# The Metaverse and Consumers' Vulnerabilities

*Niti Chatterjee, Gianclaudio Malgieri***

## *A. Introduction*

In the age of relentless technological advancement, the virtual and augmented realms are rapidly melding with our physical world. The emergence of the 'Metaverse'—an expansive digital universe blending augmented reality (AR) and virtual reality (VR) technologies—ushers in an era of immersive experiences that challenge the very fabric of our understanding of presence, interaction, and digital boundaries. Yet, as this expansive digital universe unravels, the implications for its end users, especially the vulnerable ones, grow more pronounced and intricate.[1]

This chapter embarks on a comprehensive exploration of the intertwined realms of the Metaverse and its influence on end users in a situation of vulnerability.[2] Beginning with a dive into the definitional aspects of AR and VR, it strives to demystify the immersive technologies that constitute the backbone of the Metaverse. It sheds light on the intricate sensors and the burgeoning domain of emotion recognition in AR/VR devices, which promise to make digital interactions more intuitive but also present new challenges.

A significant facet of this exploration pertains to wearable devices. These wearables, as intimate extensions of our physical selves in the digital realm, have the potential to induce new types of vulnerabilities in end users. They could also exacerbate existing areas of concern, transforming minor vulnerabilities into major threats. These wearables, while enhancing immersion

* Niti Chatterjee contributed mostly to Part I and II. Gianclaudio Malgieri contributed mostly to the Introduction and Part III.

1 Carlotta Rigotti and Gianclaudio Malgieri, 'Human Vulnerability in the Metaverse' (2023) Alliance for Digital Human Rights (AUDRI) Report Series <https://audri.org/resources/report-human-vulnerability-in-the-metaverse/>.

2 Gianclaudio Malgieri, *Vulnerability and Data Protection Law* (Oxford University Press 2023).

and user experience, necessitate a deeper probe into their broader implications.

Vulnerability, a term often laden with complex socio-legal connotations, is re-evaluated in the context of digital consumption and, more specifically, within the realm of AR/VR technologies. How does the Metaverse amplify existing vulnerabilities? In what ways might it induce new ones? These critical questions are dissected, laying the groundwork for a broader contemplation of the overarching impacts on end-users.

By venturing into these complex discussions, this chapter aims to foster a nuanced understanding of the Metaverse's vast potential and the attendant ethical, legal, and societal challenges it poses, especially for those at the crossroads of vulnerability.

## *I. Demystifying immersive technologies*

### 1. Definitional Aspects

In order to understand how the metaverse and associated immersive technologies may impact end-users of these technologies, it is important to highlight the definitions and key identifiers of AR/VR technologies.

#### a) AR Technology

AR adds digital elements to the natural/physical world by *"overlaying computer-generated information on reality*" irrespective of place or object.[3] Such placement of digital details (objects/animations) enhances the users' real-world[4] and enables decision-making through added information that users cannot detect using their 'human' senses.[5] Typically, AR projects computer-generated elements on display screens like smart glasses (*e.g.*, Google

3 Donna Berryman, 'Augmented Reality: A Review' (2012) 31 Medical Reference Services Quarterly 212.

4 Bernard Marr, 'The Fascinating History And Evolution Of Extended Reality (XR) – Covering AR, VR And MR' (*Forbes*, 17 May 2021) <https://www.forbes.com/sites/bernardmarr/2021/05/17/the-fascinating-history-and-evolution-of-extended-reality-xr--covering-ar-vr-and-mr/> accessed 8 January 2023.

5 Ronald Azuma, 'A Survey of Augmented Reality' (1997) 6 Presence: Teleoperators and Virtual Environments 355.

Glass), mobile phones, or dedicated headsets.[6] It 'expands' the physical world by relying on a digital 3D depiction of our surroundings ('*digital twin*') to link physical environment to the digital object.[7] A combination of access controls to hardware, alongside specialized software and AI, powers AR technology. Since physical reality is an essential component of AR,[8] access to a camera-equipped device is required to recreate a digitalized version of the physical environment.

Popular examples of AR include games like Pokémon Go[9] or Instagram/Snapchat filters.[10] In the consumer market, AR-enabled interactive products have demonstrated a 94% higher conversion rate for shoppers.[11]

b) VR Technology

Unlike AR, physical environment is not requisite for VR. It comprises technologies that *"simulate interactive virtual environments … with which users become subjectively involved and … feel physically present*".[12] VR completely 'virtualizes' the user's physical environment, creates a synthetically fabricated interface,[13] and relies on the user's sensory system ('perception') to emulate their presence in such digital reality. Key elements like immersion, interactivity, and telepresence are used to design "*embodied*" virtual

6 Lucia Jasenovcova, 'What Is Augmented Reality and How Does AR Work?' (*Resco.net*, 10 August 2022) <https://www.resco.net/blog/what-is-augmented-reality-and-how-does-ar-work/> accessed 11 January 2023.

7 Michael Porter and James Heppelmann, 'How Does Augmented Reality Work?' [2017] *Harvard Business Review*.

8 Berryman (n 3) 213.

9 Ji-Young An and Claudio Nigg, 'The Promise of an Augmented Reality Game—Pokémon GO' (2017) 5 Annals of Translational Medicine S11.

10 'Snapchat Lens vs. Instagram Filter: AR as a Marketing Tool' <https://mazingxr.com/en/snapchat-instagram-ar-filter/> accessed 11 January 2023.

11 'What Role Does Augmented Reality Play in Shaping Consumer Behaviour' (*Marketing Mag*, 17 May 2021) <https://www.marketingmag.com.au/tech-data/what-role-does-augmented-reality-play-in-shaping-consumer-behaviour/> accessed 11 January 2023.

12 Isabell Wohlgenannt, Alexander Simons and Stefan Stieglitz, 'Virtual Reality' (2020) 62 Business & Information Systems Engineering 455.

13 ibid 456.

environments where users connect to computers that become invisible to them.[14]

Immersion is "*the degree of reality experienced by the sensory and perceptual system*" in virtual environments "*using interactive devices*".[15] VR surrounds users so that they perceive their presence in a digital world,[16] distinct from their physical reality[17]: a critical aspect for the discussions in this chapter. VR experiences are often so realistic and immersive (like real-life experiences) that they have the potential "*to enact profound and lasting changes in us*".[18]

Carefully integrated software and hardware components, including haptic touch, enable a stimulated 'feeling of presence' in VR. Specialized devices are critical to fully experience VR, such as a headset that works as a head-mounted display (HMD) or a computer console to stream content and engage users.[19]

Due to *immersion* and *telepresence* in a controlled environment, VR is extensively used to treat mental health disorders.[20] It has revolutionized user experience and enhanced engagement in the gaming industry.[21] Its impact

14 Kenneth Walsh and Suzanne Pawlowski, 'Virtual Reality: A Technology in Need of IS Research' (2002) 8 Communications of the Association for Information Systems 297.

