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Fire risk perception and building evacuation by vulnerable persons: Points of view of laypersons, fire victims and experts

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ABSTRACT

Fire risk perception and its influence on building evacuation were studied in order to improve building evacuation processes. The sample adopted in this study consisted of (i) laypersons, mostly elderly; (ii) healthcare professionals working with vulnerable individuals who live with disability on an everyday basis, for their point of view on disabled persons; (iii) fire victims for their experience (persons who suffered burns in a fire).

Qualitative research was used to study fire risk perception and to understand the attitudes and behaviours of individuals. The information was collected during interviews following a questionnaire that combined questions of a general nature, questions referring to the fire and questions focused on the experience of evacuating a building.

Results of this inductive, exploratory and qualitative method showed differences between the analysis of experts, the point of view of laypersons and the experience of fire victims. They also showed that risk perception is influenced by psychological, social, physical, political (here regulatory and normative) and cultural factors. Fire risk perception is based on the individual-environment-risk paradigm. Among the factors characterising risk perception, we noted the preponderant role of trust emerges, as well as that of the human environments (daily and emergency), the physical environment (building) and the climate of safety in which the event takes place. These different dimensions of fire risk perception show that it is a combination of psychometric and cultural paradigms. Building evacuation is seen as a psychological process involving both emotion and cognition.

The resulting model aims to improve the understanding of a building evacuation process and to provide tools to anticipate crises.

1. Introduction

It has been established that in the early moments of a fire, occupants smell smoke or hear the alarm but react belatedly. At the very beginning, the person does not appreciate their being in danger, ignores the situation or looks for an explanation for the phenomenon. Such responses often lead to belated evacuation or protection measures [36,37].

By way of psychological and psychosocial approaches, the study of risk perception provides an understanding of human behaviour when coping with danger, and the decisions and actions taken in such context. Risk perception plays a part in risk management and risk control, in crisis anticipation and in people's support for prevention strategies. Receptivity or non-receptivity to prevention messages also depends on risk perception [25].

For Slovic [55], "danger is real, but risk is socially constructed" and "risk assessment is inherently subjective and represents a blending of science and judgment with important psychological, social, cultural and political factors" [55]. Most psychological theories of risk perception usually acknowledge two assumptions: first, human behaviour is an adaptive process between a being and its environment, and, second, risk perception is necessary for this adaptation. For Slovic et al. [51], the subjective judgments of experts and laypersons are fundamental elements in risk assessment. If such judgments are incorrect, risk management will not be optimal.

People's behaviour in response to an event depends on how the situation is interpreted. The victims involved in an emergency suffer physical or psychological aggression. It is necessary to distinguish between fear which belongs to the realm of emotions and stress that reflects a person's state of adaptation (physical operating parameter). Stress characterises a phenomenon which is biological, psychological as well as social [31,32,35,41]. In a

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situation of danger, the maintenance of trust is needed to reduce stress and negative emotions [1,4].

The concept of trust is thus a complex and abstract notion, without consensus as yet. The literature gives several definitions of trust according to its nature (behaviour, belief, commitment, etc.), its type (interpersonal, inter-organisational, intra-organisational and institutional), its components (emotional, cognitive, conative) and its factors (credibility, reliability, integrity, goodwill, etc.) [15,48,49]. There are two predominant approaches in the literature [11]. In one, trust is identified as a psychological state upstream from behavioural intents that translates into an assumption, an expectation or a belief concerning the partner in the exchange, reflecting cognitive and affective components. In the other, trust is either understood as a behavioural intent resulting in a willingness to rely on the partner in the exchange, or leads to an action, thus referring to a conative dimension. In the classification proposed by Guibert [19]: “trust”, which is based on social relations, on belonging to a group, on shared values and relates to a belief in the reliability of a person (I trust this or that person); “confidence” which evokes the conviction that the situation is under control with a low level of uncertainty (I feel confident); “reliance” which contains the idea of a dependence on others or on technology (I rely on this or that).

Risk perception is the vector between danger and awareness of the danger, connecting the five senses to the awareness of danger. This process is accompanied by different psychological consequences: fear, anxiety or panic, depending on how the atmosphere of the situation is experienced [28].

In fire situations vulnerability does not only concern persons [20]. This author classifies vulnerabilities in four categories: innate vulnerabilities reflecting the factors related to the person (e.g. immobile individual, elderly, etc.); vulnerabilities gathering empirical factors relating to the level of experience, training, knowledge of procedures; situational vulnerabilities reflecting certain aggravating factors such as falling asleep, taking narcotics or alcohol, for example; and vulnerabilities reflecting technological inefficiency of technological devices. This analysis allows for the classification of risk groups by type of vulnerabilities, to understand how vulnerabilities can grow and spread, and to establish if a person who is not vulnerable may become so. Thus, vulnerabilities are not static they are dynamic and interdependent and can evolve during the event.

