situation when users are inside the stall. The participants were asked to immerse themselves in different scenarios where they are sitting inside a stall: “Another person enter”, “You pick a stall next the one that is already occupied”, and “You can hear that another person have left one of the stalls and is in the pre room”. For each of the three following scenarios we used questions to start the conversation (Appendix F – R.phase 2, activity 3, Questions).

FINDINGS FROM ACTIVITY 3

The participants are aware of other people when they enter the pre room (e20), and will consider which noises they make (e22). The publicness of the context becomes very clear when another person enters a restroom you would be otherwise alone in (e23).

When leaving the stall participant would wait to flush if they hear another person leaving because it is awkward to open the door at the same time (e24).

Not knowing the other person using the restroom was preferred by some participant, but others would use the information to determine their behaviour (e26). This suggests that it is not without relevance who you meet in the restroom, e.g.:

[...] Rie and Jonathan wants to keep the person as a faceless stranger. Jesper would on the other hand like to know what kind of person he is sitting next to because he uses that information to determine his own behaviour (e26)

ACTIVITY 4 - SOCIAL NORMS

The fourth and last activity relates to two paradoxes found in our previous research. The first paradox seeks to address the multi purposedness of the public restroom setting in relation to a perception of acceptable behaviour. For example the possibility of cleaning your body or clothing, changing clothes, doing your hair and using the toilets. The question was: *Why is there a difference between what you can do at a restroom, and what people actually do?*

The second paradox addresses a question raised by the previous research about the possibility to dissolve the awkward and embarrassing behaviour between users by simply initiate interaction between them. This is the question we asked them: *Why are we afraid to make noise, and what happen when we do it anyway?*

FINDINGS FROM ACTIVITY 4

In the discussion related to the first paradox participants agree that the context determines the appropriate behaviour at specific restrooms, e.g.:

[...] Jens explains how shirtless male students at his university are seen in the morning washing off sweat from their bike ride to the university. Rie agree and adds that “it is okay to change your clothes at 4am at a german tank-stations if you are on a bus trip, and everyone does the same. But you can’t do the same at Lyngby Storcenter

[Danish shopping mall]. In that case you would have to go into the stall to change.”[...] (e28)

In the discussions related to the second paradox the participant explained that noise in general and noises related to the restroom use, e.g. urinating and coughing, was not considered a problem per se because it is what you expect when using a public restroom, but anything related to excretion was highly undesirable (e29).

[...] “It should ideally sound like you are only there to pee” - Rie. The other participants agree to that statement (e29)

CONDENSED LIST OF FINDINGS

The elaborations from the focus group creates along with the components, scenarios, micro actions, and form submissions from r.phase 1 a vast amount of empirical data, which is difficult to comprehend and confusing because of overlaps and varying relevance. We have combined the data sources (Figure 5.13) to accommodate this problem in a condensed list of findings (Appendix C - Condensed list of findings).

Identifier	Data
(name)	Components
S _x	Scenarios
m _x	Micro actions
f _x	Form submission
e _x	Elaborations

Figure 5.13 - Overview of data sources

Figure 5.14 – Analysis matrix

	Distance	Sound	Hygiene	Exposure	Availability
Entering the restroom	<p>If the restroom is believed to be occupied some users look for other restrooms/wait in advance (f4, f25, f20)</p>				<p>Motion sensored lights hints if the restroom haven't been used for a while (f26)</p>
Choosing a stall	<p>Some participants explain that they are willing minimizing distance to others users if they have a good reason to do so (e18)</p> <p>Choosing stalls or urinals furthest away from other users or potential other users is a strategy to respect the social norms of the setting (e5, e6, e7, e13, e14)</p> <p>Sitting down on a warm seat causes disgust because it reminds the user of recent previous use (f19)</p> <p>Strangers keep distance to each other (s1, s2, s6, s17, s18, m10)</p> <p>Users keep distance when using urinals (s1, s2, s6, s7, s9, s11, s12, s15, s16, s17 s18, m6)</p>	<p>A respondent mentions minimization of sound as a reason to keep distance (e8)</p>	<p>Users try to pick the cleanest stall based on assumptions (f13, f22, f23, f30, e4) or sensory experience (f11, f21, f32)</p> <p>Participants agree that dirty traces of another person or a bad smell is worse than using a stall right after another person (e19)</p> <p>Some participants are willing to wait for an occupied stall in order to avoid using a filthy one (e17)</p> <p>Dirty toilets with marks of previous use are avoided and users find another stall (f6, e17, f21, f32)</p> <p>Bad smell is avoided (f21, e11, f32, f33)</p>	<p>In the preroom (right before choosing a stall) participants feel very publicly exposed because they are visible to other people and they have an agenda that others know about (e3)</p>	<p>A participant will use up to ten seconds to fake other activities while he determines which toilet have recently been used by the person on his way out of the restroom in order to avoid using the same (e15)</p> <p>Users checks more than one stall (s9, s2, s5)</p>
Doing your thing	<p>The door is the physical component that separates the public sphere with the private sphere (f11)</p> <p>Four participants relates the feeling of privacy to the situation inside the stall where they have locked the door and are doing their thing (e1)</p> <p>Users prefer to know if they are alone (f11, f32)</p>	<p>Users strive to mask sounds that they feel are embarrassing (e29)</p> <p>Generally users seems to make a little noise as possible to follow the social norm and not discomfort others or being embarrassed (f11, f20, f21, f32, e22, f33, f34)</p> <p>By observing we found that a user seemed way more comfortable when being alone (making noises, taking a lot of time) (s2)</p>		<p>One participant felt that it is in the stall (when you do you thing) you feel the publicness of the setting (e2)</p> <p>Other persons present in the restroom makes users feel less private (e23)</p> <p>A user becomes aware of his occupation of a toilet if he hears another one enter. He starts to figure out what the 'new guy' does: find a stall, waits, leaves? (f29, e20)</p>	
Leaving stall	<p>Listening to when others are done can help you time when to leave the restroom with as little social interaction as possible (f4, f26, e24)</p>			<p>You become 'responsible' for the room you are using even if you enter it in a bad shape. The next guy will think you did it (f29, e12)</p> <p>Leaving smell for someone is embarrassing, especially if you meet the next person on the way out (f4, f21)</p>	<p>Doors are left open after use signal status availability (s2, s5, s10, s12)</p>
General	<p>Different characteristics of the stall changes the perception of privacy, such as open roof, cut off doors or frosted glass (f23, components)</p> <p>Deliberately distance was seen in observations (s1, s6, s9, s15, s16, s18)</p>			<p>The context of the restroom determines user's' feeling of exposure in a given activity (e21, e28)</p> <p>You can do one flush to clean the toilet, but not a second. If it didn't help you should go in line for the clean toilet (e16)</p>	

The condensation and sorting was done iteratively. Similar observations and statements are merged in descriptions with multiple sources, e.g. “*You become responsible for the room you are using even if you enter it in a bad shape*” derives from e12 and f29 where we argue that respondent are expressing similar statements. Some findings include multiple sources and others only one. The condensed list of findings is a useful tool to make the combined research manageable for the analysis in the next phase.

R.phase 3 – Analysis

In this phase we explore and communicate the aspect of transitions in large public restrooms. The empirical data from r.phase 1 and 2 is analysed in this phase. The result is seven key insights that serve as design implications and is the foundation for the design work in next chapter.

We used the method of affinity clustering to structure the relevant findings from the condensed list in several structures to identify similarities and differences between them. One meaningful way of clustering sprung out of the structure of the experience flow. By reusing the transitions of *entering*, *choosing a stall*, *leaving stall*, *cleaning* and *exiting* we are able to sort the finding and tie them to transitions in the use flow. The sorting of our data revealed no findings related to the transition of *cleaning*. Therefore we exclude cleaning

as a transition from our scope. By using the structure of experience flow we are able to sort the findings, yet it does not address the complexity of our findings. We structured the findings related to different themes by card sorting the findings until distinguishable, yet relevant themes formed a structure as an affinity diagram (Löwgren and Stolterman, 2004). We identified *distance*, *sound*, *hygiene*, *exposure* and *availability* as aspects of transitions in large public restrooms. In Figure 5.14 we present the condensed list of findings in an analysis matrix placed in relation to transitions (y-axis) and aspects of transitions (x-axis). We suggest reading each column of the matrix from the top to follow the logic of the experience flow.

The matrix allows us to overview the condensed list of findings. The empty areas in the matrix made us discuss why they were empty; resulting in the matrix becoming tool for identifying missing findings. Thereby the tool supported our iterative process of analysing findings.

To convert our findings into workable design consideration we identified correlations in the matrix. The relationship between filled areas across both aspects of transitions and transitions led to the seven key insights we present in the following section.

The five aspects of transitions i.e. distance, sound, hygiene, exposure and availability are directly addressing our research question for this thesis, because they answer the question *what are the aspects of transitions of large public restrooms?*

KEY INSIGHTS AS DESIGN IMPLICATIONS

In this section we present seven key insight to conclude our research phase. The insights are rooted in the data and findings from r.phase 1 and 2 and is through our analysis narrowed down to seven sentences as a foundation for our design phase in the next chapter. Their validity and complexity is described in detail in each section prior to the key insight itself.

We have discovered a contrast between the private activities inside the stall and the short physical distance to strangers and the public outside. Users felt private inside the stall (e1), but recognising that it was inside the stall that they felt the publicness of the setting (e2). The blurred line between the public and the private aligns with our understanding of public and private that rejects a dichotomous distinction (explained in chapter 3). We found that noise from activities inside the stall challenges the a user feeling of privacy; especially noises relating to excreting as they are perceived as embarrassing, as the two quotes illustrates.

“Hate going to the toilet to do more than just peeing, when someone goes into the stall next door. It's embarrassing if you make noises when doing number 2 when somebody can hear you.” – Anonymous respondent (f21)

“It should ideally sound like you are only there to pee” – Rie (e29)

We treat privacy as *being free from sensory or physical invasions and the ability to control when, how and to what extent information about you is communicated to others* (explained in chapter 3). We argue the noises made inside the stall by excreting or peeing weakens user's privacy, because these sounds can be viewed as private information, that you communicate to others. Based on these findings we state the following insight.

The established feeling of privacy inside the stall is challenged by the needed activities which exposes the user publicly through sounds (1)

Keeping physical distance is the single most observed behaviour from Amager Torv (s1, s2, s6, s7, s9, s11, s12, s15, s16, s17, s18). Strategies for keeping distance was elaborated in the focus group and were explained as highly related to social norms (e6, e7, e13, e14) and privacy (e23), e.g.:

[...] “I don't know what it is, but I think you would like to create a distance to people in public restrooms” – Jonatan (e13)

In the dilemmas in the focus group we learned that if one stall was occupied and the rest was in fine shape, five out of six participants would choose the stall furthest away (e7, e8). A similar result was found in dilemma 4, where all toilets was

fine and available, but a person was standing by the sink and washing his hands. None of the six participants chose the stall closest to the person. Users consequently prefer to be alone in the restroom, which multiple form submissions states (f4, f11, f25, f32). We found that users have strategies for creating possibilities for the next user to choose maximal distance to the stall occupied by the user (e5). The above mentioned findings illustrate that keeping distance is relevant in every transitions when visiting a large public restroom. We argue that physical distance is related to privacy. Physical distance will minimize the risk of physical invasion of privacy. Physical distance can also help individuals to control to what extent information about them is communicated to others, because the greater the distance is the lower the risk is to be associated with noises and smells in the restroom. Thus we state the following insight.

Keeping distance to other users is crucial in all transitions (2)

The second exercise during the focus group revealed details about the importance of different parameters when choosing a stall. Compared to the participants choices to create distance in the dilemmas with clean stalls, it became interesting when the state of the stalls varied. In dilemma 3 none chose the toilet in the middle with a bad smell. Half chose a stall that had drops of liquid on the floor, and the

other half would wait and use the stall they knew had just been used. This tells us that users will sacrifice their ideal physical distance to achieve a higher level of hygiene. The same was clear in dilemma 5 where three participants would stand outside the stall and wait for it to be available, because of dirty toilets in the two other stalls. We did not seek to find out exactly where the line of 'acceptable hygiene' is drawn. But the form submissions have taught us that users interpret hygiene in very different ways (f6, f11, f21, f30, f32). The following quotes show how users find hygiene central to their choice of stall.

"I hate when there is sh*t in the toilet, i always leave and find another stall" – Anonymous respondent (f6)

"I always choose the most clean stall. If the toilet is dirty I go to another toilet. Also if it smelly" – Anonymous respondent (f21)

This means that perception of hygiene is subjective. Yet, we found implication for a common understanding of a fine line between what is acceptable and unacceptable standards. Based on the findings we present the following insight.

Hygienic considerations overrule the strive to keep physical distance to other users (3)

We found that distance is not only understood as physical distance between users. Users also strive to keep distance

to other people's recent presence by gathering information from the environment. Recent presence can be represented as a warm toilet seat (f19), bad smell (f21, e11, f32, f33), the sound of others (f26, f34) or physical marks in the toilet (f6, e17, f21, f32). When entering an empty restroom, the light will sometimes turn on automatically because of automatic sensors. The light response functions as a sign of no recent activities:

“If the light is activated with a sensor I assume that I alone in a public restroom [...]” – Anonymous respondent (f26)

In the case where the light is already turned on it is a sign of recent use, but this depends on the user's prior knowledge of the sensor controlled light. Other components visible to the user will also inform him or her about the restroom, e.g. the door and the lock (s2, s5, s10, s12). Noise from the pre room is perceived by users inside stalls, and helps them determine available components outside and time their exit from the stall (e24), as the following quotes exemplify.

“I don't leave the toilet when i hear that the person next to me is about to leave” – Anonymous respondent (f4)

The fact that users discreetly check more than one stall reveals the importance of having acquired an overview (s2, s5, s9, e15).

All these examples of users creating an overview for themselves leads to the following insight and highlight how invasion of privacy also can be sensorial and not only physical; meaning that users feel less private if they are too close to the sensory perceivable traces of others.

