The Metaverse, Extended Reality and Children

About us

UNICEF works in the world's toughest places to reach the most disadvantaged children and adolescents — and to protect the rights of every child, everywhere. Across 190 countries and territories, we do whatever it takes to help children survive, thrive and fulfill their potential, from early childhood through adolescence. And we never give up.

UNICEF Innocenti – Global Office of Research and Foresight tackles the questions of greatest importance for children, both current and emerging. It drives change through research and foresight on a wide range of child rights issues, sparking global discourse and actively engaging young people in its work.

UNICEF Innocenti equips thought leaders and decision-makers with the evidence they need to build a better, safer world for children. The office undertakes research on unresolved and emerging issues, using primary and secondary data that represents the voices of children and families themselves. It uses foresight to set the agenda for children, including horizon scanning, trends analysis and scenario development. The office produces a diverse and dynamic library of high-level reports, analyses and policy papers, and provides a platform for debate and advocacy on a wide range of child rights issues.

UNICEF Innocenti provides, for every child, answers to their most pressing concerns.

This document is interactive and designed for digital viewing.

Please consider the environment and refrain from printing.

Acknowledgements

Contents

Synopsis

The metaverse is a proposed extension of reality in which people may be able to do much of what they do in the real world through an integrated network of three-dimensional (3D) virtual worlds or environments. Activities could include socializing (such as attending concerts), playing (through video games and world building) and working (for example, workplace readiness training) by way of digital avatars. This developing space has relevance for children as well as adults.

This report considers both positive and negative effects that virtual environments could have on children; the drivers of and predictions for the growth of the metaverse; and the regulatory and policy challenges posed by the metaverse. The report also includes recommendations for government and private sector stakeholders on actions to take to protect children and mitigate the potential harms of the metaverse on them. Key points for consideration for all stakeholders are listed below.

- While the mature metaverse does not yet exist – and some question whether it ever will – today's virtual environments such as Roblox, Minecraft and Fortnite are considered to be early instances of where the metaverse is headed. The increasing popularity of social online gaming is a key driver for children to spend time in virtual environments.

- Underpinning technologies on which virtual environments are built are maturing and becoming more mainstream. These include better and cheaper virtual reality (VR) and augmented reality (AR) devices (known together as extended reality or XR); advances in artificial intelligence (AI) to render virtual worlds and chatbots; and digital currencies and non-fungible tokens (NFTs) that enable virtual economies.

- The metaverse and XR technologies offer many potential benefits for children, such as in the areas of education and health. Children could learn in a more immersive and engaging way by travelling virtually to remote locations or reliving a historical event. Mental health support, such as reducing anxiety and treating depression, could be provided using VR that helps children learn how to manage their symptoms in a safe, simulated environment.

- At the same time, the potential risks to children are significant. These include safety concerns such as exposure to graphic sexual content, bullying, sexual harassment and abuse, which in immersive virtual environments can feel more 'real' than on current platforms. Further, vast amounts of data, including about non-verbal behaviour (e.g. gestures, facial expressions, eye movement and heart rate) could

be collected in virtual environments and through XR technologies – potentially allowing a handful of large tech companies to facilitate hyperpersonalized profiling, advertising and increased surveillance, impacting children's privacy, security and other rights and freedoms.

• Many existing regulations already cover the opportunities and risks that come with the unfolding metaverse, virtual environments and XR technologies – even if their application remains to be tested in new contexts. In some instances, however, the coverage is partial and they may need to be expanded; in other cases, new regulations may be needed to address novel challenges. These are explored in the report.

• Given the growing interest in, and rapid advancement of, metaverse-related technologies, it is crucial that policies and regulations keep pace not only to realize potential benefits, but also so that potential harms and unintended consequences for children are anticipated well in advance and mitigated in regulations and technology design and implementation. Recommendations towards this, such as governments needing to assess to what extent current legislation provides cover for children, are provided in the report.

Read the article *What happens to children when the physical and virtual worlds merge? 10 things you need to know…* →

Tens of millions of children and young people are already active in virtual environments and game spaces. While it remains to be seen whether the metaverse is the future or just hype, or how exactly virtual environments will evolve, their potentially profound impact on children and youth means it is essential to engage with these technologies today.

1. Why focus on the metaverse *and* XR?

The metaverse is not an easy concept to grasp; there is no agreed upon definition of what it is or what it may become. The metaverse does not yet fully exist, and some believe that it may never mature as predicted. However, the broad consensus is that if it does mature, the metaverse will be an integrated network of 3D virtual environments or worlds in which people will be able to do much of what they do in real life.

Activities could include play, socialization, learning, financial transactions and work. The metaverse could be a parallel digital realm that mirrors and extends beyond the physical world, representing a unique convergence of new technologies, virtual marketplaces, social networks, gaming and professional workspaces.

The metaverse could be a great leveller for digital opportunity, or it could further worsen today's digital inequity

Elements of the metaverse are available today – often referred to as 'metaverse spaces' – in non-immersive forms that are unconnected to one another, such as the play environments of Roblox, Minecraft and Fortnite where children create 3D worlds or meet in the thousands for music concerts. Stand-alone virtual worlds, from the early days of Second Life in 2003 and Club Penguin, which was designed for children and had an active user base as early as 2007, are on the rise. As described in the chapter in this report on drivers and predictions for the growth of the metaverse and XR, some technology companies are investing significantly in creating or expanding their metaverse-like spaces and governments are providing financial support to their domestic virtual environment industry. A few governments are working on setting up a presence in virtual worlds to better reach their citizens.

If the metaverse is fully realized and used as its proponents hope, it could potentially have profound impacts on children and youth who are already the most active age cohort online. In a US survey, Generation Z respondents (those born between 1997 and 2012) expect to spend 4.7 hours per day in metaverse spaces by 2027.[1] As this report shows, the metaverse and XR technologies raise key opportunities and concerns for children depending on how they are designed and developed. They could usher in new opportunities in areas such as social interaction, identity development and the provision of education and health care. Or they could move us towards "an era of constant reality capture"[2] – including data collection on body movements, facial expressions and eye tracking – to profile, surveil and influence child users as never before. They could lead to innovations in how to achieve safety in complex virtual worlds or exacerbate the limitations of current approaches to content moderation and online safety for children in the digital environment. Immersive virtual spaces could allow for new forms of participation and freedom

of expression for children, or undermine their freedom of thought and privacy, or perhaps both. The metaverse could be a great leveller for digital opportunity, or it could further worsen today's digital inequity.[3]

It is important to note that the metaverse is not XR; XR technologies simply offer users a way to experience virtual environments. The metaverse ecosystem will include many elements, from content, applications, hosting platforms, hardware infrastructure, and devices, to systems for payments and monetization, identity and authentication, security and governance. While XR is just one aspect of the metaverse ecosystem, we have chosen to explore it alongside the metaverse because it is an existing set of technologies that offers cues as to what may lie ahead in future metaverse applications, especially given its immersive qualities. XR technologies have received attention as a potential developmental tool for children,[4] and have been the subject of research to gauge the opportunities and risks they present. As the metaverse is still developing, we can't yet say with certainty what impact it will have on children. However, we can draw some lessons from our knowledge of the impact that current technologies, and online and gaming platforms, have on children's well-being. We can also learn from approaches used so far to mitigate the negative impact of these technologies. This report is thus grounded in the present as well as forward looking, and draws on existing research, technological advancements and policies to inform our thinking about the future.

Scope and target audience of the report

The report aims to answer the following questions:
- What makes up the metaverse ecosystem?
- What are the drivers and predictions around the growth of the metaverse and XR?
- What are the potential positive and negative impacts of the metaverse and XR on children?
- What are the regulatory and policy perspectives on the metaverse and XR?

The report is primarily aimed at two audiences:
- Government policymakers drafting or reviewing legislation, and regulators that oversee the legislation, who need to understand this topic and how it relates to children. Also government stakeholders who are assessing the potential impacts of the metaverse and XR, investing in these sectors or setting up spaces in virtual environments.
- Technology companies providing metaverse-related products and services and developing codes of conduct guiding their use.

We conclude the report with policy and practical recommendations for both groups. Other stakeholders in the virtual environment, XR and gaming ecosystem, including United Nations bodies, civil society organizations and academia, should also find the report useful in thinking about how to best empower and protect children in this nascent digital space.

How the report was developed

To develop the report, we reviewed available scholarly and grey literature, analyses and predictions that cover the metaverse, XR and children. Given the limited information that is available on the metaverse and children's rights, UNICEF and Diplo convened a roundtable in June 2022 with 30 experts to complement the literature review. They ranged from civil society (IEEE Standards Association, Information Commissioner's Office, United Kingdom, Joan Ganz Cooney Center, World Economic Forum and World Wide Web Foundation), academia (Berkman Klein Center for Internet & Society, Harvard University), government (Government of Barbados and eSafety Commissioner, Australian Government), and the private sector (Imìsí 3D, Meta, LEGO and Roblox). The participants joined the event remotely from across Africa, Europe, Latin America and the Caribbean, the Middle East, North America and Oceania. The key messages of the roundtable are incorporated in this report.

**VR headset
and controllers**

Photo by stem.T4L
on Unsplash →

2. What makes up the metaverse ecosystem?

The term metaverse[5] is derived from the 1992 science fiction novel Snow Crash,[6] which depicts it as a dystopia in which humans, behaving through programmable avatars, interact with each other and non-human avatars, in a 3D virtual space that uses the metaphor of the real world.

Today, however, it is being trumpeted as the opposite: a future place of opportunity and prosperity. Even as there is yet no common understanding of the metaverse, one widely referenced definition by metaverse analyst Matthew Ball[7] gives it the following characteristics:

- it is "an interoperable network of real-time 3D virtual worlds";
- it is "persistent" – in other words, it does not end when a user logs out or leaves it;
- users have a "sense of presence" in the virtual environment;
- and there is "continuity of data", such as identity, actions, communications, and payments, meaning that when a user comes back into the metaverse, everything they did before is still there.

While the metaverse is under development, and XR is recognized as ideal to its full experience, "hundreds of millions are already participating in [non-immersive] virtual worlds on a daily basis (and spending tens of billions of hours a month inside them) without XR devices."[8] Today there are virtual environments for children; some are immersive such as Rec Room,[9] some not, such as Minecraft,[10] which are not connected to each other. Development of such metaverse-like spaces is being driven by a convergence of several technologies and digital trends that will make up the overall ecosystem.

Some of the key underpinning technologies on which virtual environments are built, and on which the metaverse will be built, are briefly explained below.

AR with Pokémon Go

Image source: Chris Helgren/Reuters in Malik, O. (2016). 'Pokémon Go will make you crave augmented reality', *The New Yorker* →
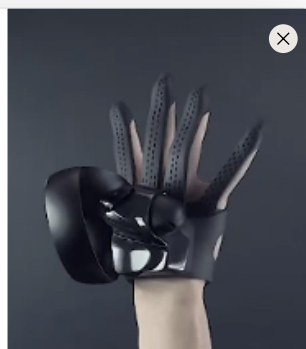
Haptic glove

Image source:
Plexus →

Hologram surgery with MR

Image: iStock →

Key technologies underpinning virtual environments

Extended reality (XR) is an umbrella term used to describe immersive technologies of VR, AR and mixed reality (MR).

