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The emergency reaction questionnaire – First steps towards a new method

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ABSTRACT

During emergencies, people are more or less capable of performing adequately. Knowledge about human behavior while facing emergencies has become more significant nowadays. This knowledge can help improving our already present defensive responses and natural coping mechanisms when facing imminent dangers, natural disasters, and catastrophes. A new method is here offered to explore the core points of this topic. The Emergency Reaction Questionnaire (ERQ), is proposed for predicting one’s reaction and behaviour in an emergency. First, a large item pool was created based on interviews with people facing emergencies on a weekly basis and related literature. The factor structure, reliability and validity were assessed on a large sample of lay people (N = 1115, 440 males) and specific groups of firefighters and people doing extreme sports (N = 85, all males). Participants were Caucasian with an age range of 18–70. We also used measures of anxiety, depression, and sensation seeking, behavioral inhibition and activation and coping in stressful situations. The ERQ was proved to be reliable and consistent in time and having sound psychometric properties both on the community and special samples. Results show that psychometric properties are satisfying; the test has excellent validity ratings. Consequently, the ERQ can be used in future research effectively and facilitate a better understanding of how people react in a highly dangerous situation. Future directions in the utilization of the new method are discussed.

1. Introduction

After the attack against the Twin Towers of the World Trade Center in 2001, the bombing of London’s underground in 2005, or the explosions during the football game in Paris in 2015, people often asked themselves how they would have reacted if they have been there. When faced with unexpected and dangerous situations, different individuals react in ways that might be surprising, including to themselves. For example, when crossing a road and a car approaches at high speed, one might freeze for too long [1]; or when learning scuba diving and the mask gets filled with water one might ascent too fast [2]. Emergencies can occur during natural disasters such as avalanches, earthquakes, floods and hail, and human-made disasters such as a building collapse, air disasters, industrial/technological accidents, and fires. They can also occur during unexpected personal situations such as when crossing a road, riding a bicycle or driving a car, or when faced with dangerous animals or people. The present manuscript defines emergency as a sudden and unexpected dangerous situation in terms of survival value. Disasters are collectively experienced traumatic events with a severe impact, which affect large numbers of people [3]. Most disasters imply emergencies, but they can differ mainly in the number of people involved. They have in common the fact they entail a threat. A threat can be defined as a stimulus that elicits defensive responses [4]. A defensive organismic state is triggered by activity in survival circuits that detects threats and generates automatic defense reactions [5].

In contrast with the general public idea, although people feel more or less fear during emergencies, most behave reasonably, and, thus, panic, hysterical, or irrational behaviour is rare [6,7]. To our knowledge, Tyhurst [8] was the first to conduct an empirical study, relying on psychiatric interviews with people who had survived a community disaster, searching for individual differences. According to the results about 15% of people reacted in an organized way, 15% completely froze, could not react, and suffered shock, while the rest – 70% – showed different levels of disorganized behaviour. These findings have been frequently cited [9–11], and subsequent studies confirmed that the vast majority of people behave in organized, rather than a chaotic way [12] or even display protective behaviour towards self or others [13,14]. Such findings may indicate the influence of social norms and
Anxiety Sensitivity, for example, seems to be an evolutionarily defensive behaviour that helps to promote the perceptual assessment of threats [44]. Freezing, as these should modulate the exaggerated fear reactions of the limbic regions properly. The center of this fear model is the amygdala, which is connected with medial frontal cortex and hippocampus for the control of threat memory [39–41]. Presently, the vast majority of panic attacks are due to false alarms [42] that trigger a brain prewired to overrespond. But these connections can also be wired or rewired via experience to calibrate stimuli detection and responses to threats [4,43]. The neural circuitry underlying these defenses usually increases the chance of surviving to predicted threats [4,5,25], and in the presence of threat predicting cues defensive motivational circuits tend to control instrumental behaviors [4]. However, people’s defensive responses can be poorly calibrated, particularly to unexpected events. Emergencies may threaten the physical integrity of those involved and require immediate responses different from the daily routine activities. Freezing, for example, seems to be an evolutionarily defensive behaviour that helps to promote the perceptual assessment of threats [44].

During tonic immobility, the organism is immobile but in tachycardia and hyper-alert, prepared to flee if an opportunity takes place, in contrast with fainting, characterized by vasodilatation and extreme bradycardia [46,48]. When activated by a threat, a variety of responses results produce signals that change brain activity, and usually increases general arousal, constituting a defensive organism state. These states are multidimensional, and different components may be activated to different degrees under different conditions [4]. Physiology influences cognitions, and cognition influences feelings, which influence behaviour and physiology in recursive sequence [49]. The value of responses that anticipate future events helps to explain why natural selection shaped classical and operant conditioning [42], but the defensive behaviors are immediate responses, and conscious fear is not the origin of defensive behaviors elicited by threats [4]. Therefore, it is essential to build up a questionnaire able to directly access the defensive mechanisms, instead of using the more intuitive but indirect fear or anxiety related questionnaires.