Users will use sensory input and contextual cues to create an overview of the possible options (4)

There is a clear difference between being or not being alone in the restroom. As mentioned in the previous insight users will gather cues to figure out if they are alone or not. Users are aware of the noise they make, when other people are in the restroom (e22). In the focus group a participant explained that he would only flush one toilet if there was two dirty toilets, when the third was occupied. If the flush did not clean the toilet sufficiently the user would not try the same again because of his awareness of the other users in the restroom (e16). A participant in the focus group explained that he would fake other activities like checking his phone while he was in fact discreetly gathering information about the stalls (e15). The fact that users are aware of their own activities and others' can be explained as curiosity and eavesdropping. Curiosity of what the other users are doing e.g., finding a stall, waiting, or leaving (f29, e20). This explanation is in line with *curiosity* as “a tendency on the part of individuals to

invade the privacy of others [...]" (Westin, 1967, p. 19). These findings about the consciousness of other users leads to the following insight.

Users are conscious of other peoples awareness of their actions, which make them act discrete (5)

Leaving a restroom is not a reversed version of entering a restroom. Reasons lie both in the physical, practical and perceptual aspect of the transitions. We have found that users physically move in different ways when going in and out (s1-s16). The activities when entering and leaving differ practically, e.g. picking a stall and cleaning hands. Furthermore we have found that the state of mind is also different, e.g. being in a hurry when entering (e3) vs. cleaning hands slowly (s2). Users experience a difference before and after the purpose of the visit is fulfilled. This turning point relates to the transitional shift of entering and leaving. The temporal overlap between users creates temporal bond to the facilities where users feel responsible for the state of the stall they are leaving (f29, e12). In a social setting this bond can cause embarrassment for users as they are afraid of causing disgust to others (f4, f21), e.g.:

"If I sit at the toilet and someone is entering the big room I feel like I have to hurry because he could be waiting for me. Then I really start paying attention to the sounds of others because I need to figure out if the new guy gets a

stall, is leaving or the other person next to me is hurrying up. Or worst of all, if I have to pass him as a walk of shame because of the smell or other disgusting things out there." - Anonymous respondent (f29)

In order to avoid embarrassment, we have found users to be indirectly aware of their role in the temporal structure, and strategic about how to exit by being exposed as little as possible. We phrase this insight as the following.

The use flow creates temporal relations to the spaces and other users (6)

We have found that users strives to maintain privacy and keep distance by being passive. This was apparent in our observations at Amager Torv where conversations was only initiated between people that were familiar with each other. In continuation of this notion no physical interaction between users were observed or evident in the rest of the data. Eye contact was only reported as a mean to communicate (f13), as the quote state, and is avoided at the urinals (f28).

"If there is a confusing line (who is first?) then eye contact is smart to show that you see the other person and are polite to ask who is first." - Anonymous respondent (f11)

The context of large public restrooms does not encourage interaction in terms of intersubjectivity; resulting in the following insight.

Users seeks to interact with public restrooms privately and therefore avoid physical contact, conversations and eye contact (7)

6 – Design

In this chapter we present our design construction based on the key insights from the research phase. The chapter is divided into three design phases (labelled as d.phases). Figure 6.1 illustrates the process of our design phase. It is meant to offer a abstract overview and not be read too literally.

D.phase 1 is both divergent and convergent as we seek to explore the design space through a vast amount of sketches (orange circles) followed by a process of clustering. The clustering leads to three conceptual directions (green triangles). In d.phase 2 we concretize two concepts by prototyping (pink squares). In d.phase 3 we refine one concept in detail (blue star).

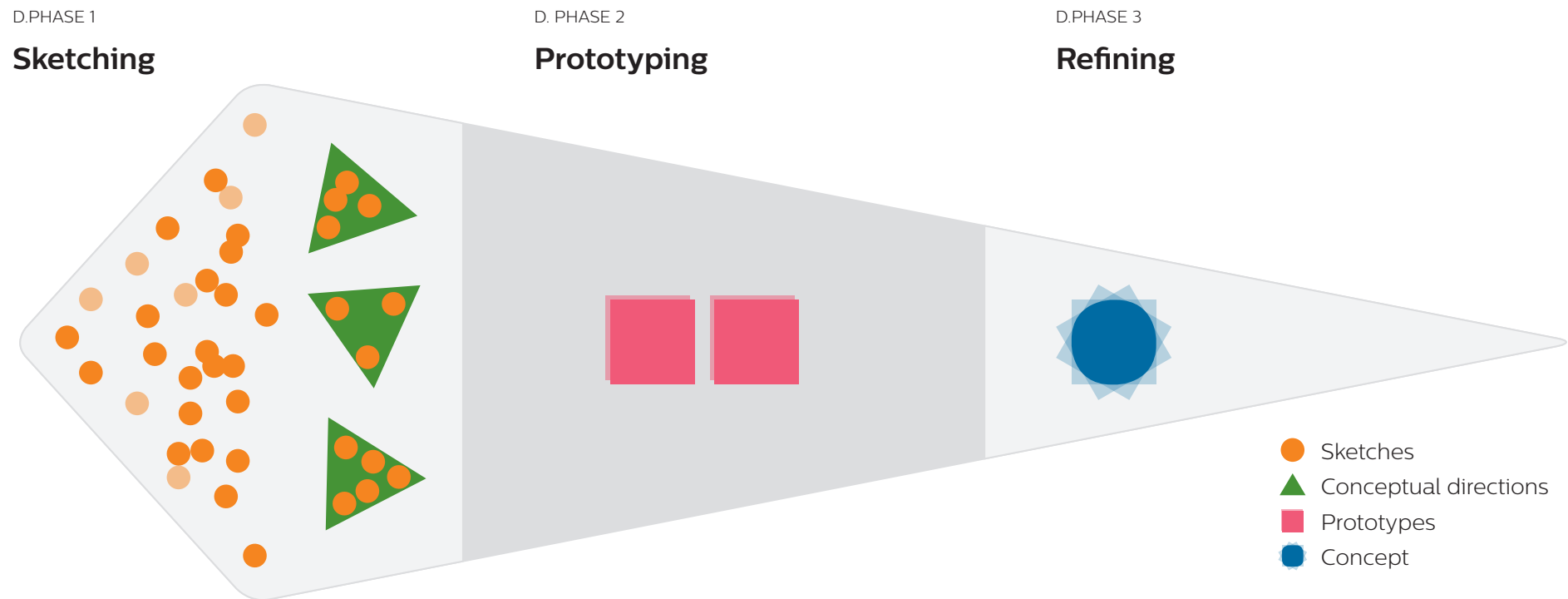


Figure 6.1 - Design process overview

D.phase 1 – Sketching

D.phase 1 begins as a divergent and creative process, which seek out the breath of the design possibilities. We draw on Buxton's (2007) idea of sketching as tool to suggest and explore by externalising. We sketched as a brainstorm method using Kelly's (2000) guidelines (explained in chapter 4).

In the following sections we present the process of brainstorming a myriad of ideas. The brainstorm resulted in 42 different sketches – some containing several ideas. We present 16 sketches in this chapter (Figure 6.2 to 6.17) and provide a full list of the sketches in Appendix G – Overview of sketches. The sketches differ a lot in refinement. Some are concrete and have detailed drawings, others are more general or quirky.

Here we present two of these sketches in detail to illustrate different answers to a similar question. Sketch #4 – *Footprints in the pre room* suggests an interactive floor where physical movement on the floor in the pre room would leave visual footprints that would fade over time, and thereby represent a user's presence as traces visible to following users as cues. This sketch originates from the question “how can we maximize the exposure of *other users*?”. The main idea of the sketch is, that users should have information about previous users available. This information could support their choices in the situation and thereby potentially change their

behaviour. Sketch #1 – *Shadows on the wall* addresses the same question of how to maximize the exposure of other users, but takes the perspective from inside a stall. It suggests that a user's presence in the pre room should be displayed as a shadow on the wall visible to the user inside the stall. The shadow would augment information about other users and thereby help them navigate in the transitions of leaving.

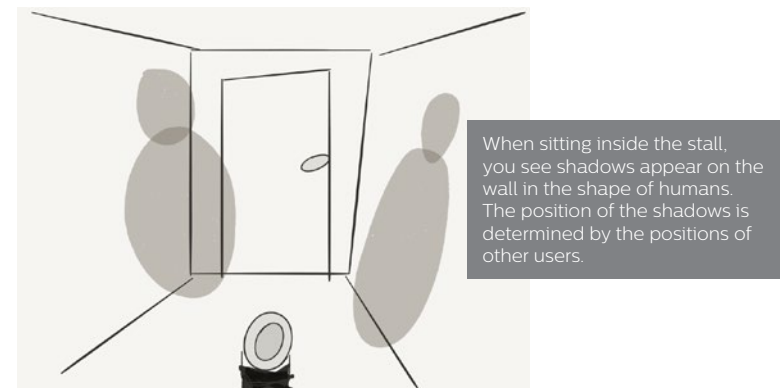


Figure 6.2 – Sketch #1 – “Shadows on the wall”

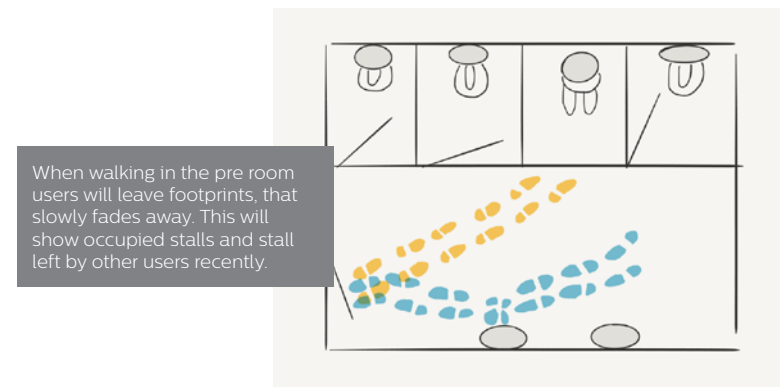


Figure 6.3 – Sketch #4 – “Footprints”

These two sketches exemplify that even though the starting point of the ideation was set by the same question, the ideas manifested in the sketches can be very different depending on which transitions or situation they address.

At this point we treat elements in the sketches very open minded. Elements like “shadows” might as well be a coloured light or morphing surfaces of the wall. The footsteps in #4 might likewise be coloured lines on the floor or moving sticks hanging down from the ceiling. Our use of these methods demonstrates Schön’s (1987) notion of having a *conversation* with the material as a *reflective practitioner*.

CLUSTERING IDEAS

D.phase 1 shifts from being divergent to being convergent when we start clustering design ideas. We did however get new ideas and continued sketching while clustering because new ideas arose when former sketches was explored and elaborated. We evaluated every sketch individually and pinpointed ideas. In the following section the clusters are described, exemplified and evaluated as conceptual directions.

THREE CONCEPTUAL DIRECTIONS

The three conceptual directions are: *Enriching the experience of choosing a stall* (CD1), *Enriching the experience before entering the restroom* (CD2) and *Enriching the experience of leaving the stall* (CD3). Each conceptual direction is grounded in sketches generated through the brainstorm. The sketches exemplify aligned and contradictory ideas that in combination shapes the conceptual direction. We present a description for all three conceptual direction and validate their potential to address findings from our research.

ENRICHING THE EXPERIENCE OF CHOOSING A STALL

A system inside the restroom with intentional or automatic user input, that in a direct or subtle way informs the user of which stall is the best pick based on relevant factors.

Several ideas was concerned with the transitional aspects of choosing a stall. This transition has been identified in the research as particularly complex due to factors of hygiene, distance and exposure.

EXAMPLES

An example of a sketch contributing to this conceptual direction is sketch #11 where a “Choosing zone” in the pre room enables the user to interact with layers of information about the stall’s status when interacting with a system through the zone.

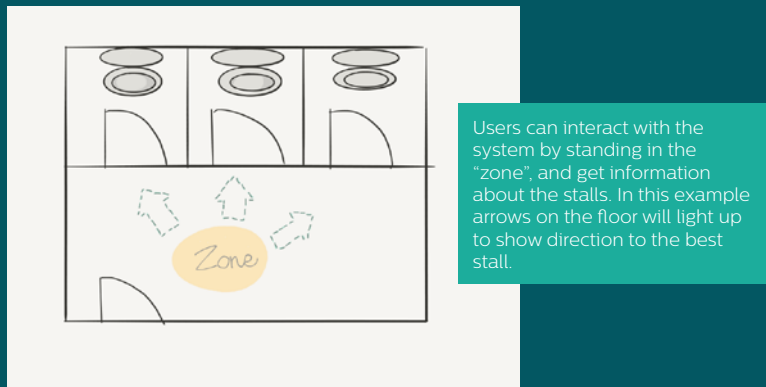


Figure 6.4 – Sketch #11 – “Choosing zone”

This sketch illustrates several ideas. First of all it makes an otherwise hidden touch-point visible by defining a zone that sets the scene for an interface that could be interacted with through bodily engagement, e.g. movement, gestures, position, or audio visual inputs, e.g. visual orientation, speech. Here inputs are generated by a user’s conscious actions and enables them to interact with information related to for example a stalls previous use or its hygiene. Other sketches enriches the experience of choosing a stall without ‘asking’ the user for additional inputs, but instead utilizes the action of entering as an inherent input of the transition. In sketch #2 and #3 the stall door is displaying information of the state and previous use automatically when the user enters. The sketches suggest a ‘waving’ or ‘morphing’ door as a signal for condition.

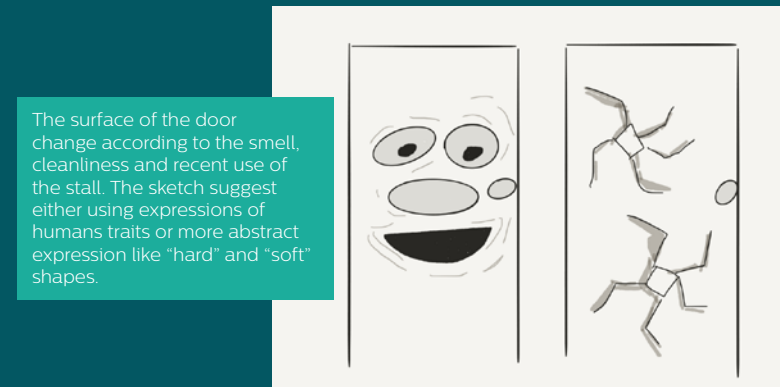


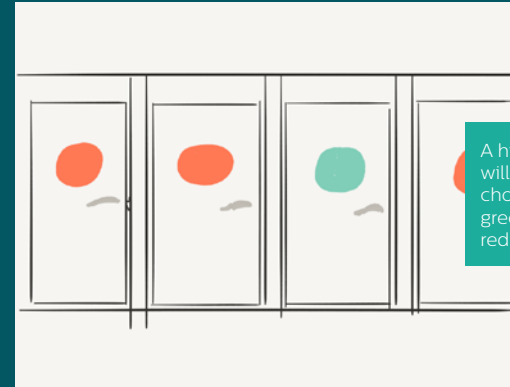
Figure 6.5 – Sketch #2 – “Morphing door”

The doors of stalls in good condition invite to use with a wave-like moving behaviour.