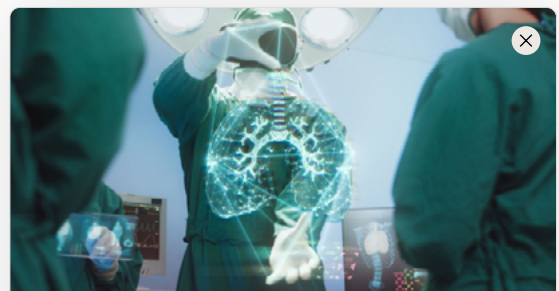**Virtual reality**[11] uses hardware and software to create an artificial environment that looks and sounds real. VR simulates 3D experiences by recreating parallel or fictitious surroundings in which the user immerses themself completely, often using a VR headset and hand controller for navigation and haptic feedback. The user's perception is that they are detached from the physical world. Oculus Quest and PlayStation VR are examples of popular headsets used by children.

Augmented reality[12] overlays our view of the actual world with digitally generated real-time sound and vision. The user usually views the combined actual and digital content through a handheld device or smart glasses. AR became mainstream in 2016 with the rise of the Pokémon Go game,[13] which involved players using their devices to locate virtual characters overlayed onto real-world surroundings. Aside from gaming, AR can be used in many other contexts, from shopping where you can visualize a product in your house before buying it,[14] to education where students and teachers can overlay information, visuals, and other content onto the real world, such as overlaying past events onto historical buildings.[15]

Mixed reality[16] combines elements of both VR and AR. In mixed reality settings, digital content blends into the physical environment: virtual objects or characters behave as if they are real, interacting with light, sound and space. Physical objects that you hold, for example, can also appear in the virtual environment. MR devices are envisioned as tools that will provide value to various sectors, including manufacturing, education and health. The first so-called hologram operation was

performed[17] using Microsoft HoloLens 2. It allowed surgeons to have visual representations of relevant information during the surgery, including real-time access to patient data.

Haptic technologies[18] stimulate our sense of touch, enhancing the user experience by adding tactile feedback. Simple haptics are already integrated into mobile phones, controllers and wearable devices. Haptic suits with multiple sensors provide a more immersive experience.

Artificial intelligence (AI) describes machine-based systems that can, given a set of human-defined objectives, make predictions, recommendations, or decisions that influence real or virtual environments.[19] AI will play an important role in supporting immersive technologies and the functioning of the metaverse. For example, it will render virtual worlds, drive digital 3D versions of chatbots thereby shaping interactions with other avatars, and enable real-time translations through natural language processing.[20]

Blockchain[21] technology, a distributed and secure ledger of transactions, allows the ownership of digital assets – be it digital money or content. Blockchain enables cryptocurrencies such as Bitcoin or Ether and some digital avatars. It also supports **non-fungible tokens (NFTs)** – digital tokens that represent non-fungible assets in the real or digital world (such as art, music, real estate, or in-game items), as these are stored on a blockchain. While it is expected that cryptocurrencies and NFTs will play a pivotal role in enabling the economic and trade potential of the metaverse, it is important to note that virtual economies that use neither cryptocurrencies nor NFTs have existed for some time. Second Life, for example, was one of the first virtual economies, where users can still create, sell, and buy goods and services using its in-game digital currency, the Linden dollar, which is not based on blockchain.

Neurotechnology[22] enables a direct connection of technical components – such as electrodes or computers – to the human nervous system. The hardware is meant to either record signals from the brain, often 'translating' them into technical control commands, or to manipulate brain activity by applying electrical or optical stimuli. In the context of VR and the metaverse, neurotechnology could in the future allow users to control their avatars and communicate with others, through just their thoughts. While such applications may not be fully developed for some time, companies are already working on 'neural control interfaces'.[23]

Beyond the underpinning technologies, additional elements are needed to develop the metaverse ecosystem. As Matthew Ball notes, "The Internet as we know it today spans nearly every country, 40,000 networks, millions of applications, over a hundred million servers, almost 2 billion websites, and tens of billions of devices…Though the Internet is resilient, wide-ranging, and powerful, it wasn't built for live and interactive experiences involving a large number of participants."[24] The metaverse ecosystem (see Figure 1) will require enablers (from payments and monetization to drive the virtual economies to security and privacy to ensure trust), infrastructure and hardware (from massive computing power to render 3D worlds to XR devices), platforms (to host creators and 3D spaces), and content and experiences (accessible via applications and virtual worlds). Each of these layers represents entire industries and sectors, indicating the complexity of the ecosystem. It is out of the scope of this report to explore each layer, but a key theme is that while there are existing technologies, standards or policies surrounding the elements, they collectively do not make up a fully realized metaverse. Global collaboration and technological advances will be needed for this to happen, and in a way that upholds child rights.

Figure 1: Layers of the metaverse
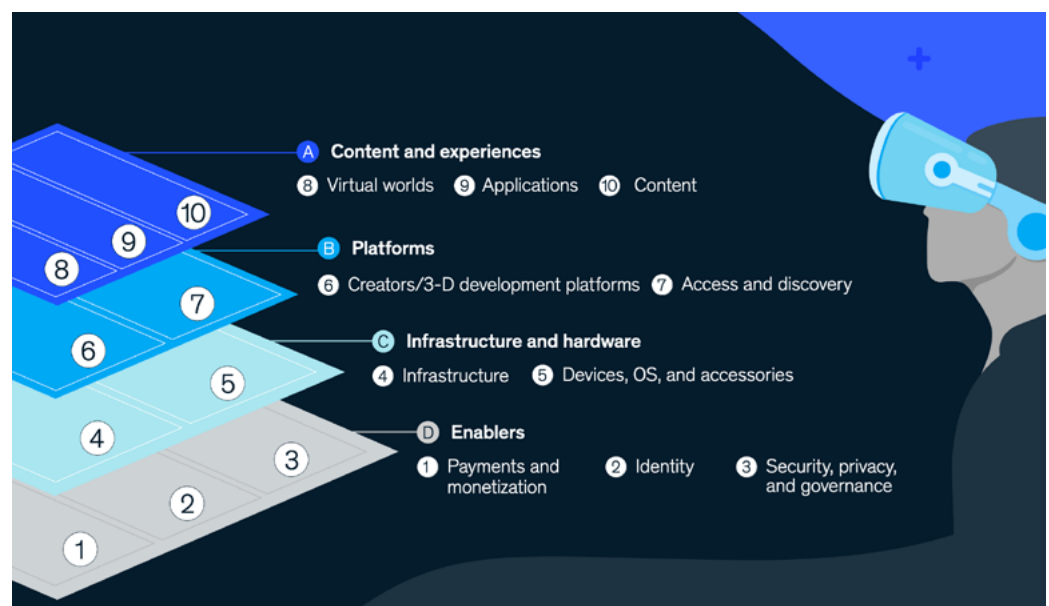
Source: McKinsey & Company (2022). 'Value creation in the metaverse: The real business of the virtual world'

3. What are the drivers and predictions for the growth of the metaverse and XR?

While it is uncertain how the metaverse will evolve, Deloitte[25] offers three potential scenarios that may be useful: "low orbit: the metaverse excels at certain things but never becomes a general-purpose platform; double star: there is not a single metaverse, but a handful of major players vying for a share of a dynamic marketplace; or big bang: an open, interoperable metaverse becomes the dominant interface through which we conduct most of our daily activities." Some of drivers that could influence what shape the metaverse takes are described below.

Beyond **the maturing of the technologies underpinning the metaverse**, including innovations in AI, blockchain, wearables and VR, the ongoing increases in computing power, cloud infrastructure and connectivity are key enablers of more immersive environments. The development of quantum computing could also add much-needed computational power[26] to the metaverse, VR and MR, translating to more immersive and seamless experiences – a main selling point for these technologies. **Low-cost solutions have also emerged** from the tech industry, such as cheaper VR headsets, which are expected to make the metaverse more accessible to consumers and businesses alike. A recent forecast from The Economist[27] predicted that worldwide shipments for VR and AR headsets will increase from just under 20 million in 2022 to 50 million in 2026. While these figures are high, to put them into perspective, approximately 1.35 billion smartphones[28] were shipped in 2021. While the XR market is still in the growth phase, many virtual environments will continue to allow for non-immersive access from PCs and mobile devices (not using XR devices).[29]

Another key driver for the metaverse is potential **market growth**. The disruptive power of the metaverse and its related technologies is predicted[30] to transform entire markets and it has been estimated[31] that by 2030, VR and AR technologies could contribute a total of $1.5 trillion to global GDP (see Figure 2). There are **many business opportunities and investments** to be made in XR technologies and companies from varying sectors. In the first five months of 2022, corporations, venture capital, and private equity have already invested more than $120 billion in the metaverse.[32] Many companies are considering developing their own enterprise metaverse-like spaces to support their business operations and clients, by merging immersive technologies with AI and business intelligence (examples include NVIDIA Omniverse and Microsoft Mesh). For example, Facebook altered their business strategy when they rebranded as Meta and formalized the company's focus on developing the metaverse. Chinese

tech giants[33] are also building out their metaverse and XR capabilities. Morgan Stanley estimates the metaverse market in China could eventually reach $8 trillion.[34] Another driver of commercial interest in the metaverse is its potential to enable new forms of marketing[35] that are highly personalized and placed directly in virtual games and experiences. One estimate holds that spending on metaverse advertising is on track to total between $144 billion and $206 billion by 2030.[36]

Figure 2: VR and AR projected contribution to global GDP
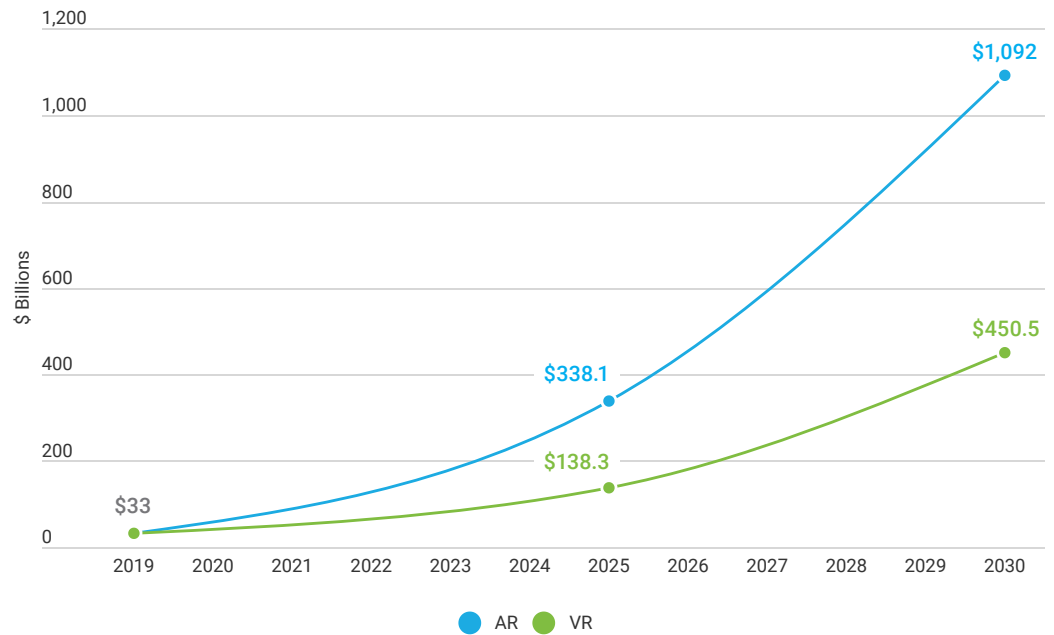
Source: PwC (2019). 'Seeing is Believing: How virtual reality and augmented reality are transforming business and the economy'

