



Challenges and Potentials of Pro-Social Collaborative Play in Extended Realities

Vinaya Tawde, Masaryk University, Simone Kriglstein, Masaryk University and Austrian Institute of Technology, Gloria Mittmann, Wanda Spahl, Karl Landsteiner University of Health Sciences

Digital gaming has become a widespread activity for diverse audiences, and technical advances have elevated user experiences in these games. Extended reality (XR), which encompasses augmented reality (AR), mixed reality (MR) and virtual reality (VR), is one of the newer technological advances engaging the user within immersive or blended environments [1]. Pro-social play within these immersive or blended settings holds great potential for fostering real-world connections (e.g., between family members in different countries) or a sense of belonging in a group of players (e.g., among students in the same class) [2]. This is particularly promising for digital gaming in noncommercial contexts, such as the creation of learning and mental health experiences in education settings.

Despite this potential, pro-social or collaborative play remains underexplored within XR. Based on discussions in the one-day workshop “Making a Real Connection: Pro-Social Collaborative Play in Extended Realities—Trends, Challenges and Potentials,” this article describes challenges and opportunities in this specific area of work and important design principles. The workshop occurred during the 22nd International Conference on Mobile and Ubiquitous Multimedia in Vienna, in 2023. There were 15 participants, mostly early-career researchers from universities in Austria, the Czech Republic, Germany, and the U.K., and from various disciplines. We organized a variety of exchange formats (for details on the workshop format, see [3]) to promote interdisciplinary exchange on practical challenges, opportunities,



Figure 1. Discussion was facilitated through idea exchanges in small groups and flip chart presentations.

and best practices encountered in pro-social and cooperative interaction design. Topics included relationships between students, family members, friends, and intimate partners, as well as sensory connections for people with autism (for the full papers, see [4]). Moreover, one of the workshop foci was on ethics, facilitated through a presentation on ethical challenges and potential in pro-social XR games, including the affordability of XR equipment, the acceptability of XR technologies as a source of trust among

nongamers, privacy considerations, and the reproduction of stereotypes in game design.

LESSONS LEARNED FOR DEVELOPING XR PRO-SOCIAL PLAYS

Two groups of workshop participants generated ideas, shared them, and engaged in broader discussions (Figure 1). Here, we summarize key insights and outline design challenges, opportunities, and principles for XR pro-social plays.

Design challenges. Designing for XR presents several unique challenges, which arise due to the immersive, interactive, and often physically and socially demanding nature of XR environments. Here, we outline the main challenges addressed in the workshop (see Figure 2 for full list).

Data and privacy. XR systems gather a wide range of data, including biometrics, physical movements, spatial data, and interaction patterns.

Misconceptions persist that XR primarily serves gaming enthusiasts and requires costly equipment, limiting appeal to broader audiences.

This type of extensive data collection raises significant privacy concerns. Designers must carefully consider data sensitivity, the necessity of data collection, and potential risks of misuse and privacy breaches.

Accessibility and diverse user group. Providing access to people with special physical and cognitive needs, as well as those with limited sensory abilities, such as young people with autism, is a challenge. Current efforts to include these groups are often insufficient. Recruiting participants with disabilities and special needs to test and refine XR design should be brought into focus. Additional barriers may include discomfort with technology, lack of accessible equipment, and concerns about physical safety in immersive environments.

Toxicity and exclusion. Detecting toxic and antisocial behavior in real time is difficult for developers due to the complex and anonymous interactions in XR environments.

Immersive experiences amplify emotional impact, making toxic interactions feel intensely personal. Developers also have to avoid unintentional exclusion due to game mechanics or narratives that overlook different abilities or cultural contexts.

Safety and vulnerable target groups. Protecting vulnerable users, such as minors, is crucial. For example, exposing children to inappropriate content or interactions in XR can have a stronger impact than in traditional media, given the heightened sense of presence and realism. Concerns were raised about minors lacking critical thinking skills to navigate these environments safely. Inappropriately designed and tested immersive experiences may amplify anxiety, stress, and other mental health concerns, creating disorientation or blending of virtual and real-world perceptions.

Marketing and expanding user base. Effectively marketing pro-social XR

play to diverse users is critical, as many potential users may overlook its value. Misconceptions persist that XR primarily serves gaming enthusiasts and requires costly equipment, limiting appeal to broader audiences.

