
Exploring Potentially Abusive Ethical, Social and Political Implications of Mixed Reality Research in HCI

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Michael Nebeling**Abstract**

In recent years, Mixed Reality (MR) headsets have increasingly made advances in terms of capability, affordability and end-user adoption, slowly becoming everyday technology. HCI research typically explores positive aspects of these technologies, focusing on interaction, presence and immersive experiences. However, such technological advances and paradigm shifts often fail to consider the “dark patterns”, with potential abusive scenarios, made possible by new technologies (cf. smartphone addiction, social media anxiety disorder). While these topics are getting recent attention in related fields and with the general population, this workshop is aimed at starting an active exploration of abusive, ethical, social and political scenarios of MR research inside the HCI community. With an HCI lens, workshop participants will engage in critical reviews of emerging MR technologies and applications and develop a joint research agenda to address them.

Author Keywords

Mixed Reality; Abuse; Design Fiction; Ethics.

CCS Concepts

•Human-centered computing → Mixed / augmented reality; Virtual reality; •Social and professional topics → Codes of ethics;

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Introduction

From the proliferation of immersive VR HMDs in the home (e.g. Oculus Quest, HTC Vive), to the steady advancement of AR headsets with sophisticated sensing (e.g. Hololens 2, Magic Leap) and consumer-friendly form factors (e.g. Bose Frames, Focals by North), Mixed Reality¹ headsets (MR HMDs) are becoming increasingly prevalent, and ever more integrated, into our everyday lives. Mixed Reality was a particularly important topic at CHI 2019, with the HCI community contributing significantly to the advancement of HMD technology focusing often on aspects such as presence, usability, haptics and interaction [7, 23, 10].

However, as we hurtle headlong towards actually realizing imagined futures where MR is an ever-present feature in our daily lives [15], there has been a growing concern regarding the potential ethical, social and political quandaries of consumer technologies [5, 19]. Consider the recent impact that Facebook had on public discourse and political division in multiple countries—an (arguably) unintended consequence of enabling filter bubbles and dissemination of non-fact checked content [11]. Might we unintentionally enable equally destructive behaviors in the race to provide more immersion, more presence, and enhanced sensing of the world and its inhabitants?

In recent years, Greenberg *et al.* [6], Hecht *et al.* [9] and Soden *et al.* [19] led the call to arms for questioning the techno-positive framing of computing research, with Green *et al.* [5] exploring VR HMD usage “in-the-wild.” This workshop builds upon these themes with a specific focus on the field of MR research inside the CHI community. The goal is not to start another more general discussion around these

¹We refer to the concept of mixed reality as spanning the complete reality-virtuality continuum based on Milgram *et al.* [16], including complete virtual (VR), partially augmented (AR) and everything in between [20].

topics, but to actually explore potential abuse grounded in work that is published within our community (last 5 years of SIGCHI conferences). This should further highlight that our community can not just mainly focus on positively framing interactions for MR HMDs, since even these interactions could carry a high potential for abuse.

Potential Misuses and Abuses of MR

MR HMDs are the potential successors of current ubiquitous technologies such as smartphones and PCs - but with a far greater capability to integrate themselves into our lives, and the lives of those around us. With improved ergonomics and design, everyday wearable HMDs will provide us with personal, private, always-available sensing and augmentation of reality, enabling a constant flow of digital information. In cases where reality can be occluded, these HMDs will provide a means to escape that reality and find ourselves present in virtual realities. These HMDs offer powerful new capabilities: creating illusions of an altered surrounding reality [13, 17], imperceptibly augmenting our perception and intelligence [18], and creating virtual spaces and experiences that might be difficult to distinguish (at a conscious or unconscious level) from reality [22]. These capabilities will inevitably revolutionize personal computing, in many ways for the better. However, our research also opens the door to intentional or accidental misuse and abuse, of particular concern given both the perceptual [4] and psychological [22] realism now possible.

Where art has pushed the boundaries in imagining “dystopian realities” (William Gibson, Blade runner, Ready Player One, Black Mirror, The Banquet etc.), research has more recently begun to consider the ethical, social and political concerns regarding the use of MR technology. Madary and Metzinger [14] examined the risks for individuals and society given the adoption of VR technology, discussing the unknown



Figure 1: This figure shows an example of embodied sexual harassment in a VR MMORPG. A player in the VR game *Star Trek: Bridge Crew* points to a female avatar/player (top) and then rudely gesticulates (bottom). From www.youtube.com/watch?v=YV9rI0kU3m8.

long-term effects of immersion, the risks of isolation and the neglect of others, the unknown psychological impact of risky content (e.g. violent or sexual content), and privacy. Wilson and McGill subsequently explored how VR experiences could be differently affective compared to non-VR, specifically in relation to violent experiences, suggesting that game ratings agencies for example might aspire to convey these differences to consumers [22].

