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Abstract

In its second volume CAVRN explores the implications that VR and AR technologies have on politics and policymaking, identity, ethics, socialisation and community building, and the economy from a critical, interdisciplinary perspective.

This volume of CAVRN presents critical perspectives of AR and VR spanning over 7 articles. While coming from different perspectives each article tackles the entanglement of social, cultural, and historical factors that influence both the use of VR and AR and its material affordances.

The contributions in this volume span three main areas: **1)** the production and design of AR and XR; **2)** the social and material implications of dominant XR narratives; and **3)** XR and identity.

Critiquing Virtual and Augmented Reality

Hype cycles and history repeating

By Kate Euphemia Clark / University of Sydney,
Marcus Carter / University of Sydney,
Ben Egliston / University of Sydney,
Luke Heemsbergen / Deakin University

The articles that make up Volume 2 of the Critical Augmented and Virtual Reality Research Network (CAVRN) were written in the midst of yet another shift in the way that extended reality technologies are being framed by big tech companies. The speed at which trends and ideas are produced, marketed, and discarded can make critical reporting on XR difficult. CAVRN brings together critical perspectives from a diverse range of disciplines to not only make sense of these shifts but critically engage with them – drawing parallels, understanding points of divergence, and exploring how the narratives that tech companies develop about AR and VR shape the technology itself.

Since the last volume of CAVRN was published (in September 2023) the discussion has moved decidedly away from the metaverse and Mark Zuckerberg's bold new vision of the future of the internet as a three-dimensional immersive space – although this idea has not been discarded altogether. Instead, we have started to see the impact of Apple's new Vision Pro – and its promises of spatial computing in XR discourses. The Vision Pro is not due to be released in the US in February 2024. However, its soft launch has caused much excitement and raised many questions about its role in the future of (what Apple terms) spatial computing.

Meta has also changed directions in its marketing, as we saw in Meta Connect in 2023. Connect is Meta's two-day showcase of Meta's new hardware and software offerings, which notably did not highlight the metaverse this year, instead focusing on the Quest 3's mixed reality capability, as well as integrating AI into its platforms and development tools.

This volume goes beyond addressing new concerns that arise from the changing landscape of Silicon Valley, instead focusing on how this changing landscape does (and does not) impact our use of VR and AR. In particular, this issue looks at popular constructions of XR (and the ways that big tech companies are often involved in this) and how this shapes how we use, legislate, and develop XR technology. Volume 2 also explore how this influences identity construction, access, and opportunity in XR.

CAVRN: Volume 2

The second issue of CAVRN features 7 contributions that provide valuable insights that are central to the discipline of AR and VR studies across three main areas: the ways that design and production process enable (and constrain) possibilities of XR; the way that descriptions and conceptualisations of XR impact what XR is and what it does; and XR and identity.

Contributions by Maxwell Foxman and Aurelia O'Neill explore the role of design and production in the shaping of XR. Foxman explores the role that game engines like Unity play in shaping VR and metaverse offerings. Foxman highlights that Unity is not only central for the development of metaverse offerings, but to all aspects of gamemaking – including ideation, implementation, and distribution. Foxman asks us to think about the ways that game engines will impact the ways that we produce and consume content in the metaverse.

O'Neill's article offers a review of Curtis Hickman 's Hyperreality: The art of designing impossible experiences that explores Hickman's design framework for XR, which explores how to construct 'implausible' design scenarios in XR. O'Neill highlights the ways that Hickman's design principles could be expanded upon to provide more robust user safeguards, reigning in Hickman's creativity with moral responsibility.

Articles by Luke Heemsbergen, Marcus Carter and Ben Egliston, and a further article by Egliston, explore the ways that AR and VR are talked about in popular discourses, and how this impacts our understanding of, use, and policing of XR technologies. Heemsbergen questions the way that we talk about AR technology as a 'layer' added onto reality. He suggests that this separation of the physical and digital environment does not reflect our lived experience of AR. Instead, Heemsbergen proposes that we should look at AR in terms of the relationship between computing data and environment, and explores how this will impact AR policy.

Carter and Egliston give us insight into the difficulty of securing image permissions for their upcoming book, Fantasies of Virtual Reality. They suggest that the lack of archival material on immersive technologies means that we often struggle to picture how VR technology is evolving – and crucially – the ways it has not changed since its earliest iterations in the 1960s. Without this history, Carter and Egliston suggest that we may struggle to connect that history to the technology that we use today.

In another article, Egliston also explores what happens when industry and investors are the loudest voices in the future of XR. Egliston explores patents and financial reporting, not to uncover the future path of technology, but to uncover the ideologies and logics of tech companies, which can shine a light on how tech companies picture themselves and their futures.

Our final set of articles deal with XR and Identity. Kiah Hawker examines the ubiquity of AR beauty filters on platforms like Snapchat, TikTok, and Instagram. These filters are often analysed in the context of young women's self-image. However, Hawker explores the possibilities for open-ended and creative gender exploration that these beauty filters encapsulate. Hawker asserts that beauty filters are a core part of self-expression.

Finally, Ben Egliston, Kate Euphemia Clark, and Marcus Carter explore the use of VR by people with disabilities. They highlight how VR is designed with a particular (read white, cis, able-bodied, middle-class) body in mind, which leads to design choices that exclude people with disabilities from accessing VR, even as the promise of VR to transform the lives of disabled people is being used to promote the potential 'social good' of VR.

"My VR does not acknowledge me as a person"

Is the metaverse leaving disabled users behind?

By Ben Egliston, Kate Euphemia Clark & Marcus Carter / The University of Sydney

Last month, Apple revealed its long-teased Vision Pro headset, a device that uses augmented reality technology to project a digital image onto the physical world. But, Apple revealed, it won't work — at least out of the box — if you wear glasses. Instead, you'll need to buy inserts to attach to the device lens.

