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Perspective

CP2DIMG: An Innovative Research Program Aimed at Preparing Firefighters and Police Officers to Manage Emotions and Stress in Operational Contexts

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Abstract: This paper presents a research program called CP2DIMG conducted at the Federation of Environment and Society Research at the University of Corsica. The goal of CP2DIMG is to better understand the influence of emotions on operational personnel's decision-making, aiming to test training systems dedicated to individuals facing high stress during their professional activities. This type of training system is intended to enhance emotional and mental resilience, thereby improving decision-making ability in uncertain situations under the influence of emotions related to the event. For implementation, the method will be tailored to the specificities of two categories of operational personnel: firefighters and municipal police officers. The expected results will address significant demands from operational professionals in the Mediterranean region for firefighting safety but also for large-scale or highly complex interventions. This study fully integrates into the challenges of the Mediterranean region: forest management, risk prevention plans, and preparedness of local actors responsible for crisis management. Furthermore, individuals responsible for crisis management, including local government officials and risk management and security personnel, will be able to use the obtained results for effective decision-making.

Keywords: decision-making; emotions; life-saving; new wildfire context; operational context

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1. Introduction

Wildfires are part of Mediterranean ecosystems and societies [1–3]. However, the occurrence of high-intensity wildfires has dramatically increased throughout the region during the last decades, especially in the European Mediterranean countries [4]. Changes in climatic and weather conditions are major contributors to the increase in wildfire hazard and risk [5,6]. With global temperatures expected to rise and severe droughts becoming more frequent, fire seasons are likely to be prolonged in many ecosystems. Consequently, new regions around the globe may face heightened wildfire risk [7]. Anthropogenic factors have also played a significant role in increasing fire risk worldwide [8,9]. These factors include changes in land use, rural exodus, and the abandonment of previously cultivated

land. The situation is exacerbated by rapid and unregulated urbanization in wildland-urban interfaces (WUI), fire exclusion policies that lead to fuel accumulation, and a predominant focus on fire suppression rather than effective prevention strategies. The combined impact of these factors suggests a substantial likelihood of increased wildfire risk in the future, with extreme catastrophic wildfire events occurring more frequently [10]. The catastrophic fires that ravaged the small town of Kinglake in the Australian State of Victoria on the infamous 'Black Saturday' in 2009 serve as a global reference for the destructive power of such events. Within twelve hours, the fire consumed 100,000 hectares of land, claiming the lives of 120 people [11]. Consequently, firefighters will be increasingly called upon to address this new context.

These high-intensity wildfires are not only dangerous because of their impact on humans, climate, and ecosystems but also because their behavior is unpredictable and uncontrollable [12]. Recognizing that suppression efforts may reach their limits of effectiveness, there is a need to redirect efforts towards prevention measures based on fuel treatments as well as new methods of evacuating populations [13]. However, such evacuations can evoke negative emotional and behavioral reactions among affected individuals and pose challenges for policymakers and professionals involved in crisis management [14]. Indeed, during these events, evacuees and decision-makers must deal with strong emotions such as fear, anxiety, confusion, frustration, or anger, which affect their behavior and decision-making [15]. Psychological and behavioral management of population evacuation during a high-intensity fire is also essential for the safety and well-being of the population [16].

The social identity theory, developed by H. Tajfel and J. Turner [17], highlights the importance of belongingness in how individuals perceive and behave in social environments [18]. This theory can be used to understand collective responses and acts of solidarity or division during population evacuations. Therefore, understanding these behaviors and the factors that influence them is essential for effective crisis management.

In this paper, the psychological and behavioral aspects of population evacuations during forest fires, as well as crisis management strategies and best practices developed to address them, are analyzed. Psychological models and theories that help understand the emotional and behavioral responses of individuals and policymakers, as well as key stress factors of individuals and groups involved in crisis management, are examined. A research program entitled CP2DIMG is also presented, which aims to analyze the effect of emotions experienced by a firefighter or a police officer on their decision-making and then evaluate their ability to manage them in order to optimize their actions during a high-intensity wildfire, focusing particularly on resilience.

Resilience is a concept established by C. Holling [19,20] for ecological systems, widely applicable in other fields such as organizational systems, social systems, economic systems, socio-ecological systems, engineering, infrastructure systems, energy and water systems, and transportation. Resilience can be understood as the capacity of individuals and communities to bounce back or "move forward" after external shocks such as natural disasters or slow-evolving changes such as economic decline or public service deterioration. As such, resilience is not an inherent characteristic of individuals or communities but is culturally defined and informed [21]. As defined by P. Lièvre [22], during a high-intensity fire, the operational context of firefighters and police officers can be characterized as extreme and exhibits the specific features of this environment: dynamic, uncertain, and risky [23]. These operatives must establish suitable logistics to organize the response to these events [24]. Such situations require high technical expertise and concentration in challenging working conditions. The common objective of these operatives is to protect people, animals, property, and the environment. Faced with these challenges, firefighters and police officers, like all individuals exposed to these situations, experience intense emotions that must be regulated to enable them to be effective in their mission and to ensure their own safety [25–27].

In the field of human resource management, the regulation of emotions in professions involving emotional incidents is gaining momentum and attracting increasing interest [28]. Indeed, the impact of these various emotional peaks can be significant at the time, disrupting the decision-making process, but also in a post-traumatic manner [29]. In order to better understand this impact, it is proposed to place firefighters or police officers in a context that is virtually recreated and close to reality and to study the emotions experienced, their effects on the decisions made, and their consequences on the expected actions. Thus, the CP2DIMG project aims to define emotional influences and their effects on decision-making, establish a common foundation for all operatives, and delineate pertinent parameters for emotion evaluation. This includes determining the operational modes for evaluation, such as psychometric tests, measuring tension, heart rate, and pupil dilation, and utilizing image processing techniques. The project will also implement scenarios and develop a digital product for use with a virtual simulator, compatible with tests in an immersive environment. Additionally, potential future valorization of this research program could involve the implementation of training programs for local and external operatives, with the development of simulators for training operatives to handle non-standard situations using immersive rooms. The limitations and research perspectives are also discussed to improve knowledge and practices in this field, as well as the importance of adopting a multidisciplinary and collaborative approach.