Subsequent research has expanded to consider issues across MR. Bye [2, 3] constructed a framework for considering ethical challenges across MR, identifying challenges across the “domains of human experience”, discussing such topics as spatial doxxing (with headsets providing scraped personal information based on facial recognition), the collective right to augment public spaces, and the ability to alter or mute others. Franks [1] noted that MR could be both a force for, and hazardous to, equality, as “when existing inequalities are unacknowledged and unaddressed in the ‘real’ world, they tend to be replicated and augmented in virtual realities”. Franks also remarked on the potential for MR to induce trauma and “compassion fatigue” through exposure to e.g. violent actions or sexual harassment; enhance the capability of the state to monitor and punish our actions and the actions of others; enable new forms of virtual violence e.g. avatar rapes, “profoundly disturbing” events where avatars could be coerced or externally controlled against the user’s wishes; and lead to unequal accessibility in terms of cost and design (see Fig. 1).

In the same theme, Lemley *et al.* [12] considered how existing crimes might be transposed to, or enacted within, MR, discussing how the law might take into account virtual equivalents of sexual assault, particularly given haptic realism, indecent exposure, and the ability to augment our personal sensescape, and the sensescapes of others:

What if people use this... to make your avatar appear ridiculous... without your knowledge or consent? Or what if they want to make you appear naked... or suppose your ‘personal space’ bubble prevents you from perceiving other avatars as groping you, but they can still see themselves groping you? What’s more, in AR, all this can happen when the people are physically right next to each other.

Workshop Goals

The overall goal of this workshop is to engage in a discussion of upcoming social, ethical and political challenges for MR HMDs, arising from within the field of HCI. We argue for a research agenda around MR that goes beyond tracking, input and display techniques [23, 10]. For instance, do we need a code of conduct, as suggested by Madary and Metzinger [14], or do we need to enshrine some protections more strongly, perhaps even into law [12, 1] - an MR equivalent of Asimov’s “Three Laws of Robotics”²? Can we navigate the tension between personal privacy, and public abuse of MR by, for example, sharing or revealing aspects of our usage to others?

The current success and growing commercial interest also bears the risk of an overly “Techno-Positive” narrative about MR systems. This is fueled by both the demands of conferences such as CHI and UIST, and funding agencies, for novelty and impact, and the influence that commercial partners might have in funding research. We would argue this leads to important topics being neglected by the HCI community due to a lack of interest by those who aim to sell this technology (e.g. the long-term impact of VR), and introduces the possibility that research may be directed by the financial interest of MR companies (e.g. health, addiction) rather than the public good. As much as we believe in the good intentions of these companies, unfavorable circumstances, consumers dealing with technology or dramatic

²technologyreview.com/s/527336/do-we-need-asimovs-laws/

Table 1: We will solicit participation in the following areas of interest.

Augmented and Altered Reality

From augmenting the perception of self and others, to the impact of augmented intelligence and perception.

Alternate Virtual Realities

Are there risks that in creating more immersive, perhaps even preferable, realities we will encourage isolation and withdrawal [21]? What are the implications of re-creating reality? Might VR experiences lead to desensitization or dissociation?

Risky Experiences

Given the ever increasing interaction, haptic and visual fidelity, what are the concerns when transposing existing graphic media (e.g. sexual content, violence) and potentially addictive content (e.g. loot boxes) to MR?

Criminal Acts

What does count as virtual abuse and to what extent can we safeguard against virtual abuses of others, and hold abuses to account?

Equality and Accessibility

Are those that don't own the bleeding-edge headsets at a disadvantage? Are we in danger of transposing the inequalities of reality to virtuality?

Privacy

Potential misuse of stolen or leaked biometric data of the wearer (e.g. gaze, skin response) but also collocated others (e.g. body tracking, facial scans).

changes in our democratic systems can lead to usage scenarios that we do not foresee or even imagine.

We want to emphasize that the goal of the workshop is not to demonize MR technology or create fear mongering, but rather build upon the conversations kickstarted by others [19, 5]. We wish to examine the pitfalls and ethical challenges of MR through the lens of HCI, exploring the emerging topics that must be tackled if the technology is to be successfully and safely integrated into society in the future.

