The Canaries' Experience: saving lives through a true events based virtual reality experience a multidisciplinary approach using avatars in suicide prevention and intervention

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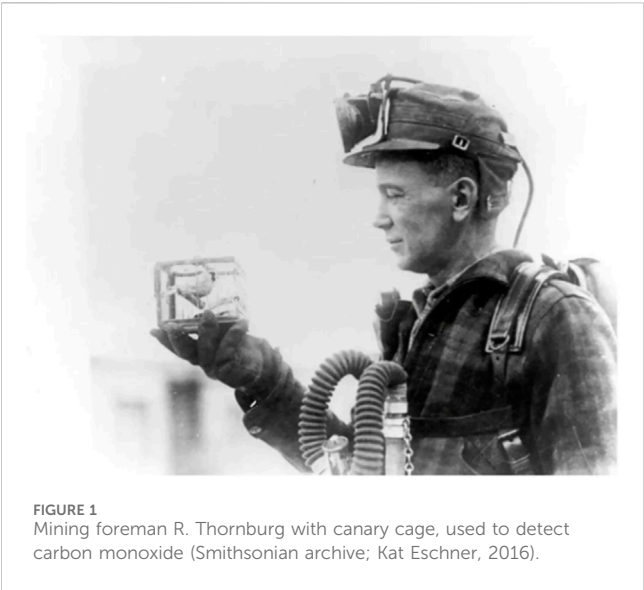
This paper outlines the conceptual foundation of *The Canaries' Experience*, a PhD research project at Liverpool John Moores University focused on the development and evaluation of immersive technology for preventive mental health interventions. The project forms part of a broader interdisciplinary initiative that integrates artificial intelligence, virtual reality, immersive storytelling, and spatial audio to deliver personalised therapeutic experiences. Targeting individuals at risk of self-harm and suicide particularly in high-risk or isolated, confined, and extreme (ICE) environments it aims to enable early detection and mitigation of psychological distress. Situated at the intersection of mental health, digital therapy, and narrative design, the initiative highlights the potential of scalable, integrated approaches to enhance psychological resilience and promote cross-sector collaboration.

KEYWORDS

virtual reality, suicide prevention, ice, artificial intelligence, game, story telling, telltales, isolation

Introduction

Creative Premise: Imagine a world where hidden distress is as detectable as a gas leak: small, early signals trigger timely support before crises escalate (see Figure 1). Just as canaries once warned miners of invisible danger, modern sensing and narrative technologies can surface concealed distress among young adults and other vulnerable groups (Zhang and Wang, 2024). Physiological sensing and Zhang's pilot of behavioural feedback systems, extends into a poetic yet actionable vision: which may render legible through ambient data, that could prompt care before collapse. Immersive technologies such as virtual reality (VR) further expand this vision, offering embodied simulations and therapeutic environments that could surface emotional states and rehearse coping strategies in safe, responsive spaces (Schloss et al., 2025). Emerging research in youth mental health and AI-enabled early intervention highlights the urgency of such models, particularly for

FIGURE 1
Mining foreman R. Thornburg with canary cage, used to detect carbon monoxide (Smithsonian archive; Kat Eschner, 2016).

TABLE 1 Psychological effects of prolonged isolation, confinement, and extreme conditions.

Duration (months)	Positive emotions (%)	Negative emotions (%)
0	80	20
3	60	40
6	50	50
9	40	60
12	30	70

Data sources: University of Houston (2021); Sandal et al. (2006); Leonard (2023).

TABLE 2 Summarises comparative effectiveness across four configurations.

Intervention	Engagement (1–10)	Emotional recovery (1–10)	Source
VR alone	6	5	Freeman et al. (2017)
VR + spatial audio	8	7	Sphere of Sound (2025)
VR + AI	7	6	Vrenity (2023)
VR + spatial audio + AI	9	8	Inverse (2025)

VR combined with spatial audio and AI showed the highest levels of user engagement and emotional recovery.

populations underserved by conventional pathways (Marshall et al., 2025; Stiles-Shields et al., 2024).

