Connecting Personalized Realities: Challenges and Opportunities in a Personalized Society

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Abstract

Enabled by advances in XR and AI, personalized services are increasingly affecting how individuals perceive, interact with, and navigate their realities. The resulting Personalized Realities (PR) may help people to interact more effectively with their surroundings, and allow more equitable access to information. However, PRs may also disconnect them from a collective understanding through isolated perceptions and perceptual filter bubbles. As democratic societies strive for social cohesion and shared knowledge and experiences, individual PRs may thus further add to existing social fragmentation. Yet, as PRs are framed as a concern that adapts experiences for a single user, they do not capture the full societal implications of a world where personalized mediation of reality is ubiquitous. In this paper, we therefore introduce the term *Personalized Society (PSoc)* to describe societies in which people predominantly access information and interact with others through a *personalized mediation* of reality. We discuss the duality of a PSoc, where personalization should be beneficial to the individual but at the same time connect people rather than isolate them. We identify key tensions arising in a PSoc and propose initial design considerations for fostering social cohesion alongside individual PRs, illustrating these through selected scenarios. Finally, we discuss the extent to which regulatory frameworks, such as the Digital Services Act, can be applied to protect individual and societal rights in a PSoc.

Keywords

personalization, XR, societal impact, social cohesion, perception of reality

1. Introduction

Advances in Extended Reality (XR)[1], Artificial Intelligence (AI), and Ubiquitous Computing (UbiComp) increasingly bring *personalization* to the physical world [5]—ranging from smart lights that adapt to people's mood [6], to personalized navigation instructions in XR [7], to personalizing audio input to the needs of people [8]. As the capabilities and form factor of XR devices such as head-mounted displays improve [9], such personalized services may be available ubiquitously, similarly to when people wear prescription glasses or hearing aids nowadays. Research on ubiquitous XR in general (cf. [10, 11, 12]) sees benefits in such ubiquitous mediation of physical reality, including seamless information access [10], increased accessibility [13] and (remote) interpersonal interactions [14]. However, they also note that who controls such interfaces may "determine how users experience the world, how they conceive of themselves, and how they regard others" [15, p.99] and thus warn against possible deception and manipulation possibilities [16, 14, 17, 18].

Personalized XR may also situate people in literal "filter bubbles" that constrain their sensory perception to only the content they want to perceive (cf. [5, 4, 19]). We refer to an individual reality[2] that has been modified by a system based on personal data (i.e. data that allows to identify an individual,

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[1]We use XR as an umbrella-term that covers other related concepts such as Augmented, Mixed, and Virtual Reality, see [1, 2, 3, 4].
[2]Here, we use the term *individual reality* broadly to describe the lived experience of an individual, regardless of whether such reality corresponds to philosophical notions such as (in-)direct realism, idealism, or skepticism.

cf. [20]) a Personalized Reality (PR) [21]. In a more philosophical sense, people already have their personal view of the world around them, constrained by their sensory abilities and how they make sense of it. Any technology-driven filtering in the sense of PR would work on top of this and hence *further* constrain people's perception. There is an abundance of situations where constraining one's perception is helpful, e.g., to reduce information overload [22], to reduce exposure to harmful content [23], or for strategically widening of one's own worldview [5].

Some speculative visions have illustrated how such PRs may look like in the future with ubiquitous, AI-enabled XR technologies widely available [24, 25, 26]. They envision "a reality just for you" [25] by "understanding your values from what you do and what you view" [24]. This is not anymore a futuristic vision, as devices that may mediate reality in a personalized way are increasingly available and capable. For instance, XR glasses such as the Even G2 [3] or Pickle 1[4] have a similar form factor as prescription glasses by now. The Pickle 1 is also marketed as "an intelligence that sees with you, remembers your life, and learns to understand you", bearing a similar tone as the aforementioned visions. This narrative demonstrates an integration of XR advances with (generative) AI techniques may enable mass personalization at very low cost [27].

However, these visions and products show the perspective of single individuals while not considering a wider view that encompasses social groups and societies. As people actively seek to sense the realities of others and to connect with what others experience [28, 29] and democratic societies rely on a sufficiently similar access and perception of information [30], individual PR may pose a threat to a communal, shared experience of reality (cf. [31]). Thus, researchers have warned that already *fragmented realities* [32] may be further fragmented through a combination of personalization, ubiquitous XR, and AI [33, 34, 35]. If everyone perceives their own personalized version of reality, it may become increasingly difficult to communicate with others about facts and objects.

As people are increasingly perceiving personalized perceptions of reality, we can speculatively speak of the emergence of a *Personalized Society* (PSoc). In a PSoc, people rely on personalized access to information, experience personalized interactions with smart devices, and communicate with others through personalized intermediaries. As this personalization is often targeting individuals (cf. [36]) one major challenge in a PSoc is how people can still experience common or connected realities. Thus, in this paper we explore ways to ensure that common social realities are not diminished in a PSoc.

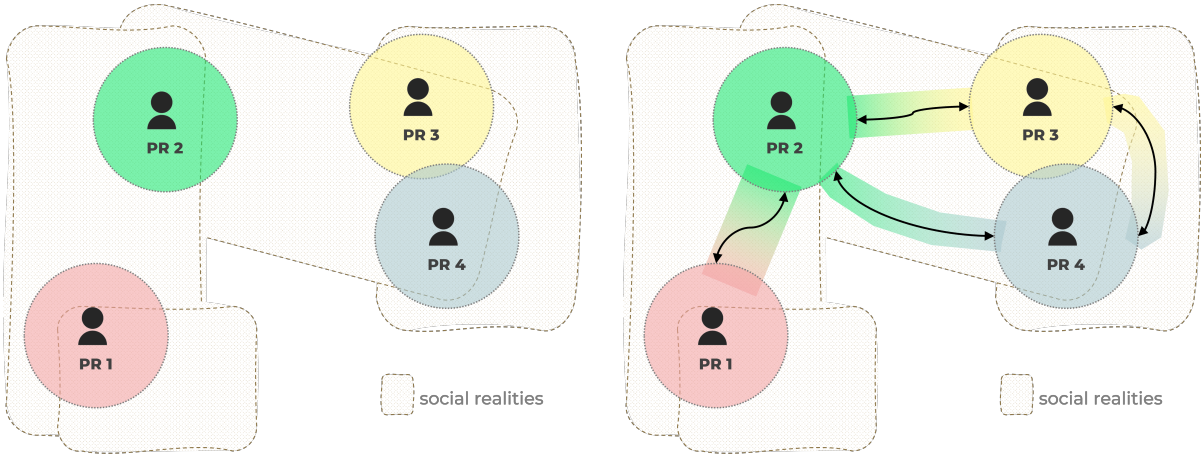
2. Connecting Personalized Realities in a Personalized Society

In the following, we suggest and explore two different pathways to mitigating these risks or isolated perceptions and fragmented realities while retaining the benefits of individual PR: (1) Bridging across individual PRs and (2) Integration of social values in PRs.