Design opportunities. Pro-social, collaborative play in XR brings unique opportunities, often intertwined with challenges. For instance, while XR's immersive nature can amplify negative experiences like toxic behavior, it also has the potential to deepen feelings of connection. Here, we outline the key opportunities identified in the workshop (see Figure 2 for full list).

Safety/panic button. Participants discussed ways to enhance user experience and safety in XR games, emphasizing features that give users control over their environment. A promising option is a safety/panic button. Allowing users to exit or alter the experience when feeling uncomfortable or threatened provides an important sense of security. Safety buttons could connect to real-time support, empowering vulnerable users.

Collaboration with different devices. Affordable XR devices offer the opportunity to reach broader audiences. A major area of discussion was enabling collaborative XR experiences across various devices, since everyone does not have access to high-end VR headsets or AR glasses. Advances in XR now support solutions accessible via smartphones, tablets, and personal computers.

Interdisciplinarity. Fostering real-world connections in XR enables interdisciplinary collaboration, bringing in varied knowledge. Projects discussed included contributions from psychology, sociology, and the humanities on exploring social connections in nondigital contexts, such as through interviews and physical workshops with nondigital tools.

Open sourcing. Another opportunity is open sourcing within the XR developer community. Making source codes accessible lowers barriers, enabling others to learn XR development practices and techniques. This practice promotes exchange and feedback, enhancing the quality of XR design through community collaboration.

Challenges and Opportunities of Designing for Pro-Social Collaborative Play in Extended Realities



Figure 2. Discussion about the various challenges and opportunities in developing XR games aimed at fostering social connections.

Design principles. At the end of the workshop, participants collaboratively formulated design principles for pro-social and collaborative play in XR (Figure 3).

Designing XR pro-social plays involves comprehensive principles that guide researchers in creating meaningful and effective experiences. These principles emphasize careful planning to establish clear objectives and timelines, recognizing knowledge gaps and the importance of constant learning. Specificity in goal setting ensures every aspect of the project contributes to its purpose, such as gaining insights or achieving specific outcomes. Collaborating with experts and understanding user groups is crucial to the ability to refine the experience iteratively, build on thorough research, and define clear team roles. Fostering a shared understanding through a common language enhances communication and innovation, especially in interdisciplinary teams. Defining equipment specifications and making games open source encourages transparency, community involvement, and the potential for broader impact and sustainability. Collectively, these principles ensure XR's pro-social plays are technologically sound, socially impactful, and user centered.

CONCLUSION

Key challenges in designing pro-social, collaborative XR experiences include managing data privacy, addressing diverse user needs, mitigating toxicity, and safeguarding vulnerable groups. Opportunities lie in implementing safety features, improving accessibility, fostering interdisciplinary collaboration, and promoting open-source practices for broader community engagement.

XR does not inherently create real connections. However, developers can foster this goal through deliberate design decisions, continuous testing, and critical ethical reflection across all phases of XR technology development, including user research, device compatibility, and distribution planning. Another key insight was that workshop participants expressed a need for discussions about the ethical aspects



Figure 3. Reflection and discussion on design principles and best practices while developing XR games aimed at fostering social connections.

of their work (for further information, see [5,6]). Open forums for researchers and practitioners are also recommended to critically examine XR's social impact and support the creation of meaningful, inclusive experiences.

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ENDNOTES

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👤 **Vinaya Tawde** is pursuing her Ph.D. at Masaryk University, where she focuses on designing games for mental health in collaborative augmented reality. Her research interests include user-centered design in gameplay, user behavior analysis, and using design thinking to develop user interface patterns for mental health applications in gaming.
→ 554262@mail.muni.cz

👤 **Simone Kriglstein** is an associate professor at Masaryk University, as well as a scientist at the Austrian Institute of Technology and the University of Vienna. She specializes in designing and evaluating user interfaces and interaction methods in different fields, including games.
→ kriglstein@mail.muni.cz

👤 **Gloria Mittmann** is a game designer and holds a Ph.D. in research psychology. Her experience lies in designing serious games, especially those that enhance mental health and sense of belonging.
→ gloria.mittmann@gmail.com

👤 **Wanda Spahl** is a postdoctoral researcher in the Division of Biomedical and Public Health Ethics at Karl Landsteiner University of Health Sciences. Her research centers on healthcare policies and practices, with a focus on marginalized groups and digital technologies.
→ wanda.spahl@kl.ac.at