First RespondXR: Digital vulnerability of immersive training for first responders

NIAMH HEALY, University College London, UK

MARINA HEILBRUNN, County Court Advocate and Bloomsbury Law Tutors, UK

JILL MARSHALL, Royal Holloway, UK

MARK MCGILL, University of Glasgow, UK

DAVID MCLLHATTON, Coventry University, UK

LENA PODOLETZ, University of Edinburgh, UK

LEONIE TANCZER, University College London, UK

1 INTRODUCTION

Simulations are high-fidelity replications of real scenarios which allow participants to rehearse or practice real-world tasks [10]. Simulations often incorporate technology to help produce and replicate particular environments, such as the use of screens, cameras and microphones to create live events for participants in a training suite [5]. Police training in the United Kingdom has long utilized simulations as a way to train initial recruits [1], deliver regular in-service training [7, 9], and provide more specialist training [6]. Simulations allow participants to learn skills that may be expensive, risky or impractical to train in other ways, and have been demonstrated to improve performance of real-world tasks.

Since 2010 a significant reduction in central funding has coincided with changing trends in crime, creating new challenges for policing in the UK [3]. Police forces have looked to advancing digital technologies to help deal with budgetary and capacity constraints in light of increasing demand [11]. In this context, Extended Reality (XR) applications, including Virtual Reality (VR) and Augmented Reality (AR), have been proposed as an effective, cost-efficient way to deliver simulation training for police officers [12]. Rather than run simulations within physical settings using actors and live equipment, police forces and academic researchers have explored using computer-generated virtual environments, typically accessed via a head-mounted device (HMD), to create immersive, interactive training for participants. Within the UK, several police forces have already implemented XR training applications for a variety of purposes, including for weapons instruction [8], de-escalation training (e.g. in the context of domestic abuse) [2], and developing interpersonal skills, for example, increasing empathy amongst officers responding to hate crimes [4]. However, in the rush to exploit the benefits of XR for immersive training, there has been a lack of consideration of the potential vulnerabilities that XR training for police may present for individual police officers, police forces themselves and wider society.

In response to this, our project, First RespondXR, funded through SPRITE+ [1], maps the vulnerability space associated with the use of XR for police training from the perspective of (a) those delivering the training, (b) the first responders

Authors' addresses: Niamh Healy, niamh.healy@ucl.ac.uk, University College London, Gower St, London, UK, WC1E 6BT; Marina Heilbrunn, County Court Advocate and Bloomsbury Law Tutors, Bristol, UK, mheilbrunn@hotmail.co.uk; Jill Marshall, Royal Holloway, London, UK, jill.marshall@rhul.ac.uk; Mark McGill, University of Glasgow, Glasgow, UK, mark.mcgill@glasgow.ac.uk; David Mcllhatton, Coventry University, Coventry, UK, ac1376@coventry.ac.uk; Lena Podoletz, University of Edinburgh, Edinburgh, UK, lena.podoletz@ed.ac.uk; Leonie Tanczer, l.tanczer@ucl.ac.uk, University College London, Gower St, London, UK, WC1E 6BT.

who will be undertaking this training, and (c) the technical teams bringing forward new XR-based simulations. We are currently producing a **map of the vulnerabilities** associated with XR training for police to help guide the safe, secure and ethical use of immersive training technology in policing. The intended end-user for this map is decision-makers within police training procurement and the map will consider vulnerabilities related to a wide range of actors, including training participants, police forces, and the public.

2   ABOUT OUR PROJECT

The First RespondXR Project was funded by the SPRITE Hub as part of its virtual sandpit focused on 'digital vulnerabilities'. Our pilot project ran from December 2021 through to March 2022. Our team is multidisciplinary and geographically distributed, situated at five universities distributed across the UK. The disciplines covered by our team span human-computer interaction (HCI), criminology, security, law and gender studies.