Apple's announcement gives cause to question the tech industry's visions of a so-called "metaverse" – what rival Meta CEO Mark Zuckerberg describes as an "embodied internet" supported by technologies like Augmented Reality (AR) and Virtual Reality (VR), or what is collectively called Extended Reality (XR). The reality of the metaverse is already much less frictionless than imagined by its proponents, particularly for users with some form of disability.

The celebrated affordance, and central goal, of XR technologies is the sensation of embodiment: the sense of having a body that exists within a digitally rendered space. It is upon the promise of this sensation that big tech companies like Meta, Apple, Microsoft, and HTC have invested billions in XR research and development.

Part of what makes this possible is the "Natural User Interfaces" that power our experiences in XR: voice interaction, gaze interaction, motion or gesture-based controls, and body-tracking. Just like other digital interfaces like smartphones or videogames, XR is designed with the body in mind. But despite this promise of an intuitive and effortless interface, not all users — particularly those with disabilities — can perform in the way required

by the XR system. Without a more inclusive approach, a wide range of users may remain locked out of this next computing frontier.

A history of exclusionary design

The body is a central consideration in XR. For example, in a 2019 blog post by Meta — describing a then state-of-the-art sensor system for its Quest and Rift VR headsets — the company has gone to painstaking lengths to reduce undesirable visual errors, such as image stuttering or jittering. Errors like these can cause vomit-worthy nausea in even the most experienced VR user. But when we say that companies like Meta have been attentive to the body, what we mean is that they've been attentive to certain kinds of bodies — namely, that of the able-bodied male. Throughout the company's history, this has rung true.

In 2014, social media researcher danah boyd wrote that the Rift's testing on men resulted in the headset privileging the proprioceptive capacities of the male user. More recently, it was revealed that the design of the Quest had predominantly accounted for the interpupillary distance of male users (interpupillary distance is the distance between the centres of the users' eyes). Lining up the centre of the eye with the lens in a VR headset is important for comfortable and non-blurry use, and differences in interpupillary distance have been identified as one of the key causes of motion sickness. Despite this, the adjustable interpupillary distance range in Quest devices that is "best" for most men (99 per cent of male users) is only optimal for 93 per cent of women.

These kinds of biases meant that the device itself wasn't calibrated for women, resulting in increased feelings of nausea for these bodies rendered "abnormal" by Oculus' development processes.

Disabling interfaces

The same narrow understanding of the body is clear around issues of accessibility and disability today.

In 2017, a report on survey research by a partnership of LucasFilm's ILMxLab and the Disability Visibility Project gave an account of people with disabilities' experience in using VR, pointing out various ways that VR interfaces by virtue of their design are "disabling". Elsewhere, Ablegamers, a disability advocacy group for increased accessibility of videogames, presents a comprehensive breakdown of accessibility issues in VR. These include heavy emphasis on motion controls, requirement of very specific body positioning, or a privileging of the visual and gestural (with less attention to accessible audio).

As we see in promotional material for VR, the framing of the user is commonly in terms of what disability theorists and activists after Rosemarie Garland-Thomson calls a "normate body". By this she means the socially constructed, ideal image of the body — one that is white, able-bodied, heterosexual, and male — something that accrues power and authority if approximated. As we see, through AbleGamers or through the ILMxLAB/Disability Visibility Project report, these normate bodies are encoded into the design of VR interfaces.

A more recent example is the lack of control over avatar height in the Oculus platform. The Oculus Quest headset uses external facing cameras to scan the environment around the user to situate the user as accurately as possible in the virtual environment. This means if you crouch in real life, your avatar crouches in the game.

But for wheelchair users and people with limited mobility, such an approach makes many Quest games unplayable. Interfaces are often designed to be only within reach of the standing user, and the sitting user's view is rendered at crotch-height of the virtual non-player characters. Seated mode, where it does exist, is designed for the comfort of the normate body, rather than the inclusion of those for whom sitting is a necessity.
This limitation has an easy solution, currently available on the Steam VR platform. Instead of the device determining the (virtual) floor height, Steam VR allows the user to make themselves "taller" with a slider and assign a button to allow them to switch between standing and sitting during gameplay.

While XR is a technology that engages the physical body — systems that are, after all, driven by movements of the eyes and hands — there also barriers for those neurodiverse users or those with cognitive impairments. For instance, in our current research project, one disability services provider told us that despite VR proponents often claiming the liberatory potentials of the technology for those with cognitive impairments, there were limited options to reduce the speed at which prompts are displayed in software.

"…one disability services provider told us that despite VR proponents often claiming the liberatory potentials of the technology for those with cognitive impairments, there were limited options to reduce the speed at which prompts are displayed in software"

By configuring these types of options at the platform level, VR can be inclusive of a wider variety of users. Virtual environments are entirely virtual, they can be rendered in ways that are inclusive. Instead, the assumptions made about users at a design level work to exclude people from the promises of the technology.

What can be done?

As one disabled VR user puts it, "[my VR system] does not acknowledge me as a person". The frustration of many disabled users is further amplified by the fact that proponents of XR often market the technology as one that might empower people with disabilities — allowing them to do things in the virtual world that they couldn't in the physical. But what further can be done? Given the breadth of the term disability (and the resource constraints on many smaller software developers), simply saying that developers need to design with accessibility in mind is a naïve and unrealistic demand.

VR market leader Meta provides a series of optional "best practices" for designing for accessibility (rather than providing solutions that are baked into the hardware or through tools for developers).

These push accessibility requirements onto app developers — but due to a lack of standardised technical resources, each development team needs to "reinvent the wheel" when it comes to accessibility.

Apple take a more productive approach: offering development tools that developers can use to design for disability. These tools allow developers to include a wider range of options for software customisation (for instance, changing the main input feature from hand gesture based to gaze).

A further — and important step — will be to ensure that developers are incorporating the perspectives and insights of people with disabilities more centrally into the design process as to ensure more of an eye to disability (a point emphasised in participant responses in the ILMxLAB disability report). Virtual reality is only a reality for some.

Despite being ostensibly intuitive or natural, we must ask ourselves: intuitive and natural for whom? Given that VR is promised to become a more central part of everyday life — whether communication or work — the stakes of exclusion for people with disabilities are significant.