Extensive research was performed in the last decades on adverse psychological outcomes of sudden disasters and crises, exploring the prevalence, persistence and predictors of anxiety, depression, acute stress disorder, posttraumatic stress disorder and other psychiatric problems [50–54]. Also, a great effort was made to find the protective factors, which foster resilience, the person’s capacity for, or patterns of positive adaptation during or following exposure to adverse experiences [55]. These include, but are not limited to, attachment, intelligence, the capacity of behaviour regulation system, social interactions and support, past and present life stressors or healthy lifestyle [55–58]. All of the factors as mentioned earlier influence human actions in stressful situations. The two trends share a common point, both explore the medium- or long-term consequences, the aftermath of an emergency, and not the individual behaviour “in situ”.

The majority of the prior studies, however, used face-to-face or telephone interviews or simulations, which are time-consuming and expensive, require trained and experienced interviewers, and may create measurement errors (recall biases). We aimed to develop a questionnaire to provide a quantitative measure of individual behaviour in an emergency. Research about disasters (e.g., natural disasters) and emergencies (e.g., terrorist attacks) is growing. For example, a Google scholar search for words such as “natural disasters” & “psychology” form 1980–1989 will result in 30.600 articles; from 1990 to 1999 outputs 35.500 articles; from 2000 to 2009 is of 40.600 articles and this last decade (2010–2019) the search results in 76.200 articles. Using terms like “terrorism” and “psychology” the discrepancy is higher, jumping from 3.530 from 1980 to 1989 to 59.600 in 2010–2019.

With this grow in research, follows a need to make strong bonds between the diverse multidisciplinary teams implicated in complex studies, which often require a collaboration between diverse fields such as emergency planning, crowd and individual behaviour. With this in mind, our overarching goal was to create a new questionnaire that is capable of predicting one’s reaction in an emergency. To help decide whether the person will be able to start immediate remedial actions and do it in an organized way or will this person start to panic and block or set back others’ actions. We planned to do this by identifying the attitudes and key moments of the behaviour of people with dangerous jobs e.g., fighter pilots, firefighters, and ambulance crew – in risky and highly critical situations.

2. Method

We sought a brief, stand-alone measure of emergency behaviour that met the following criteria: evidence of psychometric soundness, face validity for average adults without dangerous jobs, low likelihood of
ceiling effects in high-achieving populations, and most importantly, a precise fit with the definition of an emergency. After reviewing several papers, we only found Gershon and colleagues’ works that meet our criteria [59–61]. However, they are investigating emergency preparedness, which is a different concept that includes previous experiences, safety plans for the future, and the ability of essential workers and their willingness to report to duty during an emergency. The measure we found can only be used to assess the preparedness for a disaster for persons with disabilities [62].

2.1. Procedure

In the absence of adequate existing measures, we developed and validated a self-report questionnaire called the Emergency Reaction Questionnaire (ERQ). First, we reviewed a book with in-depth interviews [63], where famous fighter pilots tell their stories, reactions, and attitudes to survive emergencies, where they had to eject from their plane during their piloting careers. We collected the most common reactions – e.g., “I could easily exclude all disturbing stimuli,” “funny enough I didn’t feel panic at all.” Based on their statements and experiences, we conducted focus group discussions with firefighters and different members of an ambulance crew about how they reacted to dangerous and threatening situations during their jobs. We also included some people who did not have dangerous jobs to understand their opinions and thoughts on such an event. Using the knowledge acquired from the discussion and with the help of two firefighters and an ambulance driver, the authors generated a pool of 49 items.

There were four question groups: organized – unorganized X general – specific. We aimed to capture the two extreme ends: the organized behaviour and remedial actions in an emergency, and the chaotic behaviour as “freezing” or feeling helplessness and hopelessness. We used general questions that are more trait-like constructs – e.g., “I easily panic.” – specific questions about life situations that can occur to everyone – e.g., “I can make the right decisions even if I must act on the spot.”. We randomized the items used. Participants rated each item on a five-point Likert-type scale, from one “Not true at all” to five “Absolutely true.” We distributed the questionnaire online on various forums using Google Forms. See Supplementary Table 1 for the final version of the ERQ.