15 Yongming Pan, 'VR Reality of the Relationship between Augmented Reality and Virtual Reality in the Context of Virtual Reality' (2021) 2066 Journal of Physics: Conference Series 012056.

16 Donghee Shin, 'How Does Immersion Work in Augmented Reality Games? A User-Centric View of Immersion and Engagement' (2019) 22 Information Communication and Society 1212.

17 Mana Farshid and others, 'Go Boldly!: Explore Augmented Reality (AR), Virtual Reality (VR), and Mixed Reality (MR) for Business' (2018) 61 Business Horizons 657.

18 Jeremy Bailenson, *Experience on Demand: What Virtual Reality Is, How It Works, and What It Can Do* (W W Norton & Company 2018) 21.

19 Zaynah Bhanji, 'A New Reality: How VR Actually Works' (*Predict*, 12 October 2018) <https://medium.com/predict/a-new-reality-how-vr-actually-works-663210bdff72> accessed 11 January 2023.

20 Lucia Valmaggia and others, 'Virtual Reality in the Psychological Treatment for Mental Health Problems: An Systematic Review of Recent Evidence' (2016) 236 Psychiatry Research 189; Carlos Coelho and others, 'The Use of Virtual Reality in Acrophobia Research and Treatment' (2009) 23 Journal of Anxiety Disorders 563.

21 Jyoti Gupta, 'How Virtual Reality Is Transforming the Gaming Industry' (20 May 2019) <https://yourstory.com/mystory/how-virtual-reality-is-transforming-the-gaming-ind> accessed 11 January 2023.

on consumer choices is also on the rise, with nearly 30% of surveyed users buying products because of testing them through VR.[22]

## 2. Sensors in AR/VR Technology

In this chapter, '*AR/VR devices*' or '*wearable devices*' refer to hardware components like smart glasses, dedicated headsets (like HMD), computer consoles, and other controllers (including haptic suits and gloves) that facilitate immersive user experiences, excluding mobile phones.

Notably, there is ambiguity in characterizing the concepts of AR, VR, and MR across institutions, academia, and even businesses,[23] particularly regarding standardized terminology. Recently, the European Parliament (EP) defined the '*metaverse*' as a "*digital simulation of a multidimensional space*" comprising mirrored reality (AR), simulating an entirely new space (VR), or mixing both.[24] Clarifying these terminologies would inadvertently expand this chapter. However, technologies that amalgamate AR and VR are referred to as XR or immersive technologies for our purposes.

As we noted previously, AR and VR combine various elements; for the sake of brevity of this chapter, it is sufficient to recognize that there are overlaps in sensory information processed by both technologies. Below is a high-level understanding of the functional elements in AR/VR devices that influence user experiences, providing context for their impact on human vulnerabilities discussed in Part II of this Chapter.

22 'June 2022 Global Consumer Insights Pulse Survey' (PWC 2022) <https://www.pwc.com/gx/en/consumer-markets/consumers-respond-to-waves-of-disruption/gcis-report-june-2022.pdf> accessed 1 November 2023.

23 Philipp A Rauschnabel and others, 'What Is XR? Towards a Framework for Augmented and Virtual Reality' (2022) 133 Computers in Human Behavior 107289.

24 Mariusz Maciejewski, 'Metaverse' (JURI Committee, European Parliament 2023) PE 751.222.

*Table 1: Sensors in AR/VR Devices*

| Sense | Sensors | AR | VR | Effect | How It Impacts |
|---|---|---|---|---|---|
| Sight | Camera(s) (and illuminators) or even infrared sensors in HMD. | ✓ | ✓ | Eye tracking by measuring eye activity, pupil positions and gaze movement.[25] | Enables '*foveated rendering*' (to display high-quality graphics by identifying the area where the gaze is located) and '*focus rendering*' (ability to display information about the object that holds the user's gaze and hide other objects/make them semi-transparent).[26] These are useful for **gaze mapping** (providing engagement heatmaps) and understanding behavioral attributes like **near-accurate perception about a person's attention**.[27] Some AR/VR devices undertake 'head tracking' and may undertake 'predictive full body tracking' based on sensor data available through HMD and controllers[28] This enables **increased empathy and deeper connections** in virtual environments.[29] |
| Touch | Handheld controllers/ haptic gloves and suits. | ✓ | ✓ | Gesture/ motion tracking through tactile rendering / force feedback and manipulating de- | Increases 'immersion' experience, creating an overall positive experience and **eliciting higher virtual embodiment for users**.[31] Certain 'full body haptic suits' display the capacity to emulate sen- |

25 Josef Erl, 'Virtual Reality: Everything You Need to Know about VR' (*MIXED Reality News*, 16 July 2022) <https://mixed-news.com/en/virtual-reality-guide/> accessed 11 January 2023.

26 Ben Dickson, 'How Eye Tracking Will Enhance the AR and VR Experience' (*TechTalks*, 11 June 2018) <https://bdtechtalks.com/2018/06/11/ar-vr-eye-tracking-foveated-rendering/> accessed 4 February 2023.

27 'Eye Tracking — a Catalyst for Innovation in AR, VR, and MR' (*Tobii*, 2022) <https://www.tobii.com/products/integration/xr-headsets/> accessed 3 February 2023.

28 Matthias Bastian, 'Meta Shows Stunning Full Body Tracking Only via Quest Headset' (*MIXED Reality News*, 23 September 2022) <https://mixed-news.com/en/meta-shows-stunning-full-body-tracking-only-via-quest-headset/> accessed 4 February 2023.

29 '5 Benefits of AR Body Tracking' (*AR Insider*, 30 December 2021) <https://arinsider.co/2021/12/30/5-benefits-of-ar-body-tracking/> accessed 4 February 2023.

| Sense | Sensors | AR | VR | Effect | How It Impacts |
|---|---|---|---|---|---|
| | | | | gree-of-freedom (**DoF**).[30] | sations of being electrocuted or even standing in the rain.[32] |
| Sound | Spatial (3D) audio sensors and microphones installed in wearable devices (like HMD). | ✓ | ✓ | Mimicking sounds heard in real-life, to create sounds with precise realism[33] and voice command integration. | These allow for **more 'intuitive'** and natural experiences for users, adding **more realistic elements** to the virtual environment.[34] |

Additionally, AR/VR devices (like HMD and haptic suits) rely on other sensors like gyroscopes (measure the position of the device), proximity and depth sensors (examine distances/spatial orientation), accelerometers (detect changes in movements) and GPS (detect real-time location) to collect information about the user's natural surroundings.[35]

Thus, AR/VR devices collect and process varied data points, including the user's area of interest, engagement levels, and information about their physical environment. While most data collection is consensual or contractually agreed upon, whether such consent is effectual or impinges on human autonomy remains an open question.