The Ambivalence of Beauty (Filters) in AR

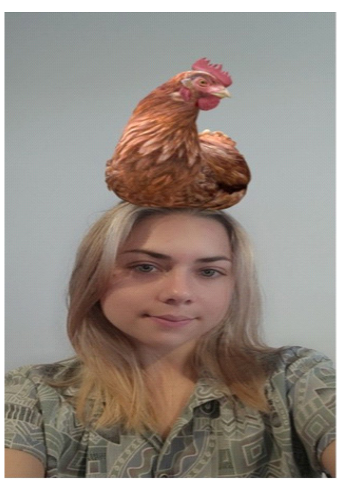
Gender Exploration & Selfie Culture

By Kiah Hawker / University of Queensland

While using apps like TikTok or Instagram, if you decide to include an augmented reality (AR) filter (or lens) onto your image the top filters that come up, algorithmically targeted to users, will almost always include at least one 'beauty filter'. A beauty filter is an AR filter which affords real time facial augmentation in ways that seem designed to align with and reinforce heteronormative western beauty standards. For example, they clear or smooth a user's skin or add make-up.

Beauty elements such as these offer the 'default' effects coded into many AR filters, whether they are advertised as heteronormative 'beauty' or not. Filters hold great capital and popularity within these platforms, often being necessary to partake in popular trends; regardless of whether users ask to be 'beautified'.

Take, for example, the classic 'Chicken filter' on Snapchat. At first glance, this filter appears to simply add a chicken to the user's head in a humorous manner.



However, this filter also significantly smooths the user's skin and adds a small layer of make-up to the face. This example highlights the beauty filter themes as a default – a filter which primarily aims to be 'silly', or 'fun' also smooths out and beautifies a user's face. Filters hold great capital and popularity within these platforms, often being necessary to partake in popular trends; regardless of whether users ask to be 'beautified', or not. This article delves into the complexities of AR beauty filters, moving beyond the simplistic debates about vanity and authenticity to explore the nuanced possibilities they offer.

The ensuing moral panics surrounding the beauty filter and its impact on young women's self-image are undoubtedly valid and well researched (Elias and Gill 2018; Morley 2022; Cug et al. 2022). However, to broaden our understanding of these filters, we must also acknowledge their potential for open-ended, creative gender exploration by all users.

"Filters hold great capital and popularity within these platforms, often being necessary to partake in popular trends; regardless of whether users ask to be 'beautified', or not"

Through a material-theoretical lens, the best place to start to make sense of the impacts of the beauty filter is the selfie. This is because a beauty filter is primarily applied to a selfie image. Since its introduction into academic discussion, the selfie has been framed as a creative, empowering and expressive tool 'used in one's ever-evolving project of the self' (Tiidenberg 2016, pg. 1576; Walker-Rettberg 2017; Senft & Baym 2015;).

This is in response to the mainstream media moral panics that portray selfies as narcissistic, vain and frivolous. Senft and Baym (2015, pg. 1590), also counter the conceptualization of selfies as 'only acts of vanity and narcissism', and state that the selfie consists 'of far more than stereotypical young girls making duck faces in their bathrooms'. This argument is significant in shifting historical social perceptions of selfies, as more than just trivial acts performed by younger women.

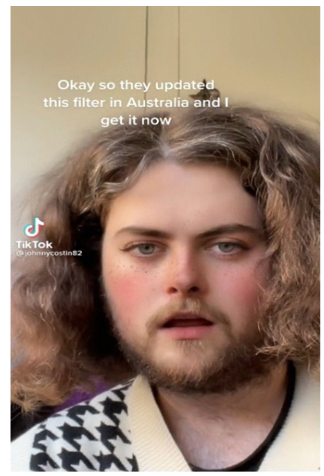
Rather, selfies warrant significant social and political power which questions boundaries of agency and self-empowerment for users within digital contexts. Burns (2015, pg. 1720), also unpacks the criticism surrounding selfie-taking by stating: "Once the selfie is established as connoting narcissism and vanity, it perpetuates a vicious circle in which women are vain because they take selfies, and selfies connote vanity because women take them."

Other literature argues that we should not situate selfies as inauthentic or frivolous due to the large commercial influence they have within influencer culture. Influencers use selfies as part of their promotional practices, using nuanced practices like 'subversive frivolity' to subtly embed endorsements and advertorials within their images (Abidin, 2016 & Hawker and Carah 2019). In these capitalist incentive structures, heteronormative filter augmentations provide utility for users to benefit.

However, the increasingly widespread and varying uses of AR beauty filters requires us to expand this theoretical framing. It is important to note that using beauty filters is a valuable and valid form of self-expression – however we must make this point without constructing a negative view on the playfulness and frivolity selfies enable. The focus to frame selfies and filters as much more important than just a playful and frivolous activity dismisses a large part of the social enjoyment and self-exploration all users can have through these practices, which I expand on below.

First, we need to consider gendered differences in beauty filter use. We now see more users being able to conform to previously unattainable beauty standards through the beauty filter. Furthermore, it is important to note historically, the preferred gender representation of a user quite strongly influenced how they engage with and apply beauty filters.

Over the past few years, beauty filters have been typically only applied by feminine-presenting and non-binary users. Masculine-presenting users did apply beauty filters; however, this was often perceived in an ironic or subversive manner. This is because the 'male' body is inherently more open to ironic appropriations, whereas the female body is often viewed within a 'hetero-sexy' frame (Albury, 2015 & Dobson, 2011). Hetero-sexy refers to 'imagery, iconography, and decorations', which 'reinforce current notions of feminine gender performativity as "sexualised"' (Dobson 2011, pg. 1). So therefore, while women, men and non-binary users all did apply beauty filters in both ironic and sincere ways, it was technically and socially more difficult for women, and some non-binary presenting users to apply the filters in a humorous or subverting manner. However, these historical boundaries are rapidly shifting.