2.2. Participants

Each respondent could participate in only one phase of the study; therefore, the following three samples are exclusive to each other. All of our subjects were Hungarian and Caucasian. None of our participants reported having any clinical diagnoses or comorbidities. Our research was carried out following the Code of Ethics of the World Medical Association (Declaration of Helsinki), and informed consent was obtained from all participants included.

2.2.1. Development sample

A total of 750 participants were recruited for the study with a range of demographic and socio-economic/educational backgrounds were recruited for the study. The sample consisted of 324 male and 426 female volunteers who were collected using the snowball method on the Internet. Their mean age was 23.17 (SD = 8.05). Respondents were collected through the Internet, using Google Forms. To obtain a heterogeneous sample, the survey was accessible to different strata of the population.

2.2.2. Test-retest sample

Sixty-two university students (11 male and 51 female) participated in the 3-week test-retest. Mean age: 20.32 (SD = 1.49). The paper-and-pencil questionnaire was administered in psychology courses.

2.2.3. Confirmatory factor analysis sample

A total of 246 volunteers (105 male and 141 female, mean age = 23.13, SD = 7.78) were recruited throughout the internet after the test development to test the factor structure of the questionnaire on an independent sample.

2.2.4. Validity sample

In total, 142 male participated in the validation of the questionnaire, their mean age was 33.38 (SD = 10.34): 42 of them were firefighters, 43 were sensation seekers with different extreme hobbies – e.g., parachuting, hang-gliding, flying, rafting. Since we could only find male firefighters and the vast majority of the sensation seekers were also male, we decided to use a male only control sample in this phase (N = 57). None of the control group had a dangerous job or an extreme hobby. Participants were collected through the Internet, using Google Forms.

2.3. Assessment measures

To access convergent and divergent validity, we not only gathered data from two special groups, but we also used several relevant questionnaires. Our goal was to determine whether our questionnaire is associated with the specific traits that the literature suggests. Bar-Haim and colleagues [64] found that threat-related cognitive bias in anxiety and suggest that the abnormalities in the threat-detection mechanism of anxious individuals would result in a hyper-vigilant mode towards the threat. According to Mogg and colleagues [65], the core deficit of anxiety is the inhibition of the accurate processing of threatening information. Anxious individuals during later, more strategic stages of processing tend to direct their attention away from threat [66]. This may result in feeling overwhelmed, helpless, and in freezing and unorganized behaviour.

The State-Trait Anxiety Inventory (STAI) [67] is a 40-item scale used to measure state and trait anxiety. Good to excellent internal consistency and adequate test-retest reliability has been reported. Our results showed good internal consistency (Cronbach’s α = 0.92).

The Sensation Seeking Scale (SSS) [68] is a 40-item scale used to measure sensation seeking. The questionnaire has good internal scale reliability. Our sample showed reliability of Cronbach’s α = 0.80.

The Coping Inventory for Stressful Situations [69] is a 48-item scale used to determine the individual preference of coping style (Task focus, Emotion focus, and Avoidance). Good to excellent internal consistency (Cronbach’s α = 0.76–0.92) was reported by the authors. Our sample showed a consistency of Cronbach’s α = 0.79 - 0.88.

The Behavioral Inhibition and Behavioral Activation Scale (BIS/BAS) [70] is a 24-item questionnaire. The authors reported good internal consistency and adequate test-retest reliability. Our sample showed a consistency of Cronbach’s α = 0.51 - 0.81. Poor value for one subscale was taken into account during data analysis.

The Beck Depression Inventory [71] is a 21-item measure of cognitive and somatic symptoms of depression with excellent internal consistency and adequate test-retest reliability. Our sample showed consistency of Cronbach’s α = 0.92.

3. Results

3.1. Data analyses

The JASP statistical program v0.11 [72] was used for further statistical analyses throughout the entire study. Exploratory factor analysis was conducted using principal components analysis and varimax rotation. The required Eigenvalue was set to unity; items with 0.4 or less factor weight was suppressed. In the first step a total of 16 items were excluded due to the following reasons (number of items excluded in parentheses); did not belong to any factors (one), factor weight was too low (three), too few items belonged to a factor (three), did not fit to any other factors (four), the total variance explained by the factors was too
We identified four factors that had Eigenvalues greater than unity, explaining 51.77% of the variance in the items. Together, these four factors accounted for 31.267%; 9.8%; 6.85%; 3.85% respectively, which is considered good. The four factors were consistent with our question groups set before the analyses and were named General Readiness, Specific Readiness, General Helplessness, and Specific Helplessness – see Table 1 for factor loadings of retained items.

### 3.2. Internal consistency

The ERQ total score and subscales showed good internal consistency. The General Readiness scale yielded a Cronbach’s alpha value of 0.86; the Specific Readiness scale had 0.80; the General Helplessness had .80, and the Specific Helplessness had .84. For the overall test, the Cronbach’s alpha is .92.

