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Original article

Beliefs of University Employees Leaving During a Fire Alarm: A Theory-based Belief Elicitation

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ABSTRACT

Background: Despite workplaces having policies on fire evacuation, many employees still fail to evacuate when there is a fire alarm. The Reasoned Action Approach is designed to reveal the beliefs underlying people's behavioral decisions and thus suggests causal determinants to be addressed with interventions designed to facilitate behavior. This study is a uses a Reasoned Action Approach salient belief elicitation to identify university employees' perceived advantages/disadvantages, approvers/disapprovers, and facilitators/barriers toward them leaving the office building immediately the next time they hear a fire alarm at work.

Methods: Employees at a large public United States Midwestern university completed an online cross-sectional survey. A descriptive analysis of the demographic and background variables was completed, and a six-step inductive content analysis of the open-ended responses was conducted to identify beliefs about leaving during a fire alarm.

Results: Regarding consequence, participants perceived that immediately leaving during a fire alarm at work had more disadvantages than advantages, such as low risk perception. Regarding referents, supervisors and coworkers were significant approvers with intention to leave immediately. None of the perceived advantages were significant with intention. Participants listed access and risk perception as significant circumstances with the intention to evacuate immediately.

Conclusion: Norms and risk perceptions are key determinants that may influence employees to evacuate immediately during a fire alarm at work. Normative-based and attitude-based interventions may prove effective in increasing the fire safety practices of employees.

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1. Introduction

With workplaces being where adults spend one-third of their lives [1], compliance with established occupational health and safety procedures is critical to prevent unnecessary injury and death. One notable workplace safety issue is fire. Non-residential structural fires, such as places of work, have increased over the last five years by 20% in the United States (U.S.). From 2015–2019 in the U.S., there were nearly 500,000 non-residential fires that resulted in over 12,000 civilian injuries and nearly \$11 billion in property loss [2].

Despite fire safety protocol mandates, many employees still fail to evacuate buildings immediately when there is a fire alarm [3]. It is estimated that two-thirds of injuries and half of fire-related fatalities are preventable if individuals evacuate immediately rather than prioritizing other activities (e.g., gather belongings) [4–7]. Existing fire evacuation literature [5,8–11] predominately focuses on evacuation modeling (e.g., occupant movement patterns, statistical predictions of engineering fire control); however, these studies do not provide insights into the beliefs that inform employees' decision-making to evacuate immediately in occupational settings. Because of this dearth of literature, theory-based research

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is needed to understand employees' beliefs into immediately evacuating when they hear a fire alarm at work.

The Reasoned Action Approach (RAA) can reveal the beliefs underlying people's decisions. Meta-analyses demonstrated the RAA successfully explains intention for many different health behaviors [12,13]. Furthermore, meta-analyses show that interventions using constructs in the RAA effectively change behavior [14]. According to the RAA, intention is the most proximal determinant of behavior [15]. Intention is determined by three global constructs: attitude toward the act (AA), perceived norm (PN), and perceived behavioral control (PBC). These global constructs are, in turn, seen as arising from three sets of underlying beliefs: perceived advantages and disadvantages of behavioral performance underly AA; beliefs about people who might approve or disapprove of the behavior underly PN; beliefs about the circumstances that might facilitate or hinder behavior underly PBC.

In a prior analysis, we examined how AA, PN, and PBC predicted the intention of a sample of university employees in the U.S. to evacuate immediately during a fire alarm at work, and we found that 59.8% of the variation in intention was predicted by RAA's three global constructs [16]. Given the success of the RAA predicting intention among university employees to evacuate during a fire alarm at work, the next step in applying the theory is to identify the beliefs underlying AA, PN, and PBC via a salient belief elicitation (SBE). A SBE is a method where people can disclose their top-of-the-mind consequences (perceived advantages/disadvantages of doing a behavior), referents (perceived approvers/disapprovers of them doing that behavior), and circumstances (perceived facilitators/barriers of them doing that behavior) either through an open-ended survey response or through an interview guide question. This current study is an RAA SBE to identify the university employees' beliefs about their perceived consequences, referents, and circumstances of them leaving the office building immediately the next time they hear a fire alarm at work. To the authors' knowledge, the present study is the first one to use a theory-based approach to examine belief factors associated with fire evacuation among individuals in a work setting.