The figure to the right shows a masculine-presenting user applying the 'Faux Freckle' filter on TikTok. The user states they are excited as the filter is now available in Australia. Interestingly he is not using the filter in an ironic manner, but rather using it 'sincerely'. This user is now the top post for this filter and the associated sound on TikTok and his comment section is full of women stating, in as many words, "I can't believe how much better this looks on him than me". It is becoming increasingly common for masculine-presenting and non-binary users to apply conventionally feminine beauty filters in sincere ways.

This blurs the boundaries surrounding who can look feminine within online spaces.

This can be seen in TikTok user @imwilliamdolan's user of the 'brown doe eyes' filter. The beginning of the clip shows their face with the brown doe eyes filter that feminises their facial features. Here they play a feminine and pop-like clip. Then they step backwards and show their masculine frame, and heavy metal style music begins playing. This TikTok user does not ever disclose their gender or pronouns and their content primarily revolves around people guessing this. This account's content is centrally focused on using TikTok filters to play around with and obscure their gender orientation. The beauty filter is now so immersive and realistic that it can achieve both masculine and feminine looks, convincingly, while applied.

This further demonstrates the intricate and contextual ways in which the beauty filter is applied to various gender performances. This then also impacts our framing and understanding of selfie-taking practices

The inclusion of masculine-presenting users in this practice allows us to shift from some original moral panics that framed selfie-filters practices as just trivial acts performed by women. Now both men and women are using them to obscure and 'play' with gender. We cannot label these culturally significant acts of self-expression to a simplistic binary of 'good or bad' which does not consider the nuanced and complex applications which they allow. Rather, if we embrace the complexity of what it means to take a selfie with a beauty filter, we open it up to more applications from feminine-presenting users without the fear of judgement.

References

Abidin, C. (2016). "Aren't These Just Young, Rich Women Doing Vain Things Online?": Influencer Selfies as Subversive Frivolity. Social Media + Society, 2(2), 205630511664134. https://doi.org/10.1177/2056305116641342

Burns, A. (2015). Self(ie)-Discipline: Social Regulation as Enacted Through the Discussion of Photographic Practice.

Carah, N., & Dobson, A. (2016). Algorithmic Hotness: Young Women's "Promotion" and "Reconnaissance" Work via Social Media Body Images. Social Media + Society, 2(4), 205630511667288. https://doi.org/10.1177/2056305116672885

Cug, J., Tanase, A., Stan, C. I., & Chitca, T. C. (2022). Beauty Filters for Physical Attractiveness: Idealized Appearance and Imagery, Visual Content and Representations, and Negative Behaviors and Sentiments. Journal of Research in Gender Studies, 12(2), 33–47. https://doi.org/10.22381/JRGS12220222

Highfield, T., & Leaver, T. (2016). Instagrammatics and digital methods: Studying visual social media, from selfies and GIFs to memes and emoji. Communication Research and Practice, 2(1), 47–62. https://doi.org/10.1080/22041451.2016.1155332

Jones, A. (2002). The "Eternal Return": Self Portrait Photography as a Technology of Embodiment. Signs: Journal of Women in Culture and Society, 27(4), 947–978. https://doi.org/10.1086/339641

Marwick, A. E. (2015). Instafame: Luxury Selfies in the Attention Economy. Public Culture, 27(1 75), 137–160. https://doi.org/10.1215/08992363-2798379

Rettberg, J. W. (2014). Seeing Ourselves Through Technology: How We Use Selfies, Blogs and Wearable Devices to See and Shape Ourselves.

Senft, T., & Baym, N. (2015). What Does the Selfie Say? Investigating a Global Phenomenon.

Tiidenberg, K. (2016). Boundaries and conflict in a NSFW community on tumblr: The meanings and uses of selfies. New Media & Society, 18(8), 1563–1578. https://doi.org/10.1177/1461444814567984

Morley, N. 2022, "Beauty Apps for Digital Self-Monitoring and Self-Tracking: Expressive Gestures and Movements, Negative Moods and Emotions, and Visual and Haptic Imagery", Journal of Research in Gender Studies, vol. 12, no. 2, pp. 63-78.

Pixel Theory

(Or, have we ever been physical?)

By Luke Heemsbergen / Deakin University

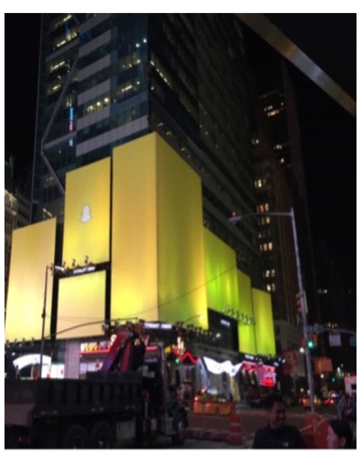
Layering of the virtual on to the real is usually how Augmented Reality is described and explained, but layering is a strange metaphor to understand what is at stake when considering the physical-digital environments we live with.

As provocation, consider when typographic ink lands on physical paper; the newspaper or a billboard exists as a real thing. But, if pixels flick on a liquid crystal substrate, a virtual experience sits apart from our physical life. There's a clear atomic-electronic divide when we conceptualise technology. But does this divide remain useful when we consider how 'technologies' mediate our lives?

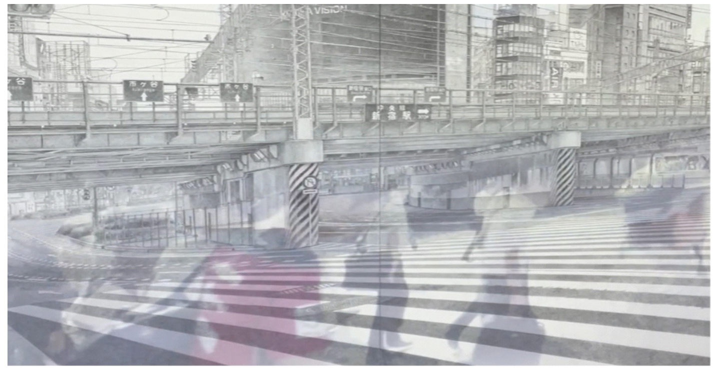
"More useful is considering how AR can mediate our shared world in ways newsprint cannot…"

Similar to how the study of 'cyberspace' has moved on to realise embedded, embodied and interwoven digital experience (Hine, 2015), considerations of AR media need to move on from dyads that separate the electronic and atomic, and enter the real.