Figure 6.6 - Sketch #3 - "Waving door"

The system suggested in these sketches (as in "Choosing Zone") relies on additional input than what the user generates directly or indirectly. It requires access to information about preceding actions in the restroom. If a door physically extends the presence of others users by waving (in sketch #3), or expresses a mood based on the hygienic state, it requires a system that stores information and offers it as meaningful output. Sketch #6 ("The best choice") and sketch #9 ("Stall scoreboard") represents ideas that through an algorithm offers the user information on which stall to choose - more or less commanding or nudging.



A highly visible sign on the door will show which stall is the "best choice". One way is to use a green colour on the best choice red colours on the rest.

Figure 6.7 - Sketch #6 - "The best choice"

A board on the door tells the state of the stall with a score from 1 to 10.

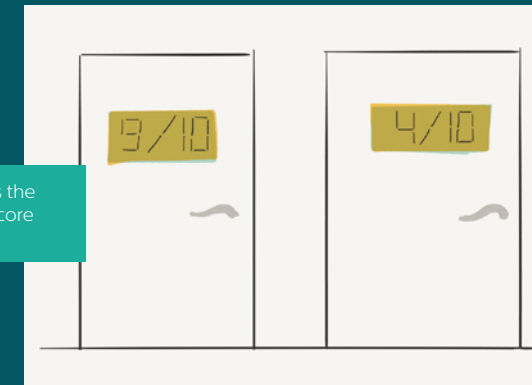


Figure 6.8 - Sketch #9 - "Stall scoreboard"

Variables for this algorithm could be systematic measures such as time since last use, cleanness, or activity, but also user generated input such as a timer or rating buttons. Sketch #20 ("Sleeping stall") and #21 ("Spotlight stall") uses light to signalize availability as output of the system based on sensed information calculated on a logic build in the system.



Figure 6.9 - Sketch #20 - "Sleeping stall"



Figure 6.10 - Sketch #21 - "Spotlight stall"

These sketches are examples of opposite ideas where the absence of light in the "Sleeping stall" is used to signalize availability by signaling inactivity. Oppositely the "Spotlight stall" signalizes availability by nudging the user to pick a certain stall by lighting the stall.

SUMMARY

Even though many of these ideas and sketches point in different directions, they still fit within the conceptual direction of enriching the experience of choosing a stall. They require a system where input is generated either in the situation by the user or by previous use of the restroom. Information is given to the user in advance of choosing. The information given to the user builds on an calculation of ranking based on parameters such as use, smell, cleanliness, and occupation of other stalls.

RELEVANCE

This conceptual direction is centered around gathering information to give the user an overview of possible options and is thereby related to key insight 4: *Users will use sensory input to create an overview of the possible options.* By creating a system that takes over this process of gathering sensory inputs, it also addresses key insight 5 about how *awareness of others makes people act discrete.* The reason is that awareness might be an obstacle for the act of gathering information, which fortunately is done by the system here. If a system is successful in supporting the right choice for the users, it might consequently also help people keep distance and deal with hygienic considering (addressing key insight 2 and 3) because the algorithms calculation of 'the best choice' will take these issues into account.

ENRICHING THE EXPERIENCE BEFORE ENTERING THE RESTROOM

A system accessible outside the restroom that makes information about relevant factors of the restroom available to users before entering.

While sketching it became apparent that the current design of public restroom forces users to enter the restroom before they can make any decisions of how to use it. As stated in our research users strive to keep physical distance at all times when using public restrooms and that contextual cues are used to create an overview. This highlights the potential for enriching the experience before users enter the restroom, by giving them a possibility to create an overview beforehand.

EXAMPLES

Finding a free parking spot for your car in the city can be tricky. To deal with this problem municipalities and private parking companies have put up signs and developed mobile applications that displays free parking spots and their located (Vibe, 2014). Likewise, information screens in for example Copenhagen Airport tell users how much waiting time they should expect at security check-in based on encrypted Wi Fi information (Karskov, 2014). Services like these prepares and informs users ahead of time by giving them the option the readjust their strategy for finding a parking spot or waiting in line. In the context of public restrooms we used this as

inspiration and sketched ideas on how we could prepare the user before they have to enter the public restroom.

Sketch #18 (“Availability light”) suggests a simple idea of displaying the availability status of stalls outside the restroom (similar to light displays outside airplane- or train toilets). The idea of displaying information before entering requires an interface outside the context.

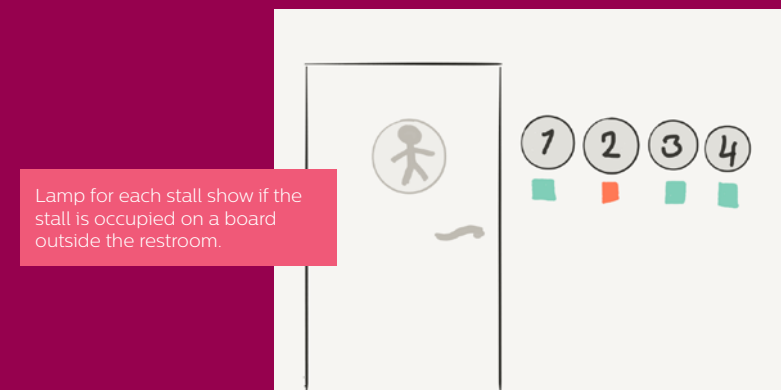


Figure 6.11 – Sketch #18 – “Availability light”

When using a digital interface the possibilities for data visualization opens up. Sketch #15 focuses on visualizing the temporal aspect of the situation by displaying the flow of different users as a log.

A screen creating a temporal overview of the recent occupation of stalls and pre room. Occupation is shown as blocks on the screen.

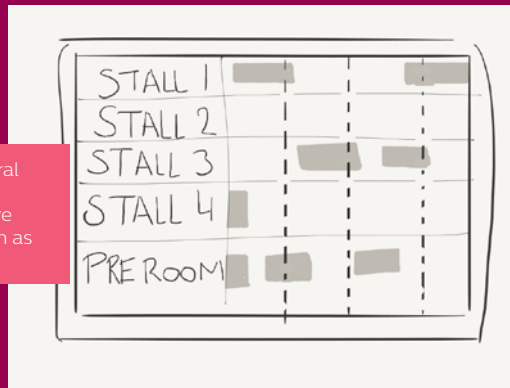


Figure 6.12 - Sketch #15 - "Flow overview"

As opposed to the premise of the presented ideas above, where a display outside the restroom is linked to the physical location of the restroom, sketch #27 suggests mobility instead of a fixed location. The idea of bringing the data into an application accessible on smartphone allows users to interact with the information in depth using advantages of screen based interactions.



A mobile app that provide information about occupation, use and hygiene of the public restrooms close to the user.

Figure 6.13 - Sketch #27 - "Restroom ranking app"

SUMMARY

A characteristic of the presented sketches in this conceptual direction is that they are distant to the embodied interactions of using a public restroom as the interaction lies beforehand. The factors of transitions are data-driven and related to assumptions of what a user might expect instead of being experienced. However, it highlights the potential for redefining how users understand and act in the transitions of public restrooms by using digital technology to instantly equip users with knowledge that would otherwise require physical movement.

RELEVANCE

We see a relation between this conceptual direction and key insight 6 stating that *the use flow creates temporal relations to the space and other users* because it calls for a system that mediates the inherent temporality of the flow of users. Potential users that realize a high intensity of use and unavailability of a restroom might choose differently in advance. This will help users avoid queues and thereby indirectly help users keeping distance. This system would ideally avoid two people present in the restroom at the same time.

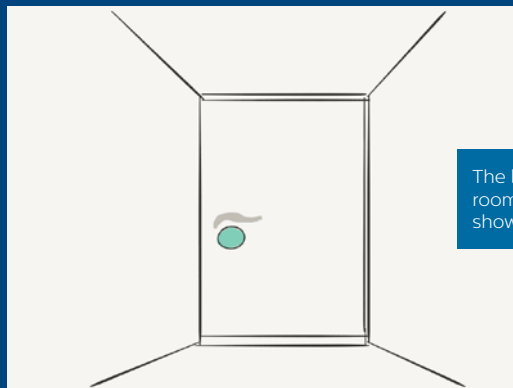
ENRICHING THE EXPERIENCE OF LEAVING THE STALL

A system that exposes other users to a user inside a stall without compromising the privacy of both parties.

The fact that users are tied to a specific location, over a certain period of time, while doing private things, that potentially exposes them to other people, makes them aware of the transition of leaving the stall.

EXAMPLES

In sketch #1 the presence of people in the pre room is made visible to a user by shadows (explained earlier). This creates a visual transparency for the user inside the stall. Sketch #8 (“Reversed locks”) suggests a similar idea where the lock is reversed from displaying occupation of the stall to display whether or not the pre room is occupied.



The lock express the if the pre room is empty or not instead of showing occupation the stall.

Figure 6.14 - Sketch #8 - “Reversed locks”

These two sketches questions the power structure by exposing the occupation of the pre room rather than the stall. An intruding way of offering information from outside the stall to the user inside the stall is presented in sketch #24 where the toilet seat is morphing or vibrating based on other people's presence and location in the restroom.

The toilet seat is communication information about the presence of others through tangible signals.

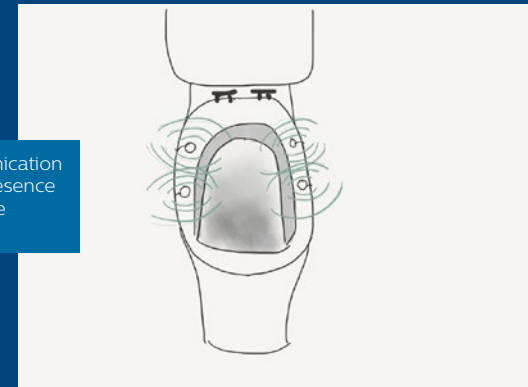


Figure 6.15 - Sketch #24 - “Informative toilet seat”

Sketch #1, #8, and #24 offer additional information to the user inside the stall that is otherwise kept in the blind by the physical barriers. In sketch #13 sounds from components are modulated and emphasized to amplify actions in the different stages to maximize exposure.

Sound from components like the sink is captured by a microphone. Then the sound is amplified through a speaker. This maximizes the exposure of the user using the component.

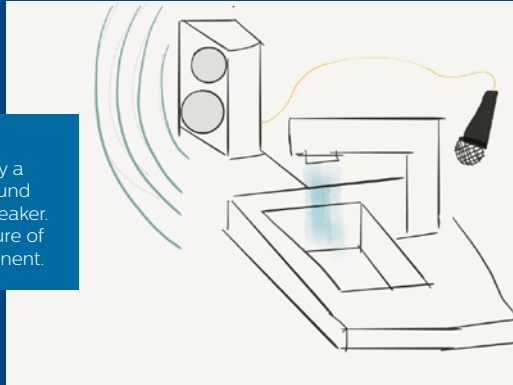
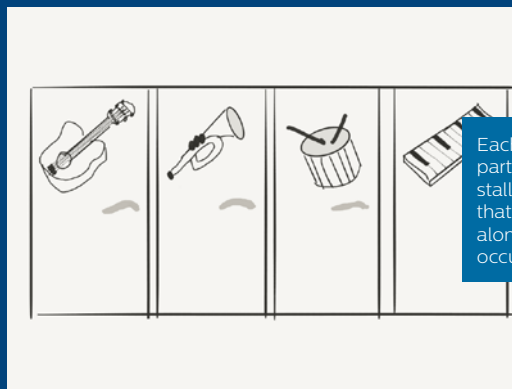


Figure 6.16 - Sketch #13 - "Modulating sounds of components"

The idea of amplifying sound addresses a paradox of noise in public restrooms. Even though sound is generally avoided to minimize exposure, sound in the form of noise has the potential for mask undesirable exposure. An extension of this idea is presented in sketch #23 ("Stalls as an orchestra"). This idea turns each stall into an instrument of an orchestra enabling collaboration among users in a symphony.



Each stall corresponds to a particular instrument. When a stall is occupied the sound of that instrument will be played along with the sound of other occupied stalls.

Figure 6.17 - Sketch #23 - "Stalls as an orchestra"

SUMMARY

All the sketches within this conceptual direction focuses on enriching the experience inside the stall. Some ideas illustrates the potential of changing the experience by exposing information about other users. The sketches also demonstrates how this can be done in subtle ways and by using different modalities.

RELEVANCE

This conceptual direction is focused on the user inside the stall, but users in the pre room and inside another stalls are also affected by it. We identify this CD to have a potential for addressing key insight 4 about *creating an overview using sensory inputs*, because the exposure of other users might minimize the need to gather information through other senses. A user being aware of other users' presence can be beneficial in order to keep physical distance as key insight 2 calls for. If sound or noise is used as the modality to expose other users it can also have an influence on how privacy is challenged by the sound created by the needed activities (key insight 1) because it can mask or remove the sounds that would otherwise expose the user to other people in the restroom.

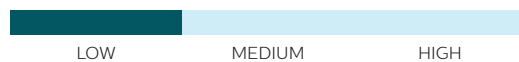
SHARPENING FOCUS

Our goal by clustering ideas and sketches have not been to determine which conceptual direction is the best. Instead we have tried to define the potential for further explorations by using different ideas to understand the underlying factors in the different transitions and keep the multifacetedness and the complexity of the design space open. In the evaluation figure each conceptual direction have been evaluated on the following parameters (Figure 6.18): *Potential for physical interaction*, *ease of implementation*, and *problem driven*. These parameters was agreed upon as relevant parameters for making sure that further work would fit within the theoretical framing of the project, was realistic to implement, and was rooted in conducted research.