2. Methods

2.1. Recruitment

Current employees at a large public Midwestern university in the U.S. were asked to complete an online survey administered through Qualtrics (©2020) in February 2020 (see Supplement). University employees were recruited through convenience and referral sampling. Participants were aged 18+, were current full- or part-time faculty (those providing education, e.g., professors, lecturers, researchers) and staff (administrative and support functions, e.g., assistant, registrar) employees, and had internet access. This study was approved by the Indiana University Institutional Review Board (Protocol #1911129390).

2.2. Measures

2.2.1. Demographic and background characteristics

Participants reported their age, gender, race/ethnicity, education level, and employment status. Details on sample size calculation and recruitment strategy are described elsewhere [16]. Four variables found in the literature to be associated with evacuation were included as background characteristics [17–22]. *Past behavior* was measured with one item about behavior during the last fire alarm at work, "During the last fire alarm at work ..." (0 = *ignored alarm*; 1 = *evacuated eventually*, 2 = *evacuated immediately*). *Past experience with building fires* was measured with the item, "Have you ever

been in a building when it or something in the building caught fire?" (0 = *no*, 1 = *yes*). *Perceived risk of an office building fire* was measured with the item, "There is a risk for fires in my office building" (1 = *not very probable*, 5 = *very probable*). *Self-reported knowledge of evacuation policies and procedures* was measured with six statements (1 = *definitely not*, 5 = *definitely yes*). Self-reported knowledge was calculated by averaging the six items, with a higher value indicating higher knowledge.

2.2.2. Intention

Intention was measured by averaging three items. One item ("My leaving my office building immediately the next time I hear a fire alarm at work") used a 7-point likelihood scale (1 = *very unlikely*, 7 = *very likely*). Two items ("I will leave the office building immediately the next time I hear a fire alarm at work" and "I plan to leave the office building immediately the next time I hear a fire alarm at work") used a 7-point agreement scale (1 = *strongly disagree*, 7 = *strongly agree*). A higher value indicates higher intention.

2.2.3. RAA beliefs

Perceived consequences were elicited with two open-ended questions: "Name one *advantage* or *good thing* that might happen if you immediately leave the office building the next time you hear a fire alarm at work" and "Name one *disadvantage* or *bad thing* ...". *Perceived referents* were elicited with two open-ended questions: "Name one type of person or group who would *approve* of you leaving the office building immediately the next time you hear a fire alarm at work" and "Name one type of person or group who would *disapprove* ...". *Perceived circumstances* were elicited with two open-ended questions: "Name one thing that would make it *easier* for you to leave the office building immediately the next time you hear a fire alarm at work," and "Name one thing that would make it *harder* ...". Internal reliability consistency and validity of the measures are also described elsewhere [16].

2.3. Analysis

For this exploratory mixed-method study, we conducted two separate analyses, each with its own analytical samples from the 540 employees (of approximately 10,000) who completed the survey. All analyses were conducted using SPSS v27 (IBM Corp, 2021). We conducted a descriptive analysis of the ten demographic and background variables, as well as conducted a Pearson correlation coefficient with intention. The analytical sample consisted of 498 participants who provided complete data for these variables.

2.3.1. Salient belief analysis

We conducted an inductive content analysis of the responses to the six open-ended questions to identify beliefs about leaving during a fire alarm [23,24]. The analytical sample consisted of 503 participants who answered all six questions. First, we exported responses into Excel. Second, we read responses to gain familiarity with the data. Third, we created a codebook and coded specific beliefs. Fourth, we assessed interrater reliability with a random 25% of responses per question. The kappa statistic revealed strong agreement: advantages (0.88), disadvantages (0.92), approvers (0.95), disapprovers (0.97), facilitators (0.94), and barriers (0.95) [25]. Fifth, we combined specific beliefs to form salient beliefs through a frequency analysis (beliefs with similar content area). Responses were coded 1 (*mentioning belief*) and 0 (*not mentioning belief*). To suggest which of these might be operating as determinants of intention, we calculated the correlation of each with intention.

