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It's (not) just a matter of terminology: Everyday understanding of "mass panic" and alternative terms

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ABSTRACT

Although the idea of mass panic is quite common in reports on accidents involving crowds, most experts consider it to be erroneous. In a nutshell, they argue that panic and animalistic behavior of humans are not the main causes of crowd accidents, but that it is rather an organizational issue. However, few of the existing studies have addressed the question of what lay people associate with the term. With our mixed-method study, we sought to shed light on people's underlying ideas and assumptions about mass panic. Additionally, we were interested in how these ideas change using two alternative terms, namely "mass accident" and "mass disaster". Results showed that participants in the questionnaire ($N = 282$) and interview ($N = 17$) study indeed strongly associated the term "mass panic" with irrational and selfish behavior, and less with orderly behavior. In addition to the organizers, people in the crowd were seen as responsible for such accidents. Besides, most actions judged appropriate to defuse the situation were related to the advice "Don't panic". Deviating from the concept, however, it was indicated that helping behavior can be found in critical situations. The questionnaire in which participants only saw one of the three terms revealed no change in the everyday understanding with the alternative terms. Nevertheless, interviewees found their own "mass panic explanation" insufficient but also had no alternative ideas of what causes such accidents. Therefore, replacing the problematic concept of mass panic requires not only alternative terms, but also the dissemination of scientific explanations.

1. Introduction

Accidents in crowds are rare, but in recent decades, they have become more common occurrences and have caused many fatalities and injuries (Feliciani et al., 2021). Whenever such a tragedy occurs, terms like "stampede" and "mass panic" are on everyone's lips, especially in the media. Of course, these terms are common, catchy, and everyone seems to know what must have happened. But what ideas and explanations of crowd accidents actually underlie this understanding? And, practically speaking, how does this everyday understanding shape the behavior of people in crowds?

The word "panic" is widely used in our everyday speech. According to an English dictionary ("Meaning & Definition for UK English | panic," 2021) panic is a "sudden uncontrollable fear or anxiety, often causing wildly unthinking behavior". As this study was conducted in Germany, it is important to know that the German term *Panik* has a similar meaning ("Duden | Panik," 2021). From a scientific point of view, however, the term is more difficult to grasp – presumably partly because it is so common in everyday language (Dezecache, 2015; Haghani et al., 2019). In his review, Dezecache (2015) considered several definitions and proposed three core components of panic, namely a negative and highly intensive affect, a situation subjectively perceived as dangerous from which escape is difficult but not impossible, and the intention to rescue oneself even by irrational means and at the expense of others.

Building upon this interpretation, a mass panic might be understood as a situation in which such individual panic has spread to an entire crowd, leading to irrational, selfish, and competitive (escape) behavior that is ultimately responsible for fatalities and injuries in a crowd accident (e.g., Drury et al., 2013a). In this article, we call this the "image of mass panic". This perception is frequently conveyed and reinforced by media and popular culture (Clarke, 2002; Dezecache, 2015; Fahy et al., 2012). As several studies (Cocking et al., 2009; Dezecache, 2015) have

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argued, the image of mass panic can be mainly traced back to Le Bon's idea of contagion, which suggests that emotions in crowds are as contagious as microbes (Le Bon, 1896). At this point, we would like to stress that we are only referring to accidents in crowds in which the dynamic of the crowd itself is dangerous. Other incidents that can also have dire consequences in crowds, such as terrorist attacks or natural disasters, are not considered here. These incidents (or at least the fear of them) are only mentioned when we discuss possible assumptions about the causes of crowd accidents.

The image of mass panic was nevertheless questioned quite early (Mintz, 1951; Quarantelli, 1960), and, to this day, many researchers in the field of crowd dynamics have criticized this concept. While some reject it as completely inappropriate (e.g., Auf der Heide, 2004; Clarke, 2002; Cocking and Drury, 2014; Drury et al., 2013a; Quarantelli, 2001; Sime, 1990), others consider it too general to refer to very different crowd accidents (Helbing and Mukerji, 2012). In short, the main points of criticism are as follows: First, in actual crowd accidents, competitive behavior can happen, but people also go to great lengths to help each other (Cocking et al., 2009; Drury et al., 2009a, 2009b; Johnson, 1987). Additionally, while people are of course scared – even to the point of fearing death – most people do not panic in an irrational sense, i.e., they do not run around screaming and pushing each other. Instead, their behavior is often calm, appropriate, and rational, even if it does not look like this from the outside (e.g., flight can be appropriate even if it looks "panicky"). Since people often have to decide how to react within a very short time based on insufficient information, their decisions are not always objectively right. But in the respective situation, it can indeed be the best decision (Dezecache, 2015; Quarantelli, 1960; Sime, 1990). Also, the most frequent causes of death are related to high density and pressure. People fall, for example, and others accidentally trample over or fall on them, or people asphyxiate even while standing because of extreme overcrowding (Gill and Landi, 2004; Helbing and Mukerji, 2012; Johnson, 1987; Moitinho de Almeida and von Schreeb, 2019). However, most people do not egoistically push each other and leave others to their own fate just to save themselves. Besides all that and maybe most important, the visitors themselves are not to blame for the accident. The term "mass panic" implicitly assumes that panic is the precipitating factor for the disaster, or, in other words, that nothing would have happened if no one had panicked (Garcia, 2011). However, cases from real-life scenarios have shown that people's movements in extremely dense crowds are often determined by the motion of the crowd rather than by their own intentions (Johnson, 1987). So, although it is very difficult to identify the guilty ones in retrospect (e.g., the Love Parade trial ended without a conviction ("German court halts Love Parade trial with no convictions," 2020)), victim blaming appears to be the wrong approach. Last but not least, despite all problems with the term "panic", the term "mass" must also be critically questioned. Of course, panic behavior could occur in single cases, but then it affects only individual persons and not the entire crowd (Drury et al., 2009a; Quarantelli, 2001). When talking about a mass panic or a stampede (which is an animal analogy), though, one gets quickly to the issue of herding behavior. Although studies from various disciplines are not entirely conclusive (Haghani et al., 2019) and there are examples of people adopting the behavior of others (Drury, 2018), it is also clear that human behavior is much more complex than simple, unthinking imitation – even in cases of emergency. However, it should be mentioned that there is also work in the field of crowd dynamics, especially in the area of modeling, that uses the image of mass panic uncritically, sometimes explicitly referring to experiments with animals (for an overview, see Haghani et al., 2019).

The image of mass panic does not only influence research, but also professionals involved in public safety (Drury et al., 2013a; Nogami, 2018) and emergency planning (Drury et al., 2013b) – potentially with fatal consequences. For instance, visitors are not or at least not adequately informed about potential hazards (e.g., fire, terrorist attacks) due to fear of mass panic (Auf der Heide, 2004; Drury et al., 2013b). However, there is evidence that clear information speeds up the evacuation (Proulx and Sime, 1991). Furthermore, it is conceivable that the image of mass panic together with the associated advice "Don't panic (and stay calm)" affects the behavior of the visitors themselves in critical situations. But to the best of our knowledge, it has not yet been investigated whether and in what way this is the case.