CD1 and CD3 overall scores equally high, where CD1 is estimated to be more problem driven than CD3. Oppositely CD3 is estimated to have a higher potential for physical interactivity than CD1. CD2 is scored low on potential for physical interactivity, low on ease of implementation, and does not score high as problem driven. Due to this evaluation we eliminate CD2 in our further exploration. This evaluation of our conceptual directions does not rely on quick decision making or gut feeling. It is a product of several discussions where sketches and ideas were explored in detail.

CD1 - ENRICHING THE EXPERIENCE OF CHOOSING A STALL

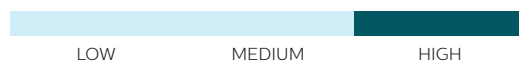
Potential for physical interaction



Ease of implementation



Problem driven



CD2 - ENRICHING THE EXPERIENCE BEFORE ENTERING THE RESTROOM

Potential for physical interaction



Ease of implementation



Problem driven



CD3 - ENRICHING THE EXPERIENCE OF LEAVING THE STALL

Potential for physical interaction



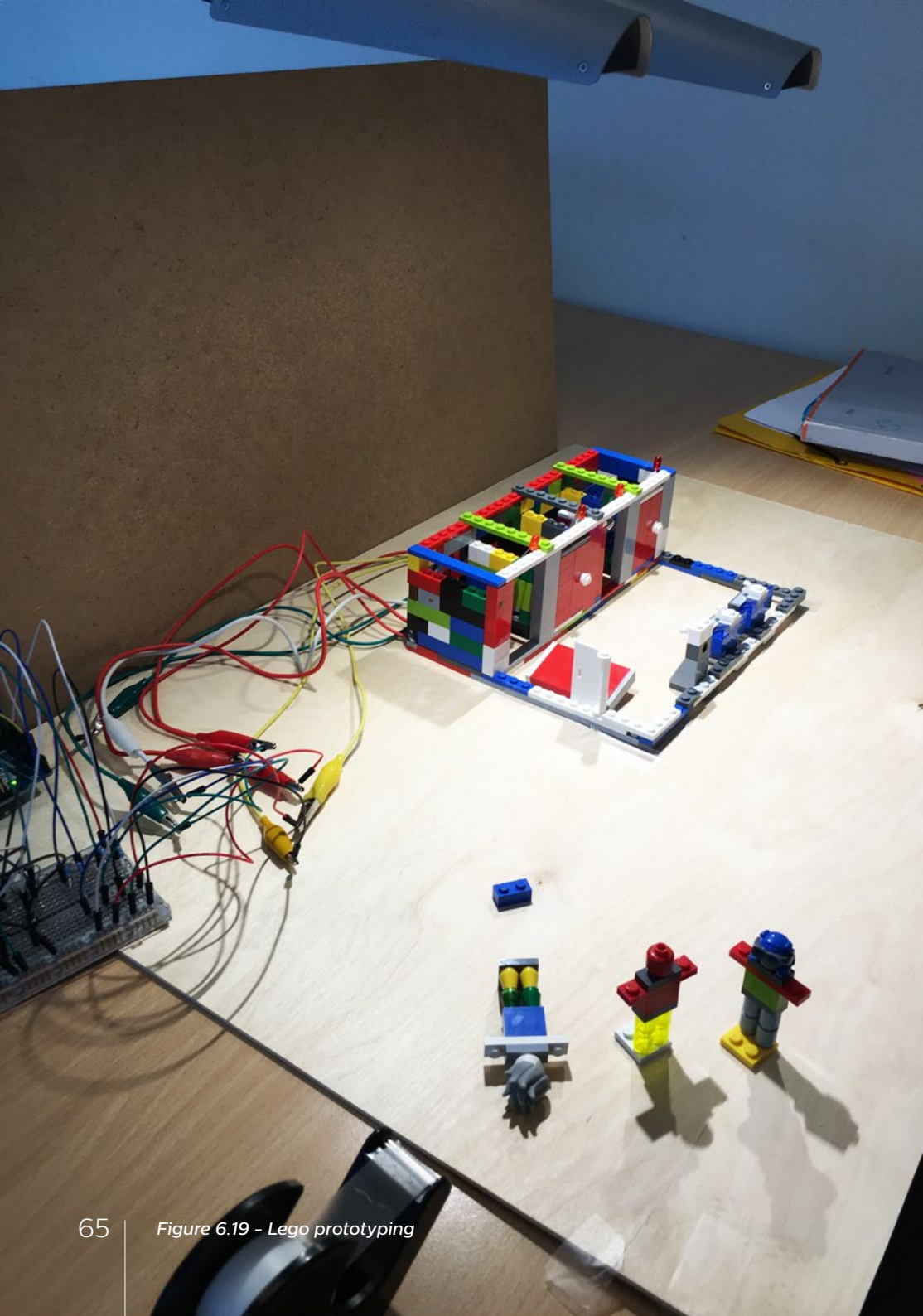
Ease of implementation



Problem driven



Figure 6.18 - Evaluation of conceptual directions



D.phase 2 – Prototyping

The two conceptual directions will from this section be referred to as prototypes. The reason for this shift is to make a clear distinction from sketching to prototyping as Buxton (2007) suggest. In this phase we concretize ideas to learn, discover, generate, and refine the prototypes. The prototype should however not be confused with the final design. A prototype is the manifestation of ideas through the process of prototyping, and in the sense a way of getting closer to the right design (Lim et al. 2008).

LEGO PROTOTYPES

In this design phase we raise the fidelity-level by moving from sketches on paper to prototyping ideas using Lego (Figure 6.19).

This shift results in a concretisation of the ideas because they become physical manifestations constituted by variables as filters. We here present the final stage of our two prototypes as two stop motion scenarios with names to describe the conceptualization. The scenarios illustrates the use of the method *experience prototyping* (elaborated in chapter 4). Experience prototyping focuses on what it might be like to engage with the system and helps explore conditions for other experiences (Buchenau & Suri, 2000). The prototypes are named: “Choosing Buddy” and “Tune Toilet”. The former illustrates a conceptualisation of CD1 (enriching the experience of choosing a stall) and the latter of CD3

(enriching the experience inside the stall). These prototypes are not final design concepts ready to being implemented, but illustrations of ideas generated through an iterative prototyping process. The two prototypes are described in text, and can be accessed as stop motion videos from Appendix A – Online material (which we recommend).

PROTOTYPE 1: CHOOSING BUDDY

A user enters the restroom and a zone in the pre room suggest the user to stand in it. The user has the possibility to interact with a system for example by looking at a stall or moving around in the zone. The system gives feedback to the user by highlighting a stall using light. The user chooses a stall, enter it and locks the door. Another user enters the zone from the outside and is suggested the stall furthest away from the occupied one. The first user leaves the stall and a third user enters the zone. This time the system does not suggests the stall furthest away from user two because of the recent use. Instead it suggests the stall next to the one furthest away because the system is able to calculate which stall is the 'best' choice.

PROTOTYPE 2: TUNE TOILET

A user enters the pre room and the bass track of R.E.M.'s song "Losing My Religion" starts playing. When the user enters a stall the music changes from being the bass track to being the drums, because the user is now occupying a specific stall instead. Another user enters the restroom and the drums are accompanied with the bass track. The second user chooses a stall and the bass is replaced with a guitar. A third user enters the pre room to the sound of drums and guitar. The bass starts again. He chooses another stall where the vocal track is merged into the overall soundscape. As the user's leaves the soundscape becomes fragmented with the grumbling bass track following the users out.

FILTER DIMENSION

Filters can help us explore different aspects of the design ideas, and deal with the complexity of the design space:

Prototypes allow designers to do this by filtering a dimension out from other ones but also enable them to see the relationships among different dimensions as well. (Lim et al., 2008, p. 15)

We adapt Lim et al.'s dimension of filters and thereby break down the design ideas into workable pieces and focus on certain qualities instead of designing everything at the same time (Lim et al., 2008).

In Figure 6.20 the dimensions of our two prototypes are articulate, as a compilation of dimensions in their incomplete conceptual nature. The articulation does however represent design decisions made and thereby become descriptive to some extent. The dimensions are intricate and dynamic; meaning that no dimension can be isolated from the others as they are intertwined. They are nonetheless useful for communicating the qualities we are prototyping.

Filtering dimension	Choosing Buddy	Tune Toilet
<i>Appearance</i>	Direct signs (lights)	Subtle signs (sound)
<i>Data</i>	Complex algorithm (Availability data, hygienic data, use data)	Simple algorithm (Availability data)
<i>Functionality</i>	Support and guide the user when choosing a stall	Mask user's' activities inside a stall Offer positional information of other users
<i>Interactivity</i>	Intentional input Direct feedback	Automatic input Fluent feedback
<i>Spatial structure</i>	Tangible ("Choosing zone")	Intangible (in the air)

Figure 6.20 - Filtering dimensions

The *functionality* of the prototypes derives directly from the conceptual direction rooted in the two different transitions. Choosing Buddy seeks to guide and support the user when choosing a stall. Tune Toilet's function is to mask a user's activities inside the stall and offer positional information about other users. The *spatial structure* is given by the nature of the structure of *large public restrooms* (elaborated in Chapter 2). We work within the physical composition of this space; meaning that both prototypes becomes installations embedded into the existing structure of public restrooms. The interface in Choosing Buddy is tangible so that the user intentionally can engage with a system and gets direct signs as feedback through lights. The interface of Tune Toilet on the other hand is intangible as the behaviour is automatic making use of subtle signs through sound. The *data* in both prototypes is produced by the use of the context and then converted to meaningful information through a system. Tune Toilet requires fewer data types to support the functionality, where Choosing Buddy relies on a wider range of data types such as availability data, hygienic data and use data.

MANIFESTATION DIMENSION

Externalization of ideas is at the core of prototyping. Schön argues that the *world can speak back to us* (Schön, 1987) through this process, and thereby extend our mind to include external artefacts in the thinking process (Lim et al., 2008). The manifestations can take any form, shape, and appearance depending on the material it is constructed by. Löwgren and Stolterman address the notion of *digital material* as a different kind of material because it is a *material without qualities* (Löwgren & Stolterman, 2004). They argue that the materials for designing digital artefacts have fewer intrinsic material limitations, which results in a bigger design space and makes prototyping even more open-ended. To work with the digital materials we have chosen to use physical computing tools and to construct and program physical interactive prototypes. These digital software environments are used in combination with physical materials in our prototypes.

In Figure 6.21 we present the specifics of how the prototypes are formed by defining the medium (material), the level of detail (resolution), and the range of what is being covered (scope) in the manifestations (Lim et al., 2008).

Manifestation dimension	Choosing Buddy	Tune Toilet
<i>Material</i>	Visible: Lego, lights Invisible: Arduino + sensors data	Visible: Lego, speaker Invisible: Processing + sounds
<i>Resolution</i>	Mock-up simulation Faking of data	Mock-up simulation Realistic simulation data
<i>Scope</i>	Scenario testing (experience)	Scenario testing (experience)

Figure 6.21 - Manifestation dimensions

The two prototypes share a lot of characteristics related to *material*, *resolution*, and *scope*. Physical materials are used to shape the spatial structures and the tangible components of the interactive systems, e.g. Lego, lights, and speakers. The invisible digital system is build using code as the material and is visible to the user through an experience or engagement with the interactive components. The level of sophistication (the resolution) can be described as *mixed-fidelity* according to McCurdy et al. (2006) because we make use of low-fidelity and high-fidelity in different dimensions of our design. In Choosing Buddy all the data is simulated and

the functionality of the interactive zone is not prototyped in detail as an example of low-fidelity. The composition of music and the triggers are prototyped in greater detail in Tune Toilet as an example of high-fidelity. We simulate situations from the field by either faking the data or simulating it. We test the simulations as scenarios to get a sense of the potential experience of the installation. Even though the Lego prototypes are build in a small scale on the table, the scenario ensures a decent degree of contextualization to the real setting.

CHOOSING A CONCEPT

By defining, testing, and designing the filters mentioned above, we have explored the potential of the two prototypes. The stop motion scenarios reveals possibilities and constraints in the two prototypes. At this point the prototypes are conceptualized enough to be labelled as concepts even

though they are not fully designed yet. Due to practical limitations we only continue with one concept, which we will refine in the following phase. In Figure 6.22 we rate the two concepts based on their relation to aspect of transition and their embeddedness in use flow of the restroom. A check-mark means that the concept shows potential, a line means that it does not.

As the figure illustrates Tune Toilet scores a total of seven out of eight whereas Choosing Buddy scores four out of eight. Moreover we believe that Tune Toilet has the potential to change the perception of distance and exposure in an innovative and fun way. It also represents a solution that is backed by many of our key insights (explained in CD3) which supports design decisions in the following refinement phase.

Figure 6.22 - Rating the two concepts

Concept	Distance	Sound	Hygiene	Exposure	Availability	Entering restroom	Choosing stall	Leaving stall	Score
CHOOSING BUDDY	✓	—	✓	—	✓	—	✓	—	4
TUNE TOILET	✓	✓	—	✓	✓	✓	✓	✓	7

D.phase 3 – Refining

In d.phase 1 and d.phase 2 we have narrowed the scope from three open conceptual directions to two prototypes to one design concept – Tune Toilet. In this phase we focus on how the concept is refined into a final design, which is presented as a high fidelity full scale installation in the next chapter. In the following we describe the context in which we are designing, followed by design of input and output. Input is mainly refined in relation to triggers of the interaction. By refining output we take a closer look at sounds, which plays a pivotal role in the concept. This include the type and behaviour of the sound. Afterwards we refine the coupling between input and output.

CONTEXT

An important fact in this refinement phase is that we are now designing for a concrete context – a large restroom at the ITU. The restroom has a large pre room with access to four stall. The stalls do not contain sinks or hand dryers as these are mounted in the pre room. It is build with closed stalls; meaning that they have solid walls between the stalls. This is interesting for our design because it makes the detection of other users harder compared to restrooms with partitions where the sound can travel more freely. Because we are

both men, we imagine on the basis of ethical considerations that our presence would interfere less in the men's restroom than in the female's restroom. This is why we have chosen the men's restroom.

INPUT

The only input the system requires is availability data saying whether or not anyone is inside the pre room or in any of the stalls. There are multiple ways to sense the presence of people. The status of the door lock is one way of using the information already available in the restroom. This is however not a viable solution because the lock is analogue and is not available in a digital format unless extensive modifications of the doors are made. Distance sensors on the other hand are simple to integrate with an Arduino environment (Figure 6.23). Because people sometimes sit still on the toilet, distance sensors are favourable compared to motion sensors. One constraint of a distance sensor is the specific direction of measuring. This forces the sensor to point directly towards the place where people are physically present. The fact that people move around in the pre room makes it impossible to use distance sensors here. Instead we chose a motion sensor in the pre room because it register motion in the full range in front of it (Figure 6.24).

