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Key Principles Involving Ethical and Deontological Issues in Military Stress Management Training in Virtual Reality Environments

Paulo Veloso Gomes, Ana Vianez, Henrique Curado, António Marques, and Javier Pereira

LabRP/CIR, ESS, Polytechnic of Porto, Porto, Portugal
CITIC Research Center, University of A Coruña, A Coruña, Spain
Correspondence: velosogomes@ess.ipp.pt

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Abstract: The integration of Virtual Reality in military contexts, which simulates realistic combat and high-risk operational scenarios, provides a controlled environment for developing various skills and psychological resilience. This technology has proven to be a valuable tool for enhancing soldiers' training and preparedness. The creation and use of VR programs, especially those involving the collection of biofeedback data to study military stress, carry significant ethical and deontological responsibilities. This study examines the regulation of using powerful algorithms to analyse biofeedback data to study military stress, emphasizing informed consent, privacy and confidentiality, beneficence and nonmaleficence, transparency in data usage and compliance with legal and regulatory standards.

1 Introduction

The Military Interactive Multisensory Model for immersive environments, which integrates biofeedback mechanisms, offers several key advantages while also raising significant ethical and deontological concerns. One of the primary benefits is the creation of highly realistic simulations that engage multiple senses like sight, sound, touch and smell, enabling military personnel to train for complex, high-stress scenarios in a controlled and safe environment. By incorporating biofeedback, this model allows real-time monitoring of physiological responses, such as heart rate, stress levels, and cognitive load, giving trainers insight into a soldier's mental and physical state during training. This data can be invaluable for optimizing performance, improving stress resilience, and tailoring training programs to individual needs.

However, the collection and use of such sensitive physiological data also come with ethical responsibilities. Issues surrounding informed consent, privacy, and data security are paramount, as soldiers must be fully aware of how their data is being collected, stored, and utilized. Ensuring confidentiality is crucial to prevent misuse or unauthorized access to personal health data. Additionally, principles of beneficence and nonmaleficence must guide the use of biofeedback technologies, ensuring that the information gathered is used to improve well-being and performance without causing harm or undue stress to trainees. The transparency of data usage and compliance with legal and regulatory frameworks are also essential to uphold ethical standards.

Furthermore, the integration of biofeedback in training must balance fairness and justice, ensuring that the data-driven adjustments do not favor certain individuals or groups unfairly,

and that the use of this technology is inclusive and equitable. Continuous monitoring and support are required to mitigate any negative impacts, especially given the potential psychological pressures inherent in military training environments.

The creation of Virtual Reality (VR) scenarios for military applications (Figure 1) involves significant ethical considerations and adherence to deontological principles to ensure the integrity and well-being of military personnel Harris et al. (2023b). Specialists who design these programs are morally obligated to develop simulations that enhance training and preparedness while fundamentally respecting universal ethical standards. When considering military stress and the collection of biofeedback data, several critical ethical considerations must be comprehensively addressed within the context of military ethics and deontology in VR program development Forester-Miller and Davis (2016).

Figure 1 - Virtual Reality Interactive Multisensory Model for Military Training.

Ethics and deontology are crucial in safeguarding the integrity of the military personnel involved in the development and implementation of these programs. This is particularly important given the sensitive nature of biofeedback data, which includes physiological metrics such as heart rate, skin conductance, and brain activity Mehlman and Li (2014).

The growing use of VR training in the military necessitates a balanced approach that prioritizes both innovation and ethical conduct. This is crucial because VR simulations can have a significant impact on soldiers' mental and physical well-being. To address this, the U.S. Department of Defense (DoD) and the UK Ministry of Defence (MoD) have implemented rigorous ethical guidelines that emphasize informed consent, data protection, and transparency Lin (2010)Harris et al. (2023a). Similarly, NATO's Human Factors and Medicine (HFM) Panel plays a vital role in ensuring compliance with international ethical standards for VR military training Harris et al. (2023a). A leader in this field is the U.S. Army Research Laboratory (ARL) Taran (2019). Their unwavering commitment to ethical research is evident in their robust Human Research Protection Program (HRPP) Hoffman et al. (2013). This program ensures informed consent by fully briefing soldiers on the purpose of VR training studies, potential risks, and data handling practices. This transparency is particularly important within the military hierarchy Taran (2019)Hoffman et al. (2013). Beyond ethical considerations, the U.S. ARL actively contributes to advancements in VR with tangible benefits for soldiers. For instance, their VR Battle Stress Inoculation Training program helps soldiers with Post-Traumatic Stress Disorder (PTSD) Rizzo et al. (2005). Additionally, the ARL's VR Language and Cultural Training for Peacekeeping Missions further exemplify their commitment to both innovation and ethics. Soldiers immersed in virtual environments practice communication and cultural understanding in foreign language scenarios, leading to an increase in cultural competency and promoting more effective peacekeeping operations Bailenson et al. (2008).