2. Psychological and Behavioral Aspects of Evacuations during High-Intensity Wildfires

2.1. Psychological Aspects

As an evacuation during a high-intensity wildfire can be a stressful and traumatic experience for those involved, both evacuees and decision-makers, it is essential to understand the emotional and behavioral responses of individuals in these situations [30]. Therefore, it is necessary to refer to mental models and theories that take into account both individual and collective aspects. For example, the model of self-efficacy [26] suggests that when individuals are confident in their ability to cope with challenges and overcome obstacles, they tend to better manage crisis situations. Similarly, George Bonanno's theory of resilience proposes that people have an innate capacity to cope with difficult situations and adapt to change even in extreme circumstances [31]. However, population evacuations during wildfires can also elicit negative emotional reactions such as anxiety, fear, panic, anger, or confusion. Decision-making models in crisis situations, such as the Protective Action Decision-Making (PADM) model by Lindell and Perry, emphasize the influence of emotions on individual choices in terms of safety [32].

Furthermore, evacuations during wildfires often involve whole groups and communities that may share norms, values, and shared identities. H. Tajfel and J. Turner's social identity theory underscores the importance of belongingness in how individuals perceive and behave in social environments [17]. The theory can be used to understand collective responses and acts of solidarity or division during population evacuations. Wildfire evacuation operations require the collaboration of various experts and officials, such as firefighters, police forces, government services, and elected representatives, who must unite their efforts to effectively manage the crisis. Disaster sociology, developed by T. Drabek and D. McEntire, highlights organizational and interorganizational dynamics that can influence the performance of the actors involved [33].

In this section, psychological models and theories that help understand the emotional and behavioral reactions of evacuees and decision-makers during high-intensity fires are examined. The importance of norms and collective identities in how individuals perceive and act in their social environment, as well as organizational and interorganizational dynamics that can influence the performance of involved actors, is also emphasized. These psychological aspects of population evacuations during high-intensity wildfires result in significant consequences for crisis management and the safety and well-being of the affected populations.

2.2. Behavioral Aspects

During population evacuations, individual behaviors can vary considerably, ranging from cooperation and compliance with authorities' orders to resistance and disobedience [34]. Peter Gollwitzer and Paschal Sheeran's approach–avoidance model suggests that these behaviors can be influenced by the perception of crisis situations [35]. For example, individuals may be more likely to cooperate with authorities if they perceive the situation as serious and have confidence in protective measures. However, individual behavior can also be influenced by emotional factors such as fear, anxiety, or panic, which can affect judgment and decision-making. The stress and coping theory by R. Lazarus and S. Folkman underlines the importance of cognitive appraisal of stressful situations in how individuals cope with them [36].

Therefore, crisis management professionals must pay attention to the emotions and behaviors of individuals to better meet the needs of evacuees. Additionally, population evacuations may involve collective behaviors such as queuing, forming support groups, or establishing information exchange systems [37]. J. Drury and S. Reicher's theory of collective regulation draws attention to the importance of collective identity and solidarity for group behavior during catastrophic events [38]. Thus, crisis management professionals must be able to mobilize collective resources to address the needs of evacuated populations.

Finally, population evacuations often entail complex coordination among various actors, such as firefighters, law enforcement, government agencies, private partners, or elected officials. Crisis coordination models, like D. McEntire's hierarchical coordination model, underscore the importance of clarity in roles and responsibilities for effective coordination [39].

In this section, the individual and collective behaviors of those involved are examined. Effective approaches to managing emotions and behaviors during population evacuations in a crisis, which include the adoption of strategies and best practices in crisis management, will now be focused on.

3. Strategies and Best Practices for Crisis Management by Firefighters and Police Officers in Managing Emotions and Behaviors during Population Evacuations

In the face of the psychological and behavioral challenges of evacuating people during a high-intensity wildfire, firefighters and police officers must implement crisis management strategies and practices developed to handle the emotions and behavior of evacuees and decision-makers. Communication is a crucial component of these strategies because it assists in conveying clear and precise information to evacuees and decision-makers, reducing uncertainty and confusion, and facilitating decision-making [40]. Communication must be tailored to the needs of the affected population, using various channels and taking into account cultural and linguistic differences [14]. Additionally, communication must be continuous and transparent to prevent rumors and misunderstandings [41].

Preparation is another key element of crisis management, as it helps reduce stress and anxiety levels among evacuees and decision-makers by providing them with the knowledge and skills needed to respond to crisis situations. Preparation should include simulation exercises, emergency planning [42], and training for professionals involved in crisis management, as well as information and guidance for evacuated populations [43]. Serious games can address these important needs for extreme situation simulation for responder training. These interactive computer games allow users to simulate real crisis scenarios to improve their decision-making and crisis-management skills [44]. Group training allows professionals involved in crisis management to work together to better understand their roles and responsibilities, as well as to strengthen their collaboration and communication. These tools have the potential to enhance the readiness and efficiency of professionals in handling crisis situations, as well as the management of emotions and behaviors of populations.

Coordination is also an important element of crisis management as it allows for optimizing resources and minimizing conflicts among the involved actors [40]. Coordination

should be based on clear agreements and well-defined roles [45], most often planned [42], taking into account local specificities and available resources. Coordination should be flexible and adaptable to the developments of the crisis and the needs of evacuated populations.

