

# Creating Personalized Realities That Connect People’s Perceptions of Reality

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## Abstract

Driven by advances in Extended Reality, Ubiquitous Computing, and AI, personalized services are increasingly interwoven into people’s everyday lives. Such Ubiquitous Personalization (UP) may enable more efficient interaction and equitable information access. However, the Personalized Realities (PR) such UP creates may also diminish shared experiences and isolate individuals in fragmented realities. Additionally, by potentially mediating people’s full reality, UP grants unprecedented control to system designers, enabling both beneficial and manipulative practices. In my dissertation, I thus investigate how responsible UP systems in single- and multi-user contexts may create beneficial PRs while mitigating harmful implications. Through mixed-methods research combining conceptual frameworks, technical prototypes, and controlled user studies, I systematically study responsible UP systems and provide concrete examples for their implementation. My research aims to provide theoretical and practical foundations enabling researchers and practitioners to design, evaluate, and deploy useful PR experiences that connect people’s realities instead of isolating them.

## CCS Concepts

• Information systems → Personalization; • Human-centered computing → Mixed / augmented reality; Ubiquitous and mobile computing systems and tools.

## Keywords

extended reality, personalization, ubiquitous computing, privacy, responsible computing, societal implications

## ACM Reference Format:

Jannis Strecker-Bischoff. 2026. Creating Personalized Realities That Connect People’s Perceptions of Reality. In *Extended Abstracts of the 2026 CHI Conference on Human Factors in Computing Systems (CHI EA ’26)*, April 13–17, 2026, Barcelona, Spain. ACM, New York, NY, USA, 6 pages. <https://doi.org/10.1145/3772363.3799183>

## 1 Introduction

People actively seek to sense the realities of others and to connect with what others experience [12, 32]. This provides the basis for

*shared worlds* [6] and *intersubjectivity*<sup>1</sup> [55], which in turn may be seen as pillars for a healthy society. These shared experiences rely on stimuli that all involved people can perceive and make sense of, though these are naturally constrained by people’s abilities. There are some (socially accepted) technological solutions such as prescription glasses or hearing aids that help people perceive stimuli they would not otherwise. While these solutions effectively mediate reality for these individuals, they are usually not regarded as such, as they mainly enhance existing stimuli rather than adding content to them. In contrast, emerging devices such as Extended Reality (XR) head-mounted displays (HMDs) (e.g., Apple Vision Pro, or Samsung XR), or AI glasses (e.g., Ray-Ben Meta) not only have the possibilities to enhance existing but also to change, add or replace stimuli. Instead of a single factual truth for a given stimulus, there may potentially be several in XR, e.g., one for all Apple Vision Pro users and one for Samsung XR users, as the philosopher David Chalmers warns [7]. However, as we have argued (cf.[59]), when *personalization* (i.e., system-initiated interface adaptation based on personal data [60]) is employed on these devices, each personalized perception of reality may be considered *factually true*, as each person objectively perceives a mediated version of reality. We call the perceivable result of such Ubiquitous Personalization (UP) a *Personalized Reality (PR)* [60]. Since personalization itself is traditionally “fundamentally concerned with individual rather than collective or communitarian life”[35, p.43], PR may thus contribute to increasingly disconnected *Fragmented Realities* [23]. Additionally, the entity that controls a person’s PR is in a powerful position, as they are essentially able to, at will, “determine how users experience the world, how they conceive of themselves, and how they regard others” [39, p.99]. This is no longer futuristic thinking, as there are, for instance, smart glasses with integrated AI capabilities emerging that are marketed as “an intelligence that sees with you, remembers your life, and learns to understand you”<sup>2</sup>.

Thus, as ubiquitous XR and PR experiences gain widespread adoption, it is necessary to study this development to enable their responsible design and implementation while mitigating harmful consequences. In my dissertation, I aim to provide a holistic understanding of UP systems and the PRs they create, examining both the technological approaches enabling UP and the social implications of resulting PRs. I am especially focusing on studying how UP systems and PR experiences can be designed to benefit individuals while avoiding a dystopian future of isolated realities. My work aims to connect people’s PRs to retain shared perceptions of reality while preserving the benefits of personalized applications.