3. Results

3.1. Demographic and background characteristics

Most participants were 30–49 years old (50.8%), female (66.1%), White (89.2%), and had graduate degrees (53.2%). Most were full-time employees (96.6%) and staff (74.9%). Compared to faculty, staff had a higher intention to leave the office building immediately the next time they heard a fire alarm at work ($r = 0.125$, $p = 0.005$) (Table 1). The mean of 1.49 for past behavior suggests most people left the building the last time they heard a fire alarm (90.9%). However, many did not leave immediately (46.8%) and instead took time to gather their belongings or investigate. Regarding past experience with fires, 33% of participants had previously been in a building when it or something in the building caught on fire. The average perceived risk of being in a fire was 3.07 (neither), with 36.1% of participants reporting that the risk for fires in their office building was *not very probable* or *not probable*. Participants described their self-reported knowledge of evacuation policies and procedures as high ($M = 4.03$, $SD = 0.79$). Those who had left during the last alarm ($r = 0.542$, $p < 0.001$), those who had past experience with fires ($r = 0.110$, $p = 0.013$), and those with higher self-reported knowledge ($r = 0.184$, $p < 0.001$) had higher evacuation intention.

3.2. Perceived consequences

Table 2 presents the perceived consequences. Participants perceived that leaving the office building immediately the next time they hear a fire alarm at work protects them. About a third (34.6%) mentioned that leaving the office building immediately the next time they hear a fire alarm at work “might protect me from injury and death.” This includes responses such as protection

Table 1
Demographic and background characteristics (N = 498)

Demographic characteristics	N	%	r with intention
Age			0.060
18–29	65	13.1	
30–39	145	29.1	
40–49	108	21.7	
50–59	114	22.9	
60–64	41	8.2	
65 and above	25	5.0	
Gender			0.081
Male	169	33.9	
Female	329	66.1	
Race/Ethnicity			–0.004
White/Caucasian	444	89.2	
Non-White/Caucasian	54	10.8	
Education			–0.070
Less than a bachelor's degree	86	17.3	
Bachelor's degree	147	29.5	
Graduate degree	265	53.2	
Employee status			0.033
Full-time	481	96.6	
Part-time	17	3.4	
Staff			0.125**
No, I am faculty	125	25.1	
Yes, I am staff	373	74.9	
Background characteristics	Mean	Standard deviation	r with intention
Past behavior (last alarm)	1.49	0.57	0.542***
Past experience with fires	0.33	0.47	0.110*
Perceived risk of being in a fire	3.07	1.19	–0.010
Self-reported knowledge of evacuation policies and procedures	4.03	0.79	0.184***

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table 2

Perceived consequences of leaving my office building immediately the next time I hear a fire alarm at work

Advantage My leaving the office building immediately the next time I hear a fire alarm at work ...	N	%	r with intention
Might keep me safe	161	32.0	0.041
Might protect me from injury and death	174	34.6	0.014
Might protect others from injury and death	24	4.8	–0.034
Might lead to setting a good example for others	42	8.3	–0.041
Might help 1st responders	29	5.8	0.02
Might help me to be prepared for a real fire	39	7.8	–0.003
Might lead to other benefits	47	9.3	–0.032
None	2	0.40	—
Disadvantage My leaving the office building immediately the next time I hear a fire alarm at work ...	N	%	r with Intention
Might get me injured or killed	48	9.5	0.005
Might get others injured or killed	22	4.4	–0.207***
Might get exposed to bad weather outside	95	18.9	0.058
Might not have my personal belongings	84	16.7	0.100*
Might negatively impact my work	195	38.8	–0.034
Might be a false alarm	10	2.0	–0.085*
None	60	11.9	—

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

from death, injury, or smoke inhalation. Additionally, 32.0% indicated that leaving “might keep me safe.” Few (4.8%) mentioned that evacuating “might protect others from injury and death.” Participants (7.8%) reported that evacuating immediately might help them “to be prepared for a real fire.” Participants mentioned that leaving immediately “might set a good example for others” (8.4%). Participants perceived other health benefits beyond mortality of self and others. For example, they might get fresh air, get a break, or chat with coworkers outside (9.3%). None of the perceived advantages had a statistically significant relationship with intention.

