Panic and Human Behavior in Fire

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Abstract

Today, most buildings are equipped with fire safety and fire protection systems. Nevertheless, fires still occur and result in fatalities. The salient part of the problem emanates from the fact that the majority of fire protection systems in buildings are put in place with false and incorrect expectations with respect to how people actually react in emergency situations. In other words, occupants are likely to react differently from what they are mostly expected to do upon which fire safety systems are put in place in buildings. This antithesis of behavior is attributed to people's panicky reaction and behavior which may contribute to occupants demonstrating dysfunctional and irrational responses. Nonetheless, do people really react and behave in an irrational, anti-social and panicky manner in the event of a fire and emergency or the word panic has wrongly been used in various contexts and building occupants behave rationally in a socially-acceptable fashion in reality? The present study is aimed at demystifying panic definition and investigates on what people's actual behavior is in case of an emergency such as a fire drawing on some previous research findings.

Kew words: *Panic, Behavior, emergency, fire situation, actual response.*

Introduction

Over the years, panic has been discussed by several authors and practitioners. Psychologists and sociologists have paid attention to the concept of panic for a variety of situations. By the 1970s, nonetheless, some researchers began looking into

human behavior during emergency with scrutiny. In the fire field, it was assumed that the concept of panic is a vague myth meant to blame the outcome of a tragedy on the occupants when in reality the building design or its management was potentially at fault (Fahy & Proulx, 2009).

> Whether it is overall community disaster planning or whether the plans involve management or designing of space use in emergencies in a specific high-rise building, the planner must proceed with accurate knowledge and understanding if any success is to be achieved. plans based on major incorrect assumptions or faulty suppositions about human behavior in the situation for which planning is developed will be useless (Quarantelli, 1975. P.1).

Panic behavior cannot be understood well unless it is seen from different aspects. Quarantelli (1975) aptly suggests that planning can reduce human casualties, personal losses, property damage and the general social disruptions which occur as a result of natural catastrophes or technological accidents. The overall dominant view is that, human beings are very likely to do badly in the face of extreme danger and emergency. Behavior in disasters is, thus, regarded as illogical actions, irrational decisions, personal and group disorganization contributing to the worst case scenario in widespread hysteria and panic. Quarantelli (1975) goes on to say that the darker, impulsive, irrational, more animal-like side of the human creature will be exhibited in highly stressful situations. In other words, human beings are not reeds that bend easily with the wind, instead, they are even more fragile saplings that will break and snap under the surge of a very threatening event. However, later on in his book he concludes that, drawing on the empirical evidence, it is clearly indicated that the general belief of human beings' panicky behavior is fundamentally incorrect. Human behavior and response in disasters in modern, industrial societies is fairly good and acceptable by almost any reasonable criteria one could see. It is hard to find any compelling evidence, apart from anecdotal stories, that suggests that behavior under stress is any more illogical, irrational, or dysfunctional than every day behavior.

In order to clarify what we mean by panic and occupants panicky behavior we need to provide some definitions of panic. Definitions of panic can be found in

dictionaries and in the sociology and psychology literature. Fahy & Proulx propose some definitions of panic gleaned from different sources. It has been defined by Goldenson, for example, as "reaction involving terror, confusion, and irrational behavior speeded up by a threatening situation". Johnson maintains that panic is "behavior encompassing selfish competition uncontrolled by social and cultural constraints". In this line, Keating suggests four elements of panic: 1) hope to escape through dwindling resources: 2) contagious behavior: 3) aggressive concern about one's own safety: and 4) irrational, illogical responses. In another definition, Quarantelli (1990) views panic as an acute fear reaction marked by flight behavior and the panicky participant as non-rational in his/her flight behavior. Somewhere else Quarantelli (2001) describes panic as dysfunctional escape behavior generated by fortuitous, ever varying circumstances, but involving impending danger. He also defines panic as collective flight based on a hysterical belief. The Oxford English dictionary defines panic as an "excessive feeling of alarm or fear… leading to extravagant or injudicious efforts to secure safety" (Clarke, 2002).

Clark (2002) presents some other classical definitions of panic that are briefly discussed here: Park & Bugress (1924) "panic is the crowd in dissolution". Lang, K., Lang, G.E (1961) "panic is a collective retreat from group goals into a state of extreme privatization". LaPierre (1938) "panic behavior is the antithesis of regimental behavior, uncoordinated interaction with unpredictable consequences". And according to the Medical Online dictionary, panic is a sudden strong feeling of fear that prevents reasonable thought or action.