2.1. Bridging across individual Personalized Realities

In a PR, people perceive an adapted version of their original unmodified reality. This means common social realities and and *shared worlds* [37] that had been perceived by multiple people before, may be now only partially or not anymore perceived by those people (see Figure 1a). To mitigate the resulting potentially harmful societal consequences [38], a look at research on connecting perspectives in XR contexts is helpful. To connect individual perceptions of reality (see Figure 1b), methods have been proposed for bridging perspectives in multi-user XR contexts (e.g., co-located or remote collaboration [39]), as well as contexts in which some people are bystanders who do not have access to the primary users' content. Here, XR HMDs may create an information asymmetry [40] which could be mitigated by informing bystanders, e.g., through awareness cues [41] or asymmetric viewing experiences using large displays [42]. Connecting individual perceptions between users of the same system has been studied, e.g., in collaborative work or training settings, where individuals selectively exchange curated resources

[3] https://www.evenrealities.com/products/smart-glasses. Last accessed February 10, 2026.
[4] https://www.pickle.com/1. Last accessed February 10, 2026.



(a) (b)

Figure 1: (a) In a Personalized Society, people experience filtered versions of the common social realities through their own PRs. (b) To reclaim some of the lost shared space between people, connections between the PRs enable a personalized *and* common experience.

aligned with their learning paths, fostering shared understanding while preserving autonomy. For instance, in collaborative XR, users may have asymmetric roles and capabilities [39]. Yet, they can be made aware of each others intentions with the help of shared verbal and non-verbal communication cues [43] that allow them to develop mutual understanding (cf. [44]) and empathy.

However, when content is personalized for individual users, even if all involved people are in the same XR environment, they might not perceive the same content, as each one has an individually adapted perspective. To address this issue, we have proposed the sharing of personalized content across people [45]. Here, people who share a social context with others may decide which parts of their own personalized perspective should be accessible to others and thus connect their perspectives again (see Figure 1b). To concretely implement this socially oriented view on PR, a careful balance of individual and social benefits is needed. If the sharing or personalized content negatively impacts the usefulness for the individual, it might not be perceived as helpful anymore.

2.2. Including social values in Personalized Realities

Additionally to methods that are more device or output-dependent, also the personalization algorithm itself may be adapted in a way that connects people's perspectives. For traditional recommender systems, researchers have, e.g., proposed algorithms that recommend content preferably from diverse opinions over like-minded content to "build bridges" between perspectives [46]. One way to adapt the personalization algorithm towards societal goals in PR, could be to include *social values* in the personalization process, similar to what researchers have proposed for Web-based recommender systems [47] and XR [48]. In the field of *Value-sensitive Design (VSD)* [49], values are broadly defined as "what a person or group of people consider important in life" [50, p.1]. In the design of personalized experiences, these values can be embedded, e.g., through VSD frameworks, participatory workshops, or by including people as dedicated value experts [47, 48]. In a PSoc, including *social* values (i.e. what a person or group of people consider important in a *social context*) in the personalization algorithm might be helpful to strengthen connections between people. Here, the connections are rather abstract, as there is no direct link between two people's PR. Instead, if social values such as mutual understanding, diversity, or duty are influencing what and how content is personalized, the result may, e.g., increase the social connection within the specific social group. Note that the aforementioned definition of values does not necessarily mean that social connection and shared world perception may be desired. Different groups of people and societies may have different values they may strive for (e.g., individualistic vs. collectivistic, or hierarchical vs. communal). Additionally, if the inclusion of social values in PR is

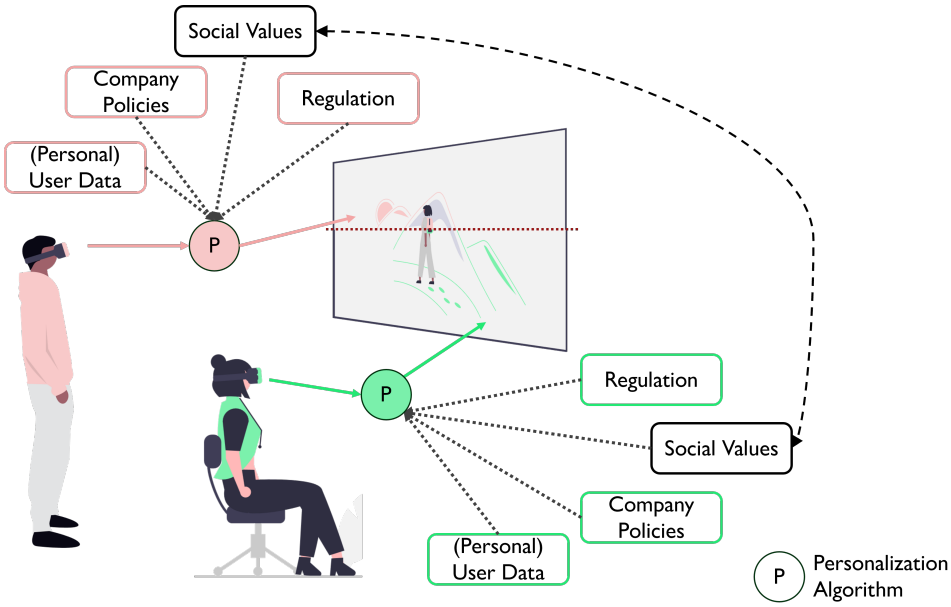


Figure 2: In a PR experience, there are multiple factors that may influence the personalization algorithm for each person. These include, e.g., (Personal) User Data, Company Policies, and Regulation. Including Social Values may be one method to make sure the personalized content in individual PR is (to some extent) taking into account the social context in which the person is situated.

forced upon a user by another entity, it may be perceived as paternalistic and will negatively impact the perceived autonomy. Thus, the implications of including social values in PRs heavily depend on which values are included by whom and to what aim.

The included social values may then have influence over different aspects of the content displayed in a PR. This includes, e.g., the positioning of virtual content so that another person is not obstructed (cf. [51]), which parts of other people's appearance may be visually altered (cf. [52]), or which information from other people may be used to personalize one's own reality (cf. [53]). The concrete implementation of the inclusion of social values may work as plugins for XR apps, or in conjunction with (open-source) operating systems such as Mentra OS[5] for smart glasses, or Meta Horizon OS[6] for XR HMD. The value descriptions may be created by various social entities, such as individuals, associations, institutions, NGOs, or governments. A recent example of including social values into a system is the "Switzerland"-system prompt for the open-source LLM *Apertus*, which provides instructions for a Swiss social context, such as "Emphasize consensus-building and federalist principles" or "Respect Switzerland's linguistic and cultural diversity"[7].

3. Opportunities and Challenges in a Personalized Society

In this section we illustrate how a PSoc may emerge based on technological developments and how the discussed connection methods between individual PRs may be helpful in different societal contexts in a PSoc. We hence complement the extensive research on ubiquitous XR in general (e.g., [54, 55, 56, 57]) and its possible societal implications (e.g., [17, 54, 58, 11, 59]) by focusing on scenarios where such ubiquitous, social XR is *personalized*.

[5]https://mentraglass.com/os. Last accessed February 10, 2026.
[6]https://developers.meta.com/horizon/. Last accessed February 10, 2026.
[7]https://github.com/forpublicai/chat.publicai.co/blob/main/community/system_prompts/switzerland.md

3.1. Emergence of a PSoc

PR experiences have the potential to improve the way people interact with their environment by better matching their abilities to the affordances it offers (cf. [38]). Hence, they may increase equitable access to everyday services [60] and support people's decision-making [61]—thereby improving societal participation. Yet as PR becomes more widespread, an increasing share of social interactions are mediated in personalized ways, giving rise to what we call a *Personalized Society (PSoc)*. This concept allows us to examine ubiquitous personalization at a societal rather than individual level. On a technological level, participation in a PSoc requires that people have devices which are capable of personalizing their perception of reality. Devices such as smartwatches or smartphones provide a rather subtle version of personalization, as people need to actively look at the devices to perceive personalized content. However, devices such as XR HMDs or smart earphones may mediate a human sense fully (vision and hearing, respectively), and thus have the potential to personalize everything a person perceives with these senses.