<sup>1</sup>i.e. “the common-sense, shared meanings constructed by people in their interactions with each other and used as an everyday resource to interpret the meaning of elements of social and cultural life” [55, p.1126]

<sup>2</sup><https://www.pickle.com/1>. Last accessed February 26, 2026.



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ACM ISBN 979-8-4007-2281-3/2026/04

<https://doi.org/10.1145/3772363.3799183>

## 2 Related Work

The term *Personalization* commonly refers to the processing of personal data by a system as input, the adaption of how a system works in response to personal data, and the personalized content that such a system outputs (cf. [6, 16, 54, 66, 67]). The European Union’s General Data Protection Regulation (GDPR) defines such personal data as “[...] any information relating to an identified or identifiable natural person” [15, p.33]. Often, the term Personalization is used synonymously with Web Personalization [54] where it is applied, e.g., to advertisements [13], music recommendations [45], or social media posts [33]. Benefits of personalization include, e.g., higher efficiency and comfort for users, reduction of information and option overload [6], provision of equal access to users with diverse capabilities and interaction requirements [17, 38], and better preference matching [67]. In contrast, potential harms of personalization include, e.g., a lack of transparency [6], manipulation possibilities [71], perceived or actual loss of control for users [66], and privacy risks [67], whereas the potential of personalization technologies to create and nourish echo chambers and filter bubbles is debated [22, 43, 65].

### 2.1 Extending Personalization from the Web to Physical Reality

This scope extension of personalization systems from the Web to any reality is facilitated by a combination of technologies such as Extended Reality (XR) [50]<sup>3</sup>, Artificial Intelligence (AI), and Ubiquitous Computing (UbiComp). XR may (fully or partially) diminish, modify, or augment the perception of physical objects and the user’s experience of their environment in a personalized way. While XR is often only associated with visual displays, such as HMDs or smartphones, it may stimulate all human senses [57]. This allows extending personalization of physical artifacts also to, e.g., auditory [70], tactile [46, 72], edible [49], and olfactory interfaces [36]. A recent, emerging example of personalized audio interfaces are AI-enabled glasses such as the Meta Ray Ban glasses, that, among other functionalities, allow people to converse with an AI agent. The information these smart glasses access is increasingly personalized, as OpenAI CEO Sam Altman describes the future of ChatGPT as “a shift from being all reactive to being significantly proactive, and extremely personalized.”<sup>4</sup> As these AI glasses are comparatively light-weight and affordable, their always-on personalized information access may be the first mass-product that creates Personalized Realities in everyday life. Beyond LLMs, generative AI is increasingly used to modify these XR experiences in real-time, e.g. to allow the creation of 3D objects [27], or for personalized learning experiences in XR [47]. In addition, embedded connected devices (i.e., UbiComp [68]) may personalize users’ physical reality more directly through dynamically adapted properties, without relying on mediators such as XR devices. Recent examples include humanoid robots preparing personalized drinks [30], personalized smart coffee machines [40], self-actuating furniture improving ergonomics for specific users [69]. In summary, devices that provide

personalized content for any sensory modality in various areas of people’s lives are increasingly capable and available.

### 2.2 Ubiquitous Personalization and Society

However, research on ubiquitous XR (see *Pervasive AR* [21] and related concepts [4, 19, 31, 44, 52]) that describes continuous, omnipresent, everyday XR interfaces, warns about the possible harmful implications such ubiquitous interfaces may have. As their potential harms (e.g., loss of control and agency [31], the creation of (perceptual) filter bubbles [2, 53], or information asymmetries [51]) are similar to the harms of personalization, they are likely to be amplified when combined. One of these implications may be, for instance, the erosion of *shared worlds* [6], i.e. common experiences and references that connect society. When individuals perceive personalized versions of reality, this may further deplete the common experiences that bind people together and thus significantly impact individuals and society [2, 53, 62] as physical reality with its *shared worlds* provides a foundation of how people understand reality around them and communicate with others about it.