Suicide remains a major global public health challenge, with over 720,000 deaths annually and more than half occurring before age 50 (WHO, 2023; IASP, 2023). Social isolation and loneliness amplify psychological and physical health risks, contributing to depression, anxiety, cognitive decline, and increased cardiovascular morbidity comparable to other major risk factors (Cain and Callan, 2025; Leal Filho et al., 2019; Owen Taylor et al., 2023; MotillonToudic et al., 2022; CDC, 2023). These harms were intensified by the COVID-19 pandemic and are especially acute in Isolated, Confined, and Extreme (ICE) environments, for example, long duration space missions, polar stations, and prisons, where confinement, monotony, altered light dark cycles, and reduced social contact heighten vulnerability (Alfano et al., 2021; Sandal et al., 2006). Temporal patterns in suicidal behaviour, including afternoon and evening peaks and weekly variations among young adults, further indicate the need for interventions that are both personalised and temporally responsive (Sheikh et al., 2024).

Table 1 summarises affective trends across three studies of prolonged isolation. The University of Houston (2021) provided baseline data from simulated confinement; Sandal et al. (2006) offered longitudinal insights from polar research teams; and Leonard (2023) tracked mood changes in space analogues. All three studies show a steady decline in positive emotions and a rise in negative affect, with a crossover point around 6 months. These metrics informed early co-design workshops, anchoring narrative pacing and escalation thresholds. Participants described the emotional decline as "the quiet slide," a framing that shaped our emphasis on early detection and reversible branching.

Sandal et al.'s study remains foundational for its ICE specificity and its integration of team dynamics and coping strategies. Although published in 2006, its emphasis on relational processes continues to inform contemporary mental health support in confined settings. These insights contributed to the conceptual development of a hybrid care model and avatar system designed to incorporate social presence, guided rehearsal, and escalation pathways. Avatars may be live embodied or adaptive agents, offering relational scaffolding within VR vignettes. Escalation pathways support transitions to human-led care when sustained distress is detected. This approach remains subject to empirical testing and refinement.

In an era when digital technologies enable continuous tracking of physiological and behavioural signals through wearables and mobile applications. VR environments can be used to simulate coping strategies, and AI systems may support early identification of distress by analysing multimodal data (Freeman et al., 2017; Slater and SanchezVives, 2016; Hill and Hollis, 2018). However, existing tools often lack the relational depth of human led therapy and may struggle to deliver narratives that reflect individual psychological dynamics. This study proposes a framework that combines multimodal sensing, adaptive AI, and symbolic VR rehearsal to explore how such technologies might support emotional regulation and timely intervention in low risk, repeatable scenarios.

The Canaries' Experience combines continuous multimodal sensing, adaptive AI, spatial audio, and short narrative VR vignettes that users can rehearse in low risk, repeatable scenarios (see Table 2) (Freeman et al., 2017; Slater and SanchezVives, 2016). The system is deliberately hybrid: lightweight on device models use speech, movement, and wearable signals to update a user's current state, while algorithmic detection and adaptive narratives operate alongside trained facilitators and predefined clinical escalation

pathways to preserve human oversight and ethical accountability (StilesShields et al., 2024; Cushnan et al., 2024).

A practical decision layer treats multiple possible momentary feelings as competing possibilities and selects short, reversible story paths that fit the moment. When sustained signs of elevated risk are detected, the system recommends a safe vignette and flags a facilitator or escalation route. This decision layer is described as "quantum informed": a probabilistic, multihypothesis framework that draws conceptually from quantum cognition a modelling metaphor for representing and updating competing hypotheses about a person's state, not a claim about quantum brain processes (Pothos and Busemeyer, 2013; Busemeyer and Bruza, 2012).

The design aims to support early detection of emotional deterioration, deliver temporally responsive interventions, and reduce pressure on overstretched clinical services in both ICE and community contexts (Sandal et al., 2006; Alfano et al., 2021). Avatars may be live embodied by facilitators or operate as adaptive agents to support scalability (Hollis et al., 2020). Ethical safeguards including informed consent, privacy protection, and clearly defined escalation thresholds are integral to the hybrid model (Torous et al., 2020). To address this need, we propose *The Canaries' Experience* as an interdisciplinary intervention. The following section outlines its theoretical grounding, technological design, and ethical safeguards.