Current technological developments indicate that a PSoc might not be a vision of the future anymore, but a phenomenon that is currently emerging. "Smart glasses" or "AI glasses" (i.e. glasses that allow voice interaction with an AI)[8] and XR glasses that additionally display virtual content[9] by now have a similar form factor as prescription glasses. Additionally, the underlying LLMs and AI agents are increasingly steered towards personalized responses. For instance, OpenAI CEO Sam Altman describes the future of ChatGPT as: "a shift from being all reactive to being significantly proactive, and extremely personalized."[10]. Thus, these smart glasses may be the first widely available and comparatively affordable devices that allow to access personalized information seamlessly while people perceive physical reality at the same time. Thus, we today see the emergence of a (basic form of) PSoc. As the necessary devices mature and new ones emerge, they will increasingly enable personalized interactions in everyday life. A discussion of PR and PSoc, as well as their benefits and potential harms as well as overall desirability, is required before our society reaches the tipping point into a PSoc.

Open Challenges Today, buying the devices needed to experience PRs presents a financial barrier for some people [62], and therefore low-cost access to XR content (cf. [63]) would allow socially broader participation in a PSoc. Beyond the cost of hardware, rendering personalized experiences in real time is also computationally demanding, and sustained use will likely require subscription fees. As with many digital services, lower-cost tiers may be subsidized through advertising and the sale of user data, echoing familiar dynamics from social media (cf. [64]) and raising the prospect of a multi-tier system where the quality of one's PR is dependent on one's economic means. This imbalance may deepen over time. As personalized XR becomes more widespread, the unmediated experience of public space may come to feel lacking by comparison, making (personalized) augmentation harder to opt out of for those who rely on it daily. People without access to these systems may then face a double disadvantage: excluded from the benefits of PR while also being left behind as public information and shared infrastructure increasingly assume that everyone is connected, a pattern already visible in the imbalanced roll-out of digital-only public services [65]. Also, to enable connections between PR in a PSoc for those who use it, technical interoperability between PRs systems from different vendors will be needed. In the European Union, e.g., this may be mandated by the Digital Markets Act [66].

3.2. Inter-personal Communication

When people have a device that allows personalized mediation for human senses such as sight, hearing, or touch, people may also rely on this for inter-personal communication. For instance, personalized speech translation could enable talking to another person who speaks a language unknown to oneself.

[8] See, e.g., Meta Ray-Ban Glasses https://www.meta.com/ai-glasses/.
[9] See, e.g., XREAL One Pro https://www.xreal.com/us/one-pro or Rokid AI Glasses Style https://global.rokid.com/pages/rokid-ai-glasses-style.
[10] https://x.com/sama/status/1971297661748953263. Last accessed January 21, 2026.

Already today, Apple AirPods[11] or Google Translate[12] have the functionality to live translate from one language to another. Although this works only for a limited set of languages so far, it provides ground work for what has been featured in science-fiction literature as a "universal translator"[13] that may translate any language. Paired with personal data from the primary user, the translation could then even include, e.g., explanations of cultural or social references the user is unfamiliar with (in relation to their own values), be based on their local dialect, or adjusted to their accessibility needs (cf. [67]).

Additionally to audio translation, using XR HMD, also signs and text on physical media could be translated with virtual overlays (cf.[68]). Knowing the users' language skills, the translation could be adapted to their knowledge level and gradually help them learn the language. Such a personalized visual translation could help people to connect better with the local population, especially paired with audio translation for personal conversations. For both translation methods, it is important that the translations stay faithful to the cultural and social values from all involved cultures to avoid mistranslating something.

Open Challenges One the one hand, personalized translation may connect people with each other that would not have been able to communicate otherwise. Yet, on the other hand, this also creates a dependency on the controller of this devices and presents opportunities, e.g., for deception where the translation has been deliberately altered by a malicious actor (cf. [69]). Additionally, future personalized translation methods would need to ensure that dialects and languages variances are preserved, as current translations often are limited to certain language variants. Additionally, through a reduced incentive to learn foreign languages [70], automatic personalized translations may lead to lower cross-cultural understanding [71]. Thus, the research on and design of personalized inter-personal communication should look for ways to retain the (cross-)cultural benefits of learning and speaking a foreign language in an age of simultaneous automatic translation.

3.3. Public Institutions

Beyond language learning, also places that exist for fostering a wider range of education will be affected by the increased prevalence of PR in a PSoc. Public institutions such as schools, libraries, and universities serve a dual purpose: educating individuals while fostering a sense of shared community among those who attend them. Both goals face new pressures in a PSoc. On the individual level, personalized learning can cater to learners' individual needs and learning styles [72]. At the same time, researchers have called for a "more inclusive, and participatory democratic education" [73, p.482], where AI-generated personalized content complements rather than replaces human teachers. Additionally, PR could also help people connect across differences within these institutions, for instance by quietly surfacing shared interests that might seed a study group, or offering a student a quick explanation when a peer uses a term in an unfamiliar way.

Open Challenges Public institutions may be greatly challenged in a PSoc because they are attended by a heterogeneous group of people that may have very different preferences for their individual PRs. While they can provide measures aiming at increasing the social cohesion (e.g., team-building workshops), it is unclear how these could extend to the virtual content consumed privately by people. For instance, while physical restrictions (cf. smartphone bans [74]) are relatively straightforward to enforce, virtual restrictions such as limiting access to certain AI-generated content or PR filters pose more difficult challenges. A more restrained approach than bans, could be, for instance, that these institutions require for any PR experience that is consumed on their premises to include its social values (e.g., based on its vision or guiding principles) in the personalization process. However, such a requirement would need to be carefully balanced with individual needs and rights. On a student level, there might be social pressure to conform to emerging social norms such as the continuous use of

[11] https://support.apple.com/en-us/123185

[12] https://blog.google/products-and-platforms/products/translate/language-learning-live-translate/

[13] See https://en.wikipedia.org/wiki/Universal_translator. Last accessed February 12, 2026.

XR glasses or personalized virtual avatars. This could deepen existing divides between those who can afford or are willing to adopt such technologies and those who cannot or choose not to. Additionally, PR could be misused, e.g., for bullying through personalized XR face filters where the bullied person has no way of knowing how others see them (cf. [52, 53]).

3.4. Urban Life

Also, large social groups at different granularities—from families to neighborhoods, cities, and even nation-states—have a shared interest in maintaining some common ground between how their members perceive and experience the public spaces they inhabit together. When people walk the streets in a PSoc, however, this shared ground may erode substantially. Individuals may follow personalized XR navigation cues to reach their destination [7], engage with tailored guided tours of the urban environment [75], suppress physical advertisements encountered along the way [76], or even alter the appearance of other people around them [17]. As a result, two people standing on the same street corner may be inhabiting functionally different realities, yet each may be wholly reliant on their mediated perspective to understand and navigate their surroundings. This fragmentation is not inherently undesirable. PR overlays can meaningfully help individuals navigate complex environments, surface contextually relevant information, and reduce information overload [37]. Moreover, embedding social values into the personalization process could enhance these benefits at a community level. For instance, a PR system could recommend preferably restaurants owned by local residents, or connect points of historical interest in a guided tour to the communities and people who inhabit those places today, grounding personalized experience in shared civic identity rather than purely individual preference.