National and regional governments[37] have also begun to show interest and formulate their own metaverse strategies and activities. For example, in the USA, immersive technologies are being seen as an emerging focal area at the Congressional level,[38] where legislation has been proposed[39] to help ensure that the country maintains a competitive edge in innovative infrastructure and STEM education, as well as investments in immersive technology research. Furthermore, the US military is planning to build its own metaverse[40] and use VR and AR to help aid its military training. Other countries, such as South Korea, are investing millions of dollars in the metaverse industry to help support public-private partnerships and create new jobs.[41] The European Commission recently officially launched its Virtual and Augmented Reality Industrial Coalition,[42] bringing together stakeholders from key metaverse technologies. The coalition calls for investment in European VR/AR companies, the development of common technology standards based on European values, awareness-raising of the potential of VR/AR for commercial and societal purposes, and an analysis of the potential impacts of VR/AR on society, human rights and the environment to shed light on potential risks and identify areas where guidelines for proper use of the technology might be needed. Recently, the city of Shanghai released its five-year development plan to encourage the application of the metaverse in public services and social entertainment, among other areas, and increase research and the

development of underpinning technologies.[43] In 2021, the Government of Barbados announced it would be the first country in the world to establish an embassy in the metaverse by working with a few existing VR platforms.[44]

The popularity of gaming and online social interactions is being seen as a major catalyst for the advancement of the metaverse[45] and is driving the demand for more immersive and virtually connected experiences. Gaming, in particular, has been "critical in seeding the metaverse".[46] Limited in-person social interactions resulting from the COVID-19 pandemic lockdowns have further spurred consumer interest[47] in virtual live events and entertainment. While various forecasts anticipate an increase in the adoption of XR technologies among consumers, there is a lack of data on children's potential uptake. However, we can look for early indications of children's use of XR based on the popularity of online gaming platforms and the investments major companies are making to further develop virtual environments, especially in the gaming, entertainment and social media sectors. In 2016, it was predicted[48] that by 2025 the gaming industry would see the largest uptake in VR and AR technologies, followed by the health care, engineering, live events and video entertainment industries (see Figure 3).

In 2021, the global video games industry generated approximately $176 billion in revenue.[49] These earnings are expected to continue to increase at a rapid pace, especially in China, the USA, Japan and South Korea, the four largest gaming markets.[50] Worldwide, there are an estimated 2.7 billion gamers, and children and young people are considered a key consumer group. Although gaming statistics do not always provide age-segmented information, recent reporting[51] shows that 30 per cent of new gamers are under the age of 25. The popular online platform, Roblox, is dominated by young users with 26 million daily active users under the age of 13.[52] Large children's gaming companies, such as Roblox, Minecraft and LEGO (in partnership with Epic Games), have announced plans to further develop their metaverse spaces. Chinese gaming and social giants Tencent and ByteDance have also made their metaverse ambitions and major investments known.[53]

Figure 3: VR and AR market size estimates for 2020 and 2025   ● 2020 ● 2025
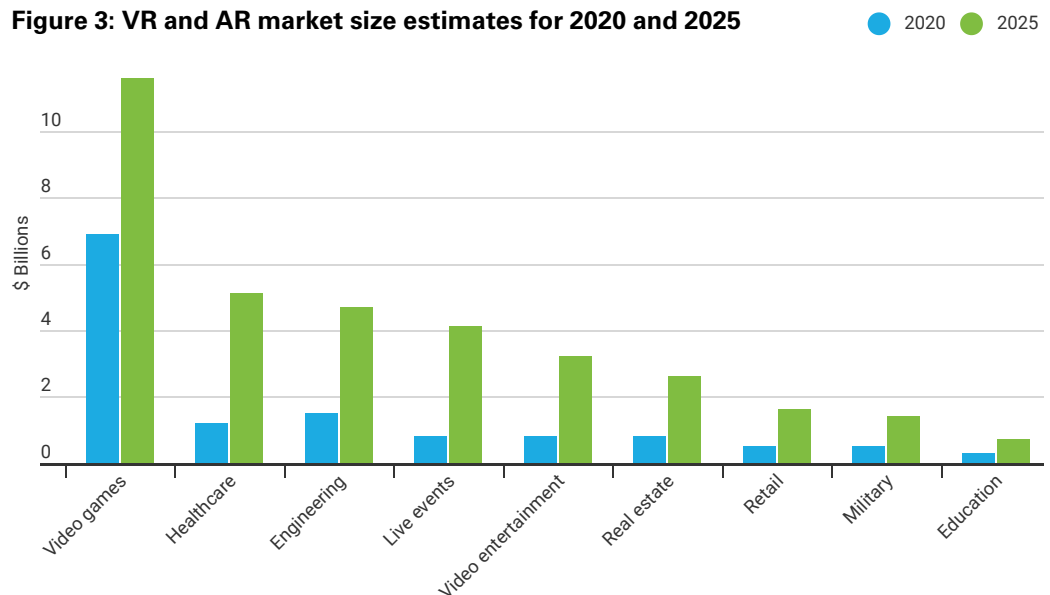
Source: Goldman Sachs (2016). 'Virtual & Augmented Reality: The Next Big Computing Platform'

4. What are the potential impacts of the metaverse and XR on children?

The trends described above are pointing to a possible societal shift that comes with great promise and hope, but also risks and unintended consequences. The non-exhaustive list below explores key potential opportunities and risks, some of which are known today based on XR-related research, and others which are anticipated given the expected role of XR in the metaverse experience. In some cases, the potential impacts present both opportunities and risks for children.

Key opportunities

Learning, playful development and socialization

Today XR-related technologies offer the potential for children to **learn in a more immersive and engaging way**[54] by enabling experiences that may not have otherwise been possible. This could include travelling virtually to museums or remote locations, or reliving historical events virtually. Such educational opportunities will be equally possible in the metaverse. They could be especially powerful if the virtual and real worlds could be melded "in ways that preserve real teacher-child, caregiver-child, and child-child social relationships."[55] Through the use of simulations, VR tools and software can provide **workplace readiness training**[56] by offering a space for young people to gain real-world skills with the freedom to safely make mistakes and learn from them. This is especially useful in cases where employees are expected to operate highly technical machinery, work in dangerous settings and follow emergency protocols in unexpected situations.

Many virtual environments allow users to develop and customize avatars, create objects and engage in world building. The "open-ended and creative design features" **stimulate children's imagination and support play**, notes Sonia Livingstone, a professor at the London School of Economics and Political Science who researches children, media, and the internet.[57] Virtual environments also facilitate **identity development** in a playful setting not possible in the real world. Virtual environments can facilitate **new forms of social interaction**, from shared entertainment experiences, such as at large-scale virtual concerts, to collaborations during game play or creative exercises – done together while being physically apart. Virtual events are popular:[58] in 2021 singer Ariana Grande drew a record 78 million players to her concert in Fortnite, with Lil Nas bringing 33 million users to his concert in Roblox. These experiences could offer new ways for children to gather

and communicate, in both large and small groups, also allowing children to exercise their right to peaceful assembly and civic participation.

Health and safety

Virtual environments are being used to offer **mental health support** in a range of contexts, such as immersive therapy to help children with autism spectrum disorder (ASD) prepare for public speaking.[59] VR tools can provide therapeutic benefits and potentially aid patients to reduce anxiety and depression and treat chronic pain.[60] AR fitness apps[61] aim to increase **physical exercise** by offering tailored activities, personal virtual instructors and fun elements such as immersive games.

The metaverse and virtual environments may provide additional mechanisms for **personal safety**, which are unavailable in the real world. For instance, in Meta's 'Horizon Worlds' users can instantly activate a protective bubble or move to a 'Safe Zone'[62] when they are feeling threatened, so that no one can approach, talk to or touch their avatars. They can also mute, block and report content or people. Other platforms are also introducing a personal boundary safeguard, with a minimum pre-set distance between a user's avatar and their non-friend avatars.

Accessibility and inclusion

The immersive nature of the metaverse has the potential for it to be **accessible to users with disabilities**.[63] For example, to help people with visual impairments, colourblind mode is already available in several games, and such users may engage in games without viewing the graphics, relying on audio or haptic motion interfaces instead. People who use alternative methods of communication can use a soundboard to have conversations through a text-to-speech feature and create a unique voice for their character or avatar. "If inclusion and accessibility are at the forefront of its design, the metaverse could prove to be more usable than current digital experiences", notes Geoff Freed, a digital accessibility expert.[64] More broadly, through real-time automated interpretation, the metaverse could foster inclusion by allowing users who speak different languages to interact.

These experiences could offer new ways for children to gather and communicate ... allowing children to exercise their right to peaceful assembly and civic participation

EXAMPLES

Leveraging XR technologies to tackle real-world challenges for children

UNICEF has been supporting start-ups around the world, such as those described below, that use XR technologies to provide learning and mental health support for children.[65]

Ideasis,[66] from Türkiye, has developed Vivoos VR, a tool that supports mental health practitioners in the treatment of phobias and anxiety disorders of children and young people, while making therapy time cost-effective and more accessible. The solution offers full control over scenario events, realistic visuals, and real-time physiological monitoring in order to create immersive experiences that provide the desired level of exposure, while reducing the potential risks of real-life exposure.

Veative,[67] from India, creates VR content for schools and industry to better learn abstract subjects such as science and mathematics through interactive activities and experiments. Veative's library, some of which is openly licensed, contains over 500 modules of learning content.

Imìsí 3D,[68] from Nigeria, has developed AutismVR, a VR game to help young users and adults simulate interactions with children with ASD. The game, which uses AI techniques, is designed for non-autistic young users and adults, notably siblings and caregivers, to gain a better understanding of the range of behavioural capacities and challenges that characterize autistic children and therefore help support their needs and development.

Source: Mohini Ufeli for Imìsí 3D, in UNICEF (2021). '<u>Imìsí3D: Case study</u>', Office of Global Insight and Policy, New York.