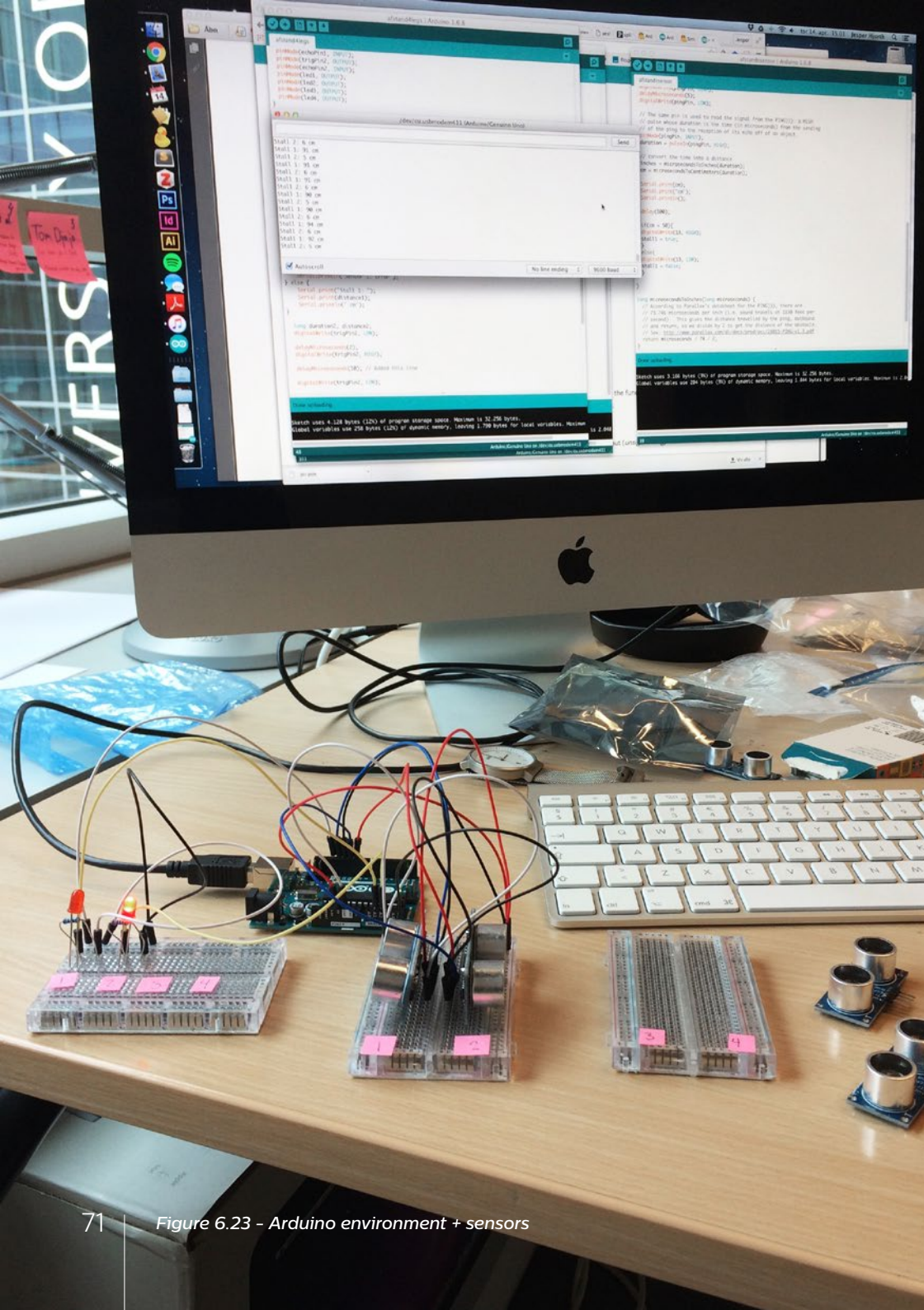


Figure 6.23 - Arduino environment + sensors

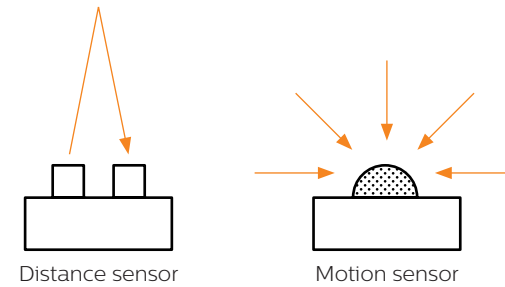


Figure 6.24 - Distance and motion sensor

OUTPUT

The Lego prototype made several qualities of sound as output apparent. Sound is first of all accessible anywhere in the restroom. We divide our refinement of the sound output into two categories to decide which sounds to use and how they should behave: *Type of sound* and *behaviour of sound*.

TYPE OF SOUND

The music track divided into instrumental tracks (used in the Lego prototype) had some issues, such as the fragmented experience of the original track. We saw the issues as an opportunity to refine the sound output. We identified four possible types of sound for composition: *Ambient sounds*, *Music tracks*, *Sound effects* and *Live stream*. Ambient sounds are looping sounds of for example chirping birds, a waterfall, and rain. Music tracks are what we used in the Lego prototype presented earlier, where R.E.M.'s song "Losing My Religion" was divided into instrumental tracks with voice, drums, bass and guitar. Sound effects are synthesised

digitally with emphasis on uniqueness and the instrumental and interactive qualities. Live Stream builds on the idea, that live real world recordings or radio channels could be the source of sound. In the boxes to the right we list pros and cons of each sound type based on our listening experience, music skill and ideas for design.

AMBIENT SOUND

- + Atmospheric
- + Easily merges into each other
- + Multiple online sources
- No connection to context
- Can be monotonous

SOUND EFFECTS

- + Creative and unique
- Requires extensive synthesizing skills
- Few relevant touch points in our concept

MUSIC TRACK

- + Instrumental balance and cohesiveness (voice, drums, bass and guitar)
- + Collaborative
- ± Different songs have different connotations for different people
- Can be perceived as ruining the track
- Few online sources

LIVE STREAM RADIO

- + Good online sources
- + Potential for a connection to the context
- Very difficult to split into multiple tracks
- Hard to control content of sound

From the perspective of AIS (*ambient information systems*), sound can be viewed as the modality through which

information is being displayed (Pousman & Stasko, 2006). We are seeking to design a system capable of informing users of occupation of five different rooms at once. This system can in terms of an AIS be describes as having an *information capacity* of five information elements; meaning that occupation of each stall should be easily perceived, and therefore have individual sounds. All sources except Live stream radio have the possibility to carry five information elements at once. **Live stream radio is excluded** due to the lack of possibility to divide live sources into meaningful outputs.

We identify the *notification level* in the remaining three sound types as low because none of them interrupt or demand attention, which qualifies them as useful when designing AIS.

By analysing the *representational fidelity* of the sound types' we explore their semiotic potential. The sounds functions as *signifiers* for people present in different locations of the restroom (other users being the *signified*). The *sense* represents the user's understanding what the signifier and the signified means. Ambient sounds, music tracks, and sound effect all uses arbitrary *symbolic* signs; meaning that no inherent logic (sense) of the situation will derive from the arbitrary sounds. We argue that the sounds (signifiers) must

be distinguishable for the user to understand them as signs representing different users (the signified). We encountered the lack of distinguishability as a problem when using the music track in the Lego prototype of Tune Toilet. Especially the bass track was difficult to distinguish from the other tracks, when multiple tracks were playing. The music track type is also problematic when focusing on the *aesthetic emphasis* of the AIS. A music track is composed and released in a certain version; meaning that if you distort the holistic nature of the track, by breaking it into pieces, you damage the beauty of the track. **Music tracks are excluded** due to the lack of semiotic representation and aesthetic pleasure. Ambient sounds have good conditions to be distinguished from each other because they can signify unique and comprehensible things, locations, or events besides being a signifier for people. Here is an example: The sound of birds can signify physical birds singing in the nature, but will in this context also signify the presence of other people because it is triggered by movement of others. Since chirping birds is a known phenomenon for people, they will have no difficulty in distinguishing it from other ambient sounds like rain or thunder as long as the ambient sounds are not too similar. Sound effects naturally have the same potential due to the distinct nature of effects. The difference between the last

two sound types lies in their main qualities: Sound effects are very direct because they are instrumental and require multiple inputs. The ambient sounds on the other hand are fluent and does not require the same amount of inputs. Multiple inputs, such as slapping on the paper dispenser or moving around inside the stall, did however not fit with our understanding of appropriate behaviour in this context. **Sound effects are excluded** due to the lack of appropriate interactive interface in public restrooms. Ambient sound meets our criteria of information capacity, notification level and representational fidelity and also provides a possibility to choose aesthetically pleasing sounds.

We found and listed to a broad palette of ambient sounds and evaluated them. The result of this selection was five different ambient sounds. We chose noisy sounds of people at a café for the pre room as a way to express noise from the shared contextual space. Running water, chimes, chirping birds, and thunder was chosen as the sounds for the four stalls in an attempt to support relaxation and comfort (Appendix A – Online material).

BEHAVIOUR OF SOUND

When we walk around on the streets and hear a significant sound we turn our head towards that sound because it has

an physical origin and a direction. Tune Toilet have a potential to exploit this depth of sound as a modality. Parameters such as direction, volume, and fading have the potential to increase the information capacity.

Playing a sound from inside the stall makes it easy for other users to couple the sound to that particular physical space. Hearing the sound being played on a low volume can work as feedforward to users and tell them which sound will be played if they chose a specific stall. However, directional sound is a very comprehensive practical solution which requires an extensive amount of wire and five individual speakers. The technical setup would additionally involve multiple computers and Arduinos. For these practical reasons we decided to work with one source of sound placed in the pre room.

The sound is carrying one core information – *is there people in the pre room or in a stall?* That question is answered by different ambient sounds being either on or off. We added a slow fade-down of the volume after a person leaves a stall. This behaviour of the sound is increasing the information capacity, and can ideally communicate recent presence to other users. The question is however, if the user is able to couple to input and the output meaningfully.

COUPLING INPUT AND OUTPUT

The coupling of input and output is a central topic of interaction design. A user's actions are coupled to the product's function through different types of feedback and feedforward (Wensveen et al., 2004). For Tune Toilet to be successful in revealing other users presence and position, the system must have an understandable coupling between the user's input (presence in a room) and the meaning of the output (sounds). The sounds playing when you sit down on the toilet is a functional feedback, but this might not be salient enough. Especially in the case when multiple sounds are being played simultaneously we predict that users will struggle to catch the connection between their presence and a specific sound. The different stalls' arbitrary representation of particular sounds is assumably also problematic. To solve this problem we created signs for each door as feedforward. Figure 6.25 shows the four stall signs implying the sound related to each stall. We used iconography to make use of the typical way to signalize differentiations of rooms in public restroom (used for gender segregation).



Figure 6.25 – Stall icons

7 – Field and lab test

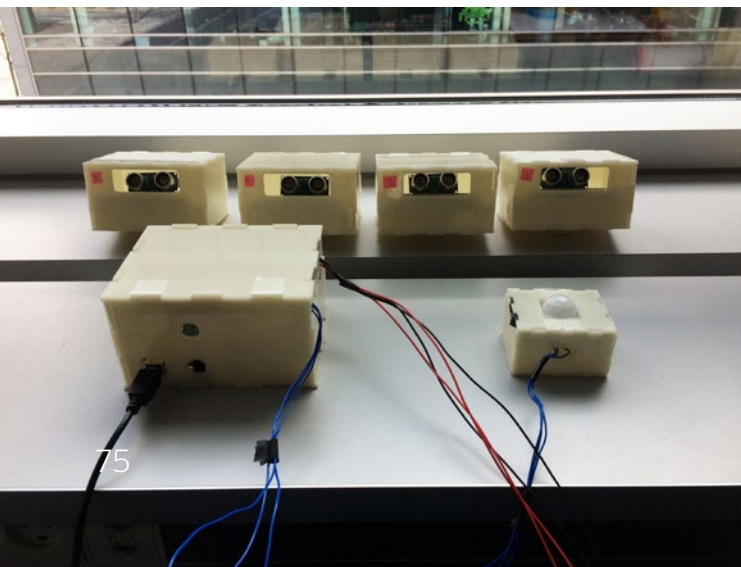
In this chapter we present our final design concept as an installation for a public restroom. Afterwards, the test setup is explained followed by an analysis of the test findings in relation to the research and design considerations.

Tune Toilet

The final design concept is a direct product our design phase presented in chapter 6, informed by our ethnographic research in chapter 5. It is build as an installation for a specific large public restroom at ITU. Figure 7.1 displays images of the actual installation. A video of the experience using the installation, from a user's point of view, can be accessed in Appendix A – Online material. The following description present the video in words.

When you enter the restroom from the outside you are instantly met by sound of a busy café. As you walk towards the stall you realize that there is three different icons on the stall doors – you pick the one with chimes. As you sit down on the toilet the café noise starts fading and the sound of chimes appear. While you sit there the sound of chimes fills the room and you find comfort with a sense of being alone in the restroom. After a while you can hear the sound of the busy café mixed with your sound of chimes. You assume that someone else have entered the restroom. Seconds later you realize that a the person have chosen a stall because the busy café starts fading and sound of birds are mixed into the sound of your chimes. The sounds are at a pleasant volume and just strong enough to cover any sounds from inside your stall. Suddenly you hear the other person leaving as the noise from the café is back and you hear water flushing outside your stall. Now the soundscape is a mixture of chimes, birds and café noise, but after awhile the sound of the chimes is the only sound left in the room and you decide to leave the stall with the assumption that you are alone. As you move from the stall to the pre room the café noise takes over and you leave the restroom.