## 3 Research Objectives

While research is beginning to imagine personalization and its impact beyond the Web [9, 14, 28, 41], a systematic description of the phenomena is needed to mitigate these potentially harmful implications stemming from PR experiences. Prior research on personalization has focused mostly on Web personalization and the personalization algorithm in particular while neglecting the other parts of personalization systems such as the delivery device or the social context in which the personalized content is perceived (cf. [35]). Similarly, research on ubiquitous XR and related phenomena has employed personalization as one of many techniques while not taking the specific requirements and implications sufficiently into account, such as isolated perceptions of reality. As personalization is employed in increasingly ubiquitous ways, a more holistic view is needed that considers all these important aspects of *Responsible Ubiquitous Personalization Systems (RUPS)* and the *Personalized Realities (PR)* they create. Thus, in my research, I will study how RUPS and PR experiences may be realized in a *responsible* manner that connect rather than isolate people’s realities by addressing four main research questions:

- RQ1** How can ubiquitous personalization systems be modeled to support the design, implementation and analysis of such systems in a responsible way?
- RQ2** What are suitable ways to give humans transparency and agency over the flow of their personal data in RUPS?
- RQ3** How can PR support humans transparently to efficiently navigate affordance-rich realities?
- RQ4** In a multi-user PR scenario, what are suitable, effective and usable methods to counter isolated perceptions of reality?

## 4 Research Contributions

### 4.1 RQ1: A Conceptual Model for Responsible Ubiquitous Personalization Systems

The first research question (RQ1) addresses the creation of a systematic description of ubiquitous personalization. To achieve this, we

<sup>3</sup>We use XR as an umbrella-term for concepts such as Augmented, Mixed or Virtual Reality, see [50, 53, 58].

<sup>4</sup><https://x.com/sama/status/1971297661748953263>. Last accessed January 21, 2026.

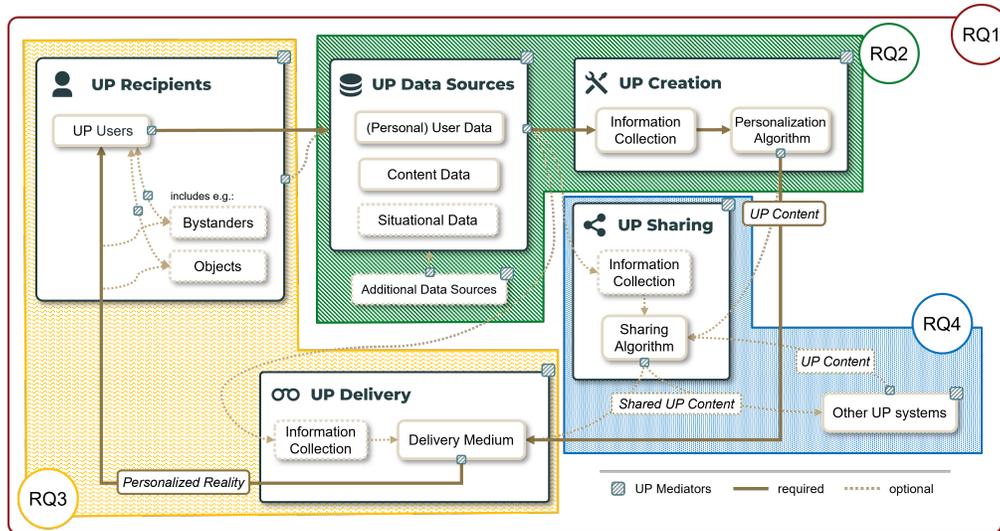


Figure 1: The RUPS model we presented last year [61] with the relevant components highlighted for each RQ.

studied conceptual models because these can help abstract complex systems, capture technical, social, and ethical interactions, and potentially guide responsible design in ways that empirical or purely technical methods may not (cf. [20, 24, 42]). Existing personalization models were developed for the Web and primarily focus on optimizing content delivery based on algorithm improvements. While these models account for some technical, societal, and economic factors, they do not present a holistic description of personalization in real-world contexts, including, e.g., delivery devices and contexts of use, and do not address the amplified risks posed by combining ubiquitous XR with personalization such as fragmented perceptions of reality. As PR extends beyond Web interfaces into hybrid environments, a new model is needed to systematically capture these unique mechanisms, their interactions, and the responsible design practices required to mitigate potential dystopian outcomes.

