Tracing Passenger Safety Perception for Cruise Ship Design

A? Aalto University

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About the author

Markus Ahola graduated with a Master of Arts in industrial design from Aalto University School of Arts, Design and Architecture in 2010. He is also an alumnus of the LAMK - Institute of Design. Before university, he worked as an industrial designer in the industry, developing user experiences and various kinds of products. Markus's research concentrates on the interaction between people and environmental design in which the case study is safety perception on a cruise ship. His dissertation has been conducted in a multidisciplinary manner between the design and marine technology departments. His research has been published in journals such as Applied Ergonomics and Safety Science. In addition to his research, Markus has a central role in the development of the multidisciplinary Cruise & Ferry Experience programme, which investigates the marine context holistically and educates future multitalents.

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Abstract

This study explores how passengers perceive safety on board a cruise ship during normal operating conditions. The research aims to deepen understanding of how the different environmental characteristics of a cruise ship impact safety perceptions and determine whether it is possible to enhance perceived safety by means of design and how the interaction of different environmental characteristics can be visualized to support the ship design process.

Passengers can only feel comfortable in conditions that they perceive as safe. Safety and comfort constitute key criteria for cruise operators when they order new cruise ships. Comprehension of passengers' safety perception can guide the design process towards improved safety and a more enjoyable cruise experience. Understanding of passengers' safety perception provides valuable information for ship societies developing cruise ship comfort classifications.

The study followed the user-centred research approach. User data were collected through 19 situated interviews and 38 days of observation in an authentic cruise ship environment during five cruises. Passenger insights were analysed by visualizing the interconnectivity of the identified human (openness, sounds) and non-human (handrails, uniforms) environmental characteristics. This revealed how individual environmental characteristics are interrelated in terms of passengers' perceived safety. The findings were verified with a survey, which applied conjoint analysis.

The research highlights the importance of passengers' perceptions for designing a safe and comfortable ship. It argues that safety perception in a cruise ship environment is responsive to passenger perceptions of certain connected human and non-human environmental characteristics that are typical of this environment. These same environmental characteristics appear in ship safety regulations and in passengers' perceptions, but their perspectives differ.

Designers are able to influence passenger safety perceptions through the openness and transparency of the space, thereby enhancing visibility and navigation as well as providing egress options. Design can also communicate trust in the ship's emergency handling capacity through the visibility and appearance of the life-saving appliances, competent crew and well-maintained equipment. Furthermore, situational awareness should be supported through the

design of the environmental characteristics, such as sounds, signage and architectural elements.

Mastering positive translations from interconnected human and non-human environmental characteristics to safety perceptions helps to enhance passengers' comfort and avoid misperceptions that lead to discomfort and even incorrect behaviour in accident situations.

Tiivistelmä

Tracing Passenger Safety Perception for Cruise Ship Design tutkii, kuinka matkustajat kokevat turvallisuuden risteilylaivoilla normaalin toiminnan aikana. Tutkimuksessa pyritään ymmärtämään, kuinka risteilylaivaympäristön ominaisuudet vaikuttavat turvallisuuden kokemiseen, onko turvallisuuden kokemusta mahdollista parantaa muotoilun keinoin ja miten erilaisten ympäristön ominaisuuksien vuorovaikutus voidaan visualisoida tukemaan laivan muotoiluprosessia.

Matkustajat voivat tuntea olonsa mukavaksi vain tilanteessa, jonka he kokevat myös turvalliseksi. Koettu turvallisuus ja mukavuus ovat tärkeitä kriteereitä, kun risteilyvarustamot tilaavat uutta risteilylaivaa. Turvallisuuden kokemisen ymmärtämisellä voidaan ohjata muotoiluprosessia suuntaan, joka entisestään parantaa matkustajien turvallisuutta ja risteilyelämystä. Tämä tieto on myös arvokasta laivojen luokituslaitoksille risteilylaivojen mukavuusluokituksia kehitettäessä.

Käyttäjälähtöisen tutkimuksen aineisto kerättiin viidellä eri risteilyllä autenttisessa risteilylaivaympäristössä. Aineisto muodostuu 19 tilannesidonnaisesta haastattelusta ja 38 risteilypäivän havainnoinnista. Aineistosta esiin nousseiden inhimillisten (avoimuus, äänet) ja ei-inhimillisten (kaide, univormu) ympäristön ominaisuuksien yhteys toisiinsa analysointiin visualisoimalla. Tästä selvisi, kuinka yksittäiset ympäristön ominaisuudet ovat kytköksissä matkustajan turvallisuuden kokemiseen. Löydökset todennettiin kyselytutkimuksella ja conjoint-analyysilla.

Tutkimus korostaa matkustajien turvallisuuden kokemisen merkitystä laivojen turvallisuuden ja mukavuuden suunnittelussa. Tutkimuksessa väitetään, että turvallisuuden kokeminen risteilylaivaympäristössä on yhteydessä matkustajien tulkintoihin tietyistä risteilylaivaympäristölle tyypillisistä inhimillisten ja ei-inhimillisten ominaisuuksien yhdistelmistä. Näitä samoja ominaisuuksia esiintyy laivojen turvallisuuden suunnittelua koskevissa määräyksissä mutta eri näkökulmasta.

Muotoilija pystyy vaikuttamaan turvallisuuden kokemiseen muokkaamalla tilan avoimuutta ja läpinäkyvyyttä, joka parantaa näkyvyyttä, tilassa suunnistamista sekä luo pelastautumisreittejä. Lisäksi muotoilun keinoin voidaan parantaa luottamusta laivan kykyyn turvata matkustajien turvallisuus hätätilanteessa ja keskeisimpiä tekijöitä ovat hyväkuntoisten turvavarusteiden

näkyvyys sekä miehistön pätevä ulkoasu ja olemus. Matkustajien tilannetietoisuutta voidaan tukea myös ympäristön ominaisuuksien kautta, kuten äänin, viitoin ja tilasuunnittelulla.

Hyödyntämällä tutkimuksen tuloksena saatua ymmärrystä voidaan välttää suunnitellun ympäristön väärinkäsittäminen ja jopa virheellinen käyttäytyminen onnettomuustilanteessa sekä kehittää matkustajien mukavuutta.

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"You are not in a place; the place is in you."
– Angelus Silesius

Curiosity towards people's experiences of things and how those are interlinked with their surroundings took me this far. I feel privileged to have had the opportunity to spend many years exploring how people perceive environmental characteristics, behave according to their perceptions and gain experiences.

At the beginning of this journey, I didn't have previous experience about safety design, cruise ships or cruise culture. Doing research in between design and engineering has taught me just how complicated and wide-ranging the design of passenger vessels is and how inspiring the shipscape can be for the researcher.

All books are collaborative exercises. First, I must thank the FIMECC Innovations & Network program, Intercity Collaboration of South-West Coast of Finland (LOURA), Kaleidoskooppi EU project and Merenkulunsäätiö for their financial support. Next, I wish to express my greatest gratitude to my supervisor Professor Turkka Keinonen for all of his crucial comments and guidance through the process. During this journey into the unknown, Aalto University's marine technology professors believed that this guy knows what he is doing and gave their full support. The truth is that I didn't always know where this thesis was going and I am greatly indebted to Professors Pentti Kujala, Jani Romanoff, Heikki Remes, and Petri Varsta for their trust, support and mentoring. Ruth Mugge, Heini Salovuori, Miika Lehtonen, Pekka Murto, Pentti Kujala, and Juhani Pitkänen had crucial roles as co-authors of the included articles and their contribution was invaluable.

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Finally, I apologize to my family for not being as present as I should have been. Paula, Anton and Fanni: thanks for your patience – this is the last thesis I will do.

Helsinki, November 2016

Markus Ahola

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Summary of the original publications and author's contribution

First Publication (PI): Perceiving safety in passenger ships – User studies in an authentic environment.

Ahola, Markus, Murto, Pekka, Kujala, Pentti, & Pitkänen, Juhani. (2014). Perceiving safety in passenger ships – User studies in an authentic environment. *Safety Science*, 70, 222-232. ISSN 0925-7535. DOI 10.1016/j.ssci.2014.05.017.

This publication identifies which elements of the passenger ship environment passengers perceive as important for their safety. The article compares results from user studies with passenger ship safety regulations to demonstrate that passengers partly perceive safety through elements that are not acknowledged in safety regulations and their perspectives on the elements considered in the regulations might deviate from those intended. The study shows that safety perception on board is created by the visible presence of life-saving appliances, communication between the ship and passenger, emotions, and the on-board community. Designers can apply the results of this study to guide the design of cruise ship environments so as to increase the sense of safety among passengers, improve natural way-finding in emergency situations, and place safety appliances where they are needed most.

In this article, the author developed the idea, prepared the framework for analysis, collected and analysed the data, and was the main contributor of the manuscript. Murto assisted in data analysis and provided valuable comments and suggestions. Professor Kujala and industry expert Pitkänen provided valuable comments and suggestions.

Second Publication (PII): Exploring cruise experience through actor-networks of the cruise ship environment.

Ahola, Markus, Salovuori, Heini, & Lehtonen, Miikka. (2015). Exploring cruise experience through actor-networks of the cruise ship environment. *International Journal of Marine Design*, 157, 1 – 12. ISSN 2048-7541. DOI 10.3940/rina.ijmd.2015.c1.36.

This publication pays research attention to the fact that the human and non-human characteristics of cruise ship environments are

commonly identified separately, even though both types contribute to the cruise experience. This qualitative study traces the characteristics of the cruise ship environment that contribute to the passenger cruise experience. Instead of viewing the experiences as belonging to the human domain only, non-human actors were brought in by drawing on Actor-Network Theory (ANT). This article relies on three actor-networks – namely, social experiencing, everyday distinction, and predictability – to demonstrate that people and things become entangled via a process of translation. That is, they can be considered as a single entity. These entities can be used as design driver for the ship environment.

The author developed the idea, prepared the analytical framework, collected and analysed the data, and was the main contributor of the manuscript. Salovuori assisted in the data collection and analysis and provided valuable comments and suggestions together with Professor Lehtonen.

Third Publication (PIII): Safety Perception as a Sociotechnical Network.

Ahola, Markus, Salovuori, Heini & Lehtonen, Miikka. (2016). Safety Perception as a Sociotechnical Network. *Proceedings of the 13th International Symposium on Practical Design of Ships and Other Floating Structures (PRADS' 2016).* 4 – 8 September 2016. Copenhagen. ISBN: 978-87-7475-473-2.

This publication addresses the inconsistency between regulated safety and passengers' perception of safety on board cruise ships. The study demonstrates that some of the features that contribute to the perception of safety are either not acknowledged in ship safety regulations or passengers often consider them from different perspective. To this end, the study traces the connections between passenger safety perception and ship safety regulations through network visualizations. Actor-Network Theory (ANT) is employed as a background framework to describe the sociotechnical environment of passenger ship safety. The research reveals that sound, handrails and the promenade can play a central role in safety perception, and although many regulations have been laid down for these typical features of passenger ships, passengers often understand them from a different perspective. Therefore, it should be recognized that human perception is a dominant factor in human behaviour; accordingly, those who develop safety regulations should seek to better understand the relationship between safety perception and safety regulations. In practice, designers can apply the guidelines presented in this study

to highlight relevant characteristics of the environment and prevent passengers from misinterpreting the environmental characteristics, and thereby influence passenger behaviour to comply with intended safety procedures.

The author developed the idea, prepared the framework for analysis, collected and analysed the data, and was the main contributor of the manuscript. Salovuori assisted in the data analysis and contributed to the manuscript. Professor Lehtonen assisted in the data analysis and provided valuable comments and suggestions.

Fourth Publication (PIV): Safety in Passenger Ship Environments: The Influence of Environmental Design Characteristics on People's Perception of Safety.

Ahola, Markus, & Mugge, Ruth. (2017). Safety in Passenger Ship Environments: The Influence of Environmental Design Characteristics on People's Perception of Safety. *Applied Ergonomics*, 59, 143 – 152. ISSN 0003-6870. DOI 10.1016/j.apergo.2016.07.021.

This publication demonstrates how the feeling of safety may be enhanced through design. In an experiment carried out for this study, 97 users evaluated 20 different corridor designs in order to determine how manipulation of the environmental characteristics affects safety perception. The results were evaluated with the conjoint method. It is suggested that if designers aim to increase positive safety perceptions, this could be accomplished with curved ceiling design and views to the outside. Furthermore, clear and continuous architectural lines should be emphasized to provide a strong feeling of guidance for passengers. Based on these findings, it can be concluded that the current design of cabin corridors on passenger ships is far from optimal from the safety perception perspective. Therefore, professionals involved in passenger ship design can greatly benefit from the given guidelines in the design of future ships.

The author developed the idea, prepared the analytical framework, collected and analysed the data, and was the main contributor of the manuscript. Professor Mugge assisted in the data analysis and collection, and provided valuable comments and suggestions.

1
Introduction

1
Introduction

Cruise ships are complex sociotechnical systems, which are designed to provide positive user experiences in multifaceted operational environments. The physical environment and operation at sea pose a risk of various hazards that can inconvenience passengers; safety is therefore a vital issue. In order to ensure that passengers have a comfortable and pleasant stay on board, multiple dimensions of the cruise ship system need to fulfil passenger demands for safety in both a subjective and an objective manner.

Seafaring constitutes one of the world's most dangerous businesses (Håvold, 2005). Consequently, cruise ship safety performance is measured alongside traditional design objectives (earning potential, speed, and cargo capacity) in order to effectively optimize the ship design (Papanikolaou, 2009). This clearly indicates the importance of safety issues in ship design. Although much research interest has been devoted to technical safety compliance, knowledge of passengers' perceptions of safety is limited. Instead, passenger safety has traditionally fallen under the umbrella of ships' technical compliance with safety standards in construction, equipment, and operation (Vassalos, 2006, 2009; Kristianssen, 2013). Consequently, passengers' objective safety is ensured with a technically oriented approach that considers ship passengers as a relatively homogenous group of people with equivalent perceptions and understanding of their environment and capabilities to act in the event of an evacuation. In practice, this involves estimating how long the evacuation process will take without considering individual human behaviour or environmental changes (Vanem & Skjong, 2006). Passengers' subjective perspective in ship safety research and design has not been sufficiently taken into consideration in ship safety research, a gap that the present study seeks to address (Akyuz & Celik, 2014; Le Coze, 2013; Papanikolaou, 2009; Zarboutis & Marmaras, 2007). Moreover, it is noteworthy that although cruise ships are intended to provide positive experiences for passengers under normal circumstances, safety is considered almost only from the *negative* perspective of risk and possible accidents. However, consideration of passengers' safety perceptions during normal – and consequently dominant – operations could provide an understanding of the factors that reduce feelings of safety. Minimizing these aspects or highlighting those experiences that create feelings of safety may improve passenger comfort.

As cruise ships are designed for leisure and living mainly under normal situations, it is worth noting that safety design for the most part excludes the end-user perspective in the dominant cruising situations. The design approach is seemingly in contrast to user-centred

design. As a remedy, the object of safety on board could be researched from the user-centred design perspective to shed light on the ways in which human beings are part of the system and in which they perceive the system during regular cruising. With user-centred design, the perceptions, needs, desires, and limitations of users are analysed while they are using a product or participating in a service process. These perspectives are often absent in engineering design or industrial engineering, which are conventionally connected to ship safety research and design. Furthermore, the user-centred design approach emphasizes observation of the users in real-life situations to discover the underlying triggers of human behaviour. Thus, it can be argued that knowledge on users' subjective insight is underrepresented in the outcomes of traditional safety analysis (Norman & Stappers, 2016). However, when addressing complicated phenomena such as safety in a certain environment, it must be noted that subjective safety complements the objective safety that is a prerequisite for maritime passenger services.

People trust their subjective perceptions when encountering a new environment. For this reason, passengers do not necessarily feel that they are safe in environments that meet safety regulations. Consequently, it is beneficial, especially for cruise ship operators, to understand how people perceive safety under normal circumstances so that this insight can be used to provide sufficient cruising comfort for positive cruising experiences. On the other side of the coin, people do not necessarily perceive themselves at risk in environments that do not meet safety design standards. This could make passengers feel comfortable in certain spaces and cause them to avoid others. In the worst case, this might compromise evacuation plans. At present, however, passenger safety perceptions have not been studied or incorporated into ship designs, which results in a one-way flow in communication, preparation, and accident response.

This research started with the following premises: People are rarely aware of or able to evaluate the objective safety of the environment (Campbell, Converse & Rodgers, 1976) and therefore rely on their perceptions of the environment and its capability to help them avoid accidents. People's impressions of safety and their subconscious processes when encountering a new environment are important for decision-making and for feelings of comfort and enjoyment during cruises (e.g. Mischel, 1973; Vallacher, 1993). Following the definition proposed by Rijswijk, Rooks & Haans (2016, p. 104), this study understands safety perception as "perceptual judgment of environmental safety using site-specific, immediate and safety-related physical information of that environment."

Prior research has shown that certain environmental characteristics influence safety perceptions (Kim, Park, Lee & Yang, 2004; Vilar et al., 2013; Wilson, 1984). Cruise ship safety is a complex mix of non-human and human environmental characteristics. A cruise ship is a system and collection of interrelated and necessary components whose interrelationships are at least as important as the individual components (Monat & Gannon, 2015). However, the different environmental characteristics are often discussed separately, perhaps because the mix of the human and social aspects is considered to be the major contributor to the difficulty of understanding sociotechnical problems (Norman & Stappers, 2016). Haavik (2014) suggests that safety research should provide an understanding of the relational phenomena underlying functions, factors, and causes from a passenger's perspective, rather than define the sociotechnical systems pragmatically, which is the prevalent method today. Moreover, it is noted that in the case of complex systems such as cruise ships, any underlying system-level difficulties are typically discovered only when a major disaster occurs (Norman & Stappers, 2016). Therefore, if sociotechnical systems are explored in terms of their separate characteristics, it is possible that the observations focus only on surface-level issues and important issues remain undiscovered. From a safety perspective, it is important to understand the properties that people perceive as being critical for a safe environment. Thus, to understand how the safety system works on a cruise ship, the different environmental characteristics should be observed and analysed side by side. Network analysis of the data is considered a feasible approach for this purpose.

Physical features ensuring efficient evacuation (Kristianssen, 2013; Vilar et al., 2013; Vassalos, 2006, 2009) may have little to do with how passengers make use of such features in emergency situations, and passengers rarely consider the technical ship capacities ensuring their safety whilst on board. Therefore, although the focus of this study is on safety perception under normal circumstances, from the comfort perspective, it is possible that the findings contribute to understanding how passengers also perceive the objective safety of the ship. According to Brave and Nass (2009), perception and stress are identified as strong indicators of how a person behaves in a particular situation. Based on this information, it is possible to identify areas where passenger safety information is insufficient or has not been successfully disseminated. Therefore, if designers understand perceptions better, they can add more evacuation route signs, for example, or use interior design solutions to support correct evacuation behaviour.

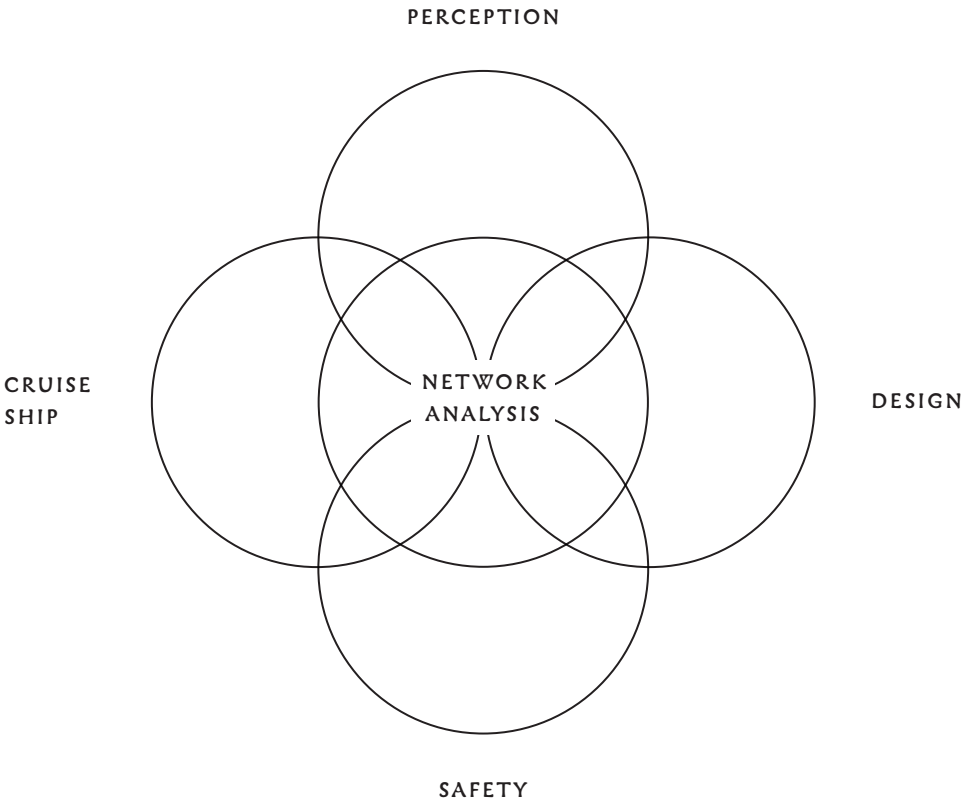


FIGURE 1. The key concepts of the dissertation.

Building on the previous sections, the aim of this article-based dissertation is to study cruise ship safety and safety design by asking the following main research question:

How do people perceive safety based on the environmental characteristics on board a cruise ship during normal operations?

In this study, safety is considered in terms of accident prevention, whereas safety in terms of security against crime prevention is excluded. The research comprises three journal articles and one conference paper covering five key concepts: *safety*, *perception*, *design*, *cruise ship*, and *network analysis*, which are illustrated in Figure 1. The first Publication (PI) investigates the safety of cruise ship environments from the passengers' perspective to identify those environmental characteristics on cruising vessels that are relevant for safety perception. Furthermore, it discusses how the identified characteristics are represented in present ship safety regulations. The second Publication (PII) and third Publication

(PIII) build on the findings of PI and discuss the fact that a cruise ship environment includes numerous interrelated human and non-human environmental characteristics that form a unique context, which people interpret by relying on their perceptions. As the individual environmental characteristics may be as relevant for safety perception as the entity that these characteristics comprise, the specific environment should be explored with network analysis, considering the different types of characteristics as elements of a system that consists of interacting components. The fourth Publication (PIV) investigates how alternative designs of the environmental characteristics of a cruise ship affect people's safety perception.

1.1 Structure of the dissertation

The second chapter of the dissertation discusses and defines safety and safety perception as a cognitive process in which humans interpret the non-human and human environmental characteristics in terms of safety. Chapter 3 introduces the context of the study: cruising, cruise ship design and how safety is currently considered on cruise ships. The fourth chapter introduces the multi-methodological research approach adopted in the study. Chapter 5 describes the empirical context of the study through five field observations, which yielded background knowledge and enabled efficient data collection in the unique cruise ship environment. A major aim of the chapter is to describe the cruise ship culture for readers unfamiliar with it. Based on the three previous chapters, the sixth chapter demonstrates the outcomes of the research. Chapter 7 discusses the conclusions and evaluates the significance of the study for the design practice and academic community.

2
Research on safety and perception

2
Research on safety and perception

This chapter discusses the key concepts of perception and safety, with an emphasis on the design perspective. First, it discusses how safety is defined in the present study. Second, the chapter elaborates on human perception and, more accurately, safety perception. Third, the chapter discusses the relation between perceptions and passenger comfort, and reviews the relevant literature on how design scholars have addressed perception. Finally, it summarizes how safety perception is approached in the current study.

2.1 Safety

Safety constitutes one of the basic human needs (Van Rijswijk, Rooks & Haans, 2016). Safety does not exist without risk and therefore discussions of safety must address risks and passengers' fear of these risks. For this reason, many previous studies that concern safety from the human perspective focus mainly on fear, as it is considered to be always present in human experiences of risk (Ellin, 2001). Fear, panic, risk and correspondingly safety are highly related to the environment people are in: fear influences our experience of the environment as much as the environment influences our experiences of fear (Koskela & Pain, 2000). Human safety is often examined in relation to the environment, especially in built environments (Koskela & Pain, 2000).

Safety can be roughly divided into normative safety, substantive safety, perceived safety and security. The difference between the safety categories is that *normative safety* refers to the extend to which a product, environment or design meets safety standards. For example, a cruise ship needs to be designed to fulfil certain safety standards in order to have permission to operate (see Chapter 3.3). *Objective safety* (or *substantive* or *technical*) is a statistically measurable condition and refers to real-world safety, such as the number of accidents and actualized risks and for instance, an electrical fire due to poor maintenance represents a failure in terms of objective safety. *Perceived safety* in turn refers to a user's level of comfort or perception of risk: in other words, it refers to passengers' perception and feeling of safety rather than real safety, fear or danger. *Security* commonly involves protection against criminal acts, such as robbery, burglary and vandalism. However, security is considered to have higher importance for people than other safety types due to the personal nature of such crimes and moral considerations. Safety research from the human perspective typically concentrates mainly on objective safety and security, although subjective safety also has a substantial effect on people's daily lives (Van Rijswijk, Rooks & Haans, 2016). This thesis focuses on people's perceived safety and builds on Van Rijswik et al.'s

(2016, p. 104) definition: "Perceptual judgment of the safety of an environment using site-specific, immediate and safety-related physical information from that environment."

2.2 Human perception

The mental process through which people acquire knowledge and understanding of their environment takes place through perception of environmental characteristics. Perception combines different environmental cues on the basis of which people make sense of their surroundings. People's prior experiences of objects and environments are connected to the perception process by interlinking perceived characteristics. According to Nilsson et al. (2012), human beings gain awareness through perception and cognition of the current situation. It is a process distributed among a particular group of operators and the artefacts they interact with, rather than the output of a specific artefact. Interlinking of features in perception is described in *feature integration theory* (Treisman & Gelade, 1980). In this two-stage process, people automatically, unconsciously, effortlessly and in an early stage of the perception process analyse details, such as the colours, orientation and movement of the object. This stage can be performed rapidly and pre-attentively to acquire an overall perception of the object or analyse a single feature. In the second stage, people combine the individual features of the object to perceive the whole object in detail. In this slower and more careful analysis, people examine two or more features at a time. In other words, people predict which objects are likely to appear in a certain context or with certain objects and thus make use of constraints based on their earlier experiences or contextual associations in efficient recognition of objects, which is highly relevant for safety perception. This understanding creates a basis for the network analysis methodology adopted in this research (see Chapter 4.3 and PII and PIII).

Consequently, human perception is highly relevant for design research and practice as it involves communication between humans and environmental design characteristics. For example, Bloch (1995) and Crilly et al. (2004) highlight the visual appearance of products as a critical determinant of an individual's response and product success. People understand the functionality of a product mainly by perceiving its visual characteristics (Norman, 2004; Oppenheimer, 2005). Hinton and Henley (1993) state that vision has the greatest bearing on our knowledge of product safety. Moreover, people's responses depend on their culture, background and prior experiences (Bloch, 1995; Crilly et al., 2004; Mänö, 1997). It is important to consider the influence of

experiences, memories and emotions in passengers' safety perception. However, this study focuses on revealing the key environmental characteristics for the design process, and excludes the influence of variables affecting the perception process mechanism itself.

2.3 Safety perception through environmental characteristics

Prior research has reported that negative human safety perception has detrimental effects on physical and mental well-being (e.g. Stafford, Chandola & Marmot, 2007; Jackson & Stafford, 2009). Building on Van Rijswijk et al.'s (2016) statement, it becomes evident that safety perception is an important research objective also in the cruise ship context:

> "In effect, perceived safety is important in and of itself, as feelings of insecurity, even when seemingly unjustified, affect people in ways similar to actually being at risk." (Van Rijswijk, Rooks & Haans, 2016, p. 103)

However, research on individuals' safety perception has been limited and the majority of related studies focus on objective safety. For example, such studies investigate safety perception from the perspectives of risk perception and safety climate and culture in the context of other high-risk industries, such as offshore industries (e.g. Cox & Cheyne, 2000; Håvold, 2015; Rundmo, 1996, 2000;), construction sites (e.g. Glendon & Litherland, 2001; Siu et al., 2004) and navigation (e.g. Hetherington et al., 2006; O'Connor et al., 2011). These studies often address empowered workers' risk-taking behaviour, and the studies contribute to employees' ability to prevent, solve, and learn collectively from any problems that occur (Edmondson, 1999). Similarly, safety perception has gained research interest in healthcare, for example regarding how employees and managers perceive safety procedures and the safety of working methods and attitudes (Blumberg & Devlin, 2006; Devlin & Arneill, 2003). What these studies have in common is that people actively influence their environments to safely perform their activities. For example, a construction worker or extreme sports enthusiast can reduce possible risks by means of protective measures or by limiting the activity to a site or time that is as safe as possible. On cruise ships, in contrast, passengers have far less control over how their safety is assured. This issue is well summarized by Harrison et al. (1995): "Anxieties about personal safety lead individuals to control where and when they go to places, and/or to control the activities of others for whom they have responsibility."

Transportation research examines perceived safety from both social and individual perspectives. For many, driving a car is much more attractive than other means of transport due to its convenience, independence, flexibility, comfort, speed, privacy, and perceived safety. Individuals have a greater feeling of safety if they experience control over their mobility (Lajunen & Summala, 1995). In addition, studies have also examined how car drivers perceive features of the environment, which may corrupt their sense of safety (Amditis et al., 2010). However, drivers can actively control the environmental characteristics and how they encounter different situations. On cruise ships, a third party controls the situation and passengers can rarely influence features that disturb their safety perception.

The gender factor has been found to have a significant influence on safety perception; in general, higher levels of fear have been reported among women than men (e.g. Boomsma & Steg, 2014; Fisher & May, 2009; Loewen et al., 1993). Several studies have found that this is because women are more prone to feelings of vulnerability (e.g. Hale, 1996; Riger & Gordon, 1981) and therefore more sensitive to feelings of insecurity and being threatened by crime (e.g. Cossman & Rader, 2011; Haans & De Kort, 2012). Little interest has been directed at the effect of psychological variables (Blöbaum & Hunecke, 2005) or psychological gender (Blöbaum & Hunecke, 2005; Haans & De Kort, 2012). Furthermore, *social* factors have an effect on safety perception, and linkages in communities may play an important role in risk perceptions (Olstead, 2011; Scherer & Cho, 2003). Despite the fact that gender and social linkages impact safety perception, these have been left outside of the scope of the study.

Safety perception is researched widely in the urban environment domain. For example, England and Simon (2010) have explored the relationship between fear and city buildings and Atkinson (2003) the influence of public monitoring on safety perception. Studies have also examined safety perception of green spaces in urban residential areas (Bonnes et al., 2011; Mambretti, 2011; Thompson et al., 2009). Many studies have focused on the importance of lighting in safety perception (Haans & De Kort, 2012; Vilar et al., 2012; Vilar et al, 2013) and the impact of colours in the perception process (Dalke et al., 2006; Duarte et al., 2011). Furthermore, Stamps (2005a, 2005b, 2010, 2013) has researched the influence of physical environmental characteristics, such as the design of walls and openings, on people's perception in urban settings. He has concluded that physical design characteristics influence the degree of enclosure (open vs. enclosed) of the environment and thereby people's ability to see and move,

which has a major effect on their perception of safety. Maier and Fadel (2009) employ the concept of affordance to explain the relationship between the human and built environments; it also serves as a theoretical basis for improving the design process and as an evaluation tool for exploring the connections between the initial intentions or objectives of the design. Although the active role of physical products in human and non-human interaction has been researched, the physical environment as an active actor still dominates these studies (Kyttä et al., 2011).

When discussing safety-related environmental information, three perspectives require highlighting: *communication*, *function* and *survival*, as these create the basis for most of the human-environment interaction discussion in the safety domain. The following passage addresses the central theories of human-environment interaction (*affordance*, *prospect-refuge* and *functionalism*) in relation to human safety perception of environmental characteristics.

People's interpretation of environmental properties can be seen as communication between the environment and people. In this process, many scholars have subsequently drawn on *affordance* theory to analyse human interpretation and behaviour. The concept is based on Gibson's theory of affordances of the environment: "what it offers the animal, what it provides for good or ill" (Gibson, 1979, p. 127). In practice this means that the handle of a cup indicates where to hold it and a door handle tells us which side of the door to push. Crilly et al. (2004) consider affordances as part of the communication process between humans, design, and the perceived qualities of semantic interpretation. Engeström and Middleton (1998) share a similar idea and view our environment as a cognitive system with a number of different elements incorporating meanings, activities and guidance that affect our behaviour. For example, in way-finding, people rely heavily on the spatial properties of the setting (Arthur & Passini, 1992) and use distinguishable features of the environment as landmarks to help them find their way (Emo et al., 2012). Norman (1988) shares the same idea when applying affordances to the product usability context: visual cues (affordances, constraints and mappings) instruct users on how a particular product could be used. Furthermore, from the perspective of affordances, Hefth (1988) views affordances as functionally significant properties of the environment where meaning emerges out of the relationship between environmental features and a particular perceiver. The affordance concept can be seen to also include social, emotional, and sociocultural opportunities and restrictions (Heft, 2001; Kyttä et al., 2011).

Thus, it can be assumed that based on the perceiver's knowledge, the information perceived from the function may differ. When considering the cognitive process of way-finding from the safety perspective, the guiding characteristics of the environment should be easily recognizable, because this enables individuals to effectively create or reconstruct cognitive maps of the environment (Zeisel, 2006). Thus our environment can be seen as creating a variety of affordances that form cognitive maps that help people to find their way, which is essential for daily life, safety and even survival. If people have difficulty finding their way, this induces stress, anxiety, and confusion (Dogu & Erkip, 2000). Thus an environment that provides a sense of unambiguous guidance can positively influence people's safety perceptions and increase comfort.

According to *functionalism, an* organism should be able to make accurate perceptual judgements about the environment by processing environmental information in order to effectively function in the environment (Brunswik, 1952; Kaplan & Kaplan, 1989). However, Van Rijswijk et al. (2016) note that perception of environmental safety may not always be directly visible to the observer. This relates to *probabilistic functionalism* developed by Brunswik (1952). The probabilistic functionalism concept examines the indirectly perceived environmental characteristics and how people use this incomplete information from their environment. In this process, people and other organisms make use of the *proximal cues* of the environment when trying to adapt effectively to the environment. These cues are directly visible but contain information whose relation with the current activity is unknown. Thus, it is suggested that perceptions are selective according to the usefulness or functionality of environmental cues for a certain response (Brunswik, 1952).

This approach is supported by Fenske et al. (2006), who claim that the human neural *object-based mechanism* allows rapid recognition of objects even from partial sections based on earlier knowledge and contextual associations between an object and other objects with which it typically appears.

Many of the studies in the human-environment interaction field are founded on (Appleton, 1975/1996, 1984) *prospect-refuge theory*. The theory relies on an organism's basic need to see and hide in order to survive. An organism estimates environmental characteristics based on the opportunities they provide for a clear overview of the situation (*prospect*) or possible shelter to hide from danger (*refuge*). Prior studies have recognized openness of the view as one of the most desirable characteristics for a safe environment (e.g. Fisher &

Nasar, 1992; Stamps, 2005a, 2005b, 2010, 2013). More openness in an environment results in a greater ability to perceive (Appleton, 1975/1996; Stamps 2005b, 2013) and a greater ability to move (Nasar, Fisher & Grannis, 1993; Stamps, 2013), which can both be directly linked to the objective safety of the environment. While the theory is commonly linked to security, that is, escaping and hiding from a threat, it is suggested that a similar effect occurs in safety perception within the built environment. For example, people prefer wider corridors when navigating during emergencies (Vilar et al., 2012, Vilar et al., 2013). Stamps (2005a) found a strong correlation between impression of safety and enclosure. This again is also connected to the perception of environmental affordances: if movement is restricted, potential escape is prevented, and blocked visibility prevents people or animals from seeing potential sources of danger, decreasing their chances of survival (Gibson, 1979; Stamps, 2005a). Luymes and Tamminga (1995) have summarized the five key principles from the prior research for the planning and design of safe public spaces to be *visibility to others, visibility by others, choice and control* and *solitude without isolation*.

What the above studies have in common is that they mainly discuss safety perceptions from the negative perspective. Negative safety perception requires an object that produces risk; hence safety studies often analyse the causes by observing the surrounding environment (Mairal, 2008). Mairal further states that risk is a context that brings together objects, facts, events, or any other entities that can cause harm, which in turn guides human interpretation (ibid). In other words, people can perceive safety in different ways, e.g. by interpreting the other characteristics of the environment, through their own capabilities, or through the risk itself.

This study builds on the above-discussed theories of human-environment interaction, summarized in Table 1. These theories explicate how people gain a feeling of safety in an environment through their senses. These studies provide a foundation for the present research and the study applies this understanding on passenger impressions when encountering the ship environment under normal cruising situations.

In this study, the affordance concept is applied to outline ways in which people create meanings for environmental characteristics in terms of safety. People need to understand the meaning of the environmental characteristics and their affordances. This could be especially important in evacuation situations, so that people perceive the affordances of their environment and behave according to their

THEORY	CENTRAL RESEARCH	FOCUS	ADOPTED PERSPECTIVE IN THIS THESIS
Affordance	(Gibson, 1979) (Norman, 1999)	Semantic interpretation of the environmental information	How the purpose emerges from the environmental information Environment is a cognitive system of different environmental characteristics
Functionalism	(Brunswik, 1952) (Kaplan & Kaplan, 1989)	Effective adaptation to the environment through environmental information	Human processing of the partial environmental information and visible environmental information, the relation of which is unknown
Prospect-refuge	(Appleton, 1975/1996) (Stamps, 2005a)	Estimation of the environmental information in order to see, hide and survive	How environmental dimensions and included objects affect safety perception

TABLE 1. Central theories that provide the framework for the current research.

perceptions. Furthermore, affordance theory views people as part of a system whose different parts are interrelated and interact with each other, which is in line with the sociotechnical perspective of the present study. However, the application of the affordance concept alone could be relevant when investigating objective safety perception. For example, it can provide a conceptual framework to explain how people make use of environmental affordances in evacuation situations to find guidance and adjust their behaviour to situational requirements. Therefore, the application of the theory is supported with two other theories. From functionalism, this research adopts the understanding that people use environmental cues in early stages of a situation to speed up their interpretation process based on their needs. Prospect-refuge theory has been applied to analyse how physical environmental objects affect safety perception and therefore the theory selection aimed to support the design perspective in the present study.

2.4 Safety and comfort

Safety is a critical determinant of quality of life (Cummins, 1996; Stamps, 2010; Van Rijswijk et al., 2016). To feel comfortable and experience other positive emotions, such as joy, people's feeling of safety

also needs to be fulfilled (Epstein, 1990; Sheldon et al., 2001). Safety and comfort have been typical aims for people through the decades:

> "Slowly across the history, humans developed technology to protect ourselves from the elements of nature – clothes, fire, houses, boats, and so on. With separation from nature came protection, safety, and an increased comfort of living" (Schultz, 2002, p. 62).

Urban environments are often examined in terms of safety and comfort. In general, it has been concluded that environments, that are perceived to be safe are also comfortable. Safety and comfort appear also as a dimension in the 22-item scale rating of *Quality of Life* (QoL) listing that is widely adopted for evaluating consumer values (e.g. sustainability consumption) in relation to important values and needs for people's lives (Steg & Gifford, 2005): safety in terms of being able to avoid accidents, feeling protected against crime, and comfort in terms of having a pleasant and easy daily life.

Although it seems that these dimensions are related, there is only little support for the relation between safety and comfort and typically the literature discusses safety and comfort as separate phenomena.

Notable exceptions include the studies of (Kyttä et al., 2011) and (Wallenius, 1999), which estimate perceived well-being and health from the perspective of fit between the perceived safety affordances of the environment and a person's own environmental quality factors. Furthermore, the relationship between safety and comfort influences the functional perspective: a comfortable seat increases safety, and the use of a seatbelt is not only a safety issue but also a source of comfort (Robertson et al., 1972).

Within this study the understanding of the relation between safety and comfort is explored through people's needs and values, as these motivate people and encourage certain behaviours.

One of the most influential works in motivation research is Herzberg's *two-factor theory*, which suggests that people have two separate sets of factors, which impact on satisfaction of people's needs; one set causes dissatisfaction, the other satisfaction. *Hygiene* factors concern the basic survival needs of a person, such as safety. These factors can cause dissatisfaction if not fulfilled. However, when fulfilled, these factors do not increase motivation or satisfaction, but instead only prevent dissatisfaction (Herzberg, 1971). The second set consists of *growth factors*, which are the motivation factors that make humans strive to become all that they are capable of becoming, and

when satisfied they work as motivators (Herzberg, 1971). These are, for example, recognition of task completion, achievement, responsibility and comfort. The only way to increase satisfaction and thereby enhance motivation is through the growth factors. However, even when missing, they cause no dissatisfaction but only absence of satisfaction (Herzberg, 1971).

Locke's (1976) concept of values and needs complements Herzberg's theory and provides a more practical application to understand people's satisfaction and dissatisfaction. He makes a distinction between *needs*, such as safety, which are the same for all humans, objective and do not require knowledge to exist, and *values*, such as comfort, that are individual, subjective and occur consciously or unconsciously and ultimately determine choice and emotional reaction (Locke, 1976). According to Locke (2000), human actions are the consequence of cognition and motivation and therefore always have an interrelationship. People's positive (value-seeking) and negative (danger avoiding) actions require both knowledge and appraisal of this knowledge (Locke, 2000). When it comes to safety, motivation has a priority over cognition: actions needed for survival go over thinking. This has to do with the fact that needs are built-in to humans and exist before the very first perception. In contrast, when people can select the action, cognition has priority over motivation, because it is impossible for people to want something without knowing that something exists or that it has a certain value, such as comfort. "Cognition and motivation, which most fundamentally involve thinking and effort, always go together" (Locke, 2000, p. 415).

Consequently, people interpret their environment in terms of dominant goals, which leads them to an emotional response when they perceive the response to have significance for their well-being (Smith & Ellsworth, 1985). Safety is an objective in user experiences (Vyas & Van Der Veer, 2006) and strong evidence can be found showing that emotions impact perceptual value judgements. It is suggested that input from the emotional processing regions of the brain is involved in an early stage of perceptual processing of the objects. (Dolan, 2002). Emotions represent adaptive responses to the demands of the environment (Russell & Pratt, 1980). Therefore, emotional behaviour is an ongoing process and people constantly evaluate and respond to the environment adaptively. In addition, emotions play a great role in the perception of design, as products elicit emotional responses (Desmet, 2003; Frijda, 1986). For example, under the safety domain, a life buoy can indicate that a potential emergency has been taken into account or may trigger thoughts of accidents.