Regarding disadvantages, approximately one-third of participants (38.8%) mentioned that evacuating “might negatively impact their work.” This included responses such as their work might be interrupted or they might have to redo work. Participants reported that they “might not have their personal belongings,” such as their personal belongings might get left behind, stolen, or burnt (16.7%). Nearly 20% of participants noted that they “might get exposed to bad weather outside” if they leave during a fire alarm. Some participants perceived that the alarm “might be a drill or an alarm induced by smoke” (2.0%) (e.g., electrical sparks). Two disadvantages were negatively associated with intention. Participants who mentioned “might get others injured or killed” ($r = -0.207$, $p < 0.001$) and that the alarm “might be a false alarm” ($r = -0.085$, $p = 0.028$) had a lower intention than those who did not mention these disadvantages.

3.3. Perceived referents

Table 3 presents the social referents elicited when asked who might approve and who might disapprove of the behavior. Supervisors were by far the most frequently elicited approving referent mentioned by almost half (43.9%), followed by coworkers (22.3%) and safety/emergency personnel (20.3%). No one was the most frequently disapproving referent (71.2%). Those who mentioned supervisors ($r = 0.124$, $p = 0.003$) and coworkers ($r = 0.122$, $p = 0.003$) had a higher intention to immediately evacuate than those who did not mention these referents as approvers.

Table 3

Perceived referents of my leaving my office building immediately the next time I hear a fire alarm at work

... would <i>approve</i> of me leaving the office building immediately the next time I hear a fire alarm at work	N	%	r with intention	... would <i>disapprove</i> of me leaving the office building immediately the next time I hear the fire alarm at work	N	%	r with intention
Supervisors	221	43.9	0.124**	Supervisors	7	1.4	0.005
Coworkers	112	22.3	0.122**	Coworkers	46	9.1	0.01
Safety/emergency personnel	102	20.3	−0.023	Safety/emergency personnel	6	1.2	−0.089*
Students, patients, and clients	9	1.8	−0.073*	Students, patients, and clients	37	7.4	−0.02
Family and friends	64	12.7	−0.037	Family and friends	3	0.6	−0.101*
No one	7	1.4	—	No one	358	71.2	—

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

3.4. Perceived circumstances

Table 4 presents the perceived circumstances and we highlight here the five most frequent circumstances. First, participants mentioned working might be a perceived circumstance, with 23.1% mentioning “them working” as a barrier and 5.2% mentioning “them not working” as a facilitator. Second, participants reported that access to exits could be a perceived circumstance, as “not having access to exists, stairs, and other means of egress” is a perceived barrier (16.1%), while access is a perceived facilitator (10.9%). Participants noted the perception of what others are doing was a perceived circumstance, with “not having everyone leave immediately” was a perceived barrier (12.1%), while “having everyone leave immediately” was a perceived facilitator (8.5%). Fourth, weather might be an important circumstance, as having “bad weather” would make it harder to immediately evacuate (11.1%) but “good weather” would make it easier. Finally, participants mentioned that knowing the nature of the alarm as a circumstance, as knowing if the alarm is real might make it easier for them to evacuate immediately (14.9%), while knowing if the alarm is a drill might make it harder (6.2%). The circumstances of access, alarm frequency, and knowing the nature of the alarm have statistically significant relationships with intention.

4. Discussion

The first purpose of this exploratory, descriptive mixed-method study was to describe the salient beliefs underlying the intention of university employees to leave immediately the next time they hear a fire alarm at work. Bivariate analyses identified that two perceived

disadvantages, four perceived referents, and three perceived circumstances had statistically significant relationships with intention. Fig. 1 visually presents the results to illustrate how the RAA can be applied to suggest practical occupational health implications.

4.1. Norms

The main finding of this research is the importance of normative factors (PN, social norms, referents, etc.) as potential determinants of intention. As described in detail in our earlier paper, PN made statistically significant independent contributions to intention, suggesting that normative factors further our theoretical understanding of occupational fire safety behaviors [16]. Prior studies [12,13] have noted that norms are a key determinant in understanding and changing behavior, especially with family/friends for home-based behaviors and with coworkers/supervisors for occupational-based behaviors. In the elicitation analyses, we identified the specific referents and found statistically significant referents were social groups in the workplace.