30 Dangxiao Wang and others, 'Haptic Display for Virtual Reality: Progress and Challenges' (2019) 1 Virtual Reality & Intelligent Hardware 136.

31 Grégoire Richard and others, 'Studying the Role of Haptic Feedback on Virtual Embodiment in a Drawing Task' (2021) 1 Frontiers in Virtual Reality.

32 Victor Tangermann, 'VR Company Shows Off Full-Body Suit That Electrocutes You Everywhere' (*Futurism*, 2022) <https://futurism.com/the-byte/vr-company-full-body-suit> accessed 11 January 2023.

33 Gergana Mileva, 'Enhancing Immersive Experiences With Spatial Audio' (9 September 2022) <https://arpost.co/2022/09/09/enhancing-immersive-experiences-spatial-audio/> accessed 4 February 2023.

34 Adobe, 'How AR, VR, and Voice Are Redefining Digital Experiences' (*Adobe Blog*, 2017) <https://blog.adobe.com/en/publish/2017/11/16/ar-vr-voice-redefining-digital-experiences> accessed 4 February 2023.

35 Rebekah Carter, 'How Do Augmented Reality and Smart Glasses Work?' (12 September 2022) <https://www.xrtoday.com/augmented-reality/how-do-augmented-reality-and-smart-glasses-work/> accessed 11 January 2023; Jasenovcova (n 6).

## 3. Emotion Recognition in AR/VR Devices

The AR/VR experience is augmented through 'avatars' designed as users' alter-egos that can shop online, play games, and socialize across different platforms. Additionally, 'non-player characters' (NPC), developed through AI, act as digital agents[36] and react to the user's emotions/actions within virtual environments.[37]

Emotion is the human reaction to a particular stimulus, generated through changes in brain activity, facial expression, gestures, etc. Eye and gesture tracking are often integrated into AR/VR experiences (see discussions in Para I.1 above). Eye tracking forms a key indicator of emotion,[38] and increases in pupil size indicate "*emotionally toned or interesting visual stimuli*".[39] Eye data can identify various aspects, like health status (*e.g.*, watery eyes), ethnic origin, personality traits, sleepiness/fatigue levels, cognitive processes, preferences, aversions, mental workload, etc.[40]

Eye tracking is an essential parameter of facial emotion recognition (FER), facilitating an understanding of our subconscious mind.[41] This section discusses the utilization of FER in AR/VR (and not the functioning of FER technologies *per se*), although FER technology involves feature ex-

36 'Project CAIRaoke: Building the assistants of the future with breakthroughs in conversational AI' (2022) <https://ai.facebook.com/blog/project-cairaoke/> accessed 11 January 2023.

37 'What Will Chatbots and AI Look like in the Metaverse?' (*Muan Group*, 11 January 2022) <https://www.muangroup.com/what-will-chatbots-and-ai-look-like-in-the-metaverse/> accessed 11 January 2023.

38 Paweł Tarnowski and others, 'Eye-Tracking Analysis for Emotion Recognition' (2020) 2020 Computational Intelligence and Neuroscience.

39 Eckhard Hess and James Polt, 'Pupil Size as Related to Interest Value of Visual Stimuli' (1960) 132 American Association for the Advancement of Science 349.

40 Jacob Leon Kröger, Otto Hans-Martin Lutz and Florian Müller, 'What Does Your Gaze Reveal About You? On the Privacy Implications of Eye Tracking' in Michael Friedewald and others (eds), *Privacy and Identity Management. Data for Better Living: AI and Privacy: 14th IFIP WG International Summer School, Switzerland, August 2019, Revised Selected Papers* (Springer International Publishing 2020).

41 JZ Lim, James Mountstephens and Jason Teo, 'Emotion Recognition Using Eye-Tracking: Taxonomy, Review and Current Challenges' (2020) 20 Sensors 2384.

traction and emotion classification,[42] and researchers often employ AR/VR devices to undertake these functions.[43]

Based on a survey of the specifications of AR/VR devices' available in the market, it becomes clear that FER indicators are primarily utilized in enterprise settings as on date. However, with leading companies (like Apple,[44] Meta,[45] and HTC[46]) incorporating eye-tracking capabilities in consumer wearable devices, the technology appears poised for mainstream adoption. The industry views ***eye tracking as the next frontier for the metaverses***,[47] enabling avatars to recreate users' emotions and engage in non-verbal communication.

Other than eye-tracking, emotion recognition systems (*i.e.*, ERS) also use gesture movement[48] and voice recognition. Patent searches reveal that companies like Sony,[49] Microsoft,[50] Linden Research (creators of the game 'Second Life'),[51] etc. hold patents for avatars reacting to users' emotions through gesture tracking and/or voice cues. Given this, AR/VR devices already possess or will soon demonstrate capabilities to track our emotions through myriad mechanisms. Involuntary gestures and other verbal/non-verbal communication methods offer insights into consumers' thoughts,

42 J Anil and L Padma Suresh, 'Literature Survey on Face and Face Expression Recognition', *2016 International Conference on Circuit, Power and Computing Technologies (ICCPCT)* (2016).

43 Dhwani Mehta, Mohammad Faridul Haque Siddiqui and Ahmad Y Javaid, 'Facial Emotion Recognition: A Survey and Real-World User Experiences in Mixed Reality' (2018) 18 Sensors 416.

44 'Apple Vision Pro' (*Apple*, 2023) <https://www.apple.com/apple-vision-pro/> accessed 13 June 2023.

45 'Supplemental Meta Platforms Technologies Privacy Policy' (*Meta*, July 2023) <https://www.meta.com/nl/en/legal/privacy-policy-updated/> accessed 16 June 2023.

46 'HP Reverb G2 Omnicept Edition' <https://www.hp.com/us-en/vr/reverb-g2-vr-headset-omnicept-edition.html> accessed 4 February 2023.

47 Scott Stein, 'Watching Me, Watching You: How Eye Tracking Is Coming to VR and Beyond' (*CNET*, 21 February 2022) <https://www.cnet.com/tech/computing/watching-me-watching-you-how-eye-tracking-is-coming-to-vr-and-beyond/> accessed 5 February 2023.