2 Methods

An exploratory research was made to provide a theoretical foundation for identifying key principles involving ethical and deontological issues in military stress management training within VR environments, a qualitative methodology was adopted to gather in-depth insights. The

study began with a comprehensive literature review, analyzing existing frameworks and studies on the ethical concerns of using VR in military contexts to provide a theoretical foundation for identifying the key ethical principles. Following the literature review, semi-structured interviews were conducted with experts in military ethics, VR technology, and biofeedback integration, as well as military personnel who had participated in VR-based training programs. The interview questions were designed to explore the participants' perspectives on the ethical challenges posed by VR's capacity to simulate high-stress scenarios and its use of biofeedback data.

3 Results

Institutions such as the United States Department of Defense (DoD), the United Kingdom Ministry of Defence (MoD), NATO, and the U.S. ARL (Table 1) have embraced ethical principles to guide the integration of VR into their military training programs. These principles are essential for ensuring the responsible and ethical use of VR technologies, particularly concerning training effectiveness and the well-being of military personnel Lin (2010).

Table 1 - Institutions and Their Commitment to Ethics in VR Military Research.

Institution	Focus Area	Consideration
U.S. Department of Defense (DoD)	Data Governance	Establishes robust data governance practices to ensure the responsible and ethical use of biofeedback data collected from soldiers during VR training and stress analysis studies. This includes comprehensive informed consent procedures, stringent data security measures, and clear data handling policies.
United Kingdom Ministry of Defence (MoD)	Privacy & Security	Prioritizes the protection of participant privacy and the confidentiality of biofeedback data collected in VR training programs. This involves adhering to stringent data protection regulations, employing independent data protection officers, and providing regular training to VR facilitators on data privacy practices.
NATO Human Factors and Medicine (HFM) Panel	Inclusivity & Support	Promotes fairness, transparency, and ongoing support for all military personnel involved in VR training programs across member nations. This entails establishing impartial selection criteria, ensuring cultural appropriateness and accessibility, and providing psychological support and debriefing opportunities.
U.S. Army Research Laboratory (ARL)	Rigorous Oversight	Enforces strict adherence to ethical guidelines through its Human Research Protection Program (HRPP) to safeguard the rights and well-being of participants in VR research studies. This includes mandatory IRB approval, regular audits of research practices, and training on ethical principles for researchers.

The integration of VR in military contexts has proven to be a valuable tool for enhancing training and preparedness among soldiers. VR can simulate realistic combat and high-risk operational scenarios, providing a controlled environment for developing various skills and psychological resilience Rizzo et al. (2012). The creation and use of such VR programs, especially those involving the collection of biofeedback data to study military stress, come with significant ethical and deontological responsibilities. To comprehensively and cohesively address these responsibilities, it is necessary to focus on several key principles: informed consent, privacy and confidentiality, beneficence and nonmaleficence, fairness and justice, transparency in data use, ongoing monitoring and support, and legal and regulatory compliance (Table 2) Gelling (1999).

Table 2 - Descriptive characteristics = Key Ethical and Deontological Principles.

Key Ethical and Deontological Principles	Ethical Principle	Consideration	Challenges
Informed Consent	Autonomy	Military personnel must be fully informed about the nature of the VR simulations, the type of biofeedback data being collected, the purposes of the data collection, and any potential risks involved. This includes detailing how the data will be used, stored, and protected.	Ensuring informed consent can be complex in hierarchical structures where there might be implicit pressure to participate.
Privacy and Confidentiality	Respect for Privacy	The collection of biofeedback data, which includes sensitive physiological information, requires stringent measures to protect participant confidentiality. Data must be anonymized and encrypted to prevent unauthorized access.	Implementing robust cybersecurity measures to secure data storage and transmission in compliance with laws like the Health Insurance Portability and Accountability Act (HIPAA).
Beneficence and Nonmaleficence	Beneficence (doing good) and Nonmaleficence (avoiding harm)	VR programs should be designed to maximize benefits, such as improved stress management and training outcomes, while minimizing potential harms like increased anxiety or simulator sickness.	Balancing realistic combat simulations with the risk of inducing psychological distress, and ensuring that the physical setup of VR systems does not cause discomfort or injury.
Fairness and Justice	Justice	Ensuring that all soldiers have equitable access to the benefits of VR training and stress analysis pro-grams. It is also important to ensure that the burdens and risks are distributed fairly and that no group is disproportionately exposed to harm.	Avoiding biases in the selection of participants and ensuring that marginalized groups within the mili-tary are not excluded or disproportionately affected.
Transparency in Data Use	Transparency	Participants should be clearly informed about how their biofeedback data will be used, including any potential secondary uses for research or training improvements.	Maintaining clear communication about data policies and obtaining explicit consent for any additional uses of the data.
Ongoing Monitoring and Support	Duty of Care	Continuous monitoring of participants during VR sessions to identify and mitigate adverse reactions promptly. Providing psychological support during and after sessions is critical.	Ensuring adequate resources and support systems are in place to respond to any issues that arise.
Legal and Regulatory Compliance	Compliance	Adhering to relevant legal and regulatory frameworks, such as those set by the American Psychological Association and data protection laws..	Navigating the complex regulatory environment, especially when integrating VR with telehealth and other technologies.