Due to this significant criticism, demands have been made to replace the term (e.g., Cocking and Drury, 2014; Quarantelli, 2001). Potential alternatives have been suggested, including "crowd crush" (Galea, 2021), or – for the German term *Massenpanik* – *Massenunglück* ("mass accident") (Dirk Helbing in Grün, 2011) or *Massendesaster* ("mass disaster") (Christian Zacherle in Hörnle, 2018). Establishing an alternative is difficult, though, as the term (mass) panic is deeply anchored in our linguistic usage, which is, in turn, maybe even due to the lack of alternatives. This is also shown by studies in which survivors and witnesses of crowd accidents were interviewed (Cocking et al., 2009; Cocking and Drury, 2014; Drury et al., 2009a, 2009b). They frequently used terms corresponding to mass panic but, when asked more specifically, their descriptions became more differentiated (e.g., panic as a justification of extreme behavior or simply as a description for individual distress (Cocking and Drury, 2014)). Further, Nogami (2016) found, in a Japanese sample, that various behavioral and emotional responses associated with panic (e.g., shouting, trembling) were not consistently used across two different mass emergencies (i.e., earthquake, plane incident). These findings demonstrate that, although the term (mass) panic itself is very dominant, it can mean quite different things. So, there is reason to doubt that all aspects which belong to the image of mass panic (i.e., irrationality, selfishness, wild pushing etc.) are exactly reproduced when lay people are asked in detail about their understanding. Moreover, it is not clear whether the associations change with a different, more appropriate term.

1.1. The present study

To understand which underlying ideas and assumptions lay people have about the image of mass panic and how they are connected to language, we conducted a mixed-method study consisting of an online questionnaire and a semi-structured interview. Interviewees were asked to articulate their everyday understanding of and associations with all three terms. Concerning the online questionnaire, we divided our sample randomly into three groups. Basically, all questions were the same between these groups, except that they were formulated to use one of the following German terms: *Massenpanik* ("mass panic"), *Massenunglück* ("mass accident"), or *Massendesaster* ("mass disaster"). This means that each participant only saw one of the terms and was not aware of the others. For ease of presentation, in this paper, we use the English terms "mass panic" (MP), "mass accident" (MA), and "mass disaster" (MD). Based on previous demands to replace the term, our main hypothesis was that the everyday understanding of crowd accidents is different for the three terms MP, MA, and MD, or, more precisely, that the term MP evokes the image of mass panic (i.e., irrational, selfish, competitive escape behavior that spreads in a crowd and leads to fatalities) more strongly than the two alternative terms. On the other hand, we expected the term MP to be more familiar since is it often used in the context of crowd accidents whereas MD and MA are rather untypical. As far as we know, there are no previous studies investigating the everyday understanding of all three terms in detail, so we conducted additional descriptive and explorative analyses.

2. Method

Ethical approval for this research was granted by the ethics board at the University of Wuppertal, Germany. Both studies were conducted in accordance with the Declaration of Helsinki. All participants who took part in either study gave informed consent.

2.1. Questionnaire

2.1.1. Sample

We recruited $N = 300$ participants (convenience sample) through the social networks of the authors, different social media platforms, the website surveycircle.com, as well as the email distribution lists of universities and different soccer fan clubs. Surveycircle is a platform where people interested in research can participate in online studies to earn points. These points can be used to promote own or other studies on the platform and thus make them more attractive for other participants. Eighteen of the initial participants were excluded due to insufficient knowledge of German (B2 or lower at the *Common European Framework of Reference for Languages*) or because they stated afterwards that they only clicked through. The final sample was $N = 282$, divided into three groups: $n = 97$ (MP), $n = 96$ (MD) and $n = 89$ (MA). Of these participants, 193 were female, 86 male, one non-binary, and two did not specify their gender. Ages ranged from 18 to 73 ($M = 29.91$, $SD = 11.04$) and most of them (97.2%) were native German speakers or had C2 proficiency of German, whereas 2.8% had C1. Most of the sample was well educated, with 96.5% having at least a higher education entrance qualification and 57.1% currently enrolled at an institution of higher education. Of those who were not students, most were employed (36.9% of the total sample size). The participants were not paid but the Forschungszentrum Juelich donated 0.30€ for each participation to a tropical rain forest foundation.

2.1.2. Structure

The construction of items was inspired by current literature (Auf der Heide, 2004; Cocking and Drury, 2014; Drury et al., 2015, 2013a, 2013b, 2009b, 2009a; Fahy et al., 2012; Künzer et al., 2012; Mawson, 2005; Nogami, 2020, 2018, 2016; Nogami and Yoshida, 2014; Quarantelli, 2001, 1960). Especially the question concerning the source of knowledge was closely based on studies of Nogami (Nogami, 2020, 2018). Besides the image of mass panic, the idea of helplessness meaning that people are passive, probably in shock and in need of being rescued by others (Auf der Heide, 2004; Drury et al., 2013a; Nogami and Yoshida, 2014; Quarantelli, 1960) was included. The questionnaire was in German and divided into nine parts addressing general ideas about crowd accidents, perceived levels of danger (slider item), sources of danger, options for action to defuse the situation, causes of occurrence, responsible parties, associations and familiarity with the respective term, and source of knowledge about crowd accidents. Exemplary items for each block as well as the total number of items and the respective measurement scale can be found in Table 1; a complete version of the translated questionnaire is provided in the Supplemental (Table S1). The anchors of the 7–point Likert Scales were chosen according to the questions (1 = least agreement, 7 = most agreement; see Supplemental (Table S1)). The order of the thematic blocks was the same for each participant, whereas the individual items were presented randomly. At the end, participants answered demographic questions about their gender, age, educational achievement, current occupation, and knowledge of the German language. We included an additional question in which participants could state if they had taken the survey seriously. The answer to this question had no consequences for them, but helped us to ensure the quality of the data.

2.1.3. Procedure

The questionnaire was conducted via the online questionnaire tool SoSci Survey (https://www.soscisurvey.de/), which is compliant with the German data privacy laws. The online format allowed us to reach various participants all over Germany. Answering the questionnaire took 10 – 15 min. On the first page, participants were informed about the topic of the study (behavior at large-scale events) as well as the procedure, their right of withdrawal without consequences, the anonymity of the questionnaire, the use of the collected data, and the donation. Additionally, contact information was provided for any questions. Once they confirmed their participation, they were randomly allocated to one of the three experimental conditions. The exact instruction on the following page was then dependent on the condition: "When answering the following questions, please imagine that you are at a concert (or a similar event with a lot of people) and a *mass panic / accident / disaster* occurs." The questionnaire was not about personal experiences but only about participants' general understanding of crowd accidents. However, an effort was made to protect those who might have had traumatic experiences at such large events by suggesting that those who had been affected should think carefully about participating in the survey and reminding them that they could abort the questionnaire at any time if

Table 1
Thematic Blocks of the Questionnaire with Exemplary Items.

Thematic block	Question	Items
1. General (27 items, 7-point Likert Scale)	In a mass panic…	… People just start running without paying attention to others. … People are paralyzed and cannot save themselves from the situation. … People are able to deal with the situation reasonably and act sensibly despite the circumstances. … People help the people they know.
2. Slider Danger (1 item, slider 0–100%)	How dangerous do you think a mass panic is?	- Harmless – life-threatening
3. Dangers (7 items, 7-point Likert Scale)	A mass panic is dangerous because…	… People stumble and fall. … People no longer show consideration for others.
4. Defusing (12 items, 7-point Likert Scale)	In order to avert the danger in the event of a mass panic or to prevent the situation from getting worse, I should…	… Not let myself be infected by the feelings of the people around me. … Call loudly for help and draw attention to the danger.
5. Causes (10 items, 7-point Likert Scale)	A mass panic can occur when…	… Things are not moving fast enough during an evacuation, resulting in a traffic jam. … Information is passed on that something dangerous could happen (e.g., terrorist attack).
6. Responsibility (4 items, 7-point Likert Scale)	To what extent are the following groups of people responsible for causing a mass panic at a large event?	- Organizers of the event - Visitors
7. Association (12 items, 7-point Likert Scale)	How strongly do you associate mass panic with…	… Panic … Help behavior / helping
8. Familiarity (7 items, 7-point semantic differential)	How do you feel about the term mass panic in the context of large events?	- Inappropriate – appropriate - Vague – clear
9. Source of Knowledge (10 items, multiple selection)	Where does your knowledge about mass panics come from?	- Media (e.g., (online) newspaper, news, radio) - Hearsay

necessary. After completion, the participants were thanked for their participation and had the possibility to read a brief explanation of the exact study purpose. This included a short summary of why the term mass panic is problematic and an outline of this study's aim of comparing the associations of the three different terms. For further questions or interest in the results, the contact information was mentioned again.