This post is about whether Augmented Reality is real.



Two adverts for Snap Inc., with pixels and pantones spatially augmenting a city. Which is more real?



Background Art

This post was, in part, inspired by Yamagami Yukihiro's installation titled Shinjuku Calling (2014), pictured above. The, installation of 'mixed media' helps show how a layered divide between analogue reality and digital virtuality doesn't explain our lived – and mediated – experience.

Currently (2023) hanging in the National Gallery of Victoria, Yukihiro's work cleverly integrates hitherto divided atomic and electronic information. Yukihiro painstakingly pencilled a streetscape of Shinjuku Station, across about two meters of white plywood. Onto these physical pigments, pixels are projected that give a virtual 'real life' video of pedestrians and cars navigating the canvas; neon glows reach across the pencil lines of stencilled signs; sunset makes the buildings glow. The virtual imbues life as we expect and experience it, past the monotone sketch. It is a breathtaking work that shifts viewers into a real time perception of a distant space as they physically traverse a two dimensional – physical but unreal – pencilled detail.

One way to consider the work is the technical 'magic' of graphite layered on plywood, with photons dancing on top, which makes something new through layers of virtual and material representations. Yet, the work is not powerful by overlaying the virtual on the physical.

Its power to make real is by relating electrons to atoms: we perceived it as a 'space' in full, through the analogue line art and pixelated ghosts of movement and light. The experience of Yukihiro's work opens up how pixels can relate to pigments; electrons to atoms. It helps focus discussion how we might think about AR as real, instead of a confusing layering of terms around virtuality, reality, physical, and digital.

The argument begins by suggesting that AR being explained as layering the digital on the physical or the virtual on the real, is less useful than it seems. This holds true to other media. Is it useful to consider the key to the medium of screens how pixels layer on otherwise inactive glass? Or for that matter, how print ink forms layers atop a physical reality of cellulose broadsheets or vinyl billboard infrastructures? This is not what we focus on when considering how humans perceive these media and act on their messages.

Considering the novel ways how AR 'layers' onto extant environments, and who decides, remains an important but somewhat limited way of understanding these emerging media. In short, foregrounding the metaphor of layering serves to distinguish between layers – one virtual one real. Yet, life is not lived in layers, but in what they connect.

"the metaphor of layering serves to distinguish between layers – one virtual one real. Yet, life is not lived in layers, but in what they connect"

Otherwise, our descriptions of life suffer a latent digital dualism (Jurgenson, 2011), which cleaves our mediated perceptions of life into atomic and electronic domains to the detriment of understanding (real) life – and to the detriment of future AR research in that service. So, the remainder of this post offers some initial thoughts on what can be done to serve as a corrective to virtual-real divides in AR research.

So What?

Before jumping into the theoretical thick of it, it is fair to ask 'so what?'.

Simply put, understanding AR as mediating the real is crucial when forming relevant governing regimes now and in future. AR is not a virtual layer on life, it is "Real Life". For the policy equation, it is crucial to focus regulatory power into buckets that the state (courts, parliament, regulators) understand as real life. My favourite example of this is fire code; Building design – the 'virtual' representations of architecture within which we gather – is regulated in a way that ensures we can't step into a building and sign away our bodily rights with a click of a checkbox. Fire codes matter.

Yet the ways in which AR relates our bodily data to actors that might 'burn us' are profligate, considering who gets our data and how it's used at the whim of a checkbox. The 'virtual' in AR creates bio-spatial surveillance regimes (Heemsbergen et al. 2021) that form real world consequences. Personal data available in AR is being used in ways not imagined when it was offered up, such as when gate analysis or eye movements captured by AR system predict chronic disease. Electro-atomic codes matter.

"Electro-atomic codes matter. "

Past the policy concerns is delightful and abstruse philosophy of technology vis-a-vis these emerging media. It asks what happens when we conceptualise AR as something other than display technologies that are often defined through virtual / real divides.

What if we conceptualise Augmented Reality media as making (a novel techne of) relations available between data-rich objects in an environment – regardless of whether those objects are made from atoms or electrons?

With apologies to Barad (2012), my theoretical interest is in the radically relational accounts of perceptible life that AR can make visible and knowable.

In this sense, media mediate social reality away from categories of 'virtual' or 'real' and instead serve as 'knowledge objects' that mediate what was previously perceptually inaccessible to humans (Bleeker et al., 2020). This mediation creates and is constrained by not just technical factors but the imagined publics (or networked publics or refractions therein) that emerge, and the economic systems that grind along in ways that might or might not produce a 'metaverse' of experiencing reality. As Couldry (2012; 2) points out media offer an ecology of 'infrastructures' that make and distribute content in forms that carry particular contexts with them.

Here, I am less concerned with product or organisational critiques, but considering the 'augmented subjectivity' (Rey and Boesel 2014) that references the co-production of physical and the digital to define (post-)human experience. Such intellectual concern is, for example, focussed on how AR media offer real-time computationally mediated perception (Chevalier and Kiefer, 2020). Below, I unpack these theoretical claims and offer a tentative path forward.

Divides

Atoms can present information physically, in ways that take up material form. They are real. Electrons present information unencumbered of specific form, they are virtual. 3D printers – if considered as a communication device – might sit betwixt this divide to prove the rule. Or from another perspective, 3D prints show the power of crossing divides of 'physical' information with 'digital' information and thus imply the power AR or VR might have as they interact with the physical world in their own way.

To explain this power, foundational work on Augmented Reality conceptualised a virtuality continuum (Milgram et al. 1995) that splits the "Virtual Environment" across a spectrum from the "Real Environment". 'Virtual' environments are computationally created and have endless programmable possibilities through virtual objects in virtual worlds. On the other hand, the 'real' is a world governed by Newtonian physics.