Throughout the workshop we will bring together scientists and industry attendees from multidisciplinary fields, to foresee the problems and challenges of MR adoption and usage, and better understand the role and responsibility of the HCI community. The community we form, and insights of the day, will serve as a foundation for future progress toward guidelines, best practices, legislation and necessary research to safeguard a society that, without such discussions, will inevitably adopt the latest and greatest MR technology without such considerations, provided by companies whose interests may not always align with the public good.

Workshop Areas of Interest

We will examine the ethical concerns regarding MR usage from an HCI perspective, focusing around but not limited to the topics listed in Table 1. We will especially encourage participation from members of the research or practitioner communities working at the intersection of these areas.

Participants and Expected Interest

We welcome participants from all fields of HCI and mixed reality - researchers, designers and practitioners, social scientists, psychologists and philosophers - provided they have some understanding and background of MR technologies. The workshop is inclusive for a non-technical audi-

ence. Participants with basic knowledge in mixed reality, HCI, and interaction design will be able to follow the content without the need for a programming background. We expect that participants from these different fields of expertise will add significantly to the outcomes, with interdisciplinary discussion revealing new research perspectives.

Pre-Workshop Plans

We will distribute a CFP in all relevant communities, announcing the CFP on popular mailing lists (e.g. ACM, CHI-announcements, digital humanities) and social media. We will also directly contact researchers and practitioners who are likely to be interested in the workshop and write to relevant institutions and research labs. Our website will be located at <https://www.medien.ifi.lmu.de/ethicsofmr/> and will act as a portal both for this and future workshops.

Workshop Structure

The workshop is planned to last one day and can be seen as a white-hat-hacker mixed reality "hackathon". We will foster active participation and limit frontal presentation. In the morning session participants will present their submission inside a poster session, functioning as an ice breaker and introduction of oneself and ones interests. In the late morning and afternoon sessions, participants will be forming groups of interests and create an abuse scenario for an MR paper published within the HCI community. The scenario will consist of: 1) a short paragraph outlining one potential nefarious application scenario, 2) a short paragraph outlining potential ways of counteracting these scenarios, 3) a low-fidelity diegetic prototype created within the workshop. These will be combined with the original paper to create a provocative piece and discussed within a tiny exhibition at the workshop, starting an open discussion with the community about the potential for abuse of mixed reality HCI research. The whole process of designing and



Figure 2: A mockup of what the AdHead scenario prototype could look like to collocated persons (top) and for wearers of AR glasses (bottom), if usage were subsidized by *Coca Cola*, exploiting the research of Gugenheimer *et al.* [8].

prototyping an abusive scenario is only used as a vehicle to engage in the topic of negative application examples of MR.

Time Schedule

09:00 - 09:15 Introduction and Welcome

09:15 - 10:15 Poster Session Discussion (5 Minutes Presentation and Discussion at each Poster)

10:15 - 10:30 Break

10:30 - 11:30 Form groups of three, choose one MR HCI Paper published in the last 5 years, brainstorm potential abuse. Focus on the method and approach you use to extrapolate the abusive scenario.

Outcome: 1 Paragraph about the “Abuse Scenario” and 1 Paragraph about “Ways to identify potential abuse”

11:30 - 12:30 Lunch

12:30 - 14:30 Create some type of artifact embodying your abusive scenario (paper prototype/low-fidelity prototype). Focus on what makes it abusive.

Outcome: Diegetic prototype exemplifying scenario

14:30 - 14:45 Break

14:45 - 15:45 Mini Exhibitions and Discussion: By reviewing each scenario and prototype, we try to understand the principles of unethical use of HMDs within the HCI community and try to deduct fundamental characteristics of what makes a scenario abusive and how to mitigate it.

Outcome: 1 Paragraph about “Ways to mitigate abuse”

15:45 - 17:00 Moderated Discussion: Where to go from here? Do we need an “implications for society” section in HCI papers similar to [9]? Do we need laws or legislation for MR similar to Asimov’s “Three Laws of Robotics”?

Outcome: 1 Paragraph about “Next Steps”

17:00 Wrap Up

Example Abuse Scenario: The AdHead

The Scenario: Gugenheimer *et al.* [8] presented a work that used external displays mounted on an VR HMD to visualize the virtual world to non-HMD users. The application scenario was framed mainly positive and focused around mitigating effects of exclusion and isolation of VR HMDs. However, the outwards facing displays could also be used to constantly display advertisements to the environment of the HMD user. A company could decide that they want to subsidise the price of their MR HMDs by selling the display space to advertisers when not used during interaction. Combined with the environmental understanding of the HMD, the user would receive a constant stream of virtual ads within their MR experiences, and be used as a billboard to show ads to collocated others (see Figure 2).