2.2. Semi-Structured interviews

To find out more openly and without pre-formulated statements (i.e., items) what lay people associate with the concept of mass panic and the alternative terms, we also conducted seventeen qualitative semi-structured interviews (in German) with acquaintances of colleagues and friends. Ten interviews were conducted in North-Rhine Westphalia, seven in Hamburg. They were scheduled for 60 min and informed consent was given before. Our interviewees were students, academics, employees, or self-employed, and between twenty-five and forty years old. Ten of them were male, seven female. Our interview guide consisted of an initial open-ended question about the experiences the interviewees had in crowds. In the demand section, they were asked what they associate with the term MP and how people should ideally behave in the event of a MP. Finally, they were asked what they understand by the alternative terms MD and MA. The interviewees were paid 10€ for their time and effort.

3. Results

3.1. Questionnaire data

All statistical analyses were performed using IBM SPSS Statistics 27. The bar plots were created using a Python code. Mean values, standard deviations and, if applicable, factor loadings for all items can be found in the Supplemental (Table S1). The significance level was set at $p < .05$ for all statistical tests.

3.1.1. Familiarity of terms

To investigate the familiarity of the terms, we averaged the seven items separately for each questionnaire and calculated a one-way ANOVA ($F(2, 279) = 5.00$, $p = .007$, $\eta^2 = 0.03$) with following Games-Howell post–hoc tests. Results depicted in Fig. 1 show that the term MP was slightly more common than MD, as expected, but not as MA.

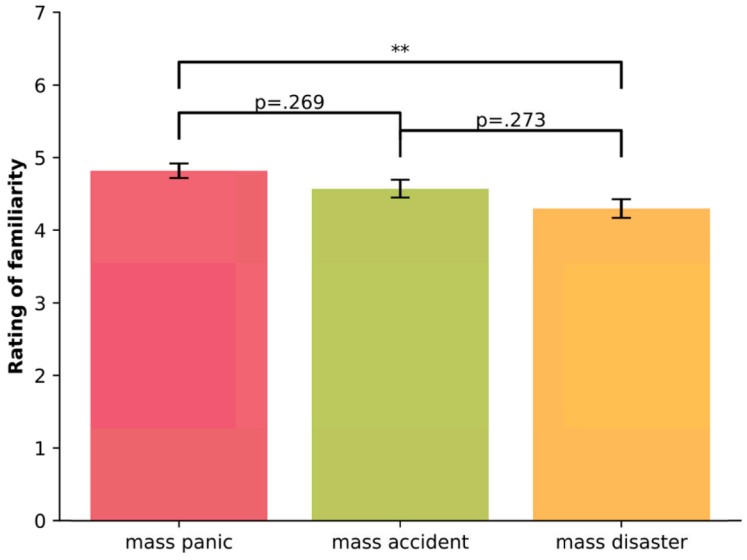
3.1.2. Differences between the three conditions

To test our main hypothesis that the MP questionnaire would evoke more associations in favor of the image of mass panic, we calculated one-way MANOVAs for the thematic blocks "General", "Dangers", "Defusing", "Causes", "Responsibility", and "Association". Results showed significant differences between the questionnaires on the combined dependent variables only for the block "Causes" ($F(20, 540) = 1.70$, $p = .029$, partial $\eta 2 = 0.06$, Wilk's $\Lambda = 0.89$). All other MANOVA models were not significant ("General", $F(54, 506) = 1.18$, $p = .190$, partial $\eta 2 = 0.11$, Wilk's $\Lambda = 0.79$; "Dangers", $F(14, 546) = 0.98$, $p = .473$, partial $\eta 2 = 0.03$, Wilk's $\Lambda = 0.95$; "Defusing", $F(24, 536) = 1.00$, $p = .468$, partial $\eta 2 = 0.04$, Wilk's $\Lambda = 0.92$; "Responsibility", $F(8, 552) = 1.76$, $p = .082$, partial $\eta 2 = 0.03$, Wilk's $\Lambda = 0.95$; "Association", $F(24, 536) = 1.50$, $p = .061$, partial $\eta 2 = 0.06$, Wilk's $\Lambda = 0.88$). For the block "Causes", the results of the following one-way ANOVAs and post-hoc Games-Howell tests can be found in Table 2. For reasons of clarity, only items for which the ANOVA was significant are presented here.

In addition to the six MANOVAs, we calculated a one-way ANOVA for the "Slider Danger", but here we found no significant difference between the groups ($F(2, 279) = 0.28$, $p = .754$). So, all in all, our main hypothesis was not confirmed. For almost all items, we found no difference between the three conditions. Only one of them differed significantly: The idea of contagious panic was more prevalent in MD than in MP. This difference was not in favor of our hypothesis and also rather small. Altogether, the ideas associated with the terms MP, MD, and MA were thus very similar, and we decided to combine the three questionnaires for all further descriptive and explorative analyses.

3.1.3. Further descriptive and explorative findings

Even though our idea of different associations with different terms could not be confirmed, it is very important to gain a deeper understanding of the everyday understanding of crowd accidents. For this purpose, we first calculated two Principal Component Analyses (PCAs) for the blocks "General" and "Association" and determined how strongly participants agreed with the identified concepts. Furthermore, we



Note. Mean values of familiarity ratings for each condition separately. Error bars represent standard error of the mean. **p < .01

Fig. 1. Comparison of Familiarity between the Three Terms.

Table 2
One-way ANOVAs with Post-hoc Tests for Selected Items of the Block "Causes".

Block	Item	One-way ANOVA			Games-Howell Test		
		$F(2, 279)$	p	partial η^2	MP – MD M_{Diff} (p)	MP – MA M_{Diff} (p)	MD – MA M_{Diff} (p)
Causes	One person/a small group of people panic and other people are infected by that panic.	3.70	0.026	0.03	−0.39* (0.022)	−0.27 (0.209)	0.13 (0.650)
	Information is passed on that something dangerous could happen (e.g., terrorist attack).	3.06	0.048	0.02	0.38 (0.050)	0.10 (0.769)	−0.28 (0.236)

*p <.05.

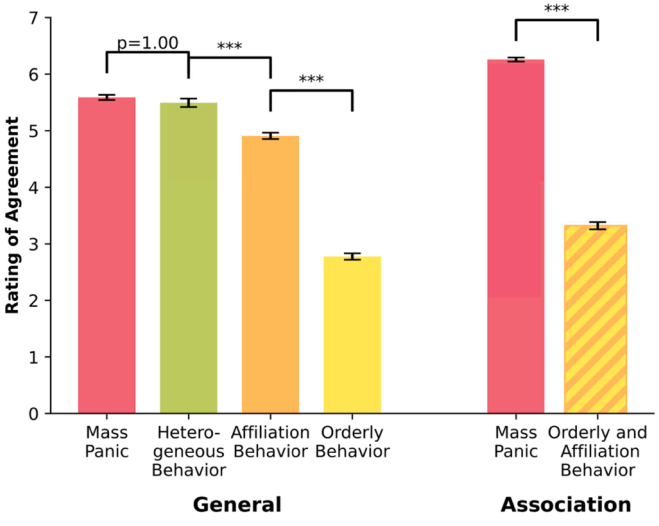
investigated their assessment of what is dangerous in a crowd accident, which behaviors might help to defuse a critical situation, why a crowd accident occurs, who is responsible, and where they got their knowledge from.