Practical implications of these findings suggest interventions should address PN and the workplace safety culture. Communication campaigns could remind employees that supervisors, coworkers, and safety/emergency personnel approve of them leaving immediately. In addition to communication campaigns, feedback after an alarm and with approval from these significant referents could help facilitate evacuation. Communication campaigns could also let employees know what their peers and other employees are doing [26]. Existing occupational health literature demonstrates that normative-related interventions have successfully increased proactive safety practices among transportation employees [27]

Table 4

Perceived circumstances of leaving my office building immediately the next time I hear a fire alarm at work

... would make it <i>easier</i> for me to leave the office building immediately the next time I hear a fire alarm at work	N	%	r with intention	... would make it <i>harder</i> for me to leave the office building immediately the next time I hear a fire alarm at work	N	%	r with intention
Not working	26	5.2	0.059	Working	116	23.1	−0.011
Having access to exits, stairs, and other means of egress	55	10.9	0.148***	Not having access to exits, stairs, and other means of egress	81	16.1	0.136***
Having everyone leave immediately and without help	43	8.5	−0.027	Not having everyone leave immediately and with help	61	12.1	−0.034
Having good weather	29	5.8	−0.005	Having bad weather	56	11.1	−0.046
Knowing if the alarm is real	75	14.9	−0.227***	Knowing if the alarm is a drill	31	6.2	−0.082*
Having my personal belongings near me	41	8.2	0.031	Not having my personal belongings near me	31	6.2	0.063
—	—	—	—	Having mobility challenges	30	6.0	0.058
Having fewer drills	9	1.8	−0.193***	Having more drills	23	4.6	−0.174***
Knowing what to do and someone telling you what to do	75	14.9	−0.007	Not knowing what to do and someone not telling you what to do	18	3.6	−0.006
Having a loud and distinct alarm sound for fire	20	4.0	0.023	Not having a loud and distinct alarm sound for fire	14	2.8	0.057
None	138	27.4	—	None	45	8.9	—

