

Haptic Suits in Emergency Professional Training: Enhancing User Experience and Stress Assessment

Nicolás Carrillo Ana; Pons Claramonte Manuel; López López Carmen Amalia; Expósito Orta Francisca; Pardo Ríos Manuel; Nieto Caballero Sergio; Fois Gonzalez Vanessa

Abstract

Emergency situations, particularly during cardiopulmonary resuscitation (CPR), often involve special circumstances that require adherence to specific clinical guidelines. One such circumstance is accidental hypothermia, defined as a core body temperature below 35 °C. As these scenarios are relatively infrequent depending on the region, emergency professionals require targeted training not only to manage the clinical situation but also to cope with the stress experienced during these events. Virtual reality (VR) and emerging technologies such as haptic suits enable the replication of complex and demanding scenarios, providing immersive and realistic training environments. This study evaluates the impact of haptic suit technology on usability, user experience, and stress levels during CPR training among emergency professionals.

Introduction

Emergency medical training must prepare professionals for rare but high-risk scenarios that demand rapid decision-making under pressure. Accidental hypothermia during cardiac arrest represents one such situation, requiring modifications to standard resuscitation protocols. Given the limited exposure to these cases in real clinical practice, simulation-based training becomes essential. Previous research has highlighted the role of emotional and physiological stress in emergency performance and learning outcomes. In this context, virtual reality training enhanced with haptic feedback may offer more immersive and realistic experiences, potentially improving learning effectiveness while mitigating stress responses.

Aim

The primary aim of this study was to evaluate user experience, usability, and stress levels among emergency professionals during CPR training sessions incorporating haptic suit technology. By integrating subjective usability assessments with physiological stress measurements, the study sought to determine whether haptic feedback enhances training effectiveness and professional well-being.

Method

The pilot phase of the study included 80 emergency responders who were randomly assigned to two groups. Both groups participated in the same virtual reality training experience; however, one group completed the training while

wearing a haptic suit, whereas the control group trained without haptic feedback. Training sessions were conducted over a three-month period.

Usability was assessed using the System Usability Scale (SUS). To measure physiological stress responses, saliva samples were collected from participants immediately before and after the training sessions to analyze changes in alpha-amylase levels, a biomarker associated with acute stress. In addition, perceived stress levels were evaluated using the Polo Stress Perception Questionnaire. Immediate post-training feedback was collected to assess participants' subjective perceptions of realism, stress, and overall experience.

Results

Participants who trained with the haptic suit reported significantly higher usability scores compared to those in the traditional training group. The average SUS score for the haptic suit group was 78 out of 100, indicating good usability and a more positive user experience. Biochemical analysis of salivary alpha-amylase revealed a marked reduction in stress levels following training sessions with haptic suits, in contrast to the increase observed in the control group.

Furthermore, participants using the haptic suit reported a heightened perception of realism in the training scenarios. This enhanced sense of realism was associated with lower levels of post-training stress, suggesting a beneficial relationship between immersive multimodal feedback and stress regulation.

Preliminary findings from a future comparative project examining VR alone versus VR combined with a haptic suit suggest that haptic technology leads to more extensive and complex neural activation. This increased bilateral activation indicates a more holistic integration of visual, tactile, and proprioceptive information, potentially resulting in a stronger sense of presence and deeper emotional and cognitive engagement with the simulated emergency scenario.

Discussion

The results indicate that integrating haptic suits into emergency CPR training enhances both usability and user experience while simultaneously reducing stress responses. The multimodal nature of haptic feedback appears to promote more immersive learning, allowing trainees to process simulated situations in a manner closer to real-life experiences. Reduced stress levels, as evidenced by physiological biomarkers, may contribute to improved learning outcomes and better preparedness for real emergency situations.

Conclusions

The integration of haptic suits into CPR training for emergency responders significantly improves usability and user experience while reducing participant stress, as demonstrated through both subjective assessments and biochemical markers. This advanced training methodology supports a more effective and

psychologically sustainable learning environment by realistically simulating emergency scenarios without increasing the psychological burden on trainees. These findings support the broader adoption of haptic technology in emergency training programs to enhance both professional performance and well-being.

Acknowledgements

This work was conducted by the Health Sciences and New Technologies Research Group at the Universidad Católica de Murcia (UCAM), Spain.

Contact Information

Manuel Pardo Ríos, PhD

Health Sciences and New Technologies Research Group
Universidad Católica de Murcia (UCAM), Spain
Email: mpardo@ucam.edu

References

- Lott C. et al. European Resuscitation Council Guidelines 2021: Cardiac arrest in special circumstances. *Resuscitation*. 2021;161:152–219.
- Paal P. et al. Accidental Hypothermia: 2021 Update. *International Journal of Environmental Research and Public Health*. 2022;19(1):501.
- Pons Claramonte M. et al. The stress experienced in an emergency medical service (EMS): A descriptive study. *International Emergency Nursing*. 2024;74:101450.
- DeMaria S. Jr. et al. Adding emotional stressors to training in simulated cardiopulmonary arrest enhances participant performance. *Medical Education*. 2010;44(10):1006–1015.
- Valentin B. et al. Cortisol and alpha-amylase as stress response indicators during pre-hospital emergency medicine training. *Scandinavian Journal of Trauma, Resuscitation and Emergency Medicine*. 2015;23(1):31.
- Polo A. et al. Assessment of academic stress in university students. *Ansiedad y Estrés*. 1996;2(2–3):159–172.