Finally, compassion and empathy are important elements of crisis management as they allow for identifying the emotions and needs of evacuees and decision-makers and providing them with adequate psychological and social support. Compassion and empathy should be integrated into interactions between professionals involved in crisis management and evacuees, avoiding judgment and promoting active listening [32].

In this section, strategies and best practices for crisis management regarding the management of emotions and behaviors during population evacuations in the event of high-intensity wildfires are presented. These strategies include communication, preparation, coordination, compassion, and empathy and should be tailored to the needs of the affected populations and local specificities. In the following section, the study context is elaborated upon, followed by an explanation of the experimental protocol implemented.

4. The CPD2IMG Research Program

4.1. The Purpose and Interest of the CP2DIMG Research Program

The objective of the Capacity for Decision-Making in Uncertainty under Overwhelmed or Poorly Managed Stress (in French: Capacité de Prise de Décision Dans l'Incertitude sous Stress Dépassé ou Mal Géré—CP2DIMG) research program at the University Pasquale Paoli of Corsica, led by the Federation of Research on Environment and Society (FRES) and initiated in September 2023 for a duration of 5 years, is to design a method capable of testing a training system dedicated to individuals experiencing emotions and aimed at improving decision-making capacity in uncertainty under overwhelmed or poorly managed stress conditions for operatives. CP2DIMG aims to explore how emotions influence the decision-making process of operatives, with the objective of evaluating a specialized training system designed for individuals encountering high stress during their professional duties. This training system is intended to enhance emotional and mental resilience, thereby improving decision-making abilities in situations of uncertainty influenced by event-related emotions. The project originated from a request by operatives (T3Team company, Ajaccio, France) seeking to conduct research on emotion management in operational decision-making. They are in search of university partners capable of providing scientific expertise in studying decision-making under stress and the execution of technical procedures during interventions. The collaboration aims to develop a methodology for testing a training system tailored to operatives, including firefighters, surgeons, professional divers, and police officers, among others. For practical implementation, the methodology will be first customized to suit the specific needs of two categories of operatives: firefighters and police officers. (https://fres.universita.corsica/article.php?id_site=61&id_menu=0&id_rub=1071&id_cat=607&id_art=6491&lang=fr, accessed on 20 April 2024).

After reviewing the research project titled CP2DIMG, the Ethics Committee of the University of Corsica granted its approval on 6 March 2023. The examination was conducted based on expertise provided by Professor Liliane Berti of the university, the opinion of the University of Corsica's data protection officer, as well as the study questionnaire and consent form. The request, which involved conducting a survey involving data collection from human populations in non-health research, was carefully reviewed in light of the documents provided and the required expertise. After deliberation, the ethics committee deemed the proposal to be in line with standard practices and unanimously approved the conduct of this survey. This favorable opinion from the ethics committee is an important milestone for the project, attesting to its adherence to ethical standards and rigorous methodology. It also highlights our research team's commitment to conducting a study that respects current ethical and regulatory norms.

The CP2DIMG project will thus carry out the following:

- Define emotional influences and their effects on decision-making;

- Establish a common foundation for all operatives and delineate pertinent parameters for emotion evaluation;
- Determine the operational modes for this evaluation (psychometric tests, tension, heart rate, pupil dilation, and utilization of image processing techniques. . .);
- Implement scenarios and develop a digital product for the utilization of a virtual simulator compatible with tests in an immersive environment.
- Potential future valorization of this research program could include the following:
- Implementation of training programs for local and external operatives;
- Development of simulators for the training of operatives facing non-standard situations using immersive rooms.

4.2. Study Context: The Operational Context

Emotions usually impact people in their daily activities because these are determining factors in the way they perceive the world. Thus, Donald Hebb wrote that "man is the most emotional of all animals". From this observation, it appears that if we are so subject to our emotions, they inevitably influence our perception, attention, memory, and decision-making [46]. An emotion is an electrochemical signal that originates in our brain and triggers reactions in our body, thus influencing the actions and reactions of everyone. It is a biochemical indication that signals an internal or external change requiring an adaptation. The center of this process is the amygdala complex [47]. Emotions result from an evaluative sequence of a stimulus or a given situation conditioning a reaction, more or less intense [48–50]. Emotion presents itself as an unconscious signal of the effectiveness of our choice [51] at first glance; as a process of adjustment and evaluation, it plays a moderating role in rational decision-making [52]. For example, firefighters, during interventions, encounter numerous stimuli within a complex context, resulting in significantly higher stress levels compared to other professions [53].

Therefore, this extreme management context [54] is characterized first by high variability. This implies that during operations, sudden, rapid, and discontinuous changes can occur. In the case of a high-intensity wildfire, there are rapid, nonlinear, and multi-scale events during its progression (spot fires, threatened residences, blocked roads. . .) [12,55–58]. The second characteristic is uncertainty. For a firefighter or a police officer, it is based on the complexity of the actions to be taken with an obligation to implement means (technical, material, skills) that cannot guarantee a certain result. Ultimately, the extreme management context is characterized by a high level of risk for the participants. It involves constant exposure to varying degrees of physical threat, a reality that is often embraced as inherent to the profession.