### 3.3. Test-retest

Three-week test-retest reliability for the total score, and all subscales were found to be high. The Pearson correlation was $r = 0.85$ for the General Readiness, $r = 0.79$ for the Specific Readiness, $r = 0.77$ for the General Helplessness, and $r = 0.85$ for the total score (all $p < .001$).

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**Table 1**

Factor loadings of retained items. The first column shows the number of items in the questionnaire, * = negatively keyed. The items presented here were translated from Hungarian to English according to international guidelines set by the APA.

| Nr. | Items of Emergency Behaviour Questionnaire                                                                 | F1 - General Readiness | F2 - Specific Readiness | F3 - General Helplessness | F4 - Specific Helplessness |
|-----|-----------------------------------------------------------------------------------------------------------|------------------------|-------------------------|---------------------------|---------------------------|
| 1.  | I like challenges, adventures, and activities that put me to the test.                                   | .72                    |                         |                           |                           |
| 2.  | I would love to try extreme jobs (e.g. fireman, soldier, ambulance man, etc.).                            | .70                    |                         |                           |                           |
| 3.  | I am attracted by extreme things, where I can really get fired up.                                        | .70                    |                         |                           |                           |
| 4.  | High level of adrenaline is not a bad feeling for me, indeed, I feel I perform more effectively.         | .69                    |                         |                           |                           |
| 5.  | When nothing risky happens to me for a long time, I feel the lack of it.                                 | .68                    |                         |                           |                           |
| 6.  | I would be open to putting myself to the test in a dangerous situation, where I can only rely on myself (e.g. skydiving, swimming with sharks, mountain climbing, rescuing, etc.). | .67                    |                         |                           |                           |
| 7.  | When I read about someone had been attacked on the streets or at a venue, I get scared and feel helpless. | .60                    |                         |                           |                           |
| 8.  | I feel above-average state of excitement to perform well.                                                | .53                    |                         |                           |                           |
| 9.  | If a situation becomes too dire, negative and fearsome, I would not fall apart, but still, be able to act organized. | .82                    |                         |                           |                           |
| 10. | I feel that I would be able to stay calm and capable of acting even in the middle of a panicking crowd.    | .73                    |                         |                           |                           |
| 11. | In an emergency, I set up a to-do list in the order of importance right away.                            | .7                     |                         |                           |                           |
| 12. | In an emergency, I can easily exclude the disturbing stimuli.                                            | .7                     |                         |                           |                           |
| 13. | I do not ask for others’ opinions, I act right away, if necessary.                                       | .68                    |                         |                           |                           |
| 14. | I can make the right decisions even if I must act on the spot.                                           | .64                    |                         |                           |                           |
| 15. | In unexpected situations, I act promptly.                                                                 | .62                    |                         |                           |                           |
| 16. | I can easily find my way about in unexpected situations.                                                 | .58                    |                         |                           |                           |
| 17. | I easily panic.                                                                                           | .75                    |                         |                           |                           |
| 18. | I am apprehensive of unusual, threatening situations.                                                    | .72                    |                         |                           |                           |
| 19. | I feel physically unwell in panic situations, I might as well even faint.                                | .65                    |                         |                           |                           |
| 20. | In threatening situations, I am usually overcome with anxiety.                                            | .65                    |                         |                           |                           |
| 21. | Even less threatening situations shock me.                                                                | .56                    |                         |                           |                           |
| 22. | The more negative the situation I am in, the less willing to act I feel.                                  | .47                    |                         |                           |                           |
| 23. | When the fire alarm is on for a longer period of time, I always become petrified with fear, even if I know it is just a test. | .63                    |                         |                           |                           |
| 24. | If a pedestrian were to be hit by a car in front of me on the crossing, I would probably just stand dumbfounded and could not be able to move. | .62                    |                         |                           |                           |
| 25. | If a seemingly hostile, huge dog would run towards me, I definitely would not be able to even think.       | .61                    |                         |                           |                           |
| 26. | If I walk alone during the night on an empty street and I hear some noise, I feel myself helpless and panic overwhelms me. | .58                    |                         |                           |                           |
| 27. | If there was a fire in the house where I live and I would feel the heat and smoke, that would definitely shock me so much that I would just wait for someone to rescue me. | .56                    |                         |                           |                           |
| 28. | When I see the pictures of a disaster, helplessness and fear overwhelm me.                                 | .55                    |                         |                           |                           |
| 29. | When I read about someone had been attacked on the streets or at a venue, I get scared and feel that if it happened to me, I would be helpless. | .50                    |                         |                           |                           |
| 30. | If I were in the middle of a catastrophe I feel that I would not be able to make logical and reasonable decisions. | .47                    |                         |                           |                           |
3.4. Confirmatory factor analysis