Key risks

Safety and security

There are concerns that virtual environments may lead to exposure to **harassment, including sexual harassment, abuse and exploitation and hate speech**.[69] After researchers from the Center for Countering Digital Hate spent 12 hours in a popular VR social platform they found that users, including children, were being exposed to abusive behaviour.[70] This included minors being exposed to graphic sexual content; bullying, sexual harassment and abuse of other users, including minors; and minors being groomed to repeat racist slurs and extremist talking points. The aspect of immersion could amplify the effects of such incidents. The Australian Government's eSafety Commissioner notes that "by providing hyperrealistic experiences – where

virtual sensations feel real – immersive technologies could increase the impact of negative interactions [such as cyberbullying, grooming children for online sexual abuse, and image-based abuse], and lead to a rise in online assaults and abuse."[71] Women who experienced virtual sexual harassment said they believed and felt the assault to be 'real'.[72] Such reports have prompted platforms to introduce the safety features, described above. New forms of **behavioural cyberbullying** may emerge, such as avatars throwing virtual objects at other avatars. Overall, virtual environments raise the need for behavioural moderation, not just content moderation. This will be more challenging to implement than current policing of text and video, but because the "metaverse provides a more immersive experience, it is crucial that the safety concerns it raises are proactively addressed", notes the Brookings Institution.[73]

> Virtual environments raise the need for behavioural moderation, not just content moderation. This will be more challenging to implement than current policing of text and video

Similarly to some existing platforms today, such as social media, the metaverse may fail to prevent **children from entering environments that are not designed for them**. Since many gaming companies recommend (but do not insist) that children under the age of 13 do not use their VR products, it is unclear if and how future VR and AR games may take younger users into account. Already there have been reports of children using platforms designed for users over 18 years old,[74] which therefore do not have parental controls and guardrails for younger users, such as the ability to disable chat functions.[75] Experts worry that people seeking to harm children online – for example, through sexual harassment or grooming for sexual abuse – will capitalize on this.[76] Currently, age assurance tends to fall mostly on the users themselves, something tech-savvy children can easily bypass. More robust age verification tools, or parental controls, can be more effective but are also not a silver bullet. Age verification can bring its own challenges, such as those relating to data protection for children.

As noted above, virtual worlds had economies – and challenges associated with them – well before the concept of the metaverse entered the global discourse. One set of problems relates to the governance of these economies: private companies either directly set exchange rates or the supply of tokens, or set the prices and supply for in-game or in-world items, which makes them de facto central banks or treasuries with no real accountability.[77] A second set of problems concerns the grey area between heavily regulated offline markets and economic activities (including labour markets, borrowing and lending, and the provision of financial services) and their counterparts in the virtual world. Cryptocurrencies, for example, fall on a broad spectrum of regulatory treatment in different countries[78] and in unregulated or insufficiently regulated environments, children may be vulnerable to financial impacts or exploitation. Further, in the online gaming world there have been reports for many years of players being paid low wages to spend excessive amounts of time collecting in-game items, which are then sold on.[79] With increased virtual environments built around virtual economies, there is the potential for this kind of **commercial exploitation of children** in the metaverse, especially the most vulnerable who may not have the ability to convert virtual currency to fiat currency (in other words, national currency) themselves.

Cybercrime is already taking place in virtual environments, from reported scams to phishing campaigns.[80] As reports show, security issues concerning digital currencies are becoming more common, NFT frauds[81] have recently skyrocketed, and illegal

uses of cryptocurrency,[82] such as money-laundering, may become more prevalent. According to some studies, security flaws in wearable devices[83] and VR headsets[84] have already been uncovered to show how they can be **hacked**. This can result in the user's private information, either stored on the device or sent over the internet, being accessible to hackers. It also potentially gives hackers control over the device and the content the victim receives, such as unwanted contact and content. Finally, without rigorous identity authentication in virtual environments, there is the risk of **identity theft and avatar duplication and misuse**,[85] which could leave children exposed to fraud or being potentially wrongly accused of offences they did not commit. According to a UNICEF report, cybersecurity experts have detected a rise in sophisticated cyberattacks that manipulate children in order to steal their identity credentials and biometrics profiles, with lifelong security implications.[86] The report notes that such threats are "becoming rampant on platforms like TikTok, Instagram, Facebook and Snapchat but will be amplified in the metaverse and in expanding networks of personal, often unsecure devices."

Children's development

Metaverse and XR-related technologies could pose risks for children's cognitive and social development. In a study[87] on how adults and children respond to VR experiences, adults were able to use their prefrontal cortex to regulate what their brains were processing during a fictitious simulation. The children in the study (median age of eight years) did not do so to the same extent and, as a result, could not always distinguish the difference between the virtual and the real world. Thomas Baumgartner, a neuroscientist and author of the study, notes that children's "prefrontal cortex is far from being fully developed at this age."[88] As virtual environments become more realistic and immersive, the line between the virtual and real world could be even harder for children to grasp, **impacting children's understanding of reality**.

> As virtual environments become more realistic and immersive, the line between the virtual and real world could be even harder for children to grasp, impacting children's understanding of reality

The merging of XR headsets with brain-computer interfaces (BCIs) such as electroencephalogram (EEG) sensors could "permit app developers and game designers to make 'personalized games' that respond differently based on whether a user is excited, happy, sad, or bored", according to the XR Safety Initiative (XRSI).[89] While such levels of personalization hold many potential benefits for play, learning and health care, experts have warned that the metaverse could enhance a **fractured view of reality**,[90] resulting in echo chambers, virtual filter bubbles, or parallel realities. Even without neurotechnology, two users in the same virtual environment could see different advertisements, political messaging or activities without knowing it, making it more challenging to identify misinformation and division. One prediction for the future of advertising in the metaverse holds that traditional marketing methods such as pop-up ads and promotional videos will be replaced by objects, activities and content delivered by computer-generated personas, that look and feel real, and tailored to each user's profile and virtual experience.[91] Children, in particular, may be at risk of being unable to detect these segmented realities due to their evolving cognitive capacities.[92]

There is also a risk that spending too much time in immersive virtual environments can encourage a **limited view of social interaction**. Children may come to think of

these spaces and, later, the metaverse, as a replacement for in-person communication or experiences. The Australian eSafety Commissioner is concerned that "being able to access unlimited extreme or intense experiences, or an environment that is more comfortable or attractive than reality, may make it difficult to leave the virtual world and participate in actual experiences and relationships."[93]

Health and well-being

Some experts are concerned about the health risks associated with VR usage, saying it could increase fatigue, damage hearing, and cause myopia or near-sightedness.[94] VR use can also result in scenarios that are dangerous to a person's physical safety. Because these devices obscure the users' view and awareness of their physical surroundings, people can easily trip, knock into objects or walk into unsafe spaces.[95] Device manufacturers recommend setting up safe physical spaces and virtual boundaries to address this risk.

Researchers[96] have shown that VR alters the perception of time spent in virtual environments, which could potentially result in excessive use. Without realizing it, children may spend too much time online in the future metaverse and not engage in a balanced and healthy lifestyle of exercise, real-world socializing or school activities. Owing to the immersive qualities of VR games, "children may need additional support to find a healthy balance between gaming and other activities," notes UNICEF.[97] This could include addressing design features in current and future technology that keep children playing without taking breaks. For instance, UNICEF and the LEGO Group initiated the Responsible Innovation in Technology for Children project,[98] which promotes 'well-being by design' to inform design choices that can promote positive well-being outcomes for children.

In virtual environments, customizable avatars represent the users' real or imagined selves and will likely serve as the primary means to communicate and interact with others. While supporting personal expression for children, this immersive hyperpersonalization may lead users to create and normalize an idealized – and otherwise unattainable – body,[99] fuelling negative body image perceptions (body dysmorphia) in the real world, especially in relation to physical traits that often draw discrimination such as disabilities, skin colour and ethnic features.

Read *The Case for Better Governance of Children's Data: A Manifesto* →

Personal data and privacy

Providers of metaverse spaces and XR technologies could be the main gatherers of vast amounts of data about users immersed in virtual environments, including kinetic data (such as body movements, facial expressions, eye tracking and pupil dilation), physiological data (such as skin temperature and heart rate), brain activity, and other health data, considered 'sensitive' data under the European Union's General Data Protection Regulation (GDPR). In addition, providers of services within virtual environments, such as advertising companies, game developers and governments, will also be collecting data on their users. According to the Brookings Institution, "When used for good, this data could lead to innovative and personalized experiences, but the potential exploitation and sale of this data leads to major privacy and human rights concerns."[100]

IN PRACTICE

From behavioural, physiological and mental tracking in future VR experiences, it will be possible to capture not only a user's outward behaviour but also their physiological and physical reactions to specific situations, allowing AI systems to infer certain mental responses, as illustrated in this example from Urvashi Aneja:[101]

Imagine a user that sees a picture of a shiny red car – in a VR experience, their emotional response can be analyzed and tracked, including how it changes over time. Pupil dilation could convey

the excitement the user feels at seeing the car and galvanic skin responses can tell us how intensely a person feels a particular emotion.

Such detailed data, including from involuntary physical reactions, could be used by the tech platforms gathering the data or by those it is sold to in the form of profiled user groups for personalizing entertainment content, or for microtargeted advertising and marketing at scale and precision, bringing both opportunities and risks.

Collection of data about non-verbal behaviour[102] brings into question **meaningful consent** to data sharing. It can **infringe upon a child's right to privacy** as algorithms can make inferences about their preferences, including gender orientation, and dislikes. Neural technologies could amplify this risk on an individual and collective level, especially for children. The capacity to monitor and shape their neural activity and mental states would have implications for **mental privacy, integrity and psychological continuity** (the idea that an individual's sense of self is based on their own memories and awareness). Further risks related to the large stores of collected data include increased identity theft, fraud, scams and doxing.[103]

Given the unprecedented amounts and types of data that will likely be collected, many of which could be shared with third parties, the potential for hyperspecific and immersive **marketing, profiling, microtargeting and manipulation** increases. Targeting can put children at risk of commercial exploitation and manipulation of their developing worldview, and could also be used to predict and influence their future behaviour.[104] "Children are highly susceptible to these techniques which, if used for harmful goals, are unethical and undermine children's freedom of expression," freedom of thought[105] and right to privacy. Given that the business model of many virtual world providers relies on the sale of virtual goods which, like advertising, will require the collection and exploitation of personal data,[106] concerns about children's profiling, microtargeting and manipulation in the metaverse are not unwarranted.

Diversity, equity and inclusion

Emerging technologies are typically designed and commercialized in developed countries. **Limited availability** and affordability of the devices and services that underpin the metaverse and XR (such as reliable and high-speed internet connectivity and cloud services, XR sets and related computing power, or customized AI models) may adversely impact developing countries, in terms of both consumers' access and developers' ability to innovate and create new and localized content and solutions. For instance, although the cost of XR hardware is declining in the Global North, it remains prohibitively high on the African continent, mainly because technology companies do not sell these products in all parts of the region. Affordability, awareness, and skills

to use the metaverse and related technologies (e.g. NFTs, cryptocurrencies and other blockchain applications) – including the support that parents and peers provide – can also limit the uptake. These limitations will likely be more pronounced for those in developing countries and lower socioeconomic settings, constraining the **diversity, equity, and inclusion**[107] needed in the development and use of metaverse spaces and XR technologies, and risk **exacerbating global inequalities**.[108]

Other key factors that will potentially impact children's future use of the metaverse and XR technologies are the **digital – and digital gender – divide and gaps in ICT infrastructure**. According to the ITU,[109] while internet penetration is increasing, especially among young people between the ages of 15 and 24, only an estimated 63 per cent of the world's population are online and there are stark **disparities across income groups and regions**. The organization notes that "to achieve universal connectivity, disadvantaged groups such as **women and girls, persons with disabilities** … those with **low incomes and people living in remote areas, require special attention**." Finally, XR technologies typically require mobility, vision, dexterity, and hearing. Even though they may actually provide assistance to persons with disabilities, currently they are generally not well-designed for those with impairments or a need for assistive technology.[110] For now, they present barriers to **user accessibility**.