The firefighter's determination to save lives can be added to these three characteristics. For instance, the motto of the Paris Fire Brigade encapsulates this sentiment: "Save or perish". During complex interventions (in terms of technical challenges, stakes involved, and duration), the firefighter's mission is to protect or rescue individuals, animals, property, or the environment. This task is often performed within the framework of extreme event management, with an imperative to exhaust all efforts in saving or protecting lives. This duty may require firefighters to perceive exposure to risk as an essential element for successfully completing their mission. For example, in the case of wildfires occurring in Wildland–Urban Interface (WUI) areas and when faced with a fully engulfed house fire and distressed victims, the inherent risks of burns, explosions, or smoke inhalation may need to be acknowledged by firefighters as integral to their actions, even without full control over the situation [59–62]. The principle of life-saving justifies categorizing the extreme management context as an operational one. The evacuation of people during a major forest fire by the fire brigade perfectly embodies the concept of an operational context previously defined because it combines the criteria of an extreme situation with the essential mission of safeguarding people. This scenario is characterized by a high level of uncertainty, as fire behavior can rapidly change due to factors such as wind, temperature, and topography, making it extremely challenging to predict its spread. Furthermore, the rapid evolution of

the fire imposes significant time pressure on decision-making, as every second is crucial to prevent the flames from reaching inhabited areas. There are also multiple risks involved, not only for the lives of the people being evacuated but also for the firefighters and the police officers themselves, who face direct danger. It is this new definition that forms the basis of the CP2DIMG program, which aims to evaluate the effects of emotions in this operational context in order to optimize decision-making.

4.3. Organization of the Research

The research work is planned to achieve the set objective as follows:

Year 1: 2023–2024

- Designing a scenario for the "general public". The objective is to put individuals under extreme stress (pushing them out of their comfort zone) or intense emotional peaks;
- Creating a "visual product" lasting 10 to 15 min;
- Designing psychometric tests to "characterize" the individuals to be tested;
- Developing an evaluation grid to allow analysis of the test results;
- Selection of test participants;
- Implementation of the first series of tests.

Year 2: 2024–2025

- Analysis of data from the initial tests of year 1;
- Design of "specific" scenarios. The objective is to subject operatives to overwhelming stress;
- Creation of two "visual products" lasting 10 to 15 min (one specific for firefighters and the other for police officers);
- Development of psychometric tests for police officers;
- Training of police officers in the method proposed by T3 company;
- Design of an evaluation grid for each group to facilitate the analysis of test results.
- Refinement of measurement methods and data analysis: a study will be conducted to detect human stress through visual cues. A vision framework will be established to capture thermal and visible facial images at close range during the experimental process. AI-based processing will be implemented to identify a set of parameters associated with stress and automatically detect it.

Year 3: 2025–2026

- Development of a method inspired by the training method proposed by T3 company for firefighters;
- Selection of test participants;
- Implementation of the second series of tests using the visuals developed during the second year.

Year 4: 2026–2027

- Analysis of data from the tests of year 3;
- Selection of test participants;
- Implementation of the third series of tests in order to evaluate the training methods (firefighters and police officers).

Year 5: 2027–2028

- Analysis of data from the tests of year 4;
- Development of educational materials tailored to the training needs of firefighters and police officers.

4.4. Experimental Protocol for the First Series of Tests

4.4.1. The Emotion-Generating Film and the Different Participant Groups

One of the objectives of the CP2DIMG research program is to examine the effect of emotions on decision-making in a professional setting among firefighters and police officers. Their abilities to manage and regulate emotions in an operational context recreated for the study were assessed in a first series of tests. Immersive technologies are relied upon to recreate a professional scenario in the form of a serious game [63]. The objective is to closely replicate the emotional aspect of the operational context. The immersive multi-sensory experience is the chosen technology, which combines a set of visual and auditory stimuli to create an experience that engages multiple senses. These technologies offer interesting potential in learning or teaching, as described by Morgado [64]. To come as close as possible to real-life intervention conditions, the proposed experimental protocol relies on four previously described criteria: rapid evolution, uncertainty, high risk for the interveners, and the obligation to act to save. Thus, the objective of this first film is to place individuals under extreme stress (taking them out of their comfort zone) or intense emotional peaks. It is worth noting that the scenario of this "general public" film was deliberately designed to evoke emotions for firefighters, police officers, as well as individuals not part of the emergency services in a context very different from that of high-intensity fire evacuation, but still within an operational context (Figure 1). The editing of the emotional induction film was designed to immerse participants in a realistic and dynamic scenario, representative of fire brigade interventions, and adhering to operational context criteria. The chosen scenario incorporates these criteria, emphasizing the necessity for rescue. The timeline identifies key elements observed, forming a temporal sequence that aims to create emotional peaks associated with the context. These peaks are driven by uncertainty, risks to individuals or responders, sudden changes in exercise conditions, or the urgency of rescue operations. Scenarios tailored for firefighters and police officers, considering specific operational contexts, are currently being designed and will be implemented during the second year of the project (2024–2025).