Context and rationale

Despite growing awareness of mental health challenges, many people delay or avoid professional support because of stigma, fear of judgment, or a desire to cope alone, producing delayed interventions and poorer outcomes (Clement et al., 2015). This gap is especially pronounced among high-risk populations and in isolated, confined, and extreme (ICE) settings where services are scarce (see Figure 2), signalling the need for discreet, temporally responsive, and scalable alternatives (Sandal et al., 2006; Alfano et al., 2021).

The Canaries' Experience addresses this need with a quantum informed storytelling architecture that combines AI, immersive VR, spatial audio, and narrative design. Codesigned with people with lived experience and informed by continuous multimodal sensing, the system uses branching, symbolically rich narratives that mirror shifting cognitive–affective states and support self-reflection (Pothos and Busemeyer, 2013; Busemeyer and Bruza, 2012). Lightweight AI analyses behavioural and physiological signals (for example, speech features, movement patterns and heart rate variability) to detect early signs of distress and adapt story trajectories in real time (StilesShields et al., 2024; Dehbozorgi, 2025). Immersive VR and spatial audio provide safe, controlled spaces for rehearsal and resilience training, enhancing presence and emotional engagement (Freeman et al., 2017; Slater and SanchezVives, 2016). Avatars can offer social presence either via live embodiment by trained facilitators or as adaptive agents to support scalability (Hollis et al., 2020). The decision layer is described as quantum informed to indicate a modelling heuristic: it represents multiple competing hypotheses about a user's current state and updates those hypotheses as new data arrive, allowing reversible and ordersensitive narrative branching. This framing draws conceptually from quantum cognition and does not imply

quantum physical processes in the brain (Pothos and Busemeyer, 2013; Busemeyer and Bruza, 2012).

Ethics

Ethical considerations are central to the project's design. The Canaries' Experience involves the collection of original data to support the development and training of machine learning models. All participants are assigned pseudonyms, and data are anonymised at the point of collection to protect privacy and reduce the risk of reidentification. Data storage and processing follow international standards for encryption, access control, and informed consent (WHO, 2023; Dehbozorgi, 2025). This approach allows the research team to code and train models directly on ethically sourced, context specific data, rather than relying on external datasets that may carry bias or lack relevance to ICE and youth mental health settings. By grounding model development in curated, anonymised data, the project aims to reduce the likelihood of AI hallucinations and ensure that outputs remain interpretable, contextually appropriate, and aligned with user experience.

Additional safeguards include user-controlled pacing, the option to disengage at any time, and monitoring for dissociation or distress during pilot testing (Rizzo et al., 2017). These measures are designed to mitigate potential risks associated with immersive technologies and to ensure that ethical principles are not only embedded in the design but also tested in practice.

The study has received ethical approval from the relevant institutional review board, and all procedures involving human participants will be conducted in accordance with established ethical guidelines. Cultural responsiveness is addressed through codesign with individuals from diverse backgrounds, ensuring that narratives and interaction styles reflect a range of lived experiences without imposing uniform assumptions.

The Canaries' Experience: concept and objectives

The Canaries' Experience integrates artificial intelligence, virtual reality, gamification, and digital avatars to explore scalable approaches to suicide prevention, particularly in isolated, confined, and extreme (ICE) environments. The intervention is designed to support early detection, emotional regulation, and therapeutic engagement through immersive, low-risk scenarios. Its core objectives are to:

- Early Detection and Intervention: Investigate how AI can analyse user interactions and physiological signals to identify early signs of distress (Dehbozorgi, 2025; CruzGonzalez et al., 2025).
- Immersive Therapeutic Experiences: Develop gamified VR storytelling using symbolic elements and avatar interactions to support motivation and emotional engagement (Deterding et al., 2011; Slater and SanchezVives, 2016).
- ICE Applications: Tailor interventions to ICE settings by simulating comforting environments and offering structured emotional rehearsal (Smith et al., 2023).

FIGURE 2
Coal mine rescue team briefing, 1961. Ron Case/Keystone Features/Getty Images.