The full scope and impacts of the metaverse and XR on children and their rights are not yet fully understood

In the context of potential opportunities and risks, overall, the full scope and impacts of the metaverse and XR on children and their rights are not yet fully understood. As experts noted at a recent AR/VR policy conference: There is "insufficient research to understand how children might experience AR/VR differently from adults, how these technologies might impact their mental health or cognitive development, and how to best integrate these solutions into established pedagogical approaches to optimize learning outcomes."[111] Further, "child safety remains a notable knowledge gap in our understanding of the impacts of immersive technologies." The current 'techlash'[112] stems from the lessons learned from uncritically adopting new technologies and then having to live with their unintended negative consequences. Clearly there is a need to better understand the opportunities and risks of the metaverse and XR, and to collectively aim for the appropriate regulatory guardrails to be in place.

5. What are the regulatory and policy perspectives?

Many of the opportunities and risks that come with the metaverse and virtual environments are addressed in existing regulations and policies related to digital technologies. The questions are, to what extent are they covered, and to what extent are such regulations and policies being implemented?

In some cases, existing regulations and policies provide full coverage, while others may need to be revisited, or new ones developed, in light of emergent challenges the technology creates. To illustrate the range of responses, selected regulatory and policy considerations are explored below from a government and, where applicable, industry perspective, around key themes. Potential challenges in relation to implementation are also examined.

Content and safety

Regulators around the world are stepping up their efforts to reduce illegal and harmful online content, which will likely impact the development of the metaverse and virtual environments. Debates are ongoing among policymakers in the USA to create safer and more accountable tech platforms by reforming Section 230 of the Communications Decency Act, or adopting a range of other measures, including competition enforcement and stronger privacy legislation.[113] In the European Union, the forthcoming Digital Services Act (DSA)[114] aims to create a safer online experience for children.[115] For example, requirements incorporate the swift removal of illegal online content, which includes child sexual abuse material, illegal hate speech, terrorist content or an illegal product; and a ban on targeted advertising to children and restrictions on data harvesting for profiling. The illegality of content is defined by EU law or EU member states law. Very large online platforms (those with more than 45 million monthly active users in the EU) will also have to release detailed biannual reports of their moderation efforts, including the number of staff, expertise, languages spoken and the use of artificial intelligence to remove illegal content.[116] The Committee on the Rights of the Child's General Comment No. 25 (2021) on children's rights in relation to the digital environment, prohibits "practices that rely on neuromarketing, emotional analytics, immersive advertising and advertising in virtual and augmented reality environments to promote products, applications and services … from engagement directly or indirectly with children."[117]

In its Code of Practice on Disinformation,[118] updated in 2022 and connected to the DSA, the European Commission has garnered support[119] from some of the biggest tech companies to undertake specific measures related to removing harmful (though not necessarily illegal) online content. A 2022 European Commission proposal[120] for a

regulation to prevent and combat child sexual abuse online could oblige providers to detect, report, block and remove child sexual abuse material from their services, and introduce age verification measures. While these measures bode well for future users of the metaverse and virtual environments, the European Parliamentary Research Service points out that the "need to further amend EU law to keep users safe online cannot be ruled out."[121]

The effectiveness of moderation and safety regulations and policies, however, depends on the capacities of policymakers, social services and law enforcement authorities. In many cases, these institutions are already constrained in dealing with issues in the digital environment.[122] The emergence of child protection issues in complex new immersive environments will likely exacerbate this challenge, raising questions such as: How will it be made possible for law enforcement to identify perpetrators and their victims in a space where users are represented by avatars and fictitious names? How will law enforcement agencies ensure cooperation with companies and entities across jurisdictions in a decentralized environment, where elements of the metaverse will be coming from a great diversity of creators and owners?

Non-government stakeholders, including industry, have set out on a path of self-regulation with regard to safety and moderation in the metaverse. The Oasis Consortium, a non-profit organization, released a set of User Safety Standards[123] "that include hiring a trust and safety officer, employing content moderation, and integrating the latest research in fighting toxicity" with the aim of creating a safer, better metaverse.[124] Roblox and video game company Riot Games, among others, have pledged to uphold the standards. In 2020, because there had been "very little regulatory discussion around children's privacy in XR", the non-profit XRSI developed a Privacy and Safety Framework[125] with expert input from industry, government and academia. The framework aims to create a "baseline set of standards, guidelines, and best practices that are regulation-agnostic", even while it draws on requirements from GDPR, the Family Educational Rights and Privacy Act (FERPA) and Children's Online Privacy Protection Act (COPPA) in the USA, the Age-Appropriate Design Code in the United Kingdom (UK), and a few other evolving laws. Most recently, the Responsible Metaverse Alliance,[126] also a non-profit organization, aims to support politicians and governments internationally in addressing potential harms of the metaverse.

> **How will law enforcement agencies ensure cooperation with companies and entities across jurisdictions in a decentralized environment...?**

Online platforms already face enormous moderation challenges, which will increase as content takes on new virtual forms. For example, in addition to moderating activity, not only content, platforms need to consider different levels of user immersion. For instance, one user might be accessing a virtual space in full 3D view from a VR headset, while another could be participating in the same space in a 2D view from a mobile phone. Consequently, platforms may need to design content policies that deal with varying degrees of perception – including of potential harms inflicted – in the same experience.[127] It remains to be seen if current government regulations and industry policies provide sufficient cover for children and, further, whether they can be effectively enforced in emerging virtual environments.

Security

The global cybercrime regulatory environment is largely fragmented, creating challenges for cybersecurity, user safety and adequate responses in a future metaverse. In general, countries have different definitions of what constitutes cybercrime, and prescribe disparate procedures for collecting and exchanging evidence, and for prosecution. Despite this, there is some progress in the harmonization of cybercrime regulations between countries. For example, the Organization of American States (OAS) created a framework of guidelines to manage cybercrime as early as 1999, while African states adopted the African Union Convention on Cyber Security and Personal Data Protection (although only 13 countries have ratified it and another 2 need to do so before it enters into force and has legal effect). The most prominent agreement is the Council of Europe's Convention on Cybercrime (known as the 'Budapest Convention'),[128] ratified by over 60 countries from around the world, and thus the de facto international agreement on combating cybercrime. However, some major players such as China, Brazil and India have not signed the convention. Negotiations are under way in an Ad Hoc Committee on Cybercrime,[129] under the Third Committee of the United Nations, on a possible new international convention on cybercrime to be completed in 2024. It is uncertain how the new draft convention would work and interact with existing instruments such as the Budapest Convention, and be applicable to metaverse-related cybercrime.

Efforts to strengthen cybersecurity at the regional and national levels, which will have implications for metaverse-related crimes, are also under way. For example, to improve the EU financial sector's cyber resilience and mitigate cybercrime threats, the Commission has been requested by the Parliament to propose legislative changes in digital and cybersecurity requirements for the bloc.[130] At the national level, labelling and certification schemes for security of Internet of Things (IoT) devices,[131] such as those in the UK, Finland and Singapore, may be a basis for expansion of such models to XR and immersive technologies as well.

Personal data protection and algorithmic influence

Protection of personal data is becoming an important issue on many policymakers' agenda, while data governance laws from Europe, the US, and China are the most globally influential.[132] Several regulations have been adopted at the national and regional levels, of which arguably the most important is the EU's GDPR, which is increasingly considered a standard worldwide, as many other countries have GDPR-like data protection laws.[133] Although the European Parliament has emphasized[134] that existing regulation would address data privacy issues in the metaverse, there are justified concerns about user consent and data transfer.[135] In cases of Article 6 of GDPR, where the consent of the data subject is the basis of the lawfulness of personal data processing, the following questions arise: How and when should users' consent be obtained, and how should the different entities and organizations that provide metaverse services display their own privacy notice to users?[136] These and other questions concerning users' consent will need to be addressed, and regulations may need to be revisited. On the other hand, some believe[137] that effective consent gathering would be almost impossible in an immersive environment.

The metaverse poses other challenges for data regulations. For instance, data protection authorities already face difficulties in verifying whether their citizens' data is used across jurisdictions and sectors in compliance with applicable laws. What will make this even more difficult are the complexity of the various technologies underpinning the metaverse (including the ability of authorities to understand how these technologies manage personal data), and the greater number of providers of different services that will make the metaverse more distributed. Collectively, this will make it more challenging to determine accountabilities and liabilities.[138] Further metaverse challenges include defining the distinction between data controller and data processor[139] and even determining jurisdiction.[140] As policymakers attempt to navigate these new questions around regulatory interpretation and implementation, drawing on guides for better governance of children's data, such as UNICEF's *The Case for Better Governance of Children's Data: A Manifesto*[141] and Responsible Data for Children principles[142] (developed with GovLab), will help to keep children's rights and best interests in focus.

Read ***UNICEF's Policy Guidance on AI for Children*** →

Since AI and algorithms will drive personalized and targeted experiences in the metaverse, it may seem comforting that major economies are pushing legislation to demand greater transparency and accountability of Big Tech in this regard. For example, China's algorithmic law[143] is prohibiting AI-based recommendations that can manipulate what people think, with additional special protections for children. The EU's forthcoming Digital Markets Act[144] prohibits 'gatekeepers' from using children's personal data to target them directly or profile them, while the Digital Services Act[145] and the AI Act[146] will provide additional protections for children. In the US, the Federal Trade Commission is strengthening rules for greater accuracy, fairness, and equity in companies' use of AI.[147] The UK's Age-Appropriate Design Code, legally binding since 2020, requires that online service providers treat children and their data in a safe and appropriate way.[148] Inspired by this code, the California Age-Appropriate Design Code Act,[149] coming into effect from July 2024 to broadly protect the privacy and data of children online, will require providers of online products and services in California that collect personal information of California residents and that are "likely to be accessed by children" to conduct Data Protection Impact Assessments (DPIA). The assessments should address whether any algorithms and targeted advertising systems used by the online product, service, or feature could harm children. As above, the question of enforcement of these new rules by regulators and compliance by the tech industry, however, will likely be complex in the metaverse.

Standardization and inclusion

An important element for greater technology accessibility and inclusion is the availability of common standards. When developed openly and with multi-stakeholder input, standards support interoperability of devices and services produced by different industries or across regions, enhance innovation and introduce a diverse range of features into products, such as making them more accessible for users with disabilities. For the fully envisioned metaverse to materialize, it will need to incorporate the whole gamut of digital worlds with interoperability between them all.[150] As expected, various international standards bodies have developed, or are working on, guidelines and standards for technologies underpinning the metaverse.

Examples are the IEEE Standards Association's standards on VR and AR[151] and the W3C's XR Accessibility User Requirements,[152] which list user needs and requirements for people with disabilities when in immersive environments or using XR technologies.

