

Improving Effectiveness of Cyber Crisis Management Trainings: Lessons Learned from an Exploratory Study Assessing Immersion, Cognitive Load, and Situation Awareness

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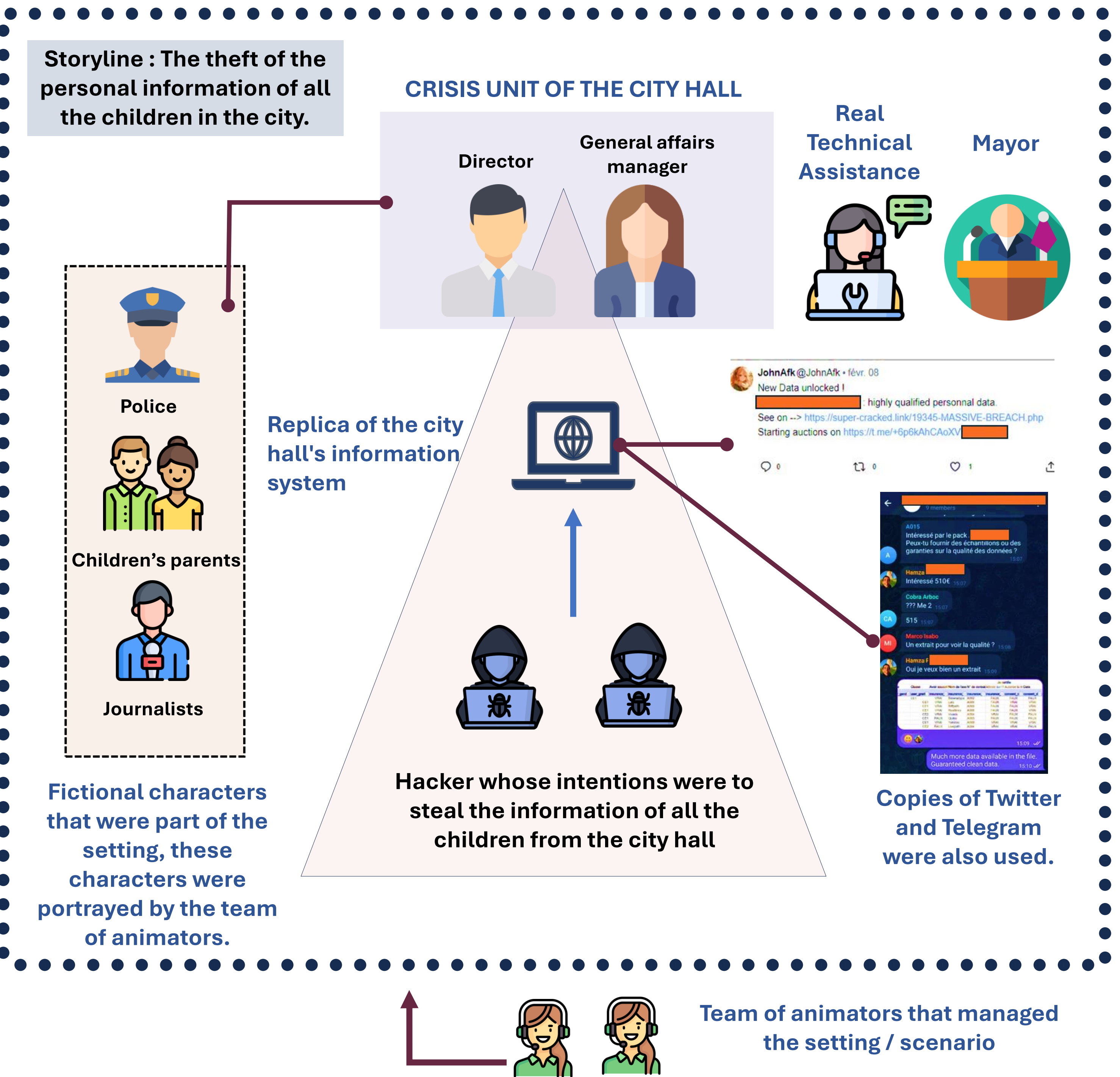
CONTEXT OF RESEARCH

- 1 Cybersecurity threats are becoming a prevalent risk in our societies. Today's risk of a cyber crisis is particularly high due to many organizations' reliance on digital technology.
- 2 This reliance on information systems is growing rapidly, outpacing the level of mastery and maturity needed to manage such threats.
- 3 The RESISTECC project aims to train staff from small businesses and public institutions in France to effectively manage cyber crises through simulated training.

