LUND UNIVERSITY

The status quo of Fire Evacuation Training

Menzemer, Leo Willem; Vad Karsten, Mette Marie; Gwynne, Steve; Ronchi, Enrico

2024

Document Version:
Publisher's PDF, also known as Version of record

Link to publication

Total number of authors:
4

The status quo of Fire Evacuation Training

By: Leo Willem Menzemer [a, b], Mette Marie Vad Karsten [a], Steve Gwynne [b, c], Enrico Ronchi [b]

[a] DBI – The Danish Institute for Fire and Security Technology, Denmark
[b] Division of Fire Safety Engineering at Lund University, Sweden
[c] Movement Strategies, UK

How people react in emergencies is a very important factor that may determine the outcome of a fire, not least when it comes to building fires. Training building occupants for evacuation in fire emergencies is not yet widely practiced as a part of general safety strategies and usually only guided per regulatory requirements [1]. To the knowledge of the authors, this holds at least true for regions where they can actually access existing policies on the matter. As such, evacuation training may often be seen as a compliance and checkbox exercise rather than a chance to enhance human safety.

Methods for fire evacuation training
People can be trained in many ways and an often-encountered distinction in the literature is one between so-called "traditional" training, often denoting rather analogue approaches and tools (e.g., egress drills, poster-/slide-based workshops), and "modern" training, which is usually found to describe the use of (digital) technology in aiding the training (e.g., games, virtual reality, video-aids) [3]. In that context, it was found through a scoping review that the scientific literature of the past decades is strongly dominated by research focusing on "modern" training approaches, namely Serious Gaming, Virtual Reality, and Augmented Reality [3]. This trend seems rather counterintuitive, as in practice "traditional" evacuation methods and especially drills are the prevalent form of training that is employed - not least because it is often the only type of training that is referenced or required within regulatory frameworks [1]. This trend may possibly be linked to a combination of: a) research and publishing practices, where applications of 'novel' approaches and emerging technologies are more likely to appear in scientific publications, b) the fact that the implementation of change to established practices takes time, and c) that regulatory prescriptions of fire evacuation training do often not specify any (detailed) scopes or assessment criteria, and thereby practically disincentivize elaborate approaches.

Generally, evacuation training can be approached through the lens of its potential merits by considering: a) how knowledge can be effectively acquired, b) the transferability of that knowledge into real-life applications, and c) the retention of knowledge shortly after the experience and in the longer term. How each of these aspects can be adequately captured and quantified is, however, not unanimously agreed upon in the literature. In fact, it can be observed that studies on evacuation training programs often employ individual approaches to the assessment of the training outcomes, which does not allow a

comparison between different types of training. Nonetheless, there is evidence of improved behaviour as a result of training for evacuation (e.g., [4]), as well as quantitative findings that more engaging types of training improve long-term knowledge retention [5,6]. Figure 1 summarizes some important features of evacuation training and prominent (in practice or research) methods in fire evacuation training.

Training Methods				Training Effect	Knowledge Retention	Knowledge Transfer
Serious Games	Virtual Reality	Augmented Reality	Evacuation Drills			
Allows to experience hazardous situations in a safe environment			High cost and effort	Qualitative evidence of training benefits across studies	Short-term knowledge retention seems independent of training methods	Benefits from training decision making rather than the repetition of patterns
Assessment methods vary greatly	Increased trainee engagement through high immersion	Merging dynamic virtual simulations with real-world space	Disruptive and often organized ineffectively and unenganging			
Static scenarios for dynamic events	Realism depends on the virtual elements and computational capacities		Often inconsistently planned and assessed	Engagement, immersion and realism are influencing factors	Long-term effect increases with engagement, immersion & realism	Transferability depends on the degree of realism of a simulation
	Easy to collect behavioural data		Potential for most realistic simulations	Assessment methods for measuring evacuation knowledge and performance vary greatly		

Figure 1 Summary of findings from a literature review on evacuation training methods, after [3].