Ironic to much scholarship that cites it, the details of Milgram et al.'s 1995 paper seeks to move past the 'comparatively obvious distinctions between the terms "real" and "virtual"' (1995: 291) through three dimensions that measure towards (or away from) the illusion of an unmediated ideal 'reality'. This unmediated ideal is explicitly referenced via Naimark's (1991) taxonomy of 'Realspace Imagery', which forecasts the capacity to record and display sensory information indistinguishable from the unmediated reality of human perception. While this was useful to come to terms with new display technologies, it seems a poor way to think about media, in relation to our lived reality.

When we consider the human experience, assumptions on what is virtual or not, what is reality or not, can seem misplaced. Starting from a point that equates reality to the physical is not very accurate. The physical world and reality are not interchangeable concepts; differences between reality and our perception of it range from biological to sociological mediations. Are glyphs virtuality or reality when carved in rock? layered on paper with graphite? Shone through liquid crystal? How do any of these media make reality?

We have never lived unmediated lives

The divide between atoms and electrons, physical and 'not' is less than accurate in understanding the human experience – as explained from a variety of disciplines.

From neuro-evolutionary perspectives (Hoffman 2019), physical reality itself is only perceived in particularly useful ways to keep life going; neuro-biological reality is mediated in ways that provide best 'fit' to succeed. From another perspective, Harari (2014; 41) suggests that sapiens are unique in their capacity to "transmit information about things that do not really exist, such as … nations, limited liability companies, and human rights". This has been done through verbal language, written documents, social institutions, etc. We have never been merely physical.

Or, putting it another way, meaning in human experience must be mediated – reality is the media that we make up; we consensually hallucinate them into being, or they would otherwise not exist. The classical hallucination of the digital age comes from William Gibson (1984; 51):

"Cyberspace. A consensual hallucination experienced daily by billions of legitimate operators, in every nation…Lines of light ranged in the nonspace of the mind, clusters and constellations of data"
More recently the duality of a cyber-space, differentiated and ghettoised from other 'spaces' of interaction has been called into question (Jurgenson 2011; Rey et al 2014). The 'technology' of cyberspace is receding into the background as terms like 'spatial computing' become redundant for the augmented subjectivity (Rey et al 2014) of how we experience real life.

Consider that contextually relevant data (whether measured in geospatial or temporal variables) is endlessly integrated into your mobile phone experience all day without a second thought to phones creating 'virtual' 'cyber' spaces.

Real and Virtual need not be mirrors of themselves. They instead form complex intra-relations:

‘nowadays’ the physical is infiltrated by computational surveillance of space and bodies in generative feedback loops that allow you to find a good restaurant from your car, feel reminders on your wrist while in a meeting, or automatically alert authorities to a car crash.

Generating novel relations through computational surveillance of space and bodies in generative feedback loops is what Augmented Reality does; AR relates computed environmental information back into physical space.

“AR relates computed environmental information back into physical space.”

It is not a layering these data, but data-based relations made knowable in new ‘real’ ways. Usually these relations are presented visually, and meant to be perceived by humans as part of reality. If presented aurally, we assume such media are very much part of reality – lest we consider ‘virtual’ the doppler of an approaching mechanical siren on the street, or for that matter the music in your ears from noise cancelling headphones, or other hearables that augment the perceived environment.

AR is Real

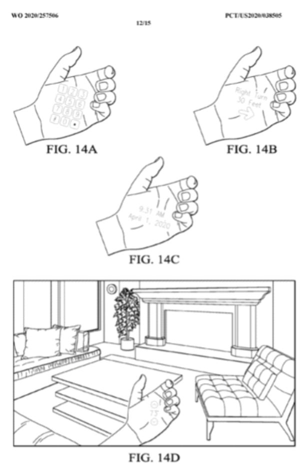
And here is where I have trouble with the utility of differentiating what makes newspaper media more real, or more part of the real world then AR media. AR media suffer a ‘virtual’ designation that has to ‘mix’ with ‘physical’ reality. Both newspaper and AR offer a medium and spit information onto it; AR’s information is just less picky or sticky. Through real-time computation, AR media indeed prove more spatially aware that they are part of reality than instantly out of date newsprint.

More useful is considering the ways that AR mediates, which newsprint cannot. This leads us to better consider how AR’s speciality is building new and radical relations between computable knowledge and the physical world that in unison we perceive as our environment.

“AR media offer radically relational accounts of perceptible life“

A great AR example of this is Hu.ma.ne.

Humane provides a handy (sorry) reminder of the power of focussing on how AR media offer radically relational accounts of perceptible life. Just like newsprint, Humane’s patents, prototypes and pitches ditch the technology of ‘displays’ to directly present symbols onto surfaces of the environment. I admit their work happens to spit up photons rather than ink, but I’m not sure why one (ink) would be any more ‘real’ than the other (photons). Both offer made up trickeries that we hallucinate into meaning something; speaking to a spectrum of real or virtual does not add much value in future.



“The laser projection can label objects, provide text or instructions related to the objects and provide an ephemeral user interface… [to among other things] share and discuss content with others.”

Patent WO 2020/257506 A1; Chaudri et al.

Considering how Hu.ma.ne mediates relations of data-objects in the world shows the new relations available through AR’s mediation of environment with data; ephemeral and realtime – it offers a different reality to life than one dictated by newsprint and billboards. I would not describe it as virtual, however, or as layering information on the physical. It is mediating environmental features together (data and form) that we previously could not perceive. Their work considers the way AR can mediate that other media cannot.

I will end this post by stealing from Gibson’s classic consensual hallucination to help better project how AR is real. In how I propose we think about augmented reality, we might say:

“Augmented Reality Media. Consensual hallucinations experienced daily …[where] Lines of light are ranged in the space we perceive, opening the mind to clusters and constellations of data as environment”

“**Cyberspace**. A consensual hallucination experienced daily by billions of legitimate operators, in every nation...Lines of light ranged in the nonspace of the mind, clusters and constellations of data”

AR media are then better described as relations between computing-data and environment made perceptibly real. That’s AR. The physicality and virtuality of each bit/byte of AR media, or trying to consider how one layers atop the other, doesn’t really get at the most important points. Physical media and ‘non-physical’ media break down in AR space. These divides are subsumed with radically relational accounts of what is perceptible in our mediated reality.