48 Gavin Buckingham, 'Hand Tracking for Immersive Virtual Reality: Opportunities and Challenges' (2021) 2 Frontiers in Virtual Reality.

49 Ozlem Kalinli-Akbacak, 'Multi-Modal Sensor Based Emotion Recognition and Emotional Interface', (Patent No. US9031293B2).

50 Charlene Mary Atlas and others, 'Digital Personal Expression via Wearable Device', (Patent No. WO2020013962A3).

51 Jeremiah Arthur Grant, 'Virtual Reality Presentation of Body Postures of Avatars', (Patent No. US10438393B2).

and the availability of such data can enable more intuitive and nuanced 'persuasion' profiles.

Thus, to sum up, AR technology places digital objects/information within physical environment. VR technology immerses the user in the virtual environment. Despite technical differences, both technologies employ a combination of sensors through wearable devices that manipulate sensations of touch, sound, and FoV/ fidelity of sight based on eye-tracking. Additionally, wearable devices may embed ERS that use eye movement, gestures, and voice cues, to identify and detect user reactions. These can be used to potentially gain deeper insights into the user's conscious and subconscious mind, thereby creating avenues for manipulation and inducement/exacerbation of vulnerabilities.

## *II.Human Vulnerability in the Context of AR/VR*

### 1. Conceptualizing Vulnerability

Etymologically, 'vulnerability' means "*susceptibility to being wounded*"[52] and includes a lack of resilience against possible harm.[53] Vulnerability is multidimensional and multidisciplinary: the notion of 'susceptibility' implies that it draws on the **potential** for harm over its actual occurrence.[54] Generally, vulnerability is contrasted against the "*hyper-autonomous, non-vulnerable man*",[55] an ideal yet fictional character. Autonomy is seen as vulnerability's valued antithesis or opposing force[56] – thus, while autonomy

52 Maria Patrao Neves, 'Article 8 - Respect for Human Vulnerability and Personal Integrity' in Henk AMJ ten Have and Michèle Jean (eds), *The UNESCO Universal Declaration on Bioethics and Human Rights: Background, Principles and Application* (UNESCO 2009).

53 Jonathan Herring, *Vulnerable Adults and the Law* (1st edn, Oxford University Press 2016) 139.

54 Gianclaudio Malgieri and Jędrzej Niklas, 'Vulnerable Data Subjects' (2020) 37 Computer Law & Security Review 105415.

55 Herring (n 53) 9.

56 Alison Diduck, 'Autonomy and Vulnerability in Family Law: The Missing Link' in J Herring and J Wallbank (eds), *Vulnerabilities, Care and Family Law* (Routledge 2013) 104.

begets *"self-sufficiency and independence*", human vulnerability requires an implicit submission of autonomy.[57]

A "*mature, moderately well-educated, clear thinking, literate, self-supporting person*" is often used as the baseline to measure 'vulnerability', assuming that everyone is alike.[58] Such standardization qualifies certain demographic groups as automatically vulnerable, like children (due to their cognitive development), minorities (due to social marginalization), etc.[59]

Legal frameworks, including the EU's Charter of Fundamental Rights[60] in Articles 21, 24, 25, and 26, use similar standardization to provide special protections for minorities, children, the elderly, and persons with disabilities. However, scholars argue that the concept of a 'vulnerable legal subject' should consider an individual's lifespan, reflecting the various developmental and social stages they pass through.[61] Human vulnerability must consider the social relationships and institutions an individual depends on throughout life.[62] This highlights a fundamental paradox: **vulnerability is both particular and universal**.[63] The universality principle acknowledges that anyone can be susceptible to physical, economic, institutional, or social harm.[64] Yet critics argue that safeguarding potential vulnerabilities risks obscuring actual injuries suffered, thus potentially undermining inequalities in society and institutions put in place to address them.[65] Additionally, it disregards the influence of privilege in shaping social practices.[66] Univer-

57 Martha Fineman, 'The Vulnerable Subject and the Responsive State' (2010) 60 Emory Law Journal 251.

58 Florencia Luna, 'Elucidating the Concept of Vulnerability: Layers Not Labels' (2009) 2 International Journal of Feminist Approaches to Bioethics 121, 123.

59 'Categories of Vulnerability – Specific Vulnerable Populations | Yale Assessment Module Training' <https://assessment-module.yale.edu/human-subjects-protection/categories-vulnerability-specific-vulnerable-populations> accessed 16 March 2023.

60 Charter of Fundamental Rights of the European Union [2012] OJ C 326/391.

61 Martha Fineman, 'Feminism, Masculinities, and Multiple Identities' (2013) 13 Nevada Law Journal 619.

62 Martha Fineman, 'Vulnerability and Inevitable Inequality' (2017) 4 Oslo Law Review 133.

63 Lourdes Peroni and Alexandra Timmer, 'Vulnerable Groups: The Promise of an Emerging Concept in European Human Rights Convention Law' (2013) 11 International Journal of Constitutional Law 1056, 1058.

64 Ibid.

65 Alyson Cole, 'All of Us Are Vulnerable, But Some Are More Vulnerable than Others: The Political Ambiguity of Vulnerability Studies, an Ambivalent Critique' (2016) 17 Critical Horizons 260.

66 Frank Cooper, 'Always Already Suspect: Revising Vulnerability Theory' (2015) 93 North Carolina Law Review 1339.

salizing everyone as deserving of special protections could also dilute the concept by itself.

As a midway, bioethical research posits a 'layered approach' to vulnerability, advocating for a dynamic and relational understanding to ensure a flexible application.[67] For instance, using the example of women, Luna notes that vulnerability is based on factors like poverty, illiteracy, and societal attitude to reproductive rights. Simply being a woman may not make someone as vulnerable as being a poor, illiterate woman in a country with limited reproductive rights. This relational aspect of layered vulnerability contextualizes specific personal situations.[68] As Malgieri and Niklas summarize, "*all individuals are vulnerable … but some individuals have more layers of vulnerability,*" and legal protections must be proportional to the "*quantity and quality of layers*".[69]

In essence, "*everyone is vulnerable*",[70] and the state is duty-bound to protect and be responsive to their expectations.[71] Accordingly, vulnerability entrenches the principles of equality and equity.