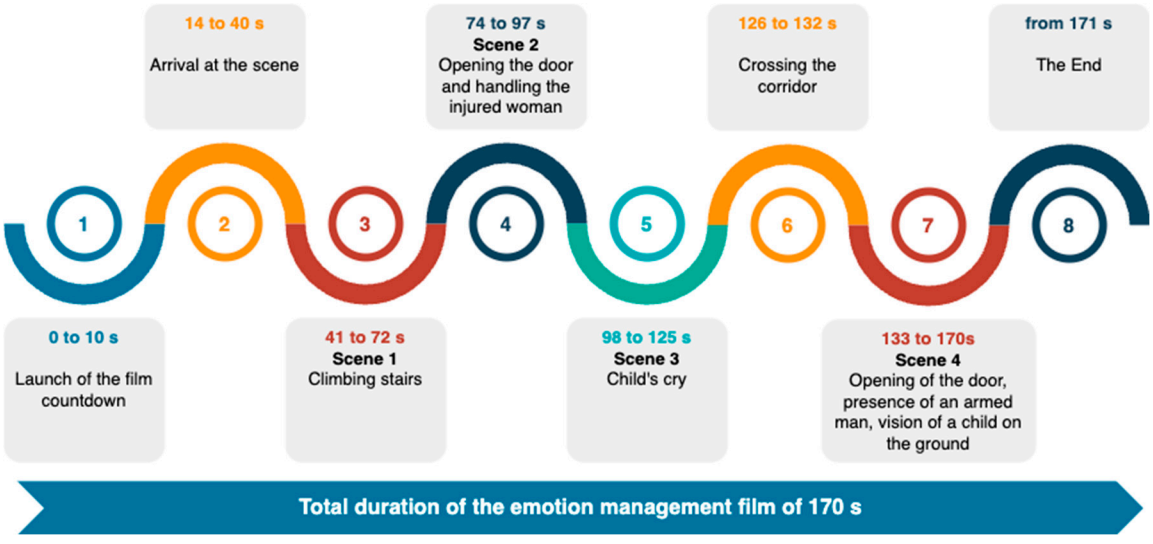
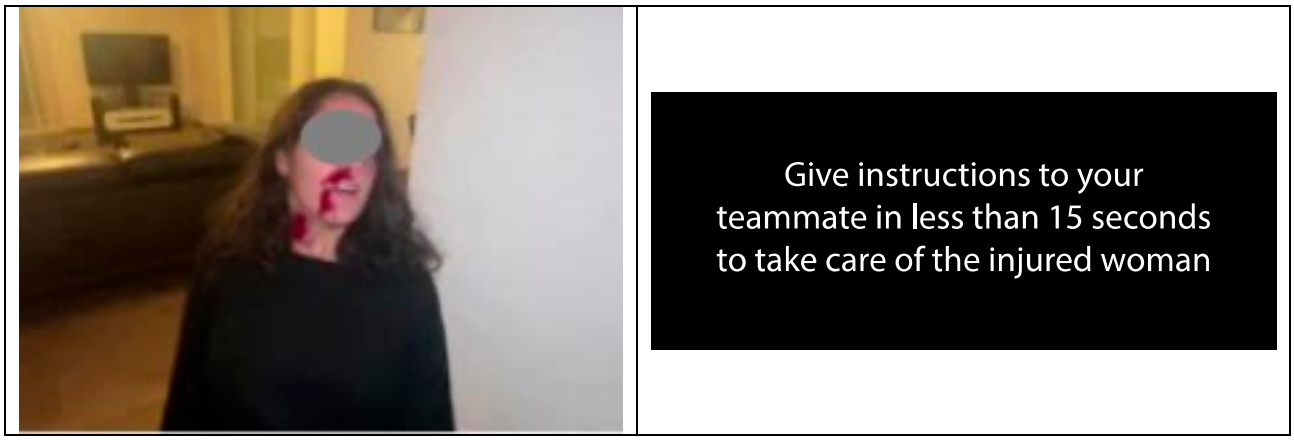


Figure 1. Timeline of the "general public" film.

The experimental protocol involves screening a film for three samples of participants from different populations (pilot group, control group, and target group). The film depicts an intervention where the firefighter or police officer, exposed to risks, must make decisions to save lives (Figure 2a,b).



(**a**) (**b**)

Figure 2. (**a**) Image from the movie (scene 2) where a character is injured. (**b**) Question n°1 inserted into the film and posed to the participants: "Give instructions to your teammate in less than 15 s to take care of the injured woman".

The pilot group should be composed of a sample of students. They should receive information regarding the experimental protocol, which involves evaluating the emotions felt during the viewing of intervention videos. This group is intended to provide an initial assessment of the protocol. Participants of the control group are recruited from civilians in administrative or technical positions, ensuring the exclusion of individuals with volunteer firefighter status. This group, placed under the same conditions as the study group, validates the emotional effects sought by the film without seeking to determine the impacts on decision-making. Participants of the target group should be recruited on a voluntary basis from firefighters and police officers in Corsica. These latter two groups are exposed to a simulation of intervention in an operational context with elements of uncertainty (incomplete information), rapid intervention (limited time for action), risk to the interveners (threat to physical integrity), and an obligation to save or protect lives (Figure 3a–c). The control group should serve as a benchmark to evaluate the intensity of the emotions sought without real expectations regarding coherence in choices (lack of rescue techniques in this sample).

(**a**)

Figure 3. *Cont.*

(**b**)

(**c**)

Figure 3. (**a**) A participant at the beginning of the test. (**b**) A participant during the test. (**c**) A participant decision.

The aim of this type of test is to trigger intense emotions at selected moments. In the case of the target group tests, the participant's task is to verbally instruct their partner on the actions to take based on the events presented in the film (Figure 4).

Throughout the experience, the participant's emotional responses are recorded [65]. These data are supplemented by psychometric tests administered before and after the intervention simulation to evaluate the valence and arousal dimensions of emotional state.

Figure 4. A participant and his partner during the test (target group).

4.4.2. Emotion Measurement Tools

In the context of this study on emotions, particular attention was given to the selection of measurement tools. These tools were chosen to conduct self-assessment and apply structured psychometric tests according to the following five methods:

- Differential Emotions Scale (DES) [66];
- Perceived Stress Scale (PSS) [67,68];
- Emotion Regulation Questionnaire (ERQ) [69];
- Self-Assessment Manikin (SAM) [70];
- Melbourne Decision Making Questionnaire (MDMQ) [71].

In addition to these psychometric measures, the measurement of a physiological factor, heart rate, was integrated. This measurement provides an additional dimension to our analysis by offering an objective insight into the physiological reactivity of participants in different experimental situations. In the context of our study, attention was focused on the choice of heart rate measurement equipment, which centered on the Checkme™ O2 bracelet (https://getwellue.com/products/checkme-o2-max-wrist-pulse-oximeter, accessed on 20 April 2024), an oximeter and heart rate monitor developed by Shenzhen Viatom Technology. This choice was guided by several key criteria related to the effectiveness and practicality of the device. It is a tool intended for healthcare professionals and recommended by a medical equipment supplier. The Checkme™ O2 is distinguished by its lightweight design, which provides optimal comfort for participants. This feature is deemed essential to avoid any discomfort or distraction during the experience, allowing participants to fully focus on the presented scenarios. The device is paired with the ViHealth (https://www.viatomtech.com/support, accessed on 20 April 2024) application, a platform designed to facilitate data recording and storage (Figure 5). This application enables efficient data collection and real-time monitoring of physiological measurements. The data can then be exported in various formats (CSV, PDF, etc.). The management of collected data is simplified by the intuitive interface of the ViHealth application, allowing for quick and accurate analysis of heart rate and oxygen saturation measurements. The accuracy of the Checkme™ O2 in measuring heart rate and oxygen levels ensures that the collected data are reliable and representative of the participants' physiological responses.