But you don’t have to take my word for it. In 1999 as the first extended reality wave was forming around Virtual Reality hype, the scholar Nicola Green defined to “become virtual” as not merely having “access [to] a wholly ‘other’ space and becom[ing] digital” but rather, the processes of “making connections between programmed and nonprogrammed spaces in specific locales, and power-laden social, cultural, and economic relationships” (1999; 410-11). How fitting that Augmented Reality Media are now showing how that reality can be made perceivable out and about the lived world.

References

Barad, K. (2007). Meeting the universe halfway: Quantum physics and the entanglement of matter and meaning. Duke University Press.

Bleeker, M., Verhoeff, N., & Werning, S. (2020). Sensing data: Encountering data sonifications, materializations, and interactives as knowledge objects. Convergence, 26(5-6), 1088-1107.

Chevalier, C., & Kiefer, C. (2020). What does augmented reality mean as a medium of expression for computational artists?. Leonardo, 53(3), 263-267.

Couldry, N. (2012). Media, society, world: Social theory and digital media practice. Polity.

Jurgenson, N. (2011). Digital dualism versus augmented reality. The Society Pages, 24.

Gibson, William (1984). Neuromancer. New York: Ace Books.

Green, N. (1999). Disrupting the field: Virtual reality technologies and “multisited” ethnographic methods. American Behavioral Scientist, 43(3), 409-421.

Harari, Y. N. (2014). Sapiens: A brief history of humankind. Random House.

Heemsbergen, L., Bowtell, G., & Vincent, J. (2021). Conceptualising Augmented Reality: From virtual divides to mediated dynamics. Convergence, 27(3), 830-846.

Hine, C. (2020). Ethnography for the internet: Embedded, embodied and everyday. Routledge.

Hoffman, D. (2019). The case against reality: Why evolution hid the truth from our eyes. WW Norton & Company.

Milgram, P., Takemura, H., Utsumi, A., & Kishino, F. (1995, December). Augmented reality: A class of displays on the reality-virtuality continuum. In Telemanipulator and telepresence technologies (Vol. 2351, pp. 282-292). Spie.

Naimark, M. (1991, August). Elements of real-space imaging: a proposed taxonomy. In Stereoscopic displays and applications II (Vol. 1457, pp. 169-179). SPIE.Rey, P. J., & Boesel, W. E. (2014). The Web, digital prostheses, and augmented subjectivity. PJ Rey and Whitney Erin Boesel//Routledge handbook of science, technology, and society.–NY: Routledge, 173-188.

Picturing Early Virtual Reality

By Marcus Carter & Ben Egliston / University of Sydney

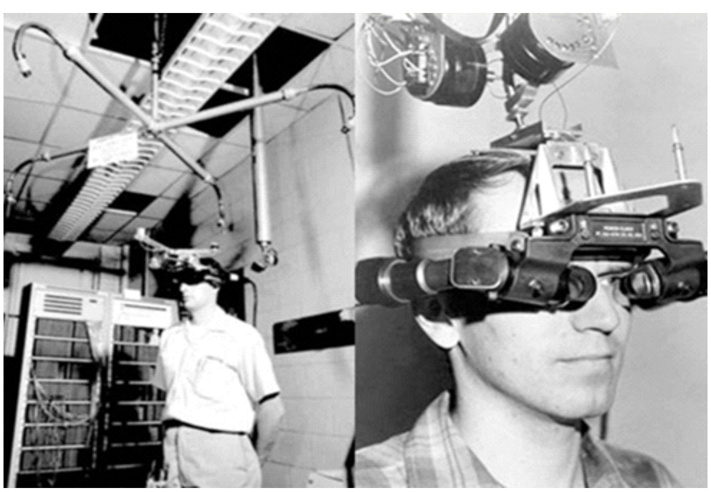
Recently, we submitted our VR book – Fantasies of Virtual Reality – to the publisher, at which point we turned our mind to the much-neglected art log. This has been, for Marcus in particular in the past week, quite the rabbit hole, where we learnt more about the earliest history of VR and further developed our deep respect for archivists.

The Sword of Damocles

The early origins of (digital) Virtual Reality are frequently recited in histories of VR and AR.

Most of the attention focuses on Ivan Sutherland who had developed Sketchpad in as part of his PhD thesis published at MIT in 1963 (an achievement for which Sutherland won a Turing Prize in 1988). Sutherland is widely regarded as one of the pioneers of computer graphics.

Following the completion of his doctorate, Sutherland took a job at the National Security Agency, before taking on a position in the US Army as a first lieutenant, in which he headed the US Department of Defense Advanced Research Project Agency's (DARPA) Information Processing Techniques Office (IPTO) from 1964-1965.



Ivan Sutherland's Sword of Damocles VR hevadset.

It was after his tenure as DARPA head that Sutherland, now working at Harvard, along with his doctoral students Bob Sproull, Quintin Foster, and Danny Cohen developed the 'Ultimate Display' – a computer display with a head position sensor, which meant that the display could change based on movements of the head – what is often described as the progenitor to VR.

First demonstrated in 1968, the system was nicknamed 'Sword of Damocles' because of the intimidating mechanical structure suspended above the user, necessary for tracking changes in the position of the screen so that the image could be updated. The experience of Sutherland's display was more similar to Augmented Reality, because the display was actually see-through, similar to something like the Google Glass.

Now, in most histories of Virtual Reality one of a few available black and white images of the Sword of Damocles are used. These are either from Sutherland's 1968 paper, "A Head-Mounted Three Dimensional Display" (Left) or from his Turing Award website (right). Great photographs, but neither are in the public domain and available for use in a commercial book.