Practical perspective towards fire evacuation training

Discussions around designing fire evacuation training need to keep their audiences in mind. This is to ensure its acceptance, and thus also efficacy. To gauge the perception of evacuation training in the general public, a study consisting of an online survey and subsequent semi-structured interviews has been carried out through 2023 [7]. The online survey collected 323 valid responses after discarding responses from participants with professional connections to the field of fire safety or evacuation.

When comparing the answers from respondents that received fire evacuation training at least at some point in their life (n=200) with those from respondents without any training (n=123), it was found that training leads to a significantly increase in the perceived severity of fires as well as how familiar participants deem themselves with safety protocols in their environments. In fact, the survey results further emphasized that the (perceived) quality of training is essential to its success, as it was found that it positively correlates with improved scores of self-rated preparedness among respondents.

To better understand the underlying motives behind the perception of evacuation training, the survey was followed by 28 semi-structured interviews conducted with members of the general public in Denmark and Sweden. In the interviews, participants emphasized the potentials that evacuation training has to help increase their emergency preparedness and subsequently positively affect their self-efficacy for evacuation. However, many participants criticized that they would not receive evacuation training, and albeit the online survey may not be representative for the underlying international population, a notable proportion of 38% did not receive any training either. Furthermore, it was mentioned by interviewees that training was not sufficiently engaging or well-organized, leading them to disengage and not experiencing its full potential. Participants that had received repeated evacuation training at an early age throughout their childhood and in school reported that certain knowledge has stuck with them throughout the years and that it would be important to convey basic knowledge on safety during evacuation to ideally everyone. Figure 2 features quotes from the interviews which highlight key positions that were expressed by the interviewees. The interested reader is referred to [7] for more in-depth accounts and analyses from the interview study and the online survey.
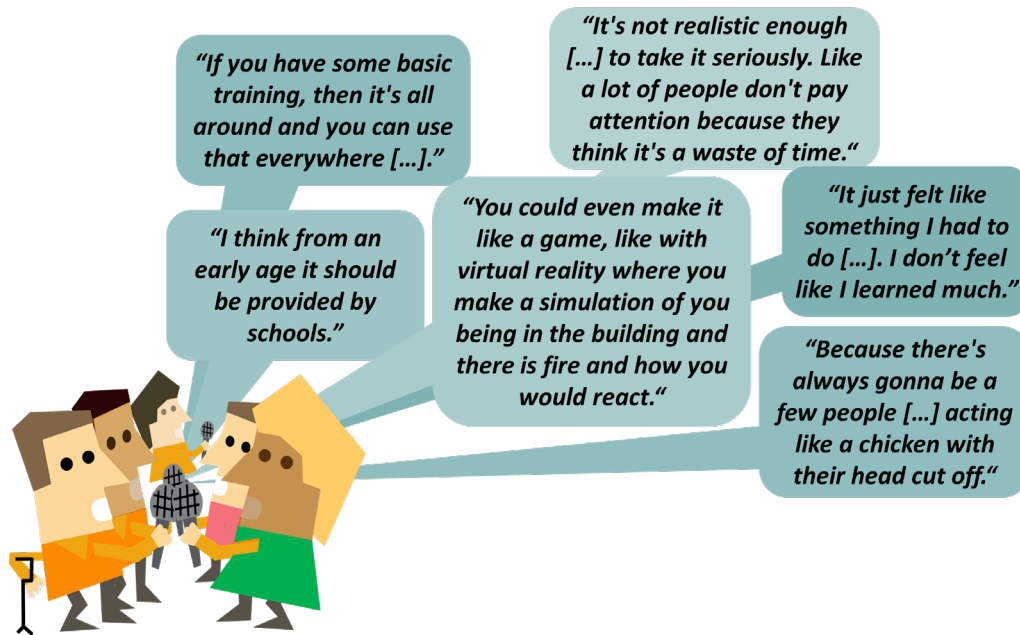
Figure 2: Statements about fire evacuation training from interviews with the general public in Denmark and Sweden.