Based on this, it is assumed that safety and comfort are not prerequisites for each other but are both needed to achieve a cruise experience that is as enjoyable as possible. If people do not perceive their safety positively, it can cause dissatisfaction and may discourage them from going on cruises in the future. Further, if people feel comfort, it increases their satisfaction and motivation to go on a cruise vacation (Herzberg, 1971). Furthermore, Locke (2000) states that satisfaction of the need is pleasurable, whereas unsatisfied need leads to inconvenience and can be even painful and life threatening. Smith and Ellsworth (1985) have suggested that if it is known how people see their environment, it is easier to identify their emotional state; conversely, if it is known what people are feeling, it is possible to deduce how people interpret the circumstances. Therefore, it is expected that the design of the environmental characteristics can evoke positive safety perceptions and increase comfort.

Provision of positive experiences for the passengers is especially critical for cruise ships, which transport passengers at sea for pleasure; thus in addition to safety, passenger comfort poses one of their main concerns (Yarnal & Kerstetter, 2005). Therefore it is important to understand how people's safety perceptions emerge to minimize uncomfortable feelings and to guarantee comfortable cruise experiences (Baker, 2013).

2.5 Summary

Feeling of safety is a strong determinant of people's quality of life, but safety is often examined objectively. People study their environment to improve their safety in emergency situations. However, "being safe is not the same as feeling safe", as stated by Van Rijswijk et al. (2016, p. 103), and people thus rely strongly on their perception of environmental safety. In this process, people observe their environment to evaluate the relevance of the different characteristics. Interpretation of relevance depends on the current needs of the individual, which can include safety and comfort. In contrast, the need for safety or comfort provides a force that directs people's actions towards needs fulfilment (Wright, 1989).

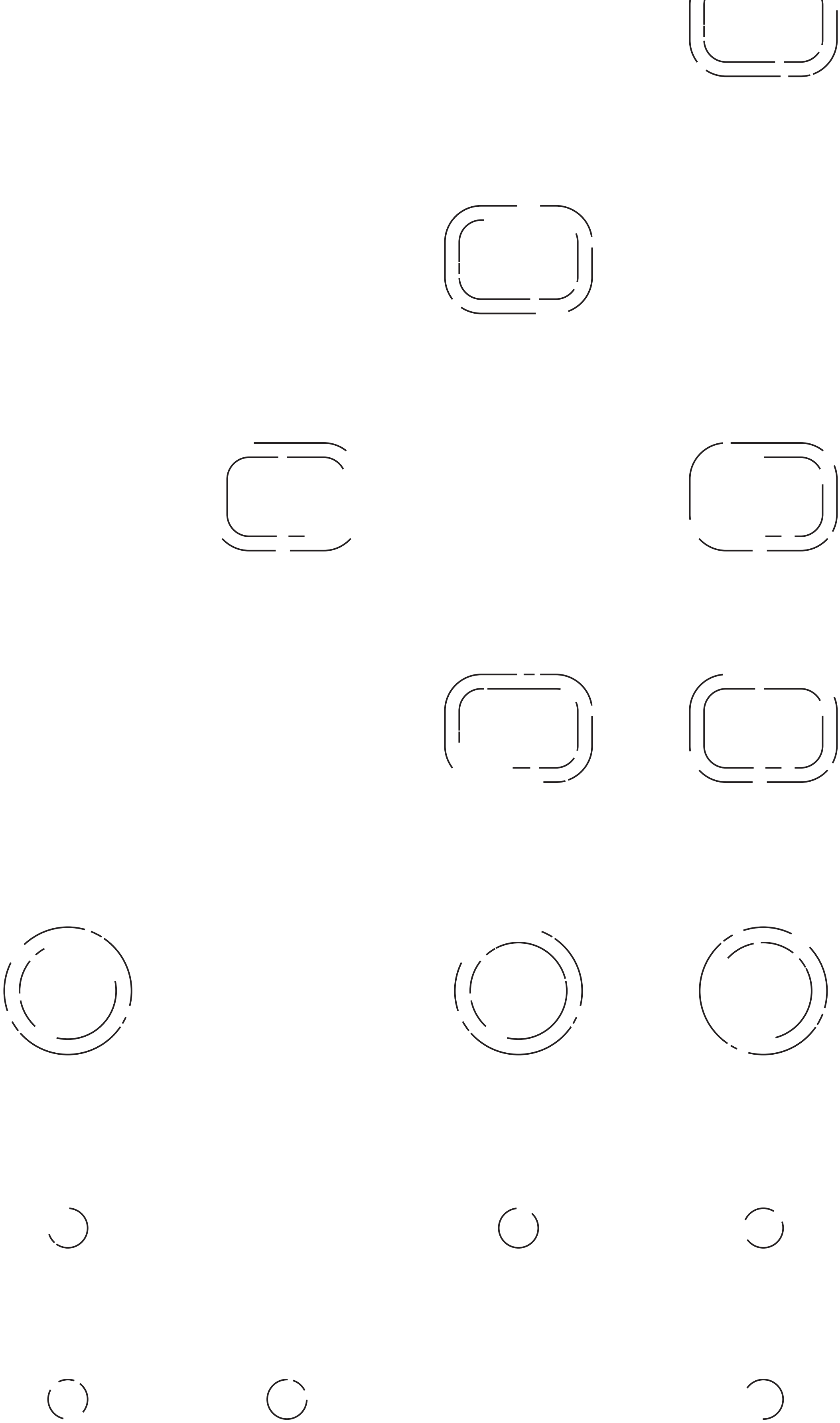
In general terms, the discussed safety studies aim to identify risk-inducing factors from the human perspective. Reducing or eliminating the recognized characteristics to improve people's perception of environmental safety typically pays attention to the negative, investigating risk rather than safety. However, people perceive the safety of their environment mainly when the situation is normal, which is the focus of this study. With positive safety, this

study refers to people perceiving that the environmental characteristics of an environment assure or improve their safety, whereas the negative perspective means that people perceive environmental characteristics as an inconvenience or a reminder of the risk itself.

It is the environmental stimulus that triggers psychological processes to estimate whether the environment is perceived as being safe or not. According to Kyttä et al. (2011), academic discussion about environmental qualities affecting perception has dealt with the topic only at a general level without attaching perception to a specific physical environment. Additionally, the prior research approaches typically evaluate artificial environments, that is, ones designed for specific research purposes (Van Rijswijk et al., 2016).

Although the studies discussed above provide important insights, more research is needed to comprehend people's safety perception in specific settings, such as cruise ships, where the feeling of safety is essential to experiencing other positive emotions. Moreover, it is typical of safety perception studies that they only examine environmental characteristics as perceived by a person in exceptional circumstances, instead of relationships between the characteristics or realistic situations (Van Rijswijk et al., 2016). This study takes as its starting point that in complex environments, such as cruise ships, which contain numerous environmental characteristics, these different characteristics should be investigated in parallel because they are interdependent. Hence, investigating safety perception as a sociotechnical network consisting of human and non-human environmental characteristics is justified.

To design comfort that enhances passengers' safety, their perception of the environment and the influence of that on their feelings should be investigated. According to Skogan (1990), with proper design and effective use of the environment, fear can be reduced and quality of life can be improved. Thus, proper design can make the overall cruise experience more enjoyable for passengers, as they perceive the environment to be safer. This is an important objective for shipping companies seeking to minimize passengers' negative experiences.



3

Cruise ship

3
Cruise ship

In general, a passenger ship is a merchant vessel that primarily functions as a passenger carrier, whereas the main function of cargo ships is to carry cargo. Passenger ships can be roughly divided into three categories. The first comprises **ferries**, which generate the bulk of their income from cargo transport, but also usually have accommodation and amenities for passengers. Typically, ferries sail on regular routes and schedules between two ports. Furthermore, ferry voyages are short, lasting from few hours to few days. The ships in the second category, **ocean liners**, are designed for transporting passengers and cargo over long distances and at a high speed across the oceans. However, presently the only ocean liner in operation is Cunard Line's *Queen Mary II*, as transportation of people and cargo across the oceans is arranged by other means. The third vessel category is **cruise ships**. This vessel type evolved from ocean liners. The mission of cruise ships is passengers' leisure-time voyages where the ship itself and its amenities are part of the experience (Ward, 2009). The sailing routes are typically round trips. The destination is the ship itself, while visiting ports during the trip serves to provide additional entertainment (see Figure 2). Cruise ship voyages typically last 3–12 nights. This study examines cruise ships and, more specifically, passengers' facilities[1], which are introduced in more detail in Chapter 5 with four examples of cruise ships.

3.1 Cruise ship business

The current form of cruising and cruise ships was triggered by competition with air traffic, which started conquering the transportation business in the mid-1960s when intercontinental air transportation became inexpensive enough to make ocean liners obsolete in transport use. At that time, many former ocean liners were converted to cruise ships. The first purpose-built cruise ship was delivered in the mid-1970s. However, it was soon discovered that ocean liners were ill-suited for their new purpose. Although many ocean liners had luxurious amenities and interior decoration, they had originally been built for fast and efficient travel across the oceans, which meant their fuel consumption was too high and their draught too deep for some of the major ports. Furthermore, their General Arrangement (GA)[2] was designed more with capacity than comfort

1 Accommodation and service spaces designed for passengers are also called public spaces and hotel services and hotel area (see figure 4).

2 General Arrangement (GA) is a definition for lay out drawing generally used in ship design.

FIGURE 2. Example of a cruise ship: *Voyager of the Seas*.

in mind. In the beginning, cruise ships were typically smaller than the preceding ocean liners. However, every new generation saw an increase in capacity, size and complexity, and this economy of scale trend is continuing today. Concerns have already been raised that the two biggest cruise ships, the *Allure of the Seas* and the *Oasis of the Seas* (Figure 2) are too massive (according to Cruise Mapper (2016b): length 360 metres, width 65 metres and height 65 metres) for many ports, canals and bridges, which limits their operational area. However, current development of the infrastructure indicates that, for example, ports have started to catch up to the increasing size of the ships (see also Chapter 5.2). In parallel with the growing size of cruise ships, smaller vessels that take passengers to more exotic destinations have remained an essential segment in the cruise experience offering.

Cruise Lines International Association (CLIA) has estimated that the cruise ship business is valued at a total of USD 119.9 billion, with 471 cruise ships operating worldwide (CLIA, 2016). Figure 3 shows a breakdown of the regional deployment of cruise ships. The industry has seen continuous growth and it is expected that, in the year 2016, 24 million passengers will be taking a cruise, as compared to 17.8 million in 2009 (CLIA, 2016), and all the market areas are still growing. Although Europe has been the fastest-growing market area for a long time, it will soon reach its saturation point. In Asian markets, on the other hand, passenger capacities could be potentially increased to 2.2 million. Thus, cruise operators are currently seeking to develop their Asian business and moving their ships to Asian waters, widening their focus beyond the North American and European markets.

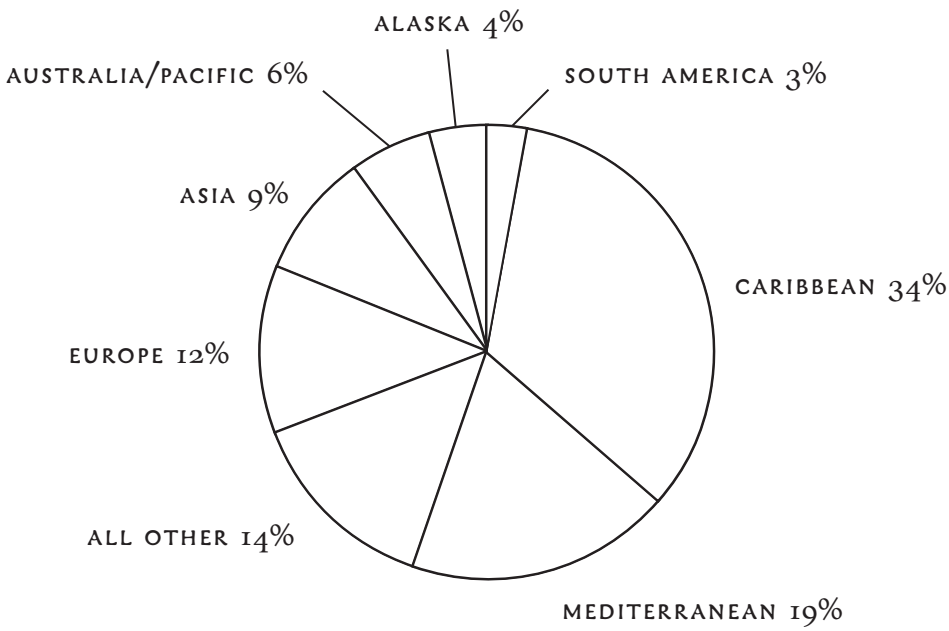


FIGURE 3. Cruise line deployment by region (CLIA, 2016).

The typical cruise ship passenger is 49 years old (current median age) and currently employed (72 per cent of the passengers) (CLIA, 2015). Although the current median age is relatively high, the deviation is wide: 25% are in the 30-39 age group, 25% in the 50-59 age range, and 25% in the 60-74 age group (CLIA, 2015). Similarly, an equivalent age range and wide age distribution were observed during field studies, in which the majority of the passengers were middle-aged. Notably, however, on *MSC* (Mediterranean Shipping Company) cruises, the passengers were significantly younger (see Chapter 5). Thus, it can be concluded that the median age also depends on the operation area and cruise operator. That said, the median age of the cruise vacationers has dropped by 15 years during the past ten years, and the core market currently comprises young adults between 20-30 years (CLIA, 2015). The majority of the passengers come from the US (12.2 million), UK (1.61 million) and Germany (1.77 million) (CLIA, 2016).

3.2 Cruising experience

The first scheduled passenger ship excursion dates back to the early 1800s when the first leisure voyage was made with the wooden steamer *St Andrew* near the Scottish isles (Robins, 2008). Back then, ship amenities were far more limited than those provided on today's luxurious floating cities, and the main mission of the ships was to

transport people across the oceans. The situation remained stable and relatively marginal until contemporary cruising established itself in the 1900s when the first examples of ships built specifically for pleasure cruises rather than transportation were launched.

A considerable change in the history of passenger ship operation dates back to the 1960-1970s when large-scale cruising developed gradually from the tradition of transatlantic ocean liners. This took place notably in the Caribbean. According to Ward (2009), contemporary cruising refers to the use of a passenger ship for leisure-time voyages, with the ship itself and its amenities being part of the experience.

The rise of post-modernism and peak in oil price can be seen to have greatly influenced the genesis of the cruise industry. Western commercialism, with its shopping malls, theme parks, and Las Vegas-style mixture of fads, became dominant in the 1970s. In this new trend, the consumer experience started to have a central role. (Dawson & Peter, 2010; Quartermaine & Peter, 2006.) During the same period, the peak in oil price forced cruise operators to replace their old liners with more economical ones. This offered an opportunity for the cruise business to make their cruise experience offerings more attractive to the growing middle class. This development included flight-cruise packages and a new style of post-modern interior design that aimed to attract people away from their familiar theme parks and hotels. However, the greatest boom to the industry was the premiere of the *Love Boat* television series in 1977, which introduced the cruise experience to the North American middle class (Quartermaine & Peter, 2006).

Traditionally, the development of cruise ship amenities has reflected major changes in western society and inside the cruise business rather than creating revolutionary innovations. However, the interior design of the earlier ocean liners had a notable influence, operators seek to provide passengers with amenities typical of the land-based hospitality and entertainment industry; this process in which land-based inventons are tailored to suit the cruise ship environment is called *marination* in the ship industry. Effectively balancing between evolution and revolution in ship design remains important today because of the massive investments required to build a revolutionary cruise ship and because cruise operators seek to keep their brand recognizable to their customers. See also Chapter 5 for observational examples from field studies.

The first purpose-built cruise ship made its maiden voyage in 1966 when the Norwegian Caribbean Lines ship *Sunward* made her journey from Miami to Nassau (Lunn, 2010). These two cities are

still among the most popular ports of call today. The *Sunward's* three-to-four night cruises in the Bahamas were highly successful, leading to an urgent need for new vessels and the market entry of rival cruise lines (Lunn, 2010). This era saw the establishment of the largest cruise line operators that are still in business today, such as Royal Caribbean International in 1968 and Carnival Cruise Lines in 1972 (Dawson & Peter, 2010; Quartermaine & Peter, 2006). Royal Caribbean International is introduced in more detail in Chapter 5.1.

Prior research defines the cruise ship environment in different ways: for example, as a unique experience that provides a total escape, safe transportation to exotic destinations, Vegas-style entertainment, luxurious pampering, quality food, innovative on-board features and awe-inspiring aesthetics (Kwortnik, 2005). Huang & Hsu (2009) describe the benefits of taking a cruise vacation in terms of intrinsic benefits or psychological outcomes that customers obtained as a result of taking a cruise vacation. According to (Yarnal & Kerstetter, 2005), individuals take ship cruises to feel at ease and comfortable with themselves, as well as in control and liberated. This is well in line with what was observed in the study: people adapted their behaviour quickly to the unwritten cruise culture and acquired the cruising role (see Chapter 5). Thus, cruising is all about user experiences in a certain environment and therefore it is reasonable to briefly discuss the experience and the human-environment interaction in this context. These issues are discussed in more detail in paper PII. The environment has a strong impact on experiences, as the experience itself serves as an individual evaluation of activity influenced by a stimulus from a particular product or service, which then has a significant effect on emotions (Hirschman & Holbrook, 1982). However, emotions are short-lived and change in response to environmental stimuli (Nawjin, Mitas, Lin & Kerstetter, 2013). Therefore it can be concluded that the cruise experience is an offering supported with products and services included in the cruise setting. Indeed, during the field observations, it became apparent that the cruise experience is impossible without the context (see Chapter 5). Fundamentally, cruise vacations are a prototypical experiential product: a combination of a floating resort hotel, sightseeing vessel, gourmet restaurant, food court, nightclub, shopping centre, entertainment complex, and recreation facility (Kwortnik, 2005).

From the cruise experiences point of view, it is evident that the cruise ship environment should be considered a sociotechnical environment combining human and non-human characteristics. However, prior studies of user experiences (UX) in a cruise context

(Harris, 2013; Hosany & Witham, 2010; Kwortnik, 2005; McCartan et al., 2014; Yarnal & Kerstetter, 2005) and also leisure research in general investigate the complex sociotechnical environment mainly from the social perspective, where humans and non-humans are not evaluated as heterogeneous elements. However, it is important that these different environmental characteristics are studied equally to understand their interconnectivity and mutual relationships. One notable exception from the leisure research literature is the study by Paget et al. (2010), which captures tourism as follows: "actor-networks connecting, within and across different societies and regions, transport-systems, accommodation and facilities, resources, environments, technologies, and people and organizations" (p. 967). This shows that people's experiences can be successfully explored through network analysis of the connected characteristics and that therefore it is valuable to adopt the method also in research on safety and comfort.

Finally, CLIA predicted in 2016 that the cruise industry will develop its offerings in the near future according to trends, such as the desire for luxury and online connectivity during the cruise, partnering with major brands to leverage cross-promotional opportunities, the greater importance of on-board experiences as the ships themselves are the destination, increasing opportunities for overnight stays at ports, intergenerational cruises, volunteer cruising opportunities, and cultural customization (CLIA, 2016). Some of these predictions have already come true; it was discovered that major brands, such as Starbucks, have already established outlets on the ships and the passengers have a need for longer stays in ports and a reliable Internet connection.

3.3 Cruise ship design and safety

All merchant ships crossing the waters of two nations need to be registered. Registration gives a nationality (flag state) to the ship and determines under which country's laws the ship is operated. The flag state controls the ship's regular inspection of equipment, crew, and safety and pollution prevention. General standards for safety, security and environmental performance in international shipping rules are drafted by the United Nations' specialized agency International Maritime Organization (IMO). In order to ensure that this vital sector remains safe, environmentally sound, energy efficient and secure, IMO provides a framework for ship operators to measure all aspects of international shipping – including ship design, construction, equipment, manning, operation and disposal (IMO, 2016a).

In practice the registry of the ships is administered by governmental or private agencies, such as the Det Norske Veritas – Germanischer Lloyd (DNV GL) and Lloyd's Register (LR). These agencies apply IMO's regulations to practical ship design as guidelines and rules with the emphasis on different parts of the IMO's regulations. Therefore, the flag state is mainly chosen based on the business interests of the cruise operator. All the marine classification societies conduct their own research and develop regulations in their spheres of responsibility. Therefore, cruise ships are typically registered to a certain classification society based on their earlier collaboration, as the introduction of the new ship design requires complex discussion with the authority. This is important because new or alternative ship designs that have not yet been acknowledged in safety regulations need to be approved. In this process, authorities, especially the shipyards that have the final responsibility, are convinced through research-based evidence that the proposed design is as safe as or safer than the current designs.

In addition to obligatory registration and compliance with the international rules for safety, security and environmental performance, passenger ships are typically designed according to additional comfort classes. All the classification societies designate preferred comfort classes, because comfort is highly important on cruise ships. For assessing an acceptable comfort level on board, ship designers can make reference to provided comfort-class design standards (Biot & Lorenzo, 2007). Compliance with the comfort class rules is verified through measurements of defined environmental parameters for acceptable levels of ship noise, vibration and indoor climate (DNV, 2014). For example, in the DNV classification, the comfort class rating is divided into three levels, with crn=1 being the highest comfort level and crn=3 representing the acceptable level of comfort. However, this rating has been criticized because these comfort standards only provide rough guidance for the design, since they give no consideration to the subjectiveness of passenger response to different stimuli influencing their sensation of comfort (Biot & Lorenzo, 2007). Some differences related to noise and vibration were discovered between RCL and MSC vessels during the field observations (see Chapter 5).

The above account conveys a clear image of how authorities carefully control cruise ship design. Further, ship design is highly dependent on safety performance, and safety touches all the different phases of the design process that are shown in Table 2.

Due to the high complexity of a cruise ship (Ahola et al., 2011a; Håvold, 2005) the design process is sequential and iterative

CUSTOMER REQUIREMENTS – MISSION STATEMENT 1. Task, capacity, performance demands, range and endurance 2. Rules, regulations and preferences 3. Operating conditions, like wind, waves, currents, ice
FUNCTIONAL REQUIREMENTS – INITIAL SIZING OF THE SHIP 1. Based on capacity, where the areas and volumes needed for cargo spaces and task-related equipment define the vessel size 2. Based on weight, where the cargo weight and the weight of task-related equipment and of the ship itself define the vessel size
FORM – PARAMETRIC EXPLORATION Variation of main dimensions, hull form and layout of spaces on board to satisfy the demands for both capacity and weight
ENGINEERING SYNTHESIS Calculating, compromising and optimizing ship performance, speed, endurance and safety
EVALUATION OF THE DESIGN Calculating building cost and operation economics

TABLE 2. Ship design process summarized (adopted from Levander, 2004).

in nature; this process is referred to as a *design spiral*. Furthermore, cruise ships are divided into hotel and ship functions (see Figure 4). This study focuses on passenger facilities as people are most likely to form their safety perceptions in these facilities and the research findings are beneficial for the mission statement of the ship design process (see Table 2).

The main emphasis in ship safety design has traditionally been on the technical possibility of improving passenger ship safety (e.g. Papanikolaou, 2009; Vassalos, 2006; Kristianssen, 2013). According to Alderton (2004) and Kristianssen (2013), ship accidents are usually classified according to a particular event (e.g. a ship runs aground or is materially damaged by weather) rather than causes (e.g. human error, poor maintenance). A ship's safety performance is analysed through risk, which leads to a design process that integrates risk and reliability analysis methods, leading to a *risk-based design* that aims at zero loss of human life from ship-related accidents (Sames, 2009).

However, prior ship safety research has mainly addressed the human element in terms of the causal behaviour of the passengers during evacuation situations. For example, evacuation modelling concentrates on possible technical improvements that would increase the safety level of passengers, but the behaviour of the passengers has only received little attention. Studies of active behaviour have

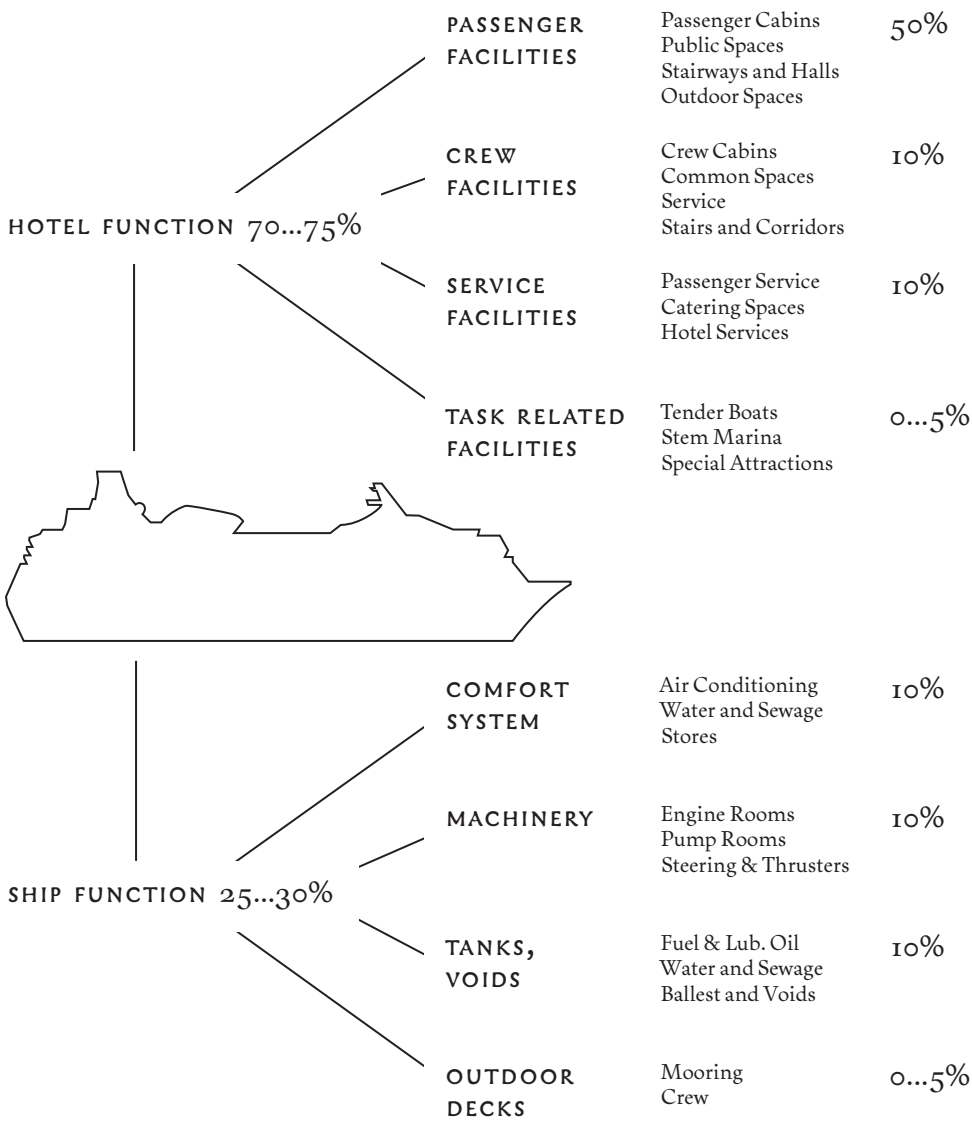


FIGURE 4. The cruise ship functions and demands (adopted from Levander, 2004).

traditionally been limited to the activity of the crew (e.g. Håvold & Nesset, 2009; Rawson & Tupper, 2001). In practice, passenger behaviour during evacuations with respect to IMO requirements is analysed only with models that consider the total number of passengers and estimated evacuation times (Vanem & Skjong, 2006). Evaluating the evacuation process is currently accomplished via virtual modelling of the initial conditions such as environment, demographics of the people on board, and response time, and evacuation dynamics, i.e. walking speed (Vassalos et al., 2002). Indeed, even though passenger performance is measured, only the most sophisticated models are capable of providing information to cope

with the uncertainty posed by the human cognition process (Caldeira-Saraiva et al., 2004).

To improve this situation, efforts have focused on developing more advanced statistical evacuation models capable of coping with human behaviour to some extent. For example, EXODUS software simulates passenger behaviour in an emergency, for instance, their response to alarm, preparatory actions, progressive evacuation to refuge or other safe place, preparation of escape systems, and abandoning the ship (Caldeira-Saraiva et al., 2004). In addition, Meyer-König et al. (2007) have developed a model that enables modelling of an individual's walking speed and evasion of obstacles and other persons.

Recent development of the introduced evacuation modelling applications has led to a situation where all future development in ship design and operation passes through risk-based procedures. Once the appointed safety features are implemented in the ship design, the safety performance of the ship concept is measured against various passenger evacuation scenarios. Risk-based ship design considers human behaviour within several different ship spaces through way-finding modelling based on the given task, i.e. find the way to the muster station and collect a life vest on the way (Papanikolaou, 2009). However these models only include limited artificial intelligence and human behaviour is generally treated as an unpredictable variable of human error or failure.

Despite this, it can be concluded that the complexity of the evacuation process, involving large numbers of people who are unfamiliar with the ship, who perform under time constraints, and are experiencing heightened emotions make the modelling challenging. Lee et al. (2003) state that human behaviour is the most complicated and difficult area when simulating an evacuation, as in reality human behaviour becomes increasingly chaotic and irregular as the complexity of the situation mounts (Helbing & Molnar, 1995). Indeed, Qiao et al. (2014) note that psychological reactions resulting from stressful situations make people behave irrationally. For example, they might follow the wrong escape route, deviating from an efficient evacuation process.

Consequently, the insufficiency of the safety regulations from the subjective point of view is identified. For example, IMO states in its vision, principles and goals that actions facilitating a better understanding of the complex, multidimensional human element should encompass all matters pertaining to passenger safety when developing safety regulations. Furthermore, there is a need for a

human-centred approach for extending knowledge of ways in which *real* passengers interpret their environment and behave according to their interpretations (IMO, 2016b).

It can thus be concluded that from the ship safety research perspective, the user-centred approach to ship safety research, which considers the passenger-environment interaction, is justified.

3.4 Summary and research gap

Safety is critical for cruise ship design. Complex physical operation environments and the natural environment (Baker, 2013; Håvold, 2005) set high expectations on the passive and active design of the passenger ship environment to provide a sense of safety and comfort and to support ease of evacuation and other safety-related actions. Much research has been conducted on forecasting actual human behaviour during ship emergency situations and the last decades have seen a shift in safety research from investigation of technical failures towards social aspects, such as cultural and human factors that cause accidents (Håvold, 2005). However, little is currently known about the subjective considerations related to safety in the passenger ship environment. Research on human-environment interaction is limited to evacuation analysis and passenger ship safety design is mainly studied from technical and functional perspectives. In its current stage, the primary emphases in safety design are on values for the main factors of evacuation, such as the effective width of exits and the estimated time it takes a person to evacuate (Lee et al., 2003). Lois et al. (2004) conclude that although the cruise ship business has an excellent safety record, there is room for improvement in understanding passenger responses to emergency situations.

Although it is evident that the subjective consideration of ship safety and comfort affects whether potential passengers will decide to go on a cruise, the research interest has been limited. Deeper understanding of passengers' safety perception is highly beneficial for shipping companies seeking to assure sufficient safety and comfort for their passengers and therefore should be researched, as Biot & Lorenzo (2007, p. 93) conclude:

> **"Passengers determine their acceptance of a cruise ship on the basis of objective and subjective considerations relating essentially on their perception of comfort and safety."**

Although ship spaces are optimized for efficient evacuation, stressed passengers in an emergency may act in accordance with their

perception and behave against the design intentions. According to Kristianssen (2013), the perception of situational and environmental factors constitutes one of the main information processing functions of a human safety state. Therefore, subjective safety has an effect on objective safety. As described in more detail in PIV, evidence shows that it can be challenging to design cruise ships that are perceived to be safe. Prior research has demonstrated that significant differences exist between users and designers with respect to their perceptions of design objects, which makes the transfer of people's needs into technical and design specifications challenging (Blijlevens, Creusen & Schoormans, 2009; Hsu, Chuang & Chang, 2000). Moreover, passenger ship design is a complex process with many conflicting requirements (e.g. technical demands caused by moving on water, berth capacity, safety regulations, comfort). As discussed in PIII, the relationship between risk and the experience of safety is characterized by complex interactions with other factors (Hale, 1996) and PI identified a large number of characteristics involved in the process.

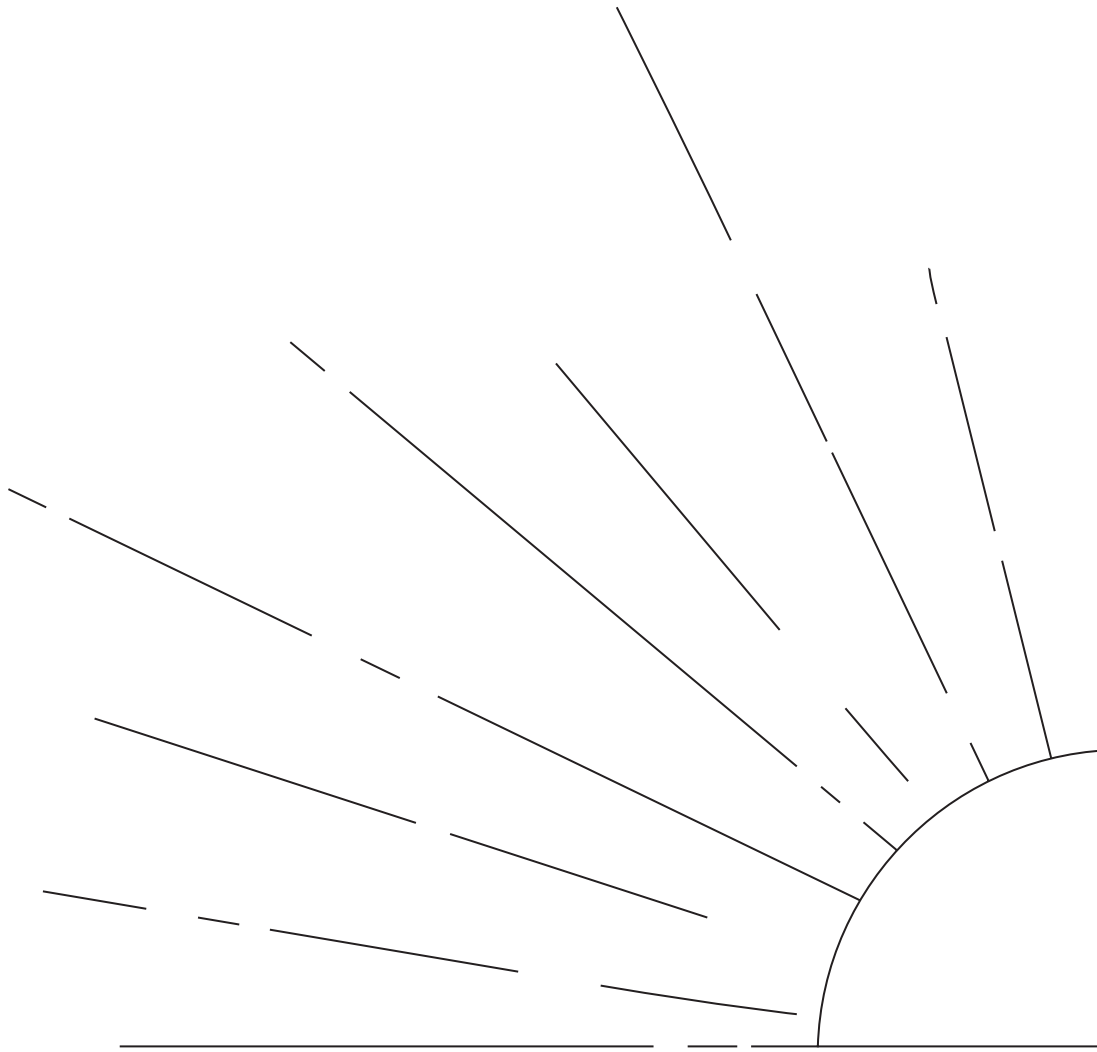
Building on what was discussed in Chapter 2, current ship safety research is inadequate because passengers perceive safety in situ: in these normal situations, the designated safety features are passive characteristics of the environment, existing in their safety role only when active. Passengers mainly trust their perception of environmental safety based on the existing characteristics in a normal situation, which provides them with the feeling of comfort or inconvenience.

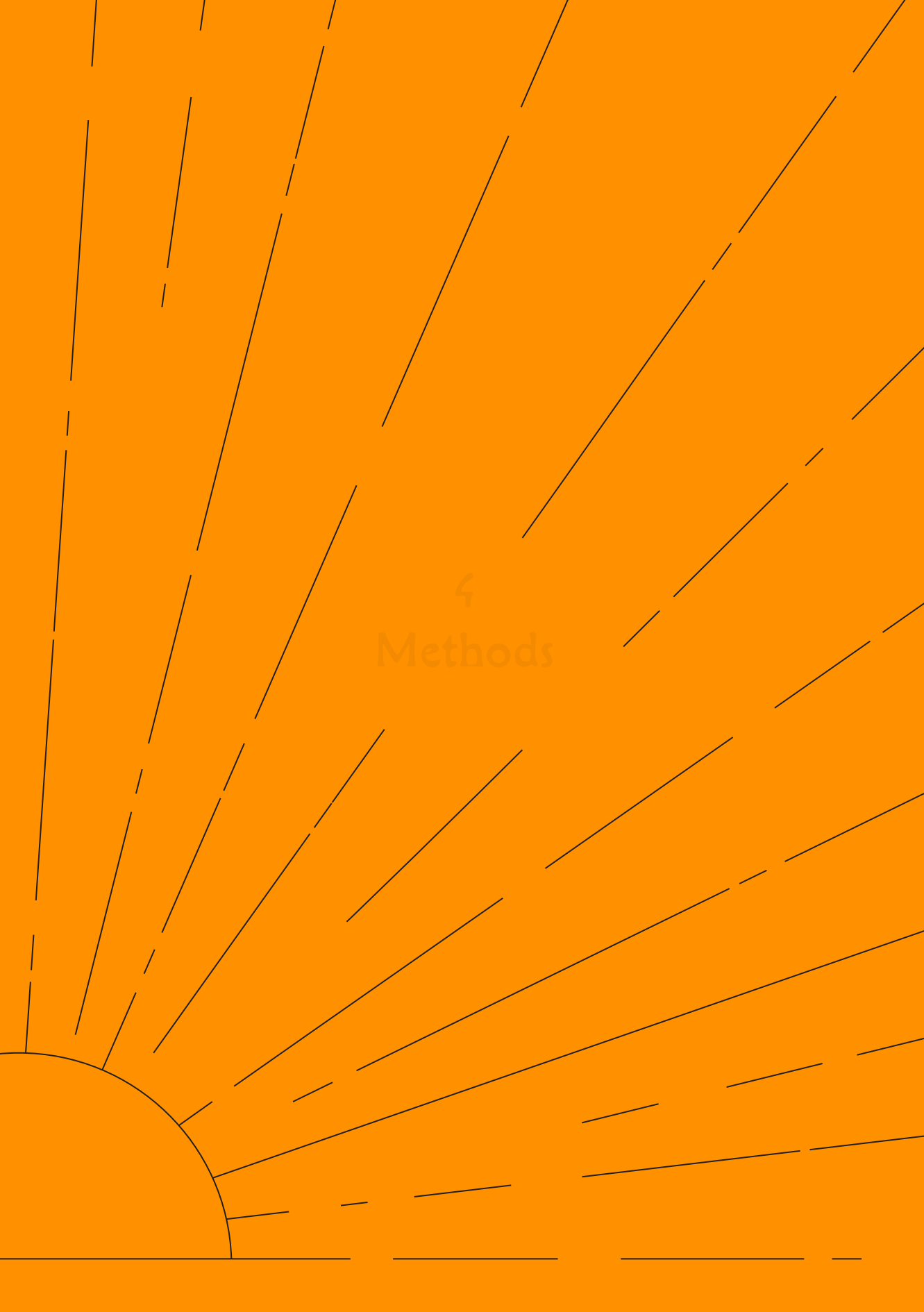
To develop passenger comfort from the safety perspective, one should better understand how passengers' perception of safety influences comfort, and it should be investigated how design can have an impact on this. This is critical for three reasons. First, passengers' safety perception defines how people encounter their environment, which further impacts their interaction with the environment, i.e. feelings and behaviour. Comfort is a critical determinant of satisfaction with the cruise experience and therefore negative perceptions need to be minimized, including those relating to the lack of safety. Second, much effort has been put on developing objective safety on passenger ships, but this approach has achieved limited results from the passengers' perspective. Ship designers lack knowledge about the subject and therefore research is needed to shed light on the interconnectedness of environmental safety characteristics, because identification of the underlying causality helps us to understand human safety perception, evoke more positive safety perceptions and improve passenger comfort. Third, it can be

argued that a relationship exists between safety perception and actual safety, as a broad research foundation rests on the fact that perception may lead to corresponding behaviours (see e.g. Carver & Scheier, 1981; Mischel, 1973; Vallacher, 1993).

Building on the discussion relevant for the current research, introduced in the previous chapters, the main research question – How do passengers perceive safety during a regular cruise? – is supported with the sub-questions:

1. **How do different characteristics of a cruise ship affect passengers' safety perceptions?**
2. **How can perceived safety be improved by design?**
3. **How can the interaction of the characteristics be visualized to support the design process?**





4
Methods

This chapter presents the multi-methodological approach to collecting and analysing the data. The current study inquires into and investigates human safety perception of cruise ships through empirical investigations in authentic cruise ship environments. Cruise ships share many similarities with other hospitality venues, holiday resorts and means of transportation, but do not belong solely to any of those categories. Therefore, the author's personal learning process and data collection in authentic settings were necessary. Passengers' real experiences and insights can only be traced in an authentic environment (Kelley, 2001) and first-hand perceptions of the subjectivity and authenticity of the human experience comprise a foundation for the qualitative research approach (Cagan & Vogel, 2001; Silverman, 2009).

Qualitative research methods make it difficult to predict how data will be collected through interviews or observation (Streubert & Carpenter, 2011) and therefore research needs to be designed carefully. In this research, there was an exceptional opportunity to go on several cruises to collect insights. This was truly helpful as the author was unfamiliar with the context, and the researcher needs to anticipate the possible outcomes and what kinds of situations will occur during observations. Furthermore, in the beginning, the focus of the research was more on the exploration of the passengers' cruise experience through the design of environmental characteristics, and the research methodology was planned for collecting insights with practical design suggestions in mind.