## 2. Vulnerability vis-à-vis Digital Consumption

Vulnerability holds conceptual significance in consumer protection. Globally, safeguarding vulnerable consumers remains a priority.[72] EU consumer law also identifies 'vulnerable' groups based on shared characteristics. With the advent of digitalization, society has been profoundly impacted, particularly in consumers' interactions with online marketplaces and the economic value of users' data as the asset fueling innovative business models.[73]

Online consumer vulnerability results extend beyond traditionally identified characteristics in the data-for-services economy. It includes *personal and demographic traits*, *behavioral drivers*, *situational drivers,* and *infor-*

67 Luna (n 58) 133.
68 Florencia Luna, 'Identifying and Evaluating Layers of Vulnerability – a Way Forward' (2019) 19 Developing World Bioethics 86.
69 Malgieri and Niklas (n 54) [2].
70 Herring (n 53) 7.
71 Fineman, 'The Vulnerable Subject and the Responsive State' (n 57) 40.
72 'United Nations Guidelines for Consumer Protection' (UNCTAD 2016) UNCTAD/DITC/CPLP/MISC/2016/1.
73 Elena Agibalova and others, 'Consumer Protection in the Digital Environment' in S Cindori and others (eds), *SHS Web of Conferences* (2021).

*mation asymmetry,* leading to a power imbalance (where sellers have disproportionately more information about consumers without their awareness).[74] Further, subjective traits of end-users, like *lack of technical understanding* (*e.g.,* the use of IoT and AI technologies in processing data) and *markets/information complexity,* lead to heuristics/rules of thumb.[75] These expanded parameters emphasize the need for a broader and more dynamic understanding of digitally induced end-user vulnerabilities, encompassing concerns like inequality, power imbalance, manipulation, and discrimination.

## 3. Vulnerability Through the Lens of AR/VR Technology

Recent trends indicate a significant rise in AR/VR adoption amongst consumers, with 75% finding immersive experiences 'valuable and impactful' for retail shopping.[76] However, this popularity could lead to vulnerability exploitation in end-users. This section examines how AR/VR devices may amplify existing concerns or introduce new vulnerabilities.

### a) Amplification of Existing Vulnerabilities

Literature indicates that AR/VR devices can exacerbate existing vulnerabilities caused by digital technologies.[77] The topic of Metaverse vulnerability has been addressed by Rigotti and Malgieri in a recent report,[78] where the authors recognize the potential benefits of the metaverse, including empowerment and enhancement of human experiences, especially for those vulnerable offline, but they raise concerns about the exacerbation of social

74 European Commission, Consumers, Health, Agriculture and Food Executive Agency, 'Consumer Vulnerability Across Key Markets in the European Union: Final Report' (Publications Office of the European Union 2016).

75 'Challenges to Consumer Policy in the Digital Age', *Background Report* (OECD 2019).

76 Capgemini Research Institute, 'Total Immersion: How Immersive Experiences and the Metaverse Benefit Customer Experience and Operations' (2022) <https://www.capgemini.com/insights/research-library/immersive-experiences/> accessed 18 March 2023.

77 Juan Londoño, 'User Safety in AR/VR: Protecting Adults' (Information Technology & Innovation Foundation 2023) 7.

78 Rigotti and Malgieri (n 1).

inequalities, digital divide issues, and potential reinforcement of conformity within this virtual realm.

Two key issues vis-à-vis general digital technologies are analyzed to demonstrate how AR/VR could intensify these problems for end-users.

(i) *Choice Architecture & Dark Patterns*:
Default settings in digital architecture hold unquestionable power, as they represent the "*pre-selected option*" recommended by software developers,[79] shaping our online conduct.[80] Users retain defaults due to '*bounded rationality*', undertaking a limited evaluation of alternatives in any situation.[81] In such evaluation, our brains rely on a "*variety of unreliable shortcuts and heuristics*" (cognitive biases).[82] This has led to the emergence of 'dark patterns'[83] or deceptive digital designs that manipulate users to act (mostly) against their interests by leveraging psychological elements.[84] These are widely prevalent in online shopping experiences.[85] Scholars have proposed various taxonomies for dark patterns, classifying them into broad categories comprising *information asymmetry* (like fake countdown timers, trick questions, or hidden costs) and *free choice repression* ('sneak into basket' (where uninvited products are directly placed in shopping carts), or 'roach motel' (where unsubscribing from services is unduly complex)).[86]

79 Jay Kesan and Rajiv Shah, 'Setting Software Defaults: Perspectives from Law, Computer Science and Behavioral Economics' (2006) 82 Notre Dame Law Review 583.
80 Ryan Calo, 'Code, Nudge, or Notice?' (2014) 99 Iowa Law Review 773.
81 Mark Leiser, 'The Problem with "Dots": Questioning the Role of Rationality in the Online Environment' (2016) 30 International Review of Law, Computers & Technology 191.
82 Daniel Susser, Beate Roessler and Helen Nissenbaum, 'Online Manipulation: Hidden Influences in a Digital World' (2019) 4 Georgetown Law Technology Review 1, 21.
83 Harry Brignull, 'Deceptive Patterns - User Interfaces Crafted to Trick You' (2010) <https://www.deceptive.design/> accessed 19 March 2023.
84 Colin M Gray and others, 'The Dark (Patterns) Side of UX Design', *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems* (ACM 2018).
85 Arunesh Mathur and others, 'Dark Patterns at Scale: Findings from a Crawl of 11K Shopping Websites' (2019) 3 Proceedings of the ACM on Human-Computer Interaction 1.
86 Mark Leiser and Wen-Ting Yang, 'Illuminating Manipulative Design: From "Dark Patterns" to Information Asymmetry and the Repression of Free Choice under the Unfair Commercial Practices Directive' (SocArXiv, 12 November 2022) <https://osf.io/preprints/socarxiv/7dwuq/> accessed 20 March 2023.

Tricky wordings in online interactions can confuse even regular users due to inattentiveness or language proficiency, regardless of age.[87] Unsurprisingly, existing dark patterns from traditional user interfaces (UX) can be modified for XR, *e.g.*, requiring users to visit physical stores to unsubscribe from VR retailer's newsletters, increasing the chances of additional purchases.[88] Moreover, embedded sensors in AR/VR devices could give rise to novel 'XR-specific' dark patterns.[89] For instance, haptic feedback from AR/VR devices can be used to design such dark patterns.[90] Haptic grabbing (stimuli through hand-controllers) could deflect users' attention away from specific virtual areas (*e.g.*, constantly providing haptic feedback to someone reading the terms of use or placing objects in their FoV to create obstructions),[91] subtly altering their thought process. Clubbed with gaze mapping of the user's attention (see discussion above in Para I.2), it could significantly change our online behavior through subtle 'nudges'.[92] Thus, tweaks in the UX architecture could facilitate manipulative practices in AR/VR to benefit business interests while users retain the 'illusion of choice'. Virtual objects' realism, immersion, and interactivity will likely compound existing problems, enabling creation of more immersive dark patterns that "*differ significantly from the classic dark patterns*" with more "***profound implications*** *for consumer decision-making*" in virtual environment.[93]

87 Ben Bate, 'How Dark UX Patterns Target The Most Vulnerable' (*Web Designer Depot*, 2018) <https://www.webdesignerdepot.com/2018/01/how-dark-ux-patterns-target-the-most-vulnerable/> accessed 13 June 2023.