Open Challenges Several open challenges remain for PSoc deployments in public urban environments. First, as PR representations of shops, landmarks, and streets become more prevalent, the role of physical storefronts as legible, shared anchors of urban life may diminish, with uncertain consequences for local economies and the character of public space. Second, the adoption of PRs wil likely be imbalanced: a meaningful portion of the population will either lack access to, or actively decline, a personalized mediation of reality. Designing for common experiences between personalized and non-personalized realities in the same physical space thus needs to be investigated further. Finally, ensuring the safety of all parties in augmented public space remains a pressing challenge. While much attention has focused on pedestrian experience, public streets are shared environments involving cyclists, car drivers, and other road users. When car drivers, for instance, operate vehicles through a mediated view of reality, the stakes of perceptual error or system failure are substantially higher (cf. [77]). Establishing appropriate safety guarantees and determining who bears responsibility when personalized perception contributes to harm represents a critical open issue for PR systems operating at urban scale.

4. Regulation of Personalized Societies

In a PSoc, individual PR, connections between them and how people interact with each other and their environment are affected by laws that govern virtual and physical spaces. Thus, laws and policy recommendations for XR [78, 79], AI [80] and Personalization [47] are as relevant here, as laws and policies that govern "offline" life.

A PSoc does not emerge in a regulatory vacuum. Existing legal frameworks governing social media platforms already address algorithmic personalization, recommender systems, and platform accountability. These regulatory efforts provide an important starting point for thinking about governance in a PSoc, where personalization no longer structures only online information environments but increasingly mediates perception of physical reality through XR and ubiquitous AI systems. Recent regulatory initiatives, such as the European Union's Digital Services Act (DSA) [81], aim to increase transparency, user autonomy, and accountability in algorithmically curated environments. For instance, Article

27 DSA requires Very Large Online Platforms to explain how their recommender systems function, offer non-personalized alternatives, and make these options easily accessible. While these provisions are currently targeted at social media platforms, their underlying principles—transparency, choice, and accountability—become even more critical when personalization moves from ranking posts to shaping lived perception in a PSoc. In the following, we map key regulatory questions from existing personalization domains to the broader concept of ubiquitous personalization in a PSoc.

4.1. What should *not* be personalized in a Personalized Society?

While personalization can be beneficial in many areas of life, there might be things that should or must not be personalized. Some information needs to reach everyone in the same way, and the involved stakeholders will need to decide where those boundaries lie. For instance, safety-critical cues such as emergency exits and hazard warnings must be perceivable by people regardless of their personalization settings to avoid potential physical harm. However, there might be exceptions needed where the presented information needs to be translated or annotated, such as icons that may not be understood cross-culturally [82]. Additionally, there might be information that should not be personalized because perceiving them in an un-altered version might be vital for common, shared realities and public discourse. This includes, e.g., civic information about access to governmental services, or the communication of basic facts about historical and current events and facts. A common reality requires that people have a basic, shared understanding of history and current events and facts (cf. Hannah Arendt's concepts of *factual truth* and *common reality* [31]). Otherwise, a personalized delivery of these might further fragment people's realities, as researchers have observed on social media [46].

4.2. Who is personalizing for whom in a PSoc?

On contemporary social media platforms, engagement-driven recommender systems optimize primarily for business metrics such as time spent, interaction frequency, and advertising revenue [83]. Economic incentives within the attention economy shape how personalization is deployed, often privileging content that maximizes arousal or engagement over content that promotes well-being or democratic health [83, 46]. In a PSoc, this dynamic scales from content ranking to environmental mediation. The entity controlling personalization algorithms—platform providers, operating system developers, AI service providers, or device manufacturers—would effectively "determine how users experience the world, how they conceive of themselves, and how they regard others" [15, p.99]. Thus, when personalization becomes ubiquitous across social realities, the normative objectives embedded in these systems gain societal weight. If engagement, monetization, or proprietary ecosystem lock-in remain the dominant optimization goals, the cumulative effect could shape collective behavior patterns at scale. The question is no longer merely who curates a feed, but who curates perceived reality. Consequently, governance in a PSoc must address not only the transparency of algorithms but also the institutional incentives that guide what personalization is optimized for.

4.3. What data is being used to personalize content in a PSoc?

Large online platforms already rely on extensive behavioral signals to personalize content [84]. These include explicit inputs such as likes, shares, and follows, as well as implicit signals such as dwell time, scroll velocity, repetition of views, or interaction hesitation [84]. Research has documented how such signals can exploit cognitive biases, reinforce engagement loops, and contribute to compulsive usage patterns [83]. In a PSoc, the scope of input data expands significantly as XR HMD, wearables, and ambient sensors may capture additional data such as gaze direction, physiological responses, spatial movement patterns, vocal tone, and real-time environmental context [85]. This data is not only collected from the primary user of a PR, but also potentially from uninvolved bystanders. Research on XR bystanders thus emphasizes the importance of talking their perspective into account when creating XR experiences [86]. Personalization in general needs personal data as an input, as we discussed earlier, therefore PR experiences will need to have mechanisms in place that allows people to intuitively

control and understand which data is used by these systems for which purpose— for primary users and bystanders. Therefore, regulating data inputs and limiting exploitative optimization criteria becomes central to preventing PSoc from amplifying the behavioral vulnerabilities already visible in online platform ecosystems.

4.4. Who retains agency over personalization in a PSoc?

Current social media systems offer limited user control over algorithmic optimization goals. While some regulations mandate transparency or chronological feeds, users typically cannot influence what the algorithm optimizes for (e.g., engagement vs. diversity vs. well-being) [84]. Emerging decentralized approaches, such as user-selectable or plug-in recommender systems, attempt to address this [87].

In a PSoc, agency becomes even more critical. If individuals rely on personalized mediation to navigate physical and social reality, the ability to inspect, modify, or override personalization parameters becomes a matter of autonomy. Can users select value-aligned personalization modes? Can they audit their perceptual filters? Can communities define shared defaults for their members? Without such controls, the addictive dynamics observed in social media risk becoming embedded in everyday perception itself.

Without meaningful agency, individuals in a PSoc risk becoming passive recipients of algorithmically mediated realities. Regulatory lessons from social media show that transparency, incentive alignment, and genuine user control are therefore not superficial concerns but structural preconditions for ensuring that a PSoc enhances participation and connection rather than deepening fragmentation and asymmetric control over perceived realities.

5. Conclusion

The emergence of a Personalized Society based on current technological developments creates social, governance, normative and ethical tensions in which individual and societal interests collide. In this paper, we presented some initial methods to mitigate these issues and discussed challenges that need to be addressed in a PSoc to guarantee connected social realities. Based on how online personalization is regulated nowadays, e.g., on social media, we further discussed how PRs may be regulated to ensure a socially oriented future in a PSoc.

We urge designers, researchers, and regulators of personalized experiences using XR, AI, and UbiComp technologies and approaches to consider the societal perspective we presented in this paper, and to prioritize connections between individual PRs. We fear that, otherwise, our societies may develop in an increasingly disconnected and isolated direction, where the common, shared social realities of people will be increasingly replaced by fragmented individual personalized perceptions of reality.

Declaration on Generative AI

The author(s) have not employed any Generative AI tools.

References

[1] P. A. Rauschnabel, R. Felix, C. Hinsch, H. Shahab, F. Alt, What is XR? Towards a Framework for Augmented and Virtual Reality, Computers in Human Behavior 133 (2022) 107289. URL: https://www.sciencedirect.com/science/article/pii/S074756322200111X. doi:10.1016/j.chb.2022.107289.