**Research Results:** We presented the outcome of RQ1 last year at the ACM DIS conference [61]. Its main contribution is the model for Responsible Ubiquitous Personalization Systems (RUPS). The RUPS model consists of five main components (see Figure 1), each potentially influenced by UP Mediators: UP Recipients, UP Data Sources, UP Creation, UP Sharing, and UP Delivery. The model builds on existing (Web) personalization models but substantially extends the scope of personalization to virtual, hybrid, and physical environments, providing a holistic description of personalization systems. We validated the model by applying it to existing personalization systems, demonstrating that it can (a) comprehensively describe these systems, (b) highlight their potential shortcomings, and (c) point toward useful extensions. This work lays the foundation for structured discourse about responsible UP systems. It provides guidance for designers and engineers of such systems and helps regulators and policymakers assess existing and future systems. In doing so, it aims to advance the understanding of how to design human-centered and societally responsible PR experiences. Each of the following RQs is addressing specific parts of the RUPS model (see Figure 1) in more detail.

## 4.2 RQ2: Increasing Transparency and Agency Over The Flow of Personal Data in RUPS

Any personalization system processes personal data by definition (see Section 2), and potentially more data in a UbiComp or XR context (cf. [18, 25, 48]). Thus, it is important to transparently communicate which personal and non-personal data in a RUPS is used for which purpose and to give users control over the flow of their data. There are existing methods for controlling privacy-related permissions in XR on a conceptual [48] and practical level [1, 11]. However, these approaches are not specifically designed for personalization contexts, where systems fundamentally depend on personal data. Thus, consent mechanisms (cf. [29]) must clearly and transparently communicate this data requirement while still providing meaningful control options for people.

**Ongoing Work:** Towards RQ2, we are currently implementing an XR application that uses Solid Pods<sup>5</sup> and the Data Privacy Vocabulary’s Personal Data Categories<sup>6</sup> to enable a very fine-grained control over which personal data the application may use for which purpose and how long. We will employ our permission interface in different scenarios that require different types and amounts of data (e.g., health, ads, or shopping), and make sure that the fine granularity does not visually overload users. We will then compare our interface to existing ones (e.g., [1, 56]) to investigate whether our proposed method is more suitable for a PR context. Once the prototype is implemented we will conduct a systematic user study and submit the results to a suitable venue in spring 2026.

<sup>5</sup>Solid Pods are Web-accessible personal online datastores that allow users to manage their data independently of the applications that consume it. See <https://solidproject.org>. Last accessed January 21, 2026.

<sup>6</sup><https://w3c.github.io/dpv/2.2/pd/>. Last accessed January 21, 2026.

### 4.3 RQ3: Transparent and Efficient Navigation Of Affordance-rich Realities Through Personalization

While (personal) data is essential input for personalization algorithms, a RUPS' output must also be evaluated for efficacy and effectiveness. Personalization reduces information and option overload [6] by filtering available options to align with user preferences. This filtering could be applied in PR experiences across affordance-rich environments such as industrial shop floors, supermarkets, or warehouses. Different methods exist for personalized filtering in PR, including diminishing non-recommended options (see Diminished Reality (DR) [8]) or highlighting recommended ones (e.g., [3]). Crucially, this option filtering requires transparent communication of what has been personalized and why. This must be carefully balanced to avoid overwhelming users with additional information in already affordance-rich environments (cf. [26]). RQ3 thus focuses on creating efficient and transparent PR experiences that are useful for individuals.