Figure 5. The Chekme sensor and the Vihealth application.

The data collection was conducted on an APPLE IPAD Pro, where the ViHealth application was downloaded, thanks to the Bluetooth connection between the two devices. The anonymized extracted data were then transferred to an external hard drive.

4.4.3. First Results Samples

The reaction of the control group to the video used in our study revealed interesting nuances regarding the perceived realism and emotional impact of the film. The participants of the control group reacted weakly, which is certainly due to the fact that they understood it was fake. Indeed, it seems that psychometric test results indicate that for the majority of participants, the intensity of emotions felt was relatively low, raising questions about the effectiveness of the film as an emotional trigger. However, a closer analysis of the data revealed that three candidates showed significantly more pronounced emotional reactions than the other participants. These three individuals turned out to be students who also serve as volunteer firefighters. This dual affiliation likely played a key role in their heightened reactivity: their personal and direct experience as volunteer firefighters probably facilitated a more immediate and deep connection with the scenarios presented in the video. This finding suggests that for individuals capable of transferring their emotional experiences related to their firefighting activity, visual support can indeed induce significant and measurable emotional variations. This phenomenon underscores the importance of considering participant's personal and professional experiences in the design and evaluation of studies focused on emotional reactions. It also offers a promising avenue for refining simulation methods to generate more authentic and intense emotional responses, especially among individuals with relevant operational experiences.

In the analysis of physiological reactions to stress during the viewing of the film, heart rate variability curves provide significant clues. The normalization method used, where the heart rate at each measurement point is divided by the value measured five minutes before the test (initial state), helps identify fluctuations relative to the participant's baseline state. When the resulting value exceeds 1, it indicates an increase in heart rate compared to the initial state, suggesting a stress reaction. Conversely, a value lower than 1 could indicate a state of relaxation or relief. A value close to 1 tends to signify that the heart rate remained stable, potentially reflecting a state of calm or emotional neutrality. It is important to consider that even a stable heart rate that deviates from 1 can be misleading. For example, if the initial measurement is incorrect or atypical for a given individual, it

could falsely suggest that the person remained undisturbed throughout the film when they might be well adapted to making decisions in a stressful context. Similarly, a stable pulse at a high level throughout the film could be interpreted as an indicator of continuous stress, which could be detrimental in situations requiring clear and rational decision-making. To dispel such ambiguities, it is crucial to correlate physiological data with participant's self-assessments. Psychometric test responses can provide subjective context to objective data, helping to interpret whether a stable heart rate indicates emotional control, stress habituation, or an inability to relax.

The study of the normalized average pulse rate graphs obtained for both the control and target groups during the film viewing (Figure 6) seems to highlight a correspondence between the measured physiological responses and the perceived emotional reactions. Indeed, the curve representing the average pulse rates of the target group in Figure 6 reflects a more pronounced reaction compared to the control group (25~30% increase in the heart rate). This statement further confirms that the film effectively generates a stronger emotional engagement among the target group.

The analysis of the charts reflecting the level of emotions experienced by the target group according to the scenes of the film (Figure 7) reveals trends that corroborate the observed physiological variations (Figure 6).

The data compiled in the graphs indicate an intensification of the stress felt during the third and fourth scenes (respectively 92 s to 124 s and 136 s to 164 s) of the film compared to the first two (Figure 8). This emotional escalation is consistent with the heart rate measurements, where peaks in pulse responses are also observed, suggesting an increased level of stress and a deeper emotional immersion of the participants at these specific moments of the film (Table 1). This parallel between subjective emotional responses and objective physiological measurements strengthens the hypothesis that these scenes have a more striking and stimulating impact, potentially due to their dramatic intensity and their temporal proximity to the end of the film.

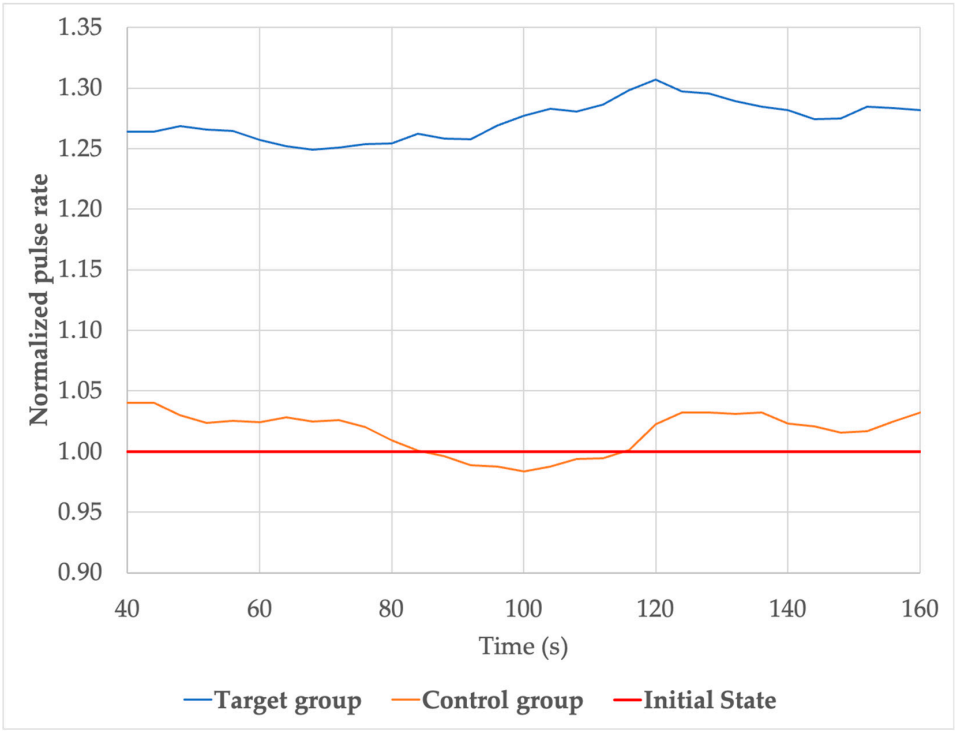


Figure 6. Normalized average pulse rates of both the control and target groups during the film viewing.