Later on in the present paper, we will examine whether or not people, more often than not, show panicky behavior based on the characteristics and definitions provided above in the event of an emergency such as a fire, but prior to attending to this, we may need to describe what the causes of panic are, because the first step in preventing crowd panic is to be aware of the causes. Some of the main triggers may include:

- Fire – Fire can be fatal and deadly and if required and necessary emergency exits and escape procedures are vague and/or hard to find and follow, panic is inevitable.
- Emotional instability – A simple flight that develops out of control could result in a sense of insecurity in a specific area in the environment.

- Fear – Fear of endangerment and entrapment may arise from emotions associated with panic and may lead to deadly and tragic consequences such as stampede and trampling.

- Anger/violence - Violence is foreseeable when feelings of anger or rage take over a crowd.
- Spatial limitations – Endeavoring to escape from an emergency and dangerous situation, there must be adequate amount of space for every individual to egress the place safely, otherwise people may be trampled or suffocated.
- Demographics – Particular locations or groups of people cause crisis events. For example, the nature of the event can pave the way for disruptive and chaotic behavior such as demonstrations that, by the nature of the emotional environment can develop into a situation.

Heid (2004) suggests that various circumstances should interplay in order to trigger panic:

- The victim perceives an immediate threat of getting entrapped in an enclosure space.
- Escape and exit routes appear to be rapidly closing.
- Flight seems to be the only way and the last resort to survive.
- No one is available to help.

Almeida, E. et al (2008) point out that if people have to leave a building in the event of fire occurring and they are not familiar with the building structure well enough, they would run for the exit they used as an entrance, even if other exits are much easier to reach or even safer. They also might disorient themselves in their surroundings and thus indicate “herding” or “flocking” behavior. It is meant by herding, a human group dynamics visible in emergency situation. To put it simply, when people feel panic, they may start acting non-logically and their ability to decide on their own volition can be minimized, if not entirely lost. As a consequence of the lack of independence, people tend to follow others in hope that they could get them out of the dangerous situation. Another phenomenon proved based on the observations is referred to as “arching” which appears when a “big crowd with a high desired velocity tries to pass through a door. Instead of passing through the door in less time, or giving the oncoming pedestrians a chance to pass through the door,

the door gets clogged and the crowd gets arch-shaped" (Almeida, et al. 2008). People always try to find the shortest and easiest way to reach their destination which, most of the time in case of an emergency, is the path and door through which they have entered the place. The basic principle is "the least effort principle".

Even though a lot has been done in this field in the last decades it is imperative to know that science, based on human behavior, cannot completely be compared to other scientific disciplines. The reason may mainly boil down to the fact that the results and the assumptions are not based on a universal validity and uniformity like mathematics and physics. For example, an investigation conducted in Sweden cannot be assumed to be applied all over the world. The same thing can be said about studies that have been done on a particular test group, such as age or gender. Appropriate application of the results to other groups seems to be unclear and vague. The reason for this may result from the fact that it mostly depends on the variety of the cultural, social and geological environments. In Sweden, for example, fire drills are a common occasion during the primary school years, which will influence one's behavior and actions during an emergency situation. Whereas, the same cannot be said with confidence for developing countries where school access is limited or not existing at all. Thus, people with such a various background and knowledge are not likely to be expected to behave in a similar way (Markus Friberg & Michael Hjelm, 2014).

Contrary to the discussion provided above, resting on a number of previous related studies what can be inferred is that, in practice, people may not exhibit panic and dysfunctional behavior when exposed to emergency situations. It is a widespread misconception to believe that people caught in a fire will panic and demonstrate crazed behavior. Instead, such crazed behaviors such as trying to flee in a stampede, crushing and fighting others are in fact extremely rare. The transition between rational normal behavior and the apparently irrational panic behavior is controlled by a single parameter, the "nervousness", which influences fluctuation strengths, desired speed, and the tendency of herding. As a result, it gives rise to paradoxical impacts like "freezing by heating", "faster is slower", and the ignorance of available exits (Helbing, et al, 2008). Panic which supposes irrational behavior for an emergency situation is rather atypical of human behavior in fire. Unlikely, people are likely to apply rational, logical, and altruistic response and decision-making in relation to their understanding of the situation at the time of a fire. However, in

retrospect, some decisions might not look optimal and negatively impacted the outcome of a fire, however, at the time of a fire, these decisions were rational and the best ones when all factors are accounted into consideration (Proulx, 2001).