Informed consent is a fundamental ethical principle that upholds the autonomy of military personnel participating in VR simulations. Ensuring that participants are fully informed about the nature of the study, the types of biofeedback data being collected, and the potential risks involved is crucial. This comprehensive information helps mitigate implicit pressure within the hierarchical military structure, supporting voluntary and informed participation Parasidis (2016).

Respecting privacy is another critical principle, particularly when the target audience includes military personnel. Safeguarding confidentiality through anonymization and encryption of data prevents unauthorized access and misuse. This protection is essential for maintaining trust between researchers and participants Wasilow and Thorpe (2019).

The principle of non-maleficence, as outlined in the ethical codes of both the American Psychological Association (General Principle A) and the British Psychological Society, is pivotal in guiding the development of effective VR programs American Psychiatric Association (2013). In addition to concerns about manipulating empathy and inducing extreme emotions, VR's capacity to potentially inflict intense suffering raises profound ethical issues. Even when participants intellectually acknowledge they are in a virtual environment, the transparent emotional layers of the human self-awareness model suggest that the suffering experienced can feel genuine. Research indicates that powerful emotional responses can occur despite participants' awareness of the virtual setting Madary and Metzinger (2016). The ability of VR to elicit profound emotional experiences has significant implications for ethics and participant safety. The risk that such experiences could escalate to levels akin to torture necessitates meticulous caution. Upholding the principles of beneficence and non-maleficence is crucial for researchers designing VR programs to ensure they maximize benefits while minimizing potential harm. This approach maintains stringent ethical standards and prioritizes the well-being of participants Meehan et al. (2002).

Justice demands that all soldiers have equitable access to the benefits of VR training and

stress analysis programs. Ensuring fairness in participant selection avoids biases and promotes inclusivity, enhancing the validity and generalizability of the study's findings. This principle helps prevent the marginalization of vulnerable groups within the military, ensuring that no group is disproportionately exposed to risks or excluded from the advantages of the research NATO (2023).

Transparency in data use is vital for upholding trust and ethical standards in research, bolstering public confidence and the credibility of research efforts. Participants need clear explanations regarding the utilization of their biofeedback data, including potential secondary applications for research or improvements in training. Transparent data policies are essential to safeguard against misuse and to honor participants' rights and expectations Metzinger (2004).

Ongoing monitoring and support are essential components of the duty of care. Continuous monitoring during VR sessions allows for the prompt identification and mitigation of adverse reactions Zhang (2020). Psychological support during and after sessions ensures that participants' well-being is prioritized. Adequate resources and support systems must be in place to address any issues that arise, enhancing the safety and ethical integrity of the research Riva et al. (2019).

Finally, adhering to relevant legal and regulatory frameworks is essential for maintaining the legitimacy and accountability of the research. Compliance with regulations set by bodies such as the American Psychological Association and data protection laws ensures that the research is conducted within established ethical and legal boundaries. Navigating the regulatory environment, especially when integrating VR with other technologies, is crucial for avoiding legal repercussions and ensuring that ethical standards are upheld throughout the study Madary and Metzinger (2016).

4 Discussion

A responsible construction of VR programs demands a strong focus on ethics. As VR becomes increasingly embedded in the human mind, not only do new technological advancements emerge, but also unprecedented ethical and legal challenges Westerhoff (2016). The interaction between the biological mind and the technological environment creates a complex intertwining of mutual influences, requiring a careful approach based on solid ethical principles Hohwy (2013). It is crucial that the development of VR for military applications deeply considers the psychological impacts, ensuring the well-being of users and respecting the highest ethical standards O'Brolcháin et al. (2016).

By adhering to these ethical and deontological principles, VR programs for studying military stress through biofeedback data collection can be both effective and ethically sound Madary and Metzinger (2016). These principles guide researchers in creating simulations that respect participants' rights, enhance training outcomes, and uphold the highest standards of ethical practice. This comprehensive ethical framework is indispensable for advancing our understanding and managing military stress while ensuring the integrity and well-being of the individuals involved Madary and Metzinger (2016) Borghini et al. (2017).

5 Conclusion

While the Military Interactive Multisensory Model presents transformative potential for enhancing the realism and effectiveness of training, its implementation must be meticulously managed to adhere to stringent ethical standards. Ensuring that training aligns with core ethical principles is essential to safeguarding the rights and well-being of participants. These principles include obtaining informed consent to ensure that participants fully understand the nature and risks of the training, as well as guaranteeing privacy and confidentiality, particularly regarding the sensitive biofeedback data collected during the training. Upholding beneficence and nonmaleficence requires ensuring that the training promotes well-being and does not cause undue

harm, while fairness and justice ensure equal treatment and access to training opportunities. Transparency in data usage is critical, particularly in how physiological data is analyzed and utilized, and ongoing monitoring and support are necessary to address any psychological or physical effects that may arise from participation. Finally, strict legal and regulatory compliance is paramount to ensure that the program operates within the bounds of existing ethical frameworks and military regulations. Thus, while the model offers significant advantages, careful attention to ethical considerations is vital for responsible implementation.

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