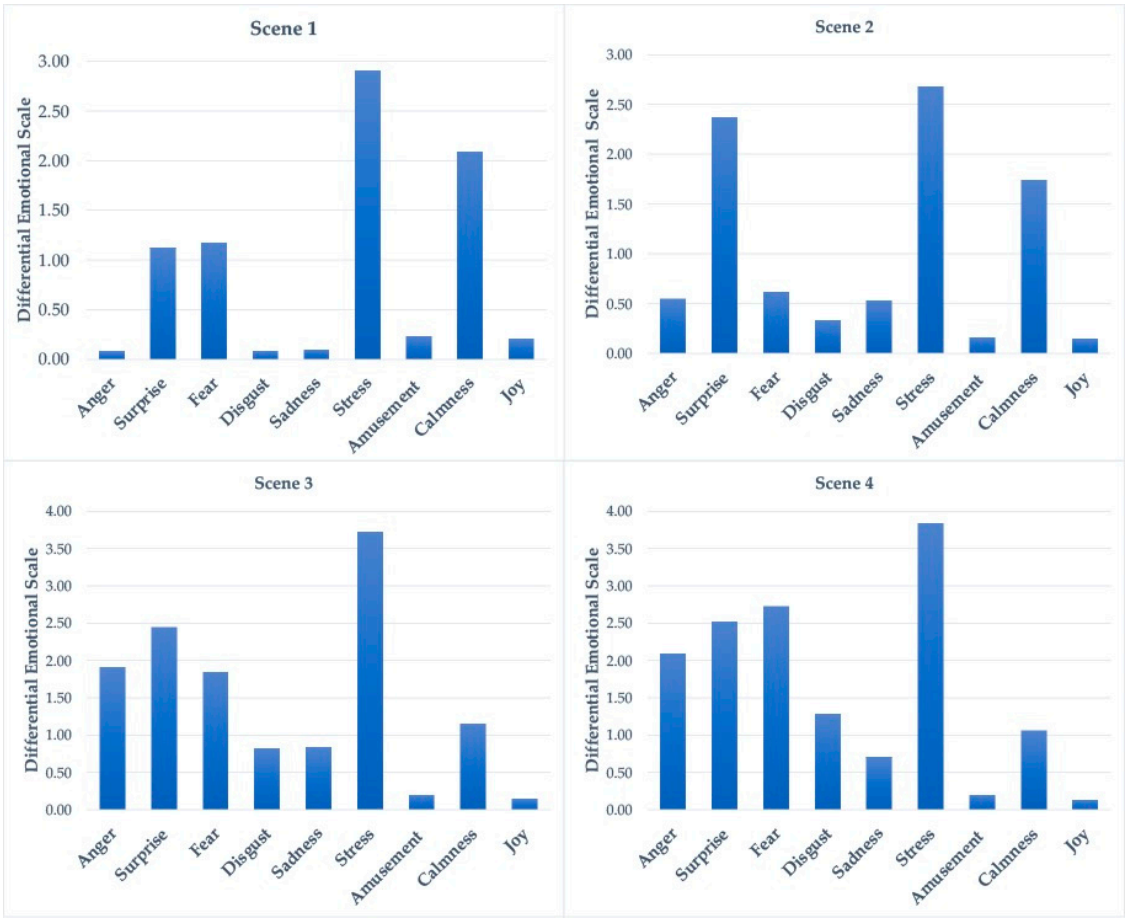


Figure 7. Diagrams of the emotions obtained for the target group during the screening of the film for each scene.

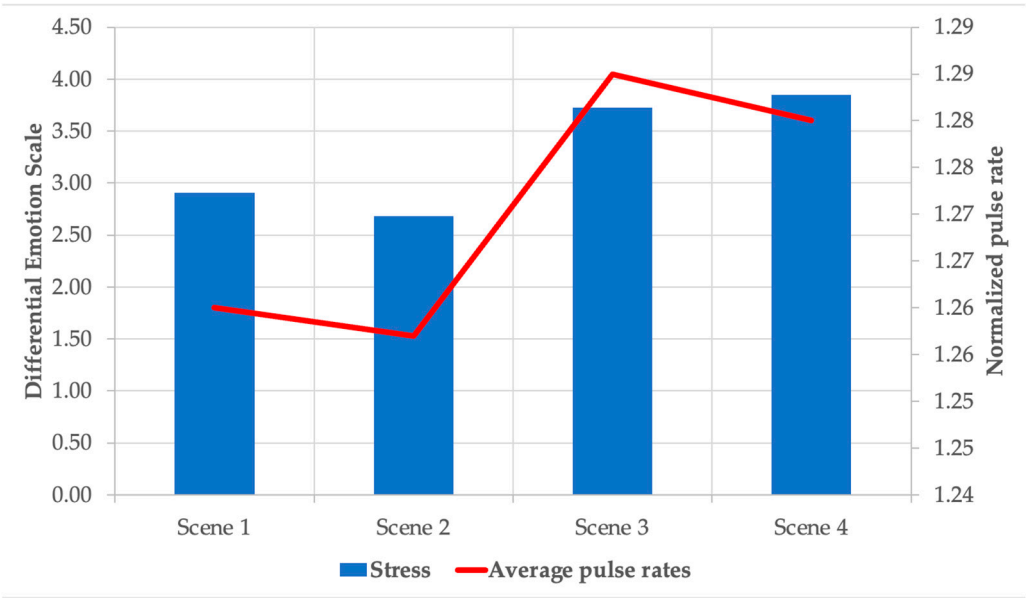


Figure 8. Diagrams of the stress obtained for the target group during the screening of the film for each scene.