[2] M. Speicher, B. D. Hall, M. Nebeling, What is Mixed Reality?, in: Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems, ACM, Glasgow, Scotland, UK, 2019, pp. 1–15. URL: https://dl.acm.org/doi/10.1145/3290605.3300767. doi:10.1145/3290605.3300767.

[3] R. Skarbez, M. Smith, M. C. Whitton, Revisiting Milgram and Kishino's Reality-Virtuality Continuum, Frontiers in Virtual Reality 2 (2021) 647997. URL: https://www.frontiersin.org/articles/10.3389/frvir.2021.647997/full. doi:10.3389/frvir.2021.647997.

[4] L. B. Rosenberg, Augmented Reality: Reflections at Thirty Years, in: K. Arai (Ed.), Proceedings of the Future Technologies Conference (FTC) 2021, Volume 1, Lecture Notes in Networks and Systems, Springer International Publishing, Cham, 2022, pp. 1–11. doi:10.1007/978-3-030-89906-6_1.

[5] J. Strecker, L. Bekavac, K. Bektaş, S. Mayer, Change Your Perspective, Widen Your Worldview! Societally Beneficial Perceptual Filter Bubbles in Personalized Reality, in: Proceedings of Purposeful XR: Affordances, Challenges, and Speculations for an Ethical Future at CHI 2025 (Purposeful XR '25), Yokohama, Japan, 2025, p. 6. URL: https://www.alexandria.unisg.ch/handle/20.500.14171/122376. doi:10.48550/arXiv.2504.10271.

[6] A. Zarindast, J. Wood, A Data-Driven Personalized Lighting Recommender System, Frontiers in Big Data 4 (2021). URL: https://www.frontiersin.org/journals/big-data/articles/10.3389/fdata.2021.706117/full. doi:10.3389/fdata.2021.706117.

[7] J.-i. Lee, W. Stuerzlinger, Towards Personalized Navigation in XR: Design Recommendations to Accommodate Individual Differences, in: 3rd Workshop on Locomotion and Wayfinding in XR at IEEE VR 2025, Saint Malo, France, 2025, p. 5.

[8] R. Natalie, R.-C. Chang, S. Sheshadri, A. Guo, K. Hara, Audio Description Customization, in: Proceedings of the 26th International ACM SIGACCESS Conference on Computers and Accessibility, ASSETS '24, Association for Computing Machinery, New York, NY, USA, 2024, pp. 1–19. URL: https://dl.acm.org/doi/10.1145/3663548.3675617. doi:10.1145/3663548.3675617.

[9] S. H. Yoon, A. Bianchi, H. Seifi, J. R. Kim, R.-D. Vatavu, J. Lee, G. Lee, Beyond Glasses: Future Directions for XR Interactions within the Physical World, in: Proceedings of the Extended Abstracts of the CHI Conference on Human Factors in Computing Systems, ACM, Yokohama Japan, 2025, pp. 1–6. URL: https://dl.acm.org/doi/10.1145/3706599.3706715. doi:10.1145/3706599.3706715.

[10] J. Grubert, T. Langlotz, S. Zollmann, H. Regenbrecht, Towards Pervasive Augmented Reality: Context-Awareness in Augmented Reality, IEEE Transactions on Visualization and Computer Graphics 23 (2017) 1706–1724. doi:10.1109/TVCG.2016.2543720, conference Name: IEEE Transactions on Visualization and Computer Graphics.

[11] D. Görlich, Societal XR—A Vision Paper, ParadigmPlus 3 (2022) 1–10. URL: https://journals.itiud.org/index.php/paradigmplus/article/view/35. doi:10.55969/paradigmplus.v3n2a1.

[12] R. Johnstone, N. McDonnell, J. R. Williamson, When Virtuality Surpasses Reality: Possible Futures of Ubiquitous XR, in: CHI Conference on Human Factors in Computing Systems Extended Abstracts, ACM, New Orleans, LA, USA, 2022, pp. 1–8. URL: https://dl.acm.org/doi/10.1145/3491101.3516396. doi:10.1145/3491101.3516396.

[13] X. Li, Y. Zhou, W. Chen, P. Hansen, W. Geng, L. Sun, 8. Towards personalized virtual reality touring through cross-object user interfaces, in: Personalized Human-Computer Interaction, De Gruyter, 2019, pp. 201–222. URL: https://www.degruyter.com/document/doi/10.1515/9783110552485-008/html. doi:10.1515/9783110552485-008.

[14] J. Orlosky, M. Sra, K. Bektaş, H. Peng, J. Kim, N. Kos'myna, T. Höllerer, A. Steed, K. Kiyokawa, K. Akşit, Telelife: The Future of Remote Living, Frontiers in Virtual Reality 2 (2021) 19. URL: https://www.frontiersin.org/articles/10.3389/frvir.2021.763340.

[15] M. Madary, Mediated Reality, in: Exploring Extended Realities, Routledge, 2023, p. 19.

[16] V. Krauss, P. Saeghe, A. Boden, M. Khamis, M. McGill, J. Gugenheimer, M. Nebeling, What Makes XR Dark? Examining Emerging Dark Patterns in Augmented and Virtual Reality through Expert Co-Design, ACM Trans. Comput.-Hum. Interact. 31 (2024) 39. URL: https://doi.org/10.1145/3660340. doi:10.1145/3660340.

[17] C. Eghtebas, G. Klinker, S. Boll, M. Koelle, Co-Speculating on Dark Scenarios and Unintended Consequences of a Ubiquitous(ly) Augmented Reality, in: Proceedings of the 2023 ACM Designing Interactive Systems Conference, ACM, Pittsburgh PA USA, 2023, pp. 2392–2407. URL: https://dl.acm.org/doi/10.1145/3563657.3596073. doi:10.1145/3563657.3596073.

[18] H. Hadan, D. M. Wang, L. E. Nacke, L. Zhang-Kennedy, Privacy in Immersive Extended Reality:

Exploring User Perceptions, Concerns, and Coping Strategies, in: Proceedings of the CHI Conference on Hu- man Factors in Computing Systems (CHI '24), ACM, Honolulu, HI, USA, 2024, p. 24. doi:10.1145/3613904.3642104.

[19] M. Abraham, P. Saeghe, M. McGill, M. Khamis, Implications of XR on Privacy, Security and Behaviour: Insights from Experts, in: Nordic Human-Computer Interaction Conference, NordiCHI '22, Association for Computing Machinery, New York, NY, USA, 2022, pp. 1–12. URL: https://dl.acm.org/doi/10.1145/3546155.3546691. doi:10.1145/3546155.3546691.

[20] European Parliament, Council of the European Union, Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC (General Data Protection Regulation), Official Journal of the European Union 59 (2016) 1–88. URL: http://data.europa.eu/eli/reg/2016/679/oj/eng.

[21] J. Strecker, S. Mayer, K. Bektas, Personalized Reality: Challenges of Responsible Ubiquitous Personalization, in: Mensch und Computer 2024 - Workshopband, Gesellschaft für Informatik e.V., Karlsruhe, Germany, 2024, p. 5. URL: https://dl.gi.de/handle/20.500.12116/44326. doi:10.18420/muc2024-mci-ws11-200.

[22] J. Hong, T. Langlotz, J. Sutton, H. Regenbrecht, Visual Noise Cancellation: Exploring Visual Discomfort and Opportunities for Vision Augmentations, ACM Transactions on Computer-Human Interaction 31 (2023) 1–26. URL: https://dl.acm.org/doi/10.1145/3634699. doi:10.1145/3634699, just Accepted.