The notion that panic occurs during a fire is very much influenced and judged by the outcome of the fire. What it is meant by that, is that, for example, when a crisis response, such as re-entering a burning and/or collapsing building, results in fatality, it is labeled "panic", whereas, in case that the akin response and reaction results in lives saved, it is labeled "heroic". All human behavior in fire can be rationalized when the event is seen through the subject's perspective (Fahy & Proulx, 2009). Elsewhere, Tingguang et al (2011) propose that panic is not something that can be measured, but it can be inferred. Most first responders inferred the panic from the outcomes, retrospectively, and not observing any actual panic from the scene. One may assume that panic is a concept similar to the entropy in thermodynamics. Invariably, we are not able to measure fire entropy directly, but infer it from the measurement of temperature, flow, etc. In a similar way, we cannot measure panic directly, instead, we can infer its level from other measurable quantities, such as the level of the internal crushing forces, how many shoes off their position, how many people died from the fault of others etc.

Moreover, contrary to common belief, the lack of panic is that that contributes to fire-related consequences. Neil Townsend, Divisional officer of London Fire Rescue Service points out that "when people die in fire, it's not because of panic, it's more likely to be the lack of panic". However, Markus Friberg & Michael Hjelm (2014) believe that in order to understand behavior during fire and emergency situations, one must know that not everyone will behave in the same way at a certain situation. Therefore, it is vital to first know what different characteristics and factors there are, such as age, gender, educational level, previous experience and cultural impact. It is also necessary to know how those factors actually have an impact during an evacuation. In this line, Drager Safety AG & Co. KGaA reports that there are three myths (misconceptions) about human behavior in the event of an emergency including: 1) Employees respond to an alarm immediately which describes that in the event of an emergency people wait for additional signals, discuss each other whether it might be just a false or test alarm and thus waste seconds that can make a marked difference between life and death. 2) As soon as people discover that an alarm is for real, they will panic, whereas, in reality, panic is neither an automatic

nor a particularly typical response. And finally 3) In the actual event everybody only thinks of saving themselves. In contrast, especially during extreme situations, humans manifest themselves as fundamentally social beings.

The question that may be raised is now that, if people do not panic in fires, what do they actually do? The occupant behavior, as Proulx (2001) proposes, differs in accordance with the three major elements: a) the occupant characteristics which including occupants profile such as occupants' age, mobility, knowledge, experience, the condition of the person at the time of the event, personality and decision-making styles, and finally, the occupants' role in the building can explain different responses. b) the building characteristics that encompass types of occupancy, the architecture of the building, the activities happening in the building at the time of the fire, and finally, the building fire safety features, and c) the fire characteristics that is heavily intertwined with people's perception and interpretation of the situation. For example, perceiving a smell of smoke will initiate a different response than directly seeing the fire. The concept of commitment that is described as people to be committed to their ongoing activity even when realized there is a fire outbreak may be another cause. In other words, people have a decision plan to carry out a specific activity and are reluctant to switch their attention to something unrelated.

The following table by Proulx (2001) represents the factors influencing human behavior in fire:

Table 1:

Occupant Characteristics	**Building Characteristics**	**Fire Characteristics**
Profile • Gender • Age • Ability • Limitation	**Occupancy** • Residential (low rise, midrise, high rise) • Office • Factory • Hospital • Hotel • Cinema • College and University • Shopping Centre	**Visual cues** • Flame • Smoke (color, thickness) • Deflection of wall, ceiling, floor
Knowledge and	**Architecture**	**Olfactory cues**

Experience • Familiarity with the building • Past fire experience • Fire safety training • Other emergency training	• Number of floors • Floor area • Location of exits • Location of stairwells • Complexity of space/Way finding • Building shape • Visual access	• Smell of burning • Acrid smell
Condition at the Time of Event • Alone vs. with others • Active vs. passive • Alert • Under Drug . Alcohol . Medication	**Activities in the Building** • Working • Sleeping • Eating • Shopping • Watching a show, a play, a film, etc.	**Audible cues** • Cracking • Broken glass • Object falling
Personality • Influenced by others • Leadership • Negative toward authority • Anxious	**Fire Safety Features** • Fire alarm signal (type, audibility, location, number of nuisance alarms) • Voice communication system • Fire safety plan • Trained staff • Refuge area	**Other cues** • Heat
Role • Visitor • Employee • Owner		

Furthermore, decision-making during a fire incident differs from day-to-day decision-making. Under emergency and stressful situations, the person usually senses that the decisions must be made quickly while the available information, based on which he/she needs to make the decisions, may be very limited or overwhelming. Therefore, behavior such as flight that might look disorganized to the observer, might actually be the most rational, logical, and correct response to the threatening stimulus perceived by the evacuating occupant.