Table 1. Pulse rates and stress values by scene for the target group.

Scene	Time (s)	Normalized Pulse Rate	Normalized Average Pulse Rate	Stress
Scene 1	40	1.264	1.260	2.906
	44	1.264		
	48	1.268		
	52	1.266		
	56	1.265		
	60	1.257		
	64	1.252		
	68	1.249		
	72	1.251		
Scene 2	76	1.254	1.257	2.681
	80	1.255		
	84	1.262		
	88	1.258		
Scene 3	92	1.258	1.285	3.725
	96	1.269		
	100	1.280		
	104	1.280		
	108	1.280		
	112	1.290		
	116	1.300		
	120	1.310		
	124	1.300		
Scene 4	136	1.285	1.280	3.847
	140	1.282		
	144	1.274		
	148	1.275		
	152	1.285		
	156	1.283		
	160	1.282		
	164	1.276		

As the comparison of heart rate data with psychometric test responses shows a coincidence between the increase in heart rate and moments perceived as the most stressful by participants, the creation of a "stress gauge" based on heart rate frequency could serve as a tool to assess individuals' ability to manage stress in real time.

It is also relevant to consider that the lingering effect of the final scenes in the participant's memory may influence their perception and their relationship to the emotions experienced. The recency effect bias [72], where the most recent events are better recalled, could perhaps explain why these final scenes are judged to be more emotionally intense. This could be taken into account to refine the interpretation of emotional data in order to understand how the sequences of events and their temporal positioning in the film influence an individual's emotional reactions. The diagrams show that the participants' emotional experiences are dynamic and evolve significantly throughout the film, which is corroborated by consistent physiological measurements.

5. Conclusions and Perspectives

The management of the population during a high-intensity wildfire is a complex challenge that requires a deep understanding of the psychological and behavioral aspects of evacuation, as well as crisis management strategies and best practices to address them. In this article, these different aspects are examined based on recent research in various disciplines. Firstly, it is shown a wildfire can have significant psychological effects on the population and decision-makers, including stress, trauma, and resilience. The importance of considering these psychological aspects, providing emotional support, and promoting communication and preparation in crisis management is emphasized. Individual and

collective behaviors involved in population evacuations are also examined, demonstrating that they can vary considerably depending on the situations and individuals involved. The importance of understanding these behaviors to better address them by promoting communication, coordination, and compassion is highlighted. Then, strategies and best practices for crisis management in handling emotions and behaviors during a wildfire are presented, emphasizing the importance of communication, preparation, coordination, and compassion.

Managing the population during wildfires is a major challenge that demands a multidisciplinary approach and effective coordination among involved stakeholders, necessitating thorough planning and training. The research program CP2DIMG, led by the Environment and Health Research Federation of the University of Corsica, is currently addressing the issue of managing emotions in decision-making within this specific operational context. This research aims to explore the impact of intense emotions on the decision-making of firefighters and police officers in extreme and complex operational situations by simulating them. The findings could contribute to a better understanding of emotional processes among them and help develop suitable emotional regulation strategies to optimize their performance and safety during interventions within a broader context of resilience.

The initial results obtained on the emotional reactions of the different control and target groups provide interesting insights into the interaction between professional experience and emotional response. The control group, having identified the fictional nature of the film, exhibited moderate emotional reactions, suggesting that awareness of the staging can attenuate the emotional impact of a stimulus. However, the notable exception of three volunteer firefighters in this group, who showed stronger reactions, illustrates how personal experience can amplify the emotional connection with the content of the film. This observation underscores the need to consider participants' personal backgrounds when designing simulations intended to evoke authentic emotions. The examination of heart rate variability during viewing revealed that values above 1, indicating a state of stress, contrasted with values below 1, suggesting relaxation or relief. These data, juxtaposed with psychometric test responses, could potentially shed light on participants' emotional states, distinguishing moments of intense stress from periods of relative calm. However, caution should be exercised in interpreting stable heart rate readings distant from 1, which could be due to initial measurement anomalies or persistent stress, the latter being less conducive to optimal decision-making. The average heart rate curve suggests that the film generated significant physiological reactions, particularly in the final scenes, which could serve as anchor points for a potential stress value "gauge". These results are corroborated by diagrams of emotions felt by scene, which indicate a correlation between the intensity of emotions and moments perceived as stressful in the film. An article describing in detail the film production process, the results, and the conclusions obtained are currently being drafted and will be submitted for publication very soon.

In the continuation of the project, methods for measuring emotions as well as data analysis will be enhanced. Hence, a study will be conducted to detect human stress through visual cues. A device capable of capturing thermal and visible facial images at close range during the experimental process will be developed. Additionally, AI-based processing will be implemented to identify a set of parameters associated with stress and automatically detect it.

This paper also underscores the importance of emotional management training for firefighters and other professionals facing similar situations. The results of this study could encourage training institutions to implement emotional regulation-focused training programs, utilizing immersive and multisensory technologies to better prepare individuals for emotional challenges encountered in the field. Lastly, the generalization of the results of this study could also provide insights into emotion management in other professions where human and emotional stakes are significant, thereby contributing to an overall better handling of stress in emotionally demanding occupations.

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