88 Xian Wang and others, 'The Dark Side of Augmented Reality: Exploring Manipulative Designs in AR' [2023] International Journal of Human-Computer Interaction.

89 'REPHRAIN White Paper: The Metaverse and Web 3.0' (REPHRAIN National Research Centre on Privacy, Harm Reduction and Adversarial Influence Online 2023) <https://bpb-eu-w2.wpmucdn.com/blogs.bristol.ac.uk/dist/1/670/files/2023/03/Call-for-Papers-by-the-All-Party-Parliamentary-Group-REPHRAIN-Response.pdf> accessed 20 March 2023.

90 Wang and others (n 88).

91 ibid 9.

92 Richard H Thaler and Cass R Sunstein, *Nudge: Improving Decisions About Health, Wealth, and Happiness* (Penguin 2009) 6.

93 Francisco Lupiáñez-Villanueva and others, 'Behavioural Study on Unfair Commercial Practices in the Digital Environment: Dark Patterns and Manipulative Personalisation : Final Report' (Directorate-General for Justice and Consumers (European Commission) 2022).

(ii) *Digital Advertisements & Marketing*:

Digital advertisements use sophisticated contextual, behavioral, or segmented targeting, using data analytics of our preferences to increase click-through rates.[94] Data collected from various sources (*e.g.*, data *given* and data *given off*) are utilized in personalized ads and marketing communications to create strategic content *"to optimize the fit with personal characteristics, interests, preferences, communication styles, and behaviors*".[95] Despite privacy concerns and AI 'black-box' criticism, such techniques enjoy both affirmation and negative reception amongst consumers (the *personalization paradox*).[96] Such practices can manipulate consumers by combining personalized practices with adaptable, dynamic technologies that use non-transparent measures to exploit vulnerabilities.[97]

Consumer exploitation studies indicate that data analytics easily assimilate information about users' biases, insecurities, fears, and emotions, with targeting strategies potentially (ab)using internal or external parameters (*e.g.*, financial condition) to influence behavior.[98] Examples include Uber's surge-pricing algorithm linked to low-battery levels[99] and Facebook's ability to target teenagers with depres-

94 Niklas Fourberg and others, 'Online Advertising: The Impact of Targeted Advertising on Advertisers, Market Access and Consumer Choice' (Committee on the Internal Market and Consumer Protection, Policy Department for Economic, Scientific and Quality of Life Policies, European Parliament 2021).

95 Nadine Bol and others, 'Understanding the Effects of Personalization as a Privacy Calculus: Analyzing Self-Disclosure Across Health, News, and Commerce Contexts' (2018) 23 Journal of Computer-Mediated Communication 370.

96 Joanna Strycharz and others, 'Protective Behavior against Personalized Ads: Motivation to Turn Personalization Off' (2019) 13 Cyberpsychology: Journal of Psychosocial Research on Cyberspace.

97 Gianclaudio Malgieri, 'In/Acceptable Marketing and Consumers' Privacy Expectations: Four Tests from EU Data Protection Law' (2021) 40 Journal of Consumer Marketing 209.

98 Nadine Bol and others, 'Vulnerability in a Tracked Society: Combining Tracking and Survey Data to Understand Who Gets Targeted with What Content' (2020) 22 New Media & Society 1996; Joanna Strycharz and Bram Duivenvoorde, 'The Exploitation of Vulnerability through Personalised Marketing Communication: Are Consumers Protected?' (2021) 10 Internet Policy Review.

99 Amit Chowdhry, 'Uber: Users Are More Likely To Pay Surge Pricing If Their Phone Battery Is Low' *Forbes* (March 2016) <https://www.forbes.com/sites/amitchowdhry/2016/05/25/uber-low-battery/> accessed 20 March 2023.

sive traits.[100] Psychological characteristics are easily inferred through digital footprints, and personalization relying on such factors leads to higher levels of persuasion.[101] Geospatial movement (identified through keyboard speed) to detect impairment (*e.g.*, tiredness) coupled with other existing data sets, such as education, personality, or recent life events, are also used in targeting.[102] This creates digital inequality through vulnerability exploitation and reinforces stereotypes by targeting content curated for specific demographic subgroups or characteristics, restricting knowledge access for other groups/individuals (*e.g.*, automobile ads targeted towards only men).[103] Additionally, dark patterns in advertisements and gaming can lead consumers to "*mindlessly click*" highlighted buttons "*in a flow state*".[104]

Virtual stores[105] and XR-enabled advertisements are increasingly commonplace. Studies show that consumers are identifiable with 95% accuracy in AR/VR through < 5 minutes of body motion data.[106] Thus, such technology can gain deeper insights into our behavior, with enhanced personalization through ads extremely likely. AR/VR advertisements include 360° views, projection of digital objects in physical environment as preview (*e.g.*, visualize new furniture in the room), product placements within virtual environment, and *magic mirroring* (enabling users to see themselves in virtual environment).[107] Location-based AR advertisement is also prevalent, such as in Pokémon Go, where users were directed to sponsored physical

100 Sam Levin, 'Facebook Told Advertisers It Can Identify Teens Feeling "insecure" and "Worthless"' *The Guardian* (1 May 2017) <https://www.theguardian.com/technology/2017/may/01/facebook-advertising-data-insecure-teens> accessed 20 March 2023.

101 Strycharz and Duivenvoorde (n 98) 5.

102 Lauren Willis, 'Deception by Design' (2020) 34 Harvard Journal of Law & Technology 115.

103 Bol and others (n 98) 2008.

104 Willis (n 102) 143.

105 Byoungho Jin and others, 'Consumer Store Experience through Virtual Reality: Its Effect on Emotional States and Perceived Store Attractiveness' (2021) 8 Fashion and Textiles 19.

106 Mark Miller and others, 'Personal Identifiability of User Tracking Data during Observation of 360-Degree VR Video' (2020) 10 Scientific Reports 17404.