There is also a belief, pointed out by the European Parliamentary Research Service, that "Big Tech companies will likely drive the metaverse architecture in defining technical standards and protocols."[153] An example is the recently formed Metaverse Standards Forum,[154] which includes founding members such as Microsoft, Epic Games and Meta (it is also open to standards organizations, industry associations and universities). Critics worry that such efforts will result in a metaverse moulded to private sector interests.[155] Beyond corporate interests, growing geopolitical polarization also influences technology standardization forums, where leading global economies increasingly compete to push for standards of their own liking (and, indeed, carrying their own cultural or political values). Such competition, fuelled by political tensions, may lead to a fragmented environment for standards, with adverse effects on global business cooperation in the development of the metaverse and XR technologies, and interoperability of products from different regions of the world. More broadly, different national approaches to metaverse governance could see it splintering[156] or never becoming universal. For children, that would mean different and fragmented opportunities – and risks – across the world, and possibly unequal access to technologies, education and skills. International, multi-stakeholder digital cooperation will be needed to avoid this outcome for children.

Recommendations

Many of the opportunities and risks that come with the metaverse and virtual environments are addressed in existing regulations and policies related to digital technologies. The questions are, to what extent are they covered, and to what extent are such regulations and policies being implemented?

The following high-level recommendations aim to help narrow the knowledge, regulatory and policy gaps that arise with the development of the metaverse. To help positively influence metaverse-related advances, we identify two key groups that need to act: policymakers and regulators, and technology companies.

1. Recommendations for government stakeholders, including policymakers and regulators

Assess and adjust, if needed, regulations and regulatory frameworks to ensure that metaverse-related technologies do not violate children's rights

- Carry out a review of how metaverse-related technologies might function to identify emerging opportunities and risks for children.

- Assess how existing regulatory frameworks, such as the European GDPR and DSA, legally binding children's codes such as in the UK, and forthcoming documents, such as the European Data Protection Board Guidelines on processing of children's data and the European AI Act, apply to metaverse and XR technologies, and whether additional regulation, standards and approaches, for example, reporting requirements about moderation, are needed.

- Where policy or regulatory gaps may be found, develop open standards, principles or legislation to provide safeguards for children. Developing proactive regulation,[157] based on the precautionary principle[158] that applies even where there is insufficient scientific evidence of harm but there is real risk of such harm – as may be the case with emergent technologies – will lead to greater protection and empowerment of children.

- Consider setting up an expert advisory board[159] made up of a wide range of stakeholders, including child rights experts, to advise policymakers and regulators on the metaverse and XR.

Foster an enabling environment to maximize the benefits of metaverse-related technologies and virtual environments for all children through promoting inclusion, child rights design and research

- Promote the meaningful inclusion of children – especially girls, those from low socioeconomic settings, children with disabilities, and from under-represented groups – in the development of new metaverse-related strategies, policies, regulations and technologies, as appropriate and with robust safeguards in place.[160]

- Raise awareness about the metaverse and its underpinning technologies among parents, caregivers and educators, including opportunities and risks, so they can support children in their explorations, and help them navigate the challenges of these new spaces.

- Promote the guiding principles of child rights by design, including well-being, safety, privacy and inclusion by design to help anticipate, detect and eliminate online harms and build safe and empowering virtual environments.

- Encourage and support funding for independent research, particularly in the Global South, on the impact emerging metaverse-related technologies have on children's various developmental stages and their physical, cognitive, emotional and psychological capacities.

2. Recommendations for technology companies providing metaverse-related products and services

Prioritize the best interests of the child in the development and implementation of metaverse-related technologies

Read *Towards
a Child-centred
Digital Equality
Framework* →

- Apply existing responsible design principles and frameworks in the design and deployment of products and systems with a child rights by design approach,[161] which should include well-being, safety, privacy and inclusion by design.

- Apply the highest existing data protection standards to children's data in the metaverse and virtual environments. Follow a responsible data approach[162] when collecting, processing and storing children's data. For example, conducting only proportionate and purpose-driven data collection (using only the minimal and necessary data), especially of sensitive health and biometric-related data.

- Support open standards to help make the metaverse and XR technologies more functional, interoperable and transparent.

Internally and with other industry stakeholders, civil society groups, researchers and regulators, work to protect children and address harmful content and behaviour in the metaverse

- Implement self-declared policies and terms of use through applying robust oversight mechanisms. Invest in more effective human and automated content and behavioural moderation, since the responsibility for safety can never be left only to children through user reporting mechanisms.

- Anticipating potential harms against young users, update moderation and community guidelines and policies for virtual environments. Best and promising practices should be openly shared.

- Incorporate children's rights advocates from civil society, psychologists and other stakeholders working at the intersection of children and the digital environment in the development of metaverse-related technologies.

Endnotes

1   Aiello, C., Bai, J., Vilchynskyi, Y., Schmidt, J., 'Probing reality and myth in the metaverse', McKinsey & Company, 2022, https://www.mckinsey.com/industries/retail/our-insights/probing-reality-and-myth-in-the-metaverse

2   Pearlman, K., 'Building responsible, safe, and inclusive extended reality ecosystems (The Metaverse)', XRSI Recommendations for the Biden-Harris Administration, XR Safety Initiative, 2022, https://xrsi.org/wp-content/uploads/2022/04/XRSI_Recommendations_Biden-Harris_11.pdf

3   Signé, L. & Dooley, H., 'A proactive approach toward addressing the challenges of the metaverse', Brookings, 2022, https://www.brookings.edu/techstream/a-proactive-approach-toward-addressing-the-challenges-of-the-metaverse/

4   Cortesi, S., et al., 'Youth and Extended Reality: An Initial Exploration of Augmented, Virtual, and Mixed Realities', Youth and Media, Berkman Klein Center for Internet & Society, 2021, https://cyber.harvard.edu/publication/2021/youth-extended-reality

5   Diplo, 'What is the Metaverse? Diplo expert explains', 2021, https://www.youtube.com/watch?v=MImBz0tgWh4

6   Stephenson, N., Snow Crash: A novel. Del Rey Books, 2000, https://bookshop.org/books/snow-crash/9780553380958

7   Ball, M., 'Framework for the Metaverse, The Metaverse Primer', 2021, https://www.matthewball.vc/all/forwardtothemetaverseprimer

8   Ibid.

9   Rec Room, https://recroom.com

10 Minecraft, https://www.minecraft.net/en-us

11 eSafety Commissioner, 'Immersive technologies – Tech trends position statement', Australian Government, 2020, https://www.esafety.gov.au/sites/default/files/2020-12/Immersive%20tech%20-%20Position%20statement.pdf

12 Ibid.

13 DigWatch, 'Pokémon Go: Digital policy in the age of augmented reality', https://dig.watch/trends/pokemon-go-digital-policy-age-augmented-reality

14 Amazon, View in your room, https://www.amazon.com/adlp/arview

15 Experience Real History, 2018, https://www.experiencerealhistory.com

16 eSafety Commissioner, 2020.

17 Bach, D., 'This "smartphone for surgeons" could be the future of operations', World Economic Forum, 2021, https://www.weforum.org/agenda/2021/02/hololens-surgery-digital-revolution-medical-techonology/

18 eSafety Commissioner, 2020.

19 UNICEF, 'Policy Guidance on AI for Children 2.0', Office of Global Insight and Policy, New York, 2021, https://www.unicef.org/globalinsight/media/2356/file/UNICEF-Global-Insight-policy-guidance-AI-children-2.0-2021.pdf

20 XRToday, 'Artificial intelligence in the Metaverse: Bridging the virtual and real', 2021, https://www.xrtoday.com/virtual-reality/artificial-intelligence-in-the-metaverse-bridging-the-virtual-and-real/

21 DigWatch, 'Blockchain', https://dig.watch/topics/blockchain

22 Müller, O. & Rotter, S., 'Neurotechnology: Current developments and ethical issues', Frontiers in Systems Neuroscience 11:93, 2017, doi:10.3389/fnsys.2017.00093.

23 Meta, 'A future that's more human and less artificial', https://about.facebook.com/realitylabs/

24 Ball, M., 'The Metaverse Will Reshape Our Lives. Let's Make Sure It's for the Better', TIME, 2022, https://time.com/6197849/metaverse-future-matthew-ball

25 Deloitte, 'A whole new world? Exploring the metaverse and what it could mean for you', 2022, https://www2.deloitte.com/content/dam/Deloitte/us/Documents/technology/us-ai-institute-what-is-the-metaverse-new.pdf

26 Basu, S. 'Exploring the Metaverse and how quantum computing plays a role', Medium, 2022, https://medium.com/my-metaverse/exploring-the-metaverse-and-how-quantum-computing-plays-a-role-a1e227f93d2b

27 The Economist, 'From Apple to Google, big tech is building VR and AR headsets', 2022, https://www.economist.com/business/2022/04/09/from-apple-to-google-big-tech-is-building-vr-and-ar-headsets

28 Nair, M., 'Global smartphone market shipped 1.35 billion units in 2021, records 5.7% growth', Fonearena, 2022, https://www.fonearena.com/blog/355823/global-smartphone-shipments-2021.html

29 Levy, S., 'What If the Metaverse Is Better Without Virtual Reality?', WIRED, 2022, https://www.wired.com/story/plain-text-metaverse-better-without-virtual-reality/

30 Nguyen, T.H., '5 impactful technologies from the Gartner Emerging Technologies and Trends Impact Radar for 2022', Gartner, 2021, https://www.gartner.com/en/articles/5-impactful-technologies-from-the-gartner-emerging-technologies-and-trends-impact-radar-for-2022

31 PwC, 'Seeing is believing: How VR and AR will transform business and the economy', 2019, https://www.pwc.com/SeeingIsBelieving

32 McKinsey & Company, 2022.

33 Yang. Z & the China team, 'Chinese Big Tech's metaverse party', Protocol, 2022, https://www.protocol.com/newsletters/protocol-china/big-tech-china-metaverse?rebelltitem=1#rebelltitem1

34 Chittum, M., 'Morgan Stanley sees $8 Trillion Metaverse Market – In China Alone', Blockworks, 2022, https://blockworks.co/morgan-stanley-sees-8-trillion-metaverse-market-eventually/

35 Norton Rose Fulbright, 'The Metaverse: The evolution of a universal digital platform', 2021, https://www.nortonrosefulbright.com/es-mx/knowledge/publications/5cd471a1/the-metaverse-the-evolution-of-a-universal-digital-platform

36 McKinsey & Company, 'Value creation in the metaverse: The real business of the virtual world', 2022, https://www.mckinsey.com/~/media/mckinsey/business%20functions/marketing%20and%20sales/our%20insights/value%20creation%20in%20the%20metaverse/Value-creation-in-the-metaverse.pdf

37 Quiroz-Gutierrez, M., 'The crown prince of Dubai says he has a "metaverse strategy" that will add 40,000 jobs and $4 billion to the economy in 5 years', Fortune, 2022, https://fortune.

com/2022/07/19/dubai-metaverse-strategy-crypto-emerging-tech-web3/

38 Robertson, D., 'Who writes the rules for the metaverse?', Politico, 2022, https://www.politico.com/newsletters/digital-future-daily/2022/04/06/whos-writing-the-rules-for-americas-metaverse-00023489

39 United States Government, America Creating Opportunities for Manufacturing, Pre-Eminence in Technology, and Economic Strength (COMPETES) Act of 2022, 2022, https://www.congress.gov/117/bills/hr4521/BILLS-117hr4521pcs.pdf