According to Quarantelli's (1980) notion, as far as human behavior and evacuation process in fires and emergencies is concerned, there are five patterns of behavior shown by people. They include warning, withdrawal movement, shelter, and return. *Warning* patterns refer to the behavior of individuals becoming alert to possible threats or learning of actual ramifications. The *withdrawal movement*

patterns refer to that part of evacuation process germane to the actual physical flight behavior. The *shelter* patterns are known as the behaviors at the place of refuge. Finally, the *return* patterns involve the evacuee's behavior when leaving the shelter location and going back in almost all cases to the area of original departure.

Building Fire Safety & Protection Systems

At the outset of the present study, it was stated that, the most building fire fatalities stem from the fact that fire safety and fire protection systems in a major number of buildings are put in place on the basis of false expectations of the building occupants' actual behavior and response in the face of an emergency such as a fire situation. Building and fire codes are traditionally prescriptive, that is, they inflexibly specify the precise minimum requirements for buildings. Prescriptive approaches are based on applying a predetermined set of rules and regulations that, if complied with, limit the risk of the design to an acceptable level. Improvements to descriptive codes occur incrementally, usually in the wake of the past incidents and case studies. The paramount importance of all prescriptive fire safety codes is that they are designed to protect against the repetition of historical events. Because they are reactive, prescriptive codes implicitly reflect historically prevalent naïve theories about human behaviors in case of an emergency. For example, the belief that people panic or behave irrationally and illogically was a predominant but invalid theory.

Contrary to prescriptive codes, performance-based codes are designed to facilitate engineered solutions to design problems. Performance-based methodology requires the quantification of both Available Safe Egress Time (ASET) and Required Safe Egress Time (RSET) to determine the degree of life safety provided.

As with prescriptive codes, there are problems with performance-based code approaches too. They have reliance on assumptions about occupant characteristics, resulting in these approaches to be prone to invalidity and naivety of the theories that underlie prescriptive provisions. In fire protection engineering, the prevailing view is that, building occupants are supposed to evacuate buildings when they hear alarm signals. The design approach that exclusively relies on assumption about human characteristics is also subject to fault with respect to incorporating human behavior into building designs, regardless of whether the approach is prescriptive or

performance-based. The point that should be made here is that, performance-based design solutions are likely the best means for fully incorporating human behavior into code-implying designs. Nonetheless, performance-based code approaches need to establish "performance objectives" for people that enable human adaptive capabilities. With help of designing buildings that support performance objectives for people, we will also enable more accurate and reliable predictions of human behavior and reaction times.

Time Delay in People Actual Response to Emergency

At this time, we should discuss causes and factors having impact on the delay and retarded response that people usually exhibit in the face of a fire situation with regard to evacuation of the building. A number of case studies and past experiences have revealed that building occupants when exposed to an emergency alarm and warnings, more often than not, do not seem to be heeding them and they do not respond to the possible threat as quickly and rapidly as they are expected to do. Having this in mind, in finding answer to why people would do behave so, we should consider the issue from different angles. To this end, the first and the most important aspect is to look into how building occupants make their decisions so that they can implement what they have decided in response to the warning threats they are faced with. Kuligowski (2009) ascertains that any action performed in a situation is the result of a behavioral or decision-making process, rather than as a result of random chance or even actions resulting directly from a change in the environment (i.e., a stimulus-response relationship). He, hinging upon research from building fire evacuations, goes on to say that, prior to performing any actions, people perceive certain cues, interpret the situation and the risks and then based on those cues they consequently make a decision about what to do on the basis of their interpretations.