[23] J. Erickson, Rethinking the filter bubble? Developing a research agenda for the protective filter bubble, Big Data & Society 11 (2024) 20539517241231276. URL: https://doi.org/10.1177/20539517241231276. doi:10.1177/20539517241231276.

[24] D. Lutz, The Maya Lenz - A speculative design concept for future AR, 2023. URL: https://www.damienlutz.com.au/thelenz/, retrieved February 17, 2026.

[25] Liquid City, Niantic, Stories from the Real-World Metaverse, 2022. URL: https://liquid.city/stories/, retrieved February 17, 2026.

[26] K. Matsuda, Hyper-Reality, 2016. URL: http://hyper-reality.co/, retrieved February 17, 2026.

[27] R. Suzuki, M. Gonzalez-Franco, M. Sra, D. Lindlbauer, Everyday ar through ai-in-the-loop, in: Proceedings of the Extended Abstracts of the CHI Conference on Human Factors in Computing Systems, CHI EA '25, Association for Computing Machinery, New York, NY, USA, 2025. URL: https://doi.org/10.1145/3706599.3706741. doi:10.1145/3706599.3706741.

[28] E. Jolly, D. I. Tamir, B. Burum, J. P. Mitchell, Wanting without enjoying: The social value of sharing experiences, PLOS ONE 14 (2019) e0215318. URL: https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0215318. doi:10.1371/journal.pone.0215318.

[29] G. Echterhoff, E. T. Higgins, J. M. Levine, Shared Reality: Experiencing Commonality with others' Inner States about the World, Perspectives on Psychological Science 4 (2009) 496–521. URL: https://doi.org/10.1111/j.1745-6924.2009.01161.x. doi:10.1111/j.1745-6924.2009.01161.x.

[30] M. Magin, S. Geiß, B. Stark, P. Jürgens, Common Core in Danger? Personalized Information and the Fragmentation of the Public Agenda, The International Journal of Press/Politics 27 (2022) 887–909. URL: https://journals.sagepub.com/doi/10.1177/19401612211026595. doi:10.1177/19401612211026595.

[31] M. Bay, Arendt in the Metaverse: Four properties of eXtended Reality that imperil factual truth and democracy, Convergence 29 (2023) 1698–1712. URL: https://doi.org/10.1177/13548565231199957. doi:10.1177/13548565231199957.

[32] J. Habich, V. Nowotny, Fragmented Realities – Searching for a Common Understanding of Truth, Technical Report, Bertelsmann Stiftung, Salzburg, 2019.

[33] N. Sharma, Q. V. Liao, Z. Xiao, Generative Echo Chamber? Effect of LLM-Powered Search Systems on Diverse Information Seeking, in: Proceedings of the CHI Conference on Human Factors in Computing Systems, ACM, Honolulu HI USA, 2024, pp. 1–17. URL: https://dl.acm.org/doi/10.1145/3613904.3642459. doi:10.1145/3613904.3642459.

[34] D. J. Chalmers, Reality+: Virtual Worlds and the Problems of Philosophy, Penguin Books, S.l., 2023.

[35] M. Tretter, M. Hahn, P. Dabrock, Towards a smart glasses society? Ethical perspectives on extended realities and augmenting technologies, Frontiers in Virtual Reality 5 (2024) 1404890. URL: https://www.frontiersin.org/articles/10.3389/frvir.2024.1404890/full. doi:10.3389/frvir.2024.1404890.
[36] I. Kuksa, T. Fisher, A. Kent, Understanding personalisation: new aspects of design and consumption, Chandos Publishing, Cambridge, MA, USA, 2023.
[37] M. Brincker, Disoriented and Alone in the "Experience Machine" – On Netflix, Shared World Deceptions and the Consequences of Deepening Algorithmic Personalization, SATS 22 (2021) 75–96. URL: https://www.degruyter.com/document/doi/10.1515/sats-2021-0005/html?lang=de. doi:10.1515/sats-2021-0005.
[38] J. Strecker, S. Mayer, K. Bektaş, Towards Societally Beneficial Personalized Realities: A Conceptual Foundation for Responsible Ubiquitous Personalization Systems, in: Designing Interactive Systems Conference (DIS '25), ACM, Madeira, Portugal, 2025, p. 23. doi:10.1145/3715336.3735709.
[39] B. Marques, S. Silva, J. Alves, T. Araujo, P. Dias, B. S. Santos, A conceptual model and taxonomy for collaborative augmented reality, IEEE transactions on visualization and computer graphics 28 (2021) 5113–5133.
[40] H. Regenbrecht, A. Knott, J. Ferreira, N. Pantidi, To See and be Seen—Perceived Ethics and Acceptability of Pervasive Augmented Reality, IEEE Access 12 (2024) 32618–32636. URL: https://ieeexplore.ieee.org/document/10436676/. doi:10.1109/ACCESS.2024.3366228.
[41] Y. Do, F. Brudy, G. Fitzmaurice, F. Anderson, Vice VRsa: Balancing Bystander's and VR user's Privacy through Awareness Cues Inside and Outside VR, in: Graphics Interface Conference 2023, 2023, p. 10.
[42] F. Welsford-Ackroyd, A. Chalmers, R. Kuffner dos Anjos, D. Medeiros, H. Kim, T. Rhee, Spectator View: Enabling Asymmetric Interaction between HMD Wearers and Spectators with a Large Display, Proc. ACM Hum.-Comput. Interact. 5 (2021) 485:1–485:17. URL: https://dl.acm.org/doi/10.1145/3486951. doi:10.1145/3486951.
[43] K. Bektaş, A. Pandjaitan, J. Strecker, S. Mayer, GlassBoARd: A Gaze-Enabled AR Interface for Collaborative Work, in: Extended Abstracts of the 2024 CHI Conference on Human Factors in Computing Systems, CHI EA '24, Association for Computing Machinery, New York, NY, USA, 2024, pp. 1–8. URL: https://dl.acm.org/doi/10.1145/3613905.3650965. doi:10.1145/3613905.3650965.
[44] Y. Tunga, K. Cagiltay, Looking through the model's eye: A systematic review of eye movement modeling example studies, Education and Information Technologies 28 (2023) 9607–9633.
[45] J. Strecker, S. Mayer, K. Bektaş, Sharing Personalized Mixed Reality Experiences, in: Mensch und Computer 2023 – Workshopband, Gesellschaft für Informatik e.V., Rapperswil, SG, 2023, p. 3. URL: https://doi.org/10.18420/muc2023-mci-ws12-263. doi:10.18420/muc2023-mci-ws12-263.
[46] A. Ovadya, L. Thorburn, Bridging Systems: Open Problems for Countering Destructive Divisiveness across Ranking, Recommenders, and Governance, 2023. URL: http://arxiv.org/abs/2301.09976, arXiv:2301.09976 [cs].
[47] J. Stray, A. Halevy, P. Assar, D. Hadfield-Menell, C. Boutilier, A. Ashar, C. Bakalar, L. Beattie, M. Ekstrand, C. Leibowicz, C. Moon Sehat, S. Johansen, L. Kerlin, D. Vickrey, S. Singh, S. Vrijenhoek, A. Zhang, M. Andrus, N. Helberger, P. Proutskova, T. Mitra, N. Vasan, Building Human Values into Recommender Systems: An Interdisciplinary Synthesis, ACM Transactions on Recommender Systems 2 (2023) 62. URL: https://dl.acm.org/doi/10.1145/3632297. doi:10.1145/3632297.
[48] M. Li, S. Goodwin, T. Dwyer, J. Evans, Exploring Human Values in Mixed Reality Futures, in: Designing Interactive Systems Conference, ACM, IT University of Copenhagen Denmark, 2024, pp. 197–213. URL: https://dl.acm.org/doi/10.1145/3643834.3660712. doi:10.1145/3643834.3660712.
[49] B. Friedman, Value-sensitive design, Interactions 3 (1996) 16–23. URL: https://dl.acm.org/doi/10.1145/242485.242493. doi:10.1145/242485.242493.
[50] A. Borning, M. Muller, Next steps for value sensitive design, in: Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, ACM, Austin, Texas, USA, 2012, pp. 1125–1134. URL: https://dl.acm.org/doi/10.1145/2207676.2208560. doi:10.1145/2207676.2208560.
[51] Z. Li, C. Gebhardt, Y. Inglin, N. Steck, P. Streli, C. Holz, SituationAdapt: Contextual UI Optimization in Mixed Reality with Situation Awareness via LLM Reasoning, in: Proceedings of the 37th