The result of the confirmatory factor analysis indicated that the proposed four-factor model provided an acceptable fit (CMIN/DF = 1.644, CFI = 0.987, TLI = 0.985, RMSEA = 0.051 [90% CI: 0.044-0.058], SRMR = 0.064). We also calculated Cronbach’s alpha values for the ERQ total score and subscales on this independent sample. The values indicated a good internal consistency: The General Readiness scale yielded a Cronbach’s alpha value of 0.87; the Specific Readiness scale had 0.88; the General Helplessness had .83, and the Specific Helplessness had .87. For the overall test, the Cronbach’s alpha was .93.

3.5. Descriptive data

After adding up the subscales and total score for the Emergency Reaction Questionnaire, we calculated a self-reported prediction of emergency behaviour for the main (developmental) sample (see Table 2 means and standard deviation values). In addition, a gender effect was identified, whereby women reported lower emergency behaviour efficiency than men (t (748) = 9.643, p < .001, Cohen’s d = 0.72). Interestingly, about 15% of people were below and 15% above one standard deviation from the mean. For females, 13.6% of females achieved a higher score than their respective means and standard deviations. In addition, a gender effect was noticeable, with females having a higher score than males (t (2,137) = 14.922, p < .001, t2 = 0.12), however, the difference in the average scores was more noticeable for males (14.02, p < .001, t2 = 0.16; F (2,137) = 11.164, p < .05, t2 = 0.06) and overall score (F (2,137) = 10.269, p < .01, t2 = 0.13) were found to be significant. These results confirm the findings of the discrimination analysis: sensation seekers scored the highest, and firefighters the lowest, while average men’s scores lie in-between them.

3.6. Construct validity

Construct validity is the degree to which a test measures what it claims or purports to be measuring. It can be obtained in two ways: using special groups that the questionnaire should be able to differentiate or statistical relationship analyses between two measures.

3.7. Validity sample analyses

One-way ANOVAs were used to analyse the scores from the validity sample – firefighters, sensation seekers, and average men. People with previous experience – due to dangerous profession, and sensation seeking – were higher in self-reported emergency behaviour efficiency than average men (F (2,143) = 10.66, p < .001, t2 = 0.13; F (2,143) = 14.02, p < .001, t2 = 0.16; F (2,143) = 15.35, p < .001, t2 = 0.18; F (2,143) = 8.80, p < .001, t2 = 0.11; F (2,143) = 19.42, p < .001, t2 = 0.21). The Bonferroni pairwise comparison showed that the two special groups – firefighters and sensation seekers – did not differ from each other, but they both differed from average males. See Table 3 for detailed descriptive statistics regarding group differences.

The scores of each assessment measures were then entered into a discriminant analysis to determine whether the ERQ is capable of discriminating the two special groups from the average population. The success rate of the categorization was 67.8%. The overall Wilks’ Lambda was significant (Λ = 0.46; χ2 (3) = 660.79; p < .001). The two discriminant functions were the ERQ and the Sensation Seeking Scale; average men scored lower on the ERQ than the two special groups, and lower on the SSS than the group of sensation seekers. Interestingly, the group of firefighters scored the lowest on sensation seeking. Thus, there was no difference on the ERQ between our two special groups. However, they did differ on SSS, of course, sensation seekers scoring higher.

3.8. Statistical relationship analyses

Convergent and discriminant validity are subtypes of construct validity. Evidence for both convergent and discriminant validity means, by definition that evidence for construct validity had been given [73]. Bivariate correlations were calculated between our questionnaire and other measures to provide evidence (see Table 4) for correlation coefficients.

Trait anxiety was found to be related fairly strongly to the two Helplessness scales (r = 0.57 - 0.6). Sensation seeking had a moderate connection to General Readiness (r = 0.57) and mediocre to the Total score (r = 0.38). Coping styles correlated differently with our scales: Task focus showed a moderate positive connection with the total score (r = 0.43), while Emotional focus coping preference correlated negatively with the total score (r = -0.53). Behavioral activation system scales were associated positively with the total score (r = 0.28 - 0.57). BAS drive scale needs to be highlighted, it had a mediocre connection with every subscale and the total score (r = 0.4 - 0.57), and it correlated negatively with Helplessness subscales (r = -0.39 to -0.43). Helplessness subscales had a mediocre connection with this BIS scale (r = 0.45), while the total score was fairly strongly and negatively related to it (r = -0.54). Depression also had a mediocre and negative connection to the overall score (r = -0.38).