3.1.3.1. Factor analysis. The general procedure for both PCAs was as follows: First, we checked for missing data but there was none. Then, the correlation matrix was analyzed. In order to better interpret the resulting structure of the factor loadings, we applied a varimax rotation. For factor extraction, we used the Kaiser's criteria, meaning eigenvalues ≥ 1 (Guttman, 1954; Kaiser, 1960), as a first step but also took theoretical considerations and interpretability of the factors into account. The scree plot for each PCA can be found in the Supplemental (Figure S1).

For the block "General", six factors were extracted when considering all factors with eigenvalues ≥ 1, which accounted for 56.27% of the total variance. However, this many factors were not suitable. Therefore, further solutions with two to five factors were tried out, and, in the end, a varimax-rotated four-factor solution was chosen (47.83% of total variance). This provided the most practical classification in terms of content, and most items loaded highly on just one of the four factors. As a result, it turned out that all items theoretically connected to the image of mass panic loaded on one common factor. In addition, the item "people are scared" (albeit less clear) as well as items connected to the idea of helplessness could be assigned to this factor. So, it was called "Mass Panic". The second factor, named "Orderly Behavior", included all items dealing with the idea that people stay calm, behave rationally, and that, if any, only single persons panic. The third ("Affiliation Behavior") and fourth factor ("Heterogenous Behavior") contained only two items, and the item "people help strangers" could not be clearly assigned to any factor. However, due to theoretical considerations, it was added to the factor "Affiliation Behavior".

For the block "Association", the extraction of factors according to Kaiser's criteria resulted in a model with three factors which accounted for 55.45% of total variance. Nevertheless, it turned out that a varimax-rotated two-factor solution (45.92% of total variance) was better in terms of interpretability and, here again, most items loaded highly on only one of both factors in this solution. The classification was divided into a factor "Mass Panic" (including "danger to life") and a factor "Orderly and Affiliation Behavior". The item "passivity / state of shock" could not be clearly assigned to either of the two factors, although, interestingly, it loaded somewhat higher on the factor "Orderly and Affiliation Behavior".

3.1.3.2. Underlying ideas and assumptions about crowd accidents. Based on the results of the PCAs, we recoded items if necessary and built new scales according to the extracted factors. For each scale, the number of items as well as the (averaged) inter-item-correlations and Cronbach's Alpha-coefficient can be found in the Supplemental (Tables S2 – S8). Subsequent analysis showed that most scales differed significantly (Fig. 2). For the block "General", a repeated measures ANOVA with a Greenhouse-Geisser correction was statistically significant ($F(2.77, 778.40) = 495.19$, p <.001, partial $\eta^2 = 0.64$). Bonferroni-adjusted post-hoc analysis revealed significant differences between all scales except for the difference between "Heterogenous Behavior" and "Mass Panic". This suggested that participants agreed more to "Mass Panic" and "Heterogenous Behavior" than to the other two scales. A



Note. Mean values of the scales built after PCAs for blocks "General" and "Association" separately. Error bars represent standard error of the mean. ***p < .001

Fig. 2. Comparison of Agreement between the New Scales of Blocks "General" and "Association".

paired *t*-test for block "Association" indicated a significantly higher agreement with "Mass Panic" than with "Orderly and Affiliation Behavior", as well.

3.1.3.3. Perceived danger. Looking at the "Slider Danger" it became obvious that crowd accidents were perceived as something very dangerous ($M = 85.37$, $SD = 13.47$). The mean values of all items from the block "Dangers" ($M = 5.72$ to $M = 6.49$) further indicated that participants evaluated every danger as very plausible. However, a Greenhouse-Geisser corrected repeated measures ANOVA revealed even significant differences between them ($F(4.41, 1240.26) = 34.77$, $p < .001$, partial $\eta^2 = 0.11$). Bonferroni-adjusted post-hoc analysis showed that two dangers were considered especially plausible and differed significantly (all $p < .001$) from all others. These were "people stumble and fall" ($M = 6.40$, $SD = 0.83$) and "people on the ground are trampled upon by others" ($M = 6.49$, $SD = 0.84$). However, another danger that leads to fatalities in actual crowd accidents, namely "people can no longer breathe and, in the worst case, suffocate" ($M = 5.80$, $SD = 1.37$) was one of the dangers rated slightly less plausible.

3.1.3.4. Option for Defusing. Indicated by the mean values, participants divided all given options for action clearly into appropriate (all *M* greater than 5) and less appropriate (all *M* less than 4). According to participants' assessment, appropriate options were: remain calm and do not panic, keep your fear to yourself and remain calm, do not let yourself be infected by the feelings of the people around, look for a way out and instruct others to move there, help weaker people, and be fully informed about the circumstances to be able to make an informed decision. Whereas less appropriate options were: call loudly for help and draw attention to the danger, make it clear to others around you that you are afraid, do nothing at all and wait until someone rescues you, get out of the situation as quickly as possible – i.e., look for a way out, push your way out –, not be given any information about the exact circumstances because that will only cause more worries, and do what the people around you are doing. Building two scales according to this classification, the difference between both was significant ($t(281) = 36.96$, $p < .001$, $d = 2.20$). Furthermore, we compared the two questions about whether participants want to be informed or not with a paired *t*-test, too. Results showed that full information was significantly preferred ($t(281) = 9.49$, $p < .001$, $d = 0.57$).

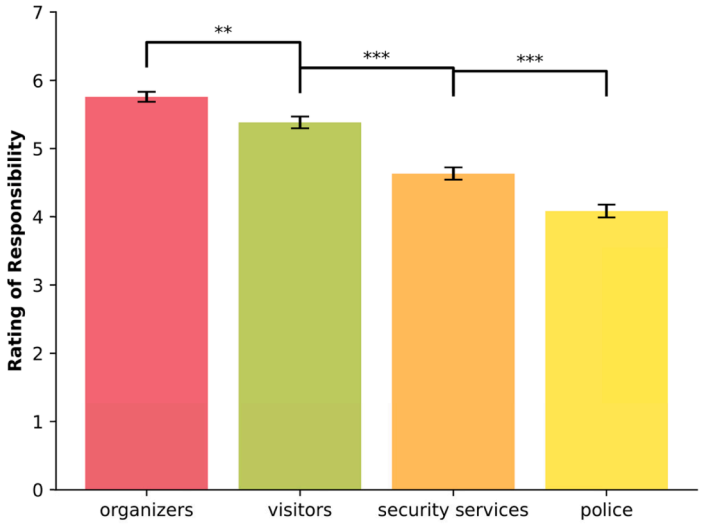
3.1.3.5. Causes. As in the case of the dangers, all the given causes were considered as very plausible ($M = 5.28$ to $M = 6.45$). Only the item "sometimes a mass panic occurs for no reason at all and no one is to blame" was rated with slightly lower agreement ($M = 4.88$, $SD = 1.63$). Calculating a Greenhouse-Geisser corrected repeated measures ANOVA ($F(6.31, 1771.73) = 73.55$, $p < .001$, partial $\eta^2 = 0.21$) and following Bonferroni-corrected post-hoc tests, it turned out that the differences between this item and all others were significant (all $p \leq 0.023$). The item "one person/a small group of people panic and other people are infected by that panic" was assessed as somewhere in between ($M = 6.04$, $SD = 1.04$). Regarding the two questions as to whether a crowd accident occurs when people are informed about a possible hazard or not, a paired *t*-test revealed that participants thought it is more dangerous if information is passed on ($t(281) = 5.81$, $p < .001$, $d = 0.35$).