The Prototype: Attaching a smartphone to an existing HMD, rendering a gallery of adverts externally (some using scraped personal information to target bystanders) and within the VR experience. During the prototyping process, participants could realize that the type of advertisement shown could potentially even worsen the scenario since the user has no control over the content (e.g. embarrassing advertisements using publicly inappropriate depictions).

Potential Mitigations: These could be *political* e.g. do existing laws regarding advertising in public adequately protect against this scenario?; grounded in *HCI/technology* e.g. could we create an MR ad-blocker, where my personal headset blocks out the presence of these adverts?; or reflect on the *social impact* e.g. should we intervene if this lowers the cost of adoption of MR technology?

Call For Participation

We invite submissions of position papers (up to 4 pages) that explore the potential misuse and abuse of Mixed Re-

ality technology, envisioning scenarios that raise ethical, social and political concerns regarding the use of MR headsets. Position papers should in particular consider the influence of, and role of, the HCI community - where might we inadvertently contribute to this issue, and how might we avert or safeguard anticipated abuses? Exemplar scenarios might come from within the field of, but are not limited to:

- Augmented and Altered Reality
- Alternate Virtual Realities
- Risky Experiences
- Criminal Acts
- Equality and Accessibility
- Privacy

Participants are strongly encouraged to consider where their scenario fits, if at all, within the descriptive framework regarding the Ethics of XR by Bye [2], and state any questions/topics of their own particular interest in this domain for the moderated discussion at the workshop. Submissions are not expected to be finished research projects but should be seen more as a motivational and provocative piece. Participants will be invited to discuss their paper as part of the poster sessions. The workshop organizers aim for a mix of participants in terms of experience and research topics to maximize diversity of interests and viewpoints at the workshop.

Please note that one author of each accepted position paper must attend the workshop, and it is unlikely we will be able to accommodate multiple authors per paper due to workshop size constraints. All workshop participants must register for both the workshop and for at least one day of ACM CHI 2020. For more information and submitting your contributions, please visit: <https://www.medien.ifi.lmu.de/ethicsofmr/>

Expected Outcomes and Post-Workshop Plans

The structure as a mini "hackathon" was chosen to facilitate an environment in which discussions around the potential for abuse of MR technology can strive. The outcome in the form of the critical piece (prototype and abusive scenario) is only of secondary importance. The goal is to create an environment in which HCI researchers can have a discussion how OUR MR inventions and publications could be potentially abused and further result in discussions about what the responsibility of the community is and how to deal with the upcoming challenges. Depending on the direction and outcome of the final discussion, a potential structure of the 'Next Steps' paragraph could be a set of rules (e.g. MR applications are not allowed to augment users visual appearance without their consent) or even an instruction on how to write the "implications for society" paragraph. All outcomes will be made available to the community via the website, and a community Slack channel will be formed to further discussion post-workshop.

Organizers

Jan Gugenheimer (www.gugenheimer.com) is an Assistant Professor at the Institute Polytechnique des Paris. His research focuses around upcoming social challenges for mixed reality technology and how to embed HMDs into the fabric of our daily lives.

Mark McGill (www.markmcgill.co.uk) is a research fellow in the School of Computing Science at the University of Glasgow. His research has explored shared at-a-distance VR experiences, VR locomotion, MR for passenger experiences, and the future of MR productivity.

Samuel Huron (<https://perso.telecom-paristech.fr/shuron/>) Samuel Huron is an associate professor in Design at Institute Polytechnique des Paris. His research has explored

information visualization authoring, design methodology, and tangible interactions.

Christian Mai (<http://www.medien.ifi.lmu.de/team/christian.mai>) is a former research associate from the LMU Munich now dedicated to make mixed-reality systems a success. Using user experience design methods he approaches the problem space arising from the application of MR HMDs in everyday contexts.

Julie R. Williamson (www.juliericowilliamson.com) is a lecturer in human computer interaction in the School of Computing Science at the University of Glasgow. Her research focuses on interaction in public spaces, including non-planar displays, virtual reality, and tangible interfaces. She is an expert in public evaluation and research on social acceptability of novel technologies.

Michael Nebeling (michael-nebeling.de) is an Assistant Professor at the University of Michigan. His research and teaching are focused on empowering more MR users to become designers; an example of this was his CHI'19 course.

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