THE OBJECTIVE of this research was to study immersion, presence, cognitive load, and situational awareness during a simulation of a cyber attack involving employees from a city hall located on the west coast of France.

KEY FACT ! The simulation was conducted using a CYBER RANGE, a platform that allows the creation of a replica of an information system—in this case, the city hall's information system.

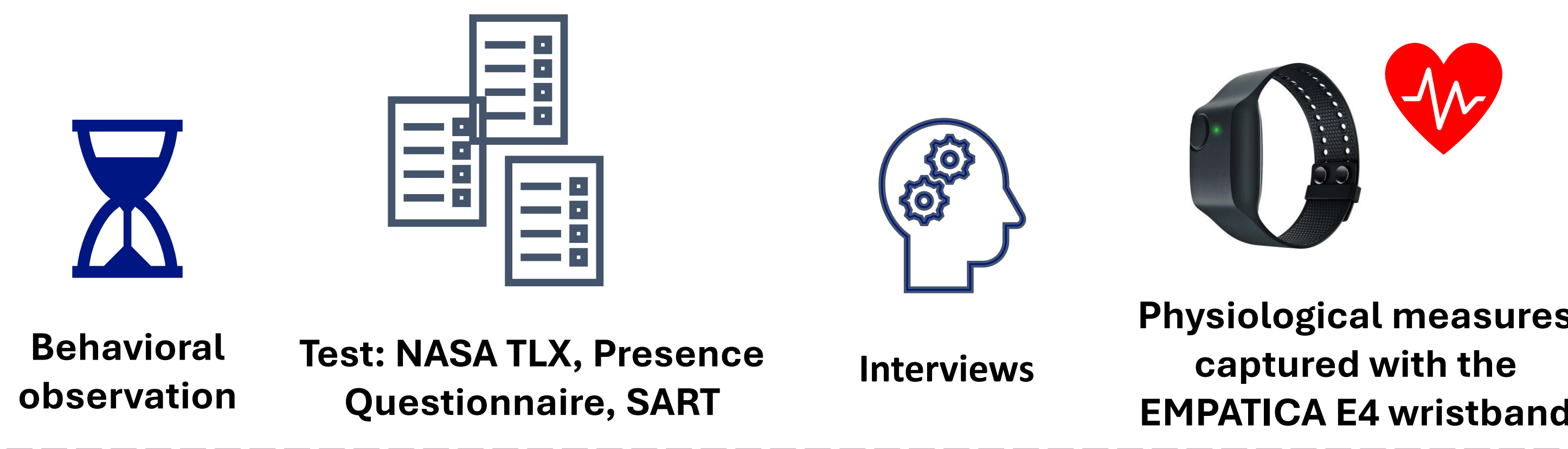
CYBER RANGE & SCENARISATION



VARIABLES & MEASURES

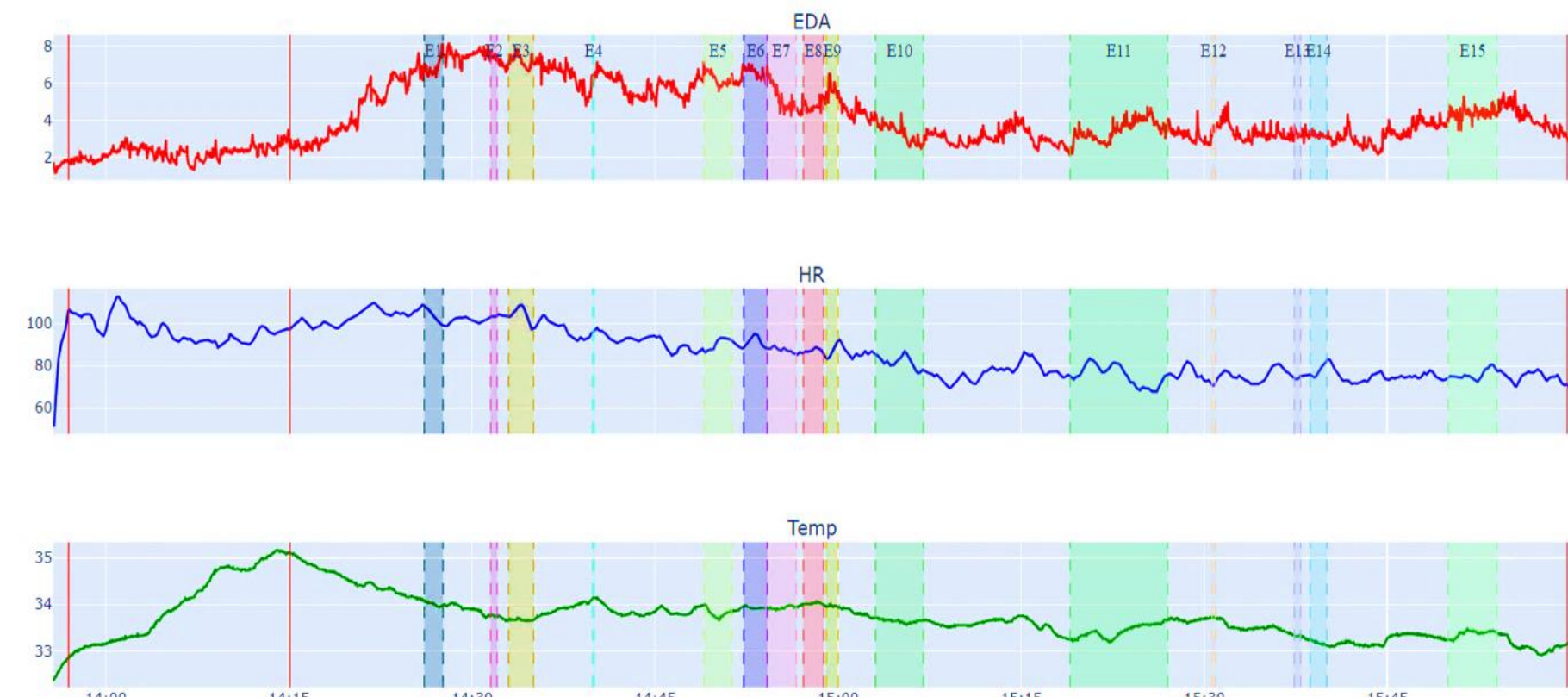
- Immersion** is a state of deep mental involvement during which the individual's cognitive processes cause a shift in their state of attention, allowing them to experience a dissociation from awareness of the physical world [1].
- Presence** is defined as the perception of being there, and it can be understood that this state precedes the state of immersion. Presence is defined as a perceptual flow that demands the direct attention of the individual [2].
- Situation awareness**: a hierarchical process divided into three levels: perception, comprehension, and projection [3].
- Cognitive load**: is a framework for optimizing complex learning. It is based on models of human cognitive architecture and information processing [4,5]
- The interest in studying these three variables is based on the hypothesis that the injection of realistic but fictional stimuli in simulations enhances immersion, presence, and cognitive processing, improving situational awareness and learning. However, it also increases cognitive load, which can reduce the ability to process information, leading to a decline in situational awareness and learning [6]**

Method :



MAIN RESULTS

- The participants' behavior and their reactions to the injected stimuli were not as anticipated by the facilitators, and this factor influenced the overall development of the exercise.