Annual ACM Symposium on User Interface Software and Technology, UIST '24, Association for Computing Machinery, New York, NY, USA, 2024, pp. 1–13. URL: https://dl.acm.org/doi/10.1145/3654777.3676470. doi:10.1145/3654777.3676470.

[52] J. Bonner, F. Mathis, J. O'Hagan, M. McGill, When Filters Escape the Smartphone: Exploring Acceptance and Concerns Regarding Augmented Expression of Social Identity for Everyday AR, in: 29th ACM Symposium on Virtual Reality Software and Technology, ACM, Christchurch New Zealand, 2023, pp. 1–14. URL: https://dl.acm.org/doi/10.1145/3611659.3615707. doi:10.1145/3611659.3615707.

[53] J. O. Rixen, C. Funk, E. Rukzio, J. Gugenheimer, May I Still Define Myself? Exploring How Dissonance in Displaying Personal Information Through Head-Mounted Augmented Reality Can Affect Personal Information Sovereignty, in: Extended Abstracts of the 2023 CHI Conference on Human Factors in Computing Systems, ACM, Hamburg Germany, 2023, pp. 1–7. URL: https://dl.acm.org/doi/10.1145/3544549.3585821. doi:10.1145/3544549.3585821.

[54] J. O'Hagan, J. Gugenheimer, J. Bonner, F. Mathis, M. McGill, Augmenting People, Places & Media: The Societal Harms Posed by Everyday Augmented Reality, and the Case for Perceptual Human Rights, in: Proceedings of the 22nd International Conference on Mobile and Ubiquitous Multimedia, MUM '23, Association for Computing Machinery, New York, NY, USA, 2023, pp. 219–229. URL: https://dl.acm.org/doi/10.1145/3626705.3627782. doi:10.1145/3626705.3627782.

[55] A. Nijholt, Experiencing Social Augmented Reality in Public Spaces, in: Adjunct Proceedings of the 2021 ACM International Joint Conference on Pervasive and Ubiquitous Computing and Proceedings of the 2021 ACM International Symposium on Wearable Computers, ACM, Virtual USA, 2021, pp. 570–574. URL: https://dl.acm.org/doi/10.1145/3460418.3480157. doi:10.1145/3460418.3480157.

[56] H. Regenbrecht, S. Zwanenburg, T. Langlotz, Pervasive Augmented Reality—Technology and Ethics, IEEE Pervasive Computing 21 (2022) 1–8. URL: https://ieeexplore.ieee.org/document/9733791/. doi:10.1109/MPRV.2022.3152993.

[57] R. Cools, R. Venema, A. Esteves, A. L. Simeone, The Impact of Near-Future Mixed Reality Contact Lenses on Users' Lives via an Immersive Speculative Enactment and Focus Groups, in: ACM Symposium on Spatial User Interaction, ACM, Trier Germany, 2024, pp. 1–13. URL: https://dl.acm.org/doi/10.1145/3677386.3682099. doi:10.1145/3677386.3682099.

[58] N. Gudowsky, J. Kowalski, T. Bork-Hüffer, Augmented futures? Scenarios and implications of augmented reality use in public spaces, Futures 151 (2023) 103193. URL: https://www.sciencedirect.com/science/article/pii/S0016328723000976. doi:10.1016/j.futures.2023.103193.

[59] M. Moslavac, S. Vlahović, L. Skorin-Kapov, Towards a Unified Definition of Social XR, in: 2025 IEEE Conference on Virtual Reality and 3D User Interfaces Abstracts and Workshops (VRW), 2025, pp. 569–573. URL: https://ieeexplore.ieee.org/document/10972808/. doi:10.1109/VRW66409.2025.00121.

[60] F. Mathis, Everyday Life Challenges and Augmented Realities: Exploring Use Cases For, and User Perspectives on, an Augmented Everyday Life, in: The Augmented Humans International Conference (AHs 2024), ACM, Melbourne, VIC, Australia, 2024. doi:10.1145/3652920.3652921.

[61] E. Herder, L. Stojko, J. Strecker, T. Neumayr, E. Yigitbas, M. Augstein, Towards new realities: implications of personalized online layers in our daily lives, i-com (2024). URL: https://www.degruyter.com/document/doi/10.1515/icom-2024-0017/html. doi:10.1515/icom-2024-0017.

[62] M. McGill, J. O'Hagan, T. Goodge, G. Wilson, M. Khamis, V. Krauß, J. Gugenheimer, Do We Need Responsible XR? Drawing on Responsible AI to Inform Ethical Research and Practice into XRAI / the Metaverse, in: Everyday AR through AI-in-the-Loop - Second Workshop on AR and AI, co-located with CHI 2025, 2025. URL: https://xr-and-ai.github.io/chi-2025/mark-mcgill.pdf.

[63] K. T. Espejon, J. M. Jayoma, E. S. Moyon, Low-Cost Mobile-Based Augmented Reality Viewer: Bridging the Gap Between Affordable AR Glasses and Smartphones, in: Proceedings of the 2023 12th International Conference on Networks, Communication and Computing, ICNCC '23, Association for Computing Machinery, New York, NY, USA, 2024, pp. 254–259. URL: https://dl.acm.org/doi/10.1145/3638837.3638877. doi:10.1145/3638837.3638877.

[64] M. Landwehr, A. Borning, V. Wulf, The High Cost of Free Services: Problems with Surveillance

Capitalism and Possible Alternatives for IT Infrastructure, in: Proceedings of the Fifth Workshop on Computing within Limits, LIMITS '19, Association for Computing Machinery, New York, NY, USA, 2019, pp. 1–10. URL: https://dl.acm.org/doi/10.1145/3338103.3338106. doi:10.1145/3338103.3338106.

[65] K. Allmann, R. Radu, Digital footprints as barriers to accessing e-government services, Global Policy 14 (2023) 84–94. URL: https://onlinelibrary.wiley.com/doi/abs/10.1111/1758-5899.13140. doi:10.1111/1758-5899.13140.

[66] European Parliament, Council of the European Union, Regulation (EU) 2022/1925 of the European Parliament and of the Council of 14 September 2022 on contestable and fair markets in the digital sector and amending Directives (EU) 2019/1937 and (EU) 2020/1828 (Digital Markets Act) (Text with EEA relevance), Official Journal of the European Union 65 (2022). URL: http://data.europa.eu/eli/reg/2022/1925/oj, legislative Body: CONSIL, EP.