Understanding the impacts of different environmental design characteristics in the formation of passengers' safety perception was gained with mixed research methods. Use of multiple methods allowed verification of the collected knowledge, as data collection was adapted based on the gained experiences and insights and the research questions were revised iteratively. Triangulation was applied to capture a more holistic and contextual portrayal of the research objective (Jick, 1979). Preparations for collecting the actual data started with a literature preview of cruise culture in general, based on the experiences gained from the authentic cruise that the author attended before the actual dissertation study (see Chapter 5.1). This first observational cruise was truly helpful and provided valuable insights for conducting research in the special context and early findings on passengers' cruise experiences. The gained insights were then supplemented with practical guidance for qualitative studies, fieldwork and ethics before participating in the second cruise. These enabled planning of suitable interview and observation situations and procedures and

further enabled understanding the daily rhythm of the passengers and planning how to recruit participants for the study. Participant interviews were mainly gathered through situated interviews, which were supported with participatory observations. The interviews provided information about what people perceive and think they do, while observation yielded information about what people actually do. The second cruise (see Chapter 5.2) can be seen as a turning point of the dissertation, as the early insights into the cruise experience yielded evidence that safety plays a crucial role in the process of enabling people to concentrate on enjoyment. The research focus was therefore narrowed down towards this central finding of the early studies. Furthermore, extensive literature on the high interdependence of ship design and safety supported the salience of investigating safety from the passengers' perspective. Therefore, the research approach in the third cruise was directed towards this finding and instead of focusing on cruise experiences the focus was shifted towards collecting insights into how passengers perceive safety in the passenger ship environment. For this purpose, self-documenting was considered the most suitable method for collecting insights about environmental characteristics influencing safety perception and supporting situated interviews and observations.

Analysis of the collected insights from the third and fourth cruises revealed that environmental characteristics do not act individually, but are always interlinked. This finding guided the research design to frame the analysis towards system analysis. In this process, Actor-Network Theory (ANT) was employed as a background framework, because its explanatory nature supports the analysis of the interaction between different kinds of characteristics and helps make sense of what is going on, or what deserves concern or attention (Mol, 2010).

After reaching the saturation point in the analysis process the comprehension of the dependencies was assisted with visualizations in which relationships between identified environmental characteristics were visualized as networks. The final phases of the analysis yielded signs about the relation of perceived safety and comfort. This anticipation directed the research towards testing whether comfort-related safety exists. The results of the analysis were verified by testing the impact of a set of design characteristics for passengers' comfort-related safety with a survey.

In practice, the author's personal learning process and engagement with the passengers' on-board activities and experiences involved 38 nights spent on cruise ships in European seas and the

Atlantic. Situated interviews and participatory observations on a transatlantic cruise (see Chapter 5.3) and a West Mediterranean cruise (see Chapter 5.4) yielded the primary understanding of the investigated phenomena, whereas observations on three other cruises played a substantial role in providing background knowledge, which is considered crucial for success when collecting and analysing the primary data. The research design of the articles included in this dissertation is summarized in Table 3. In terms of validity and reliability, the study complies with the criteria for trustworthiness defined in Morrow (2005). These criteria concern internal consistency, where the rigor of the study is ensured through the concepts of the *credibility*, *transferability*, and *dependability* of the study.

4.1 On-board observation

The author's personal learning process and engagement with everyday activities on board cruise ships plays an essential role in this research. As discussed in Chapters 2 and 3, it is evident that the environment significantly impacts the perception process and the cruise ship environment represents a unique environment that is difficult to understand without first-hand knowledge. Furthermore, when conducting a user study in such an environment, the researcher should know the environment and its special features in detail in order to succeed in data collection. When trying to learn about the characteristics of people's safety perception, the observational approach was considered the most suitable. Scholars have widely recognized the importance of conducting research in an authentic setting (Crilly et al., 2004; Gibson, 1979; Schifferstein & Cleiren, 2005). Observation is an analytic endeavour to describe the social and cultural realities and how people align themselves with them (Dourish, 2006; Andersson, 1994). The ethnographical approach to data collection requires the researcher to participate directly in the relevant setting and collect data systematically without imposing external connotations or influences (Brewer, 2000). Observational research is also typical for designers who are interested in individuals as origins of the design requirements and sources of inspiration. The credibility of the observation can be achieved through prolonged engagement in the field with the participants and detailed description of the participants' experiences and also of the context in which experiences occur (Morrow, 2005).

Objects can evoke highly subjective meanings through memories and associations, and shared cultural content is likely to be interpreted in relatively similar ways (Battarbee, 2004). Authenticity of the research environment is critical because people assign meanings to

ISSUED PAPER	RESEARCH QUESTION	RESEARCH METHODOLOGY	DATA COLLECTION	VARIABLES	ANALYSIS METHOD
PI	How do people perceive safety within the context of passenger ships?	Situated interviews with fellow passengers Participatory observation	17 unstructured interviews 21 nights observation notes		Quantitative analysis of the qualitative data
PII	How do interlinked human and non-human characteristics of the cruise ship environment contribute to the passengers' cruise experience?	Situated interviews with fellow passengers Participatory observation	8 unstructured interviews 21 nights observation notes		Network visualization Actor-Network theory
PIII	How do passengers perceive safety on board the cruise ship and how are these perceptions connected to ship safety regulations?	Situated interviews with fellow passengers Participatory observation	17 unstructured interviews 38 nights observation notes		Network visualization Actor-Network theory
PIV	How do environmental design characteristics affect people's safety perception in a passenger ship context?	Survey experiment	97 participants	Dependent: People's safety perceptions in a passenger ship cabin corridor. Independent: Circulation Dimensioning Shape & Geometry Accessories	Conjoint analysis

TABLE 3. Research design of the papers included in this dissertation.

products by tracking how the product is used in a number of real-time contexts and by witnessing the responses of other users (ibid.). Verbal descriptions are only one of three keys to obtaining insights into experiences. We need to study "what people do, what they say and what they make" (Sanders & Dandavate, 1999). These three ways of acquiring insights were followed in the present research. The execution

of the interviews in the observation setting enabled an interactive observation process, where the focus of the observation was adjusted according to interviewee insights.

Procedural ethics becomes an issue when researching human subjects. The researcher must inform the observed community about one's purpose in observing as well as the exploitation and inaccuracy of findings (Finnish Advisory Board on Research Integrity, 2009). This was also a concern from the ship operator's side with regards to informing them about the upcoming research activities on board and requesting collaboration in gathering informants for the research. On every observational cruise, the research undertakings were approved, but the operators advised the researcher to exercise high ethics and not to disturb their customers without consent and offered on-board officers for the interview. The operator's wish was followed and the research was conducted following the ethical instructions of the Finnish Advisory Board on Research Integrity. The ethical principles of the Board also suggest that research findings should be shared with the community (Finnish Advisory Board on Research Integrity, 2009). For this research, the participants were asked to provide their contact information and the included research articles have been shared with those interested in them.

In practice, conducting observational research on board a cruise ship is relatively straightforward. A large number of people live together for approximately a one-week period and each passenger often meets the same people. Indeed, it is easy to get to know other passengers and schedule interviews for obtaining detailed insights. For the same reason, it is easy to observe if and how people's behaviour evolves during the cruise and to focus on different aspects in different settings and at various times. The challenge for the interview scheduling is the tight cruise programme that keeps people busy at almost all times of day. The programme offered to passengers is so activity-packed that if a researcher wants to observe all the possible activities, the research schedule should be considered carefully. Passengers also constantly take photographs during every holiday activity, and therefore recording during observing usually did not attract attention. If the research did attract attention, the research group always clearly described the purpose and background of the research and informed the subjects that the observation data will be used anonymously to describe passengers' safety perception in general for research purposes only. Furthermore, the recordings were more focused on describing activity and artefacts rather than identifiable faces.

Participatory observation entails living together with the observed people and sharing similar experiences. Koskinen et al. (2011) say that designers are interested in gaining first-hand information on how people address, deal with, and live with design objects. To gain this information, active reflection and documentation is required to gain an immersed and embodied understanding of the relevant situations (Blowman, 2003). In this process, photographs and other relevant material can be used as evidence in the later design stages to recall to mind and communicate the particular atmosphere, situation or personality (Jääskö & Keinonen, 2004).

Participation in five cruises allowed me to gain a sufficient understanding of the events, surroundings, interactions, conversations, and use of objects in everyday situations on board, which are the requirements for observational ethnographic research (Jorgensen, 1989).

My learning process and engagement with everyday activities on board cruise ships lasted 38 nights. Although the observations took place mainly in the daytime, the cruise duration is counted in nights. Observation material collected during 21 cruising nights (73 pages of field notes, photographs [n=2237], drawings [n=16], additional material such as daily cruise programmes and brochures [n=47]) is considered the main supportive data for the interviews. Seventeen additional cruising nights are regarded as secondary data that support and complement the insights from the main data. Rich use of the visual observation material yields sufficient information about the researcher, context, processes, participants, and researcher-participant relationship in the publications to enable the reader to decide how the findings may transfer to her or his own context (Morrow, 2005). This process refers to external validity (transferability). To my knowledge, little research related to passenger ship safety has been conducted with the involvement of real passengers reporting their observations in an authentic environment and in a real-time situation.

4.2 Situated interviews and self-documenting

Nineteen unstructured interviews were conducted during two of the cruises, which are described later in Chapters 5.3 and 5.4. These interviews are considered the main data of the research. Interviews were considered the most feasible means of obtaining deeper knowledge about such personal processes as safety perception. Unstructured interviews and self-documenting were employed as the methods. Unstructured interviews allow the interviewee to provide reliable information regarding personal experiences (Bowling, 2014).

It is argued that an unstructured interview provides more valid information than a structured interview when it comes to analysing human experiences (Gorden, 1969). Participant's self-documenting aids the researcher in interpreting the insights (Mattelmäki, 2006). This supports the research aim of discovering insights into how people encounter the cruise ship environment from the safety perspective and which environmental characteristics are perceived as important for the process. The interview data is examined in PI, PII, and PIII.

4.2.1 SAMPLE SIZE

A sample size of 19 interviewees is considered sufficient and provides a solid starting point for mapping previously unknown qualitative information, in which one occurrence of the data is potentially as useful as many in understanding the process behind the topic (Mason, 2010). Such studies focus on meaning and do not aim at making generalizations, and therefore a relatively small sample size is considered sufficient (ibid.). It has been noted that new meanings emerge in interview studies after interviewing around 20 people (Green & Thorogood, 2009) and it has been suggested that 15 is the smallest acceptable sample size (Guest, Bunce & Johnson, 2006). Furthermore, multiple data collecting methods, as in this study, allow fewer participants (Lee, Woo & Mackenzie, 2002). Instead of a satisfactory sample size for statistical generalizations, the qualitative sample must be large enough to ensure that most or all of the important perceptions are uncovered, whereas too large a sample may become repetitive and superfluous (Mason, 2010).

The first data set was collected in November 2011 on a 14-night transatlantic cruise, during which 10 participants were interviewed. Although interesting insights emerged and the sample equated well with the average cruise passenger (see Chapter 3.1), the sample was considered relatively homogenous. This was because all the participants were Finnish, affiliated with Aalto University, and first-time cruisers. Therefore, the second interview set of nine individuals was collected on a cruise in September 2012 to increase the scope, adequacy and appropriateness. For the second set, participants with more diverse backgrounds were selected and the ship cruised in another region and with another operator. After transcription of the second set of interviews, saturation was reached. The saturation process is explained in detail in Chapter 4.3.

4.2.2 PARTICIPANTS

The aim of the field studies was to obtain a wide range of insights from people representing average cruise passengers. The average cruise passenger is described in Chapter 3.1. Today the average age of the cruise passenger is 49, but the range is wide and the average age is constantly decreasing and, at the moment, the core target market is young adults between 20 and 30 years (CLIA, 2015; 2016). The first set of participants was recruited from the participants of the Aalto on Waves project, in which 109 Aalto University-affiliated people travelled on a cruise ship from Portugal to Brazil in November 2011. Aalto on Waves was a student-driven innovation project, in which students, researchers, teachers, alumni from Aalto University and corporate representatives collaborated. The author participated in the cruise mainly as an observer, but also as a teacher of a passenger ship architecture course and also took part in several workshops. Ten Aalto University master-level students, all of them first-time cruisers, participated in the study. The median age of the participants was 23 years and six of them were male. Most of the participants were recruited from the author's course and the rest from other than university associations during the cruise.

In the second field study, the participants were selected randomly from among the passengers on a one-week Mediterranean cruise. Although the majority of the passengers were Italians, the aim was to find participants of different nationalities, ages, occupational backgrounds, and levels of cruise experience. Altogether nine individual participants were recruited. The median age of the second set of participants was 39.3 years, and four of them were male (Table 4).

The age distribution was from 21 to 61 years and five nationalities were involved, which corresponds to the typical cruise ship passenger profile (see Chapter 3.1). While the interview method and the sample size do not lend themselves to generalizations, the results serve the purpose of mapping previously unknown safety perceptions on board cruise ships. According to Griffin & Hauser (1993, p. 23), "interviews with 20–30 customers should identify 90% or more of the customer needs".

4.2.3 INTERVIEW PROCEDURE

Both interview sets followed an equivalent procedure of three stages, planned according to Silverman's (2009) advice to keep the qualitative data collection process as simple as possible. Therefore, the procedure was kept simple to ensure that the participants did not need to put extra effort into taking notes and that the author could easily interpret

INTERVIEWEE	GENDER	AGE	NATIONALITY	OCCUPATION
1	Female	24	Finnish	Student
2	Female	22	German	Model
3	Male	22	German	Police
4	Female	26	Chinese	Student
5	Male	59	German/Australian	Photographer
6	Female	53	Australian	Official
7	Male	32	Finnish	Designer
8	Male	61	United Kingdom	Writer
9	Female	55	German	Office worker
10	Male	32	Finnish	Student/Journalist
11	Female	21	Finnish	Student
12	Female	22	Finnish	Student
13	Male	21	Finnish	Student
14	Female	25	Finnish	Student
15	Male	22	Finnish	Student
16	Male	22	Finnish	Student
17	Male	21	Finnish	Student
18	Male	24	Finnish	Student
19	Female	23	Finnish	Student

TABLE 4. Selected demographics of the interview participants.

the insights. First, the interviews were initiated with tuning-in sessions, in which the voluntary participants were asked to share their previous experiences of safety in general. The aim was to help the participants acquire the right mindset for sharing their personal insights on how they perceive safety and interpret their environment while doing so. Furthermore, the participants were prepared for the research objectives and research set-up, and assured that the insights would be used anonymously and only for research purposes. According to Mattelmäki (2006), a tuning-in session promotes the success of the research and helps trigger informant insights and expectations. Furthermore, in contrast to research on for example victims of a ship accident, this study was free of ethical dilemmas

FIGURE 5. Example of a logbook that the participants used while writing down their safety perceptions while exploring the ship.

relating to triggering painful experiences, as the researchers studied participants' experiences in normal situations. However, such risks were kept in mind when conducting the interviews, and it was made clear to the interviewees that participation was voluntary and they could retire from the study if they wished. Second, prior to interviews, the participants were asked to explore the ship for time period of an hour and document their safety perceptions into a logbook. The logbook was a printed sheet with paths illustrating the *observational* route and empty slots for participants to indicate their positive or negative feelings (see Figure 5). According to Csikszentmihalyi and Larson (1987), the self-documenting approach can aid the researcher in understanding context-related experiences as they occur and minimize retrospection. Mattelmäki (2006) concludes that participants record their experiences in a more genuine way in situ in contrast to interviews conducted afterwards. Third, the author and the interviewee went through the logbooks to avoid misunderstandings and to facilitate further conversation. Logbooks were used as a basis for discussion, keeping the dialogue focused on the research objectives. The interviews lasted roughly 20 minutes and were recorded and transcribed. Moreover, conducting the interviews in practice is discussed in PI, PII and PIII.

4.3 Analysis of the data

A cruise ship environment is a collection of human and non-human environmental characteristics, which contribute to people's safety perception process both individually and as an entity. Prior research has shown that such environments should be explored by focusing on underlying functions, factors, and causes to understand the sociotechnical problems (e.g. Haavik, 2014; Monat & Gannon, 2015; Norman & Stappers, 2016). In addition to evidence showing that complex systems should be investigated as networks, the human perception process supports the network analysis approach. People link perceived environmental characteristics based on their earlier knowledge (e.g. Brunswik, 1952; Nilsson et al., 2012; Treisman & Gelade, 1980). Thus, it is natural for humans to interlink perceived characteristics to visualize networks that enable them to understand the current situation.

In the analysis process, Actor-Network Theory (ANT) was considered a useful background framework for analysing complex environments that contain an abundance of both non-human and human characteristics. ANT facilitates the analysis of the cruise ship environment, because it handles different types of actors equally and builds on the understanding that humans cannot exist without the non-human, and that thus the two kinds of actors are interconnected (Latour, 2005). This study explores the environmental characteristics, which in ANT are considered actors. Consequently, in the following section, the term actor is used as an explicit description of the use of the term in the methodology.

ANT networks are rarely visualized. In this research the aim was to go beyond listing of actors and verbal description of the relationships, and to make the networks more easily comprehensible. Therefore the networks were also visualized. Visual illustrations complement verbal descriptions (Murto et al., 2014) and promote the hierarchical significance of the network, as it is difficult to explain the composition of a network simply with words. According to Tufte and Weise Moeller (1997), visualizing networks provides a clear explanation of how things are related. This supports the descriptive rather than explanatory nature of ANT (Latour, 2005). Therefore, visualization was seen to elucidate how the emerging actors were linked to each other and what kinds of aims the actors have. Visualizations were adopted to explicate how things are related (Tufte & Weise Moeller, 1997) and network illustrations can highlight the actors that are active binders in the network.

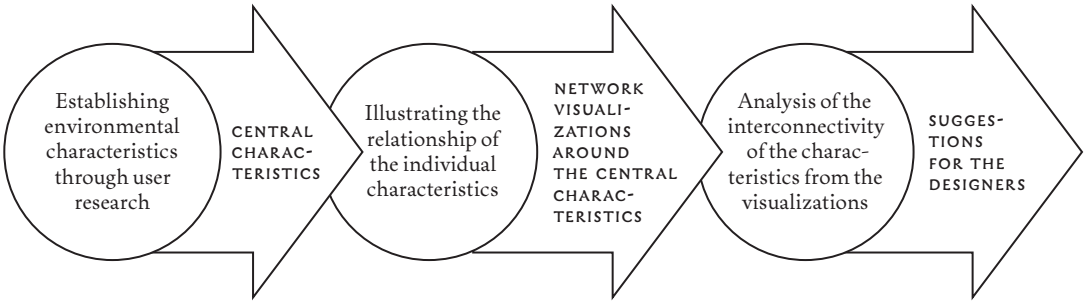


FIGURE 6. Flowchart illustrating the visualization process of the network analysis adopted in PII and PIII.

The network analysis followed the three-phase process (content analysis, network visualizations, and analysis of the relationships and central actors of the networks) that is described in Figure 6.

In the first phase, the content of the collected user data was analysed. There are many types of content analysis, including quantitative and qualitative methods, and they all are focused on systematic categorizing of textual data in order to make sense of it (Miles & Huberman, 1994). According to Rourke and Andersson (2004), the technique is commonly adopted as a systematic and objective procedure for describing communication. In this research, the data were analysed through quantitative analysis of qualitative data, which in practice means coding text into explicit themes (categories), which were described statistically (Morgan, 1993). Consequently, the analysis approach remains somewhere in between quantitative and qualitative content analysis owing to the inclusion of latent content analysis. Latent content analysis refers to the process of interpreting content (Holsti, 1969). With this type of analysis, the focus is on discovering the underlying meanings of the words or content (Babbie, 1992; Morse & Field, 1995).

These meanings were discovered through a four-step process, as the collected data were analysed via a bottom-up approach and the transcribed material was separated into safety perception themes.

First, all of the material from the field studies was transcribed and the environmental characteristics from each written transcript were extracted. To include a characteristic within the analysis, the relationship between the investigated topic and its perceived safety feature needed to be identified from a participant's narrative. For example, when a participant described a handrail that influenced his feeling of safety – "real material, like wood, is easier to trust" – the material (wood) and trust were extracted for analysis. The detailed coding framework can be seen in Table 7.

Second, individual safety perception characteristics were grouped based on their commonalities. Third, the groups were clustered together. Finally, the clusters were combined into five overall themes pertaining to passenger perceptions regarding safety actors on board. Furthermore, the reduction process was double-checked by reclassifying all 348 items according to the five themes. The above-described analysis process was adopted to this extent and the results reported in PI; the data were further analysed in PII and PIII. The point of saturation was identified when the new emerging insights were either the same or similar to previous ones. In other words, the environmental characteristics that emerged were considered to be repetitive and thus strengthen the prior findings. This is congruent with the Glaser & Strauss (1967) notion that a sufficient sample is defined with the concept of saturation that is reached at a point where the collection of new data sheds no further light on the investigated issue.

Moreover, the data contained two different data sets, collected on two different ships under different circumstances and among different passengers. Arguably, it would have been reasonable to compare these samples. However, although such comparison could have resulted in interesting outcomes, it was excluded from the study as the main aim was to understand the interaction between people and their safety perception, and how different environmental characteristics are interconnected in the process.

In the second phase, the established actors or environmental characteristics were linked to each other according to the ways in which the connections emerged from interviewee narratives. This was first accomplished by marking all the actors on post-it notes, which were then sorted according to the narratives and supportive observational insights (see Figure 7). Different characteristics were connected according to direct and indirect relationships. For example, a participant wrote: "slippery floors – they should consider the materials a little better!" In this quote, a direct relationship emerged between slippery and floor, whereas the link between slippery and material was considered to be indirect. This sampling provided numerous different combinations of actor-networks, which enabled the identification of the central actors. "Central actor" refers to the actor that was quoted most among the participants and was therefore most often interconnected directly or indirectly to other characteristics. From these central environmental characteristics, the ones connecting the other characteristics the most were selected for further analysis.

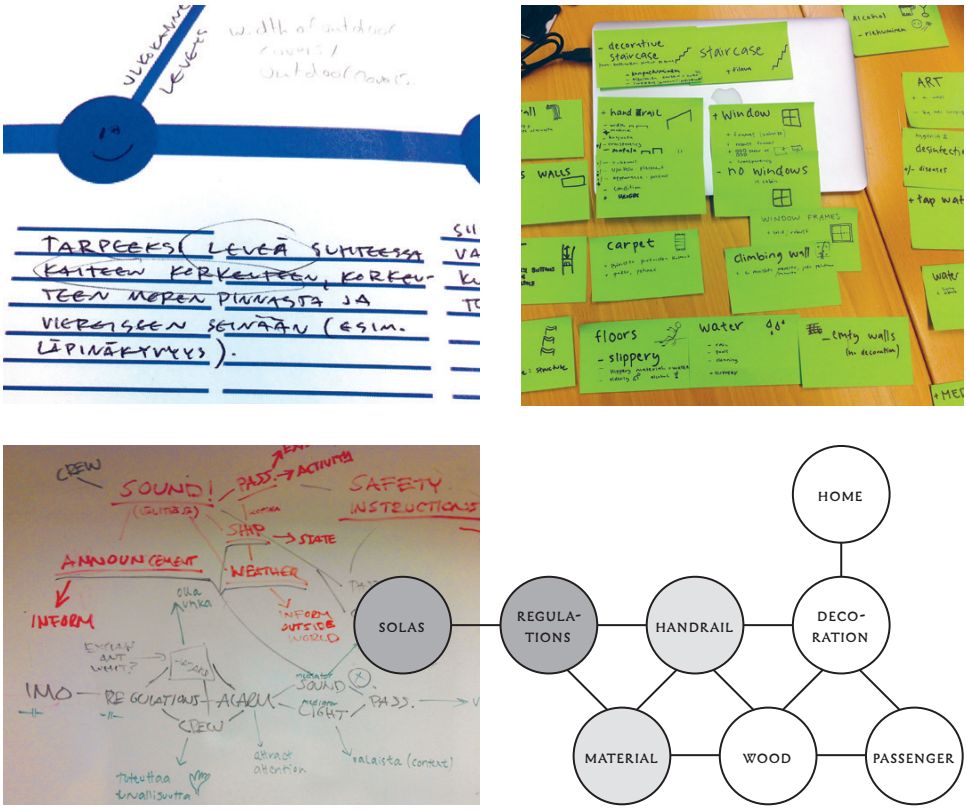


FIGURE 7. Example of the network analysis process through visualization. The upper left corner presents a participant's logbook (see also Figure 5), which is processed into individual environmental characteristics on Post-it notes for better sampling (upper right corner). The bottom left shows the sketching process where the emerging relationships are illustrated as lines between the characteristics. The bottom right presents the final outcome illustration of the network analysis (see also Figures 8 and 22–25).

Salience was reached when the participants frequently mentioned a certain individual environmental characteristic and connected other environmental characteristics to it. Moreover, network visualizations focused on the most salient characteristics, and therefore individually mentioned environmental characteristics were excluded from the network analysis. The individual characteristics that were interconnected the most with other characteristics were considered important nodes of the networks and this connectivity was illustrated for the analysis.

As the most central environmental characteristics and their most quoted interconnections were established, the analysis process was moved to a white board for better illustration of the connectivity (see Figure 7). From these white board illustrations, the final networks were visualized simply by drawing lines between

the identified characteristics (see Figure 8 and Figures 22–25). Visualizing networks in this way provides a solid explanation of their interrelatedness (Tufte & Weise Moeller, 1997) and enables highlighting the characteristics that are active nodes in a network. Furthermore, the visualization approach supports the descriptive rather than explanatory nature of ANT (Latour, 2005). Indeed, Latour outlines scientific visualizations (inscription) as the explanatory principle underlying the modern scientific culture that allows displacement, flattening, scaling, reproducibility, recombinability, superimposition, and textualization of inscriptions, without disturbing their reference to reality (Latour, 1986).

The above analysis process was the basis for PI and PIII. While PII described the context of cruise ships, PIII explored whether similar characteristics exist in passenger ship safety regulations and in passenger perceptions of safety. The identified environmental characteristics influencing safety perception were compared with the SOLAS safety regulations and added to the visualizations.
The visualization helps the reader understand how safety results from different assemblages of characteristics from the passenger perspective, and what the relationship of these identified characteristics is with ship safety regulations. Network illustrations usually show one static picture of the network (Figure 8). By following the lines that connect different characteristics, it is possible to see how the characteristics are interconnected. However, the same characteristic can have relationships with several other characteristics in the network and, at the same time, be part of several different networks (Latour, 2005), which is challenging to illustrate. Therefore, the network interpretation can begin from any characteristic in the network, and networks even enable a multidirectional *back-and-forth* interpretation of network structure and relationships. Thus, the location of or distance between individual characteristics in the network illustrations has no specific meaning.

4.4 Survey experiment

The purpose of the survey experiment was to investigate the effect of specific environmental design characteristics on people's safety perception in the passenger ship context. More specifically, the aim was to concentrate on first impressions of safety when encountering a new environment.

Prior literature reveals that openness (e.g. Appleton, 1975/1996; Fisher & Nasar, 1992; Stamps, 2005b, 2013) and guidance (e.g. Arthur & Passini, 1992; Dogu & Erkip, 2000; Emo et al., 2012) are

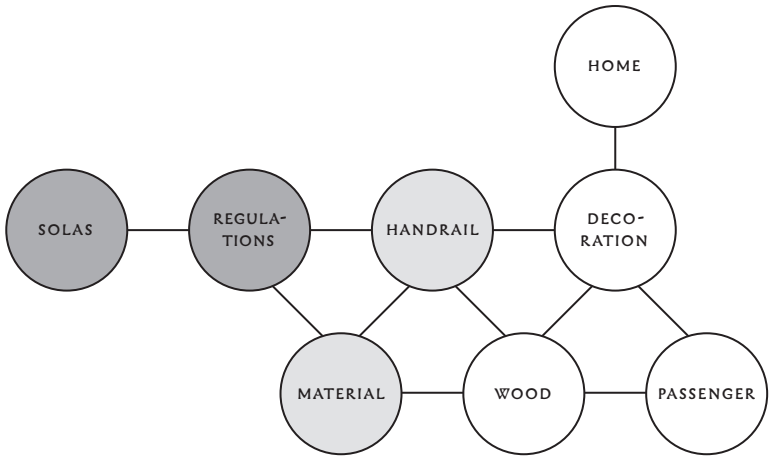


FIGURE 8. Example of the 'merged' actor-network where black circles indicate the regulative perspective, dark grey circles actors that emerge in both perspectives and light grey circles the actors emerging from the passenger's perspective (adopted from the PIII).

environmental characteristics that have a strong impact on safety perception. Therefore, this study investigated how passenger ship corridor design alternatives dealing with openness and guidance influence safety perception and comfort.

The passenger ship corridor was selected for the test environment because, according to the interviews, passengers dislike narrow corridors with low ceilings, which do not provide guidance. Corridors occupy a significant portion of the average cruise ship space and therefore represent a typical cruising environment. For example, on the *Freedom of the Seas*, the accommodation corridors cover approximately 24% of the total accommodation area (Royal Caribbean International, 2014).

The experiment consisted of a set of manipulated accommodation area corridor visualizations produced with *Google SketchUp*, *Maxwell Render* and *Photoshop* software. The visualization angle, lighting and colour balance were kept standard and only selected environmental characteristics were manipulated. Pictorial presentation of the stimuli was chosen because it provides a sufficient indication of the ways in which people perceive the environment when encountering it for the first time, if compared to a virtual environment (Stamps, 2012), which was considered to be the alternative. Furthermore, pictorial presentation has been applied in recent research on individuals' preferences and safety perceptions (e.g. Stamps 2007, 2012, 2013; Van Oel & Van den Berkhof, 2013).

Ship corridors were manipulated in terms of openness and guidance according to the classification of Sagun et al. (2014), which addresses the characteristics involved in the human-environment interaction process. Among the identified characteristics, the experiment focused on the following physical characteristics that are the easiest to control by the designer: 1) circulation; 2) dimensioning; 3) shape and geometry; 4) finishing materials; and 5) accessories (see Table 5). *Circulation* refers to the architectural system of how different spaces are interlinked (Davies & Jokiniemi, 2008). This was manipulated in the experiment by placing an outside view at the end of the corridor. *Shape and geometry* stands for the three-dimensionality of the space and was manipulated in terms of alternative corridor ceiling designs. *Finishing materials* refers to the materials used to provide the final touch for the interior design and define the surfaces of the environment, which were manipulated in terms of cabin doors in the experiment. *Accessories* means the *scattered* objects in the environment, such as art pieces, plants, and furniture. These are part of the architectural information of the environment and help people understand what the setting contains and how it is organized (Dogu & Erkip, 2000). A detailed description of the experiment design and selection of the manipulated environmental characteristics can be found in PIV.

In the experiment five environmental characteristics were manipulated (3×3×2×2×2 design) on three levels with curved, split-level, and coffered design changes, and adding an outside view and landmarks and by using reflective materials. Full-factorial experimental design would require 72 stimuli. To reduce their number to 20 an orthogonal array design was applied with the statistical software program *SPSS 22.0*. The different levels are introduced in Table 5 and a detailed description of the profile picture design can be found in PIV.

The research was conducted applying the consumer panel of the Technical University of Delft, covering over 1 700 Dutch households. The questionnaire was sent to 220 households, of which 97 returned their questionnaire (response rate = 44%, and 49% males, mean age = 48.8, SD 14.1). Most of the participants had no cruising experience. They considered the feeling of safety extremely important and represented both visual and verbal processing styles. The background information was collected for covariates for the experiment.

The participants received a letter with a purpose statement, detailed introduction, questionnaire, 20 printed experiment pictures of hypothetical cabin corridors (see Figure 9), and scoring form

ENVIRONMENTAL DESIGN CHARACTERISTICS	DESIGN AIM	LEVEL 1	LEVEL 2	LEVEL 3
1. Circulation	Guidance / Openness	No view to the outside	View to the outside	-
2. Dimensioning	Openness	Flat ceiling	Curved ceiling	Coffered ceiling
3. Shape & geometry	Guidance / Openness	Straight walls	Curved walls	Split-level walls
4. Finishing materials	Openness	Matt doors	Reflective doors	-
5. Accessories	Guidance	No landmark	Landmark in the shape of a wall clock	-

TABLE 5. Factors and information about their levels.

with a three-point scale (1=low, 2=medium, 3=high). They were asked to score and group the profile pictures three times, resulting in two three-point scores given to each profile picture (see a detailed explanation of the scoring process from PIV). The given scores were recorded into a nine-point safety perception score, where a higher score suggested that the environment was perceived to be safer. Results were analysed with a linear mixed model ANOVA in SPSS 22.0. A detailed description of the experiment design and procedure is provided in PIV.

FIGURE 9. Examples of the corridor visualizations used in the experiment. Visualization A (Profile 13) presents the corridor with a flat ceiling, split-level walls, matt doors, and without a view to the outside. B (Profile 7) presents the corridor with a view to the outside, curved ceiling, straight walls, and reflective doors. C (Profile 11) presents the corridor with a coffered ceiling, straight walls, reflective doors, a clock as landmark, and without a view to the outside. D. (Profile 6) presents the corridor with a coffered ceiling, curved walls, matt doors, and a view to the outside (adopted from PIV).

5
Empirical context – cruise ship environment

5
Empirical context – cruise ship environment

This chapter reviews my personal experiences of cruising and familiarization with the empirical context, and highlights observational notes on my personal and fellow passengers' safety perceptions. Observation in an authentic context is important, as people's perception varies according to their prevailing level of experience and biases their perception regarding its context (Bokharaei & Nasar, 2016). Furthermore, cruise ships and cruise operators are briefly introduced to deepen understanding of the cruise ship environment. The technical details of the observed ships are introduced in Table 6.

5.1 Four-night cruise in the Baltic Sea

My first experience with cruise ships and cruising dates back to August 2009, when I went on an observational cruise. This was before my dissertation research journey, and thus safety was not in the focus of my observations. However, the cruise provided the first insights into cruising experience and was therefore significant for the preparation of the research conducted in the following cruises.

The aim of the four-night expedition was to measure space usage and people flow aboard the *Vision of the Seas* cruise ship (Figure 10). Data were collected for the research project in collaboration between Aalto University and Turku shipyard. A research group of five members (four from Aalto University and one from the shipyard) participated in the cruise. All the participants shared the same research objective of observing and measuring the space utilization of the ship and familiarizing themselves with the cruising experience. Although space utilization measurements are indirectly linked to the research objective, they provide supportive understanding of living on board and people flow. The *Vision of the Seas* was chosen because of the reference size, typicality of the ship amenities, and appropriate sailing route and cruise length for the research aim and participant schedules.

M/S (Motor Ship) Vision of the Seas was built in France and it is the last of the *Vision* class cruise ship series built between 1995–1998. The series consists of three pairs of ships that share a layout and basic designs but differ in size and detail design (ibid.). Typical of the *Vision* class cruise ships is the substantial use of glass in roofs, skylights and walls for unrestricted outdoor views (see Figure 10). Furthermore, their design is based on a centreline promenade[3], 11 passenger decks,

3 A promenade refers to the central atrium, which runs along the centerline of the superstructure of many modern cruise ships.

SHIP NAME	TOTAL NIGHTS SPENT	MAIN RESEARCH METHOD	OPERATOR	YEAR BUILT	LENGTH	PASS. DECKS	TONNAGE	PASSENGER CAPACITY	PASSENGER / CREW RATIO	SPACE RATIO
MSC Sinfonia	7	Interviews/ Observation	MSC Cruises	2002	251 M	9	58 625 GT	1566	2, 06	37, 42
Vision of the Seas	18	Interviews/ Observation	Royal Caribbean International	1998	279 M	11	78 717 GT	2435	3, 69	32, 23
Voyager of the Seas	6	Observation	Royal Caribbean International	1999	311 M	14	137 276 GT	3114	2, 65	44, 32
Navigator of the Seas	7	Observation	Royal Caribbean International	2002	311 M	14	139 570 GT	3114	2, 06	44, 32

TABLE 6. Selected details of the visited ships (Cruise Mapper, 2016a; 2016c; 2016d; 2016e).

and two outdoor swimming pools, one of which can be covered. More technical details of the ship are presented in Table 6.

The ship operator Royal Caribbean International Cruises Ltd. (RCL) is the world's second-largest cruise company after Carnival Cruise Lines with a total revenue of USD 8,073,855 in 2014 and a total of 43 operated ships under five brands (Royal Caribbean International, Celebrity Cruises, Pullmantur, Azamara Club Cruises, and CDF Croisières de France). Furthermore, the company owns 50% of TUI Cruises, a cruising brand targeted at German consumers. (Royal Caribbean Cruises, 2015).

The *Vision of the Seas* is one of the 22 cruise ships operated in 140 countries under the largest brand of Royal Caribbean Cruises – Royal Caribbean International. The brand is positioned at the upper end of the contemporary cruise vacation industry. (Royal Caribbean Cruises, 2015). In practice this means casual ambience, gourmet dining, a great number of activities and entertainment, and seven-night or shorter cruises for couples and families travelling with children. The strategy of Royal Caribbean International is to attract an array of vacationing guests by "providing a wide variety of itineraries and cruise lengths with

FIGURE 10. *M/S Vision of the Seas*, which was explored the most in the thesis.

FIGURE 11. Passengers assembling at their assigned muster stations during a safety drill on a cruise ship.

multiple innovative options for on-board dining, entertainment and other on-board activities" (Royal Caribbean Cruises, 2015, p. 14). They are well known for their constant development of *first-at-seas* unique features (e.g. rock climbing wall, surf simulator, ice skating, robotic bartender, and simulated sky diving). Furthermore, the company has built many state-of-the-art cruise ship structures and the biggest cruise ship ever built – the *Allure of the Seas*.

Our cruise departed from Sweden and visited in Norway and Denmark. The cruise was targeted to court Scandinavian markets, where people more familiar with cruising on ferries between Finland, Sweden, and Estonia were offered a Caribbean cruise experience in their own region. Since then, cruises in the Baltic Sea have been offered regularly. I stepped on board with the typical expectations, such as presence of lifeboats, life vests, handrails and different caution signs, formed during my previous trips on cruise ferries. From the beginning, it became clear that the service level is higher and more personal than on ferries. For example, we were personally guided to our cabins from the lobby and the crew carried our luggage to the cabin. Significantly more crewmembers serve passengers on cruise ships than on cruise ferries. The passenger crew ratio on the Vision of the Seas is 3.69 passengers per crew member (Cruise Mapper, 2016a), whereas on cruise ferries, it may be even three times higher. The overall design of the interior met my expectations for traditional cruising with wall-to-wall carpets, brass details, and an abundance of mirrors and rich colours.

The first real event was participation in a muster drill, in which all the passengers practice assembling at the muster stations (see Figure 11). The safety drill takes place after embarking and is compulsory for all cruise ships sailing in international waters. We followed the cruise programme and acted as ordinary passengers, in this case mainly Scandinavians, except that our research group spread around the ship to estimate how certain spaces are used during different days and times of the day. A surprise emerged from the analysis of space utilization: space was used poorly in the sense that the majority of passengers followed the cruise programme and therefore gathered in the same places at the same times. For example, they occupied the sun deck in the morning (Figure 12) and the theatre and dining hall in the evening, and therefore most of the ship remained unused and empty all the time.

5.2 Six-night cruise in the Adriatic Sea

My second cruise took place in July 2011. The ship departed from Italy and also visited Slovenia and Croatia. The research group chose

this particular route and ship based on our interest in exploring a typical Mediterranean cruise and a contemporary cruise ship. In addition to the author, the research group had three members from Aalto University, who were all making empirical studies of cruising phenomena for their Master's theses in the fields of architecture, marine engineering, and economics. This section concentrates on the relevant findings for the recent research; a detailed cruise report is available as an online document (Ahola et al., 2011b). The concrete research activities were planned according to the author's earlier experience of the context and mainly concentrated on observation of the cruise ship as an architectural space, the nature of cruising culture formation in general, and interviews with the management about the cruising business.

The *Voyager of the Seas* (see Figure 13) is the first *Voyager*–class ship built for Royal Caribbean International after the *Vision* ship class (see previous chapter). At the time the ship was launched (1999) it was the biggest cruise ship in the world. The *Voyager* class consists of five post-panamax[4] cruise ships (*Voyager*, *Adventure*, *Explorer*, *Navigator* and *Mariner*) built between 1999 – 2003 in Finland. (Cruise Mapper, 2016c) The sister ships are alike and their design is characterized by many revolutionary details typical of that era. For example: a 110-metre long and four-deck high central promenade, a basketball court, at least three pools, a mini-golf course, a rock wall, an inline skating track, and the first ice skating ring and rock-climbing wall built on a ship. More technical details of the ship are presented in Table 6.

This summary of the observational cruise focuses on describing cruise ships as a physical context. Physically the cruise begins upon passenger arrival at the terminal. As the first touchpoint, the terminal has a significant effect on the overall experience. Therefore, it was surprising to find that, in a port as popular as Venice, passengers had to check in at a temporary structure that looked like something you would find on a construction site (see Figure 14). This aroused unpleasant reactions among the passengers, as they were expecting more luxurious settings, and this caused them to wonder if everything would be as promised on the cruise. Furthermore, the passengers were concerned about their safety in the temporary and high passageways. The temporary structure had been erected because cruising is a relatively young vacation type in Europe, due to which terminals are under constant development (Soriani et al., 2009).

4 Post-panamax refers to ships larger than the Panama Canal, where the size limit for ships is 32.31 metres in width and 289.56 metres in length.

FIGURE 12. Crowded sun deck of the *Vision of the Seas*.

FIGURE 13. *M/S Voyager of the Sea* at the Tunis coast.

FIGURE 14. Temporary terminal structure in the port of Venice.

FIGURE 15. Key card showing information, such as emergency gathering place, loyalty member level, seating place in dining room, participation in activities (wall-climbing, skating), and some personal information.

FIGURE 16. The three-deck high main dining room of the *Voyager of the Seas* has a seating capacity of 839 people (Cruise Mapper, 2016c).