There seems the potential to improve overall evacuation behaviour and thus performance through fire evacuation training, albeit it seems that potential is often not fully realized. As long as evacuation training is not considered as a part of a well-defined strategy for occupant safety, for example in performance-based approaches to holistic fire safety strategies, it will be hard to overcome the barrier of training as merely a regulatory checkbox rather than an asset to improve collective evacuation response and human safety in emergency situations. On the other hand, to warrant its application for defined goals, the approach to training needs to be evidence-based. Hence, any evacuation training program with that ambition needs to be a product of considerate design-processes aiming for more than mere compliance demands but impactful learning experiences. The definition of the scope of the training alongside the desired learning outcomes should be starting points, together with considering the target audience, its diversity, and individuals, as well as adequate assessment strategies to measure how well the training conveys relevant and related knowledge and how it may translate into a real-world scenario.

Conclusions

A review of previous research and predominant methods for fire evacuation training has been carried out to identify how these methods are being used in practice and in research. It was found that it is important to understand what potentials different methods offer to satisfy aspects relevant for successful fire evacuation training among building occupants. These aspects have been identified as the acquisition, subsequent transfer, and retention of relevant knowledge by trainees. In a mixed-method study, it was found through surveys and interviews that training has positive effects on people's emergency preparedness, but also that it is often perceived as insufficiently organized, which directly mirrors one of the most problematized aspects of fire evacuation training in practice (often in forms of drills). To ensure training quality, responsible organizers (e.g., property owners or managers) need to think beyond regulatory compliance and should reflect on desired learning outcomes, addressing the diversity among people, and align the program meaningfully around that path – the perceptions of evacuation training among the public may prove helpful to identify practical advice in that regard.

This article presents a brief introduction to evacuation training. The readers are referred to [3] and [7] for more information on this topic.

Acknowledgements

References

[1] S.M.V. Gwynne, E.D. Kuligowski, K.E. Boyce, D. Nilsson, A.P. Robbins, R. Lovreglio, J.R. Thomas, A. Roy-Poirier, Enhancing egress drills: Preparation and assessment of evacuee performance, Fire and Materials 43 (2017) 613–631. https://doi.org/10.1002/fam.2448.

[2] D.A. Purser, J.L. McAllister, Assessment of Hazards to Occupants from Smoke, Toxic Gases, and Heat, in: M.J. Hurley, D. Gottuk, J.R. Hall, K. Harada, E. Kuligowski, M. Puchovsky, J. Torero, J.M. Watts, C. Wieczorek (Eds.), SFPE Handbook of Fire Protection Engineering, Springer New York, New York, NY, 2016: pp. 2308–2428. https://doi.org/10.1007/978-1-4939-2565-0_63.

[3] L.W. Menzemer, E. Ronchi, M.M. Vad Karsten, S. Gwynne, J. Frederiksen, A scoping review and bibliometric analysis of methods for fire evacuation training in buildings, Fire Safety Journal 136 (2023). https://doi.org/10.1016/j.firesaf.2023.103742.

[4] M. Kinateder, P. Pauli, M. Müller, J. Krieger, F. Heimbecher, I. Rönnau, U. Bergerhausen, G. Vollmann, P. Vogt, A. Mühlberger, Human behaviour in severe tunnel accidents: Effects of information and behavioural training, Transportation Research Part F: Traffic Psychology and Behaviour 17 (2013) 20–32. https://doi.org/10.1016/j.trf.2012.09.001.

[5] D. Scorgie, Z. Feng, D. Paes, F. Parisi, T.W. Yiu, R. Lovreglio, Virtual reality for safety training: A systematic literature review and meta-analysis, Safety Science 171 (2024) 106372. https://doi.org/10.1016/j.ssci.2023.106372.

[6] M.J. Burke, S.A. Sarpy, K. Smith-Crowe, S. Chan-Serafin, R.O. Salvador, G. Islam, Relative Effectiveness of Worker Safety and Health Training Methods, Am J Public Health 96 (2006) 315–324. https://doi.org/10.2105/AJPH.2004.059840.

[7] L.W. Menzemer, M.M. Vad Karsten, S. Gwynne, J. Frederiksen, E. Ronchi, Fire evacuation training: Perceptions and attitudes of the general public, Safety Science 174 (2024) 106471. https://doi.org/10.1016/j.ssci.2024.106471.