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

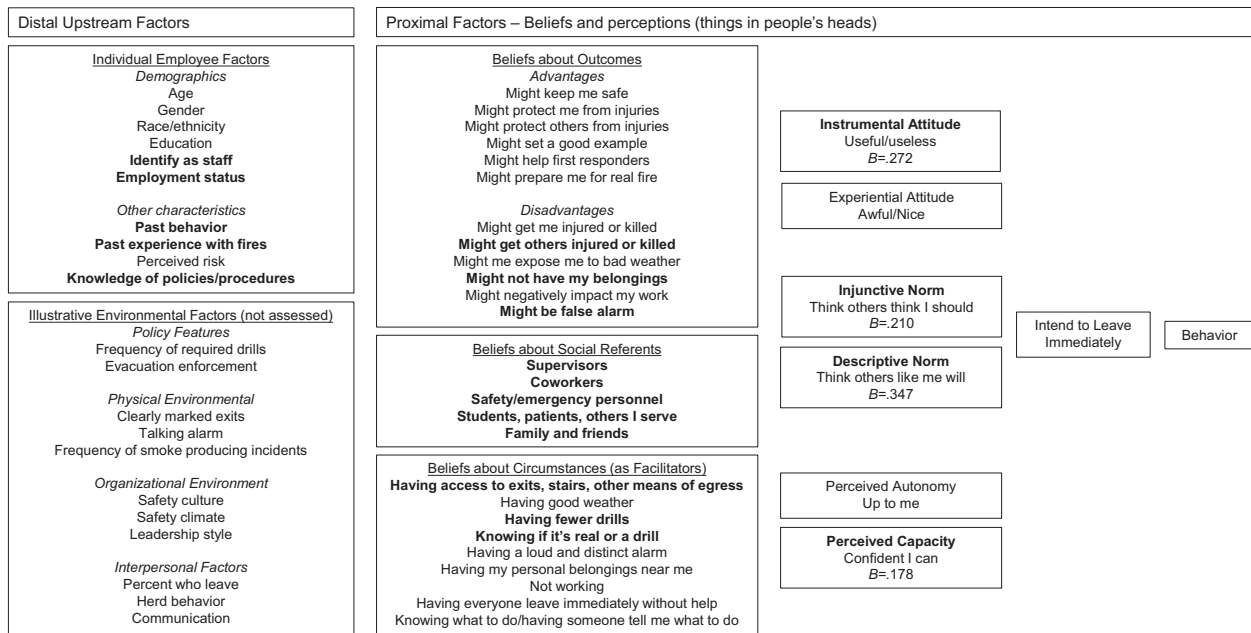


Fig. 1. Applying the Reasoned Action Approach: Understanding how university employees decide whether to leave their office immediately when they hear an alarm*
 *Bolded items significantly related to intention [16].

and discouraged workplace drinking [28]. Future research is needed to examine further the normative factors of employees' evacuating immediately during a fire alarm and evaluate the effectiveness of normative-based fire safety interventions.

4.2. Risk perception

The second main finding from this research involves the perception that the alarm might not be a real fire. Indeed, the nature and frequency of fire alarms are a key circumstance and the belief that the alarm is a "false alarm" is a key perceived disadvantage associated with intention. A reason why none of the perceived advantages were correlated with intention might be because employees believed that fire alarms at the workplace are drills, so there are no advantages to leaving or were they in any "risk" or "danger." Literature supports that low risk perception is a key determinant in fire safety behavior, as people generally have low risk perceptions of building fires and tend to underestimate the rate of smoke and fire spread [18,29].

In our discussion with a university safety professional (J. Sumnerlot, personal communication, February 3, 2022), it was disclosed that the university holds only one unannounced drill a year as required by the public safety office, most alarms were considered as "smoke-producing incidents" that correctly trigger the alarm but do not result in flames, and the university rarely lets employees know why an alarm sounded. Employees may not see a fire thus conclude that the alarms are drills. These findings suggest safety professionals should communicate more clearly about alarms versus drills. As a proactive intervention and practical implication, universities can install "talking alarms" that clearly state what the alarm means. Several studies have found voice command alarms were effective at getting sleeping children to evacuate [30–32].

In terms of communication and education, safety professionals could communicate more clearly what happened with each specific event. For emergency response activities, such as fire evacuation, extensive literature supports that after action reports and immediate communication on the response's strengths and weaknesses improve future responses (e.g., time saved). Finally, it might be

useful to develop more detailed terminology (e.g., smoking-producing incident), educate employees about the terms, and train people to evacuate under these circumstances [33–35].

4.3. Self-efficacy and environmental facilitators

The third major finding concerns the accessibility of evacuating. In this study, we found that those who mentioned "having access to exits" have more positive intentions. These findings are consistent with the statistically significant weight for PBC (self-efficacy) in our prior study [16]. Practically, self-efficacy can be improved two ways. First, one could work to change the environment to ensure employees have ways to exit their buildings and that these exits are clearly marked. Second, one could build skills at finding and using exits to leave. Training, role-playing, and skill-building are tools regularly used in occupational settings to bolster employee PBC and self-efficacy [36–40].

4.4. Limitations

The weak measure of beliefs (% mentioning) means the findings can only suggest associations with intention. Furthermore, causation cannot be examined. The study examined association with intention and not actual behavior. Analyzing open-ended responses, participants wrote beliefs regarding hearing an alarm for a *real fire* and hearing an alarm for a *drill*. Although a fire alarm sound may be the same regardless of the cause, the context of these causes is different and people might have different beliefs accordingly [15,41]. Participants sometimes wrote vague responses that might be challenging to interpret, such as "safety" for an advantage; we could not probe to provide richer data on meaning.

4.5. Conclusion

With theory- and behavioral-based studies largely missing in fire safety research, this paper illustrates how the RAA can be used to understand what employees think and believe about workplace fire safety policies. Our belief elicitation found that norms, risk perception, and self-efficacy might be key determinants in

understanding and changing the fire evacuation behaviors of employees. Results can inform the development of occupational health interventions designed to encourage employees evacuate immediately during a fire alarm. Future behavior-based research and intervention development/testing are necessary to improve employees' fire evacuation practices.