3.1.3.6. Responsibility. The results concerning the responsibility of the groups of persons are illustrated in Fig. 3. A repeated measures ANOVA with Greenhouse-Geisser correction revealed how differently responsibility was perceived ($F(2.25, 633.01) = 93.28$, $p < .001$, partial $\eta^2 = 0.25$) with all differences being significant (Bonferroni-adjusted).

3.1.3.7. Source of knowledge. On average, three out of nine options for the source of knowledge were selected. Only two participants (0.7%) stated that they could not say. Most of the others acquired their information about crowd accidents from the media (94.3%). The proportions of participants who selected the other sources are, in descending order, social media (59.2%), non-fictional works (42.6%), hearsay (39.7%), experiences of other people from the social environment (25.9%), fictional works (24.5%), own experience (23.0%), and profession (3.2%). Further sources, each mentioned by one person, were emergency management, the Love Parade disaster in Germany, online games, and training courses as a fan representative.

3.2. Qualitative interview data

The qualitative interviews were audiotaped, and the parts on MP, MA, and MD selected and transcribed. The material was analyzed with qualitative content analysis (Mayring, 2000). In a first step, the everyday understanding of MP was identified in each interview and then compared with the other interviews and typologized. In a second step,



Note. Mean values of responsibility ratings for each group of persons separately. Error bars represent standard error of the mean. $^{**}p < .01$; $^{***}p < .001$

Fig. 3. Comparison of Responsibility between the Groups of Persons.

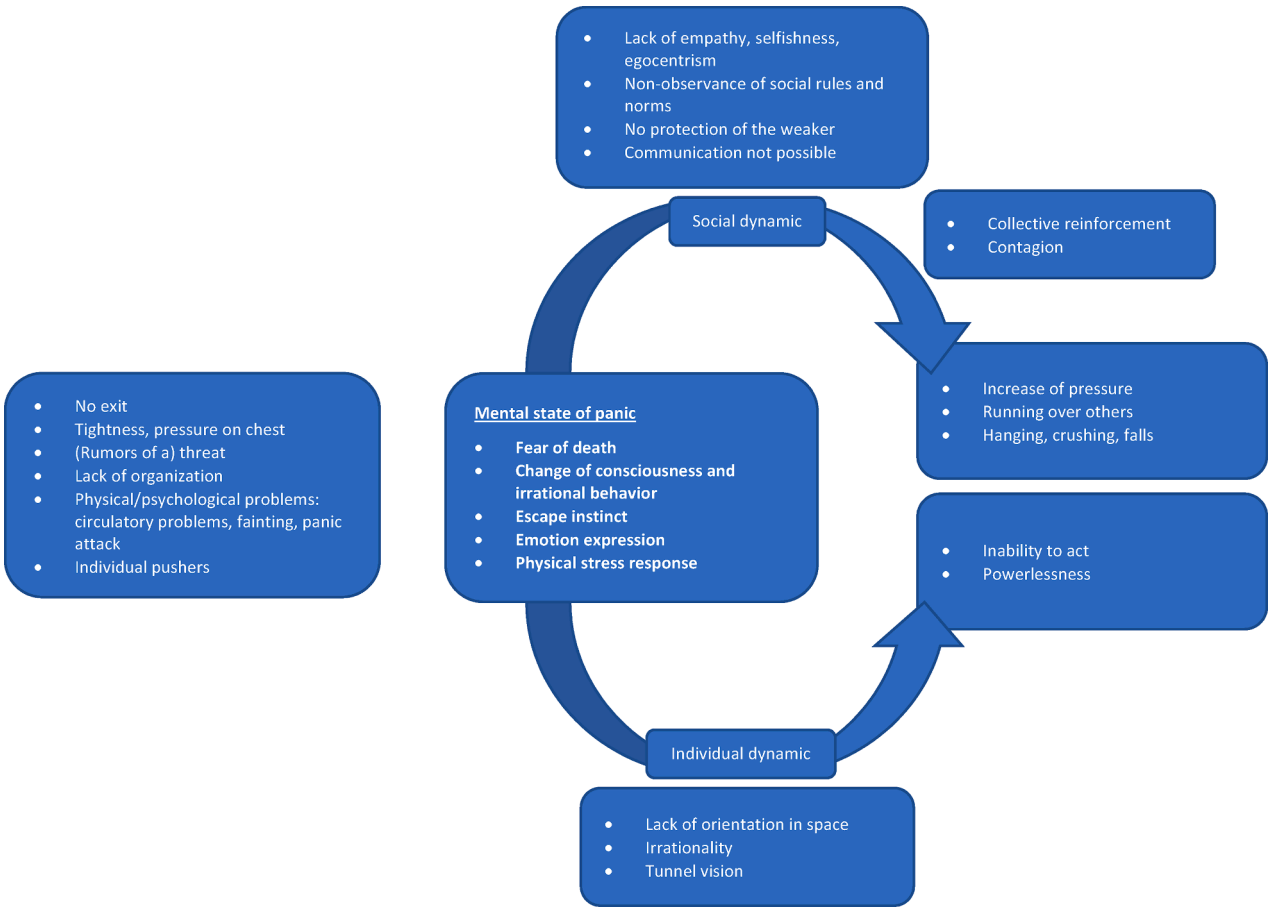


Fig. 4. Lay Theory of Mass Panic Developed from Qualitative Interviews.

the associative fields with MP were analyzed. In a third step, the suggestions on how to act in case of MP were extracted, as well as the associations with the terms MA and MD. Numbers in parentheses indicate in how many interviews the corresponding statements were found.

Interestingly, the individual understandings of MP differed in detail but not in general. Thus, only one type of lay theory could be reconstructed (Fig. 4): In all interviews, an individual psychological state of panic was at the center of the theory. This was said to be accompanied by a fear of death and an instinct to flee. A narrowing of consciousness, decrease of rationality, the emotional expression of panic, and physical stress reactions were also attributed to the state of panic. This emotional state is triggered by different factors: The interviewees listed lack of organization, an increasing sense of crowding, an external threat such as a terrorist attack (or such a rumor), counterflow movements, and blocked exits, but also individual problems such as circulatory problems, fainting, or an initially individual panic attack. On an individual level, this condition was said to lead to a narrowing of perception, a lack of spatial orientation, and, as a consequence, irrational behavior. Irrational was the term used in interviews to describe behavior that cannot lead to the goal of escaping from the crowd and preserving one's well-being. On a social level, the state of panic was said to lead to a strong egocentrism. People focus only on themselves. In two interviews, however, it was mentioned that people would only care about their own children. Furthermore, apparently, there is a failure to observe social norms, with the result that weaker people are not protected. It was thus described that social solidarity breaks down. Only one of those interviewed mentioned that people may desire to stay with those they know. Furthermore, interviewees thought that communication in the crowd is no longer possible. In many interviews (9), it was said that the panic in the crowd intensifies as in a vicious cycle and people infect each other. However, none of the interviewees described this process of contagion in detail. These dynamics were said to lead to dangerous crowd behavior, to people running over each other, and also to the individual being rendered completely powerless. Many interviewees (10) added that people in panic are not solely responsible, however, but that mass panics can be prevented through better organization.