3.9. Group differences

Differences and similarities among the three groups (average men, firefighters, and sensation seekers) were also explored after the required steps of the questionnaire validation. The assessment measures used in our study were analysed using one-way ANOVAs, and the Bonferroni correction was applied to all pairwise comparisons.

First, the ERQ subscales and main score were entered in the analysis, with the three groups as fixed factor. The test groups differed on all subscales (FES-Readiness (2,137) = 17.744, p < .001, t2 = 0.21; FS-Readiness (2,137) = 14.194, p < .001, t2 = 0.17, FES-Helplessness (2,137) = 1.461, p < .001, t2 = 0.15, FS-Helplessness (2,137) = 15.564, p < .001, t2 = 0.19) and main score (F (2,137) = 24.351, p < .001, t2 = 0.26). Average men scored lower for every subscale, and, of course, on the overall score as well, than the two special groups; interestingly, the scores of firefighters and sensation seekers did not differ.

The main effect for trait anxiety was also significant (F (2,137) = 13.511, p < .001, t2 = 0.17), the average man, again, differed from the two special groups, while they did not differ from each other, with average men achieving higher scores. All sensation seeking subscales (FSS (2,137) = 11.646, p < .001, t2 = 0.15, FSS (2,137) = 11.054, p < .05, t2 = 0.14, FSS (2,137) = 6.67, p < .001, t2 = 0.09, FSS (2,137) = 4.495, p < .05, t2 = 0.06) and overall score (F (2,137) = 10.269, p < .01, t2 = 0.13) were found to be significant. These results confirm the findings of the discrimination analysis: sensation seekers scored the highest, and firefighters the lowest, while average men’s scores lie in-between them.

The task focus and avoidance subscales of the Coping Inventory for Stressful Situations were not significant (Fs < 2, p>.1), however, the groups did differ on the emotion focus subscale (F (2,137) = 14.922, p < .001, t2 = 0.18), average men were more likely to use this coping style than the two other groups.

Two subscales of the Behavioral Inhibition and Behavioral Activation Scale were found significant, BAS fun seeking (F (2,137) = 4.44, p < .05, t2 = 0.06) and BIS (F (2,137) = 5.41, p < .01, t2 = 0.07) with medium effect sizes. Sensation seekers scored higher than the two other groups on the fun-seeking subscale, while, as expected, average men achieved the highest score on the Behavioral Inhibition Scale.

The Beck Depression scale, too, showed a significant main effect (F (2,137) = 9.634, p < .001, t2 = 0.12): average males scored higher than the two special groups.

4. Discussion

The question of how to behave in emergencies, appears not only in lay discourses, but it is a matter of interest in various disciplines including engineering, architecture, emergency medicine, public health, public safety, computer sciences, neurosciences as well as psychology and psychiatry. Here we tried to make a connection between these areas
through the development of the Emergency Reaction Questionnaire and establish its psychometric properties on a large sample of adults. The ERQ is mostly centred on the behavioural outcome, participants are reporting the likelihood of performing various defensive reactions, while we also included some items to assess their possible feelings or thoughts before, during or after an emergency because being aware of this might also play a role in the overall picture [32–36]. After creating the 30-item ERQ with a development sample, the reliability and validity of this measure were tested using a second independent sample. Internal consistency and test-retest reliability of the measure was strong. Convergent validity was evident in the strong association between the ERQ and gender. This measure was used as well as replication of the finding that about 15% of observed people in an emergency would act quickly, correctly, and completely organized, while 15% will freeze, feel helpless, lost without a clue how to act or react appropriately [8].

However, these findings also mean that about 70% of the population will still be able to act while showing different levels of disorganization. This is in line with previous research [5,12] claiming that most of the people involved in an emergency behave in a reasonable manner. Thus, panic and completely irrational behaviour seem rather rare, but this does not mean that most people will be a good first responder during emergency situations, and this questionnaire is adapted to that selection. The findings on gender differences in our self-report measures of emergency behaviour are also interesting. However, it is unclear at the same time whether this result represents an actual difference in emergency reaction efficiency between men and women, or whether it is a function of the increased willingness of females to endorse anxiety symptoms and helplessness. Nonetheless, our finding that males score higher on ERQ than females, and thus, expected to act in a more organized way in an emergency is in line with the findings of previous meta-analyses [51,52,54] and reviews [74]. They claim that females are more prone to develop anxiety and other negative symptoms than males after such an event, moreover it was shown [75] that those who are passive victims and cope worse with the acute situation are more likely to develop these disorders. Therefore, if the gender difference found on ERQ is indeed a real difference in an emergency, then it seems plausible that females tend to feel more lost, experience more fear, and as a consequence of their less efficient behaviour in an emergency they are more prone to develop PTSD and other issues compared to males [54,58]. The fact that females are highly underrepresented in specific populations like firefighters and sensation seekers might support the idea that the gender difference we identified is indeed real. Still, it is also possible females that cope well in the most difficult situations, can be of more help to other females during certain emergency situations. For example, when facing situations in which one needs to be grabbed, transported or touched, skilled females might be able to deal with certain people that might feel less comfortable in the presence of a male.