Therefore, every single action taken by building occupants is influenced by this decision-making process. In a building fire, the phases and factors that influence each action are attributed to the occupants in the building, the building itself, and the fire event. In the perception phase, building occupants can perceive external physical and social cues and stimuli from their environment. Examples of physical cues can be flames, smoke, heat and among social cues are hearing discussion, watching

others' reaction, etc. In the interpretation phase, the occupants make attempt to interpret the information and stimuli provided and perceived during the perception phase. During the interpretation phase, occupants interpret or define both the situation and the risk and threat to themselves and/or others. In the decision-making phase, occupants make decisions on what to do next based on their interpretations of the emergency situations. And finally, in the last phase of behavioral process, occupants may perform the action they decided upon in the decision-making phase.

According to Gwynne, et al, one theory that is based upon methods from the social sciences is the Emergent Norm Theory (ENT) that is, individuals are required to make a collaborative effort to come up with a meaning out of new or unfamiliar situations, often under time pressure. In other words, in an emergency such as a building fire, individuals interact collectively to create an emergent situationally-specific set of norms to guide their future set of norms. This is where another term, "Milling" appears that is referred to as a communication process whereby individuals come together to define the situation, adopt new appropriate behavioral norms and seek concerted actions in order to find a solution to the common problem at their disposal. In another theory, the Protection Action Decision Model (PADM) is introduced which provides a process describing the information flow and decision-making impacting on protective actions taken in response to natural and non-natural disasters. PADM postulates that cues from physical and social environment such as the sight of smoke and emergency messages and warnings, if taken and perceived as a threat, can interrupt normal activities of the recipient. As a result, the individual must first receive the cue(s), pay attention to the cue(s), and then comprehend the cue(s). These three steps are known as "pre-decisional processes".

One of the reasons that building occupants perform their actual response with dangerous and/or possibly deadly delay may emanate from the fact that, in general, from people's standpoint, non-evacuation is preferred to evacuation (Quarantelli, 1990). Even when a warning message is clearly perceived as a valid and socially-accepted threat, there still may be reluctance to evacuate the building. This is not because people are paralyzed at the sight of an emergency. In contrast, occupants under stress usually endeavor to consider which would be the least social atypically-looking behavior option in the situation. Accordingly, occasionally, there is a general and collective decision that the response and behavior ought to be something rather than an evacuation of the place. Put it another way, even when people feel

endangered and threatened, they still strive as much as they can to maintain their traditional and routine ways of behaving and not attracting attention to themselves in an atypical and unusual manner. Quarantelli (1990) continues to suggest that, on some occasions, the reluctance to leave the building may be because the warning and threat message lacks the second compelling and convincing component for its effectiveness and for people to take it as serious as they should. "To evoke an appropriate response, a warning must not only signify there is danger but also what should be done in the situation" (P. 7). A failure to evacuate may simply be as a consequence of a failure of the warning to convey the explicit message of how the emergency and threat may be prevented, avoided or minimized.

Conclusion

Based on what we discussed above, panic may be regarded as a very rare happening and not a typical response to people perceiving a danger. In fact, there would be very difficult to evoke panicky flight. Panicky behavior requires certain specific conditions such as the perception that escape and exit is possible from a very deadly and immediately threatening situation. Hence, warning messages which are perceived by building occupants as valid and socially confirmed, do not give rise to forgetting, overlooking, and abandoning routine and traditional roles and responsibilities (Quarantelli, 1990). Behavior during a building fire evacuation is influenced by behavioral process which has different components and phases commencing with physical and social cues and stimuli upon which people may act and they also require perception, interpretation, decision-making and finally action undertaking.

There is no much concrete evidence on mass panic in emergencies and any selfish behavior. Instead, risks associated with crowds are usually as a result of physical constraints and lack of information rather than their inherent selfishness.

Based on the various aspects of the discussion provided, we must learn how to devise human performance objectives that are compatible with the goals that people normally try to pursue in the event of a building fire. We must also learn how to integrate human performance objectives into a holistic representation of how building fire prevention and protection systems including building layouts, both

active and passive fire protection systems, occupant characteristics, and designed procedures work hand in hand to achieve high level design objectives. Therefore, we who have the responsibility for the safety of our communities must provide truthful and accurate information that people need to make life-saving decisions.

Furthermore, occupancy classifications used in fire safety regulations should be based upon appropriate occupant characteristics and not, for example, solely on fire loading / fire severity. It is, therefore, more effective and practical to learn what people tend to do actually and naturally in emergencies and plan around that rather than design your plan and then expect people to conform to it.

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