40 Knight, W., 'The US Military is Building Its Own Metaverse', WIRED, 2022, https://www.wired.com/story/military-metaverse/

41 Keane, J., 'South Korea is betting on the metaverse – and it could provide a blueprint for others', CNBC, 2022, https://www.cnbc.com/2022/05/30/south-koreas-investment-in-the-metaverse-could-provide-a-blueprint.html

42 European Commission, 'The Virtual and Augmented Reality Industrial Coalition', 2022, https://digital-strategy.ec.europa.eu/en/policies/virtual-and-augmented-reality-coalition

43 Cheng, E., 'Shanghai doubles down on the metaverse by including it in a development plan', CNBC, 2021, https://www.cnbc.com/2021/12/31/shanghai-releases-five-year-plans-for-metaverse-development.html

44 Caribbean Telecommunications Union, 'CTU and the Government of Barbados Traverse the Metaverse', Press release, 2021, https://ctu.int/ctu-and-the-government-of-barbados-traverse-the-metaverse/

45 Robertson, D., 'Gaming out the metaverse', Politico, 2022, https://www.politico.com/newsletters/digital-future-daily/2022/09/20/gaming-out-the-metaverse-00057774

46 McKinsey & Company, 2022.

47 Chitkara, H., 'Consumer demand for immersive experiences during quarantine could accelerate VR adoption, especially for the entertainment industry', Business Insider, 2020, https://www.businessinsider.com/demand-for-immersive-experiences-in-quarantine-could-push-vr-adoption-2020-4?r=US&IR=T

48 Goldman Sachs, 'Virtual & Augmented Reality: The Next Big Computing Platform?', 2016, https://www.goldmansachs.com/insights/pages/virtual-and-augmented-reality-report.html

49 Nordicity, 'The Canadian video game industry 2021', 2021, https://www.nordicity.com/de/cache/work/169/ESAC_The%20Canadian%20Video%20Game%20Industry%202021.pdf

50 Buchholtz, K., 'Asian countries make up 40% of the world's top 10 video gaming markets', World Economic Forum, 2021, https://www.weforum.org/agenda/2021/08/which-countries-have-the-largest-video-gaming-markets/

51 Kelly, C., Schuler, S. & Johnson, P., 'Gaming: The next super platform', Accenture, 2021, https://www.accenture.com/us-en/insights/software-platforms/gaming-the-next-super-platform

52 Clement, J., 'Daily active users (DAU) of Roblox games worldwide from 4th quarter 2019 to 3rd quarter 2022, by age group', Statista, 2022, https://www.statista.com/statistics/1190309/daily-active-users-worldwide-roblox/

53 Kharpal, A., 'China's tech giants push toward an $8 trillion metaverse opportunity – one that will be highly regulated', CNBC, 2022, https://www.cnbc.com/2022/02/14/china-metaverse-tech-giants-latest-moves-regulatory-action.html

54 Cortesi, S., et al., 2021.

55 Hirsh-Pasek, K., et al., 'A whole new world: Education meets the metaverse', Center for Universal Education at Brookings, 2022, https://www.brookings.edu/wp-content/uploads/2022/02/A-whole-new-world_Education-meets-the-metaverse-FINAL-021422.pdf

56 Games for Change, 'XR for Social Impact: A Landscape Review', 2020, https://gamesforchange.org/wp-content/uploads/2022/03/G4C_XR4C_2020_white_paper_Final.pdf

57 Trageser, C., What the metaverse might mean for kids, National Geographic, 2022 https://www.nationalgeographic.com/family/article/what-the-metaverse-might-mean-for-kids

58 Wickes, J., 'Inside Ariana Grande's Fortnite virtual concert', The Face, 2021, https://theface.com/music/ariana-grande-fortnite-rift-tour-performance-gaming-vr-mac-miller-travis-scott-lil-nas-x

59 Rogers, S., 'How Virtual Reality Can Help Those with Autism', Forbes, 2019, https://www.forbes.com/sites/sol-rogers/2019/04/03/how-virtual-reality-can-help-those-with-autism/?sh=421b7529198e

60 Ouyang, H., 'Can Virtual Reality Help Erase Chronic Pain?', The New York Times, 2022, https://www.nytimes.com/2022/04/26/magazine/virtual-reality-chronic-pain.html

61 Onix-Systems, 'The Benefits and Potential of Augmented Reality Fitness Apps', Medium, 2021, https://onix-systems.medium.com/the-benefits-and-potential-of-augmented-reality-fitness-apps-3a237f6e8a40

62 Meta, 'What is the Safe Zone in Horizon Worlds?', https://store.facebook.com/en-gb/help/quest/articles/horizon/explore-horizon-worlds/safe-zone-in-horizon/

63 Brodsky, S., 'Making the Metaverse Accessible is Better for Everyone', Lifewire, 2022, https://www.lifewire.com/making-the-metaverse-accessible-is-better-for-everyone-5218160

64 Ibid.

65 Kitheka, K. & Szymczak, C., 'Interacting with AR and VR', Office of Innovation, UNICEF, 2022, https://www.unicef.org/innovation/stories/interacting-ar-and-vr

66 UNICEF Innovation Fund: IDEASIS. VivoosVR, https://www.vivoosvr.com/single-post/2017/12/21/unicef-innovation-fund-ideasis

67 Veative, https://veative.com

68 UNICEF, 'Imìsí3D: Case study', Office of Global Insight and Policy, New York, 2021, https://www.unicef.org/globalinsight/media/2176/file

69 Frenkel, S. & Browning, K., 'The Metaverse's dark side: Here come harassment and assaults', The New York Times, 2021, https://www.nytimes.com/2021/12/30/technology/metaverse-harassment-assaults.html

70 Center for Countering Digital Hate, 'Facebook's metaverse: One incident of abuse and harassment every 7 minutes', 2021, https://counterhate.com/research/facebooks-metaverse/

71 eSafety Commissioner, 2020.

72 Wong, J.C., 'Sexual harassment in virtual reality feels all too real – 'it's creepy beyond creepy'', The Guardian, 2016, https://www.theguardian.com/technology/2016/oct/26/virtual-reality-sexual-harassment-online-groping-quivr

73 Signé, L. and Dooley, H., 2022.

74 Crawford, A. & Smith, T., 'Metaverse app allows kids into virtual strip clubs', BBC, 2022, https://www.bbc.co.uk/news/technology-60415317

75 MetaQuest, 'Horizon Worlds', https://www.oculus.com/experiences/quest/2532035600194083/

76 Oremus, W., 'Kids are flocking to Facebook's 'metaverse'. Experts worry predators will follow', The Washington Post, 2022, https://www.washingtonpost.com/technology/2022/02/07/facebook-metaverse-horizon-worlds-kids-safety/

77 Reuters, E., 'Linden to increase land supply, drop prices', 2008, https://web.archive.org/web/20100822173413/http:/secondlife.reuters.com/stories/2008/04/08/linden-to-increase-land-supply-drop-prices/index.html

78 George, K., 'Cryptocurrency Regulations Around the World', Investopedia, 2022, https://www.investopedia.com/cryptocurrency-regulations-around-the-world-5202122

79 Dibbell, J., 'The Life of the Chinese Gold Farmer', The New York Times, 2007, https://www.nytimes.com/2007/06/17/magazine/17lootfarmers-t.html

80 Javers, E., et al., 'Cybercriminals target metaverse investors with phishing scams', CNBC, 2022, https://www.cnbc.com/2022/05/26/cybercriminals-target-metaverse-investors-with-phishing-scams.html

81 Jacobs, H., 'The counterfeit NFT problem is only getting worse', The Verge, 2022, https://www.theverge.com/22905295/counterfeit-nft-artist-ripoffs-opensea-deviantart

82 Interpol, 'Cryptocurrency crime: Preventing the misuse of virtual assets by organized crime for money laundering', 2021, https://www.interpol.int/en/News-and-Events/News/2021/Cryptocurrency-crime-preventing-the-misuse-of-virtual-assets-by-organized-crime-for-money-laundering

83 Perunicic, K., 'Security and privacy flaws discovered on popular wearable devices', vpnMentor, https://www.vpnmentor.com/blog/security-and-privacy-flaws-discovered-on-popular-wearable-devices/

84 Everson Layden, E., 'Rutgers researchers discover security vulnerabilities in virtual reality headsets', Rutgers University, 2022, https://www.rutgers.edu/news/rutgers-researchers-discover-security-vulnerabilities-virtual-reality-headsets

85 Madiega, T., et al., 'Metaverse: Opportunities, risks and policy implications', European Parliamentary Research Service Briefing, European Parliament, 2022, https://www.europarl.europa.eu/RegData/etudes/BRIE/2022/733557/EPRS_BRI(2022)733557_EN.pdf

86 Pauwels, E., 'Protecting children in cyberconflicts', Office of Global Insight and Policy, UNICEF, New York, 2022, https://www.unicef.org/globalinsight/media/2856/file/UNICEF-Global-Insight-Rapid-Analysis-Protecting-Children-in-Cyberconflicts-2022.pdf

87 Jäncke, L., Cheetham, M. & Baumgartner, T., 'Virtual reality and the role of the prefrontal cortex in adults and children', Frontiers in Neuroscience 3(1):52-9, 2009. doi: 10.3389/neuro.01.006.2009.

88 Trageser, C., 2022.

89 XR Safety Initiative, The XRSI Privacy Framework Version 1.0, 2020, https://xrsi.org/wp-content/uploads/2020/09/XRSI-Privacy-Framework-v1_002.pdf

90 Canales, K., 'Mark Zuckerberg's metaverse could fracture the world as we know it – letting people "reality block' things they disagree with and making polarization even worse", Business Insider, 2021, https://www.businessinsider.com/facebook-meta-metaverse-splinter-reality-more-2021-11?r=US&IR=T

91 Rosenberg, L., 'Regulate the Metaverse', 2021, https://medium.com/predict/regulating-the-metaverse-7c893ed00865

92 Howard, P.N., et al., 'Digital misinformation/disinformation and children', Rapid analysis. Office of Global Insight and Policy, UNICEF, New York, 2021, https://www.unicef.org/globalinsight/media/2096/file/UNICEF-Global-Insight-Digital-Mis-Disinformation-and-Children-2021.pdf

93 eSafety Commissioner, 2020.

94 LaMotte, S., 'The very real health dangers of virtual reality', CNN, 2017, https://edition.cnn.com/2017/12/13/health/virtual-reality-vr-dangers-safety/index.html

95 Meta Quest, 'Oculus Rift: Safe Surroundings', 2017, https://www.youtube.com/watch?v=NB3Fqmwx_E8

96 Read, T., Sanchez, C.A. & De Amicis, R., 'Engagement and time perception in virtual reality', Proceedings of the 2021 HFES 65th International Annual Meeting, 2021, https://journals.sagepub.com/doi/pdf/10.1177/1071181321651337

97 UNICEF, 'Children's rights and online gaming: opportunities & challenges for children and the industry', Discussion paper series: Children's rights and business in a digital world, 2019, https://www.unicef-irc.org/files/upload/documents/UNICEF_CRBDigitalWorldSeriesOnline_Gaming.pdf

98 Kardefelt Winther, D., 'Responsible Innovation in Technology for Children: Digital technology, play and child well-being', Innocenti Research Report, Office of Research – Innocenti, Florence, 2022, https://www.unicef-irc.org/publications/1397-responsible-innovation-in-technology-for-children-digital-technology-play-and-child-well-being.html

99 Basu, T., 'The metaverse is the next venue for body dysmorphia online', MIT Technology Review, 2021, https://www.technologyreview.com/2021/11/16/1040174/facebook-metaverse-body-dysmorphia/

100 Signé, L. and Dooley, H., 2022.

101 Aneja, U., 'Opinion: The challenges of protecting data and rights in the metaverse', Devex, 2022, https://www.devex.com/news/sponsored/opinion-the-challenges-of-protecting-data-and-rights-in-the-metaverse-103026

102 Ibid.

103 eSafety Commissioner, 2020.