107 XR Advertising Alliance, 'The XR Digital Advertising Guide' (2018) <https://advertising.report//Resources/Whitepapers/03abd32e-d1fb-488d-8569-a2cc333c13d3_XRAA_Guidebook_V.1.0.0.pdf> accessed 20 March 2023.

locations through in-game activity to drive commercial interests.[108] In this context, a scenario-construction study[109] identified manipulative advertising techniques in XR, including:

a) misleading experience marketing (*e.g.*, colors of a digital object are synthetically enhanced to look comparably better in virtual environment),
b) targeting consumers during moments of vulnerability (*e.g.*, devices embedded with sensors can detect tiredness),
c) emotional manipulation through hyper-personalization techniques (*e.g.*, advertisement targeting a single user through 'deepfakes'), and
d) distorting reality (by changing the customer's FoV (see discussions in Para I.2)).

Immersive and interactive AR/VR experiences may inhibit a customer's cognitive ability to evaluate advertisements by reducing their resistance powers, making the ad more convincing and manipulative.[110] AR/VR devices with embedded sensors can classify personality traits based on user behavior in virtual stores with over 70% accuracy, providing valuable user insights.[111] In this regard, Heller posits the concept of 'biometric psychography' to identify the practice of utilizing biometrics and psychography to identify a person's interest, theorizing that XR technology "*uses behavioral and anatomical information (e.g., pupil dilation) to measure a person's reaction to stimuli over time*" revealing their "***physical, mental, and emotional state, and the stimuli that caused***" such state.[112]

108 Larry Kim, '9 Need-to-Know Facts on How Pokemon Go Players Engage with Businesses' *INC* (19 August 2016) <https://www.inc.com/larry-kim/9-need-to-know-facts-on-how-pokemon-go-players-engage-with-businesses.html> accessed 20 March 2023.

109 Abraham Mhaidli and Florian Schaub, 'Identifying Manipulative Advertising Techniques in XR Through Scenario Construction', *Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems* (ACM 2021).

110 Dan Grigorovici and Corina Constantin, 'Experiencing Interactive Advertising beyond Rich Media' (2004) 5 Journal of Interactive Advertising 22.

111 Jaikishan Khatri and others, 'Recognizing Personality Traits Using Consumer Behavior Patterns in a Virtual Retail Store' (2022) 13 Frontiers in Psychology.

112 Brittan Heller, 'Watching Androids Dream of Electric Sheep: Immersive Technology, Biometric Psychography, and the Law' (2021) 23 Vanderbilt Journal of Entertainment and Technology Law 1.

Given the quantum of sensory information collected by AR/VR devices over a period of time, including eye data and emotions, this entails a lucrative opportunity for platforms to leverage previously unknown information regarding consumer's mental states and characteristics, to build more nuanced 'persuasion profiles' and employ '*microtargeting*' through advanced neuromarketing. Thus, in XR advertisements and marketing, human vulnerabilities could be exploited in subverted ways that are harder to detect since XR experiences are highly personalized (*hyper-personalization*).

b) Inducement of New Vulnerabilities

Aside from exacerbating existing vulnerabilities, research shows that immersive technologies can be used in ways that can induce new types of vulnerability. While this field is relatively nascent, two specific methods are discussed below.

(i) *Memory Falsification:*
The malleability of the human brain is well-known, and our brain is cognitively trained to rely on past experiences during decision-making.[113] VR technology has successfully treated psychological conditions by coaching patients in "*appropriate responses*" based on the disorder.[114] Alarmingly, children exposed to a 3D-based VR rendition of themselves swimming with whales demonstrated false memory of such experiences sometime later.[115] Research involving adults confirms that our brain is "*more prone to confusing*" VR with reality, furthering evidence that VR stimuli are processed by humans "*in a more naturalistic manner*" with a **higher degree of acceptance** compared to traditional technologies.[116] Combining haptic-touch feedback from

113 Joshua Tremel, Daniella Ortiz and Julie A Fiez, 'Manipulating Memory Efficacy Affects the Behavioral and Neural Profiles of Deterministic Learning and Decision-Making' (2018) 114 Neuropsychologia 214.

114 D Freeman and others, 'Virtual Reality in the Assessment, Understanding, and Treatment of Mental Health Disorders' (2017) 47 Psychological Medicine 2393.

115 Kathryn Segovia and Jeremy Bailenson, 'Virtually True: Children's Acquisition of False Memories in Virtual Reality' (2009) 12 Media Psychology 371.

116 Marius Rubo, Nadine Messerli and Simone Munsch, 'The Human Source Memory System Struggles to Distinguish Virtual Reality and Reality' (2021) 4 Computers in Human Behavior Reports 100111.

products with associative visual cues can increase consumer engagement, positively affecting psychological product ownership and product valuation,[117] ultimately influencing purchase decisions. Thus, memories embedded through VR experiences can be manipulated to bias consumer choices (*e.g.*, by inducing artificial feelings in consumers resulting in biased product associations[118]), which promotes commercial interest and result in a loss of autonomy and freedom in decision-making for consumers.

(ii) <u>*Cross-Reality Concerns*</u>:

Our digital avatars in virtual environment can alter our behavior and self-perception (the *Proteus effect*), for instance, users with taller avatars displayed increased confidence in negotiations.[119] Therefore, embodiment in avatars can impact consumers' psychology,[120] and avatar-related design elements made available by platforms could affect our self-esteem (akin to the effect of AR face-filters[121]) and consequent decision-making. Further, emotional attachment to artificial agents (*i.e.*, NPC) previously limited to VR gaming,[122] could take new meaning in a wider XR-consumer context. With NPCs demonstrating the capability to display sophisticated emotions, it could create positive associations and empathy attachment,[123] increasing the possibility for manipulation. The immersive UX of AR/VR experiences is more adaptable than traditional technologies, enabling a more profound influence on users' behavior and preferences.[124] Such expe-

117 Andrea Webb Luangrath and others, 'Observing Product Touch: The Vicarious Haptic Effect in Digital Marketing and Virtual Reality' (2022) 59 Journal of Marketing Research 306.

118 Mhaidli and Schaub (n 109).

119 Nick Yee and Jeremy Bailenson, 'The Proteus Effect: The Effect of Transformed Self-Representation on Behavior' (2007) 33 Human Communication Research 271.

120 Olivia Petit and others, 'Consumer Consciousness in Multisensory Extended Reality' (2022) 13 Frontiers in Psychology.

121 Ana Javornik and others, 'Augmented Self - The Effects of Virtual Face Augmentation on Consumers' Self-Concept' (2021) 130 Journal of Business Research 170.

122 Mark Coulson and others, 'Real Feelings for Virtual People: Emotional Attachments and Interpersonal Attraction in Video Games.' (2012) 1 Psychology of Popular Media Culture 176.

123 Ruud Hortensius, Felix Hekele and Emily Cross, 'The Perception of Emotion in Artificial Agents' (2018) 10 IEEE Transactions on Cognitive and Developmental Systems 852.