Upon check-in, passengers are handed key cards, which are central for most of the activities on board. In addition to working as a key card to open your cabin door, it is a payment instrument and a safety device (as it states the personal muster station where to assemble in an emergency), and provides information about fee-charging services and achievements from events (Figure 15). After boarding, the first impression was of relatively traditional design, and aging could be detected, for example, from the condition of the safety appliances, materials and lighting in general. The *Voyager of the Seas* was refurbished[5] in 2014. Also the generally dim impression and lack of natural light (Figure 16) was evident in comparison to the *Vision of the Seas*, which represents older design. In general, the ship was easy to navigate because the promenade connected the different spaces well. As these spaces were located around the promenade, this provided great overall visibility around the ship. After six nights on board, it can be concluded that such a short time period is not enough for experiencing all of the facilities on this massive ship.

The crew-passenger ratio felt less personal than on the *Vision of the Seas*, which may be due to the larger size of the ship (see Table 6). It is argued that a "space ratio less than 33 means that you may find the ship crowded in areas and a space ratio greater than 39 means (44, 32 in *Voyager of the Seas*) that there should be plenty of space for each passenger" (Cruise Deck Plans, 2016). Furthermore, the massive amount of personnel on board guaranteed that all the spaces were perfectly maintained and clean.

During the cruise it became evident that safety has a central role in passengers' cruise experience and has a great influence on cruise ship design. Informal discussions with the passengers confirmed this observation, as they often referred to the unique characteristics of the context, such as lifeboats and muster drill. For this reason, the research focus was shifted towards passengers' safety perceptions as this was considered to be an essential aspect of the cruise experience.

5.3 Fourteen-night transatlantic cruise

The cruise took place on the *Vision of the Seas*, the same RCL ship that is described in more detail in Chapter 5.1 and in Table 6. Between my last visit in 2009 and this cruise in 2011, no significant changes had been made in the ship. However, this cruise was different from the previous for three main reasons. First, the cruise was significantly longer,

5 Cruise ship refurbishing describes the process in which a ship undergoes major modifications, with enhancements such as new carpets, upholstery, furniture, and linens aiming to revamp the vessel (Champion, Ahola & Kujala, 2015).

FIGURE 17. Aalto on Waves participants.

lasting 14 nights, and included more sea days than average cruises. The ship embarked in November 2011 from Lisbon, Portugal, visited Spain and arrived in Brazil in December. Second, transatlantic cruises usually take place only when ships are transported between different market areas, such as from Europe to Brazil in this case. Third, the passenger community was different because the duration of the voyage was longer than in typical cruises outside holiday seasons, which screens out potential passengers. Most pertinently, on this cruise, the passenger material was highly atypical, as 110 people affiliated with Aalto University participated in the cruise in the *Aalto on Waves* project (AoW). Aalto on Waves was a student-driven innovation project in which an Aalto University community travelled from Finland to Brazil by ship. The project aim was to offer an atypical learning environment for students to participate in lectures and address real-world problems in workshops in an inspiring and creative atmosphere. (Guseynova, 2012) This atypical passenger community is discussed in more detail in Section 5.2.2.

The practical research activities during the cruise included situated interviews and participatory observation of the fellow passengers' safety perception. The research approach was planned according to experiences from earlier cruises. The results of the research are introduced and discussed in Papers I, II and III, and therefore this section concentrates on briefly describing the observed unique characteristics of the cruise ship environment.

Most of the AoW participants (See Figure 17) travelled as a group to the departure port, where they stayed for a few days, which enabled the author to engage in numerous informal conversations with the

first-time cruisers about their expectations regarding the cruise and related safety issues. I also participated in the cruise in the role of lecturer, thanks to which I had great possibilities to recruit participants for my user studies. Furthermore, travelling as a group provided an exceptional opportunity to observe a group's safety perceptions before, during, and after the cruise, as the observed people were easy to contact for further discussion. Moreover, familiarity with the group's background enabled making a comparison of their behaviour with the other passengers.

All the activities on board are highly related on the cruise programme. The cruise programme offered numerous activities for every taste and age group, keeping the passengers busy at almost all times. On such cruises, the short distances between the venues enable passengers to participate in a large number of activities. This becomes evident especially on sea days when most activities, such as competitions, barbeques and shows, take place on the sun deck, attracting most of the passengers (see Figure 18). Weather has a great influence on enabling and limiting these activities and it was notable how often people discuss and monitor the weather on board. On this cruise, passengers discussed it particularly in terms of getting prepared for bad weather (storm) that could negatively affect their feelings of safety and comfort.

While on a cruise, passengers also want to look good, wear clothing suitable for each activity and situation, and change their clothes many times during the day. Passengers also monitor each other and the crew all the time. Monitoring includes predicting the weather outside, positions of crewmembers and possible activities on board. Active monitoring may be explained by the fact that during the first days, people are unsure of how to act and want to see what other people do and wear in certain situations.

Significant differences in social groups can be seen at different times of day. During the daytime, passengers usually spend time within their travelling group and in the evening they are keen to interact with larger groups.

5.4 Seven-night cruise in the West Mediterranean

My fourth observational field trip in the West Mediterranean took place between August and September 2012. In addition to the author, the research group consisted of three research assistants from Aalto University who were conducting research on ship safety and different user research methodologies. The selection of the cruise ship aimed at a typical European cruise, cruise ship, and customer base on board to

FIGURE 18. Live music and dancing competition on the sun deck during the sea day.

serve two purposes: the author aimed to extend the data collection from previous cruises with insights from the cruise with a different operator and two members of the research group were unfamiliar with cruising. The general aim of the observational cruise was to obtain first-hand knowledge and understanding about the cruise ship and cruising. The *Sinfonia* (see Figure 19) was built in France in 2002 for Festival Cruises and the Italy-based MSC Cruises bought it in 2004 when Festival Cruises went bankrupt. The *Sinfonia* (former *European Stars*) was significantly refurbished by MSC. More technical details of the ship are presented in Table 6.

According to the general design aims of the *MSC Sinfonia*, it aims to deliver luxury at an affordable price with an Italian ambience that includes an abundance of refined timber details and great fine art (Cruise Mapper, 2016d). The Mediterranean-based company draws inspiration from its roots and delivers the Mediterranean way of life for its passengers through good food, hospitality, and state-of-the-art design in cruising. The design emphasis focuses, in particular, on spa and wellness services and suites. MSC states that their fleet is ultra-modern thanks to ongoing *Renaissance programme*, in which basically the whole fleet has been refurbished to meet the contemporary design, service, and environmental standards (MSC, 2016). The company is the world's fourth-largest shipping company (Cruise Mapper,

FIGURE 19. *MSC Sinfonia.*

2016d) and the market-leading cruise company in the year 2013 in the Mediterranean, South Africa, and Brazil with a fleet of 12 cruise ships. (MSC, 2016).

In this summary of the observational cruise, I concentrate on the practical research work conducted on board. A more detailed description of the on board experiences and applied research methodologies can be found in Ahola et al. (2012). The research objective for all the research group members was related to ship safety, and thus much research was conducted in collaboration. The research adopted situated interviews, informal chats, and participatory observation research methodologies. We also used daily debriefs to share and pre-analyse our findings while personal diaries helped capture experiences and any arising questions. The observaations were carefully documented by means of camera, video, audio and occasional sketching.

During the cruise, interviews and short informal discussions were conducted with both passengers and staff. The passengers for the interviews were mainly recruited in a well-validated manner by first having an informal discussion and later asking about their willingness to participate in a more detailed interview. The ship employees were approached beforehand and, interestingly, they were keener to participate than crew on other cruises, possibly due to the company policy. Many interviews were conducted with the entire research group present, listening and making notes, and with an option to conduct

another more in-depth interview. Altogether, the researchers had at least brief chats with over twenty passengers. In addition, a number of crewmembers were interviewed to gain an employee perspective.

Observation of the environmental characteristics and people on board was continuous and focused on safety-related issues. The aim was to study different locations at different times during the day and acquire insights into if and how people's behaviours evolved throughout the week. The observations focused on complementing the findings from the interviews, as it was noted in the cruise report (Ahola et al., 2012, p. 11) that "many fear and comfort related experiences are difficult to put into words, especially towards relative strangers". Sometimes the best insights from the participants were gained after the formal interview, when meeting again on the ship. It is assumed that this stemmed from the abstract objective of the interviews and open-ended concentration on anything that might influence passengers' perceived safety. Thus, the participants often needed some time to think about the research objective and then afterwards wanted to add something. The findings were documented with images, plus video or audio when possible, and often shared during debriefs.

5.5 Seven-night cruise in the Eastern Mediterranean

On this cruise, we sailed with the *Navigator of the Seas*, which is a sister ship of the *Voyager of the Seas* (see Chapter 5.2) and was the largest ship of the *Voyager* class (Figure 20). However, the technical details of the cruise ship differ depending on the source because of the regularity of refurbishments that induce changes in passenger capacity, Gross Tonnage (GT)[6] and sometimes even in length. More technical details of the ship are presented in Table 6.

The cruise took place in May 2013 and sailed between port cities in Italy, Greece and Turkey. This route and the cruise ship were selected based on the research group's interest. In addition to the author, the research group consisted of three assistant researchers from Aalto University, who were collecting empirical data for their Master's theses with research objectives related to cruise ship modularization, servicescape innovation management, and way-finding design. The research methods developed and applied in earlier cruises were also adopted on this cruise. Further, my personal research agenda consisted

6 Gross Tonnage (GT) refers to the overall internal volume of the ship. GT is calculated based on "the moulded volume of all enclosed spaces of the ship" and is used to determine things such as a ship's manning regulations, safety rules, registration fees, and port dues (Lamb, 2003).

FIGURE 20. *Navigator of the Seas* (on the right) at the port of Kuþadası, Aydın, Turkey.

of verifying earlier findings about safety perception with observation and informal chatting with the other passengers. The complete cruise report (Ahola et al. 2013) is available as an online document.

Similarly to previous cruises, the passengers were excited about the safety drill that must be conducted within 24 hours from departure. The passengers were informed about the time and procedure of the safety drill through announcements and 2 800 passengers were efficiently assembled according to their cabin locations at the emergency meeting locations on outside decks.

Similarly to its sister ship the *Voyager of the Seas*, the ship was spacious and although there were almost 4 000 (2 800 passengers + 1 080 crew members) persons on board, it never felt crowded. Apparently, the most central space is the 120-metre central promenade that is four decks high. The promenade replicates the shopping street of a city with boutiques, bars, and even a classic on display. Although the promenade imitates a shopping street in a somewhat caricatured manner, it is one of the cosiest spaces on cruise ships. Personally, I believe this owes to the cosy features such as street lights, windows of the inside cabins, and roof lighting that imitates daylight that changes according to the daily rhythm (see Figure 21).

The crew on board is multicultural and the dining room alone has 250 employees of 42 nationalities. The crew works in a remarkably organized and efficient manner. However, sometimes the research group wondered whether the large amount of crew was necessary. Finally, the crew's attitude, behaviour, and hospitality in every service constitute the key factors that set a cruise apart from land-based resorts.

During the cruise, I noticed that I had developed routines on board. I always ate breakfast in the buffet, exercised, observed and edited previous notes and had lunch on the sun deck, read or wrote, and tried to schedule the interviews for the afternoon, had dinner in the dining hall, and enjoyed the shows in the evening. Although, apart from work, this is a typical programme for a cruiser, it is notable how one begins to follow routines after only a few days on a cruise even when the ship offers multiple choices.

FIGURE 21. Promenade of the *Navigator of the Seas*

6
Results – original features

6
Results – original features

6.1 Human safety perception characteristics in the cruise ship environment

The first publication (PI) found that people perceive their safety through five general themes of environmental characteristics: *passenger ship environment*, *life-saving appliances*, *communication between the ship and perceiver*, *emotions*, and *ship community*. The detailed coding framework is introduced in Table 7. These five themes are congruent with prior research, suggesting that under the safety domain, people interact with their environment through *dimensioning*, *shape and geometry*, and *communication* (Sagun et al., 2014), even though it is impossible for people to develop an idea or perform any action without engaging, at least unconsciously, with their *emotional system* (Picard, 2003).

The participants listed characteristics of the *passenger ship environment* impacting their safety perception. Safety was perceived mainly in terms of openness and transparency, which are also related to the amount of light in the ship interior. Spaces that span through several decks, such as the promenade, were considered safer than narrow accommodation corridors with low ceilings. Also, a view to the outside increased the positive safety perception. In general, the large size of the ship elicits trust and therefore positively affects the safety perception. In contrast, narrow spaces were reported to have a negative effect on safety perceptions. In particular, spaces such as staircases, corridors and elevators were perceived to have too limited a space for sufficient handling of crowds in an emergency situation. The linkage between the spaces was considered important. The notion of *clear space* was used often, meaning that the safety perception was positive if the participants were able to easily interpret where the space led to or if they could move from one space to another.

Among the details of the ship environment, handrails were the factor that the respondents referred to most often. They assessed handrails mainly from the perspective of appearance, that is, whether the construction and used materials seemed to be strong enough to be able to support the participants.

Life-saving appliances were also referred to. The term broadly covers all the directly safety-related equipment on board. Lifeboats were addressed mostly in terms of presence and means of escape. Similarly, surveillance equipment, including cameras and supervision of the passengers, triggered mainly positive safety perceptions. Passengers were concerned about the locations of alarm bells and lights as well as their ability to hear and see the alarms. In general, the life-saving appliances were expected to be

highly visible on board and abundant. The participants talked about these appliances especially in the context of the safety drill. Moreover, the drill itself affected passengers' safety feeling in a positive way: it promoted the feeling that safety is seriously taken into account. Furthermore, the fact that the crew needs to practice evacuation procedures regularly and that this is also visible for the passengers elicited trust that the crew carefully maintains the ship and its equipment.

Communication between the ship and perceiver was perceived especially through sounds in different situations. Safety instructions provided on a variety of signs were considered to have a positive effect on safety perceptions. Space awareness was placed under the communication theme, as informants used environmental information as guidance in navigation and to understand the meaning of the space. This result was supported in PIV where it was found that clear architectural lines support passengers' orientation.

Although other categories are directly linked to ship design, *emotions* emerged as a coherent theme that is highly linked with other groups of characteristics. Among emotions, trust had the strongest link to safety perception. The participants reported that trust was created by the motions of the ship and by its condition, and constant maintenance increased this affect. The only identified evident issue causing fear was the weather and the participants reported that the impact of the weather on the ship caused discomfort. To overcome this negative safety perception, they reported that more information about the weather and ship size could help.

The *ship community* theme deals with passengers and crew. The appearance of the crew (mainly their uniforms and professional attitude), their competent behaviour and training had a positive impact on safety perceptions. The participants reported being surprised by how well the crewmembers were able to communicate in different languages, and commented that communication between the passengers and crew impacts safety perception. The presence of other passengers increases the feeling of safety, and sounds from other people increased it even further. This became evident through the insight that the key card was a central environmental characteristic while observing, but it was not highlighted in the interview analysis. Similarly, the safety drill was highlighted during the early observations on board, but received only average attention from the informants. One reason for this could be that many interviews were done during the final phase of the cruise. Furthermore, the interviewees highlighted many individual broken

THEME	QUOTES	CLUSTER	QUOTES	GROUP	QUOTES
Passenger ship environment	94	Architecture	50	Ship's appearance	14
				Openness of the space	14
				Amount of light	13
				Staircase	9
		Ship decoration	44	Handrails	25
				Decor	8
				Materials	6
				Slippery flooring	5
Life-saving appliances	85	Specific life-saving appliances	53	Lifeboat	16
				Life-saving appliances	11
				Surveillance	10
				Safety drill	9
				Alarm	7
		Characteristics of the life-saving appliances	32	Number of life-saving appliances	14
				Visibility of the life-saving appliances	10
				Appearance of the life-saving appliances	8
Communication between ship and perceiver	51	Received information	27	Safety instructions	12
				Sound	11
				Announcement	4
		Navigation on the ship	24	Space awareness	14
				Navigation	10
Emotion	43	Emotion	43	Trust	12
				Privacy	9
				Fear	8
				Security	7
				Cleanliness	7
Ship community	41	Ship community	41	Crew expertise	14
				Passenger community	9
				Crew presence	8
				Service	5
				People flow	5
Total 5	314	8	314	31	314

TABLE 7. Coding framework following the one presented in PI. The framework terms were updated in terms of clarity for the research entity as follows: Ship's essence – Ship's appearance, Genuine materials – Materials, Emergency drill – Safety drill, Substance of the life-saving appliances – Appearance of the life-saving appliances and Perceiving space – Space awareness.

details they had observed on board, such as broken elevator buttons, as characteristics that inconvenience passengers, but these appear only indirectly in the coding as maintenance.

The bottom-up analysis process of identified environmental characteristics having an impact on perceived safety resulted in 31 groups, which included a total of 314 different characteristics (Table 7). The most salient, which were repeated across the clustered group characteristics, were:

1. Perception of **trust in the ship's emergency handling capability** through the visibility and appearance of life-saving appliances, competent crew, and well-maintained equipment.
2. **Openness and transparency of the spaces** both vertically and horizontally, which helps in way-finding, enhances visibility, and provides escape routes.
3. **Communication creating situational awareness** through environmental characteristics, such as sounds, signage and architectural elements.

6.2 The connectivity of perceived human and non-human environmental characteristics on cruise ships

People perceive safety in the cruise ship environment through multiple characteristics. Publications PII and PIII explored how perception is triggered through the network of interconnected environmental characteristics. In this process, the Actor-Network Theory was adopted as a background framework. Network illustrations were constructed around the most salient environmental characteristics that were highly connected with other characteristics, which together influenced the interviewees' safety perception.

Network analysis allowed identifying the processes underlying people's safety perception and revealing the interaction between human beings and environmental stimuli. The network analyses in PII and PIII yielded three kinds of insights:

1. Connected human and non-human environmental characteristics impact on passengers' safety perception.
2. The same environmental characteristics appear in passengers' safety perceptions and in ship safety regulations, but their perspectives often differ.
3. The uniqueness of cruising is created by a particular kind of composition of environmental characteristics.

These insights are discussed in more detail in PII and PIII. This chapter presents the most prominent examples of environmental characteristics networks. Figure 22 shows how connected human and non-human environmental characteristics impact on passengers' safety perception. Handrails emerged as the most frequently mentioned individual environmental characteristic in the interviewees' safety perceptions and connected different environmental characteristics. Handrails are perceived in terms of their appearance and placement: placement has a positive impact on safety perception if the passenger judges that the handrail effectively prevents people from falling and/or feels that the construction or attachment of the handrail is reliable. If a handrail appears to be too low to prevent falling, especially on outside decks, or its attachment seems too weak, this negatively affects passengers' safety perception and comfort. Ship safety regulations also provide advice on the placement, type, material, and attachment of handrails (IMO, 2004). When handrails conform to regulations, passengers are believed to have the capacity to move safely on board under different operating conditions.

Passengers perceived handrails as a customary decorative element of the ship, which distinguishes the environment from other environments. Passengers are familiar with the presence of handrails in safety-critical environments and thus their presence has a positive impact on safety perception. In addition, the application of cosy, decorative elements in the passenger ship environment, such as materials (wood) positively increased safety perception and comfort. The material used for handrails was considered essential. The interviewees indicated that the use of wood has a positive effect on their safety perception, because they were able to identify the material and known that it is reliable material.

Correspondingly, uniforms comprise an important agent in information exchange between the crew and passengers. The uniforms distinguish crew from passengers, and the status of each member of the personnel can be interpreted from the outfit. This aroused mainly emotions of trust, which positively affect safety perception. Figure 23 provides an example of the role of *sound* **in ship safety regulations and how people perceive sound**. As equivalent environmental characteristics exist in both perspectives, it is possible to merge them into one illustration to analyse how the perspectives differ. Sounds and sound-related characteristics comprised one of the most frequently quoted themes when the participants described their perception of safety. SOLAS provides a policy for the sequence

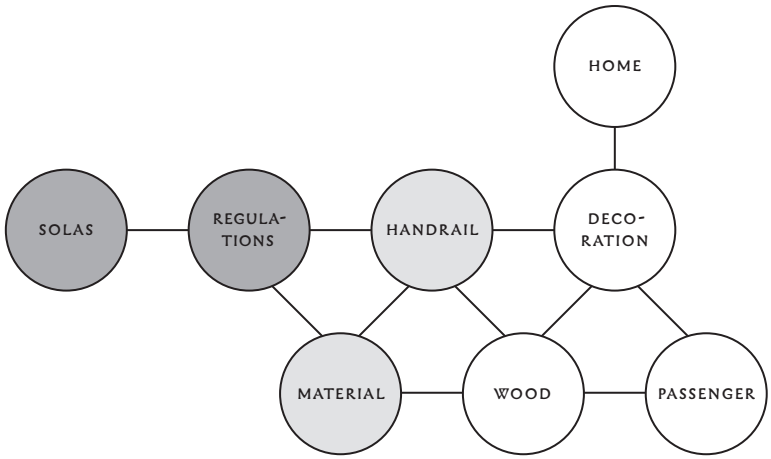


FIGURE 22. The *handrail network*. This illustration shows how the network emerges from the safety regulation perspective when read from left to right, and how the network emerged from the participants' perspective from right to left. Black circles represent characteristics that appear in the safety regulations, dark grey circles represent characteristics that are covered in both perspectives, and light grey circles emerged only in the participants' safety perspective (adopted from PIII).

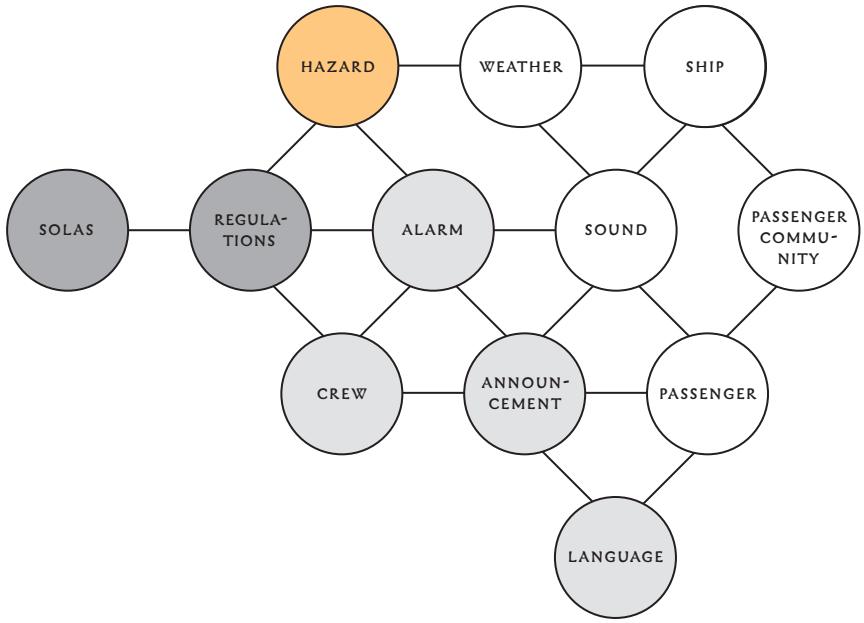


FIGURE 23. The *sound network*. This illustration shows how the network emerges from the safety regulation perspective when read from left to right, and how the network emerged from the participants' perspective from right to left. The black circles represent characteristics that appear in the safety regulations, dark grey circles represent characteristics that are covered in both perspectives, and light grey circles emerged only in the participants' safety perspective. The orange circle indicates a hazard (black box) that alters the network if activated (adopted from PIII).

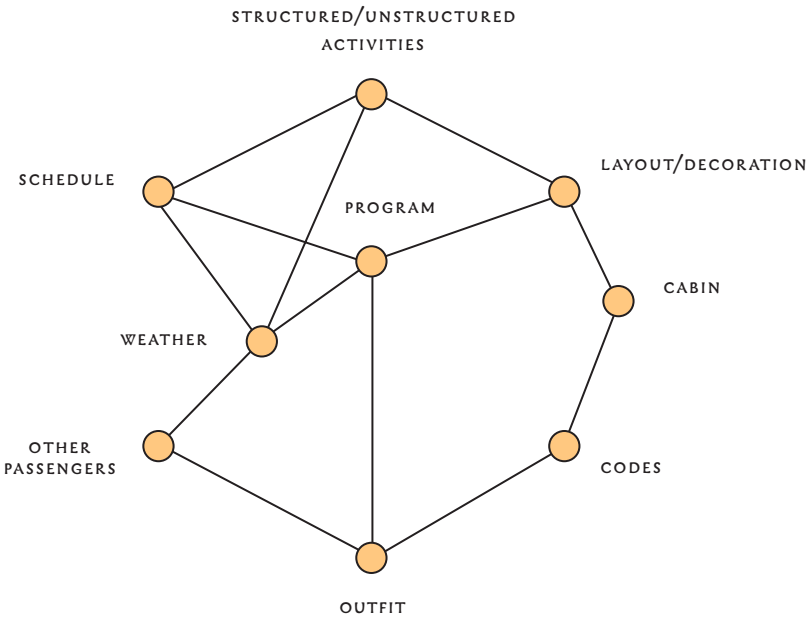


FIGURE 24. The network of everyday distinctions as it emerged from the data (adopted from PII).

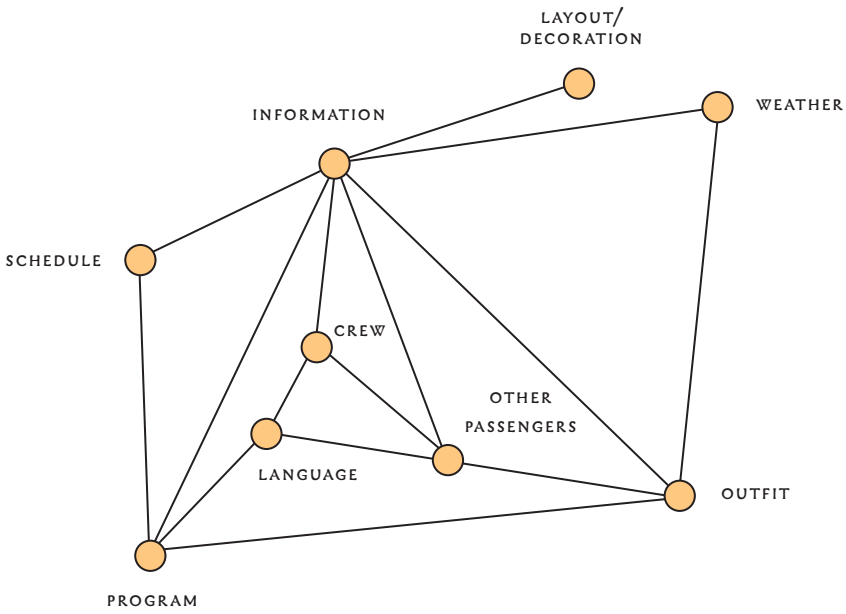


FIGURE 25. The network of predictability as it emerged from the data (adopted from PII).

of events: crew activities under hazardous situations and how the alarm should be given (IMO, 2004). In Figure 23, the hazard itself is a *black box*. When the crew gives the alarm according to safety regulations, passengers become aware of the situation. The language and tone of voice used by the crew are an important characteristic, as one interviewee concludes: "information should be given so you absolutely know what to do in case of emergency." Furthermore, the passengers reported that they carefully listen to other passengers to determine whether they are calm or nervous. The interviewees also mentioned that hearing the hum of voices made them feel safer than total silence.

Environmental characteristics that create the unique context of cruising are captured in the networks of *everyday distinction* (see Figure 24) and *predictability* (see Figure 25). These networks show how environmental characteristics transport different types of information about different design intentions to the perceiver. A cruise ship is seen as an arena for a vacation, whereas a person's mere presence can be seen as a form of participation that takes place mainly through movement, hearing, and watching. However, the cruise experience could never be established without the cruise ship (non-human characteristic) itself; the activities offered in the cruise programme rely strongly on the cruise ship layout. In Figures 24 and 25, these space-related non-human characteristics appear as a layout/decor characteristic. The programme creates a framework for the cruise activity and works as an essential means of communicating about multiple things in the cruise ship environment. Almost all the activities on cruises are scheduled and communicated through the cruise programme. It was revealed that passengers learn plenty of information beforehand and that they are surrounded by information during the cruise. The cruise programme is intended to fulfil people's expectations for the cruise experience.

6.3 The influence of environmental characteristics on people's safety perception

The aforementioned findings inspired the investigation of how the manipulation of environmental characteristics affects people's safety perception; this was researched in PIV. Findings from the publications discussed above were supported with findings from prior research suggesting that the *circulation*, *dimensioning*, *shape and geometry*, *finishing materials*, and *accessories* have an effect on safety perception. These characteristics were modified in order to make a ship accommodation corridor more open or to give it a better feeling of

ENVIRONMENTAL DESIGN CHARACTERISTICS	NUMERATOR *df*	DENOMINATOR *df*	*f*-VALUE	*p*-VALUE
Circulation (view to the outside vs. no view to the outside)	1	582,476	173,086	0.000
Dimensioning (ceiling design)	2	596,033	6,694	0.001
Shape and geometry (wall design)	2	543,943	77,674	0.000
Finishing materials (matt vs. reflective doors)	1	1189,379	2,188	0.139
Accessories (landmark vs. no landmark)	1	758,688	0,972	0.325
Dimensioning * shape and geometry	4	476,066	0,748	0.560

TABLE 8. Results of the linear mixed model ANOVA testing the effects of the environmental design characteristics on people's safety perception.

guidance, and thereby influence safety perceptions. The results from the linear mixed model ANOVA test are presented in Table 8. Ceiling *dimensioning* ($p < 0.01$), wall design *shape and geometry* ($p < 0.001$) and *circulation* in terms of a view to the outside ($p < 0.001$) had a significant impact on safety perception. The finishing materials ($p < 0.139$) or placing a landmark ($p < 0.325$) did not have a significant impact on perceived safety. Furthermore, this was the case with the interaction between dimensioning and *shape and geometry* ($p < 0.560$).

The curved ceiling design was perceived to be safer than the flat and coffered ceiling designs. Although the curved ceiling design had a positive impact, this design did not yield greater safety perceptions than the straight wall design. Participants' safety perceptions were more positive when the walls were straight or curved than with walls with a split-level design. The split-level wall design and, to some extent, the coffered ceiling were perceived to be less safe. A view to the outside had a positive impact on safety perceptions and the participants expected the passenger ship corridor to be safer when there was an outside view at the end of the cabin corridor.

The influence of the background information known to the participants was tested in the analysis as covariates, but their expertise with safety, involvement with safety, visual processing style, and age had no significant influence on the results and were excluded from the analysis.

7
Discussion

7
Discussion

7.1 Contributions to design for safety perception

On cruise ships, people have a limited possibility to control their environment (Campbell et al., 1976). Therefore, they evaluate the safety status of the cruise ship by observing environmental characteristics that appear to them as features they cannot influence. According to Parker et al. (2000), perception of personal safety is positively related to the feeling of being "in control rather than being vulnerable". Therefore, cruise ships differ from many other safety-critical environments where people have more control over their environment (Lajunen & Summala, 1995). Lack of control highlights the importance of the design of environmental characteristics on a cruise ship, as they need to fulfil passenger's safety expectations mainly through their appearance.

Designing a ship environment that elicits positive feelings of safety is a challenging process as, in addition to many conflicting requirements, significant differences exist between people's perceptions and designers' design intentions (Blijlevens, Creusen, & Schoormans, 2009; Hsu, Chuang & Chang's, 2000). Current research supported this conclusion with evidence that equivalent environmental characteristics exist in both people's safety perception and in regulated ship safety design, but the two perspectives conflicted and people perceived their environment in a way different than from what was intended in safety regulations.

Perception is about making sense of one's environment. This understanding is based on earlier knowledge and experiences (e.g. Bloch, 1995; Bokharaei & Nasar, 2016; Crilly et al., 2004; Treisman & Gelade, 1980). People have certain *expectations* for ship safety, which are formed based on earlier knowledge (e.g. safety records, personal experiences), societal impact (e.g. narratives, reputation) and emotions (e.g. feelings of risk involved in travelling on the sea, trust). Safety expectations are evaluated when people interact with the ship environment and *perceive safety*. Safety depends to a great extent on perception (Nilsson et al., 2012; Hinton and Henley, 1993; Schifferstein & Cleiren, 2005). Environmental stimuli highly affect passengers' response (Biot & Lorenzo, 2007; Dolan, 2002; Duckwort et al., 2002; Nawjin et al., 2013) and evaluation of the environment takes place through perception of environmental characteristics (Kim et al., 2004; Vilar et al., 2013; Wilson, 1984). Building on prior research, the present research showed that people on cruise ships perceive safety through several interrelated human and non-human environmental characteristics. These include environmental characteristics (see Table 7), which are familiar to people from their

personal cruise experiences (e.g. Hosany & Witham, 2010; Kwortnik, 2005; Yarnal & Kerstetter, 2005).

Safety perception is linked to comfort and therefore safety needs to be at an acceptable level from passengers' perspective in order to enable them to experience positive feelings (Mischel, 1973; Stafford et al., 2007; Vallacher, 1993). According to the need theories (Herzberg, 1971; Locke, 1976; 2000), safety is a basic human need that needs to be fulfilled to prevent dissatisfaction, and comfort is a motivator that can be used to increase satisfaction. Thus, both needs have to be fulfilled in order to enhance the cruise experience.

Network visualizations showed connections between the environmental characteristics, providing a tool for analysis and design. This conclusion supports the prior research suggesting that all the environmental characteristics can be relevant for people's safety perception and transform the information into cues of meaning and functions from design intentions to the perceiver (Bloch, 1995; Crilly et al., 2004). This also takes place between humans as people use others' behaviours to interpret their internal states or unexpressed motives (Exline, 1963). When environments are regarded as a network of human and non-human characteristics, the underlying structures can be traced (Monat & Gannon, 2015; Norman & Stappers, 2016) and it is possible to see how non-human characteristics, such as handrails, can affect human safety perception. Therefore, in addition to the overall dimensions of large spaces, such as the promenade, the design process should consider the details of environmental characteristics affecting human beings and vice versa.

The network-analysis approach provided relevant insights to be considered in the design process of the cruise ship environment for passengers' safety perception and comfort. Participant's request for openness and transparency in terms of enhanced visibility and escape routes strengthen the prior literature suggesting that the five key principles for the planning and design of safe public spaces are visibility to others, visibility by others, choice and control and solitude without isolation (Luymes & Tamminga, 1995). This enables people to see and predict what is ahead (Bokharaei & Nasar, 2016). Positive safety perception through situational awareness supports people's need to effectively create or reconstruct cognitive maps of the environment for better orientation and navigation in the environment (Zeisel, 2006). The need for perception of trust in a ship's emergency handling capability is considered to be related to the basic human need for safety (Van Rijswijk, Rooks & Haans, 2016). This is in line with Sagun et al.'s (2014) notion that in an emergency people prefer

to move in a direction they perceive to be safe rather than towards a direction that is objectively safe.

Ship safety regulations focus on passengers' objective safety and it became evident that ship safety regulations increase safety perception only indirectly. However, more research is needed to gain a deeper understanding of how the relationship emerges. The results could be applied in the development of the classification societies' comfort classes, which could offer design guidelines for people's safety perception that, among other attributes, improve passenger comfort. However, it is true that the reasoning behind the environmental characteristics that contribute to people's safety perception was kept at a fairly superficial level and more research is needed. Only the direct effects of the environmental design characteristics on people's safety perceptions were tested and more research is needed to also test the indirect effects of the environmental characteristics, such as brightness of the light, associations and consistency of colours, and how places derive affective meaning from the surroundings. It was anticipated that guidance plays a part in the processes of how environmental characteristics influence people's safety perceptions, but this was not fully verified in the study. Thus, the relation between the use of navigational aids and people's spatial strategies in terms of safety should be further investigated.

7.2 Observational remarks

The observed ships were built in the same era, which influences their interior decoration. Moreover, three out of the four ships visited were operated by RCL, which has put much effort into ensuring the consistency of interior decoration on its ships to maintain brand identity. From the design perspective, the general design of the observed ships is similar, whereas a great difference lies in the details. A major difference can be reported with regard to size, with the *MSC Sinfonia* being the smallest and the *Voyager* and *Navigator* being more than twice as large in cross-tonnage (See Table 6). In step with size, the scale and amount of different amenities increases, which has a significant impact on overall ambience, but also provides complexity to the environment, which can have both a negative and positive influence on safety perception, as discussed in PIV.

The disposition of the different spaces and layouts is relatively similar regardless of the ship, which contributes to a similar ambience. This stems from the fact that safety regulations – which limit areas and volumes to control possible flooding or fire – significantly affect the general arrangement of passenger ships.

MSC Sinfonia diverged most strongly from the others. The decoration of *Sinfonia* conveys its Mediterranean origins through colour schemes and decoration. *Sinfonia* was the only ship that had no central promenade, which impacted the brightness of the ship and navigation on board. Both aspects were considered to negatively impact safety perception, if not appropriately implemented. For example, the general arrangement of *Sinfonia* is asymmetric, which seemingly hindered the navigation and orientation of the passengers. In contrast, the number of openings on the *Vision of the Seas* made it the brightest ship among the four. In addition to being the brightest – or because of that – the *Vision of the Seas* was perceived as the most spacious. Although the *Voyager of the Seas* and *Navigator of the Seas* have a higher space ratio than the *Vision of the Seas*, they did not feel more spacious, only larger and more complicated (see Table 6).

When comparing MSC in general to RCL, some remarks can be made. The Italian culture was dominant on MSC's *Sinfonia* and most of the staff members working in the customer interface were familiar with the Italian culture and language. The enormous number of Italian passengers on the *Sinfonia* also strengthened this effect. Entertainment was more highlighted on the *Sinfonia*, passenger participation was emphasized, with most of the shows involving participation. Maybe for this reason, sociability played a more accentuated role in people's safety perceptions on the *Sinfonia*. This became evident from the data collected from the *Sinfonia*, showing that the interpretation of other people and non-human characteristics through the senses was more highlighted.

From the observational perspective, it would be ideal to compare different operators as their approach to safety differs. For example, the crew on the MSC's *Sinfonia* generally seemed to have a more relaxed and informal attitude, which certainly has a positive effect on passengers' experiences and is a good fit with the vacation atmosphere. The MSC staff members chatted and joked with each other; such light-heartedness was conspicuously absent on the RCL ships. Although the attitudes of the two operators' crews seemed different, no differences between the safety perceptions could be identified. This may be related to the fact that both operators uphold safety regulations in an appropriate manner. This includes regular crew training, professional appearance of the crew, good communication skills in different languages and constant maintenance of the ship and its equipment. All this was clearly evident to the passengers, positively influencing their safety perception.

RESEARCH QUESTION	APPLIED RESEARCH METHODS	ISSUED PAPER
How do people perceive safety based on the environmental characteristics on board a cruise ship during normal operations?	19 situated interviews on the 3rd and 4th cruises (see chapters 4.2, 5.3 and 5.4) Participatory observations on the cruises 1-5 (see chapter (4.1)	PI PII PIII
How do different environmental characteristics of the cruise ship affect passengers' safety perceptions?	19 situated interviews on the 3rd and 4th cruises (see chapters 4.2, 5.3 and 5.4) Participatory observations on the cruises 1-5 (see chapter (4.1)	PI PII PIII
How can perceived safety be improved by design?	Survey experiment for 97 consumers (see chapter 4.4) Conjoint analysis (see chapter 4.4)	PIV
How can the interaction of the characteristics be visualized to support the design process?	Visualization (see chapter 4.3) Actor-Network theory (see chapter 4.3)	PII PIII

TABLE 9. Summary of the research questions, applied research methods, and the publication forum in question.

7.3 Methodological remarks

After early insights into the cruise experience, which was the original research objective, safety was found to play a crucial role in the process of enabling people to concentrate on enjoyment. The research focus was narrowed towards this finding. User Experience scholars have a broad research foundation underlying human-design interaction (e.g. Bloch, 1995; Crilly et al., 2004; Hirschman & Holbrook, 1982; Hosany & Witham, 2010; Kwortnik, 2005; Vyas & Van Der Veer, 2006). However, discussion about positive experiences in terms of safety is limited. Similarly, in safety research, the discussion lacks the positive perspective. In ship safety, consideration of human perceptions is scarce and research is seldom conducted with the observational approach in an authentic setting, and ship safety has never before been analysed through visualizations of the environmental characteristic networks. Consequently, the present research focused on an unexplored space, taking an atypical approach that assists in the process.

In terms of dependability and reliability, the research process should be as explicit and repeatable as possible (Morrow, 2005).

Table 9 summarizes the different methods applied for gaining insights into certain research questions and in which papers the research method in question is described in more detail. The methods were applied in an interactive manner where observations were focused on interesting insights from the interviews and the other way around. This iterative process was described in detail in the methodology chapter to provide a detailed chronology of research activities and processes for the reader. Prior research (Morrow, 2005) recommends the use of triangulation to provide trustworthiness in qualitative research. This approach was successful in the current research: rigorous objectivity is emphasized with a transparent description of how the author has adequately tied the data together from different sources. Furthermore, the authentic setting enabled digging directly into the interesting findings. When methods were adopted simultaneously, it made it possible to confirm interview insights or gain more information about the situation. Several observational cruises provided prolonged engagement with the cruising context and culture, which enabled persistent observation in the field, thereby increasing internal validity. Hyysalo (2009) notes that observation often helps overcome vagueness, assumptions and identification of new opportunities. The situated interview method was considered successful in the identification of the environmental characteristics and their relation to the safety perceptions. This was mainly due to the fact that interviews were conducted in an authentic environment, which helped to stimulate the informants' memories, as they were able to refer directly to the discussed environmental characteristics.

The Actor-Network theory was found to be a successful background framework for supporting the analysis process. This sociological approach describes various phenomena based on the interactions between the human and non-human actors and conceives that any kind of action is based on the interactions between these two kinds of actors. ANT provides a tool for the researcher to understand how the safety process emerges as an actor-network and why certain environmental characteristics (actors) are part of the network providing safety perception. This, in turn, allows designers to focus on the most salient design features influencing safety perception. Thus, the ANT approach as guidance for the analysis enabled going beyond the traditional thematic coding and identification of individual characteristics, and to instead visualize how networks of environmental characteristics emerge and how individual characteristics are interconnected. This conclusion supports the suggestions of Van Rijswijk et al. (2016) and Haavik (2014) to

move away from a framework of safety perceptions that regards environmental characteristics and individual characteristics as largely isolated factors, and instead calls for the adoption of a framework that acknowledges the intricate and dynamic interaction between the characteristics. Therefore it is suggested that ANT is an effective approach to visualizing the observations and which environmental characteristics are connected to the safety perception network, their relationships, and to revealing the underlying characteristics that may affect people's safety perception.

Although this novel method provides richer information in a more assimilative manner than traditional approaches, the methodology involves some limitations and needs to be developed further. For example, the approach lacks a systematic approach with regards to which characteristics should be included and which excluded from the visualizations. Furthermore, the positioning of the characteristics in the visualization may give the wrong impression of interlinkages or hierarchy between characteristics.