- The participants required a considerable amount of time to familiarize themselves with the elements of the cyber range (a replica of the system/information infrastructure) as well as the components of the setting.
- The director perceived higher levels of mental demands, effort, and frustration compared to his colleague, the General Affairs Manager. This can be explained by the fact that the director was responsible for making all the decisions, while the manager was tasked with executing them.
- Although the participants exhibited high levels of vigilance, concentration, and alertness, they were unable to identify the attack in time or discern the methods used by the hacker and their intentions. This indicates a weakness in situational awareness on their part.



DISCUSSION

- This exploratory and pilot study allowed us to realize that:
- The key importance of the initial stimuli lies in their role in the correct development of the scenario and in achieving the proposed pedagogical objectives. The stimuli must always be prepared with consideration of how the participants will perceive them.
 - The simulation engaged the cognitive resources of the participants, but it was primarily the elements inherent to the construction of the scenario that contributed to increasing the participants' mental load. **In response to this, we propose that extraneous cognitive load (irrelevant load) can be categorized into passive sources (features of the scenario design) and active sources (introduction of stimuli intended to overload the participants).**
 - Finally, regarding immersion, it was observed that, at times, participants were highly concentrated on their roles. However, there were instances when they 'broke character' due to issues with the equipment, the context, or their various interactions.

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