In the validation study, only males were assessed as we could only find some females who were sensation seekers, and none that were firefighters. The divergent validity was found apparent between the ERQ and other commonly used measures of anxiety, emotional coping style, the inhibitory system sensitivity, and depression. We expected ERQ to be associated with sensation-seeking because one of the question groups was about general preparedness, which is somewhat similar in concept to sensation seeking. We also expected to see group differences in the preferred coping styles, based on the interviews with members of dangerous professions who reported a very heavy problem-focused coping during emergencies (see also [63]. Our results, however, indicate that this difference is more pronounced in emotion-focused coping. This suggests that the population of average males in our study were more likely to prefer the emotion-focused coping mechanism, while the special groups did not. Therefore, it seems plausible that during an emergency, average males tend first to calm down their emotions caused by the negativity and threat offered by the situation, and only then, if they ever succeed, will they try to act. Previous research [69] has shown that emotion-focused behaviour is connected to higher neuroticism and depression proneness. Supporting these findings, our results show that, indeed, average males scored higher both on the trait anxiety and depression scales. Indeed, ERQ was expected to be associated with depression, which is an affective disorder and is associated with anxiety, helplessness, hopelessness, and low activation [76]. Hence, it seems rational to claim that elevated levels of depressive symptoms and anxiety-proneness can facilitate maladaptive coping strategies and, therefore, chaotic behaviour in emergencies [37,38]. This might also be in line with the findings on the gender as mentioned above differences: females tend to be more prone to neuroticism and depression [54]. Thus, they score lower on emergency behaviour efficiency (ERQ) than males.

The overall impression from the group comparisons on the different scales is that the two special groups (sensation seekers and firefighters), who are believed to be able to manage emergencies and will not freeze in highly demanding situations, are experiencing higher levels of agency. Although automatic defensive reactions could be triggered by activity in survival circuits that detects threats [5], facing an emergency for the first time could lead to confusion and overwhelm the person [24]. Previous experience has a huge impact on how one detects and responds to threats [4,43]. If the defensive actions are recalibrated, an adequate control of fear response can be achieved [39–41]. Thus, the influence of social norms and evolutionary algorithms are equally important [15–17]. According to Gray’s theory, emotions and behaviour can be understood as the outputs of the inhibitory and activation neurological circuits [77]. They can be defined as avoidance (BIS) and approach (BAS) motivational systems. The BIS helps avoid harm, and BIS sensitive people tend to be more anxious in dangerous situations while BAS sensitive people are more motivated to explore new things and risk in adverse and dangerous situations. Therefore, on average lower BIS sensitivity leads to lower levels of depression and anxiety, and indeed, our results show that special groups, on average, are less anxious and are less depressed. Thus, such people tend to cope better with emergencies, as they can focus on the problem instead of their emotions. Presumably, the members of these special groups have a less sensitive behavioral inhibition system compared to average males, as they have previous experiences and a higher levels of self-efficacy (higher level of agency), thus, they know they can cope with whatever situation may come next. Naturally, the lower self-reported or perceived levels of BIS sensitivity might be the consequence of their own lifestyles; that is, firefighters must engage in highly life-threatening situations, as it is their profession, while the motivation behind sensation seekers is the urge for adrenaline, excitement, and reward. Interestingly, firefighters and sensation seekers

Table 2

| Developmental Sample | Males Mean | SD | Females Mean | SD | Total Mean | SD |
|----------------------|------------|----|--------------|----|------------|----|
| ERQ total            | 11.3       | 15.3| 99.6         | 17.5| 104.5      | 17.5|
| General Readiness    | 24.8       | 6.8 | 21.1         | 6.6 | 22.7       | 6.9 |
| Specific Readiness   | 28.9       | 5.1 | 27.8         | 5.6 | 28.3       | 5.5 |
| General Helplessness | 12.1       | 4.1 | 14.9         | 4.8 | 13.7       | 4.7 |
| Specific Helplessness| 14.3       | 4.5 | 18.5         | 5.6 | 16.7       | 5.5 |