The survey experiment verified that it is possible to influence people's safety perception through the design of the environment. However, although theorized based on prior research, the study could not verify that openness and guidance are the anticipated underlying processes for how people perceive safety. More research is needed to confirm this. One reason for this could be the research approach of presenting the environment with images. Even though this presentation method was considered successful in prior research for revealing people's first insights, a promising approach could be the adoption of virtual reality (VR). This would enable people to move in space and perceive it from multiple perspectives.

7.4 Conclusions

This research aims to shed light from a subjective perspective on ship safety, which has been traditionally considered in objective terms. This is achieved through a novel approach to ship safety research considering both human and non-human environmental characteristics of the complex sociotechnical system of a cruise ship in parallel by means of visualizations. Based on all that has been discussed, it is argued that people's safety perception in the cruise ship environment is critical for the environmental characteristics of the unique environment, and safety perceptions can be influenced with design.

However, it is impossible for a designer of architectural elements to substantially contribute to minimizing the causes of accidents. That

said, design can have a significant impact on how the environment is seen and experienced. Therefore, it should be considered that human and non-human environmental characteristics have a significant effect on the transfer of information about safety. Seemingly insignificant environmental characteristics can have a significant impact on safety perception. Furthermore, it should be considered that passengers' safety perceptions are affected by external factors taking place pre- and post-cruise.

Based on the observations in this current stage, the design of the cruise ship environment could benefit from taking the passengers' safety perception perspective into consideration when aiming to optimize their comfort. Characteristics such as trust, openness, transparency and situational awareness are not acknowledged in ship safety regulations, which causes conflicts between technically oriented regulations and human perception, and the differences between the two perspectives should be considered in ship safety design and research. Furthermore, it was shown that central environmental design characteristics that influence environment-human interaction are also vital for people's safety perception. Therefore, safety design should consider the effect of circulation, dimensioning, and shape & geometry of the environment. Eliminating the risk is not the only way to improve safety perception; more positive safety perceptions can also be gained through emphasizing the environmental characteristics that enhance positive safety perceptions.

To support positive translations from environmental design to safety perception, the sociotechnical environment needs to be analysed to understand how the issue is constructed, how individual environmental characteristics are interrelated, and how the system functions, because in this process the individual characteristics are as important as the entity of the characteristics. To analyse the complex composition of the environmental characteristics in people's safety perception, this work proposes that the environmental characteristics should be analysed in terms of visualized networks containing both human and non-human characteristics. The proposed method serves as an insightful design method that visualizes and communicates the connections of different characteristics in the network and assists the design processes in conceiving cause and effect relations.

Future research should consider how indirect effects influence safety perceptions. Environmental characteristics such as brightness of the light, colours, cultural differences, societal impact and how places derive meaning from the surroundings were excluded from the study, but surely have an impact on safety perception. Furthermore,

interesting findings could be obtained through experiments where informants are able to move in a test scene.

Finally, although it is vital to take objective safety into account in the cruise ship context, being safe is not the same as feeling safe. Further, passengers can truly enjoy the cruise only when they feel safe, and thus there is much to gain from increasing people's safety perceptions.

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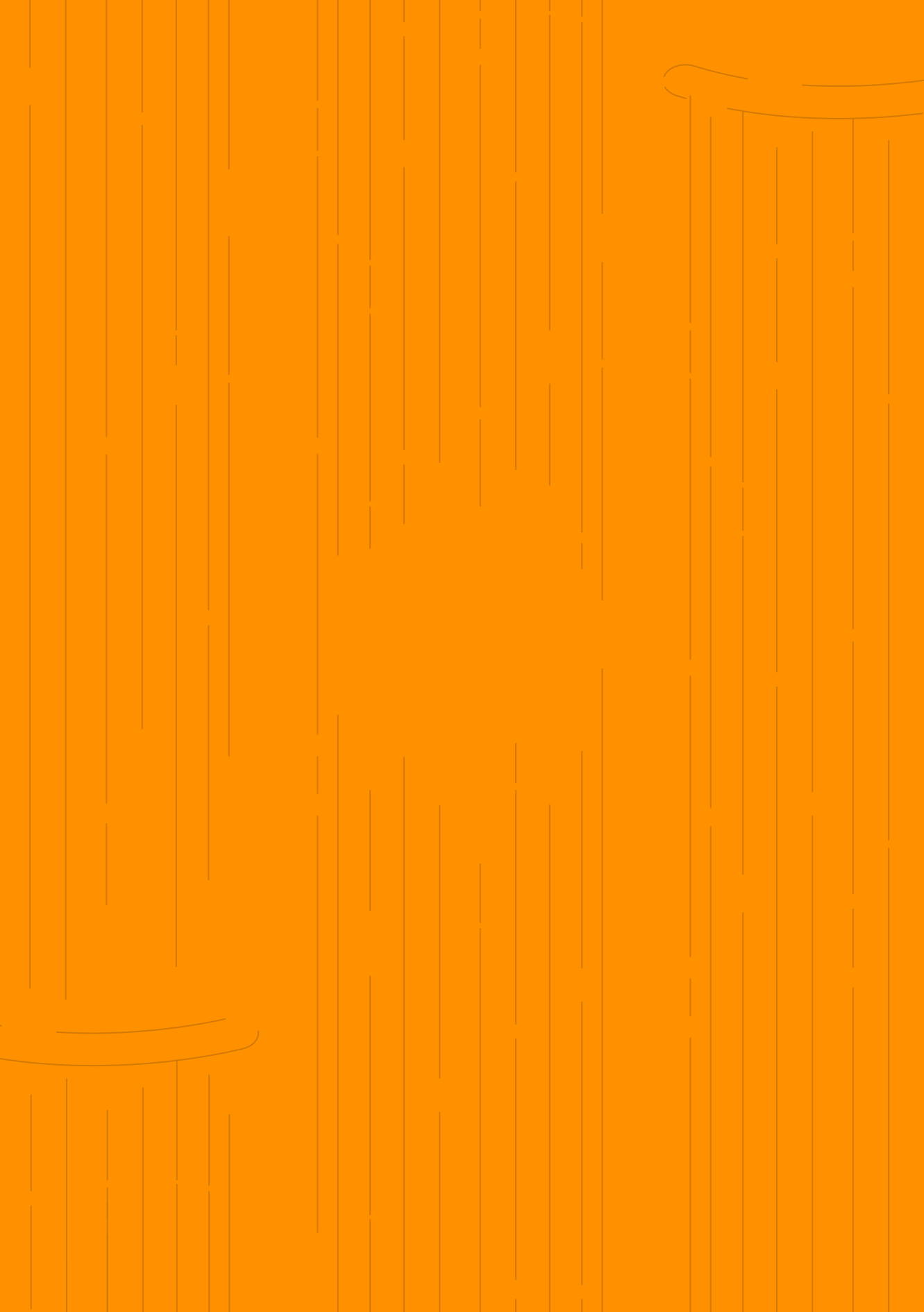

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FIGURES

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Perceiving safety in passenger ships – User studies in an authentic environment

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Abstract

The importance of including knowledge about human behaviour into the safety design for passenger ships has increasingly been taken into account. The interaction between passengers and the passenger ship is critical for human behaviour in terms of passengers' perceptions of the environment. The way people perceive the environment and the various features of the environment has been studied quite extensively in design research, but little research has been done on the specific issues that shape people's perceptions, such as safety. This paper discusses how people perceive safety within the context of passenger ships. Having conducted user studies in authentic environments, this paper identifies five safety perception themes. The results indicate that passengers perceive safety via the architecture of the passenger ship, the life-saving appliances, communication, emotions and other people. The outcomes were compared with the SOLAS regulations. The article contributes to safety research on passenger ship design, where human perceptions and reactions to the surrounding environment significantly affect behaviour and should be studied in parallel with technical progress.

1. Introduction

The significance of the human element in ship safety research has been the subject of much discussion recently. The United Nations' special agency for the safety and security of shipping— the International Maritime Organization (IMO)—states in its vision, principles and goals that actions that facilitate a better understanding of the complex, multi-dimensional issue of human element should be addressed to all matters pertaining to passenger safety when developing safety regulations (International Maritime Organization (IMO), 2003). The issue is also addressed in ship safety research: while current IMO requirements for evacuation analysis are effective for preparing the necessary equipment's and specifications, such as the dimensions of the corridors, they are not clear enough to meet a satisfactory level of passenger

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safety (Lee et al., 2003). Alderton (2004) and Kristianssen (2005) notes that ship accidents are usually classified according to a particular event (e.g. a ship is materially damaged by weather, a ship runs aground) rather than causes (e.g. human error, poor maintenance), and the main emphasis in ship safety design research has traditionally been on the technical possibility of improving passenger ship safety (e.g. Papanikolau, 2009; Vassalos, 2006; Kristianssen, 2005). For example, evacuation modelling usually concentrates on the possible technical improvements for increasing the safety level of passengers, but the behaviour of the passengers has only received minor attention; studies on behaviour have traditionally been limited to the activity of the crew (e.g. Håvold and Nesset, 2009; Rawson and Tupper, 2001). In addition, risk-based ship design typically considers human behaviour within several different contexts (way finding and selection and task description) and treats it as a generally unpredictable aspect of human error or failure (Papanikolau, 2009).

Ship safety research mainly discusses the human element in terms of the causal behaviour of the passengers during evacuation situations. Researchers typically only analyse passengers' behaviour during evacuations with respect to IMO requirements and use models that relate it to the total number of passengers and evacuation time estimations, which do not take human behaviour and environmental changes into account (Vanem and Skjong, 2006). Lee et al. (2003) argue that such analysis is pointless in practical situations if it does not take into account people's behaviour; they propose that evacuation analysis should include the human factor as well as other factors in order to assess passenger safety at a satisfactory level. Kujala et al. (2009) note that the human factor, i.e. human behaviour, is crucial for understanding the causes of ship disasters.

Understanding human behaviour first requires an understanding of the causes affecting the behaviour; the way in which we perceive the environment and its properties guides our response (Crilly et al., 2004), which in turns guides our behaviour (Bloch, 1995; O'Shaughnessy, 1992). For instance, Lee et al. state that, 'because evacuations are mainly dependent on the behaviour of evacuees, evacuation factors significantly affect the behaviour of evacuees' (Lee et al., 2003, pp. 865–866). The emergency situations contain an extensive set of different factors. Kang et al. (2010) note that passenger ships contain complex populations, which are difficult to control in an emergency situation without prior knowledge of a passenger's idiosyncrasies. Kim et al. (2004) argue that any analysis of human behaviour in emergency situations must deal with such human factors as cultural differences, gender, age and behaviour under panic. Vanem and Skjong (2006) note that the way in which people perceive of fire might have some psychological effects on passengers' behaviour (e.g. panic, shock or paralysis), which should be taken into account in passenger ship safety design. Katuhara et al. (1999) suggest that the selection of the evacuation path reflects the human psychological condition.

As mentioned above, ship safety research finds that human behaviour reflects human perceptions and motivations. Perceptions of how systems or objects work often dictate how they are operated. In cases where perceptions are false and do not match the actual characteristics of a product or system, the outcomes may be dramatic, such as the Three Mile Island nuclear accident (see Norman, 1988). Similarly, the opening mechanisms of exit doors may not be visible when the doors are badly designed, leading to potential hazards in fire situations, i.e. a door is pushed when it should be pulled or it is pushed from the wrong side (Norman,

1988). In other words, when there is a discrepancy between how something is perceived to work and how it actually works, there is a high probability of operational failure. Within the context of perceptions of ship safety, false perceptions regarding the safety of the ship could be expected to lead to people taking incorrect actions in emergency situations. By mapping these perceptions, ship designers will be better equipped to deal with the potential discrepancies between safety perception and actual safety and be able to guide passengers in how to act more safely. To the best of our knowledge, such mapping has not been carried out within the passenger ship industry. While the long-term goal with respect to perceived safety is to steer passenger behaviour in a better direction, the purpose of this paper is to first and foremost map the instances where such behavioural steering is most needed.

1.1. HUMAN PERCEPTION

Many psychologists have demonstrated that perception affects the corresponding behaviours of people (see, e.g., Mischel, 1973; Carver and Scheier, 1981; Vallacher, 1993). Our understanding of human perception dates back to James J Gibson's theory of affordance: 'The affordances of the environment are what it offers the animal, what it provides for good or ill' (Gibson, 1979, p. 127). Many scholars have subsequently debated the concept of affordance. Heft (1988) views affordances as functionally significant properties of the environment where meaning emerges out of the relationship between environmental features and a particular perceiver. Engeström and Middleton (1998) see the work environment as a cognitive system containing a number of different mediums of meanings, activity and guidance that affect our behaviour. This cognitive process is treated as a form of communication between the environment and the perceiver (e.g. Norman, 2004; Crilly et al., 2004; Bloch, 1995). According to Nilsson et al. (2012), human beings create awareness through perception and being cognizant of the current situation; it is a process distributed among a particular group of operators and the artefacts that they interact with rather than the output of a specific artefact. Therefore, when building an understanding of how safety is perceived, we should map the instances that stand out when observing a ship's environment and its safety features. Each property of the environment shapes users' interpretations and inferences, influencing their feelings, thinking and behaviour (Crilly et al., 2008): for instance, the handle of a cup indicates where to hold it and a door handle tells us which side of the door to push. Crilly et al. state: 'Depending on motivation and context, a product's perceived attributes may be even greater than its tangible properties' (Crilly et al., 2004, pp. 547–548).

Affordance theory can be successfully used when researching human behaviour. Norman (1988) describes affordance as one of the visual cues (affordances, constraints and mappings) that instructs users on how a particular product could possibly be used, and he has introduced the concept of affordance within the context of human-computer interactions (Norman, 1999). Koutamanis (2006) expanded on Norman's application and introduced the 'affordance mapping' technique to evaluate the affordance of individual building elements. Crilly et al. (2004) view affordance as part of the communication process between humans and design and the perceived qualities of semantic interpretation. Maier and Fadel (2009) have employed the concept of affordance to explain the relationship between the human and built environment and also as a theoretical basis for improving the design process and as an evaluation tool for exploring the connections between the initial intentions or objectives of the design.

1.2. SAFETY PERCEPTIONS

In safety research, the notion of perception is broadly investigated in terms of risk perception and the safety climate and culture within the context of high-risk industries, such as offshore industries (e.g. Rundmo, 1996, 2000; Cox and Cheyne, 2000), construction sites (e.g. Glendon and Litherland, 2001; Siu et al., 2004) and navigation (e.g. Hetherington et al., 2006; O'Connor et al., 2011). According to Rundmo (2000) and Siu et al. (2004), employees' perceptions of risk affect their behaviour and the probability of accidents. Brave and Nass (2002) argue that stress and a sense of safety are strong indicators of how a person will behave in a particular situation. Flin et al. (2000) have called attention to the importance of a supervisor setting a good example when it comes to safety behaviour. Chang and Liao (2008) have shown that when people lack accurate perceptions about safety, their behaviour places the lives of all the passengers at risk because of the fact that they have not properly read the safety instructions. In this respect, this article investigates the features critical to safety perception. As Chang and Liao state, 'Therefore, it is important that, in an emergency, passengers have accurate perceptions' (Chang and Liao, 2008). Likewise, Hetherington et al. (2006) commented on the importance of perception for understanding what is going on and making projections as to how a particular situation will develop when steering the ship; they highlight the importance of communication when translating perceptions into concrete instructions. Williamson et al. (1997) highlighted the importance of human perception and factors related to attitude when assessing the safety needs of a workplace, and they successfully developed a way to measure perceptions and attitudes about safety as an indicator of safety culture. However, only a limited number of articles discuss the safety perceptions of people in the types of human-system interactions that take place in built environments where safety plays a critical role, such as on passenger ships.

The concept of affordances always expresses a complimentary relationship between two separate systems. In Gibson's original concept, the systems consisted of the environment and the animals situated within it (Gibson, 1979; Maier and Fadel, 2009). For safety design, we treat a passenger ship as the environment and the passengers as the animals perceiving the environment. Passengers hardly ever consider the technical safety features of passenger ships. They consider themselves to be either safe or unsafe through the affordances of their living environment, such as how they interpret their level of safety in public spaces (corridors, lobbies, the promenade or the outside deck) and the properties of the environment. Bloch (1995) and Crilly et al. (2004) highlight that visual appearance of products as a critical determinant of consumer response and product success. The response of consumers depends on their culture, their background and their prior experiences (Bloch, 1995; Crilly et al., 2004; Manö, 1997). Additionally, products elicit emotional responses (Desmet, 2003; Frijda, 1986). For example, a life buoy can indicate that officials have taken a potential emergency into account or it can remind a person of a hazard. Likewise, colours have different meanings in different cultures. Additionally, safety is an objective of user-experience (Vyas and van der Veer, 2006) and, therefore, it should be emphasised since it is one of the basic human needs in terms of wellbeing, one that needs to be fulfilled before more trivial needs can be addressed (Maslow, 1987).

From a safety perspective, it is important to understand the properties that people perceive as being critical for a safe environment. In other words, we need to understand how passengers perceive of

the interface between, for example, the corridor and the promenade; in this way, we can better understand what attributes are relevant for human behaviour in emergency situations and design the ship's environment to naturally support safer actions. Furthermore, by understanding how passengers perceive safety and particular features of the ship, it will be possible to identify areas where passenger safety information is insufficient or has not been successfully disseminated. For example, a passenger who does not understand where to move to in an emergency situation may become a potential liability for other passengers by moving in the wrong direction during an evacuation. However, if designers understand this potential false perception, they can use additional evacuation route markings or information to support correct evacuation behaviour.

Although human error and evacuation research differs from human behaviour research, it is obvious that human perceptions and reactions to the properties of the environment play a significant role in all aspects of ship safety. We chose passenger ships as a research target because the environment of a passenger ship offers a restricted field for studying the interactions between human beings and a built environment.

2. Research instruments and analysis

Our aim was to highlight the importance of human safety perception within the context of passenger ship safety design. Knowledge can be used during the early phases of the safety design process to estimate whether or not passengers perceive of the design in the intended manner and to guide them towards desired behaviour. During the early phases of the design process, questions of 'why' and 'how' determine the criteria for 'what' should be designed (Laurel, 2003). When seeking answers to these questions, insights about the perceptions of users become essential for minimising any misunderstandings or inappropriate behaviour. Perception, though, does not directly influence safety; instead, it only affects behaviour indirectly since behaviour depends on perceptions and interpretation. For example, Crilly et al. (2004) and Forlizzi and Ford (2000) discovered that users are not passive, uneducated receivers of design content; rather, they actively construct meanings and narratives. These meanings and narratives might have an essential role in guiding instinctive human behaviour, especially during stressful situations (e.g. an emergency). Human perception has to do with interpreting objective sensorial inputs from the environment based on the given knowledge at the user's disposal. The subjective nature by which people interpret and construct meaning based on perceptions is difficult to understand. Therefore, the process of assessing safety features has to do with being able to understand how users assign different meanings and values to the safety experience in certain environments. This in turn will provide researchers with an understanding of how users construct and assign specific meanings to a particular environment (Vyas and van der Veer, 2006).

We addressed the abstract nature of the research topic by collecting qualitative data during two field studies. We chose this particular approach because qualitative research emphasises the subjectivity and authenticity of human experience (Cagan and Vogel, 2001; Silverman, 2009); it is typically conducted by observing people in real-life situations (Kelley, 2001). It is important to conduct the research in an authentic environment because visual perception seems to be most directly linked to our knowledge about the safety of a particular product (Hinton and Henley, 1993; Schifferstein and Cleiren, 2005), the perceived attributes of products (Lewalski, 1988) and our perception of that

product as well as the way in which we understand the product's functions (Norman, 2004; Oppenheimer, 2005). Although, we emphasise visual perception, it must be noted that perceptions are not only consciously formed and the relative strength and importance of various aspects of human perception (e.g. symbolic, semantic) may vary depending upon the context, motivation and type of product in question (Crilly et al., 2004).

2.1. PARTICIPANTS

The aim of the field studies was to focus on a multi-disciplinary group of people from different backgrounds in order to obtain a wide range of insights. We conducted the first field study during the *Aalto on Waves* project, where 109 people who were affiliated with Aalto University travelled on a cruise ship from Portugal to Brazil in November 2011. Altogether, 10 Aalto university master's level students (all first time cruisers) participated in the study.

We conducted the second field study during a one-week Mediterranean cruise between August and September of 2012. We selected the majority of the participants randomly from among the passengers. Altogether, we obtained seven individual insights about the perceived safety of the passenger ship. Only one of the participants had taken the cruise before. In this study, cruising is understood as a leisure activity pursued on a vessel that has been specifically designed for a cruise. The participants had different fields of expertise (police officer, office workers, students and a photographer).

The interview method was used in order to elicit a broad range of issues related to passenger safety perceptions. Altogether, we interviewed 17 passengers. While the interview method and the sample size of the study do not lend themselves to making generalisations with respect to the results, the results still serve the purpose quite well of mapping previously unknown safety perceptions. Furthermore, as Griffin and Hauser (1993, p. 23) state, 'interviews with 20–30 customers should identify 90% or more of the customer needs'. Therefore, our study deals with a large number of safety perception issues and provides a solid starting point for further research. Table 1 displays a summary of the study participants. According to the Cruise Lines International Association (CLIA), the core market for cruise vacations are adults over 25 years of age; the median age of the cruise vacationers in 2011 was 48. The average age of the cruise vacationer has dropped by 15 years during the past ten years (CLIA, 2011). According to the CLIA's statistics, our sample equates well with the expected average passenger travelling on a cruise ship in the near future.

TABLE 1. Conclusions about the participants' backgrounds based on the field studies.

	FIELD STUDY 1	FIELD STUDY 2	TOTAL
GENDER	F 4/M 6 = 10	F 5/M 2 = 7	F 9/M 8 = 17
AGE	AVG 23 years	AVG 32 years	AVG 27.5 years
AGE DISTRIBUTION	21–32 years	22–55 years	21–55 years
NATIONALITY	FIN 10	FIN 2	FIN 12
		CHI 1	CHI 1
		GER 3	GER 3
		AUS 1	AUS 1

2.2. PROCEDURE

We conducted our first field study on a cruise ship, where two out of four of the authors participated in the *Aalto on Waves* project in the role of course and seminar organisers. This offered them an opportunity to collect first-hand insights about safety perceptions within an authentic environment on the *Vision of the Seas* cruise ship. The authenticity of the research envi-

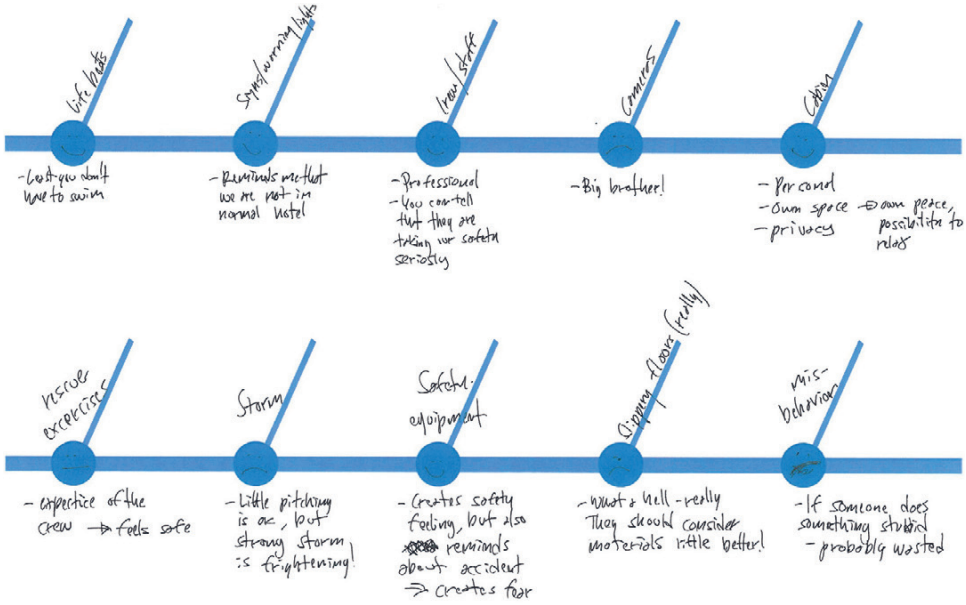

FIG. 1. Sample from a self-documenting logbook, which participants used during observations.

ronment is critical because people assign meanings to products by tracking how the product is used in a number of real-time contexts as well as by witnessing the responses of other users (Battarbee, 2004). In addition, user experiences depend to a large extent on the time at which they occurred, and as time passes the smallest experiences are forgotten and only the most significant experiences are remembered (Battarbee, 2004).

We initiated the field study with a one-hour tuning-in session, where the task and overall purpose of the study were described to the participants. First, participants were asked to share stories about situations in which they had felt either safe or unsafe and asked to identify critical aspects of the situation that had effected their perceptions. We conducted the tuning-in session in order to orient the participants' mindsets towards offering subjective interpretations of their experience. Mattelmäki (2006) noted that it is helpful to explain the situation, the objectives of the research project and how the insights will be used during the tuning-in session. We conducted the tuning-in sessions for both field studies privately in the conference spaces of the ship.

When describing the task, we asked participants to comprehensively discover the ship's spaces within a one-hour block of time and to note in a logbook all the features that they felt affected their individual sense of safety. In addition, we asked the participants to indicate whether their perception of safety was positive or negative with a smiley face and to write a short description of the reasoning for why and how they felt that way about a particular safety feature on the ship. After the participants had returned their logbooks, we examined the notes together with the participants to make sure that we understood what they had written correctly. We chose a self-documenting approach because it is a well-established research method in ethnography and sociology and has successfully been adapted to user-centered design research for determining user insights and expectations from the informant's perspective (Battarbee, 2004; Mattelmäki, 2006). The selfdocumenting approach can aid the researcher in understanding context-related experiences as they occur and minimise

retrospection (Csikszentmihalyi and Larson, 1987). This contention is based on the perception that participants record their experiences in a more genuine form in situ in contrast to in such situations as group interviews, which are conducted afterwards (Mattelmäki, 2006). To our knowledge very little safety research has been conducted in a practical manner by including real users' reported observations in an authentic environment and in a real-time situation.

The self-documenting approach was aided by a simple printed sheet that included a path illustrating the participants' optional observation route with empty lines for the critical features of the environment. The path contained empty slots for the participants to mark their positive or negative feelings (see Fig. 1). The aim was to keep the process of collecting the insights simple, yet effective, for the participant, thus ensuring that they did not have to make any extra effort when taking notes and that the researchers could easily interpret the notes. This was in line with what Silverman (2009) advises: that those conducting qualitative research should keep the data collecting process simple. On the other hand, when adopting a simple approach, the researcher does not necessarily obtain rich insights. Battarbee notes that verbal descriptions are only one of three keys to obtaining insights about others' experiences: he advocates studying 'what people do, what they say and what they make' (Battarbee, 2004, p. 62). Since the aim of the study was more to collect insights about safety features on ships that could be used in future studies, we considered the simple approach sufficient.

We also conducted the second field study in an authentic environment: on the cruise ship *MSC Sinfonia*.We used an identical formula and identical procedures for the second field study as we did for *Vision of the Seas* one. We conducted both field studies during the daytime while the ship was moving and also during good weather conditions. Notes were taken in either Finnish or English. The participants in the first study were all Finnish, whereas they were from a number of different countries in the second study. The slightly larger (capacity for 2435 passengers and a gross tonnage of 78.941) has been in active service since 1998, when it was built, whereas the *MSC Sinfonia* (capacity for 2200 passengers and a gross tonnage of 58.625) was built in 2002 and has been in active service ever since (Cruise Direct, 2012a, 2012b). Additionally, the facilities and services of the ships are slightly different because of the target market: the *Vision of the Seas* was originally designed for North American markets, whereas the *MSC Sinfonia* was originally designed for European markets. Naturally, both ships were built according to safety regulations and, therefore, they contain comparable safety arrangements. The ships can be compared based on their size and the time at which they were built; in the analysis, we considered any possible differences in safety perceptions as being related to the differences in design.

Although we had intended to collect data regarding passenger insights about safety on board the ships without assigning any right or wrong answers, the method did entail several risks. First, by only using verbal data, we increased the risk of possible misunderstandings. Second, by only observing present, or even tentative, topical groupings, we increased the risk of dismissing anything that did not fit into the topics neatly enough (Silverman, 1993). Sleeswijk Visser et al. (2005) warn that new insights emerging from research after the learning process has been completed may seem so obvious that everyone would seemingly have already known them in advance. Battarbee (2004) notes that it is easy to work with agreeable informants; the challenge is in understanding those who are unlike us. Additionally,

TABLE 2. Coding framework.

THEME	QUOTES	CLUSTER	QUOTES	GROUP	QUOTES
Passenger ship environment	94	Architecture	50	Ship's appearance	14
				Openness of the space	14
				Amount of light	13
				Staircase	9
		Ship decoration	44	Handrails	25
				Decor	8
				Materials	6
				Slippery flooring	5
Life-saving appliances	85	Specific life-saving appliances	53	Lifeboat	16
				Life-saving appliances	11
				Surveillance	10
				Safety drill	9
				Alarm	7
		Characteristics of the life-saving appliances	32	Number of life-saving appliances	14
				Visibility of the life-saving appliances	10
				Appearance of the life-saving appliances	8
Communication between ship and perceiver	51	Received information	27	Safety instructions	12
				Sound	11
				Announcement	4
		Navigation on the ship	24	Space awareness	14
				Navigation	10
Emotion	43	Emotion	43	Trust	12
				Privacy	9
				Fear	8
				Security	7
				Cleanliness	7
Ship community	41	Ship community	41	Crew expertise	14
				Passenger community	9
				Crew presence	8
				Service	5
				People flow	5
Total 5	314	8	314	31	314

there is a risk that participant might misunderstand the task at hand or try to identify the correct answers and describe only those features of the ship that he or she thinks are critical in terms of perceptions about safety.

2.3. CONTENT ANALYSIS

There are several types of content analysis, including quantitative and qualitative methods; they all share the central characteristic of systematically categorising textual data in order to make sense of it (Miles and Huberman, 1994). The technique is commonly used as a systematic and objective procedure for describing communication (Rourke and Andersson, 2004). In this research project, we analysed the data by coding text into explicit themes (categories) and described the themes using statistics. This approach is referred to as the quantitative analysis of qualitative data (Morgan, 1993). Our analysis remains somewhere in between quantitative and qualitative content analysis because of the fact that we included latent content analysis. Latent content analysis refers to the process of interpreting content (Holsti, 1969). With this type of analysis, the focus is on discovering the underlying meanings of the words or content (Babbie, 1992; Morse and Field, 1995).

Using a four-step process, we analysed the collected data via a bottom-up approach and separated the transcribed material into five safety perception themes. The first step in the process involved extracting a topic from each written transcript. All of the material from the field studies was transcribed. To include a topic within the analysis, we needed to identify a clear relationship between the investigated topic and its perceived safety feature. We identified a total of 348 different safety features on the passenger ships. Table 2 illustrates the coding framework of the bottom-up analysis. It only shows 314 of the 348 mentioned safety features because the remaining safety features consisted of fragmented groups of items mentioned by only a single passenger. In the second step, we grouped the safety features based on their commonalities. We wound up with a total of 31 groups. In the third step, we clustered the observed groups together, which resulted in a total of eight clusters. Finally, we combined the clusters into overall themes, resulting in five themes that pertained to passenger perceptions regarding the safety features aboard the ships. We double-checked the reduction process by re-classifying all 348 items according to the five themes, with the authors working together during this process.

3. Results

We discuss the results of the study as follows: first, we describe the five safety perception themes according to their prominent clusters and groups (see Table 2); second, we compare the themes with the rules established by the SOLAS (Safety of Life at Sea) Convention; the SOLAS regulations constitute the most well-known and important international maritime safety treaty and are overseen by the IMO. Merchant ships need to abide by several regulations (e.g. classification societies and flag state) and the SOLAS regulations ensure the minimum safety standards for structures, life-saving appliances, fire protection and detection systems, radio communication and carrying dangerous goods, for example. We investigated whether or not the regulations are related or closely related to the safety perception themes identified as a result of our field studies. There are some differences between the regulations concerning passenger ships and ro-ro (roll-on/roll-off, indicating the means by which cargo is handled) passenger ships; in this paper, we only compared the passenger ship regulations to our assessment of passenger perceptions of safety.

3.1. PASSENGER SHIP ENVIRONMENT

The participants most often listed safety features that fit into the 'passenger ship environment' theme (29.9%), which we then subdivided into *architecture* and *decoration* clusters.

In the *architecture* cluster, the passengers perceived safety in terms of the openness, amount of light and transparency of the ship's general arrangement (layout) and in terms of the different vertical spaces. They described their feelings of safety in terms of the openness, transparency and continuity of a space as well as the links between spaces and the amount of natural lighting: 'One can see the surroundings of the ship' and have a 'feeling of space'. The passengers considered the spaces that span several decks, such as the promenade and the main lobby, to be safer than narrow and shallow spaces. They questioned the functionality of the narrow and closed-in spaces and considered such spaces unsafe, especially in possible accident situations. This notion is interesting because it is out of tune with real safety issues; large and open spaces are usually less safe because it is difficult to isolate them and fire and water can spread easily. Therefore, it can be argued that passengers' perceptions do not always accurately reflect real safety issues. The boundaries of the spaces either increased or decreased feelings of safety; the participants indicated that a space should have clear borders and that they should be able to see into other spaces or outside the ship. For example, passengers used the words 'clear space' quite often. The passengers also highlighted a need for continuity between the spaces and a need for information about where the space leads to as important for their perceptions of safety.

The subgroup *ship's essence* also increased feelings of safety among passengers because the large size and overall condition of the ship instilled feelings of trust. They also mentioned that the fact that the ship was constantly being maintained had a positive impact on their perceptions of safety. For example, one passenger wrote: 'the surface of the ship looks well maintained'. The large size of the ship has a positive effect on the ship's movements, which increases feelings of safety. Of all the individual spaces, staircases, including elevators, had the biggest single impact on perceptions of safety. This mainly had to do with the fact that the passengers viewed them as being impractical during an emergency; they indicated that the dimensions of the staircases negatively affected their feelings of safety. This was because the participants were concerned about whether the staircases were wide enough to handle the flow of people and whether the elevators would work in an accident situation: 'in the case of an emergency and panic in a populated [space], it's not an easy feeling'.

Fire safety regulations affect the passenger ship environment the most. In order to control the possibility of fire, the spaces of a passenger ship are divided into primary vertical fire zones with a maximum length and width of 48 m and an area not greater than 1600 m^2. This might conflict with the objective of creating a sense of *openness of the space* because spaces of a particular size will need to be isolated from other spaces. The sizes of the spaces along evacuation routes are clearly defined: stairways, doorways and corridors must be no less than 900 mm in width, and this should be increased by 10 mm for every person in excess of 90 persons (IMO, 2001). The participants felt quite strongly that the minimum diameters of the corridors were too narrow in both ships. Different spaces are classified according to their fire risk level (1–14, with 14 being the riskiest), and the classification defines the extent to which the different spaces are isolated from one another. Relevant spaces are classified as follows: stairways (2), corridors (3), open deck spaces (5), accommodation spaces

with minor risks (cabins and spaces under 50 m²) (6), accommodation spaces with a moderate fire risk (stores) (7), accommodation spaces with a greater fire risk (barber shops & beauty salons) (8) and sanitary spaces (9). The regulations state that stairways and ladders should be arranged to provide a ready means of escape to the lifeboat deck and that at least two means of escape need to be provided from each vertical zone (IMO, 2001). Additional regulations state that stairways should not exceed a 3.5 m rise in elevation without including a landing and that they should not be at an angle greater than 45°. The landings on each deck level should be no less than 2 m² and they should be increased according to the number of people that the ship will carry. Stairways designed to fit more than 90 persons should be aligned both fore and aft (IMO, 2001). The participants mentioned the dimensions of the stairway in this context because they often worry about what would happen in an evacuation situation if older people were to block the way. According to our results, these regulations do not have a significant effect on passengers' perceptions of safety.

In terms of the subgroup *decor*, passengers consider the handrails the most important safety feature: 'you are able to support yourself using the handrails'. The participants called attention to the outside decks in particular, where they applauded the presence of handrails. They considered the height of the rail and how well it is constructed as the most important attributes of a handrail. Overall, the passengers perceived decorations in terms of the colour schemes and furniture: 'the colours of the surfaces should not be misleading'. The quality of the materials instills a sense of trust. Additionally, the characteristics of the materials affected their sense of safety: materials that easily decompose or break under stress, such as glass, negatively affect their sense of safety, especially when such materials are used on a large scale or without proper support. Likewise, slippery floor materials on the outside decks aroused negative feelings: 'huge glass constructions on the promenade are scary'.

In general, the existing regulations address decoration concerns by focusing on the flammability of the materials. Incombustible materials are often synthetic; metal handrails are often covered with imitation wood, which aroused negative feelings among the participants: 'real material, like wood, is easier to trust'. The regulations state that escape routes must have slip-free surfaces underfoot and that handrails need to be placed on each side of the stairway (IMO, 2001). This regulation in particular gave rise to strong discussions about safety considerations: 'slippery floors—they should consider the materials a little better!'

3.2. LIFE-SAVING APPLIANCES

The participants mentioned the theme *life-saving appliances* the second most often (27.1%); *life-saving appliances* included all specific life-saving appliances and the characteristics of the appliances (International Maritime Organization (IMO), 2003).

For the participants, *life-saving appliances* broadly concerned all of the equipment that is present on ships; however, they had the most to say about lifeboats. The presence and means of escape offered by the lifeboats was mentioned the most. This is in line with the ongoing discussion about whether or not to totally remove lifeboats because staying onboard the cruise ship itself is considered the best option for survival. However, authorities have postponed such plans as a result of passenger feedback. The participants also stated that surveillance (including cameras, camera placement and 24-h supervision) increases their feelings of safety. They responded positively to obligatory emergency drills for passengers and crew (IMO, 2001), feeling that they would help increase peo-

ple's capability to act correctly in an accident situation: 'daily emergency exercises demonstrate that the staff is taking safety seriously'. Passengers also mentioned having concerns about everything related to alarm systems, including where the alarm bell is located and how loud it would be in the event of an emergency (which they experienced during the emergency drill): 'fire extinguishers make me feel safe—that they are there'.

The regulations regarding lifeboats state that they should be distributed equally on both sides of the ship and be able to accommodate at least 30% of the persons on board the ship. The regulations differ based on the sailing route. The minimum number of different life-saving appliances is defined in the regulations based on the size of the ship and the number of passengers. Regulations concerning life-saving appliances indicate that alarm systems should be audible on all open decks (IMO, 2001).

Alongside life-saving appliances, the *characteristics of the lifesaving appliances* cluster impacted passengers' feelings of safety. This primarily concerned the number of life-saving appliances, such as individual lifejackets, placed in the cabins and the number of appliances located on the outside decks. According to the passengers, life-saving appliances should be highly visible: 'with the bright colours you are able to see the safety equipment right away'. The participants reacted positively if the appliance looked new and in good condition and negatively if the appliance looked worn out or dirty: 'a broken button [makes me] feel unsafe, because you think the thing itself is not reliable'.

Regulations concerning personal life-saving appliances indicate that lifebuoys should be readily and rapidly available and equally distributed to all of the passengers and crew. The regulations also emphasise that the location of the appliances should be clearly marked. Lifejackets should be provided for every person on board and they should be readily accessible. Furthermore, safety rules state that the life-saving appliances should be regularly maintained and inspected monthly (IMO, 2001). Although the regulations mainly concern the functionality of the appliance, they also support the perception that safety appliances should look reliable and be in good condition.

3.3. COMMUNICATION BETWEEN SHIP AND PERCEIVER

The *communication between ship and perceiver* theme includes clusters pertaining to *received information* and *navigation on the ship*. Passengers mentioned the importance of proper communication 16.2% of the time.

The participants mentioned that *received information* should come in the form of clear safety instructions, especially instructions presented on easy-to-read signs: 'signs & language—being able to read and understand [the information]'. They also emphasised the importance of sound in different situations, such as the noise of a running engine and a moving elevator: 'having a feeling of moving (ship) or falling (elevator): elevators are more stable than on land'. Noticeable sounds increased perceptions of safety. The sounds might also include announcements such as weather forecasts.

The SOLAS regulations link the idea of communication to public address systems, which are clearly audible above the ambient noise in all spaces. They suggest that a safety briefing should be given immediately before sailing or after sailing through the ship's public address system by means of announcements. Safety information provided through, e.g. posters or videos, may be used to supplement the briefing. Regulations concerning life-saving appliances indicate that alarm systems should be audible on all open decks. The evacuation routes should be clearly

marked so that the passengers can identify all the routes and escape exits (IMO, 2001). Overall, it seems that the safety regulations concerning communication and participants' perceptions of proper communication are in line with one another and we did not identify any noticeable discrepancies.

The *Navigation on the ship* cluster consists of the ways in which passengers perceive of space and navigation groups. The participants called attention to the dimensions of a particular space and how different spaces are interlinked: for example, they mentioned the importance of 'carpets in order to perceive distance and [the] rhythm of the space'. They also considered it important that the spaces should be kept clear and that the meaning of the space should be easy to perceive. The navigation group has to do with how much guidance (e.g. maps and clearly labelled routes) the passengers receive regarding where they are and how they can get to other parts of the ship: 'knowing your location'.

3.4. EMOTION

The participants mentioned the theme of emotion 13.7% of the time.

The *emotion* theme concerns all feelings directly linked to emotions, whether described emotions or aroused emotions. For example, passengers mentioned that 'trust—the feeling of trust is important'. They often mentioned that feelings of safety are linked to trusting the ship's motions and the condition of the safety appliances: 'materials and equipment are new—they will work'. The participants also perceived of private spaces (usually cabins) as being important and mentioned that they increased their sense of safety. The only clear fear that participants identified had to do with the weather and how it affects the ship: 'inform people if it will be very windy and the sea will be rough'. In short, the participants wanted more information about weather conditions. Passengers reported feeling emotionally secure when they felt that their privacy was protected, such as having good locks on the cabin door and safety boxes. A sense of cleanliness is also closely related to feelings of trust and security; the participants felt clean when the ships gave an overall impression of cleanliness. We treated cleanliness as an individual group because passengers clearly perceived of it as a single issue.

The SOLAS regulations do not have anything to say about emotions or ensuring a sense of emotional security.

3.5. SHIP COMMUNITY

The *ship community* theme concerns both passengers and crewmembers and the participants mentioned it 13.1% of the time.