We initially pursued three main streams of work. First, we conducted a systematic literature review of existing scholarship on the use of XR for training of police and adjacent professional fields. In this search we including scholarship on training applications for other emergency responders such as the military, firefighters and healthcare professions (including medics, surgeons, nurses and paramedics). Legal researchers within our team additionally conducted a legal review of relevant case law, legislation and other forms of regulations surrounding the use of XR for police training within a UK context. Finally, the technical team conducted a survey of technical risks associated with the deployment of XR systems for training.

From these materials, we have begun to analyse the potential benefits of police training in XR, compared to real-world simulations, and are in the process of compiling what evidence exists for these potential benefits. We have also begun to systematically derive a map of vulnerabilities associated with XR training for police.

In the current iteration of our map, we distinguish between four types of vulnerabilities: Human, Legal, Social, and Technical Vulnerabilities. In Table 1, we have set out the types of information included within our vulnerability map.

Type of vulnerability
Earliest point vulnerability arises
Location of vulnerability
Description of vulnerability
Example scenario
Earliest point at which harm arises
Threat i.e. by who and how the vulnerability is acted on to cause harm
Mitigation
Stakeholder best placed to mitigate
Open Problem / Question
Recommendation
References

Table 1. **Information included within the map of vulnerabilities**

An example vulnerability included in our map is the **psychological susceptibility of training participants**. As VR experiences become increasingly perceptually real, it is likely that XR training can reach a degree of realism that reactions (psychological, physiological) will be as if the experience was interpreted as real. Experience of these events is likely to be retained and VR has been shown to lead to false memory acquisition [13]. Consequently, VR experiences meet the requirements in theory to induce trauma and associated disorders.

3 OUR MOTIVATION

Our motivation to join the workshop is four-fold. First, we would like to share the preliminary research outputs of our project with attendees. We currently have a draft map of the vulnerabilities associated with XR for police training in the UK. Attending the workshop would be a good opportunity to receive feedback on this map and benefit from attendees' expertise and experience in developing and deploying XR systems within training environments. In particular, the workshop would present the opportunity to determine whether there would be appetite to, and utility in, developing a map of vulnerabilities associated with XR training more generally.

Additionally, attending the workshop would allow us to connect with important stakeholders aligned with our project. We are keen to engage with relevant communities including police officers, police trainers, other representatives of police forces and similar public services, representatives from industry and academic colleagues. Forming these connections allows us to directly share the outputs of our project as well as align our future work to the most pressing and important needs of our stakeholders. Connecting with stakeholders will also allow us to stress-test our findings and compare them with aligned research happening across the globe.

We are also eager to learn from our fellow attendees. Our research predominantly touches upon preventing problems and errors associated with XR. Attendance of the workshop would allow us to observe what solutions are currently being proposed to some of the vulnerabilities we have identified.

Finally, the impetus behind our project is that while XR may offer significant benefits when deployed for training, there are also vulnerabilities that must be considered and accounted for when deploying these systems. We are keen to ensure this perspective is included in the research agenda that will be released following the workshop.

4 OUR CONTRIBUTION TO THE WORKSHOP

As noted above, at the workshop we intend to discuss the map of vulnerability associated with XR training in policing that we are currently compiling. Along with this map, we can also contribute the findings of our systematic review of XR training for police, particularly our examination of the evidence of XR's training benefits, as well as specific observations around the UK context to police training. Niamh Healy, the Research Assistant for the project, is interested in attending along with, subject to availability, Dr Mark McGill, one of the project's Co-Investigators.

5 CLOSING THOUGHTS

While XR simulations may offer considerable benefits and improvement on real-world training offerings, XR training for police may produce unanticipated vulnerabilities that are currently not considered or accounted for when developing and implementing this technology. If police and similar services rush to adopt XR training without considering potential vulnerabilities, this could put officers and members of the public at risk as a result of faulty or flawed training, consequently undermining public confidence in policing. To fully realise the benefits of XR training, there must be appreciation of associated vulnerabilities.