Most interviewees in our sample had no personal experience with situations of mass panic. Only two people had experienced a similar situation at a political demonstration. Most participants (13) mentioned the Love Parade disaster as an example (other examples mentioned less frequently were Mecca and the Heysel Stadium disaster in Belgium). Though none of them were present at these exemplary incidents, they heard about them primarily from the media. Due to the lack of their own experiences, the interviewees fell back on their own vague and associative ideas about MP, and it became clear that knowledge from other contexts was used to make the phenomenon plausible. We mainly identified two associative fields in which ideas about MP were embedded: The term MP was most strongly linked to biological concepts. Most interviewees (12) talked about people behaving instinctively. There was talk of the instinct of self-preservation. Another association taken from the animal kingdom was that of so-called swarm behavior. It is particularly interesting that one of the individuals interviewed used the neologism "swarm panic" (instead of swarm intelligence). Herd animals and stampedes were also mentioned. These biological ideas adhered to a social Darwinist understanding in which the instinct of self-preservation leads to the dissolution of social norms meant to protect the weaker. The crowd becomes a place where Hobbes' "war of all against all" prevails. Several interviewees (5) did use this biological framing, but at the same time made it clear that they were dissatisfied with this idea, as it actually did not correspond to their view

of human beings and seemed insufficient. However, these same interviewees could not think of an alternative explanation. The second associative field of MP was dominated by psychological terms. Lay knowledge about the clinical phenomenon of a panic attack was used to imagine what happens in a mass panic. From this it was deduced that people in a state of panic are severely psychologically impaired and perceive very little, as well as being incapable of communicating with each other. A person in a panic attack was described as isolated from others. Interestingly, and contrary to our expectation, the image of "contagion" (and the associative field of spreading a disease) was hardly used in the interviews.

When asked how one should react in a mass panic situation, most individuals (11) indicated that one should remain calm, or calm others (emotion regulation). To get others out of their panic state and isolation, one should try to communicate with them. Many also said that the organization should be better in advance – but that in this situation it is no longer possible to behave properly. Some (3) suggested that one should try to face the pressure and not push. Other possible responses mentioned in individual interviews included following rules, sticking together and protecting each other, assigning a leader who gives clear commands, raising arms, and using a warning signal.

The interviewees were not familiar with the terms MA or MD and they could hardly think of anything to say about them (even less in the case of MD than of MA). Some interviewees (5) stated that there are a lot of deaths and injuries in a MA (examples: plane crash, shipwreck, natural disaster). A MA was seen as tragic and fateful – no one is to blame (however, sometimes the exact opposite was said). The term MD was interpreted by one interviewee as an ironic exaggeration (i.e., "disastrous date"). Others said that in a disaster there are clearly responsible parties. Overall, the interviewees found it difficult to articulate clear ideas about the two terms.

4. Discussion

In this mixed-method study, we investigated what underlying ideas and assumptions lay people have about crowd accidents and if these ideas change when using three different terms, namely *Massenpanik* (MP, mass panic), *Massenunglück* (MA, mass accident) and *Massendesaster* (MD, mass disaster). Thus, we have linked the criticism of the image of mass panic that has been expressed by scientists for more than 60 years (Mintz, 1951; Quarantelli, 1960) to the public perception of the term. In the questionnaire as well as in the qualitative interviews, the image of mass panic was prevalent and answers were influenced by concepts like irrationality and selfishness. In the interviews, biological terms such as instinct, self-preservation, or "swarm panic" strongly shaped notions of mass panic. The feeling of helplessness also played a role, albeit more subordinate. In turn, the occurrence of orderly behavior was rated rather implausible in the questionnaire and also hardly mentioned by interviewees. The results for helping behavior were more ambiguous. In the questionnaire, items referring to affiliation behavior were sometimes rated higher and sometimes lower, whereas interviewees reported that, in such situations, people would only care for themselves and that social solidarity would break down. Just some of them said that people would help their own children or stay with others they know. In general, helping and staying together with people one knows seems to be perceived as more likely than helping strangers or forming a cohesive unit as a whole. Surprisingly, the image of contagion which is linked to Le Bon and often critically discussed in the scientific community was less prevalent in the interviews. Although, in the questionnaire, items concerning "contagious panic" showed relatively high levels of agreement, it became evident that the participants did not think that everyone behaves the same in these situations. Altogether, this indicated that the "mass" part is less problematic than the "panic" part.

Apart from this associative knowledge, many participants did not seem to have a clear understanding of why crowd accidents occur and what happens in these situations. Many possible causes were mentioned in the interviews (Fig. 4); in the questionnaires, all provided causes were more or less affirmed. The same applies to possible dangers. Interestingly, the questions about information transfer in the two blocks "Causes" and "Defusing" were answered totally differently. On the one hand, people preferred to be fully informed so that they can make an informed decision. But on the other hand, they thought that a crowd accident is more likely to occur when information about a potential hazard is passed on. Research showed, however, that clear information speeds up the evacuation (Proulx and Sime, 1991). Not to mention the fact that the police and the security service cannot be everywhere (Drury, 2012; Quarantelli, 1960). So, it is reasonable and also recommended by experts (Brunsch, 2021; Cocking et al., 2009; Künzer and Hofinger, 2021) to inform people – especially in case of emergency – giving them the chance to act on their own responsibility.

But in order for visitors to receive adequate information from those responsible or even from other people in the crowd, the emergency must first be recognized. In very dense crowds, people are often not aware of what is happening a few meters away and it is also extremely difficult to tell from the outside whether the situation is still normal or already dangerous (Johnson, 1987). Even if technical solutions for crowd management become more and more sophisticated, feedback from the crowd would be helpful in these cases. However, as our study indicates, this might be impeded by the associations that the term "mass panic" evokes. Our results show that lay people have a clear concept of how to behave in critical situations but most strategies for action were closely related to the advice "Don't panic"; actively drawing attention to oneself was mentioned only by few interviewees, and was also rated low in the questionnaire. In the interviews, it became evident as well that one main assumption is that people are panicking and they need to calm down so that nothing happens.

Apart from a possibly counterproductive recommendation for action, this notion also implies an allocation of blame. By assuming that nothing would have happened if no one had panicked, the interviewees stated implicitly that the people in the crowd are responsible for, or at least a decisive factor in, crowd accidents. In fact, this seems to be a general implication of the image of mass panic as it was also expressed in the questionnaire where visitors were ranked as the second most responsible group out of four (for further evidence, see Garcia, 2011). Nevertheless, participants in both studies agreed that besides the visitors, the organizers are to blame for crowd accidents and that critical situations could be prevented by better organization in advance.

For the questionnaires, all these findings apply regardless of the term used for framing the items. In fact, we found only one difference between the conditions, which was also rather small (less than 0.5 scale point), namely that the idea of contagious panic was more prevalent in MD than in MP. Even though we do not want to ignore the fact that this difference contradicts our hypothesis, it should not be overestimated. By choosing MANOVAs as statistical method, we corrected for multiple testing as best we could. However, since we had many items and calculated numerous comparisons, this one small difference should probably be considered a false positive test result. The fact that the three terms – MP, MA, and MD – evoked such similar ideas in the questionnaire can be explained as follows: The image of mass panic is so predominant among our everyday speech that people automatically think of it whenever confronted with accidents at large events – there are no other concepts available. This can also be seen in the interviews, in which some interviewees were dissatisfied with their own explanations of mass panic, but had no alternative ones. So, potentially, the terms MD and MA did not create their own associations, but rather activated the concept MP and thereby the very same associations and ideas. In other words, it might have happened that the alternative terms were either mentally replaced by "mass panic" or that the questions were only processed figuratively, meaning participants had a picture of a "classical mass panic" in mind. Something very similar only the other way around has, in fact, happened in the interviews with survivors and witnesses of

crowd accidents (Cocking et al., 2009; Cocking and Drury, 2014; Drury et al., 2009b, 2009a) where participants had a different concept of the respective disasters but used the same terms associated with panic. Combined, these studies show how entangled ideas and language are and that it is difficult to change one without the other.