The participants mentioned that the expertise of the crew affected matters of community safety the most: 'trust: honesty of the staff and other "critical" members [that are] supposed to take care of you'. The expertise of the crew is demonstrated through the crew's behaviour and the constant and visible training of the crew. The presence of other people greatly affects perceptions of safety. The participants mentioned feeling safe because of the uniforms and attitude of the crew, but also because the crew is able to communicate in multiple languages: '[having a] common language is important' and 'I'm able to communicate with the crew'. The participants also called attention to the crew's working hours: '[the] staff has long hours and they look exhausted'. The participants felt safe because of the presence of other passengers: 'the other passengers seem to be either families or old people, so I think there's no harm'. The service group consists of different services that the participants mentioned as having an effect on their perceptions of safety. The idea of *people flow* has to do with how crowded the spaces are and the flow of people in public spaces (e.g. overcrowding and running kids): 'kids running in the pool area is dangerous'.

Regulations concerning the ship community are limited to the crew's expertise. The regulations indicate that every crew member should be familiar with the safety instructions and capable of contributing in accident situations and that they should participate in at least one abandon-ship drill and one fire drill every month (IMO, 2001). Regular training might have a positive effect on the perception that crewmembers are self-confident in what they are doing, which, according to the participants, would help instill a sense of trust.

4. Discussion

It might be argued that the participants mentioned technical progress the most, which is entirely true, but the perspectives of the passengers differed greatly in terms of how they felt about how particular safety features relate to technical progress. For example, one of the safety features that the passengers mentioned most often was handrails; the SOLAS regulations clearly define where to place handrails and what the dimensions should be for the different handrails. However, our research demonstrates that passengers perceive handrail safety in terms of the quality of the construction: passengers want to know that the handrail will prevent them from falling or that it is strong enough to support their weight. Thus, the support and restraint affordances of the handrails should be emphasized in design. This could be done through favouring materials that are strong and technically reliable and perceived as such and through avoiding construction that lacks either one of the dimensions (i.e. passengers will not likely rely on a handrail if they perceive that it is unsafe, no matter how strong it may be from a technical standpoint). Reliability and trust are the main attributes behind the majority of the features perceived of as being critical to safety: the emotion that the participants mentioned most often is a feeling of trust; in terms of the ship community, the participants mentioned that the crew should give the impression of being professional and that they should be able to trust the other passengers.

The study provides quantifiable results that passengers perceive safety through the overall environment before then focusing on more specific safety features. This is because the openness of the ship's spaces, the amount of light and the transparency of the spaces comprise the most coherent group of features affecting passenger's perceptions of safety. We suggest that openness and the amount of light could be increased in terms of lighting design to reduce people's possible avoidance of the dark and narrow spaces under stressful situations. Furthermore, the sense of narrowness can be minimised by placing reference points along the way and at the end of corridors or passageways. Another option might be to accentuate the benefits (e.g. control of fire or water and the ability to move if the space rotates) of the particular spaces, which are most likely not considered because such spaces are usually compared with similar spaces in buildings.We place specific life-saving appliances second after the environment in order of importance, even though the participants mentioned these appliances most often. We did this because each appliance group that the participants mentioned contained a single detailed meaning [affordance]. For example, lifeboats prevent people from drowning, whereas the items used for surveillance help the crew keep an eye on passengers. In addition, the openness of the ship's spaces, the amount of light and the transparency of the spaces call attention to the high-level affordance of the general architecture, such as affording shelter for passengers, affording them comfort and offering them a place to store their valuables. (Maier and Fadel, 2009). We conclude that openness and the amount of light increase a feeling of safety in terms of optional escape routes.

Passengers expect to see a certain number of life-saving appliances on board the ship. The evidence suggests that passengers view safety appliances as visual stimuli, which affects their perceptions of the overall safety of the ships: safety equipment is specifically designed to help us in accident situations, and we understand the reason why the equipment has been placed in the environment and, through this knowledge, we perceive of the environment as either being safe or unsafe (Crilly et al., 2004). Furthermore, it can be argued that the condition of the appliances affects our perception of the technical competence of the appliance and our overall safety. We choose to emphasise this result because of the nature of the research topic and method: the participants were observing a passenger ship to identify the safety features most critical to their perceptions of safety.

Communication is also highly important to passenger perceptions of safety. The results demonstrate that passengers form an awareness of the situation through understanding the ship's layout; it is critical that they are able to locate where they are on the ship and understand how the spaces relate to one another in order to find the best escape route in a possible evacuation situation and be able to adapt their behaviour to fit the purpose of the space. Therefore, spaces need to communicate with one another; reference points and other forms of instruction should be emphasised in design to facilitate passengers' ability to navigate. For example, colour coding of different ship sections or varying interior themes in the ship might provide a starting point for such instructions. The same idea applies to safety features that are placed in the environment: there needs to be a clear message about how and when to use them (Crilly et al., 2004; Norman, 2004). The specific safety features need to provide clear instructions for users during an emergency situation, which is most likely the first time that passengers will look at the instructions on an appliance. How passengers perceive of different spaces and the instructions for routes to take and how they interpret the way in which safety appliances should be used are critical in emergency situations and should be emphasised in design.

The information that is provided affects safety perceptions in many ways. The passengers indicated that the safety instructions made them feel safe, even if they only skimmed through the instructions. This is because passengers expect to be able to obtain certain information easily if needed. Passengers also identified the importance of hearing: for them, being able to hear the ship's sounds (e.g. the engine) contributed to their sense of safety. This result is interesting because Schifferstein and Cleiren (2005) have listed vision as the most important sense in terms of perceptions of safety and they argue that our knowledge about product safety depends to a great extent on visual perception (Schifferstein and Cleiren, 2005; Hinton and Henley, 1993). On the other hand, when considering all the other concerns mentioned by the passengers, the majority of them have to do with visual perception, which confirms the idea that we understand how a product functions mainly by visual means (Norman, 2004; Oppenheimer, 2005). This confirms our belief that it is essential to consider visual perception when designing a ship from a safety standpoint.

4.1. IMPLICATIONS OF THE RESEARCH

Scholars have already identified the need to take human behaviour into account in safety analysis (e.g. Lee et al., 2003; Wang, 2001), and this paper adds to existing knowledge on the starting point for conducting research into human behaviour, that is, on how people perceive of safety and behave based on their perceptions (Bloch, 1995; Crilly et al., 2004).

The passenger ship environment consists of thousands of designed products, and human interpretation of the design is based predominantly on people's interactions with the product (Norman, 1988). Therefore, it is essential to consider the human response to a product's appearance as one stage of communication (Krippendorff and Butter, 1984), because designers only communicate through the medium of the product's attributes (e.g. functionality, mode of use and social significance) (Crilly et al., 2004). We identified five themes that are critical to safety perceptions. These themes included the environment of the passenger ship, life-saving appliances, communication between the ship and the perceiver, emotions and the ship community, all of which can be used for further studies on how to integrate human behaviour within the safety design of passenger ships and a safety assessment framework. This paper provides additional viewpoints on ship safety design; in it, we evaluated such things as the structures and appliances on ships in terms of their affect on safety perceptions. Ships include a range of safety appliances that contribute to the actual safety of the passengers, but we provided an understanding of how passengers also perceive of the contributions made by safety appliances and how the appliances affect passengers' sense of the ship's overall safety. For example, passenger perceptions about the safety appliances could increase their actual safety if they feel more comfortable with how to use the appliance and know where it is located. Additionally, by understanding the safety perceptions of passengers, ship designers can help decrease discrepancies between how passengers should act in emergency situations and how they perceive of the ways in which they should act in such situations.

The results highlight the central role of communication as an important part of passenger perceptions on safety. The information provided to passengers needs to be clear so that the perceiver can understand the message, the information needs to be communicated well through different channels and nonverbal communication and the essential features of the environment need to be taken into account as well. The importance of the ship community is often neglected and needs to be considered in safety design as one of the most critical factors in accident situations.

We think that perceptions of safety should be emphasised to the same extent as other matters in passenger ship safety research because it directly affects passenger behaviour. We reviewed the SOLAS safety rules in order to find regulations that closely take into account our findings and found that the way in which passengers perceive of safety equipment, the way that the ship is constructed or other activities pertaining to safety are hardly ever defined. We assume that certain regulations are specific to the shipping company, such as the outfits of the crew and issues of decor. However, at the same time many of the safety regulations indirectly or directly affect the way passengers perceive of safety issues.

4.2. LIMITATIONS AND FUTURE WORK

Overall, we consider our approach to have been successful. The two case studies provided a number of good insights into a topic that can often seem quite abstract. The subjective and spatiotemporal nature of user experiences often contains objectives and thoughts that are never really mentioned or expressed verbally; therefore, tools that help users express themselves are required in matters of ship safety (Mattelmäki, 2006).

We performed a quantitative analysis of the qualitative data. The data yielded insights into the meanings of passenger perceptions of safety within the context of a passenger ship. Through this process, we

were able to identify specific topics affecting safety perceptions of safety and relate them to one another (Vyas and van der Veer, 2006). The participants in the field studies could be more diverse in the future to obtain insights from older age groups, but, on the other hand, 20–30 year old participants represent the core market group travelling on passenger ships (CLIA, 2011). Also, the cultural diversity of the participants could be increased in future studies to provide a more comprehensive understanding of how culture affects perceptions of safety.

We will continue working with the topic, since we firmly believe that the way in which passengers perceive of different safety issues fundamentally affects their behaviour and shapes their experiences with passenger ships. In future studies, we will continue researching how and why perceived safety features affect passenger behaviour in particular ways, since the reasoning behind the themes was kept at a fairly superficial level in this particular study. Furthermore, we will continue researching the extent to which differing issues impact and shape human perception, for example cultural differences and societal issues. In addition, we see that safety is an important topic from the standpoint of commercial advantage and understand that it could be used more as part of a ship's marketing campaign or even emphasised as a crucial part of the cruising experience.

5. Conclusion

In this paper, we presented and assessed themes pertaining to passenger perceptions of safety aboard passenger ships as a means of calling attention to the importance of taking human behaviour into account in safety design and to argue that the design process should include perceptions about the environment and its features. Our findings are from a non-technical and human perspective and they can be utilised in further studies that traditionally deal with more technically oriented safety design research on ships and similar spaces.

The evidence shows that people's perceptions of the environment and its features has an effect on their behaviour, which in normal situations means that we experience the situation through particular features and that in accident situations, the features of the environment can even guide our behaviour. We highlighted the importance of understanding how different environmental features impact safety perceptions because previous research has shown that perception is directly linked to our understanding of the functionality (Norman, 2004; Oppenheimer, 2005) and safety of the attributes of a given space Hinton and Henley, 1993; Schifferstein and Cleiren, 2005). Additionally, we experience our environment through particular attributes (Crilly et al., 2008). At a basic level, this means that designers need to identify the critical properties of the environments that sustain the safety of passenger ships so that they can design environments that increase natural navigation in emergency situations and the use of and knowledge about the location of safety appliances and a sense of safety among passengers.

Typically, we do not worry about our safety before it is disturbed, which means that perceiving safety is largely an unconscious process and hardly ever noticed. With this paper, we wanted to disclose features that are critical to perceptions of safety within the context of a passenger ship.

The study results show that passengers primarily perceive of safety in a comprehensive matter through their interactions with the environment around them, which helps them form an overall picture of the situation and whether or not they experience it as being safe. Second, passengers often mentioned the importance of life-saving appliances, which they

feel constitute a significant part of safety aboard a ship. Third, they emphasised the importance of good communication between the ship and the perceiver: the participants wanted to be informed and guided in what routes and measures to take and they wanted that information to be readily available. Fourth, emotions affect our sense of safety, mostly through trust, which is tightly linked to many other features included in the other themes. Finally, passengers mentioned the importance of community: the presence of competent-looking officers and other people made the passengers feel safe.

By conducting a qualitative investigation on perceptions of safety on passenger ships, we have provided knowledge about the safety features that affect human behaviour. The possible implications of such knowledge can be used in further studies on ship safety design and assessments of passenger safety.

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Exploring cruise experience through actor-networks of the cruise ship environment

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Summary

The cruise ship environment contains multiple human and non-human characteristics that together contribute to the cruise experience. Although many of these characteristics are identified separately, less research attention has been paid to the investigation of the cruise experience as an entity, and interconnectivity between its various characteristics. A qualitative study was conducted in an authentic passenger ship environment in order to document the characteristics passengers perceive as contributing to the cruise experience. Instead of seeing experiences as belonging to the human domain, this article also brings in non-human actors by drawing on Actor-Network Theory (ANT). ANT is applied to illustrate how experiences emerge and are being constituted within the passenger ship environment. Three actor-network illustrations are used: social experiencing, everyday distinction and predictability. This article proposes that people and things become entangled via processes of translation and that the shared aims that concurrently bring actors together can be used as design drivers of the ship environment.

1. Introduction

The comprehensive understanding of the ship as a sociotechnical system has gained research interest lately [2, 21, 28, 38]. Many scholars have identified the pivotal importance of a more detailed understanding of the interaction between humans and their environment in the design process. For example, the interaction between the environment and tourism has been studied widely [27, 40, 49]. Furthermore, prior research has identified the importance of the environment to the shopping experience [54, 55], health care [6, 16], and safety [2, 50]. Additionally, the significance of green spaces in urban experience has also been highlighted [7, 37, 52]. However, to our knowledge studies on human-cruise ship-interaction have been limited. This shortcoming should be covered, as at the core of this remarkable leisure industry of a total value of 36.3 billion US dollars in year 2013 [15] is the desire to maximise the passengers' cruise experience, which can be achieved through a better understanding of the humanenvironment interaction.

The cruise ship environment has been defined in many ways: for example as a unique experience that provides a total escape, safe transportation to exotic destinations, Vegas-style entertainment, luxurious pampering, quality food, innovative on board features and awe-inspiring aesthetics [23]. According to Huang & Hsu [24] the cruise experience can also be defined in terms of intrinsic benefits or psychological outcomes that customers obtained as a result of taking a cruise vacation. Furthermore, experiences are highly affected by the surrounding elements, as the experience itself serves as an individual evaluation of activity influenced by a stimulus from a particular product or

service; it is always relevant and has a significant effect on emotions [22]. Correspondingly, Nawijn et al. [41] concluded that emotions are short lived and change according to the environmental stimuli. Thus, the cruise experience is an offering supported with products and services included in the cruise setting. In other words an experiential product that merges tangible (sensory) and intangible (symbolic) attributes is co-created by the consumer and the marketer to create an offering that is pleasurable, meaningful and memorable [29]. Fundamentally, cruise vacations are a prototypical experiential product: a combination of floating resort hotel, sightseeing vessel, gourmet restaurant, food court, nightclub, shopping centre, entertainment complex and recreation facility [28].

It becomes evident from the above discussion that the cruise experience emerges from both human and nonhumans. However, prior studies about user experiences (UX) in a cruise context [21, 23, 28, 38, 61] investigated the complex socio-technical environment from the social perspective, where humans and non-humans are seldom evaluated as heterogeneous elements. However, it is also important that human and non-human needs are studied equally to understand the interconnectivity and relationships between them. This kind of approach is customary to Actor-Network Theory (ANT) [see e.g. 9, 31, 32, 34, 36] and has been successfully used to describe tourism processes [see e.g. 26, 57, 61]. For example Paget et al. [45] captures tourism in following: "actornetworks connecting, within and across different societies and regions, transport-systems, accommodation and facilities, resources, environments, technologies, and people and organizations" (p. 967). Following the success of these studies, this research draws on ANT to understand the process of people's cruise experience. This sociological approach describes various phenomena and relationships where human and non-human actors are involved [36]. This is particularly relevant for studying experience phenomena because it acknowledges human and non-human actors equally, and conceives that any kind of action is based on the interactions between these two kinds of actors [31]. According to ANT, social relationships and interactions cannot be separated from each other because purely social actors or social interaction does not exist, and that instead networks are built from diverse actors, including actors such as humans, money and machines. Consequently, it is not possible to explain collective actions and understanding without exploring interactions between these two kinds of actors [31].

To our knowledge the cruise experience or the cruise ship environment has not been investigated before with an ANT approach. However, the methodology suits the purpose well as shown by tourism scholars. For example despite ANT not being used in Kwortnik's [28] study the three main components of ANT can be located. First, human actors exist in a role of the passengers and as service producers. Second, non-human entities exist in wider context, for example the program, weather, and language. Third, the whole system would not exist without the interaction between the former two. In other words, the cruise ship environment is a complex physical and social context that must accomplish multiple tasks when producing the cruise experience [28].

We propose that cruise experience phenomena can be better understood when emerging human and non-human actors are acknowledged equally, and the revealed interconnectivity and relationships interpreted. However, more detailed understanding is needed on the applicability of the methodology to effectively use ANT methodology to influence cruise ship design.

This study contributes to the literature by providing valuable insights into

the cruise experience phenomena. This is important for several reasons. Firstly, it extends the theoretical understanding of how cruise experience emerges. Secondly, it provides more knowledge on human-environment interaction, and this is valuable for ship designers when designing environments and processes in which people gain valuable experiences. Finally, although the use of social and design methodologies in maritime research is growing [1, 38, 48] the approach is relatively radical. Nonetheless, with this approach we believe that the highly experimental environment of the cruise ship can be explained in order to characterise involved actors and their relationships, which introduces an alternative approach by translating actor-network theory into the field of cruise ship design.

2. Tracing the cruise experience with actor-network theory

Van Der Duim & Caalders [56] suggests that the tourism should be seen as emergent effects, rather than premeditated. With ANT human and non-human entities along with material and immaterial relationships can be explained in the form of networks making it possible to illustrate how these networks are built and sustained. However, a constant process of conversion and regeneration is common to all of the networks, and interactions between actors in the network need to be continuous in order for the network to remain together [31]. Therefore, actors cannot be situated precisely in certain places, but instead actors are engaged in the surrounding environment. Whilst networks can either be temporary or long lasting, Law [36] notes that the overall features of the network are larger than the sum of its parts. Building on this, networks are not regarded as static in ANT, but instead as repositories of past, present, and future decisions, actions, and perceptions. To illustrate this, temporal mobility in ANT is conceptualised through "inscription" and "translation" [3, 33].

Inscription in ANT's context refers to the process where past events are embodied in an object [3] while translation should be understood as objects being perceived and understood by others in situ. Many times translation has been used for re-conceptualsing tourism processes to establish relationships between actors [see e.g. 45, 57]. In common with these approaches, the focus of this study is to identify the translations between actors to better understand the role different actors have within the cruise experience. In other words translation defines the roles and delineates the scenario [9].

The third central concept of ANT and the present research is the "ordering". According to Law [35] ANT is the sociology of ordering rather than of order. Consequently, translations generate the ordering effects in which the ordering demonstrates how reality is constructed through processes of translations [58]. In other words when relationship between different actors is established it is called translation, which becomes a network together with other translations and this emerging process can be called cruise experience ordering. Thus, tourism and similarly cruising are products of constant ordering: a complex network of human and non-humans creates ordering effects' [18].

When human and non-human are studied as heterogeneous elements, objects, spaces, and technologies should be seen as binders, which structure, define, and configure interaction rather than as the outcrops of human intention and action [56]. This is because every extension of a network in space and in time not only incorporates more and more humans, but also incorporates more and more non-humans [59]. For example a passenger may have chosen the cruise vacation because the total escape it provides, whereas the cruise ship's layout and cruise program

enables multiple events to be attended in a short time-period, and therefore time-space decompresses immediately. Thus, the layout and program are the important binders of the experience. Furthermore, the cabin, wellness amenities, and security systems may be important binders which enable the possibility to visit exotic destinations comfortably and safely.

Building on ANT, we suggest here that the tasks or aims that bring human and non-human actors together can be seen as translations that are beneficial sources of characterising the cruise experience and the involved actors. Furthermore, when the cruise experience is analysed from the ANT perspective, the process may reveal seemingly insignificant or unrelieved actors, which are active binders which establish cruising order and therefore become valuable sources of recommendations for cruise experience design.

3. Research methodology

Data for this paper was collected through cruise ship passenger interviews and participatory observations during a one-week cruise in the Mediterranean. Since the aim of the data collection was to gather passengers' narratives about their cruise experiences, a research approach that drew on interviews and observations was considered as an ideal foundation for research methodology at hand. Furthermore, the selected data collecting method goes hand in hand with the ANT principle of understanding of what is going on, what should be of interest, or simply attended to [39].

3.1 INTERVIEWS

The exploration of subjective interpretations and meanings is central when studying human experiences and therefore interviews were conducted as interviewees have first-hand experience with the topic of interest [5, 47]. In order to gather interpretations of real experiences in a real environment with real passengers, data was collected in an authentic environment on the cruise ship *MSC Sinfonia* in summer 2012. This was a typical midsized cruise ship sailing in Europe. The data gathering process and focus of the interviews was planned according to the authors' previous experience on cruise ships. Interviewees were sourced through informal discussions with fellow passengers and the interview was then scheduled for suitable moment. All interviews were voluntary and participants were informed about the interview aims, and that the data would only be used anonymously for scientific purposes.

Total of eight unstructured interviews were conducted (50% male, mean age= 37,4). Five out of the eight participants were first time cruisers. According to the Cruise Lines International Association (CLIA) the average age of cruisers is 49 and 25% of the cruisers are in the 30-39 age group [14] Although, our sample equates well with the expected average passenger it must be noted that our sample is not restricted to one category of passengers, but represents eight different types of passengers. This approach was chosen since the informality of the method gave a more varied insight, and thus helped in tracing the extensive set of actors and their connections [12]. Furthermore, the unstructured interview method allowed the discovery of reliable information from their personal experiences [8]. Although an unstructured interview method was used, the interviewer encouraged the participants to discuss their cruise experience and the ship environment. The interviews, which lasted 30 minutes on average were recorded and resulted in 54 pages of transcribed data. The background of the participants of the study is detailed in Table 1.

3.2 PARTICIPATORY OBSERVATION

Conducting eight unstructured interviews was considered sufficient for the aims of the study as interviews were com-

NAME	A	B	C	D	E	F	G	H
Nationality	FIN	FIN	CHI	GER	GER	AUS	AUS	GB
Gender	M	F	F	F	M	F	M	M
Age	32	24	26	22	22	53	59	61
Occupation	Designer	Student	Student	Model	Police	Official	Photographer	Writer
Interview location	Nightclub	Library	Shopping area	Lounge	Lounge	Reception	Bar	Bar

TABLE 1.

plemented with extensive participatory observations; when conducting observational research, researchers must also pay attention to events, the surroundings, the interaction, conversations and the use of objects in everyday situations [5, 25]. ANT advises the researcher to follow and trace the activities, transformations and events where actors gather, because activities always leave marks, and the researcher's role is to follow those marks and compose a picture based on the activities, even if the researcher does not know in the first place what to look for or where [34]. Consequently, observations were made in the role of a regular passenger striving to adapt to the cruise ship community. In other words, the first two authors attended various events, followed a cruise programme and had informal discussions with other passengers. Observations were conducted practically all the time during the seven-day period. The observations of different events, the cruise ship environment, the interaction between human and non-humans in a typical cruise vacation were documented in 73 pages of field notes, photographs (n=2237), drawings (n=16), and additional material such as daily cruise programmes and brochures (n=47). All the observations were in accordance with standard research ethics principles and practices, and fellow passengers where not disturbed without their permission. The photography used strived to immortalise the general activity without making individuals identifiable.

Whilst the interview method, observation, and the sample size of the study do not lend themselves to making generalisations with respect to the results, the results still serve the purpose well of applying Actor-Network theory in novel way for mapping cruise experience actors and their relationships. However, the methodology did entail several limitations. Firstly, the use of only verbal and observing data contained a risk of misunderstandings of the speech or behaviour. Secondly, by only observing present situations the probability of dismissing anything that did not fit into the topics neatly enough was increased [47]. Furthermore, when conducting interviews focusing on a certain topic there is a danger that the participants may try to identify the 'correct' answers and instead describe their cruise experience or the ship environment in a way they feel is critical for the research. All in all, the results may have been richer if more participants were interviewed, but this study has demonstrated the principle of using the ANT methodology in the cruise ship context.

3.3 DATA ANALYSIS

When following the principles of ANT the aim is not to investigate the reasons for forming actor-networks, but to explain how networks emerge, stay together and break apart over time and space. Good

ANT research is therefore a story where actors are causing events and are not illustrated only as parts of the activity [31]. Therefore, collected insights from interviews and observation were interpreted after systematically organising, merging and compressing the data in order to find congruencies from the narratives and observations. Furthermore, in order to clarify how emerging actors were linked to each other and what kinds of aims the actors have, the linkages in between were visualised with network illustrations of the most congruent actors. Visualisations were used because in this way networks provide a clear way of explaining how things are related [53] and network illustrations often highlight the actors that are active binders in the network. Furthermore, visual illustrations complement verbal descriptions and provide further depth to the hierarchical significance of the network, as it is difficult to explain the composition of a network simply using words. According to Tufte and Weise Moeller [53] visualising networks in this way provides clear explanation of how things are related. The analysis of the data by using ANT revealed three congruent actor-networks, which are together ordering the cruise experience.

4. Results

Networks are different and constantly changing [31] and to visualize this nature of the networks we chose one network aim, cruise experience, and focussed on visualising how this aim is achieved through different organizations and compositions of networks. Although, the following three networks do not share exactly the same actors, they share a fundamentally similar aim – cruise experience. Thus, this paper shows and helps the reader to understand how the same outcome can be a pursuit of different combinations of actors.

In the following, three ANT illustrations (everyday distinction, predictability, and social experiencing) should be interpreted as a collection of emerged actors and their relationship that emerged from the data. Thus the location or distance between individual actors does not have any specific meaning and illustrations basis on clear visualisation.

4.1 EVERYDAY DISTINCTION

Network analysis revealed that the cruise program had a central role in the process of distinguishing the cruise experience from everyday living, and most of the activities that actors account for are related to the programme and schedule (see Figure 1). Consequently, many translations occur through the programme and the programme creates a framework for the cruise activity and works as an important means of communicating the 'cruising codes', which are the unwritten rules of behaviour and dress code in different events. In addition, passengers spend time on unstructured activities, such as reading, sunbathing, shopping and debating issues. The majority of activity was carried out in groups as part of the organised programme, rather than planned independently. We noticed that an ample amount of possible activities still allowed passengers the opportunity of scheduling their other daily activities around the programme.

For many passengers, cruising makes it possible for them to wear certain outfits that they would not wear in their on-shore life. For example three female interviewees felt that varying their clothing according to the programme has a central role in their cruise experience. We discovered that some passengers felt that changing their outfit was a necessity many times a day. One interviewee reported that she felt embarrassed if she passed the reception wearing an unsuitable outfit for the current programme, for example sportswear when there was something other than sports going on. During the evening programme, the out-

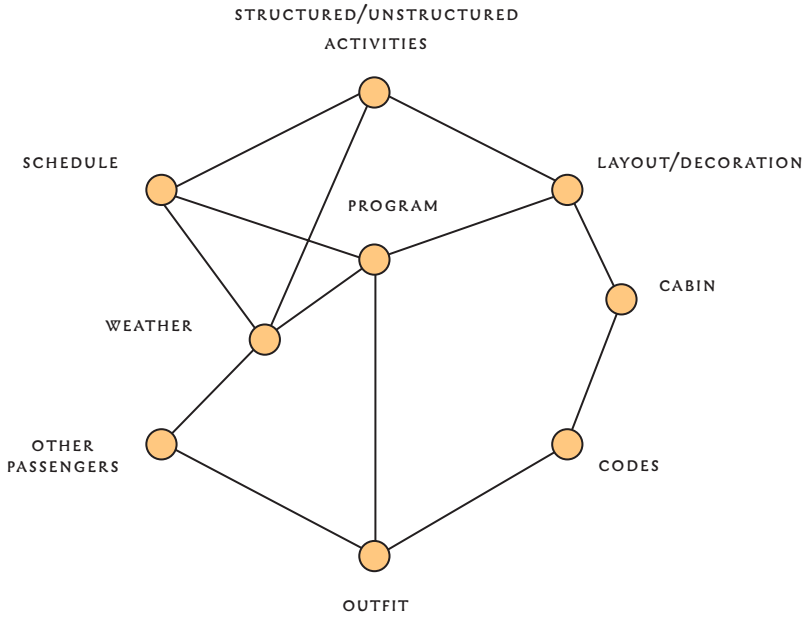

FIGURE 1. Actor network of everyday distinctions as it emerged from the data.

fit gained particular meaning, as people were focused on their appearance.

A cruise ship layout brings a special character to the programme, as short distances enable participation in multiple events during the day. This escalated the need to change outfits and passengers visit their cabins many times to do so. Furthermore, the cabin is an affective actor when it comes to everyday distinctions because people are living in a relatively compact space where most of the furniture is fixed. In addition, the layout and decoration of the ship were considered distinctively different from other holiday and everyday environments, which increased the everyday distinction.

Research showed that weather is an important binder of many actors. In a cruising context, weather was many times perceived through ship's movement, affected by wind and waves. Weather was experienced through many senses and it can be said that weather can also serve as entertainment for some passengers. The results indicated that weather can be the content of the activity and that passengers can spend long periods just lying in the sun or watching the horizon at sunset; weather was experienced as reassuring when it was warm and the sea was calm. Consequently, weather had an enabling and limiting influence on human and non-human actors, such as by enabling or limiting outdoor program and inside spaces through its effect on light, temperature and sound. For example weather strongly affected interviewees experience through the windows: "sometimes the sea looks ok, if there is sunshine, the sea looks very welcoming, but if there is not sunshine, then it feels like quite cold and, and feels like I'm happy to be here onboard [sic]" (Interviewee B).

Other actors are unable to control the weather or escape from the weather. The continuous and comprehensive influence of the weather meant that passengers take it into account on both a consistent and inconsistent basis. For example, ship movement affects their decisions, such as whether to relax or play various sports. Interestingly weather was interpreted through other passengers clothing

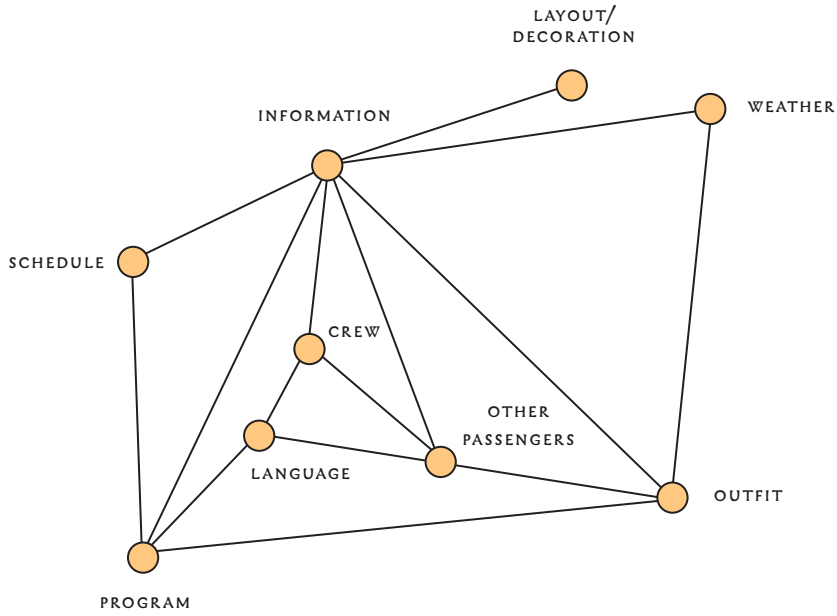

FIGURE 2. Actor-network of predictability as it emerged from the data.

as once inside the ship there were limited frames of reference as the outside view was often limited.

Passengers were ready to accept changes in their holiday plans due to the weather, even though they would have difficulties accepting that change if it were caused by other actors. For example, one interviewee stated that she was ready to accept the cancellation of an excursion because of the weather, but a whole day would be ruined if the crew caused the cancellation.

4.2 PREDICTABILITY

Because almost everything on the cruise is scheduled and fixed, passengers can easily predict the course of both formally organised and individually organised events (Figure 2). The entire cruise ship works according to the official programme, which gives a rhythm to living on board. The programme guides the activities on board the ship, and events do not start suddenly because the entire programme is carefully communicated through newsletters, advertisements and through talking with other passengers. These features make communication an essential aim of several actors in the predictability network (Figure 2). The official programme offers choices of activity throughout the day. Although passengers have the freedom to choose from many possibilities, breaking the planned 'living rhythm' is difficult because of the fixed schedule. The guidance of the cruising company makes passengers feel that other actors in the network are responsible for their mood. Some interviewees thought that they have the right to be unsatisfied with the programme because they did not participate in planning it: "so we just went down from the catamaran to the sea and came back. Which was not what we signed up for. So that was very a, how to say, maybe we misread it but it did not say [sic]" (Interviewee H).

Naturally, predictability is strongly related to the information that passengers have gained before the cruise and when on board, and information permeates everything during the cruise. Information flow enables the operations of the cruise ship ecosystem because the ship is full of actors who need to be informed about

their roles and position. Many translations occur through information, thus the role of information is to strengthen and edit the network structures. A cruise ship is an exceptional environment when it comes to information. After a ship has departed from port, the input of information from outside the cruise ship is low because communication with the outside world is less frequent and it is unusual to have new actors on-board ship during the cruise. However, the actors produce new information all the time during the cruise. This 'closed system' of information enhances predictability because the use of typical communication devices (e.g. internet and phone) are unreliable due to reliance on satellite connections. Human actors collect information, mainly visually and orally, whereas the language also has a central role. Information flows from passengers to crew, among the crew, and from passenger to passenger, and through signs.

Seemingly insignificant actors informed participants about multiple things to consider. For example, a price tag provided information about the price of an item, but also affected their interpretation of item or service quality, or other passenger's outfit helped to predict the weather. Additionally, information flows through different objects, shapes and materials and also between non-human actors. For instance, a cruise ship's database handles a tremendous amount of numerical data daily. Furthermore, clothing acts as an important agent of information exchanged between the crew and passengers. The crew differs from passengers with their uniforms, and the status of each of the personnel can be interpreted from the uniform. It was revealed that even though a network works perfectly, one human or non-human actor could make a passenger feel uncomfortable. One of the interviewees said that the choice of decoration materials and cleanliness affected her cruising experience: "I just wonder these leather brown chairs it looks actually quite disgusting, because many people here are wearing skirts, so if you sit on the chair after so you might share some sun tan lotion and sweat of others [sic]" (Interviewee B). In addition the ship's decoration is an important actor in the predictability network as it informs passengers about the familiar functions of the different spaces. Furniture and other decoration elements referred to the process (inscription) where past events are embodied in an object [3]. Correspondingly layout became more and more familiar for the passengers during the cruise and therefore represents inscription of the network.

4.3 SOCIAL EXPERIENCING

Passengers are participating in a cruise network and a network based on their own cruise experience. Typical types of participation are movement, hearing, listening and watching. A cruise ship can be seen as an arena for a holiday, and a person's mere presence can be seen as a form of participation. Differences in participation emerge. A person can either primarily participate in producing another person's cruising experience or can concentrate on one's own personal experience.

Doing things together and the emerging stories about common experiences play a central role in the cruising experience. Knowledge is shared, new things are learnt and new persons are met while socialising. It is also common that crewmembers participate in socialisation informally. Consequently, language has a central role as a enabling the verbal interaction between people. Usually people are traveling as part of a group (e.g. family or as a group of friends), where one has a 'leader' role guiding the group's activities. Even though the group's participants are spread around the multiple events on a ship, togetherness emerges as people form strong ties to the particular group they feel committed to. Building on this, interviewee B told us that she always tries

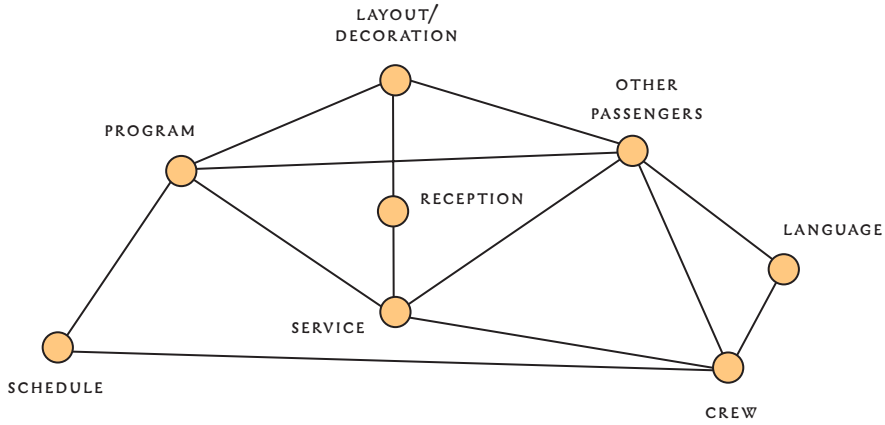

FIGURE 3. A visualisation portraying how the actornetwork of social experiencing emerges.

to organise all the group members around the same table: "I would just pick the first seat that's still available for our group, we are travelling as group, so it is, I would just get the first seating immediately, because I would be afraid that there are others taking that seat [sic]" (Interviewee F).

Passengers felt that the organised cruise programme and scheduled events removed some of the challenges of decision-making inside the group. The interviewees reported that it is easier to make decisions when the number of offered activities is limited. The cruise programme also unites passengers. For example, participation in an excursion creates relationships among passengers participating in the same activity. When observing passengers' behaviour on board, it was noticeable that a majority of passengers spent the day with their own smaller travelling group, whereas in the evening they became more open and in contact with other passengers and spent their time in larger groups. In addition, different services guide social activity on board. For example, dinner traditionally brings smaller passenger groups together at larger tables, while in alternative restaurants (supplemental dinner) seating increases intimacy with smaller table groups.

It was resulted that the cruise experience is only possible within the context of the cruise ship where meals, wellness and gym activities, i.e. program, strongly rely on non-human actors. In Figure 3, these space-related non-human actors appear in the form of layout or decoration actors. Social experiences highlight the decoration as an enabling and limiting actor: interior design can enhance social interaction, for example through furniture arrangements, improve privacy via various facades and control the flow of people through the layout and dimensions of the space: "the positive things about the ship are, there are many, many spaces where you actually can find some way a little bit to yourself [sic]" (Interviewee G). For example, beauty treatments are provided to passengers in individual rooms under the guidance of the attendant, and exercising in open spaces is done together with others, usually without guidance. It is interesting how an individual lounger serves as a single base for relaxation (i.e. sunbathing, reading and sleeping), but when paired or arranged in a group, loungers function as a basis for socialising. When passengers were forming their cruising experience network, some of them sought out other people while others sought a quieter place. In addition, reception and its crew had a central role in the social experiencing network as it functioned as a main source of information, had a central location in layout sense, and therefore was used as a meeting point.

5. Discussions

The aim of this article was to study the cruise ship environment to create an understanding of how passengers' cruise experiences emerge, and to provide insights that could be utilsed in cruise ship design. Indeed this was done first by contributing to the literature by extending knowledge about cruise experience and human-environment interaction by revealing three congruent actor-networks of cruise experience and second, to our knowledge the new design application was demonstrated as we explored the cruise experience through Actor-Network Theory.

This research made it clear that cruise experience is ordered from everyday distinctions, predictability, and social experiencing actor-networks. That is inline with the prior studies which concluded that the cruise experience emerges from escapism [23], guidance [61], social interaction [28], and the design environment which is utterly unlike design from people's everyday environment [28, 30]. However, the alternative perspective (ship design) and approach (ANT) enabled us to extent prior research on cruise experience with the knowledge on how different actors of the cruise experience are related. For example Kwortnik [28] has successfully described the cruise experience through three different effect sets (Ambience, Design, and Social), which result different human responses. Whereas our research approach resulted in the definition of three different actor-networks of human and non-human actors, which impact the overall experience of the cruise.

Although three actor-networks were a result of this study, the aim of actor-network theory is not to provide generic networks or identify generic lists of actors, but to illustrate an actor-network for a specific event. Therefore, providing a definition for the generic actornetwork of a cruise experience was impossible, and only actor-networks among the individual passengers could be illustrated. Therefore, we observed connections between actors and illustrated the most congruent networks based on these findings and realised that understanding the aims of individual actors is essential. When analysing networks, including actors and their connections, enabled us to identify what kinds of processes were taking place behind user interpretations. In other words it revealed the interaction between human and stimulus from surrounding environment. In this process passengers interpreted the networks that they are participating in and their interpretations lead to certain responses, thereby creating the overall cruise experience for the passengers.

Therefore it is important to understand what kinds of goals individual networks are aiming at in order to realise the ways in which actors are interconnected. In order to be motivated to be a part of a certain network, the aims of the individual actor and the network aims must be in line. According to actor-network theory, individual actors participate in a network if the network can cater to their desires [9]. For example, we concluded that food offers nourishment, and pampering for the passenger and meal times guide the cruise schedule, which in turn gives a rhythm to onboard living. Therefore the common approach of listing the individual actors has little value for understanding the relation of environment to the human experiences. However, valuable knowledge can be achieved by understanding the entity, aims and connections of the actors.

Furthermore, if crew uniform, meal times, and crew are listed as an actors of cruise experience it has only little value, but if it is illustrated that these actors are engaged in wordless communication (translation) it makes much more sense, i.e. dinner is served with a sophisticated table setting and servants have formal uniforms, the people follow these 'codes' and adapt their behaviour according to the set-

ting. This is directly linked to the everyday distinction network. Consequently, Yarnal and Kerstetter [61] have noted that behaviour on a cruise differs from everyday life, and the fairytale-like environment makes everyday routines quickly disappear. We believe this is a result of the source of human behaviour being situated in the way we perceive our environment, and its properties guide our response [13] and behaviour [4, 43]. Another reason might be that other people's behaviour in a social group has a great influence on individuals' behaviour. This has to do with social schemas: unconscious activation of 'schemas' (information retrieval) that affects social cognition and behaviour. [17] Our findings demonstrate that formal outfits and table settings are important binders and that can influence human behaviour.

An individual actor can belong to several networks with each having different goals. It is worth pointing out that the goals of the different networks do not conflict with the aims of an individual actor. For example, information flows through the three networks in many different forms and informs thousands of different matters. In addition to emerging as information itself, it appears that information translates through schedule, layout, decoration, language, weather, program, outfit, and other people. Thus, depending of the aim of the network the different actors can be seen informing about the everyday distinction, predictability, or social experience. Furthermore, individual networks can be a part of larger networks since everything is ultimately constructed from various open-ended networks [31]. In this case the three emerged congruent networks of the study are part of the cruise experience network. Furthermore, a quite limited network that begins from the cruise environment can easily extend beyond the cruise ship, which is a good source of improvement of the overall cruise experience.