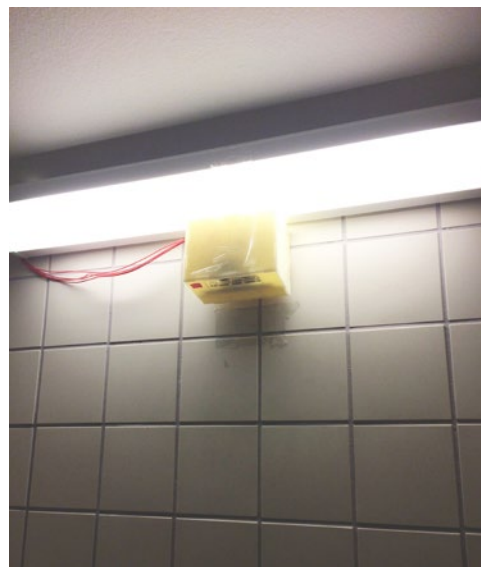
Figure 7.1 – Images of the installation



THE DESIGN

The function of the installation Tune Toilet is to mask user's activities while being inside a stall and at the same time offer positional information of other users present in the restroom. Ambient sound is used to communicate information by using subtle signs as fluent feedback. The interactive system automatically creates inputs when users start or ends transitions by being present in the pre room or in a stall. The system outputs looping ambient sounds based on the user's position. When a user enters the pre room or a stall the sound immediately goes to max volume. When a user leaves a room the sound from that room starts fading down and thereby extends the user's presence in the room. The

system is intangible as there is no physical tangible interface to interact with. Iconic signs on the stall doors gives feed forward to support the coupling between the input (physical position) and the output (sounds). This linking needs to be experienced through interaction as the system does not work unless minimum one person interacts with it. This brings us to the social aspects of the design. The flow of a public restroom means that multiple users are present at the same time. We have utilized this finding by designed the system so that users affect each other's experiences. One user cannot be in control of the whole system as the interaction depends on the restroom flow in that specific moment in time, containing multiple users having unique experiences, based on their placement in the flow and position in the restroom.



TECHNICAL SETUP

In this section the practicalities of the installation is explained. Figure 7.2 illustrates the technical setup as a blueprint. The installation is using live data generated in the restroom. The installation is an addition to the restroom; meaning that equipment (wires, sensors, controllers etc.) is visibly apparent to users. While setting up the system the decision was made to skip the fourth restroom due to a technical issue of an unstable sensor caused by too long wires.

In the technical illustration sensors are coloured orange. The installation contains four distance sensors: One in each stall pointing down. These sensors are determining if a user is sitting down on the toilet; meaning that the stall is occupied. One motion sensor is mounted on the wall in the pre room close to the door to register movement as activity. All input sensors reacts instantly resulting in auditive output being mixed and played through a speaker located in the pre room (coloured green). The five sensors are all wired to an Arduino micro controller through a breadboard as a hub. The controlling system is coloured

purple in the illustration. The Arduino controlling unit and the sensors are all built into laser cut boxes to make them look as little ‘techy’ as possible (Figure 7.3).

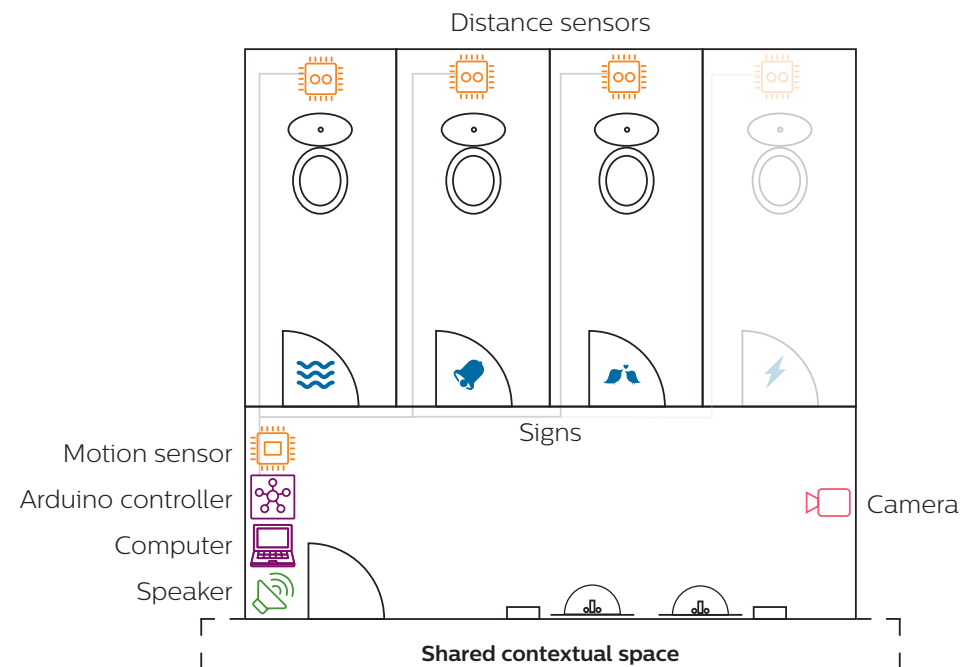


Figure 7.2 - Blueprint of the technical setup

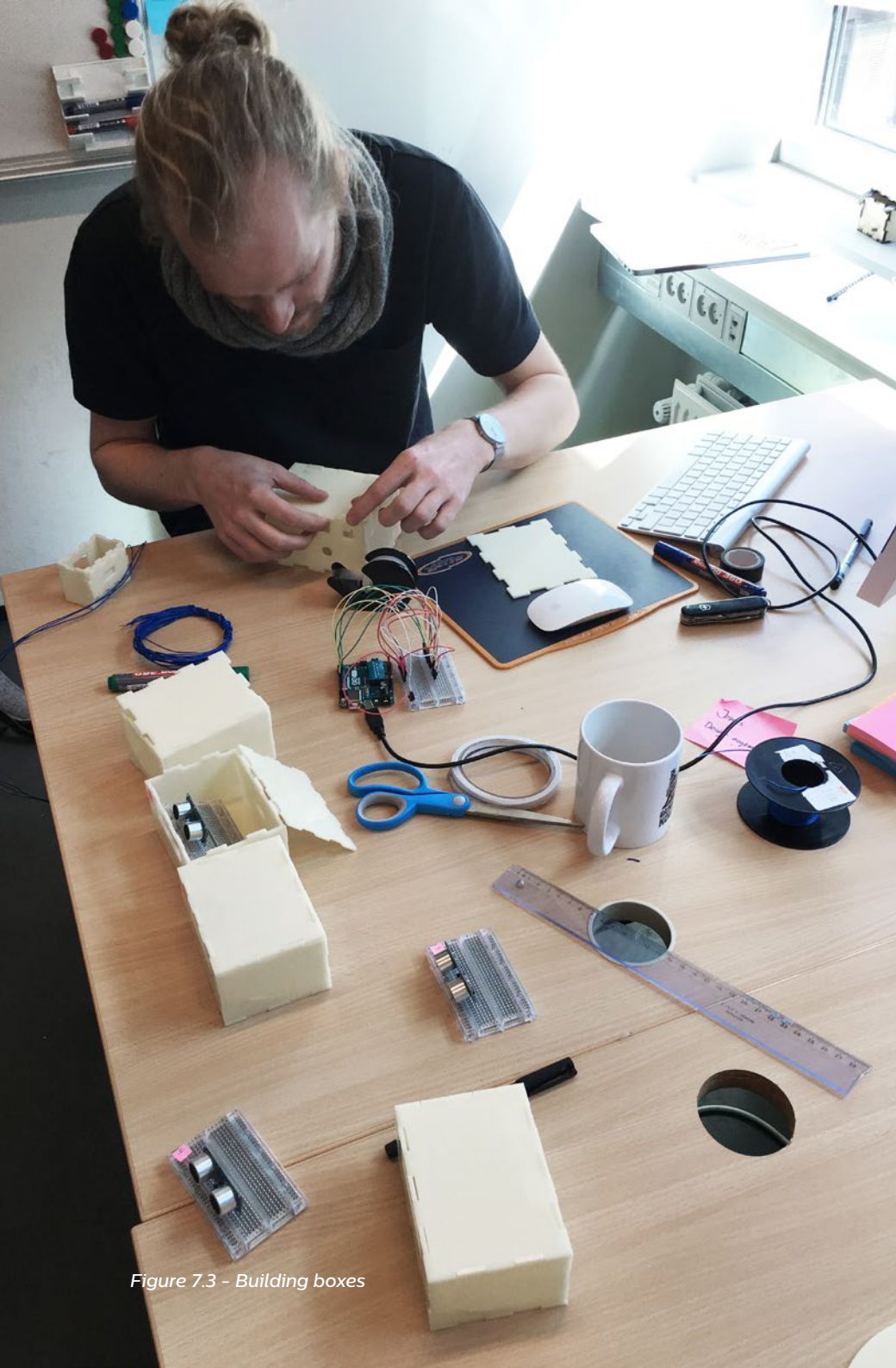


Figure 7.3 - Building boxes

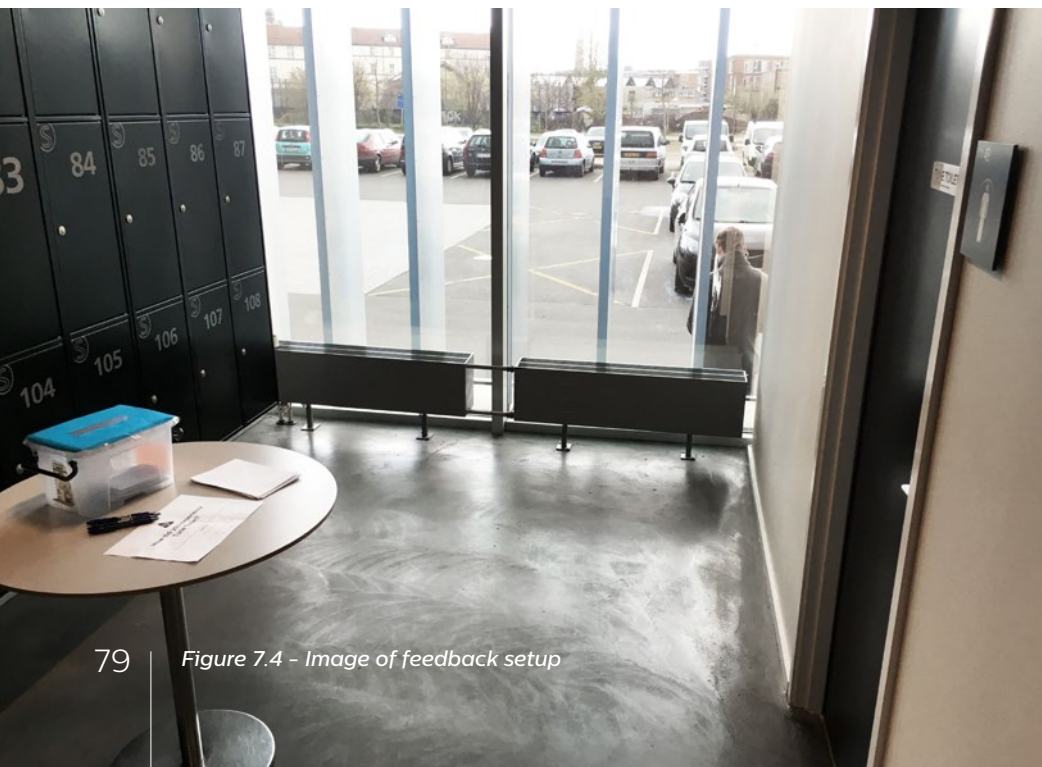
The micro-controller handles the availability status of the stalls by reacting to objects in the threshold of 10 cm to 130 cm. It also handles the activity status of the pre room by spotting movement in its range. The data is sent to a computer through the console each second containing five rows of text telling if the five rooms are being used. The computer uses Processing to control the volume and mix the audio. It turns up the volume as soon as it receives information stating that the room is being used, and fades the volume down when it is not being used. By testing and experiencing the installation while sitting it up at ITU we found that a 30 second audio fade out (going from 100% to 0%) in the stalls and a 15 second fade out in the pre room supports the intentions of our design. For documentation and analytical purposes we put up a camera during our simulations (coloured pink). The Arduino and Processing code can be found in Appendix H - Code.

Test

The installation was installed at the largest men's restroom at ITU during the morning of April 28, 2016. On this Thursday with normal activities at the university, we tested and refined the system to ensure that it functioned as intended. At 11:30AM the system was up and running in the restroom.

In the period from 02:00PM to 02:30PM we put up a sign saying that the restroom was unavailable to general use. At 04:00PM we uninstalled the system. While the installation was active and available to everyone, a table was placed outside the restroom with a questionnaire containing 10 questions (Appendix I - Test questionnaire and data), pens and a submission box (Figure 7.4). We kept a distance to the restroom with the goal of not influencing the experience of the users, but checked the system every ten minutes to ensure it was working correctly.

We differentiate our test as a *field test* and as a *lab test* drawing on Koskinen et al.'s (2011). The installation was working as a field test for four hours. In the field test we made use of the contextualization of the restroom; meaning that it was accessible to the public as it usually is. We did not interfere or instruct users on how to use it. The questionnaire following the visit was voluntary and was filled out by 13 people. Findings from this quantitative method are presented with qualitative findings later in this chapter. The installation functioned as a lab test for half an hour, where the restroom was used for our simulation. In the lab test the restroom became de-contextualized from its normal use, for example by allowing men and women in the same restroom and ask them to simulate visits repeatedly. The goal of creating a de-contextualized simulation test was to understand details of the experience. In the test we focused on the installations intended functionalities: masking user's activities inside a stall and offering positional information about other users. By focusing on these two functionalities in the simulation test we seek to understand social dynamics and privacy in depth. The lab test also allow us to understand how users experience the installation during multiple visits. Four



participant took part of the simulation. Three women and one man in the age between 26 – 29 years old participated (Figure 7.5).

The participants did three simulation rounds each followed by a discussion. The first discussion concerning practical matters, in the second we let their impressions and experiences guide the discussion, and in the third we brought the discussion to a level of perspectivation. We asked them to fill out the questionnaire after the first and the last simulation to get a sense of their interpretation progress. We facilitated the simulation as a focus group with an interview guide to keep to focus during the lab test (Appendix J – Structure and questions for simulation).



Figure 7.5 – Simulation focus group

Analysis

Since only 13 users filled out the questionnaire, we will not analyse the data in depth, as it is hard to prove significance of findings. We will however refer to tendencies in the answers. The discussions in the simulation generated significantly more data than the questionnaire. The transcript is kept in the participant's native language Danish, but used quotes are translated to English. Round one (4:23) and two (2:37) of the simulation are considerably shorter than round three (22:16) where the main part of the discussion took place.