Institutional Review Board statement

The study was approved by the Institutional Review Board of Indiana University (Protocol #1911129390) on 3 December 2019.

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Conflict of interest

The authors declare no conflict of interest.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.shaw.2023.03.002>.

References

- [1] Hazan M. Longevity and lifetime labour input: data and implications; 2006. <https://www.jstor.org/stable/25621384>.
- [2] National Fire Protection Association. Fire by occupancy or property type; 2020.
- [3] Pillemer DB, Picariello ML, Pruett JC. Very long-term memories of a salient preschool event. *Appl Cogn Psychol* 1994;8(2):95–106.
- [4] Gershon RR, Magda LA, Riley HE, Merrill JA. Mass fatality preparedness in the death care sector. *J Occup Environ Med* 2011;53(10):1179–86.
- [5] Kuligowski E. Predicting human behavior during fires. *Fire Technol* 2013;49(1):101–20.
- [6] Proulx G, Pineau J. Differences in the evacuation behaviour of office and apartment building occupants. Los Angeles, CA: SAGE Publications Sage CA; 1996. p. 825–9.
- [7] Thompson MR. The three Rs of fire safety, emergency action, and fire prevention planning: promoting safety at the worksite. *AAOHN J* 2003;51(4):169–79.
- [8] Fahy RF, Proulx G. Toward creating a database on delay times to start evacuation and walking speeds for use in evacuation modeling; 2001. p. 175–83. Boston, MA, USA.
- [9] Koo J, Kim BI, Kim YS. Estimating the effects of mental disorientation and physical fatigue in a semi-panic evacuation. *Expert Syst Appl* 2014;41(5):2379–90.
- [10] Liu M, Lo SM. The quantitative investigation on people's pre-evacuation behavior under fire. *Autom Constr* 2011;20(5):620–8.
- [11] Tong D, Canter D. The decision to evacuate: a study of the motivations which contribute to evacuation in the event of fire. *Fire Saf J* 1985;9(3):257–65.
- [12] McEachan RRC, Conner M, Taylor NJ, Lawton RJ. Prospective prediction of health-related behaviours with the theory of planned behaviour: a meta-analysis. *Health Psychol Rev* 2011;5(2):97–144.
- [13] McEachan R, Taylor N, Harrison R, Lawton R, Gardner P, Conner M. Meta-analysis of the reasoned action approach (RAA) to understanding health behaviors. *Ann Behav Med* 2016;50(4):592–612.
- [14] Steinmetz H, Knappstein M, Ajzen I, Schmidt P, Kabst R. How effective are behavior change interventions based on the theory of planned behavior? *Z fur Psychol/J Psychol* 2016;224(3):216–33.
- [15] Fishbein M, Ajzen I. Predicting and changing behavior: the reasoned action approach. Psychology Press; 2010.
- [16] Le AB, Middlestadt SE, Lin HC, Docherty CL, Smith TD. Belief factors associated with employees' intention to evacuate during a fire alarm. *Workplace Health Saf* 2022;70(9):388–97.
- [17] Gershon RR, Magda LA, Riley HE, Sherman MF. The World Trade Center evacuation study: factors associated with initiation and length of time for evacuation. *Fire Mater* 2012;36(5–6):481–500.
- [18] Kinader MT, Kuligowski ED, Reneke PA, Peacock RD. Risk perception in fire evacuation behavior revisited: definitions, related concepts, and empirical evidence. *Fire Sci Rev* 2015;4(1):1.
- [19] Kobes M, Helsloot I, De Vries B, Post JG. Building safety and human behaviour in fire: a literature review. *Fire Saf J* 2010;45(1):1–11.
- [20] Proulx G, Reid JM. Occupant behavior and evacuation during the Chicago Cook County Administration Building fire. *J Fire Prot Eng* 2006;16(4):283–309.
- [21] Tsurushima A. Symmetry breaking in evacuation exit choice: impacts of cognitive bias and physical factor on evacuation decision. Springer; 2019. p. 293–316.