In line with extant research stating that people are seeking enjoyment and overall pampering from the cruise [11, 60], our research revealed that translation of enjoyment and pleasures takes place through the programme. The programme for example separates the cruise experience from everyday life, plays central role in predictability since living on board is guided by the programme, and therefore guides the social experiences as well. This supports Yarnal and Kerstetter's [61] finding that passengers are aware of being guided, but feel that it is a part of the experience. It can be argued that cruise programme is one of the most unique elements of cruising as in other vacation types similarly intensive and multi-sided programmes seldom exist. The cruise programme (with the help of other actors) enables passengers' to participate in multiple events, thus giving freedom to leave the planning to other actors. We interpreted this to be translating the pampering. Furthermore, ready made 'daily plans' enable passengers to participate in multiple events. Thus, it is translating enjoyment for the passengers. For this reason on cruises, passengers have the time and strength for activities different from those that are a part of their daily lives and they are able to escape from daily routines [46]. In contrast, we found that at times the ample amount of offered activities seemed to actually create stress in passengers as they tried to get the most out of their cruise. This results in disappointment when they could not participate on all of their desired activities.

Even though the official and unofficial programmes are strongly focused on the social dimension, the network comprising social experiences cannot work without nonhuman actors [31]. the programme actor was related with layout and decoration and schedule in all three emerged networks. Thus, the programme is engaged with ship's layout that enables quick movement between events as a wide range

of different services are packed into a compact package. This makes the ship environment appear as a unique environment in comparison with all the other vacation environments. According to Carù and Cova [10] companies enable customers to shape their own experiences by providing a context. Therefore it can be argued that in terms of cruise experience, important translations occur through ship's layout. Whereas the schedule keeps passengers aware of different activities on board, it also enables the program to organise without overlaps and it keep passengers evenly entertained. This in turns supports the conclusion of Cartwright and Baird's [11] note of the central role of entertainment in cruise culture.

People interpret other actors in their environment mainly by visual means [42, 44]. Many times participants reported that their visual interpretation of weather had an influence on their programme, and indeed outfit selection. Weather is therefore related to several actors and plays an interestingly central role in predictability network. Furthermore, weather exists in the everyday distinction networ, and that may be because for many passengers, weather is the reason to go on a vacation, as it was reported many times that the destination was selected because of the weather; bad weather could therefore spoil the whole holiday experience [61]. Although the weather had both an enabling and limiting influence on many activities on board it is a complicated phenomenon, which behaviour and structures cannot be completely explained [34] and therefore designers are unable to influence the weather actor. Furthermore, we found that people interpreted their environment in order to understand the functions of different spaces and therefore the layout and decoration highly affects experiences taking place in different spaces within the cruise ship environment. This supports the conclusion that the aims of the actors are always bounded by the surrounding environment [31] and that emotions change according to environmental stimuli [41] which in turn has a significant affect on experiences [22]. For example interviewee F described how the environment affected her experience: "there is a type of waterfall, a water feature, in this area, which provides a nice sound, a little bit of a background noise, that's quite soothing and it's decorated in marble as well so it looks very classic and elegant [sic]." Furthermore, visual interpretation is related to the 'affordance' process where meaning emerges from the relationship between environmental features and a perceiver. For example, the shape of furniture guides a person to a certain use or behaviour [20]. In addition, visual interpretation of the other actors in the environment appeared in terms of wordless communication as the crew did not only affect multiple actors in the network as a source of information, but the crew also gives a 'face' to most of the service options included in the programme. In addition to non-verbal communication, a fundamental means of information is the spoken language.

Ultimately, it seemed that participants were well aware of what a traditional cruise experience includes and the real surprises are created together with fellow passengers, who also become a source of information in uncertain situations. This result confirms the Gentile et al. [19] conclusion that the best experiences are usually co-created experiences and consequently cruises are usually done in groups [61]. We also noticed that passengers became familiar with the cruise ship layout and and the social schema of cruising during their first few days, which quickly resulted in new routines. The findings are interesting as the majority of the participants (five out of eight) where first time cruisers. Therefore, it could be argued that the gained image of cruise experience is quickly fulfilled when going on the cruise.

Finally, while the interview method, observation, and the sample size of the study do not lend themselves to making generalisations with respect to the results, the results still serve the purpose well of applying the Actor- Network theory in novel way for mapping cruise experience actors and their relationships. However, the methodology adopted did result in several limitations. Firstly, the use of only verbal and observational data results in a risk of misunderstanding of the speech or behaviour. Secondly, by only observing present situations we increased the probability of dismissing anything that did not fit into the topics neatly enough [47]. Furthermore, when conducting interviews focusing on a certain topic there is an inherent danger that the participants will try to identify the 'correct' answers and describe their cruise experience or the ship environment in a way they feel is important for the research. Finally, the limited sample size was a limiting factor and the results may have been richer if more participants were interviewed.

6. Conclusions

Our research revealed that a seemingly insignificant actor might have a significant influence on the overall cruise experience. Therefore, the utilisation of the ANT approach in the design process can help improve the passenger cruise experience through even small design improvements, actions and investments. When modelling the cruise environment based on ANT, it is possible to discover what the cruise environment consists of. When the actors constituting to passengers overall cruise experiences are established, the cruise environment and processes can be designed in such a way that it optimises their surroundings and they receive better service, without making radical structural changes or massive investments in interior design or to the programme.

Illustrating the cruising environment actor-network serves as an insightful design method and assists the design processes for conceiving cause and effect relations. When a designer makes a design decision affecting one of the actors in the ship-scape network, the real context of the decision can be seen through the actor- network. Emotions and experiences hold an untapped business potential in the cruising industry and a deeper interpretation of passengers' needs and desires as well as offering a new means for finding a competitive edge and improving the business.

For example, a fairly distant actor in the network can have an impact on other, more seminal, actors in the network. Our findings demonstrate that the non-human actor 'outfit' has a significant affect on cruise experience. First, the varying of the outfit during the day for different events increases the everyday distinction and gives passengers new possibilities and the enjoyment of wearing outfits they would not elsewhere. In addition, the crew wears distinctive uniforms distinct from passengers, and that too has a significant effect. Second, wearing atypical outfits gives passengers a freedom to have certain cruising role. The exposed cruising role might be something that reflects the passenger's innermost identity or it can be a role they would like to have. However, it has an effect on 'social experiencing' and 'everyday distinction' networks, which became important networks in cruise experience ordering. Third, other people's clothing decisions shaped behaviour. For example, passengers adapted their behaviour according to formal outfits. Finally, outfit translates information about several things. It helps passengers to predict the on-going activities from fellow passenger, the outside weather can be interpreted from clothing, and outfits mark out the crewmembers and their assignment on board. Therefore, when considering the issues and actors and how they are connected, the cruise experience could be developed in order to provide better ability to

meet the above described consumer needs. In practice this could mean emphasising dress codes, providing possibilities for role-play, and further distinction of the crewmembers based on their role on board could help passengers to approach correct person for the appropriate matter.

The programme plays a central role in cruise experience and it exists in all three actor-networks as an active binder of other actors. In practice this means that when developing the cruise experience it should be considered that affect of the program actor extends beyond its traditional role of providing information about the ships activities and entertainment. First, in cruise ships the programme has a unique relationship with the layout, and short distances enable passengers to participate in multiple events. This could be better utilised. For example, the corridors are only serving people flow although they occupy the considerable share of the cruise ship's public spaces. Naturally, safety regulations have an impact on utilisation, but ad hoc activities could still be organised to utilise the space in different ways. Furthermore, programme guides passenger's choices about having a meal, selecting an excursion, how to dress or whether or not to sunbathe. Respectively, it is good to understand that these choices might have an effect on the passenger's schedule and role among the other passengers. Thus, programme requires more flexibility to consider individual needs.

Additionally, the programme denotes a relatively strict rhythm for the daily life on board. Therefore, order and the hierarchy of the cruising experience give the impression that everything follows a fixed pattern. In reality, the actor organisation in the networks can be quite undefined. Although the cruising company may think that they are controlling the information flow, a deeper understanding of the information flow and its effects can be achieved by investigating the actors which are translating the information. Consequently, according to our findings, information flows through and between different objects, shapes and materials such as: schedule, layout and decoration, language, weather, programme, outfit, and other people. Therefore, we propose that in order to guide passenger's behaviour towards a better cruise experience these actors and their meaning, as an informants should be considered.

Furthermore, we also found that passengers in general were able to adapt their behaviour quickly inline with with cruising culture and that they became familiar with ship's services and layout in relatively short time. This is interesting as the actor-networks are constantly mutating and even a small change in the network can change the passengers cruise experience. Therefore, marine design should consider how the ship-scape could be renewed and transformed during the cruise to provide the passengers with new forms of enjoyment. One solution for this could be to support positive translations with good design. For example, changing environmental elements (e.g. paintings, flowers, or fabrics) that are active binders of the network on a daily basis or ultimately a move towards spaces that can be transformed to provide new experiences. However, this needs further research on the modularity of the ship interior design. Thus interior design elements could be effectively interchanged according to different activities.

Our findings reveal that a seemingly limited network that begins from the cruise environment can easily extend beyond the cruise ship. Thus, pre and post cruise should be considered when developing the cruise experience and therefore the ship terminal and other external factors may have a significant meaning in terms of the overall experience.

Finally, we contribute to the existing body of knowledge by detaching actors

from their traditional roles in order to better assess what roles they really have and what kinds of networks they are included. Individual actors can belong to several networks, whereas our current understanding situates individual actors only to one network. In general, our research is based on Latour's notion that research should not concentrate on what class or group the actor of a certain issue belongs to, but rather it should find out more about how the issue is constructed and how it works in reality [31]. Indeed, we argue that the approach we have adopted here could be beneficial for the cruise ship design as well as rethinking the cruise experience.

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Safety perception as a sociotechnical network

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Abstract

Improving passenger safety through implementing human cognitive process knowledge into passenger safety regulations is a focus of current discussion in passenger ship safety. Perception plays important role in human cognitive process and ultimately guides people behaviour. This study investigates how passengers' perceive safety on board cruise ship and traces the connections between passengers' safety perception and ship safety regulations. Article takes a novel approach to safety research and employs network analysis to illustrate the connectivity of the two parties and investigates sociotechnical environment of passenger ship safety. The research reveals that sound and handrails can play a central role in passengers' safety perception, and although many regulations are applied to these typical features of passenger ships, passengers understand them from a different perspective. It is therefore suggested that passenger ship safety design must begin to consider passenger perceptions to avoid their fault interpretations of the environmental elements.

Keywords

Safety perception; human-environment interaction; passenger ship; ethnography; network analysis

Introduction

The cruise ship business has an excellent safety record, yet there is room for improvement in understanding passenger responses to emergency situations (Lois et al., 2004). Several attempts at including human behavior in passenger safety regulations exist, but the current perspective of ship safety scholars is focused on physical capacities to ensure efficient evacuation (Kristiansen, 2013; Vassalos, 2006 and 2009). This misses the fact that such capacity may not be utilized in the emergency situation due to the passenger stressed condition. In currently passenger safety regulations, the passenger safety perception is unnoticed and unincorporated, this creates a one-way flow for communication, preparation, and accident response. Consequently, improving passenger safety through implementing human cognitive process knowledge into passenger safety regulations is a focus of current discussion (Akyuz & Celik, 2014; Le Coze, 2013; Papanikolau, 2009; Zarboutis & Marmaras, 2007) and there's a demand for more multi-disciplinary and passenger-oriented approach (IMO, 2003). According to Haavik (2014), passenger safety research should provide an understanding of the relational phenomena of functions, factors, and causes from a passenger's perspective, rather than define the sociotechnical systems pragmatically as is done today. The pragmatic approach has prevailed because passenger safety has traditionally fallen under the umbrella of ships' technical compliance with safety standards in construction, equipment, and operation. These have little to do with how passengers make use of such capacities in emergency situations and technical capacities of a ship to ensure passengers safety are something that passengers rare-

ly consider whilst on board (Ahola et al., 2014). Instead people rely on their perceptions of environment's safety.

This study considers positive safety perception so that people perceive environmental characteristics of certain environment assuring or improving their safe, whereas from negative perspective this means that people perceives some environmental characteristics inconvenience or reminding about the risk itself. Negative safety perception requires an object that produces risk; hence safety studies often analyze the causes by observing the surrounding environment (Mairal, 2008). According to Koskela & Pain (2000), fear influences our experience of the environment, as much as the environment influences our experiences of fear. On that account, human safety is often studied in relation to the environment, especially in built environments (Koskela & Pain, 2000) because, according to the psychophysical research domain, the physical design is one of the first initiators of the spatial relationship (Mambretti, 2011). Investigation safety in certain environment requires a comprehensive approach and consideration of the environmental characteristics as a whole. This is because risk is a context that brings together objects, facts, events, or any other entities that can produce harm, which in turn guides human interpretation (Mairal, 2008). In other words, people can perceive safety in different ways, including through interpreting the other actors in the environment, through their own capabilities, or through the risk itself. In general terms, safety studies from the human perspective aim to identify what causes fear, and if reducing or eliminating the recognized actors results in people perceiving the environment as being safer.

Considering all that has been discussed, it can be concluded that investigating and forecasting safety is difficult and almost impossible to study in real time. A strong research base on forecasting the objective human behavior during ship emergency situations does exist, but according to our knowledge, little is known how safety is considered subjectively in the passenger ship environment. Therefore, more refined methodologies are needed, which reflect how individual persons might interact with the environment in possible accident situations as human behavior is probably more 'chaotic' and irregular, in relation to the complexity of the situation (Helbing & Molnar, 1995). Indeed, Qiao et al. (2014) notes that psychological reactions resulting from stressful situations make people behave irrationally. This may cause, for example, the selection of an incorrect escape route that deviates from the efficient evacuation process. Furthermore, in technical and passenger perspectives on safety research, the great numbers of human and nonhuman actors involved in the process are identified (see e.g. Ahola et al., 2014; Mairal, 2008; Vassalos et al., 2002). These actors should be investigated with each other's, because the various actors do not work independently of each other, but instead work in relation to each other and are therefore interdependent. Hence, investigating safety as a sociotechnical network seems justified:

> When we are chasing the cause of a phenomenon, this may be done by establishing an understanding of the different functions, factors, relations and causes that constitute the phenomenon (Haavik, 2014: 39).

Thus to extend understanding of the human perception of safety, one possible method could be to illustrate the social aspect as a network to analyze the interconnections of different actors. This kind of approach is seen as necessary when aiming to challenge our understanding of the social influence in the safety domain. Furthermore, it is believed that in order

to develop passengers' safety, it should be better understood how their perception of the environment influences their decision-making, and it should be investigated how design can have an impact on this. One aspect for investigation could be passenger perception, as passengers perceive safety through their environment, and behave according their expectations (Mischel, 1973).

Research instrument and analysis

The ethnographical approach requires the researcher to participate directly in the relevant setting, in order to collect data systematically and without imposing external connotations or influences (Brewer, 2000). The researchers' learning process and engagement with everyday activities on board passenger ships was conducted in an authentic environment during two typical cruises on board two cruise ships: a two-week cross- Atlantic cruise with the *Vision of the Seas* in November 2011, and a one-week cruise in the Mediterranean with *MSC Sinfonia* in August 2012. Two of the authors participated in both cruises, and one participated on the first cruise. This allowed all authors to gain a good understanding of the events, surroundings, interactions, conversations, and use of objects in everyday situations on board, which are the requirements for observational ethnographic research (Jorgensen, 1989).

Altogether 17 unstructured interviews and three weeks of extensive observations were collected. Relatively small sample size is sufficient for qualitative studies concerned with meaning and not making generalized hypotheses (Mason, 2010). It is even suggested that fifteen is the smallest acceptable sample (Guest et al., 2006) and in interview studies all the new meanings emerges after interviewing around 20 people (Green & Thorogood, 2004). Furthermore, as the use of multiple data collecting methods require fewer participant's (Lee, Woo & Mackenzie, 2002) it is considered that sample of the study provides a solid starting point for the purpose of mapping previously unknown qualitative information, in which one occurrence of the data is potentially as useful as many in understanding the process behind the topic (Mason, 2010). Consequently, instead of having satisfactory sample size for statistical generalizations, the qualitative sample must be large enough to assure that most or all of the important perceptions are uncovered, whereas too large data may become repetitive and superfluous (Mason, 2010). The sufficient sample is defined with concept of saturation: the point where the collection of new data doesn't shed any further light on the investigated issue (Glaser & Strauss, 1967). In our study the data was first collected on a two-week cruise, and after transcription of the data the collection was complemented in a one-week cruise in the following year to reach the saturation.

Unstructured interview method was chosen as it allows the interviewee to provide reliable information, as described from personal experiences (Bowling, 2014). It is argued that an unstructured interview provides more valid information than a structured interview when it comes to analyzing human experiences (Gorden, 1969). The interviews were recorded and transcribed. Participants of the study with age distribution between 21 – 55 years are introduced in Table 1.

TABLE 1: Participant selected demographics.

	GENDER	NATIONALITY
CRUISE 1	F 4 / M 6	FIN 10
CRUISE 2	F 5 / M 2	GER 3 FIN 2 AUS 1 CHI 1
TOTAL	F 9 / M 8	4 Nationalities

Also participant observations were conducted during various activities that the passengers participated in during the cruise. Insights collected from these participant observations were then used in addition to those from the interviews. Participant observation sessions varied from guided programs to unstructured activities. Researchers joined different activities at various times to observe if insights gained from the interviews were taking place, and to see if these occurred generally for the passenger ship community. As the safety perception of the passengers was difficult to obtain through pure observation, researchers concentrated on features that emerged during the interviews, and sought opportunities to converse with the observed person or small group about safety matters in the various situations. The observations were recorded with notes, voice recordings, and photographs.

DATA ANALYSIS

Actor-network theory (ANT) was roughly followed to trace what is social and how it emerges as an interaction between actors, which is in line with the core focus of the theory (Latour, 2005). Latour continues that although the word theory appears in the name Actornetwork theory, what is actually at hand is a method. According to Mol (2010) ANT is about gaining a sense of what is going on, what deserves concern, or simply attention. Furthermore, the assumption that human and non-human actors will emerge and have impact on passenger safety perception supports the use of ANT, as it is a tool used to make sense of the relationships and materiality of the world including nonhumans in sociological analysis (Law, 2009). According to ANT, social relationships and interactions cannot be separated from each other because actors or interactions that are purely social do not exist, and networks are built from diverse actors including humans, money, and machines (Latour, 2005).

ANT is not used to investigate the reasoning on which networks are formed, but rather to explain how networks emerge, stay together, and break apart, over time and space (Latour, 1993). In line with the methodological prescriptions of ANT, analysis remained open for emerging connections and networks to be identified over the process of the transcript data and observation note analysis, until the most active and most often mentioned actors became crystallized. After actor networks from the passenger perspective were identified, similar approach was applied to find equivalent actors from SOLAS.

Next a novel approach was used to compare the perceived actors from the passengers' perspectives, and the equivalent or connected actors identified from the International Convention for the Safety of Life at Sea (SOLAS) safety regulations. Emerging actors were visualized as merged network illustrations, to analyze the interconnectivity between different actors and perspectives: simply drawing lines in between the identified actors as their interconnections emerged from the data collection. Visualizing networks in this way provides clear explanation of how things are related (Tufte & Weise Moeller, 1997). This enabled to highlight the actors that are active nodes in a network from the visualizations. It is considered that visual illustrations complement verbal descriptions and provide further depth to the hierarchical significance of the network, as it is difficult to explain the composition of a network simply using words. Furthermore, the visualizations support the descriptive rather than explanatory nature of ANT (Latour, 2005).

Results

We present two examples of safety networks that emerged in the passenger ship setting and how to analyze the emerging actor-networks. Using ANT as a background framework enables to go beyond

traditional thematic coding and identification of individual actors, and instead visualize how actor-networks emerge, how individual actors are connected, and therefore trace the social constitution of the networks. Customary to ANT is that networks are always changing (Latour, 2005), therefore the following visualizations capture one aspect (passenger safety) of the network and show how this is achieved, through two different organizations and compositions of networks. The examples help the reader understand how safety is a result of different assemblages of actors from the passengers' perspective, and what the relationship of these identified actors is with ship safety regulations. Thus, interpretation of the network can begin from any actor in the network, and networks even enable a multi-directional 'back and forth' interpretation of network structure and relationships. Thus the location or distance between individual actors in the following illustrations doesn't have any specific meaning and the basis of the positioning of the illustrations is that of clear visualization.

SOUND NETWORK

Figure 1 illustrates our first example of a passenger ship safety actor-network, based on the recognized actor of 'sound'. Sound or sound related actors were one of the most frequently mentioned actors (92 citations in total) when participants' described their perception of safety: 'being able to sense [hearing, eyesight, and smell]'. Sound is therefore present in the actor-networks as an active node that connects many other actors. In general the sound actor plays a pivotal role in informing passengers of different matters and is therefore critical in communication between activities on ship, the ship itself, and other passengers. For example it was said that 'announcements assist my safety feeling and I prefer having a lot of information [sic]'. Also, just constantly hearing and feeling the ships engines operating provides passengers a sense that all technical matters with the ship are acceptable, and conversely when the engines are no longer felt then a sense of emergency initiates. Sounds are an important safety perception to passengers. As one interviewee concluded with 'information should be given in away, so you absolutely know what to do in case of emergency [sic]'.

The relationship and sequence of events involving actors engaged in the 'sound' network from the perspective of safety regulations is that SOLAS provide policy is simply specifying how crew should act in the event of a hazardous situation, and by what means the alarm should be given (see IMO, 2003; 2004). The hazard itself plays the role of a 'black box' in the network: when closed it is included as a potential actor (risk); in the event of an incident, the box is 'opened', the actors connected to it become active, and the network alters to account for these newly emerged actors (i.e. a hazardous incident is required for the alarm to be sounded). When the alarm sounds passengers become aware of it via their senses, mainly sound. It is via the alarm network that a signal (originating from safety regulations) is conveyed from the crew, capturing passengers' attention for further instructions. The crew gives these instructions via announcements. However, there is no discussion of offering advice for example when engine or propulsion systems change conditions, whereas that is critical to passengers.

When sound is considered from the perspective of the passenger, the actor-network reveals that sound communicates more than just alarms and announcements. The 'announcement' actor emerged as interviewees reported how language and tone of voice used in the announcement affects their perception. Announcements given in multiple languages confused passengers and they

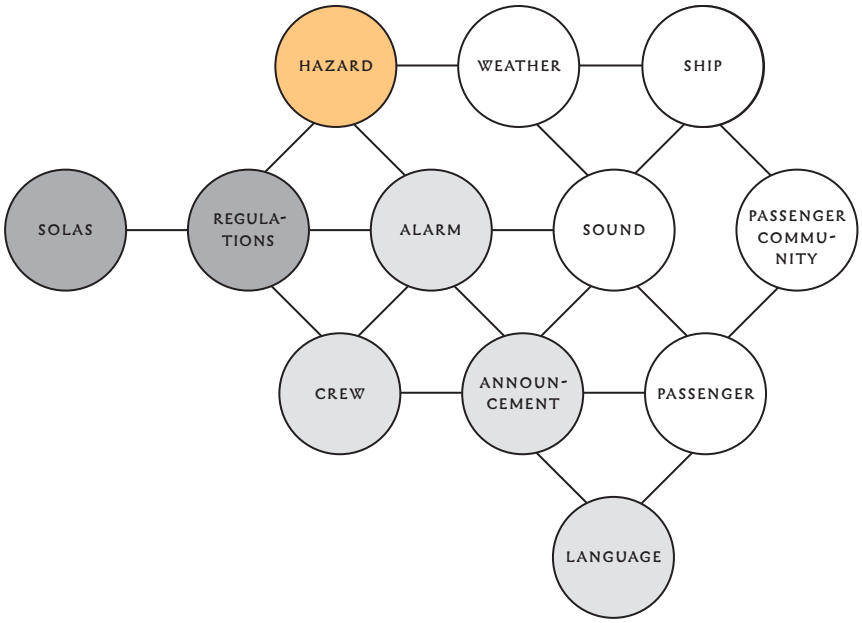

FIG. 1: Illustration shows how the 'sound' network emerges from the safety regulation perspective when read from left to right, and how it emerges from the participants' perspective from right to left. Black circles represent actors that appear in the safety regulations, dark grey circles represent actors covered in both perspectives, and light grey circles emerged only in the participants' safety perspective. The orange circle indicates a hazard (black box) that alters the network if activated.

could rarely focus until the information was given in their own language. This was most relevant when a passenger's native language was not the main language of the population, as the order of announcements made in different languages is relative to the population size speaking each language. Passengers thus often missed information, which had a negative affect on safety perception. On the other hand, the use of multiple languages positively affected safety perception because it gave the sensation of being able to communicate in their native language on board. For example, 'the trained and friendly crew has also a excellent language skills [sic]'. The tone of voice of the announcer revealed to the passenger if the announcement was, for example, an advertisement, general information, or something more serious, like guidance. It was inferred that if an announcement were made in an emergency situation, passengers would attempt to recognize the seriousness of the situation through the tone of voice of the announcer. For example, one interviewee described the feeling as a 'general sense of calm – no one is panicking' when listening to a non-emergency announcement.

It was revealed that sound also conveyed information to the passengers about the ship itself. The sound of the engine running calmed passengers by indicating that the engine or elevator was working correctly. Sounds made by shoes, heard throughout the ship, communicate the kind of movement being made (e.g. nervous or calm), as well as the location of other passengers. Interviewees also expressed that hearing the hum of voices made them feel safer than total silence. Sound provided information about the outside world, and safety was perceived via sounds that indicated the state of the weather. Sounds that indicated a storm, for example, could alert passengers to dangers associated

with the weather, and weather was the only actor that caused clear fear among participants. Participants displayed a desire for more information about weather conditions, perhaps to increase their perception of safety. One interviewee declared 'they should inform people if it will be very windy and the sea will be rough'. Additionally, 'weather' is linked to the 'ship' and 'hazard' actors; since weather can be the origin of sounds heard on the ship (e.g. ship moving through large waves and rain hitting windows), and weather may cause a hazard.

HANDRAIL NETWORK

Figure 2 illustrates our passenger ship safety actornetwork based on the second actor identified in this study, the 'handrail'. From SOLAS safety regulations it was found that the regulative perspective is fairly technical, and outlines rules for the placement, type, material, and attachment of handrails on passenger ships (IMO, 2004). When the handrails conform to these regulations, the belief is that passengers have a safe capacity to get around. Participants of the study also perceived the handrail actor to be crucial for passenger safety. Since SOLAS also provides regulations for handrails, the handrail actor was found to be an active node of many networks from both perspectives, and the actor-network was composed around this actor.

Handrail was the most cited single safety actor among the interviewees and it was mentioned 25 times in total, whereas it was revealed that handrail related actors were mentioned 51 times in total (see detailed coding framework from Ahola et al., 2014). As an actor in the safety perception network, the handrail emerged mainly in terms of support and barriers. For example one interviewee noted 'you are able to hold yourself by rails [sic]' when describing their perceived safety on board. Passengers perceived safety through the placement and appearance of the handrails: if their placement is perceived to prevent people from falling, or if the construction or attachment of the handrail is perceived reliable, it has a positive impact on safety perception. Many times participants indicated that some handrails, especially on outside decks, looked too low to prevent falling, and the attachment too weak to really support them. Given these perceptions, the passengers will not make use of the capacity designed into handrails when meeting the SOLAS regulations. Thus the regulation is essentially defected by passengers not using them.

Handrail material was considered an essential actor of the network, and it was interesting to find that the handrail is essential from emotional and decorative perspectives also. Interviewees indicated that the use of wood in handrails affects positively on safety perception because they were able to identify the material, and were familiar with its strong characteristics, which aroused feelings of trust. The passengers felt that 'real material, like wood, is easier to trust'. Incombustible materials are mainly used inside passenger ships due to the flammable nature of wood (IMO, 2004), and handrails are often made from materials that only imitate wood. This confused participants and they felt that 'the colors of the surfaces should not be misleading'. As incombustible materials are often synthetic, participants were confused when the appearance of the handrails conflicted with how they felt to the touch, and this aroused mistrust. Natural materials were perceived to be of a higher quality, and therefore increased positive safety perception. Furthermore, the large-scale use of fragile materials concerned passengers. For example, decorative glass constructions on the promenade were not perceived to have proper support and distressed participants; one interviewee noted that 'huge glass constructions on the promenade are scary'.

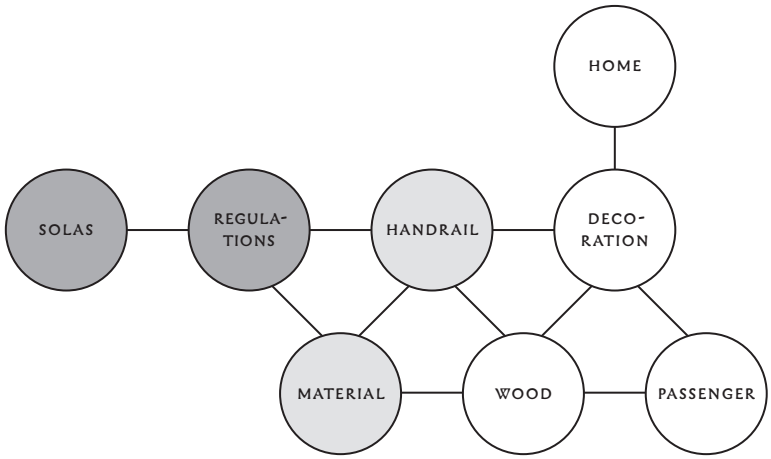

FIG. 2: Illustration shows how the 'handrail' network emerging from the safety regulation perspective when read from left to right, and from the participants' perspective from right to left. Black circles represent actors that appear in the safety regulations, dark grey circles represent actors that are covered in both perspectives, and light grey circles emerged only in the participants' safety perspective.

The handrail is a customary decorative element of the passenger ship environment, which passengers recognized as distinguishable from other environments. Study revealed that passengers are familiar with handrails being present in safety critical environments, thus their presence on passenger ships has a positive impact on safety perception. In addition, the use of familiar decorative elements from the home environment such as materials (wood) and colour schemes (natural) increased the perception of safety when applied to handrails and also to ship environment in general.

Discussion

Analysis of the actor-networks shows that similar actors exist in the regulative and passengers' perception of passenger ship safety, and a clear linkage can be traced between the two perspectives. However, our analysis also reveals that these two points of view differ. First, safety regulations proactively ensure that passengers are informed about possible danger, the crew operates according to situational requirements, and the ship is designed to handle a flow of people towards designated places (e.g. evacuation points, muster stations). However at the same time, people regard their safety as situational and don't pay much attention to it beforehand. This may be caused by the motivation towards safety, as passengers are on board mainly to enjoy their holidays, and possible accidents seem distant (Ahola et al., 2014). This differs to regulations, which are established with possible accidents in mind. Second, passenger and safety regulation perspectives differ because passengers perceive their environment mainly through actors customary to the shipscape (e.g. decoration, community, and background noise) (Kwortnik, 2008), but which are not discussed in safety regulations due to the functional focus of regulations. Third, people rely heavily on instinct and what they have learned previously when interpreting their environment (Kyttä et al., 2011; Still & Dark, 2013), a process in which emotions and senses play an important role. Indeed, according to Picard (2003), it is impossible for a person to have a thought or perform an action without engaging, at least unconsciously, his

or her emotional systems. Whereas passengers are many times unfamiliar with safety appliances and procedures, which may cause uncertainty.

Although the passenger and safety regulation perspectives do differ, it must be noted that the identified actors appear in the network because they share a common aim – passenger safety. This makes us believe that subjective safety could have an impact also on objective safety, i.e. passengers perceive and interpret their environment designated way. For example, state that any interface that ignores a user's emotional state, or fails to elicit the appropriate emotional response, can dramatically hinder performance, and risks being perceived as untrustworthy and ineffective (Brave & Nass, 2002). Thus, evacuees might avoid the shortest way to the muster station if emergency exits fail to arouse their trust of the right direction.

This research reveals that sound, handrail, and the promenade can play a central role in passenger safety perception, and many safety regulations are applied to these typical features of passenger ships. For example, sound is noted to be a significant form of communication in both perspectives: sound enables the crew to communicate with passengers through alarms and announcements, which are regulated in SOLAS. On the other hand, our research revealed that although passengers consider sound important for their safety perception, sound communication via announcements and alarms doesn't have a focal point in their safety perception during normal situations. Instead, safety perception perceived through sound is mostly via sounds carried by the weather, passenger community, and the ship itself. Consequently, people interpret the current situation through different sounds and tones: e.g. the announcer's tone affects people's perception and people perceive the situation as more safe if they are able to hear the presence of the other passengers. Therefore, sounds from the passenger community may also play an instructive role in emergency situation. This corresponds to findings that different situations are experienced through the joint effect of many senses (Hirschman & Holbrook, 1982). Furthermore, our result adds to Vanem & Skjong's (2006) discussion about on board safety procedures, in terms of human responses to alarms and many other proposed evacuation models (e.g. Caldeira- Saraiva et al., 2004).

SOLAS regulations concerning handrails refer to the positioning and placement of them on board, in order to support people and prevent them from falling. The practical importance of handrails has also been noted by safety scholars (e.g. Ahola et al. 2014, Lee et al., 2003), yet our participants perceived handrails emotionally; in terms of whether they aroused feelings of trust or mistrust. This was mainly because they felt the handrail's appearance was misleading; construction of the handrails was perceived as inadequate, and the material perceived to be wood was actually a wood imitation film. These perceptions affected the passenger's overall trust with safety and they questioned if things were actually as they seemed. Therefore it is important to consider how handrail material and appearance affect human perception and further behavior. In general people readily trusted familiar things; they felt they were able to trust materials or construction that they recognized as familiar. Furthermore, the familiar objects in the environment increased a feeling of coziness, which respectively increased their positive safety perception.

Thus it can be concluded in line with Mairal (2008) that negative safety perception is a result of uncertainty of upcoming happenings (i.e. their interpretation of actors, for example upset tone in announcement, unfamiliarity of actors or

blocked view), and positive safety perception results from the ability to trust their surveillance of the causes of possible risk, either by themselves or with a help of other actors.

Conclusion

The first aim of the paper was to study how passengers perceive safety on board passenger ship, as research interest on the topic is scant although perception directly guides human decision-making and behavior. In addition, it is shown in Ahola et al. (2014) that passengers 'perceive safety on board through actors that are acknowledged both in passengers' safety perception and in passenger ship safety regulations. Thus, the second aim was to visualize the relation of passenger safety perceptions to current safety regulations. Indeed with a novel approach of employing Actor-network theory as a background framework in safety research enabled to visualize and communicate the connections of different actors in the network involving the safety of passenger ships. By reassembling the social aspect (Latour, 2005), our findings provide a valuable guidance for future passenger ship safety research and show intermediate results how non-human actors (e.g. handrail) can affect such a social phenomenon as safety perception. To our knowledge the approach of this study creates basis for a new research direction where safety is investigated as a constantly moving and emerging social construction of networks.

Building on the research of Ahola et al (2014) the current research reveals that although these viewpoints are different, they share the same actors and can therefore be connected. The results indicate that the difference in viewpoints is that the technical viewpoint is more anticipatory and functional in nature, while passengers establish their perceptions in an instance, and are strongly based on feeling.

The use of ANT proves the existence of the connection and provides better understanding of the connection between these actors. Following the principles of ANT, a connection between two actors means that both of these actors belong to the same network, and belonging to the same network means that both actors support the same overall network aim (Latour, 2005); in this case, passenger safety. Consequently, in this research it is revealed what people are connecting to their perception of safety, and what is the relationship between the emerged actors. In addition, results and current safety regulations are reflected upon to see if those actors recognized from the passenger perspective should gain more attention or be approached from different point of view. Because between technically oriented regulations and social influences, possible misunderstandings can arise that should be considered in the ship safety design. Therefore, if a designer wants to deeply understand what kind of influence design decisions have, he or she should understand all the characteristics of the handrail (actor) in order to understand how these characteristics are first, perceived by the user, and second, how the characteristics should be communicated through design.

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Safety in passenger ships: The influence of environmental design characteristics on people's perception of safety

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Abstract

Although objective safety is a widely studied topic in ergonomics, subjective safety has received far less research attention. Nevertheless, most of human decision-making and behavior depends on how we perceive our environment. This study investigates the effects of various environmental design characteristics on people's safety perception in a passenger ship context. Five different environmental design characteristics were manipulated to increase the openness of the space or to create more clear navigation, resulting in 20 different cabin corridors for a passenger ship. Ninety-seven respondents were asked to rate these corridors on the perceived safety in an experiment. The results showed that people feel more safe when the corridors have a curved ceiling, when the walls do not have a split-level design, and when there is a view to the outside. Designers can use these insights when designing future environments.

1. Introduction

Safety is a critical determinant for people's quality of life (Cummins, 1996; Stamps, 2010; Van Rijswijk et al., 2016), and much research has been devoted to create safer products (e.g., Benedyk and Minister, 1998; Min et al., 2012; Wilson, 1984) and environments (e.g., Duarte et al., 2011; Hsiao et al., 2013; Stamps, 2005a,b; Vilar et al., 2013), such as cruise ships (Papanikolau, 2009). However, when experiencing environments in daily life, people are generally hardly able to effectively evaluate the objective safety level of their environment (Ahola et al., 2014; Campbell et al., 1976). Instead, people often rely on their perceptions to ascertain an environment's safety. Consequently, it is important to go beyond objective safety ('being safe') by uncovering the factors that influence whether people will 'feel safe' (Van Rijswijk et al., 2016).

People need to feel safe before they can feel comfortable and experience other positive emotions, such as enjoyment (Epstein, 1990; Sheldon et al., 2001). As a consequence, positively influencing people's safety perceptions is especially crit-

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ical for environments with entertaining purposes, such as cruise ships. Cruise ship operators transport passengers by sea for pleasure, and passengers' comfort is one of their main priorities (Yarnal and Kerstetter, 2005). Thus, it is important to understand how safety perceptions are evoked to minimize uncomfortable feelings in order to guarantee passengers' enjoyment of the cruise experience (Baker, 2013).

One way to evoke more positive safety perceptions is through a successful environmental design. In this respect, various scholars have proposed that designers[1] need to consider safety perceptions in the design process (Ahola et al., 2014, Kim et al., 2004; Vilar et al., 2013; Williamson et al., 1997). However, evidence exists that it can be challenging to design cruise ships that 'feel safe'. First of all, prior research has demonstrated that significant differences exist between users and designers with respect to their perceptions of design objects, which makes the transfer of consumer needs into technical and design specifications challenging (Blijlevens et al., 2009; Hsu et al., 2000). Second, designing passenger ships is a complex design process with many conflicting requirements (e.g., technical demands caused by moving on water, berth capacity, safety regulations, comfort). Third, in the study of Ahola et al. (2014), it was identified that shallow and narrow cabin corridors of the passenger ship have a negative influence on passengers' safety perception and because of this passengers also feel more uncomfortable in these environments. Taking into account the fact that these spaces cover a significant area of passenger ships and that designing passenger ship is a complex endeavor, ship 'safety' designers' would benefit from more knowledge on the specific environmental design characteristics (e.g., design of ceiling, walls, and doors) that they should consider during the design process in order to evoke more positive safety perceptions.

To provide these insights, research has started to investigate the effects of certain environmental design characteristics on safety perceptions. However, this stream of research remains relatively scarce and only limited insights are offered to designers to use as a starting point in their design process. The majority of studies have focused on the importance of lighting (Haans and de Kort, 2012; Vilar et al., 2012, 2013) and colors (Dalke et al., 2006; Duarte et al., 2011) for improving people's safety perception. Moreover, research has started to uncover the effects of physical environmental design characteristics, such as the design of the ceiling, walls, and doors. For example, Stamps (2005a,b, 2010, 2013) has investigated the influence of physical environmental design characteristics on people's perceptions in urban settings. These findings showed that physical design characteristics in an environment influence the degree of enclosure (open vs. enclosed) and thereby the ability to perceive and move, which are the most important influencing factors for people's safety impressions in urban settings. Although these studies provided important insights, more research is needed to comprehend people's safety perception in specific indoor settings for which safety is essential in order to experience other positive emotions, such as passenger ships.

In a qualitative study, Ahola et al. (2014) provided some first exploratory insights on the architectural elements that can affect people's safety perceptions in a passenger ship. Their findings suggested that openness and guidance are preferred characteristics for a safe ship environ-

1 With the term designer, we mean different experts that are involved in the interior design of a ship, such as industrial designers, architects, and ship engineers.

ment. We propose that by purposefully designing and arranging specific environmental design characteristics (e.g., design of the ceiling, walls, and doors) in passenger ships, it is possible to trigger greater openness or a better feeling of guidance in order to make people feel safer and increase their comfort. However, to effectively design for safety a more detailed understanding is needed on how specific environmental design characteristics will influence safety perceptions.

The present research contributes to the literature by investigating the effects of five environmental design characteristics that were shown to influence environment-human interaction (Sagun et al., 2014) on openness and a feeling of guidance, and consequently, on people's safety perceptions for a passenger ship context. Specifically, we focus on people's first impressions of safety that influence these impressions when encountering a new environment. As discussed, these first impressions are important for people to feel comfortable and enjoy the cruise experience. Providing an understanding on this matter is important for two reasons. First, it contributes to our understanding on which environmental design characteristics contribute to people's safety perceptions in indoor settings. Second, more knowledge on the relationship between environmental design characteristics and safety perceptions is relevant for designers when designing environments in which people will feel comfortable.

2. Design for subjective safety

In the literature, openness is recognized as one of the most desirable characteristics to create a safe environment (e.g. Fisher and Nasar, 1992; Stamps, 2005a,b, 2010; 2013). More openness in an environment results in a greater ability to move (Nasar et al., 1993; Stamps, 2013) and a greater ability to perceive (Appleton, 1975/1996; Stamps, 2005b, 2013), which are both directly linked to the objective safety of an environment. For example, it is demonstrated that people tend to prefer wider corridors when navigating in an emergency situation (Vilar et al., 2012, 2013). If movement is restricted, a potential escape is prevented, and blocked visibility prevents people or animals to see potential enemies or other sources of danger, which both will decrease their survival chances (Gibson,1979; Stamps, 2005a). In addition to these effects of openness on objective safety, prior research has demonstrated that people's perceptions of safety in urban environments, such as areas with buildings and parks, are also influenced by openness (Mambretti, 2011; Stamps, 2005a, 2013). Stamps (2005a) concluded that for urban environments enclosure and openness are reflected by five physical variables: 1) percentage of view covered by obstacles (limiting the motion and vision); 2) percentage of regions permitting both vision and motion; 3) lightness; 4) distance of the visibility, and 5) number of sides open at the scene. These variables are rather general and to a certain extent determined by the space/environment in which people are moving. Nevertheless, designers could also use other more specific environmental design characteristics (e.g., design of the ceiling, walls, and doors, and views to the outside) to create more (impressions of) openness in an indoor setting.