[67] T. T. M. Minh Tran, S. Yoo, O. Weidlich, Y. Cao, X. Yu, X. Cheng, Y. Ye, N. Gulbransen-Diaz, C. Parker, Envisioning Audio Augmented Reality in Everyday Life, in: 2026 CHI Conference on Human Factors in Computing Systems (CHI '26), ACM, 2026, p. 16. doi:10.1145/3772318.3790620.

[68] F. Mathis, Y. Sun, A. Preussner, MRTranslate: Bridging Language Barriers in the Physical World Using a Mixed Reality Point-and-Translate System, in: Proceedings of the 2024 International Conference on Advanced Visual Interfaces, AVI '24, Association for Computing Machinery, New York, NY, USA, 2024, pp. 1–9. doi:10.1145/3656650.3656652.

[69] E. H. A. de Haas, L.-H. Lee, Deceiving Audio Design in Augmented Environments : A Systematic Review of Audio Effects in Augmented Reality, in: 2022 IEEE International Symposium on Mixed and Augmented Reality Adjunct (ISMAR-Adjunct), 2022, pp. 36–43. URL: https://ieeexplore.ieee.org/document/9974497/. doi:10.1109/ISMAR-Adjunct57072.2022.00018.

[70] S. A. Crossley, Technological disruption in foreign language teaching: The rise of simultaneous machine translation, Language Teaching 51 (2018) 541–552. doi:10.1017/S0261444818000253.

[71] J. Scally, A. Parrish, A. Montgomery, Intercultural competence and languages: inextricably linked or linked inexplicably?, Compare: A Journal of Comparative and International Education 52 (2022) 492–510. doi:10.1080/03057925.2020.1851000.

[72] M. L. Bernacki, M. J. Greene, N. G. Lobczowski, A Systematic Review of Research on Personalized Learning: Personalized by Whom, to What, How, and for What Purpose(s)?, Educational Psychology Review 33 (2021) 1675–1715. URL: https://doi.org/10.1007/s10648-021-09615-8. doi:10.1007/s10648-021-09615-8.

[73] N. Kucirkova, S. Leaton Gray, Beyond Personalization: Embracing Democratic Learning Within Artificially Intelligent Systems, Educational Theory 73 (2023) 469–489. URL: https://onlinelibrary.wiley.com/doi/abs/10.1111/edth.12590. doi:10.1111/edth.12590.

[74] M. Campbell, E. J. Edwards, D. Pennell, S. Poed, V. Lister, J. Gillett-Swan, A. Kelly, D. Zec, T.-A. Nguyen, Evidence for and against banning mobile phones in schools: A scoping review, Journal of Psychologists and Counsellors in Schools 34 (2024) 242–265. URL: https://doi.org/10.1177/20556365241270394. doi:10.1177/20556365241270394.

[75] M. Chikobava, A. Krüger, "Do You Even Need a City Guide Anymore?" Expert Adoption of XR Technology for Guided City Tours, in: 2025 IEEE International Symposium on Mixed and Augmented Reality (ISMAR), 2025, pp. 1202–1212. URL: https://ieeexplore.ieee.org/abstract/document/11220432. doi:10.1109/ISMAR67309.2025.00126.

[76] C. Katins, J. Strecker, J. Hinrichs, P. Knierim, B. Pfleging, T. Kosch, Ad-Blocked Reality: Evaluating User Perceptions of Content Blocking Concepts Using Extended Reality, in: CHI Conference on Human Factors in Computing Systems (CHI '25), ACM, New York, NY, USA, 2025, p. 18. doi:10.1145/3706598.3713230.

[77] P. Jansen, J. Britten, M. Colley, M. Sasalovici, E. Rukzio, MIRAGE: Enabling Real-Time Automotive Mediated Reality, in: Proceedings of the 2026 CHI Conference on Human Factors in Computing Systems (CHI '26), ACM, New York, NY, USA, 2026, p. 20. doi:10.1145/3772318.3791195.

[78] E. Hine, I. N. Rezende, H. Roberts, D. Wong, M. Taddeo, L. Floridi, Safety and Privacy in Immersive Extended Reality: An Analysis and Policy Recommendations, Digital Society 3 (2024) 33. URL:

https://doi.org/10.1007/s44206-024-00114-1. doi:10.1007/s44206-024-00114-1.

[79] A. G. Cork, M. Richardson, H. K. Lukosch, M. Khamis, C. Katins, V. Krauβ, L. Ruffin, S. Papazoglakis, V. Sanchez, X. Pan, M. J. Proulx, D. Stanton Fraser, Shaping the future: principles for policy recommendations for responsible innovation in virtual worlds, Frontiers in Virtual Reality 6 (2025). doi:10.3389/frvir.2025.1645330.

[80] V. Dignum, Responsible Artificial Intelligence: How to Develop and Use AI in a Responsible Way, Artificial Intelligence: Foundations, Theory, and Algorithms, Springer International Publishing, Cham, 2019. URL: http://link.springer.com/10.1007/978-3-030-30371-6. doi:10.1007/978-3-030-30371-6.

[81] European Parliament, Council of the European Union, Regulation (EU) 2022/2065 of the European Parliament and of the Council of 19 October 2022 on a Single Market For Digital Services and amending Directive 2000/31/EC (Digital Services Act), Official Journal of the European Union 65 (2022). URL: http://data.europa.eu/eli/reg/2022/2065/oj/eng, legislative Body: EP, CONSIL.

[82] M. Zender, A. Cassedy, (mis)understanding: icon comprehension in different cultural contexts, Visible Language 48 (2014). URL: https://journals.uc.edu/index.php/vl/article/view/5880.

[83] N. M. Richards, W. Hartzog, Against engagement, Boston University Law Review (2024). URL: https://scholarship.law.bu.edu/faculty_scholarship/3818.

[84] M. Fabbri, L. Boratto, Auditing recommender systems for user empowerment in very large online platforms under the digital services act, in: Proceedings of the Nineteenth ACM Conference on Recommender Systems, RecSys '25, Association for Computing Machinery, New York, NY, USA, 2025, p. 51–61. URL: https://doi.org/10.1145/3705328.3748074. doi:10.1145/3705328.3748074.

[85] J. A. de Guzman, K. Thilakarathna, A. Seneviratne, Security and Privacy Approaches in Mixed Reality: A Literature Survey, ACM Computing Surveys 52 (2020) 1–37. URL: https://dl.acm.org/doi/10.1145/3359626. doi:10.1145/3359626.

[86] J. O'Hagan, P. Saeghe, J. Gugenheimer, D. Medeiros, K. Marky, M. Khamis, M. McGill, Privacy-Enhancing Technology and Everyday Augmented Reality: Understanding Bystanders' Varying Needs for Awareness and Consent, Proceedings of the ACM on Interactive, Mobile, Wearable and Ubiquitous Technologies 6 (2023) 177:1–177:35. URL: https://dl.acm.org/doi/10.1145/3569501. doi:10.1145/3569501, openAlex: W4319837288.

[87] M. Kleppmann, P. Frazee, J. Gold, J. Graber, D. Holmgren, D. Ivy, J. Johnson, B. Newbold, J. Volpert, Bluesky and the at protocol: Usable decentralized social media, in: Proceedings of the ACM Conext-2024 Workshop on the Decentralization of the Internet, DIN '24, Association for Computing Machinery, New York, NY, USA, 2024, p. 1–7. URL: https://doi.org/10.1145/3694809.3700740. doi:10.1145/3694809.3700740.