- Multidisciplinary Collaboration: Combine insights from psychology, AI, VR, and narrative design to ensure contextual relevance and practical feasibility.
- Expected Outcomes: Explore potential improvements in user engagement, emotional regulation, and the scalability of suicide prevention tools (Freeman et al., 2017; Cheng and Ebrahimi, 2023).
- Potential Impact: Address post-COVID mental health needs, improve quality of life in ICE environments, and foster collaboration across mental health, technology, and research sectors (Cushnan et al., 2024; Cheng and Ebrahimi, 2023).

Building on these objectives, The Canaries' Experience examines how distinct disciplines may converge to inform a more holistic model of suicide prevention. Artificial intelligence may contribute predictive insights from behavioural and physiological data. Virtual reality offers the potential to simulate immersive therapeutic environments. Cognitive behavioural therapy provides evidence-based strategies for reframing thought patterns, while storytelling activates neural networks associated with empathy and shared understanding (Beck, 2011; Slater and SanchezVives, 2016; Hasson et al., 2012; Hamari et al., 2014). Emotionally charged narratives have been shown to enhance memory retention and engagement through neurochemical responses such as dopamine release (Deterding et al., 2011). Deterding's work on gamification highlights how narrative framing, symbolic rewards, and meaningful choices can increase intrinsic motivation and emotional salience, mechanisms that may support therapeutic engagement when applied to mental health interventions. In ICE environments, storytelling may offer psychological relief by supporting distraction, comfort, and emotional processing (Woods et al., 2025). Narratives grounded in lived experience can foster empathy and understanding, while shared stories within families or clinical settings may reduce anxiety and improve cooperation.

Figure 3 illustrates the effects of storytelling on neural activity and emotional regulation.

Gamification enhances narrative by embedding play, rewards, and interactive scenarios that support motivation, treatment adherence, and retention of therapeutic concepts. Gee (2003) demonstrated how video games embody principles of effective learning including situated meaning, identity exploration, and feedback loops, which continue to inform therapeutic design.

The Canaries' Experience draws on both ludology (game mechanics) and narratology (narrative structure) to explore how interaction and story can foster empathy, agency, and personal growth. Frasca (1999) distinguished games as rule-based systems, while Jenkins (2004) framed them as "narrative architecture," spatial environments that invite story construction through player interaction. These foundational perspectives remain relevant for understanding how games convey meaning beyond linear narrative.

Watson (2016) expanded this by examining how empathy can be designed into game scenes through spatial layout and emotional pacing. More recent studies, such as Cheng and Ebrahimi (2023), highlight gamification's potential to enhance engagement and emotional regulation in mental health contexts, while noting the need for caution around behavioural dependency. A 2024 scoping review by Aschentrup et al., 2024 confirms that gamified digital interventions show promise, though outcomes remain heterogeneous and mechanisms of effect require further study.

Designing experiences with meaningful choices and consequences may further enhance engagement, allowing users to explore the emotional impact of their actions in safe, controlled environments (Cheng, 2020). Together, storytelling and gamification form a therapeutic framework that is conceptually grounded, empirically promising, and suitable for immersive interventions in ICE contexts.

Prototype development

The Canaries' Experience prototype demonstrates how AI and VR can be integrated into mental health interventions. Participants

FIGURE 3
An Infographic showing the effects of storytelling on the brain.

engaged with character scripts and provided feedback through discussion and written notes, generating insights from diverse perspectives (Smith et al., 2023). The research team combined expertise in psychology, scriptwriting, computer science, and suicide prevention, guided by Participatory Action Research (PAR) principles to ensure co-creation and inclusivity (Brown et al., 2025). Narrative techniques such as magical realism, prosopopoeia, and ecocriticism were used to shape immersive environments with emotional resonance. Magical realism was selected for its ability to externalise psychological distress in symbolic yet relatable forms, offering a liminal space for safe emotional processing across cultures (Laws, 2016). Prosopopoeia gave voice to symbolic figures like the canaries, embodying vulnerability and resilience (Benne, 2016). These literary strategies support empathy and translate abstract struggles into emotionally legible forms (Hasson et al., 2012).