The aim of this research is not to assess fire risk but to understand how risk is represented in people's minds, what motivates their choices and behaviour in a fire situation, in order to improve building evacuation. We are convinced that early awareness of a danger is favourable to a successful evacuation. In our case, the persons concerned are elderly persons and disabled persons, who are vulnerable persons in all phases of an evacuation as noted by Gwynne [20]. And, more generally, in fire situations we are all potentially vulnerable because the presence of smoke, toxic gases, obstacles and deafening noises has negative consequences on our capacities and faculties. To ensure the safety of all and meet the goal of a successful evacuation, we should identify the determinants of risk perception and discover how evacuation is perceived by persons who are vulnerable or are made so by the fire situation in all phases of a building evacuation.

This paper focuses on individuals, and is based on qualitative research and reported experience from vulnerable persons living with disability in everyday life, health experts working with vulnerable persons and fire victims. The feelings and experiences collected allowed us to determine, on the one hand, the dimensions that structure risk perception, as well as the judgment biases in risk perception, and, on the other hand, to assess the building evacuation process. The resulting model aims to improve the understanding of a building evacuation process and to provide tools to anticipate crises, applicable to the general public, grouped together in a “building evacuation engineering” concept that proposes strategies seeking to reduce the uncertainty and complexity of the process [57,58].

2. Overview of risk perception

Many factors are involved in risk perception, either related to the risk itself or to the person who perceives the risk. Without being exhaustive, Table 1 summarises qualitative parameters involved in risk assessment from the literature.

Different models allow us to understand risk perception, its acceptance by persons and to address people's reactions faced with a risky situation. Depending on the model, the risk is seen as a mathematical construction (expected utility theory), or as an assessment through social values (psychometric paradigm), or a focus of the information treatment processes (cognitive paradigm) or as socially constructed (cultural model).

In the expected utility paradigm, (Von Neumann and Morgenstern, 1947), (Edward and Tversky, 1967), risk is the product of its probability of occurrence and its potential consequences and presupposes that human beings behave rationally. An individual will then choose the solution with both the most probable (reflecting the notion of risk aversion) and the best outcome, i.e. the most “useful”, considering all possible types of impacts [7,10,23]. The expected utility paradigm presents limitations which were brought to light, by several works: Allais and Ellsberg's experimental paradoxes in the 1960s (quoted in [23]), in which individuals reviewed the usefulness linked to a gain when its probabilities were modified; by Herbert Simon's bounded rationality theory (quoted in [23]), which stipulates that the cognitive limits of a decision-maker make it necessary to build a simplified model of the world to be able to manage it, and in which an individual tries to reach a satisfactory achievement level, and not necessarily the optimal one [23]; and by the prospect theory of Kahneman and Tversky [22], in which people react differently to gain or loss prospects depending on the circumstances [23]. When people achieve gains, they become cautious and avoid taking risks in order to preserve those gains. However, when they suffer losses, they go on taking risks because they feel they have nothing to lose.

According to Tversky & Kahneman [61], in an uncertain situation, individual choices seem to follow an informal, implicit and intuitive rationality. To make a decision, people use simple mental strategies of information treatment called heuristics. The subjective treatment of information during decision making is affected by a dozen cognitive biases and heuristics [8,10,61], among which: the availability heuristic (evaluation based on the most commonly prevalent or the most recent information); representativeness heuristic (approximation of the situation to one already known); anchorage-adjustment (assessment of the situation with reference to a previous case and assessment of the context); overconfidence; persistence of opinion bias; effects of presentation and of framing biases.

These studies on cognitive psychology demonstrated that heuristics are affected by cognitive biases [23], which cause important and systematic mistakes and induce judgment distortions. This can lead to flawed certainties and thus reduce safety [27].

In the cognitive paradigm (Simon, 1955 quoted in [7]), assessment of the options is made in status nascendi, i.e. at the time of the assessment. The paradigm aims to understand the information treatment process behind the judgment, from the context in which information is acquired. In the cognitive paradigm, behaviours are not a reflex in response to a stimulus but result from psychological processes [10,23]. However, to overcome some difficulties inherent in cognitive functioning (limited human cognitive capacities, misleading personal experience), individuals use