Interestingly, even though "mass panic" is used almost exclusively in our everyday language, the level of familiarity with the three terms was assessed similarly in the questionnaire study. The interviewees, in turn, had very few associations with the alternative terms (MD and MA) and judged them to be inappropriate for the crowd context. These divergent results can be explained by reference to the methods: In the questionnaire, the detailed items already specified what kind of misfortune was involved, whereas this additional information was not given in an open-ended question in the interview ("What do they imagine a MA to be?"). Since the familiarity question was asked toward the end of the questionnaire, participants had already been confronted several times with the alternative terms and could fill them with (familiar) associations. In practice, this means that the terms MA and MD are only associated with crowds when additional information is given. This can also be interpreted as a positive result, because it indicates how flexible the terms MA and MD are and how easily people can get used to something new.

All in all, our quantitative findings were largely in line with the qualitative ones. This is very important as the items of the questionnaire were created on a theoretical basis to determine lay people's agreement with the image of mass panic or alternative concepts discussed in the literature. Due to the large sample size, we were able to gain a good impression of the prevailing concept. However, the genuine problem with questionnaires is that the participants just have to agree or disagree with the given statements. It is hard to say whether the ideas would also have been produced spontaneously or whether completely different concepts would then have been described. Even though far fewer people were interviewed, the free descriptions again indicated a relatively clear predominance of the image of mass panic. Additionally, the findings from the interviews were partly able to explain or extend the questionnaire results. This supports the validity of our data from both studies and the general use of mixed methods. At this point, please note that we did not discuss every single item of the questionnaire in detail here (see Supplemental (Table S1) for descriptive analysis), though it would have been interesting. This paper should only give an overview about the everyday understanding and associations. Anything else would have been beyond the scope. However, the data set is open access and available to anyone who would like to conduct further analysis.

4.1. Limitations

Although, our mixed-method approach provided a powerful study design to gain valuable insights into the everyday understanding of mass panic, we do not want to omit the limitations. First of all, the non-representativeness of our sample can be criticized most. With $N = 282$ for the questionnaire study and $N = 17$ for the interviews, we had large sample sizes relative to the respective study designs. Concerning age and gender they were also reasonably diverse but overall, the participants were mostly highly educated. This is mainly due to the recruitment via the social environment of the authors and a survey platform that is primarily used by people interested in research. However, obtaining a representative sample was never aimed. Knowledge about crowd accidents is not part of the usual general education and most people get their information from (social) media – as our but also other studies (e.g., Nogami, 2018; Nogami and Yoshida, 2014) have shown – which is equally accessible to all social classes. Therefore, there is no reason to expect different results with a more diverse sample. What is important to note, however, is that we only included German native speakers or people who speak German at a very high level. Thus, the study cannot say anything about associations of people who are just learning the language. This leads us to the next limitation, namely that the findings are of course only transferable to the German-speaking area. Nevertheless, at least in English and Japanese, the criticism of the terms "(mass) panic" or "stampede" is very similar. Therefore, our study provides first indications and may be useful for further investigations in other languages. Last but not least, we only examined two alternative terms. There might be another term that evokes completely different associations and reflects more accurately what happens in a crowd accident. Based on our results, however, we assume that the image of mass panic is so ingrained that no other term would automatically produce other, more accurate associations.

4.2. Practical implications

Our study shows that the rejection of the term "mass panic" is justified, especially since it is not just a language issue but also has fatal practical consequences. Firstly, there is the moral aspect of victim blaming after a crowd accident. According to our participants, visitors are the second responsible party for injuries and fatalities after organizers, who bear the primary responsibility. Secondly, similar to those responsible who may withhold information about the seriousness of the situation (Auf der Heide, 2004; Drury et al., 2013b), visitors do not seem to draw attention to the danger or themselves in critical situations. The results of our mixed-method study support the assumption that the advice "Don't panic (and stay calm)" is mainly followed. Even though crowd safety is clearly the responsibility of professionals, in some situations the expression of discomfort may help to recognize the danger at early stages. Nevertheless, further research is required to determine whether people actually behave this way and how this affects the dynamics of the situation – perhaps with the help of reconstructing past disasters. All in all, however, our findings support the calls for a new term that does not represent the old ideas, but the proposed terms MD and MA do not sufficiently fulfill this task. Simply exchanging the term is thus not enough; what is needed is a more elaborate education on the underlying theory of crowd accidents. The interviews showed that people are not satisfied with their existing explanations, so other explanations are likely to be accepted. Furthermore, it is important that the public will adopt the new term and perceived it to be appropriate and unambiguous. People appear to get used to a new term very quickly, however, it must be ensured that an alternative really evoke adequate associations. In our study, for example, the idea of contagious panic was even higher for MD. As mentioned above, this finding was unexpected, rather small and may be a false positive. However, further research is needed so that a new term could solve the problem instead of making it bigger. To advance the change, reporters and editors should be better informed about the problematic concept of mass panic, since most people gain their knowledge from (social) media. Prospectively, these channels could also be used to establish new, more realistic concepts and to disseminate scientific explanations of crowd accidents.

4.3. Conclusion

To conclude, we found out that lay people's ideas and assumptions about crowd accidents are rather vague and associative and closely related to the image of mass panic. We also learned that these ideas do not change just because a different term is introduced. Nevertheless, changing the term in combination with accurate information seems to be an important initiative. Therefore, science and (social) media should work together to develop and establish an appropriate alternative term and explanation of crowd accidents. This is the only way to overcome the classical image of mass panic with all its negative and fatal consequences.

CRediT authorship contribution statement

Helena Lügering: Writing – review & editing, Writing – original draft, Visualization, Software, Resources, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Dilek Tepeli:**

Methodology, Investigation, Formal analysis. **Anna Sieben:** Writing – original draft, Visualization, Supervision, Methodology, Formal analysis.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

The raw data of the questionnaires and the interview transcripts (in German) are available through the Pedestrian Dynamics Data Archive hosted by the Forschungszentrum Jülich, https://doi.org/10.34735/ped.2021.10.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ssci.2023.106123.

References

Auf der Heide, E., 2004. Common Misconceptions about Disasters: Panic, the "Disaster Syndrome," and Looting, in: O'Leary, M. (Ed.), The First 72 Hours: A Community Approach to Disaster Preparedness. iUniverse Publishing, Lincoln, pp. 340–380.

Brunsch, D., 2021. Publikumszentrierte Sicherheits- & Krisenkommunikation auf Veranstaltungen. In: Ronft, S. (Ed.), Eventpsychologie. Springer, pp. 569–604. https://doi.org/10.1007/978-3-658-28888-4.

Clarke, L., 2002. Panic: Myth or Reality? Contexts 1, 21–26. https://doi.org/10.1525/CTX.2002.1.3.21.

Cocking, C., Drury, J., 2014. Talking about Hillsborough: 'Panic' as Discourse in Survivors' Accounts of the 1989 Football Stadium Disaster. J. Community Appl. Soc. Psychol. 24, 86–99. https://doi.org/10.1002/casp.2153.

Cocking, C., Drury, J., Reicher, S., 2009. The psychology of crowd behaviour in emergency evacuations: Results from two interview studies and implications for the Fire and Rescue Services. Irish J. Psychol. 30, 59–73. https://doi.org/10.1080/03033910.2009.10446298.

Dezecache, G., 2015. Human collective reactions to threat. Wiley Interdiscip. Rev. Cogn. Sci. 6, 209–219. https://doi.org/10.1002/wcs.1344.

Drury, J., 2012. Collective resilience in mass emergencies and disasters: A social identity model. In: Jetten, J., Haslam, C., Haslam, S.A. (Eds.), The Social Cure: Identity, Health and Well-Being. Psychology Press, Hove, UK, pp. 195–216. https://doi.org/10.4324/9780203813195.