The analysis consists of two parts. The first is an initial coding of each statement (Appendix K – Coded test transcript). The second part is a affinity clustering of relevant statements based on the initial coding (see Figure 7.6). The affinity clustering resulted in a sorting under the following headlines: *technical issues*, *experience* and *functionality*. *Understanding*, *mixed sounds* and *direction of sound* are subcategories to functionality, and *aesthetics of sound* is a subcategory to experience. These categorisations lead to insights, that we presents under the three headlines. See Figure 7.7 for an overview of the affinity diagram.

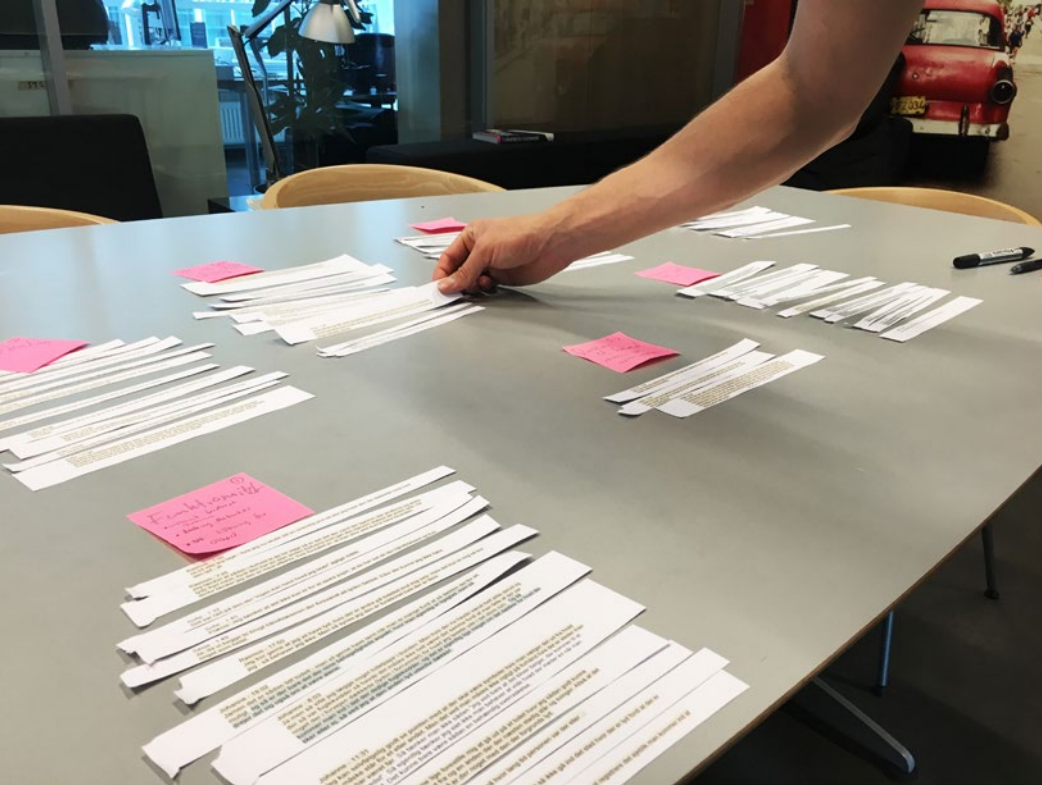


Figure 7.6 – Affinity clustering data from tests

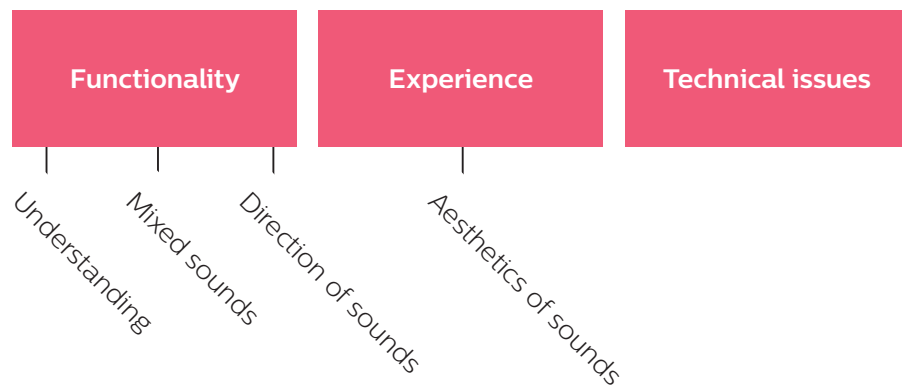


Figure 7.7 – Affinity diagram structure

TECHNICAL ISSUES

The participants stated two technical issues both concerning the sensors inside the stalls. The first issue is the sensor not registering the person, as the following quote illustrates. *“I don’t think mine worked the first time. It was in the one with the music – the bells. I don’t think there was so much sound now that I think of it.”* (Sofie, 1:36, round 2).

The consequence is that the sound from the stall is not being played; meaning that the user is ‘invisible’ to the system and is not being represented as an ambient sound. This is crucial for the installation because it restricts the user from interacting with the system. The second issue with the sensors was the case of constant sound of water, caused by a sensor sending buggy measurements. Because the installation have no other feedback than the functional feedback of the sounds, this issue is restricting the user from realizing the interaction. The following quote illustrate this issue. *“I think it was on all the time when I was in there.”* (Sofie, 1:24, round 3)

Beside the technical issues (which was fixed between every simulation), we found the system to be working well during the tests. One participant had a expressed her experience in alignment with our intentions of the design, e.g. *“I had the impression that it was precisely when I sat down that it happened (sound started).”* (Johanne, 1:01, round 1).

FUNCTIONALITY

Our intended functionality was to mask the sounds of users and give them positional information about the presence of other users. The answers of the questionnaires generally stated that people felt more private than normal, as Figure 7.8 illustrates.

Did you feel more or less exposed than you normally do when sitting inside the stall?

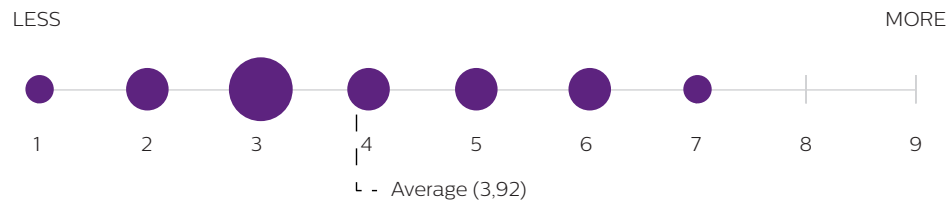


Figure 7.8 - Answers of question 4

The masking of sound was also articulated by participants in the simulations, e.g.: *"It was nice in that 'nobody can hear my' kind of way."* (Sofie, 1:32, round 1)

Another participant found a particular sound more effective to mask the sounds of his activities as explained in the following quote.

I think that in relation to the three sounds, then it is the water that kills the sound of farts and other sounds the best, because it has a frequency that does, so it kind of kills the other sounds. That's why I think it is the most effective, if the purpose is to that you should not hear each other. (Rasmus, 7:25, round 3)

These findings related to the masking sounds suggest that Tune Toilet is creating a soundscape which mask the sound of the user's activities sufficiently without exposing them at the same time.

No participants described any use of the second functionality of using the sound to determine the presence of others. 85% answers "no" in the questionnaire to the question: "Did you use the sound to determine where the others were?". The following quote exemplify a general difficulty to understand this functionality. *"I don't think I have understood the system then. Or what the sounds are used for - besides killing the bad sounds."* Rasmus (0:29, round 2). This suggest a problem of the system, about the user's ability to use it in the way we intended. Findings related to the category of mixed sounds explain how the sounds are mixed into a soundscape, where it is hard to separate the sound into individual sources of information. These quotes highlight this issue:

I don't think you can distinguish between [the sound of] five stalls. (Rasmus, 20:40, round 3)

[...] I couldn't separate at all [the sounds]. (Sofie, 0:28, round 1)

[...] I think it's funny that you only heard your own sound, because I could not concentrate to separate the sounds at all. I think it was very much one sound. (Sofie, 9:08, round 3)

Beside the combination of sounds, we found the sound in the pre room (café noise) to be problematic. As the quote exemplify, the problem lies in the many sounds which the café noise consists of. “It is also because it is a sound composed by many sounds.” (Sofie, 13:36, round 3).

The direction of sound can be another explanation of why the participants did not use the sounds for orientation. We have already described the subject of direction and its potential in chapter 6, but decided not to build this comprehensive setup. The consequence seems to be an underutilized potential to create a clear coupling between the sounds and the presence of people:

So, if you actually could hear that the sounds came from inside the stall – I think that would, you know remove many of the connections you have to create, before you get that there is a connection [between the sounds and the position of a person]. (Sofie, 11:51, round 3).

This might also help the 69% who do not feel that they understand what controls the sounds, according to the questionnaire.

EXPERIENCE

We identified some statements about the experience that goes beyond the functional aspects. The first relates to privacy. We argue that the described feeling of being alone and private in the two quotes in the following are similar. “[...] *there [inside the stall], I felt very private, when it was just my own sound.*” (Sasja, 2:58, round 3), “*I just think I felt very alone when there was bird sounds. You know, that was a good thing.*” (Johanne, 7:00, round 3).

They both address a connection between hearing only one sound and an amplified feeling of privacy. We argue that this address a functional quality of the system, which is that you are able to hear when you are alone. In that way Tune Toilet struggles to communicate the presence of others as we have previously argued, but it is very successfully in communication the absence of others.

Other quotes emphasize the quality or aesthetic experience of the sound. Especially the sound of the birds was considered pleasant: “*Yes, i thought that too (that the hand dryer was noisy). It kind of ruined the pleasant chirping.*”

(Rasmus, 4:26, round 3), “*I think I would pick the chirping birds.*” (Johanne, 7:59, round 3), “[what sound would you pick?] Chirping birds.” (Sasja, 8:00, round 3). The sound of the water was also considered nice. “*The waves? I just thought it was that really wild and nice swwhhhh noise.*” (Sofie, 1:57, round 2), “*I also really liked the waves in fact. I think they are very pleasant.*” (Rasmus, 6:45, round 3).

While observing the involuntary participants from at distance we paid attention to their mood. Most of them left the restroom with a smile on their face. In the questionnaire 100% of the respondents answered “Yes” to the question: “*Would you use this restroom again, now that you know that it plays sound?*”. This imply that at least some users had an overall pleasant experience using the installation since they are willing to use it again. We do however assume that users not having a pleasant experience probably wouldn’t have filled out the questionnaire. We also encountered a person writing feedback on the questionnaire explanation sheet saying: “Not sh*tting with all that tech #paranoia”. Therefore we must conclude that not all users were satisfied with the experience.

Evaluation

We conclude this chapter by evaluating user experience of the system and reflect critically on the test.

USER EXPERIENCE

To evaluate our system we use Hassenzahl & Tractinsky’s (2006) three facets of UX: *Beyond the instrumental*, *emotion and affect*, and *experiential* (presented in chapter 3). The three overlapping perspectives offer a narrowed scope of the complex nature of UX. Our evaluation using the facets bridges the gap from our practical work (research, design, and tests) to our reflective discussions in the next chapter.

BEYOND THE INSTRUMENTAL

The findings from the test demonstrates how the sounds, especially of singing birds and the sound of the water, was perceived as pleasant. Findings related to the aesthetic nature and user’s willingness to use the restroom again addresses the UX facet going *beyond the instrumental*. The goal of this perspective is “*to enrich current models of product quality with non-instrumental aspects to create a more complete,*

holistic [interaction].” (Hassenzahl & Tractinsky, 2006, p. 93). We argue that we have created a more complete design by including non-instrumental aspects in the form of well chosen sounds, which influences the overall user experience. We are however unable to answer why these sounds are pleasing, because it was out of our scope for the test. This is an obvious area to which Tune Toilet could help generate knowledge, if a test and the following questions had that aim.

EMOTION AND AFFECT

The ambient information system has the ability to make privacy “hearable”, explained with users feeling private when sitting inside the stall and only hearing their own sound. This is in line with Hassenzahl and Tractinsky’s (2006) UX facet of *emotion and affect*. Inspired by the authors we ask “*did we design emotions?*”. On one hand the answer is “no” because we failed to design conditions for feeling private, in the situation where other users were present in the restroom. On the other hand the answer is “yes”, because the design in fact successfully creates emotions related to feeling private when being alone. UX have a focus on positive emotions, because

preventing dissatisfaction is a core objective (Hassenzahl & Tractinsky, 2006). We argue that privacy is a positive emotion because of how the participants articulated it, and because our research found that users wish to be alone. The fact that users prefer to be alone makes the absence of others matter, and that is why the sound amplify the feeling of privacy.

THE EXPERIENTIAL

In our approach to UX “*an experience is a unique combination of various elements, such as the product and internal states of the user (e.g. mood, expectations, active goals), which extends over time with a definitive beginning and end.*” (Hassenzahl & Tractinsky, 2006, p. 94). This means that the users’ experience is formed by the situatedness and temporality of our tests. The installation at the restroom at ITU offers conditions for the experience users can have such as the a feeling of privacy. Yet, we can not guarantee or determine a particular experience in our design. Thus, our installation demonstrates the *experiential* UX facet by setting the scene for experiences that are complex, unique, hard to repeat, subjective, and dynamic over time (Hassenzahl & Tractinsky, 2006).

CRITICAL TEST REFLECTIONS

While testing the installation and analysing our findings we reflected on our methodological approach. In this section we evaluate our decisions from a critical perspective. As in any design process the possibilities are endless, causing decisions to rely on the design researchers skill and intuition (Koskinen et al., 2011). We present these critical reflections to highlight some problematic aspects of the test phase in a constructive way to support future design research similar to the herein presented.

The installation at ITU was only available to the public for four hours resulting in a total of 13 filled questionnaires. In this period of time we encountered technical issues; meaning that not all users experienced the system in an ideal situation. A longer test period with more users seems preferable to inform the research better. Likewise, we discovered potential improvements or changes to the system that would have been worth trying through iterations if the test had run for a longer period of time. In hindsight we would have liked to explore suggestions like removing the sound in the pre room or make the trigger of the sound more visible.