Table 3

| Average Men | Firemen | Sensation seekers |
|-------------|---------|------------------|
| Mean        | SD      | Mean             | SD   | Mean    | SD |
| ERQ total   | 108.1   | 15.6 | 124.2 | 13.3 | 123.1 | 13.9 |
| General Readiness | 22.9 | 5.9 | 27.9 | 4.9 | 26.8 | 6.5 |
| Specific Readiness | 26.6 | 4.8 | 32.2 | 4.7 | 33.1 | 4.3 |
| General Helplessness | 14.9 | 4.6 | 11.4 | 4.8 | 11.5 | 3.5 |
| Specific Helplessness | 12.7 | 4.4 | 8.6 | 3.5 | 9.3 | 3.4 |
only differed in sensation seeking, and fun-seeking (BAS), which are closely related to each other [78]. Individuals who score high on fun-seeking are eager for reward and tend to act in the heat of the moment [70]. Thus, it seems that motivation is the key to understand the difference between the two special populations: Sensation seekers have an inner desire (on a biological basis), while firefighters are more prosocial. Specifically, people might choose to become firefighters driven by a prosocial motivation to help others, while in the case of sensation seekers, it is the biological necessity that makes them engage in (at least in others’ eyes) highly dangerous situations. Importantly, the social interactions and support, comradeship in the case of firefighters, is a protective factor [56,57] that can also explain their results. We would also like to underscore that, contrary to average men, both groups are prepared, but while firefighters receive professional training, sensation seekers can mostly rely on their own experiences.

In sum, we conclude that our results are promising, and we demonstrated that this new questionnaire, the ERQ, can be used in studying the complex, engaging, and essential field of emergency behaviour. Further exploration is needed in the lights of the terror attacks, other safety issues, and investigating emergency preparedness [59,61,79]. We think that this questionnaire can be the key to doing so, because it has the possibility of a quick survey even right after such an event happens, to explore the basics of this field and to allocate the questions that need to be investigated outside the laboratory. To allow for an even quicker testing, a brief version of the ERQ can be developed in the future. Results of further studies could be applied in practice, for example, to improve fire safety, train children in school how to act in an organized way in emergency situations. Moreover, major computer modelling groups that work on events and public space planning have already expressed an interest in such results and called for more psychological input [80–82]. Possible implications of the questionnaire regarding various threats such as the COVID-19 pandemic can also be of interest in future studies.

Research on immediate human responses to an emergency will assist with the long-term physical and mental health of affected people or their social environment. Given the limitations and paucity of previous research associated with emergency behaviour, the present findings are promising as we seek to establish a new way of studying this area. Of course, these are the first steps towards a new method. Future studies are still needed to gather more data from both average and special populations (e.g. police officers, members of the army), create standards for age groups and genders. Further validity must be sought, for instance by testing rookies at special rescue forces and the fire department, in a longitudinal setting from the application through to the point where they become qualified, and then after working for a year. Rescue workers and ambulance personnel have been shown to have much higher prevalence of PTSD than that of the general population [83]. Our questionnaire can help shed a light on the background of this problem, and also be useful in selection and implementing preventive measures for personnel. Future studies can also test people who have never been in an emergency situation before but are willing to undergo specific training and see how they react and improve.

### Data transparency

Data dataset we use in this manuscript was collected for the purpose of this study only. There is no other published, in press, or under review studies that come from the same dataset as the one in the submitted manuscript.

### Data availability statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

### Declaration of competing interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential 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.ijdrr.2020.101684](https://doi.org/10.1016/j.ijdrr.2020.101684).

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### Table 4

| ERQ                  | General Readiness | Specific Readiness | General Helplessness | Specific Helplessness | Total Score |
|----------------------|-------------------|--------------------|----------------------|-----------------------|-------------|
| Trait Anxiety        | -.33**            | -.62**             | .61**                | .67**                 | -.66**      |
| SSS total            | .57**             | .33**              | ns.                  | ns.                   | .38**       |
| CISS Task Focus      | .29**             | .41**              | .34**                | -.35**                | .43**       |
| CISS Emotional Focus | -.22              | -.47**             | .54**                | .50**                 | -.53**      |
| CISS Avoidance       | .25*              | ns.                | ns.                  | ns.                   | ns.         |
| BAS Drive            | .46*              | -.57**             | -.43**               | -.39**                | -.57**      |
| BAS Fun Seeking      | .55**             | .38**              | ns.                  | ns.                   | .39**       |
| BAS Reward Responsiv | .27               | ns.                | -.22*                | ns.                   | .28         |
| BIS                  | -.29***           | -.53**             | .45**                | .46**                 | -.54**      |
| BECK Depression      | ns.               | -.44**             | .29**                | .34**                 | -.38**      |

*p < .05; **p < .01; non-significant results are not displayed."