In addition to openness, an environment that offers people the feeling of a clear guidance can positively influence people's safety perceptions. If people have difficulty finding their way, this may result in stress, anxiety, and confusion (Dogu and Erkip, 2000). As a consequence of this uncertainty and stress, people may feel less safe in such an environment (Ahola et al., 2014). When navigating, people rely heavily on the spatial properties of the setting (Arthur and Passini,1992). For example, people use distinguishable features of the environment as landmarks to

help them find their way (Emo et al. 2012). From a safety perspective, the guiding characteristics of the environment should be easily recognizable, because this enables people to effectively create or reconstruct cognitive maps of the environment (Zeisel, 2006). While navigating, these cognitive maps help people remember how to find their way, which is essential for daily life and even for their survival.

Based on the former, we conclude that openness and a feeling of guidance are important criteria for evoking a positive safety perception. By designing specific environmental design characteristics, such as ceilings, walls and doors, designers can trigger openness in a space or enhance people's feeling of guidance. The present study focuses on investigating the effects of such environmental design characteristics on people's safety perceptions in passenger ships.

3. Methodology

To test the effects of various environmental design characteristics that are likely to trigger openness and a feeling of guidance on people's safety perceptions, we performed an experimental study, in which 97 participants rated variations of cabin corridors of a passenger ship in which the environmental design characteristics of circulation, dimensioning, shape and geometry, finishing materials and accessories were manipulated. As we aimed to understand people's first impressions of safety when encountering a new environment, we used pictorial representations of the environment. Pictorial representations can provide a good indication of how people will perceive a particular environment when seeing it for the first time. Accordingly, pictures have been frequently used in other recent work on people's preferences and safety perceptions in environments (e.g., Stamps, 2007, 2012, 2013; Van Oel & Van den Berkhof, 2013). Furthermore, a study on the visualization of urban spaces suggested that static color images are at least as effective as any other mediums for evaluating the visual appeal of environments (Stamps, 2012).

3.1. STIMULI

In passenger ships, narrow and shallow spaces are perceived unsafe because they provide limited visibility to other spaces or the outside, and because people are unable to gather enough information to comprehend where the space leads them (Ahola et al., 2014). Cabin corridors in passenger ships are normally narrow and shallow and cover a significant area of the ship. In a typical passenger ship, such as the Freedom of the Seas, cabin corridors (9,900M2) alone cover approx. 24% of the overall passenger accommodation area of 41,500m2 (Royal Caribbean International, 2014). Additionally, cabin areas are optimized for accommodation capacity, which results in long and similar-looking corridors. Because cabin corridors look alike between different decks and in different walking directions, people find it difficult to navigate, which negatively affects their safety perceptions (Ahola et al., 2014). Because cabin corridors form a crucial environment in passenger ships, where safety and comfort are highlighted in the design process, cabin corridors were chosen as a suitable environment to investigate how different environmental design characteristics affect people's safety perceptions.

To select the environmental design characteristics that will encourage more openness in a passenger ship or that create more guidance, we built on Sagun et al. (2014), who have classified characteristics involved in the interaction process between people and the environment into: 1) circulation; 2) dimensioning; 3) shape & geometry; 4) finishing materials; and 5) accessories. In their classification, certain other characteristics, such as communication, temperature, and sounds, were also distinguished. However, in line

with prior research on the effects of environmental design characteristics (Van Oel & Van den Berkhof, 2013), we decided to focus only on physical design characteristics of the environment because the designer can directly control these. Within these characteristics, we aimed to select and manipulate those environmental design characteristics that provided the best opportunities to influence people's safety perceptions based on prior research and consultations with design experts from the maritime industry. Because of the specific nature of a passenger ship environment in terms of structural and safety design, we also consulted three ship design experts in the stimuli design process and they confirmed in individual interviews the plausibility and feasibility of all introduced manipulations for contemporary passenger ship design. Specifically,we asked experts whether there are structural limitations or safety regulations that would prevent designers from implementing the different manipulations of the design characteristics in future ships and whether the effects on ship systems (i.e. heating, ventilating, and air conditioning systems) and berth capacity are minimal. Even though certain manipulations are not implemented in passenger ships at the moment (e.g., curved ceilings), the experts concluded that these could all be implemented in future ships.

Below, we will discuss how we have manipulated each of these environmental design characteristics.

3.1.1. Circulation

'Circulation' is one of the basic concepts of architectural design and suggests the system of prescribed routes (including stairs, corridors etc.) that are frequently used (Davies and Jokiniemi, 2008). The environment needs to have a fluent circulation to facilitate people's orientation. According to Dogu and Erkip (2000), difficult orientation causes decreased feelings of safety and being able to see outside is a good means to encourage more fluent circulation and orientation within the location. At present, cabin corridors in passenger ships generally do not provide views to the outside. Consequently, we manipulated circulation in our study by having a view to the outside either present or absent at the end of the corridor.

Having a view to the outside at the end of the corridor helps people to see that the corridor leads outside and because the outside view attracts their attention, reaching the 'destination' may feel more fluent and prompt (Dogu and Erkip, 2000). Having a view to the outside is also the first means of interaction between people and the outside, which has a positive effect on safety perceptions in terms of providing a direct way to the outside and thus a better feeling of guidance (Sagun et al., 2014). Furthermore, it can reflect the favorable direction for survival (Appleton, 1975/1996; Stamps, 2005a). In addition, it provides visibility to the outside, which extends the space and provides the desired openness (Ahola et al., 2014).

3.1.2. Dimensioning

'Dimensioning' is defined as the spatial dimensions (e.g., width, height, and length) of an environment. Obviously, dimensioning has a strong effect on openness: high spaces are naturally more open than low spaces, and wide spaces are more open than narrow ones (Hayward and Franklin,1974). In this respect, Vilar et al. (2013) demonstrated that people prefer to take wider corridors when evacuating in an emergency situation. It is likely that such corridors are perceived as more safe. Clearly, dimensioning is not optimized for openness in the case of cabin corridors of passenger ships. Cabin corridors are generally perceived as enclosed due to the narrowness and shallowness of their width and height. Limited corridor dimensions result from optimized berth capacity, and

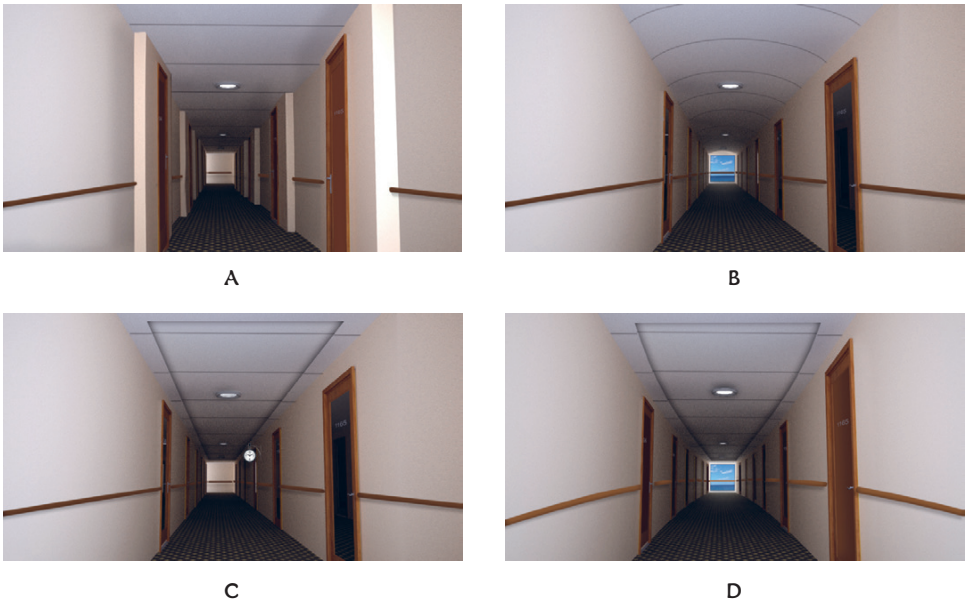

FIG. 1: Examples of the corridor visualizations used in the experiment. Visualization A (Profile 13) presents the corridor with a flat ceiling, split-level walls, matt doors, and without a view to the outside. B (Profile 7) presents the corridor with a view to the outside, curved ceiling, straight walls, and reflective doors. C (Profile 11) presents the corridor with a coffered ceiling, straight walls, reflective doors, a clock as landmark, and without a view to the outside. D. (Profile 6) presents the corridor with a coffered ceiling, curved walls, matt doors, and a view to the outside.

therefore, widening the dimensions is not considered a realistic option. Due to the limited possibilities to increase dimensions horizontally, we decided to manipulate the ceiling with the intention to increase vertical openness. Because room for piping et cetera needs to be reserved, it is to some extent possible to change the traditionally flat ceiling design, while minimizing detrimental effects on berth capacity. Therefore, the environmental design characteristic 'Dimensioning' was manipulated by including two different ceiling designs in addition to the traditionally flat ceiling design (see Fig. 1A), that nevertheless have a minimal effect on the ship's structure.

The first option to create more vertical openness is by using a curved ceiling design (see Fig. 1B). Prior research has demonstrated that curvilinear architecture can increase human well-being and has a positive effect on emotions, because curvature is the most dominant form in nature (Madani Nejad, 2003; Pearce and Turner, 1990; Van Oel & Van den Berkhof, 2013) and people prefer living spaces that share essential qualities to natural forms (Salingaros, 1998). Correspondingly, Bar and Neta (2006) demonstrated that people prefer curved shapes over sharp and 'controlled' shapes, because the latter convey a sense of threat. We expect that this preference for curvature will positively influence people's safety perceptions, because people prefer to have consistent judgments about objects (Dion et al., 1972). Consequently, a curved ceiling design may have a positive effect on safety perceptions.

The second ceiling design that we included to increase the vertical openness in the corridor is a coffered ceiling design. A coffered ceiling is a type of ceiling in which the ceiling comprises of two different levels. For example, in comparison to the rest

of the ceiling, a rectangular contour in the middle may be positioned slightly higher (see Fig.1C). By applying two different heights in the ceiling, people may perceive the corridor as more open.

3.1.3. Shape and geometry

The environmental design characteristic 'Shape and Geometry' defines the way the three-dimensionality of the space is formed and thus is a significant determinant of the environment that distinguishes the setting from others (Arthur and Passini, 1992). By manipulating the 'Shape and Geometry', designers give borders to a space that can help in perceiving the distances and edges of the overall space. Ahola et al. (2014) reported that such borders were linked to the clearness of the space, and therefore, positively affect safety perceptions. In cabin corridors of passenger ships, the walls play a prominent role for the three-dimensionality of the space in addition to the ceiling (which was manipulated as part of 'Dimensioning'). Nowadays, the cabin corridors make use of either a straight or split-level wall design. A straight wall design can be considered as open, clear, and easy to perceive, which is expected to have a positive effect on safety perceptions. Split-level wall design stands for wall design in which the wall is structured into two different levels that alternate each other. For example, in comparison to the rest of the corridor walls, the doors to the rooms can be positioned either more to the front or to the back, thereby creating a recurring pattern (see Fig. 1A). Prior research proposed that people may use certain patterns (e.g., in the carpet) for perceiving distances and the rhythm of the space (Ahola et al., 2014). Correspondingly, it may be that the pattern created by the split-levelwall design can enhance people's spatial perceptions and thus contribute to their feeling of guidance. On the other hand, the splitlevel wall design may also increase the complexity of the space. According to many environmental researchers (e.g. Bentley et al., 1985; Rapoport and Hawkes, 1970; Stamps, 1999, 2005a), people prefer moderate levels of complexity in their environment. Excessively simple stimuli are disliked because these are considered boring, whereas too complex stimuli lead to confusion and avoidance. Based on the latter, the complexity of a split-level wall design may also have a detrimental effect on people's safety perceptions.

In addition to these twowall designs, we explored the effect of a curved wall design on safety perceptions. Curved walls were chosen for similar reasons as mentioned for the ceiling design above: people tend to prefer curvature, which can trigger a positive bias. In support of this argument, Van Oel & Van den Berkhof (2013) found that curved wall design is one of the most preferred characteristics in airport design. On the other hand, curved wall design also increases the spatial complexity, which may have a negative effect (Berlyne, 1971; Barrow and Tenenbaum, 1981).

3.1.4. Finishing materials

'Finishing materials' give the final touch to the environment (Sagun et al., 2014) and by selecting particular surface materials for the doors, walls, and floors, the appearance of a space can be manipulated. Traditionally, cabin corridors in passenger ships make use of matt materials. However, it is well known that glossy and reflective surfaces can optically extend space dimensions, thereby creating more visual openness in a horizontal direction. Consequently, we expected that having mirroring door panels in the corridors of a passenger ship may positively influence safety perceptions, and therefore, this environmental design characteristic was included in our study.

3.1.5. Accessories

With 'Accessories', we understand the 'scattered' objects of the environment that

can be placed in different environments without architectural constraints, such as art pieces, plants, and furniture. Accessories are part of the architectural information of the environment that helps people to understand what the setting contains and how it is organized (Dogu and Erkip, 2000). For example, exit signs provide clear information about where the nearest exit is and can thus help people to navigate (Vilar et al., 2013). Logically, seeing safety-related accessories, such as exist signs and life-saving appliances (e.g., fire-extinguishers) would result in a feeling of greater safety because this is true from a conscious consideration of the environment. However, our research aim was to uncover first impressions by exploring the environmental design characteristics that influence people's perceptions of safety. Prior research has proposed that people navigate according to attention-attracting environmental accessories, also known as landmarks, and thus may use other types of accessories to get a feeling of guidance (Ahola et al., 2014). As we wanted to uncover the more irrational effects of environmental characteristics on people's safety perceptions, we purposefully focused on accessories without an obvious relationship to safety.

Cabin corridors in a passenger ship contain many spatial settings that look very much alike, and therefore, it is desirable if the environmental information has an identity that distinguishes a particular corridor from surrounding spaces (Arthur and Passini, 1992). We expect that placing a unique environmental accessory as a landmark in the corridor could enhance the recognition of the space, and therefore, positively affect safety perceptions. When people recognize a unique landmark, they know where they are (Meilinger, 2008).

Within this study, we test the effects of a landmark by adding a hanging wall clock to the environment. We chose the wall clock, because in comparison to standing art pieces, wall clocks will minimize potential negative effects on visibility, motion possibilities, and openness.

The five environmental design characteristics and the specific manipulations for each characteristic are summarized in Table 1.

3.2. EXPERIMENTAL DESIGN

An experimental study was conducted to test how the manipulation of the environmental design characteristics for the cabin corridors of a passenger ship affect people's safety perceptions. Specifically, we manipulated five environmental design characteristics ($3 \times 3 \times 2 \times 2 \times 2$ design) that were expected to result in more open-

TABLE 1. Conjoint factors and information about their levels.

ENVIRONMENTAL DESIGN CHARACTERISTICS	DESIGN AIM	LEVEL 1	LEVEL 2	LEVEL 3
1 Circulation	Guidance/ Openness	No view to the outside	View to the outside	
2 Dimensioning	Openness	Flat ceiling	Curved ceiling	Coffered ceiling
3 Shape & Geometry	Guidance/ Openness	Straight walls	Curved walls	Split-level walls
4 Finishing materials	Openness	Matt doors	Reflective doors	
5 Accessories	Guidance	No landmark	Landmark in the shape of a wall clock	

TABLE 2. Hypothetical cabin corridor profiles obtained by means of the orthogonal array design.

PROFILE	ENVIRONMENTAL DESIGN CHARACTERISTICS & LEVELS				
	CIRCULATION	DIMENSIONING	SHAPE & GEOMETRY	FINISHING MATERIAL	ACCESSORY
1.	No view to the outside	Curved	Curved	Matt	Landmark
2.	View to the outside	Flat	Straight	Matt	Landmark
3.	No view to the outside	Flat	Straight	Matt	No landmark
4.	No view to the outside	Coffered	Straight	Matt	Landmark
5.	No view to the outside	Flat	Straight	Reflective	No landmark
6.	View to the outside	Coffered	Curved	Matt	No landmark
7.	View to the outside	Curved	Straight	Reflective	No landmark
8.	View to the outside	Flat	Split-level	Matt	Landmark
9.	View to the outside	Flat	Straight	Reflective	Landmark
10.	No view to the outside	Curved	Split-level	Reflective	Landmark
11.	No view to the outside	Coffered	Straight	Reflective	Landmark
12.	No view to the outside	Flat	Curved	Reflective	No landmark
13.	No view to the outside	Flat	Split-level	Matt	No landmark
14.	View to the outside	Curved	Straight	Matt	No landmark
15.	View to the outside	Flat	Curved	Reflective	Landmark
16.	View to the outside	Coffered	Split-level	Reflective	No landmark
17.	View to the outside	Flat	Split-level	Reflective	No landmark
18.	View to the outside	Coffered	Straight	Matt	No landmark
19.	No view to the outside	Curved	Curved	Reflective	No landmark
20.	No view to the outside	Curved	Split-level	Matt	No landmark

ness and a better feeling of guidance (see Table 1). Because including the effects of all five environmental design characteristics in a full-factorial experimental design would require too many stimuli (i.e., 72 stimuli) to be tested, we used a conjoint analysis approach with a fractional factorial design. Conjoint analysis is generally used to analyze people's evaluations and perceptions of products based on the different functions and aesthetics (Hair et al., 2006; Mambretti, 2011). Accordingly, the approach is appropriate to uncover which environmental design characteristics are most influential for people's safety perceptions. To reduce the number of profile presentations, a fractional factorial design of twenty hypothetical environments was constructed based on combinations of the different levels of the five environmental

design characteristics (see Table 2). In contrast to a full-factorial experimental design, only a relatively small set of stimuli profiles needs to be included in a fractional factorial design, whereas it remains possible to reliably test the main effects of the five independent variables. These profiles were created with an orthogonal array design using the statistical software program SPSS 22.0. The authors verified the suitability of the proposed profiles. The reduced number of stimuli that was used in the conjoint analyses imposes restrictions on the statistical analysis, and thus only one interaction effectwas analyzed in addition to the main effects. After consideration of the five environmental design characteristics that were manipulated, we expected the strongest interaction between the wall and ceiling designs. Consequently, we included the interaction effect between dimensioning and shape & geometry. The levels of these two environmental design characteristics have a certain degree of correspondence due to which the combined effect of these two factors may have particular consequences for people's perceptions. Prior research has demonstrated that people's attitude towards objects may be more positive when there is congruity between the different elements (Van Rompay and Pruyn, 2011). Correspondingly, the congruity between a curved (flat) ceiling and curved (straight) walls may influence people's safety perceptions, and therefore, this interaction effect was included in our data analysis.

Fig. 1 presents four examples of the visualizations that were used in the experiment. Google SketchUp, Maxwell Render and Photoshop software programs were used to make the visualizations. All visualizations were standardized as much as possible, for example, with respect to lighting, colors, handrails, and perspective. Furthermore, the visualizations were pretested (N = 6) to ensure that the manipulations of the environmental design characteristics (i.e.,walls, ceilings, window, material of the door, and the added accessory) were perceived as intended. Similar to the main study, participants conducted the pretest individually. In the pretest, participants were asked to express how they interpreted the different environments, if they identified the manipulation of the different characteristics between visualizations and they scored the profile pictures according to given instructions. Specifically, they were asked how they interpreted the ceilings, walls, doors, added accessory, and the end of the hallway. All pretest participants were unaware of the specific study purpose. Pretest participants recognized all manipulations in the visualizations, which provided us with evidence that we were successfully investigating the effects of these environmental design characteristics on people's safety perceptions.

3.3. PROCEDURE AND PARTICIPANTS

A letter was sent to all participants, in which participants were explained the general research objective, the general procedure, and in which they were asked to volunteer in the study by completing the research in their own house on their own pace. Furthermore, it was explained that all responses will be analyzed anonymously and will be treated confidentially. If participants chose to participate, they could continue by reading the detailed instructions, the questionnaire, and by examining the 20 pictures of hypothetical cabin corridors printed in color on A5 paper (see Fig. 1), and an A3 scoring form with a three-point scale (1 = low, 2 = medium, 3 = high). The order in which the profile pictures were offered to participants was randomized. In the instructions, participants were asked to imagine that they were traveling in a passenger ship. Next, we asked participants to look at the different profile pictures and to determine whether they perceive the cabin corridor as safe or not by following several steps. As a first step,

we asked participants to complete the first grouping by asking participants to organize all 20 profile pictures on the A3 scoring form into three groups (1 = low, 2 = medium, 3 = high) based on their expectations regarding the safety of the environment. When they were satisfied with organizing the pictures, they were asked to record this first score on the top of each picture and to make three piles, one for each of the three scores (i.e., pile 1, pile 2, and pile 3). Next, it was explained that even though some environments received the same score in the first grouping, more subtle differences in safety perceptions may exist. Accordingly, participants were asked to do a second grouping by taking the pictures of pile 1, and re-organize these on the A3 scoring form into three groups (1 = low, 2 = medium, 3 = high), again based on their expectations regarding the environment's safety. Participants noted this second score on the bottom of each picture. This procedure was repeated for the pictures belonging to piles 2 and 3. We performed multiple pilots to ensure that the procedure was clear to respondents. The former procedure resulted in two three-point scores given to each profile picture. We recoded these scores into a nine-point safety perception score by taking the first score as the primary indicator (1 = 1-3; 2 = 4-6; 3 = 7-9) and the second score as the secondary indicator. For example, a picture that received the score 1 in the first grouping and the score 3 in the second grouping, obtained a final safety perception score of 3. Similarly, a picture that received the score 3 in the first grouping and the score 1 in the second grouping, obtained a final safety perception score of 7. Higher scores thus suggested that the environment was perceived to be safer.

After scoring all profiles, participants were asked to fill in a questionnaire. This questionnaire included several individual differences scales that were expected to influence people's ratings and thus served as covariates in the data analysis. Specifically, expertise with passenger ships was measured with the item: How much experience do you have with passenger ships? (1 = not at all; 7 = a lot). Involvement with safety in passenger ships was measured with three items on seven-point scales (unimportant vs. important; irrelevant vs. relevant; does not matter vs. does matter; Cronbach's a α 0.88). Furthermore, we included four items (Cronbach's a α 0.68) to measure people's ability to visually process information: 1) I generally prefer to use a diagram than a written set of instructions; 2) I like to "doodle"; 3) When I'm trying to learn something new, I'd rather watch a video (e.g., Youtube) than read instructions; and 4) My thinking often consists of mental "pictures" or images, which were based on Childers et al. (1985). These items were measured using seven-point Likert scales ranging from strongly disagree (1) to strongly agree (7). Finally, participants were asked to return both the filled-in questionnaire and the 20 profile pictures by making use of the return envelope. After two weeks, all participants received a debrief in which they were thanked for participation and were given some additional insights in the research goal. All participants received a small financial compensation (€3.45) for their participation.

A consumer panel of Dutch households was used for the research. All panel members have volunteered to become a member of the panel and agreed to be approached for participation in scientific research. From the available 1700 households, we selected a subset of 220 panel members based on age and gender towarrant a satisfactory distribution in our sample. The questionnaire and pictures were sent by regular post to these 220 panel members. Of the addressed 220 panel members, 97 participants (response rate = 44%) returned their questionnaire. Participants did not report any difficulties in following the instructions or conducting the survey.

TABLE 3. Results of the Linear mixed model ANOVA testing the effects of the environmental design characteristics on people's safety perceptions.

ENVIRONMENTAL DESIGN CHARACTERISTICS	NUMERATOR *df*	DENOMINATOR *df*	*f*-VALUE	*p*-VALUE
Circulation (view to the outside vs. no view to the outside)	1	582,476	173,086	0.000
Dimensioning (ceiling design)	2	596,033	6694	0.001
Shape & geometry (wall design)	2	543,943	77,674	0.000
Finishing materials (matt vs. reflective doors)	1	1189,379	2188	0.139
Accessories (landmark vs. no landmark)	1 758,688	0,972	0.325	
Dimensioning * Shape & geometry	4	476,066	0,748	0.560

3.4. DATA ANALYSIS

To analyze the effects of the five different environmental design characteristics on safety perceptions, the conjoint rating data of people's safety perceptions was analyzed with a linear mixed model ANOVA (ANalysis Of VAriance) in SPSS 22.0. Linear mixed model ANOVA is typically used for the analysis of population effects in conjoint experiments based on rating scales (Næs et al., 2010). Our model included circulation, dimensioning, shape & geometry, finishing materials, and accessories as main effects, and the twoway interaction effect between dimensioning and shape & geometry as fixed factors. The respondent number was included as a random factor. Additionally, interaction effects between respondent number and the five factors were included as random factors to account for individual preferences. As including these interaction effects did not change the effects of the environmental design characteristics on safety perceptions, these interaction effects were removed from the final analysis. Expertise with passenger ships, involvement with safety, visual processing style, and age were included as possible covariates in the linear mixed model ANOVA.

4. Results

The 97 participants who returned the questionnaire consisted of 49% males and were on average 48.8 years old (SD = 14.1). Most participants had relatively little experience with passenger ships intended for cruising (M = 2.91, SD = 1.79), and 30% indicated that they did not have any experience at all. A feeling of safety was considered very important by the majority of participants (M = 6.11, SD = 1.07). There was diversity in participants' visual/ verbal processing style (M = 4.28, SD = 1.19) suggesting that both people with a visual and verbal processing style participated in the study.

The included covariates expertise with passenger ships, involvement with safety, visual processing style, and age did not significantly influence the results, and were excluded from the analysis. The mixed model ANOVA results are presented in Table 3. Significant effects were found for circulation (no view to the outside vs. view to the outside; $p < 0.001$), dimensioning (ceiling design, $p < 0.01$), and shape & geometry (wall design, $p < 0.001$) on people's safety perceptions. No effects were found for finishing materials (matt vs. reflective doors), accessories (landmark) and the interaction between dimensioning and shape & geometry (all p's > 0.05).

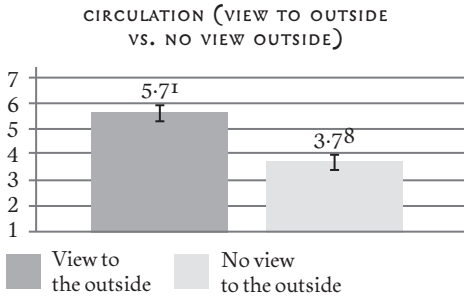

FIG. 2. Mean safety perception for different circulation conditions. Error bars represent the 95% confidence interval.

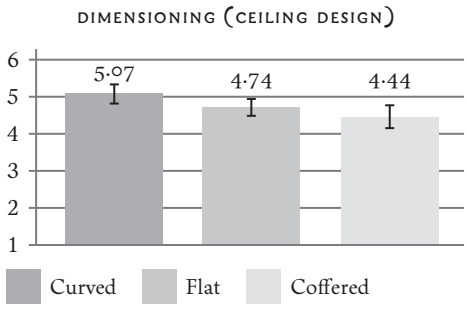

FIG. 3. Mean safety perception for different dimensioning conditions. Error bars represent the 95% confidence interval.

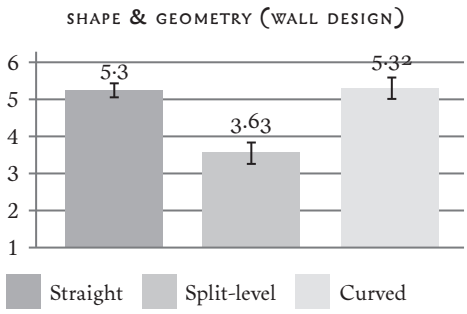

FIG. 4. Mean safety perception for different shape & geometry conditions. Error bars represent the 95% confidence interval.

More specifically, with respect to circulation participants expected the passenger ship environment to be safer when there was a view to the outside at the end of the cabin corridor (Mview to the outside = 5.71 vs. Mno view to the outside = 3.78; see Fig. 2). Posthoc pairwise comparisons with Bonferonni adjustment on the three levels of the environmental design characteristic dimensioning revealed that participants' safety perceptions were more positive when the ceiling is curved than when it is flat (Mcurved = 5.07 vs. Mflat = 4.74, $p < 0.05$) and coffered (Mcurved = 5.07 vs. Mcoffered = 4.44, $p < 0.01$; see Fig. 3). No significant difference in safety perceptions was found between flat and coffered ceilings ($p = 0.20$). With respect to shape & geometry, post-hoc pairwise comparisons showed that participants' safety perceptions were more positive when the walls are straight or curved than when the walls follow a split-level design (Mstraight = 5.30 vs. Msplit-level = 3.63, $p < 0.001$; Mcurved = 5.32 vs. Msplit-level = 3.63, $p < 0.001$; see Fig. 4). No significant difference in safety perceptions was found between straight and curved walls ($p > 0.20$).

5. Discussions

This study aimed to explore the effect of environmental design characteristics on people's preliminary safety perceptions in a passenger ship context. The very first perceptions of safety strongly affect human information processing, decision-making, and are key in order for people to feel comfortable and enjoy the cruise experience (e.g., Mischel, 1973; Vallacher, 1993). Based on the classification of Sagun et al. (2014), we modified specific characteristics in the design of cabin corridors that were intended to make a space more open or give a better feeling of guidance, and thereby positively affect people's safety perceptions. Our findings show that designers can indeed influence people's safety perceptions through purposefully changing the environmental design.

Specifically, we found significant effects for the ceiling and wall design. These results support Stamps' (2005a) conclusion that people's perceptions of safety are influenced first and foremost by their overall view. By using more realistic stimuli, we demonstrate that the dimensions and shapes of the walls and ceilings are also

important for safety perceptions in ship environments. The splitlevel wall design and to some extent the coffered ceiling were perceived as less safe. Based on prior research (Ahola et al., 2014), we expected that split-level walls would give a better feeling of guidance. Furthermore, coffered ceilings were expected to give more openness to the corridor space. However, our findings demonstrated that both environmental design characteristics had a detrimental effect on people's safety perceptions. A potential explanation for this effect is that split-level walls and coffered ceilings are visually complex. Prior research has demonstrated that complexity influences people's perceptions of products (Creusen et al., 2010) and environments (Bentley et al., 1985; Rapoport and Hawkes, 1970; Stamps, 1999, 2005a). People generally prefer moderate levels of complexity from an aesthetic perspective (Berlyne, 1971; Rapoport and Hawkes, 1970). Thus far, complexity has not yet been considered as an influencing factor for safety perceptions. Nevertheless, our findings provide some preliminary evidence for the value of low complexity in order to enhance people's safety perceptions when designing ship environments. Due to the complexity of split-level walls and coffered ceilings, the continuation of the horizontal and perspective lines is disturbed. As these horizontal and perspective lines can improve people's orientation within the space, people's feeling of guidance may be weakened for split-level walls and coffered ceilings, resulting in lower safety perceptions. This is in line with the notion that especially in complex situations even relatively simple architectural design characteristics can become difficult to interpret, which can set limitations for people's information processing and decisionmaking (Kinateder et al., 2014). Although a degree of complexity may be desired to create aesthetically pleasant and interesting environments (Rapoport and Hawkes, 1970), from a safety perspective a more simple environmental design with clear and continuous lines is preferred for the corridors in passenger ships. Nevertheless, more research is needed to completely understand the effect of visual complexity in environments on people's safety perceptions. For example, it could be interesting to study the effects of complexity for various environments. It may be that even though the effect is negative for narrow and long environments, such as corridors, complexity can have a positive effect in more spacious environments, such as restaurant areas in passenger ships. Furthermore, future research could investigate whether greater levels of complexity would negatively affect people's safety perceptions if the complexity does not disturb the continuation of the horizontal and perspective lines, for example, by changing the carpet design or wall paper.

Having a view to the outside in a corridor also had a positive impact on people's safety perceptions. A view to the outside extends the space and makes the corridor visually more open. Furthermore, the clear destination triggered by the outside view can make people feel more safe as it helps in their orientation (Dogu and Erkip, 2000). A view to the outside can be implemented by having a window at the end of the corridor. Although experts confirmed the technical feasibility of such a window in a passenger ship, it may not be the most optimal solution from an economic perspective. Currently, outside views are occupied for the economically more profitable spaces, such as cabins and restaurants. Another possibility to create a view to the outside is by adding an artificial view to the outside (e.g., virtual window), which broadcasts the outside scenery of the ship. However, it is uncertain whether such an artificial view to the outside would have a similar effect on people's safety perceptions. Further research is needed to test this effect. Finally, a curved ceiling design was perceived as more safe than flat and coffered ceilings.

This result corroborates and extends the conclusions of prior studies that people prefer curvilinear architectural designs over rectangular or flat designs (see e.g., Madani Nejad, 2003; Van Oel & Van den Berkhof, 2013). Curved shapes in architecture can increase people's subjective well-being and trigger positive emotions. We extend these findings by demonstrating that curvature in the ceiling design of a passenger ship is also desired from a safety perspective. Nevertheless, a curved wall design did not result in greater safety perceptions than the straightwall design in our study. We believe that this is the result of the fact that only moderate curvature could be implemented in the wall design, whereas high levels of curvature were possible for the ceiling design. Due to the limited design latitude in the corridor's width of passenger ships, the achievable curvature was limited because this would otherwise negatively affect berth capacity. As a consequence, a curved ceiling was more important for positively influencing people's safety perceptions.

Designers can use these guidelines to design passenger ships that will be perceived as safe as expected or even safer. Although our research focused on corridors in passenger ships, we expect that the provided guidelines may also be applicable to other environments that have long corridors, such as hospitals and hotels, and thus designers involved in the design of these environments can benefit from our findings as well.

It was assumed that placing a wall clock as a landmark in the environmentwould positively influence safety perceptions because landmarks are significant elements for fluent navigation (e.g. Ahola et al., 2014; Arthur and Passini, 1992; Dogu and Erkip, 2000). However,we did not find support for such an effect.We believe that this may be because landmarks are typically used when people orientate themselves (Meilinger, 2008) and distinguish an environment from the surrounding environments (Arthur and Passini, 1992). In the experiment, we wanted to test people's first impressions of an environment's safety. Pictures are considered an adequate means to investigate such perceptions (Stamps, 2007, 2012; Van Oel & Van den Berkhof, 2013). Although visualizations are frequently employed and can provide important insights considering people's evaluations of environments (Van Oel & Van den Berkhof, 2013), they also have some shortcomings. For example, people were not able to move around in the environments, which might reduce the effects of landmarks, as participants were not able to compare different corridors with different landmarks or move along the corridor where a landmark could help them to estimate the distance. This may also explain why we did not find an effect for the reflective door panels on people's safety perceptions in our study. More research is thus needed to test the effects of accessories and finishing. A promising approach would be to study these effects using virtual reality (VR) techniques (Duarte et al., 2011; Vilar et al., 2013). This would enable people to move in the corridor, see multiple perspectives, and to investigate actual navigation behavior, which could help to provide a more comprehensive understanding of the effects of different environmental design characteristics on people's safety perceptions. It would also be interesting to replicate our effects concerning the value of low complexity for people's safety perceptions using such VR techniques. In addition, future research could study the effects of other types of accessories on people's perceptions of safety in passenger ships. For example, a more robust-looking design of the handrail may also trigger more positive safety perceptions.

Our study was limited to the investigation of five environmental design characteristics that were based on the classification of Sagun et al. (2014). We selected these design characteristics because they

were expected to strongly contribute to people's safety perceptions. Specifically, we were able to extend the work of Sagun et al. (2014) by putting their classification into practice and showing that three of the identified characteristics indeed significantly influence people's perceptions of safety. Nevertheless, we realize that other environmental design characteristics than the ones included in our research may also have an effect. Future research could extend our findings by investigating the effects of other manipulations of either the overall view or the details (e.g., hand rail design) on people's safety perceptions. In addition, our fractional factorial design allowed us to test only one interaction effect. It would be interesting for future research to explore other possible interactions between environmental design characteristics.

Another limitation of our study is that we could only test the direct effects of the environmental design characteristics on people's safety perceptions. Although we theorized based on prior research (e.g. Ahola et al., 2014; Dogu and Erkip, 2000; Madani Nejad, 2003; Stamps, 1999, 2005a; Van Oel & Van den Berkhof, 2013) that openness and guidance are the anticipated underlying processes for how the different environmental design characteristics influence people's perceptions of safety, we were not able to verify this in our study. More research is needed to confirm this for these and other environmental design characteristics.

Our findings did not reveal significant effects of the participants' age, expertise with passenger ships, involvement with safety, and their visual/verbal processing style when including these as covariates. This provides preliminary support that many people will be influenced by these environmental design characteristics. Nevertheless, we acknowledge that our sample was relatively inexperienced with respect to passenger ships. It would be worthwhile for future research to replicate our findings for people who have had more experience.

Finally, it would be interesting to explore to what degree the provided guidelines are applicable to other, especially larger spaces, such as promenades and lobbies.

6. Conclusions

It is important for designers to consider the safety perceptions in passenger ships in order to develop environments in which people will feel comfortable. Summarizing, our findings demonstrate that if designerswant to increase people's safety perceptions, they could use a curved ceiling design and a view to the outside at the end of the corridor. Furthermore, they should make use of clear and continuous architectural lines and thus avoid complicated ones, such as split-level wall designs. Employing these guidelines will create more openness and will give a more clear guidance to people. Based on these findings, it can be concluded that the current design of the cabin corridors in passenger ships is far from optimal from a safety perception perspective. At present, these environments often contain split-level characteristics, for example to cover heating, ventilation, and air conditioning systems, and curvilinear design or views to outside are a rare sight. Although we realize that changing the architectural design in passenger ships is a challenging task because there are many contradicting requirements to consider, we do feel that professionals involved in the passenger ship design can greatly benefit from our guidelines for the design of future ships. For example, ship classification societies that develop references for ship comfort design, could make use of the provided understanding in order to design passenger ships that are not only safe from an objective perspective, but also feel safe. Only if people feel safe, they can truly enjoy the travel, and thus there is much to gain by increasing people's safety perceptions.

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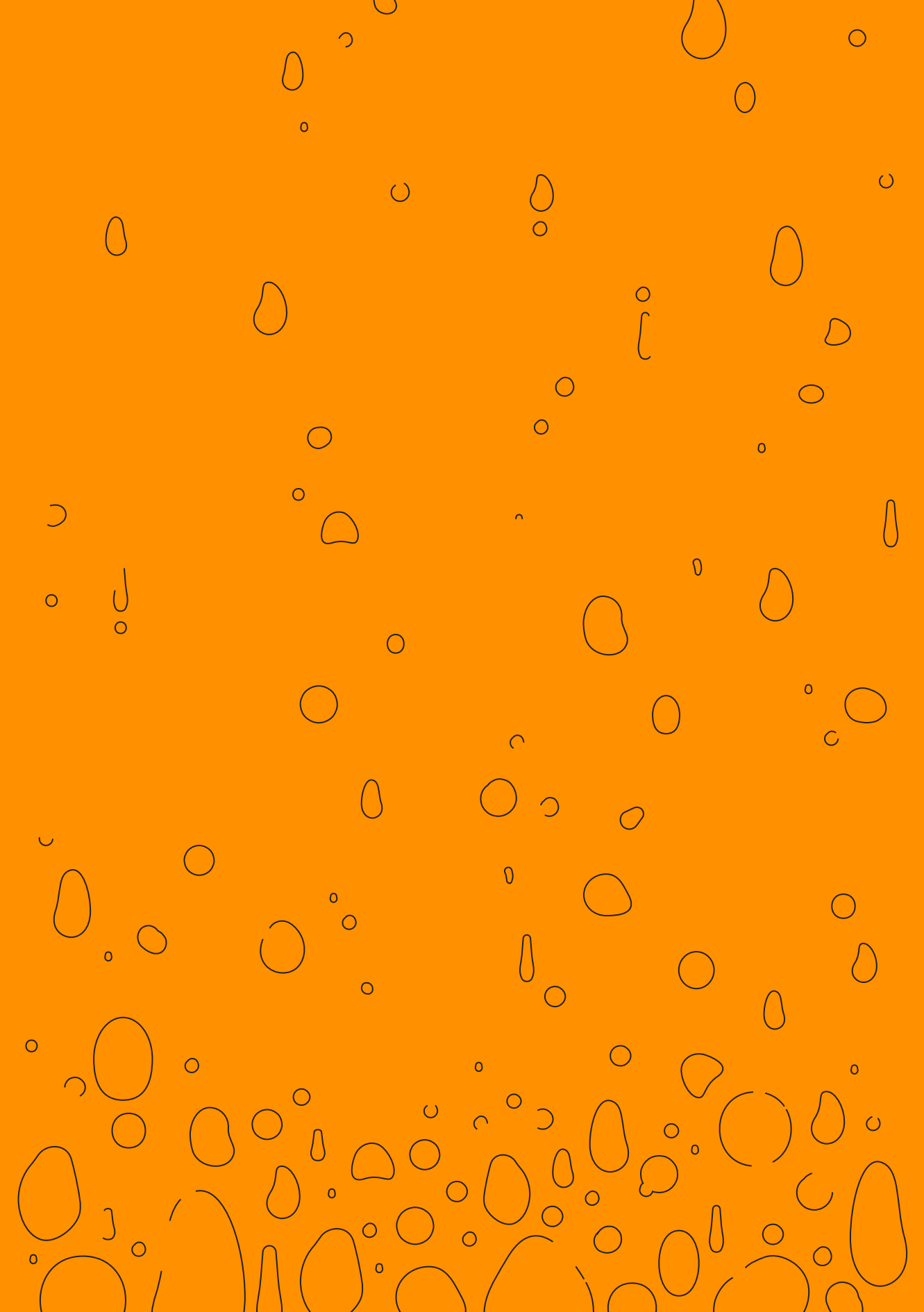

The fundamental questions of how people perceive safety in a cruise ship environment and whether these perceptions can be improved through design are addressed in this book. This dissertation makes a contribution to prior research by investigating ship safety from the passengers' perspective. Safety in every form is essential for life and comfort, but has not been extensively studied from the environmental design and sociotechnical viewpoints. The research interlinks these issues.

Multi-methodological approach is employed to trace passengers' insights, which are analysed through a novel approach of visualization of the interconnectivity of the identified environmental characteristics. The results highlight the importance of a user-centric approach in ship safety design and guide ship design towards improved comfort and more enjoyable cruise experiences.

In addition to research interest, prolonged engagement with the context provides broad portraits of cruising culture for the reader.

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