- [22] US Fire Administration. U.S. Fire Statistics; 2019. <https://www.usfa.fema.gov/statistics/>.
- [23] Hsieh HF, Shannon SE. Three approaches to qualitative content analysis. *Qual Health Res* 2005;15(9):1277–88.
- [24] Middlestadt SE, Bhattacharyya K, Rosenbaum J, Fishbein M, Shepherd M. The use of theory based semistructured elicitation questionnaires: formative research for CDC's Prevention Marketing Initiative. *Public Health Rep* 1996;111(Suppl. 1):18.
- [25] McHugh ML. Interrater reliability: the kappa statistic. *Biochem Med* 2012;22(3):276–82.
- [26] Eldredge LKB, Markham CM, Ruiter RA, Fernández ME, Kok G, Parcel GS. Planning health promotion programs: an intervention mapping approach. John Wiley & Sons; 2016.
- [27] Fugas CS, Meliá JL, Silva SA. The “is” and the “ought”: how do perceived social norms influence safety behaviors at work? *J Occup Health Psychol* 2011;16(1):67.
- [28] Barrientos-Gutierrez T, Gimeno D, Mangione TW, Harriat RB, Amick BC. Drinking social norms and drinking behaviours: a multilevel analysis of 137 workgroups in 16 worksites. *Occup Environ Med* 2007;64(9):602–8.
- [29] Wolski A, Dembsky NA, Meacham BJ. Accommodating perceptions of risk in performance-based building fire safety code development. *Fire Saf J* 2000;34(3):297–309.
- [30] Smith GA, Kistangari S, Splaingard M. Optimizing smoke alarm signals for those at highest risk for residential fire-related death: testing the effectiveness of children's smoke alarms for sleeping older adults. *Fire Technol* 2022;58(1):311–26.
- [31] Smith GA, Chounthirath T, Splaingard M. Comparison of the effectiveness of female voice, male voice, and hybrid voice-tone smoke alarms for sleeping children. *Pediatr Res* 2020;88(5):769–75.
- [32] Smith GA, Chounthirath T, Splaingard M. Effectiveness of a voice smoke alarm using the child's name for sleeping children: a randomized trial. *J Pediatr* 2019;205:250–6.
- [33] Biddinger PD, Savoia E, Massin-Short SB, Preston J, Stoto MA. Public health emergency preparedness exercises: lessons learned. *Public Health Rep* 2010;125(5-Suppl. 1):100–6.
- [34] Ferrer RR, Ramirez M, Sauser K, Iverson E, Upperman JS, others. Emergency drills and exercises in healthcare organizations: assessment of pediatric population involvement using after-action reports. *Am J Disaster Med* 2009;4(1):23–32.
- [35] Savoia E, Lin L, Viswanath K. Communications in public health emergency preparedness: a systematic review of the literature. *Biosecur Bioterror* 2013;11(3):170–84.
- [36] Bandura A, Freeman W, Lightsey R. Self-efficacy: the exercise of control. Springer; 1999.
- [37] Burke MJ, Sarpy SA, Smith-Crowe K, Chan-Serafin S, Salvador RO, Islam G. Relative effectiveness of worker safety and health training methods. *Am J Public Health* 2006;96(2):315–24.
- [38] Casey T, Turner N, Hu X, Bancroft K. Making safety training stickier: a richer model of safety training engagement and transfer. *J Saf Res* 2021;78:303–13.
- [39] Dong X, Entzel P, Men Y, Chowdhury R, Schneider S. Effects of safety and health training on work-related injury among construction laborers. *J Occup Environ Med* 2004;1222–8.
- [40] Raurell-Torredà M, Rascón-Hernán C, Malagón-Aguilera C, Bonmatí-Tomás A, Bosch-Farré C, Gelabert-Vilella S, Romero-Collado A. Effectiveness of a training intervention to improve communication between/awareness of team roles: a randomized clinical trial. *J Prof Nurs* 2021;37(2):479–87.
- [41] Fishbein M. A reasoned action approach to health promotion. *Med Decis Making* 2008;28(6):834–44.