The mix of men and women in the simulations did not seem to affect the experience. We did however encounter different behaviours in the pre room based on gender, which illustrates our lacking knowledge of female restroom use. One of the reasons for making the simulation as a lab setting was to eliminate the unavoidable technical look and feel of the installation. We expected that users could get anxious of entering a restroom with sound and technical equipment. Our concern was confirmed by the feedback quote we received from an anonymous user. This problem might have faded over time as the involuntary users could have gotten use to the system by trying it multiple times.

Our test resulted in mainly qualitative insights regarding experiences. Other approaches for measuring experiences of the interaction in detail could have been useful. Albert & Tullis (2013) suggests using *user experience metrics*, to measure the user experience in quantifiable numbers in order to evaluate aspects of *effectiveness*, *efficiency* and *satisfaction*. Lenz et al. (2013) suggest using interaction attributes to measure the aesthetics of interaction. Due to our focus and the limited time of this project we did not utilize other UX frameworks than Hassenzahl and Tractinsky's (2006) three facets.

8 – Discussion

In this chapter we discuss design implications of our intangible ambient information system that use sound, theoretical implications of privacy in a public context, and methodological reflections on our process.

Intangible ambient information system that use sound

We argue that the theoretical starting point from Pousman and Stasko (2006) have been useful as a frame to design, evaluate and discuss an ambient information system that uses sound. The authors suggest that ambient information systems are tangible, but include an example that we understand as intangible. As mentioned in chapter 3 we find this contradiction problematic, and sought to explore the possibility to include intangible systems in the definition. Based on our successful use of Pousman and Stasko's (2006) terminology in the design and evaluation of Tune Toilet, we argue that the definition should include intangible information systems that uses sound. To support the design of future intangible ambient information system that use sound we present five design suggestions based on our experience from Tune Toilet.

Our first suggestion is to keep the information capacity low. The most complex functionality of Tune Toilet was to use sound to determine the position of other users. Our simulation showed that no participants were able to do so. We have argued that this was due to difficulties in distinguishing the different sounds from each other, when multiple tracks were playing. We argue that a low information capacity is essential in ambient informations system that uses sounds because the sounds will be indistinguishable otherwise, and thereby create a mixed and confusing soundscape. Tune Toilet is an example of a system with a too high information capacity because it uses too many sounds.

Our second suggestion is to avoid individual sounds categorized as mixed sounds; meaning that one track consist of different sounds. The characteristics of the sound in the pre room was an issue that complicated the distinction of sounds additionally. The sound of café noise was characterized as a mixed sound by the participants of the simulation making the combined soundscape blurry.

As a third suggestion we encourage designers to explore and utilize the potential for an aesthetic experience of sounds. We found the sound of birds and water to be considered pleasant, which suggest the aesthetic potential of sounds. However, our research did not focus on why the sound of the chirping birds and water was perceived as pleasant. If we were to understand the aesthetic of sounds we should include research from the academic fields such as music and sound studies.

Our fourth suggestion is that designers should be aware of the noise of the environment. In our test we experienced that the hand dryers for example was able to drown the sounds from Tune Toilet, which exemplify how ambient informations systems that use sound are vulnerable to others sounds from the environment.

Our fifth suggestion is that users should be able to learn the functionality of the system overtime. By this we recommend to avoid context where the same users seldom or never returns. This suggestion is based on the findings on the difficulty to learn the functionality of Tune Toilet. The participants

articulated a general lack of familiarity and experience with ambient information systems that use sound, which we see as an additional fact that challenge the chances of learning the system.

To summarize we suggest designers of ambient informations systems that use sound to:

- Keep the information capacity low
- Avoid using mixed sounds
- Explore and utilize the potential aesthetics of sounds
- Be aware of the noise of the environment
- Make the system learnable over time

We recognize that this list of suggestions is inconclusive. Additional research is necessary on subjects such as the type of sounds, aesthetics of sounds, sounds in contexts, information capacity, learnability, and potential of different contexts.

Designing for privacy in a public context

Based on findings from our research and design we here discuss aspects of privacy. This leads to a reflection on how our theoretical framing of privacy fits the goal of designing for privacy in a public context. Based on the discussion we suggest the concept of *involuntary exposure* to complement the existing literature on privacy. Afterwards we explore how the concept of involuntary exposure can be used in similar contexts when designing for privacy in a public context.

We have treated privacy as to be free from sensory or physical invasions and have the ability to control when, how, and to what extent information about a person is communicated to others. In the research we argue that physical distance is important to avoid physical invasion of privacy. Furthermore we argue that distance is used as a strategy to avoid sounds and smells of others and thereby avoid sensory invasion of privacy.

We argue that privacy is more complex than keeping distance when it comes to the ability to control when, how, and to what extent information about you is communicated to others. Because the sounds from a user are related to private activities, we argue that they are private informations. The explanation of why these private informations are preferred kept from others lies in the theoretical concept of *curiosity*; meaning that a user is consciously aware of other users eavesdropping. We used this argument in chapter 5 to explain what makes users act discrete. Masking sounds can be viewed as a factor that gives more control of information, because the information is not perceivable for others. The concept of curiosity explains why users fear that others will notice sounds from their stall, but it does not explain the fact that the user is responsible for the sounds, and that the invasion of privacy therefore becomes self-inflicted. In a situation when a user is sitting inside a stall and the activities are revealed by sounds, we argue that the invasion of privacy

is related to *self-invasion* which is “*the lack of reserve through which an individual fails to observe his own minimum boundaries of privacy*” (Westin, 1967, p. 52). But as opposed to being unable to *observe* own minimum boundaries of privacy, we argue that the large public restroom is a context that do not allow users to *control* own minimum boundaries of privacy. Thereby a user is performing involuntary self-invasion.

Based on these examples we argue that the concept of invasion of privacy presented in the literature is too narrow because it focuses on outside factors as responsible for the invasion of privacy. Furthermore we argue that the concept of self-invasion fail to incorporate self-inflicted invasions of privacy, that are the product of lack of control in a given context. We suggest the concept of *involuntary exposure* which we define as the situation where individuals are consciously involuntarily communicating information about themselves to others.

We have identified involuntary exposure in large public restrooms that are characterised by public ownership, being accessible to everyone and discouraging interaction between users. We see a potential to use the concept of involuntary exposure along with the rest of the concepts related to privacy in other more traditional contexts of interaction design. Modern use of screen based communication on mobile devices have a wide range of issues, which could be understood in terms of privacy. We argue that screen based notifications from instant messages or applications is putting the individual in high risk of involuntary exposure, if the device is visible to others. Private messages and notifications from healthcare applications are examples of this. The same issue is apparent for computer screens and tablets in open work environments, where the physical devices are visible to others. With these examples we suggest a potential for further research on involuntary exposure, and that the notion should be addressed when designing for privacy in a public context.

Process and method

In this section we discuss general and specific methodological learnings from our research, design, and the combination of ethnographic research and constructive design.

When we started investigating the field of public restrooms we discovered a limited access to the field due to ethical and cultural constraints. We turned the issues of access into a challenge by looking for creative ways of mixing methods to gain knowledge of people's behaviour in public restrooms. In our campaign *Restroom Secrets* we utilized the waiting time when people are sitting inside the stall by giving them the option to inform us in a creative way using an anonymous questionnaire. We argue that this campaign helped us gain insights that we otherwise wouldn't have been able to get due to the level of intimacy found in the data.

Konopinski (2013) argue that primary research methods (ethnographic fieldwork) must be supported by secondary research (evaluation, analysis, and synthesizes of primary and secondary information) in order to successfully conduct ethnographic research. In our research we have used theory, academic literature, existing design work as secondary

research to inform of primary research. Findings gathered from field research have also supported our process iteratively, e.g. using data from r.phase 1 to target the activities in the focus group in r.phase 2. Thus we argue that our creative mix of methods have made us able to access the difficult field of public restrooms.

The primary goal of our design phase was to make a design construction in order to intervene with the world to gain knowledge. We approached the process of construction methodologically by using brainstorming, sketching, tinkering, and experience prototyping. We argue that these methods have supported our design process in two ways:

1. By sketching and prototyping ideas shifted from being imaginative to physical manifestations externalized in the shared world. In this shift we have experienced that the *world can speak back to us* (Schön, 1987) and support collaboration between designers.
2. By materializing prototypes using *filters* and *manifestations* (Lim et al., 2008) and *experience prototypes* (Buchenau & Suri, 2000) we have managed to form design knowledge iteratively. By prototyping we have accepted the fact that conceptualizing of ideas require a *reflective conversation* with the materials (physical and digital) and research findings (Schön, 1983).

When designing the interactive prototype we did however encounter a methodological issue. We did not experience smooth transitions between different solutions that enabled easy and fluid rearrangements of components and behaviours as Alessandrini (2015) argues is needed when using physical computing tools. By working with Arduino and Processing we found the prototyping process limiting and constraining. The unfolding of potential ideas was limited by our programming skills and general challenges of physical computing (e.g. working with component, building circuits and cabinets). These limitation resulted in narrow design explorations in terms of physical prototyping because we ended up tweaking rather than prototyping. Thus we support Alessandrini's call for the development of physical computing tools that better support the flow of the prototyping process.

In this thesis we have combined ethnographic research with CDR. We argue that this combination have been an effective approach for gaining knowledge. We have used ethnographic field studies as a basis for a design construction. We have

generated additional knowledge by testing our design in lab and field. We argue that the construction have helped us discover things that would otherwise go unnoticed (Koskinen et al., 2011):

- Our theoretical and practical contribution to the literature of *ambient information system* would not have been possible if we had not designed and tested Tune Toilet. Thus we argue, that we would not have been able to present knowledge of intangible ambient information systems that use sound, only by conducting primary and secondary ethnographic research. Instead we find our evidence in the combination.
- By testing the construction in the actual context we gained insights on how users experience privacy in relation to sound. This made us able to suggest the notion of *involuntary exposure*. Privacy in the context of public restroom is complex, and we argue that the design construction allowed us to explore aspects of transitions (sound) relevant to privacy by designing around the paradox of maximising/minimizing exposure.

9 – Discussion

In this conclusion we answer our research question presented in the introduction and summarize the knowledge claims from the discussion. The answer of our research question is the primary outcome of this thesis. The research question is answered by a combination of the insight from the ethnographic research, and our findings from testing our design concept Tune Toilet. The secondary outcome is a contribution to the design area of intangible ambient information systems that use sound and a theoretical contribution to the notion of privacy.

The full scale prototype Tune Toilet gave reason to argue that the definition of ambient information systems should include intangible ambient information systems that use sound. The test of the prototype additionally led to five suggestions for design, which can guide designers of similar systems. The five suggestions are *to keep the information capacity low, avoid using mixed sounds, explore and utilize the potential aesthetics of sounds, be aware of the noise of the environment, and make the system learnable over time.*

In the discussion we present the notion of *involuntary exposure* to complement the existing literature on privacy. The notion help understand complex situations where users are conscious about performing self-invasion of privacy. The notion of involuntary exposure is our attempt

to conceptualize an issue of privacy, which the literature on privacy did not address. With this theoretical contribution we suggest that the subject of *designing for privacy in public contexts* has potential for further research.

To answer our research question: “*How do aspects of transitions influence people's experience in use of large public restrooms?*”, we address the embedded questions. “*What are the aspects of transitions of large public restrooms?*” is answered before we answer the question “*How these aspects influence people's experience in use of large public restrooms?*”

Based on our ethnographic research on large public restrooms we identify the aspect of transitions to be *sound, distance, hygiene, exposure and availability*. By combining insights from the ethnographic research with knowledge generated by the constructive design activities we are able to answer how these aspects of transitions influence people's experience in use of large public restrooms.

Sound as an aspect of transitions can create both desirable and undesirable experiences. Sensorial invasion of privacy

can occur if a sound from another user is considered too close. User's own sounds and noises can lead to involuntary exposure, because they carry information about activities that are considered private. Tune Toilet made it clear, that sounds from the environment can mask the sound of the user and thereby minimize the risk of involuntary exposure. Sound can be utilized to create user experiences beyond the instrumental, as Tune Toilet exemplified by causing the experience of feeling private inside the stall. Sounds was furthermore a source to aesthetic experiences.

Distance is arguably the most important aspect of transitions because it is relevant in all transitions of large public restrooms. Distance influence the experience in use of large public restrooms by minimizing the risk of physical and sensorial invasion of privacy. Distance is achieved in three ways. First and foremost by keeping physical distance to other users. Secondly by creating distance to representations of other users such as traces, smells and, sounds. Finally distance is achieved through strategies that allows future users to keep distance e.g. by not selecting a stall in the middle.

The transitional aspect of exposure relates to invasion of privacy that is caused by an individual's inability to control when, how and to what extent private information is communicated to others. Visual exposure of intentions have been found in the transition of choosing a stall, e.g. rushing to the stall. The sounds created by a user's activities inside a stall is an example of invisible exposure. The essence of how exposure influence people's experience in use of large public restrooms is captured in the notion of involuntary exposure – the situation where individuals are consciously involuntarily communicating information about themselves to others.

We defined transitions as a *physical movement from doing one action to another*. The physical movement is in multiple transitions related to moving from one location to another such as entering, choosing a stall, and leaving stall. The aspect of availability in transitions is tied to the user's perception of the location he or she is moving to, or intend to move to. Availability of stalls is not only determined by occupation, but by additional factors such as cleanliness, recent use, and smell. As an example we found that users did not consider a

stall to be available if the hygienic status was not satisfying. A user's perception of availability is experienced through information gathering activities. Gathering information can be perceived as difficult with the presence of other users because people strive to act discrete. The way availability influence experience is based on how the user is able to gather information without being exposed.

Hygiene influences a user's experience through aspects of distance, sound, exposure, and availability. By influencing through other aspects we mean that hygienic considerations overrule other aspects and compromise an ideal situation. An example of a compromise is when a user chooses a stall next to an occupied one because the one further away is dirty. In this example the user compromise the ideal distance which will also increase the risk of involuntary exposure through sounds. We found that users experience hygiene negatively; meaning that it is a condition of the restroom that is not being noticed when it is acceptable, but is considered when it is unacceptable.

The way these five aspects of transitions influence people's experience in use of large public restrooms is highly intertwined as the descriptions above imply. It is in the understanding of these complex relations, that we can inform future design, and not by the attempt to force a complex world into clear definitions.

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