104 Pearlman, K., 2022.

105 UNICEF, 'The Case for Better Governance of Children's Data: A Manifesto', Office of Global Insight and Policy, New York, 2021, https://www.unicef.org/globalinsight/media/1771/file/UNICEF%20Global%20Insight%20Data%20Governance%20Summary.pdf

106 Wheeler, T., 'The metachallenges of the metaverse', Brookings, 2021, https://www.brookings.edu/blog/techtank/2021/09/30/the-metachallenges-of-the-metaverse/

107 Lu, J., 'Metaverse platforms face diversity, equity and inclusion challenges. Here is how to address them', World Economic Forum, 2022, https://www.weforum.org/agenda/2022/06/metaverse-platforms-face-diversity-equity-and-inclusion-challenges-heres-how-to-address-them/

108 Signé, L. and Dooley, H., 2022.

109 ITU, 'Global Connectivity Report 2022', 2022, https://www.itu.int/itu-d/reports/statistics/global-connectivity-report-2022/

110 Soroushian, J., Neschke, S. & Jackson, B., 'Thinking ahead about XR: Charting the course for virtual, augmented, and mixed reality', Bipartisan Policy Center, 2022, https://bipartisanpolicy.org/download/?file=/wp-content/uploads/2022/04/XR-Report_Final-Copy.pdf

111 Dick, E., 'Public policy for the metaverse: Key takeaways from the 2021 AR/VR policy conference', Information Tech-

nology & Innovation Foundation, 2021, https://itif.org/publications/2021/11/15/public-policy-metaverse-key-takeaways-2021-arvr-policy-conference/

112 Cambridge Dictionary, 'techlash'. https://dictionary.cambridge.org/dictionary/english/techlash

113 Kerry, C.F., 'Section 230 reform deserves careful and focused consideration', Brookings, 2021, https://www.brookings.edu/blog/techtank/2021/05/14/section-230-reform-deserves-careful-and-focused-consideration/

114 European Commission, 'Proposal for a Regulation of the European Parliament and of the Council on a Single Market for Digital Services (Digital Services Act) and Amending Directive 2000/31/EC', COM/2020/825 final, 2020, https://eur-lex.europa.eu/legal-content/en/TXT/?qid=1608117147218&uri=COM%3A2020%3A825%3AFIN

115 Vosloo, S., 'EU Digital Services Act: How it will make the internet safer for children', World Economic Forum, 2022, https://www.weforum.org/agenda/2022/06/eu-digital-service-act-how-it-will-safeguard-children-online/

116 Goujard, C., 'Big Tech firms set to face tough EU content rules', Politico, 2022, https://www.politico.eu/article/eu-strikes-deal-on-law-to-fight-illegal-content-online-digital-services-act/

117 UN/CRC/C/GC/25. Convention on the Rights of the Child, General Comment no. 25 (2021) on children's rights in relation to the digital environment. https://docstore.ohchr.org/SelfServices/FilesHandler.ashx?enc=6QkG1d%2fPPRiCAqhKb7yhsqIkirKQ-ZLK2M58RF%2f5F0vEG%2bcAAx34gC78FwvnmZXGFUI9n-JBDpKR1dfKekJxW2w9nNryRsgArkTJgKelqeZwK9WXzMkZ-RZd37nLN1bFc2t

118 European Commission, 'The 2022 Code of Practice on Disinformation', 2022, https://digital-strategy.ec.europa.eu/en/policies/code-practice-disinformation

119 Lomas, N., 'EU unveils tougher industry Code to combat disinformation', TechCrunch, 2022, https://techcrunch.com/2022/06/16/eu-disinformation-code-reboot/?guccounter=1

120 European Commission, 'Proposal for a regulation of the European Parliament and of the Council laying down rules to prevent and combat child sexual abuse', COM/2022/209 final, 2022, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM%3A2022%3A209%3AFIN&qid=1652451192472

121 Madiega, T., et al., 2022.

122 UNICEF, 'Legislating for the digital age: Global Guide on improving legislative frameworks to protect children from online sexual exploitation and abuse', UNICEF Child Protection Team, New York, 2022, https://www.unicef.org/media/120386/file/Legislating%20for%20the%20digital%20age_Global%20Guide.pdf

123 Oasis Consortium, 'User safety standards for our digital future', 2021, https://f.hubspotusercontent30.net/hubfs/21144981/Oasis-User-Safety-Standards.pdf

124 Basu, T., 'This group of tech firms just signed up to a safer metaverse', MIT Technology Review, 2022, https://www.technologyreview.com/2022/01/20/1043843/safe-metaverse-oasis-consortium-roblox-meta

125 XR Safety Initiative, 2020.

126 Responsible Metaverse Alliance. https://responsiblemetaverse.org

127 Castro, D., 'Content Moderation in Multi-User Immersive Experiences: AR/VR and the Future of Online Speech', Information Technology & Innovation Foundation, 2022, https://itif.org/publications/2022/02/28/content-moderation-multi-user-immersive-experiences-arvr-and-future-online/

128 Council of Europe, Convention on Cybercrime ('Budapest Convention'), ETS No. 185, 2001, https://rm.coe.int/1680081561

129 DigWatch (n.d.). 'Cybercrime Ad Hoc Committee'. https://dig.watch/processes/cybercrime-ad-hoc-committee

130 European Parliament, 'European Parliament resolution of 8 October 2020 with recommendations to the Commission on Digital Finance: emerging risks in crypto-assets – regulatory and supervisory challenges in the area of financial services, institutions and markets', 2020/2034 (INL), 2020, https://www.europarl.europa.eu/doceo/document/TA-9-2020-0265_EN.html

131 Achten, N., 'Governance Approaches to the Security of Digital Products, A Comparative Analysis', Center for Security Studies, ETH Zürich, 2021, 2021, https://genevadialogue.ch/wp-content/uploads/Governance-Approaches-to-the-Security-of-Digital-Products-Report-2021-Geneva-Dialogue-and-EHTZ-CSS.pdf

132 UNICEF, 'The Case for Better Governance of Children's Data: A Manifesto', 2021.

133 Woodward, M., '16 Countries with GDPR-like data privacy laws', SecurityScorecard, 2021, https://securityscorecard.com/blog/countries-with-gdpr-like-data-privacy-laws

134 European Parliament, 'European Parliament resolution of the 5 May 2022 on competition policy – annual report 2021', 2021/2185 (INI), 2022, https://www.europarl.europa.eu/doceo/document/TA-9-2022-0202_EN.html

135 Lau, P.L., 'The metaverse: three legal issues we need to address', The Conversation, 2022, https://theconversation.com/the-metaverse-three-legal-issues-we-need-to-address-175891

136 Norton Rose Fulbright, 2021.

137 Aneja, U., 2022.

138 Paul, N., Jannuzzi, M. & Pappas, N., 'Reed Smith Guide to the Metaverse', 2nd edition, Reed Smith, 2022, https://www.reedsmith.com/en/perspectives/metaverse/2022/08/data-protection-and-privacy

139 Madiega, T., et al., 2022.

140 Lau, P.L., 2022.

141 UNICEF, 'The Case for Better Governance of Children's Data: A Manifesto', 2021.

142 UNICEF and GovLab, 'Responsible Data for Children Principles', 2019, https://rd4c.org/principles/

143 DigWatch, (2022). 'China publishes regulation for algorithms used in recommendation systems', 2022, https://dig.watch/updates/china-new-algorithm-regulation

144 DigWatch, 'EU's Digital Services Act (DSA) & Digital Markets Act (DMA)', https://dig.watch/processes/eu-digital-service-act-dsa-digital-market-act-dma

145 Ibid.

146 European Parliament, 'Proposal for the Regulation of the European Parliament and of the Council laying down harmonised rules on artificial intelligence (Artificial Intelligence Act) and amending certain Union legislative acts', COM/2021/206 final, 2021, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52021PC0206

147 Jillson, E., 'Aiming for truth, fairness, and equity in your company's use of AI', Federal Trade Commission, 2021, https://www.ftc.gov/business-guidance/blog/2021/04/aiming-truth-fairness-equity-your-companys-use-ai

148 Information Commissioner's Office, 'Age appropriate design: a code of practice for online services', 2020, https://ico.org.uk/for-organisations/guide-to-data-protection/ico-codes-of-practice/age-appropriate-design-a-code-of-practice-for-online-services

149 California State Legislature, 'The California Age-Appropriate Design Code Act', 2022, https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=202120220AB2273

150 McKinsey & Company, 2022.

151 IEEE Standards Association, 'Standards' https://digitalreality.ieee.org/standards

152 W3C, 'XR Accessibility User Requirements', W3C Working Group Note 25 August 2021. https://www.w3.org/TR/2021/NOTE-xaur-20210825/

153 Madiega, T., et al., 2022.

154 The Metaverse Standards Forum, https://metaverse-standards.org

155 Wheeler, T., 2021.

156 Chen, L., 'How China threatens to splinter the Metaverse', WIRED, 2022, https://www.wired.com/story/china-threatens-splinter-metaverse/

157 Signé, L. and Dooley, H., 2022.

158 Hayes, A.W., 'The precautionary principle', 2005, https://pubmed.ncbi.nlm.nih.gov/15968832/

159 Pearlman, K., 2022.

160 Galea Baron, J. & Friscia, F., 'Child consultation and responsible business conduct in the digital environment: Rights, risks, and opportunities', Kids Included Report. https://www.kidsincluded.report/josie-galea-baron-fabio-friscia

161 Designing for Children's Rights (D4CR), 'Principles of designing for children with children's rights & ethics'. https://childrens-designguide.org/principles/

162 UNICEF and GovLab, 2019.

Disclaimer

This is a working document. It has been prepared to facilitate the exchange of knowledge and to stimulate discussion. The text has not been edited to official publication standards and UNICEF accepts no responsibility for errors. The statements in this publication are the views of the author(s) and do not necessarily reflect the policies or the views of UNICEF. The designations in this publication do not imply an opinion on legal status of any country or territory, or of its authorities, or the delimitation of frontiers.

Send inquiries to innocenti@unicef.org

United Nations Children's Fund
UNICEF Innocenti – Global office of Research and Foresight
Via degli Alfani 58
50121, Florence, Italy

© United Nations Children's Fund (UNICEF), May 2023

This document is interactive and designed for digital viewing.

Please consider the environment and refrain from printing.