The project also employs ecocritical design to link human experience with nature, highlighting environmental influences on mental health (Buell, 1995). Drawing on Warren Spector's principles of player choice and dynamic storytelling, users make meaningful decisions that shape their journey and support personal growth (Backe et al., 2023). To deepen immersion, spatial audio creates a three-dimensional soundscape that enhances realism and supports emotional recovery (Dewey et al., 2024; Shepard, 1994). When combined with VR, AI, and gamification, it produces a multisensory experience that fosters engagement and therapeutic impact. Studies confirm spatial audio's role in modelling sound behaviour and enhancing presence (Koyama et al., 2025; Guglielmi, 2023).

Implementation and future directions

Translating *The Canaries' Experience* from concept to practice requires a pragmatic roadmap that addresses cost, accessibility, and deployment in ICE environments. While high-end VR equipment may be prohibitive, mobile-based platforms have shown promise in delivering therapeutic outcomes at lower cost (Smith et al., 2023). Partnerships with organisations such as NASA, polar research stations, and humanitarian agencies will be essential for testing feasibility in real-world ICE contexts (Alfano et al., 2021; Sandal et al., 2006).

Accessibility in ICE settings requires tailoring to operational constraints, team dynamics, and wellbeing protocols (Nezami, 2025). Broader community deployments will demand cultural adaptation to ensure relevance across diverse populations (Chu and Leino, 2017). To reduce barriers, the project adopts open-source development principles and cross-sector collaboration, aiming for integration into existing health infrastructures (Hollis et al., 2020).

Given the resource constraints of ICE environments, the system prioritises lightweight, mobile-based VR platforms, edge AI processing to reduce reliance on cloud connectivity, and intermittent biosensor monitoring. These adaptations balance therapeutic effectiveness with the practical limitations of austere settings such as polar stations or long-duration spacecraft.

A structured validation pathway will guide implementation. Small-scale pilot studies in analogue ICE environments (e.g., polar stations, space simulations, clinical VR labs) will assess usability, safety, and preliminary outcomes (Smith et al., 2023; Alfano et al., 2021). Participatory design methods will engage end-users, clinicians, and cultural advisors to refine both interface and narrative content (Brown et al., 2025). Data collection will focus on physiological markers, engagement, and self-reported wellbeing, with strict adherence to ethical and privacy standards (Dehbozorgi, 2025; Cushnan et al., 2024).

These pilots will also test the feasibility of lightweight VR, edge AI, and intermittent sensing in resource-constrained settings. Protocols will be designed for replication, including participant recruitment, multimodal data collection, and participatory workshops. This staged approach provides a clear pathway from concept to scalable intervention.

Conclusion

The Canaries' Experience demonstrates how metaphor, interdisciplinarity, and immersive design can converge to address one of the most urgent challenges in global mental health. By integrating VR, AI, gamification, spatial audio, and narrative techniques, the project offers more than a technological tool: it proposes a conceptual model of suicide prevention that is ethically grounded and potentially adaptable across diverse cultural and environmental contexts. Rooted in the symbolism of the canary as an early warning system, the intervention reframes hidden psychological struggles as potentially detectable and actionable, enabling timely support in both ICE environments and everyday life.

Rather than positioning technology as a replacement for human care, *The Canaries' Experience* explores how digital innovation might complement traditional therapeutic practices by extending reach and responsiveness. This approach seeks to address immediate mental health needs while laying the groundwork for a future in which care could be seamlessly embedded into daily experience, fostering resilience, empathy, and wellbeing on a global scale.

As a prototype, the intervention remains subject to empirical validation. All anticipated outcomes, including early detection, emotional recovery, and engagement, should be interpreted as provisional and open to refinement through iterative testing, stakeholder feedback, and cross context evaluation.

> "Like the canary in the coal mine, this project signals hidden dangers before they become crises, transforming silence into early warning, and early warning into hope."

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Author contributions

SS: Conceptualization, Data curation, Formal Analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review and editing. OB: Conceptualization, Data curation, Formal Analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Supervision, Validation, Visualization, Writing – review and editing. RW: Conceptualization, Data curation, Formal Analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – review and editing. NM: Conceptualization, Data curation, Formal Analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – review and editing. PS: Conceptualization, Data curation, Formal Analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Supervision, Validation, Visualization, Writing – original draft, Writing – review and editing.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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