Drury, J., 2018. The role of social identity processes in mass emergency behaviour: An integrative review. Eur. Rev. Soc. Psychol. 29, 38–81. https://doi.org/10.1080/10463283.2018.1471948.

Drury, J., Cocking, C., Reicher, S., 2009a. Everyone for themselves? A comparative study of crowd solidarity among emergency survivors. Br. J. Soc. Psychol. 48, 487–506. https://doi.org/10.1348/014466608X357893.

Drury, J., Cocking, C., Reicher, S., 2009b. The Nature of Collective Resilience: Survivor Reactions to the 2005 London Bombings. Int. J. Mass Emerg. Disasters 27, 66–95. https://doi.org/10.1177/028072700902700104.

Drury, J., Novelli, D., Stott, C., 2013a. Psychological disaster myths in the perception and management of mass emergencies. J. Appl. Soc. Psychol. 43, 2259–2270. https://doi.org/10.1111/jasp.12176.

Drury, J., Novelli, D., Stott, C., 2013b. Representing crowd behaviour in emergency planning guidance: 'mass panic' or collective resilience? Resilience 1, 18–37. https://doi.org/10.1080/21693293.2013.765740.

Drury, J., Novelli, D., Stott, C., 2015. Managing to avert disaster: Explaining collective resilience at an outdoor music event. Eur. J. Soc. Psychol. 45, 533–547. https://doi.org/10.1002/ejsp.2108.

Duden | Panik [WWW Document], 2021. URL https://www.duden.de/rechtschreibung/Panik (accessed 12.1.21).

Fahy, R.F., Proulx, G., Aiman, L., 2012. Panic or not in fire: Clarifying the misconception. Fire Mater. 36, 328–338. https://doi.org/10.1002/fam.1083.

Feliciani, C., Shimura, K., Nishinari, K., 2021. Introduction to crowd management. Springer Nature. https://doi.org/10.1007/978-3-030-90012-0.

Galea, E., 2021. It's a crowd crush NOT A STAMPEDE - the difference is important! LinkedIn. https://www.linkedin.com/pulse/its-crowd-crush-stampede-difference-important-ed-galea/.

Garcia, L.-M., 2011. Pathological Crowds: Affect and Danger in Responses to the Love Parade Disaster at Duisburg. Danc. J. Electron. Danc. Music Cult. 2, 6–11. https://doi.org/10.12801/1947-5403.2011.02.01.15.

German court halts Love Parade trial with no convictions, 2020. DW News. https://www.dw.com/en/german-court-halts-love-parade-trial-with-no-convictions/a-53325748.

Gill, J.R., Landi, K., 2004. Traumatic asphyxial deaths due to an uncontrolled crowd. Am. J. Forensic Med. Pathol. 25, 358–361. https://doi.org/10.1097/01.PAF.0000147316.62883.8B.

Grün, G.-C., 2011. Was sind crowd dynamics? https://www.jetzt.de/forschungsfrage/was-sind-crowd-dynamics-528031.

Guttman, L., 1954. Some necessary conditions for common-factor analysis. Psychometrika 19, 149–161. https://link.springer.com/content/pdf/10.1007/BF02289162.pdf.

Haghani, M., Cristiani, E., Bode, N.W.F., Boltes, M., Corbetta, A., 2019. Panic, Irrationality, and Herding: Three Ambiguous Terms in Crowd Dynamics Research. J. Adv. Transp. Vol. 2019, Article ID 9267643. https://doi.org/10.1155/2019/9267643.

Helbing, D., Mukerji, P., 2012. Crowd disasters as systemic failures: Analysis of the love parade disaster. EPJ Data Sci. 1, 1–40. https://doi.org/10.1140/epjds7.

Hörnle, M., 2018. Letzte "Nachtschicht" in Heidelberg: "Massenpanik" ist ein Mythos. Rhein-Neckar-Zeitung. https://www.rnz.de/region/heidelberg_artikel,-letzte-nachtschicht-in-heidelberg-massenpanik-ist-ein-mythos-plus-fotogalerie-_arid,327609.html.

Johnson, N.R., 1987. Panic at "The Who Concert Stampede": An Empirical Assessment. Soc. Probl. 34, 362–373. https://doi.org/10.2307/800813.

Kaiser, H.F., 1960. The Application of Electronic Computers to Factor Analysis. Educ. Psychol. Meas. 20, 141–151. https://doi.org/10.1177/001316446002000116.

Künzer, L., Zinke, R., Hofinger, G., 2012. Mythen der Entfluchtung, in: Vereinigung zur Förderung des Deutschen Brandschutzes eV (Ed.), Tagungsband Jahresfachtagung. pp. 725–735.

Künzer, L., Hofinger, G., 2021. Eine Einführung aus Sicht der Human Factors-Psychologie. In: Ronft, S. (Ed.), Eventpsychologie. Springer, Wiesbaden, pp. 515–542. https://doi.org/10.1007/978-3-658-28888-4_23.

Le Bon, G., 1896. The crowd: A study of the popular mind. Macmillan Company, New York.

Mawson, A.R., 2005. Understanding mass panic and other collective responses to threat and disaster. Psychiatry 68, 95–113. https://doi.org/10.1521/psyc.2005.68.2.95.

Mayring, P., 2000. Qualitative Content Analysis [28 paragraphs]. Forum Qual. Sozialforsch. / Forum Qual. Soc. Res. 1, Art. 20. https://doi.org/10.17169/fqs-1.2.1089.

Meaning & Definition for UK English | panic [WWW Document], 2021. URL https://www.lexico.com/definition/panic (accessed 12.3.21).

Mintz, A., 1951. Non-Adaptive Group Behavior. J. Abnorm. Soc. Psychol. 46, 150–159.

Moitinho de Almeida, M., von Schreeb, J., 2019. Human Stampedes: An Updated Review of Current Literature. Prehosp. Disaster Med. 34, 82–88. https://doi.org/10.1017/S1049023X18001073.

Nogami, T., 2016. Who Panics and When: A Commonly Accepted Image of Disaster Panic in Japan. Int. Perspect. Psychol. 5, 245–254. https://doi.org/10.1037/ipp0000050.

Nogami, T., 2018. Disaster myths among disaster response professionals and the source of such misconceptions. J. Contingencies Cris. Manag. 26, 491–498. https://doi.org/10.1111/1468-5973.12218.

Nogami, T., 2020. Negative misconceptions about disaster behaviour through availability cascades: An examination of secondhand information and the moderating effect of trait anxiety on disaster myths. J. Community Appl. Soc. Psychol. 30, 369–380. https://doi.org/10.1002/casp.2441.

Nogami, T., Yoshida, F., 2014. Disaster myths after the Great East Japan Disaster and the effects of information sources on belief in such myths. Disasters 38, 190–205. https://doi.org/10.1111/disa.12073.

Proulx, G., Sime, J.D., 1991. To Prevent "Panic" in an Underground Emergency: Why Not Tell People the Truth? In: Cox, G., Langford, B. (Eds.), Fire Safety Science: Third International Symposium. Elsevier Applied Science, London, pp. 843–852.

Quarantelli, E.L., 1960. Images of Withdrawal Behavior in Disasters: Some Basic Misconceptions. Soc. Probl. 8, 68–79. https://www.jstor.org/stable/798631.

Quarantelli, E.L., 2001. Panic, Sociology of. In: Smelser, N.J., Baltes, P.B. (Eds.), International Encyclopedia of the Social and Behavioral Sciences. Pergamon Press, New York, pp. 11020–11023.

Sime, J.D., 1990. The concept of panic. In: Canter, D. (Ed.), Fires and Human Behaviour. David Fulton, London, pp. 63–81.