124 Matija Franklin, 'Virtual Spillover of Preferences and Behavior from Extended Reality', *CHI Conference on Human Factors in Computing Systems* (2022).

riences may also lead to dissociation from physical and social environments, with users believing that certain tasks performed virtually have the same real-life consequences.[125] While this is a known complication of using VR for '*positive transfer effect*' in psychotherapy,[126] it may lead to dangerous results in uncontrolled consumer settings.

4. Broader impact on end-users

The preceding discussions demonstrate that AR/VR devices can worsen end-user vulnerabilities and facilitate newer vulnerabilities. While such harms remain largely theoretical, a recurring prominent concern is the 'manipulation of the mind'.[127] Such manipulative influence combines intentionality, asymmetry of outcome in favor of the manipulator, and non-transparency to violate users' autonomy.[128] These have also transcended into political discourses (for e.g., the Brexit and Cambridge Analytica situations[129]). In the consumer context, '*surveillance capitalism*' through our digital identities enables micro-targeting and behavioral modification, resulting in the loss of human will and independence.[130]

AR/VR's ability to identify and analyze our subconscious thoughts and emotions using neurological and behavioral tools could deepen these problems. For instance, hyper-personalization through AR/VR can lead to heightened exploitation of our existing vulnerabilities, which can erode human autonomy and attack individual agency[131] by making choices illusionary and using *sludging* to maneuver users' decisions, undermining our dignity and right to self-determination. Notably, these could intensify

125 Dhoya Snijders and others, 'Responsible VR. Protect Consumers in Virtual Reality' (Rathenau Instituut 2020) <https://www.rathenau.nl/sites/default/files/2020-03/Responsible%20VR.pdf> accessed 15 December 2022.

126 Mel Slater and others, 'The Ethics of Realism in Virtual and Augmented Reality' (2020) 1 Frontiers in Virtual Reality.

127 Yusef Al-Jarani, 'All Fun and (Mind) Games? Protecting Consumers from the Manipulative Harms of Interactive Virtual Reality' (2019) 2019 University of Illinois Journal of Law, Technology & Policy 299, 311.

128 Marcello Ienca, 'On Artificial Intelligence and Manipulation' (2023) 42 Topoi 833.

129 Daniel Susser, Beate Roessler and Helen Nissenbaum, 'Technology, Autonomy, and Manipulation' (2019) 8 Internet Policy Review.

130 Shoshana Zuboff, 'Surveillance Capitalism' [2020] *Project Syndicate Quarterly*.

131 James J Cummings and Alexis Shore, 'All Too Real: A Typology of User Vulnerabilities in Extended Reality', *In Proceedings of the 1st Workshop on Novel Challenges of Safety, Security and Privacy in Extended Reality* (2022).

echo chambers, perpetuating increased inequality and discrimination by reinforcing stereotypes and biases.

Another concern is the power imbalance and information asymmetry: AR/VR devices assimilate nuanced data about preferences and perceptions more than traditional technologies. Assuming legally valid data collection, users may remain unaware of all uses of innocuous information due to the technology's nascency and associated information asymmetry. Thus, wider XR adoption could deepen the imbalance between platforms and users owing to more intrusive data processing and create arbitrary dependencies.[132] Since users typically believe that data collection is "*a series of single bounded transactions, where individual pieces of data are "given" to an organization in exchange for a specific service*",[133] the processing operations in AR/VR may create new layers of vulnerability for users.

Therefore, to sum up, AR/VR devices can amplify existing vulnerabilities in end-users through XR-specific choice architecture, dark patterns, targeted advertisements, and personalized marketing. Intrusive data collection mechanisms in AR/VR devices enable platforms to gain deeper insights into users' emotions and behavior, leading to newer vulnerabilities through techniques like memory falsification and cross-reality concerns. These can influence users' choices, preferences, and behaviors, resulting in manipulation, loss of autonomy and agency, and increased power imbalance between platforms and users.

### *III. Conclusion and input for policy remarks*

The trajectory of AR/VR technologies' influence on end-users presents profound implications. As we have navigated through this chapter, it becomes abundantly clear that the Metaverse, with its promise of immersive experiences, holds inherent pitfalls, especially for persons in situations of vulnerability. The confluence of cutting-edge technology with behavioral science, facilitated by AR/VR devices, has the potential not just to shape but to reshape human behavior and cognition in unprecedented ways. The threats, ranging from manipulation of the mind to the undermining of human dignity and autonomy, are not merely speculative but have tangible instances rooted in recent political and societal discourses.

132 Gianclaudio Malgieri and Antonio Davola, 'Data-Powerful' (5 February 2022).
133 Fourberg and others (n 94) 31.

The dynamics of power and information, already skewed in the digital age, threaten to become even more imbalanced with the widespread adoption of AR/VR technologies. While users perceive data sharing as a bounded transaction, the depth and breadth of data assimilated by these devices blur such boundaries, introducing multifaceted situations of vulnerability. The very attributes that make AR/VR appealing—such as hyper-personalization—can be weaponized to erode individual agency, making choices more illusionary than ever.In essence, while AR/VR technologies stand as a remarkable testament to human innovation and creativity, they equally highlight the urgent need for ethical, legal, and societal introspection. It is incumbent upon policymakers, technologists, and society at large to collaboratively address these challenges, ensuring that the Metaverse remains an inclusive and empowering space, rather than one that magnifies situations of vulnerability. As we stand at the threshold of this new digital frontier, the decisions we make now will shape the future landscape of human interaction, autonomy, and dignity in the immersive digital universe.

Additionally, this discussion is directly relevant to the ongoing conversation surrounding the Digital Fairness Act that the European Commission is pursuing. As AR/VR technologies are increasingly integrated into consumer markets, their unique ability to collect, analyze, and manipulate user data at unprecedented levels of granularity poses new challenges for digital fairness. The concerns raised in this chapter about hyper-personalization, emotional manipulation, and memory falsification directly align with the Act's goals to prevent exploitation and ensure that users, especially vulnerable ones, are protected from undue influence and manipulation in the digital marketplace.

The importance of this alignment lies in the potential for AR/VR technologies to create environments where user autonomy and decision-making could be subtly compromised through techniques such as dark patterns and manipulative advertising. In the context of the Digital Fairness Act, these risks highlight the need for more robust protections that not only address traditional online platforms but also anticipate the novel ways immersive technologies can impact user behavior and cognition. By ensuring that the principles of fairness, transparency, and accountability extend to the Metaverse, the European Commission can safeguard against the deepening of existing vulnerabilities and the creation of new forms of exploitation, making the digital space more equitable for all users.