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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 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.

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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