REFERENCES

[1] 2018. The Hydra Foundation Community. https://www.hydrafoundation.org/international-hydra

[2] 2018. Police use virtual reality to help tackle domestic abuse. *BBC News* (Feb. 2018). https://www.bbc.co.uk/news/av/uk-wales-43121253

[3] 2019. Police - Performance Tracker 2019. https://www.instituteforgovernment.org.uk/publication/performance-tracker-2019/police#:~: text=The%20police%20in%20England%20and,in%20funding%20from%20central%20government.&text=In%202018%2F19%2C%20%C2%A313.3, uptick%20in%20the%20last%20year.

[4] 2021. Greater Manchester Police officers given virtual reality training around hate crime. *ITV News* (Aug. 2021). https://www.itv.com/news/ granada/2021-08-18/gmp-officers-to-virtual-reality-training-around-hate-crime

[5] 2021. Hydra Training for Custody Staff – ICVA Observes…. https://icva.org.uk/hydra-training-for-custody-staff-icva-observes/

[6] Laurence Alison, Claudia van den Heuvel, Sara Waring, Nicola Power, Amy Long, Terence O'Hara, and Jonathan Crego. 2013. Immersive Simulated Learning Environments for Researching Critical Incidents: A Knowledge Synthesis of the Literature and Experiences of Studying High-Risk Strategic Decision Making. *Journal of Cognitive Engineering and Decision Making* 7, 3 (Sept. 2013), 255–272. https://doi.org/10.1177/1555343412468113 Publisher: SAGE Publications.

[7] Christopher J Cushion. 2020. Exploring the Delivery of Officer Safety Training: A Case Study. *Policing: A Journal of Policy and Practice* 14, 1 (March 2020), 166–180. https://doi.org/10.1093/police/pax095

[8] Derbyshire Constabulary. 2020. Derbyshire police trialling cutting edge virtual reality training tool. https://www.derbyshire.police.uk/news/ derbyshire/news/news/forcewide/2020/august/derbyshire-police-trialling-cutting-edge-virtual-reality-training-tool/

[9] Laura Huey. 2018. What Do We Know About In-service Police Training? Results of a Failed Systematic Review.

[10] F. Lateef. 2010. Simulation-based learning: Just like the real thing. *Journal of Emergencies, Trauma and Shock* 3, 4 (2010), 348–352. https: //doi.org/10.4103/0974-2700.70743

[11] National Police Chiefs' Council and Association of Police and Crime Commissioners. 2016. Policing Vision 2025. https://www.npcc.police.uk/ documents/Policing%20Vision.pdf

[12] Q. Nguyen, E. Jaspaert, M. Murtinger, H. Schrom-Feiertag, S. Egger-Lampl, M. Tscheligi, Ardito C, Lanzilotti R, Malizia A, Malizia A, Petrie H, Piccinno A, Desolda G, and Inkpen K. 2021. Stress Out: Translating Real-World Stressors into Audio-Visual Stress Cues in VR for Police Training. *18th IFIP TC 13 International Conference on Human-Computer Interaction, INTERACT 2021* 12933 (2021), 551–561. https://www.scopus.com/inward/record.uri?eid=2- s2.0-85115272274&doi=10.1007%2f978-3-030-85616-8_32&partnerID=40&md5=2a15c3b07d6909302b970a6b8c688dc6 Place: ["AIT Austrian Institute of Technology, Vienna, 1210, Austria", "University of Salzburg, Salzburg, 5020, Austria", "KU Leuven, Leuven, 3000, Belgium", "USECON GmbH, Vienna, 1010, Austria"] Publisher: Springer Science and Business Media Deutschland GmbH.

[13] Kathryn Y. Segovia and Jeremy N. Bailenson. 2009. Virtually True: Children's Acquisition of False Memories in Virtual Reality. *Media Psychology* 12, 4 (Nov. 2009), 371–393. https://doi.org/10/cp9rfc Publisher: Routledge _eprint: https://doi.org/10.1080/15213260903287267.