**First Research Results and Ongoing Work:** Contributing to RQ3, our ShoppingCoach prototype visually diminishes unhealthy products based on personalized nutrition recommendations in a supermarket using an XR HMD to discourage people from choosing these products [63]. Our results showed that the diminishment indeed helped participants (N=12) to be more compliant with the given recommendations. Thus, DR seems to be a promising technique for managing information overload in PR. Furthermore, we have also worked with others on other techniques that may be helpful in making PR experiences more efficient, such as the automatic generation of XR user interfaces (UI) using LLMs [37], using DR for XR ad-blocking [34], or gaze-based activity recognition [5]. Towards the transparency requirement, we built a system that provides personalized recommendations in XR to support first-time players of a strategic board game. The recommendations use analogies tailored to each user's existing knowledge, such as other board games or movies (e.g., "try increasing your science production, similar to how you would expand a settlement in Catan to maximize resource generation"). By connecting new concepts to familiar knowledge, these personalized analogies make the system's reasoning more transparent and understandable to users. Our evaluation (N=32) showed that personalized recommendations enhance explanation satisfaction and hedonic user experience. We will present these results at ACM IUI in March 2026 [10]. Building on these initial results, we will continue studying techniques such as DR or gaze-input in more prototypes, and how to improve the transparency, e.g., by differentiating personalized from non-personalized content through visual cues such as icons or brief explanations. As PR experiences may span many different technologies with distinct requirements, such as AI glasses, robots, or smart home appliances, RQ3 aims to collect techniques showing how efficient and transparent PR experiences can be realized across different contexts, rather than a single output. Here, I would appreciate discussing potential techniques and contexts with other PhD Students and Mentors at the Dissertation Research Roundtable, to ensure that RQ3 covers a diverse set of methods.

### 4.4 RQ4: Societally Beneficial Multi-User Personalized Realities

As personalization is often seen as targeting and affecting only individuals, individual benefits drive the proliferation of personalized services. However, this perspective disregards how consuming and interacting with personalized content can have direct and indirect consequences for others, including bystanders. As physical reality serves as a basis for *shared worlds* [6] and the commonsense, shared meanings people construct (i.e., *intersubjectivity* [55]), PR potentially diminishes this perceptual overlap by personalizing physical reality, thereby affecting people's conceptual worldview, as we have argued [59]. In RQ4, we will therefore investigate methods for mitigating "perceptual filter bubbles" and isolated perceptions in multi-user PR by enabling users to share personalized content. This would preserve a shared perceptual basis through connections between people's personalized perceptions of reality, similar to how people currently make sense of unmediated stimuli together.

**Ongoing Work:** Towards answering RQ4, we initially presented different methods of sharing personalized content across users [62] (e.g., swapping the perceived content to foster mutual understanding on controversial topics in a museum exhibition), and later embedded them in the RUPS model [61]. So far, we described these sharing modes theoretically without a concrete implementation. To concretely implement these sharing modes, we are currently working on extending our ShoppingCoach prototype [63] for a multi-user scenario. In a shopping scenario, sharing personalized recommendations across users may be especially helpful, since people often buy groceries not only for themselves but also for, e.g., family members, flatmates or friends. For this implementation, I would be especially grateful for feedback at the Dissertation Research Roundtable on how to practically implement such sharing of personalized content that it is beneficial for individuals but also considers the social context in which it is employed. To provide further basis for discussion on these social aspects, in an upcoming workshop paper, we envision the implications on different areas of a society where people primarily access information and interact with others through a personalized mediation of reality, thus creating a *Personalized Society* [64].

## 5 Dissertation Status and Long-term Goals

In summary, I have a concrete plan of the research questions my dissertation addresses, and have gathered results for some of these RQs. However, there are still open questions for the research I am currently working on, where I would appreciate feedback from peers and mentors at the Dissertation Research Roundtable. I am currently a fourth-year PhD student at the University of St.Gallen in Switzerland. I have completed all required coursework and the expected completion date of my PhD studies is spring 2027. Upon graduation, I plan to seek a post-doctoral position in research where I can continue investigating how people's realities may be responsibly personalized while keeping bridges to and overlaps with the realities of others. Additionally, I would like to extend beyond personalization as an adaption method, and investigate the interplay between conceptual and perceptual worldviews in this space more.

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