In 1968, Sutherland moved to the University of Utah where he worked with David C Evans, pioneering early computer graphics research and establishing one of the most influential early computer science programs. They founded Evans & Sutherland, a computer graphics firm still in operation today, and continued doing military contracting.

In Search of Image Permissions

In our search of a photograph of Sutherland's early

VR system that we could secure permissions to use, Marcus contacted the University of Utah's archives, hoping that something might be found in the David C. Evans photograph collection. We quickly heard back from their Photo Archivist, who informed us:

"You are not the first person to ask and I have looked for it many times! It is not in the David Evans photograph collection or the University of Utah Computer Science photos, and we do not have a Ivan Sutherland collection."

They did provide us some helpful tips on how to navigate the university's archives, and so armed Marcus went through every key-word he could think of for finding more documents about Sutherland's early VR system, which, of course, was not commonly called VR until the 1980's thanks to Jaron Lanier and VPL Research.

The image (above) on Sutherland's Turing Award page is credited as being of one 'Don Vickers', could other such photographs be credited in a similar way? No. But Don Vickers's ended up being much more interesting than I realised.

Sorcerer's Apprentice

Sutherland's studies of VR did not end with the Sword of Damocles, but were taken up by Donald L. Vickers, one of his students at The University of Utah. His 1974 thesis and the December 1972 edition of the lab's Graphical Man/Machine Communications Technical Reports. They both contain pictures that I hadn't previously seen of the Damocles system.

Vicker's thesis describes the development of the 'Sorcerer's Apprentice', a magic-wand type interface for interacting with computer graphics while wearing Sutherland's head-mounted display. As reported in his thesis, "a hand-held wand lets the observer interact with the objects by "touching" them, moving them, changing their shapes, or joining them together". A claim, perhaps, to the first natural user interface in VR?

Unsurprisingly, Vickers reports in his thesis that "the ability to observe and modify three-dimensional objects in real time and in natural manner is very striking and very realistic". In possibly the first acknowledgment of VR as a nauseous interface, I (MC) chuckled to read in the 1972 technical report that while "some can use it well the first time, but most require several sessions on the system to pass the "tolerance limit"– that point when the system becomes useful instead of merely tolerable." How little VR has changed!

Howard Rheingold's 1990 book Virtual Reality (which remains a fascinating look at early Virtual Reality) features an interview with Vickers – credited as Daniel, rather than Donald – with more history of VR's early development that is often overlooked in the simplified histories that begin (and end) with Sutherland's 1968 display.

"The first fully functional HMD system was fired up in a laboratory in Salt Lake City on January 1, 1970. Daniel Vickers, who was a student at the University of Utah at that point, has been at Lawrence Livermore National Laboratory ever since. He had the job of getting the systems running together and creating the software that would integrate them. I called him at Livermore and asked him if there was a specific day that he can remember when the first fully functional HMD system with eh first virtual world software was working. He laughed and recalled: "I remember getting the software up and running and making the first successful test on January 1, 1970, because the system consisted of several components that were always being used, and there weren't too many time slots available to debug software. It was easy to get hold of the systems New Year's morning because everybody else who used the equipment had been partying the night before. The first image was a wire-frame cube, two inches on a side. I called home and told my wife and brought my family over to see it. We felt it was a breakthrough. We could see real possibilities for the future." (Rheingold, 1991, p. 106)

Rheingold's history features a few more fascinating quotes from Vickers, who recalls "we discovered that the sense of presence was enhanced when we added the wand. The more senses you involve, the more complete the illusion appears to be" (Rheingold, 1991, p. 111).

Unfortunately, this discovery doesn't solve the permissions problem. After leaving the University of Utah, Vickers seems to have worked at Lawrence Livermore National Laboratory – primarily a nuclear weapon's research facility co-founded by Edward Teller – until the mid 1990's. Vickers credits the photos, like most of the photographs from Sutherland's lab, to Michael Milochik, but I have not been able to track down any current contact details for either.

Fortunately all is not lost! We did hear back from the computer history museum who do have three lantern slides used by Ivan Sutherland in talks about the Sword of Damocles, of the head-mounted three dimensional display in their collection. The Computer History Museum is able to provide high resolution files – and critically, permissions – to use these images in publications, for a very reasonable $25 fee. Our quest to include at least some images of early VR was successful.

The Importance of Picturing Early VR

Images like these are critical for how we understand the history of Virtual Reality as a medium. Images make history, and their discoveries, feel more real and help students connect this history to their realities today.

Going back to these primary sources also allows us to go beyond the often overly simplistic historical narrative of Sutherland and the Sword of Damocles. Vickers' memory of January 1 1970 reminds us of what an exceptional technical achievement these early head-mounted displays were, but also how fundamental most of the qualities of XR are: Sutherland and Vickers could be describing a Quest 3 headset when discussing interacting with their early VR prototypes, and the impact of interactivity on presence and immersion.

Sutherland Head-Mounted Three-Dimensional Display, image from the Computer History Museum

To end with a further compliment to the Computer History Museum: the physical device used in Sutherland's Sword of Damocles – the head-mounted three dimensional display – is held in the Computer History Museum in Mountain View, California catalog number X1044.90.
No sign of Vicker's magic wand, though.

If anyone finds themselves in Mountain View, everyone publishing VR books would sincerely appreciate it if you could pop by, take a few high-resolution photos, and share them with a creative commons license for everyone to use.

References

Sutherland, Ivan E. (1965) "The Ultimate Display," Proceedings of the IFIP Congress, Vol. 2, pp 506-508.

Sutherland, Ivan E. (1968) "A Head-Mounted Three-Dimensional Display," Proceedings of the Fall Joint Computer Conference, Vol. 33, pp 757-764.

Vickers, Donald L. (1974) Sorcerer's Apprentice: Head-Mounted Display and Wand" University of Utah Computer Science Technical Report

Vickers Donald L., (1970) "Head-Mounted Display Terminal,' Proceedings of the IEEE 1970 International Computer Group Conference, Washington, D.C., pp. 270-277.

Evans, David C. & Stockham, T. (1972) Graphic Man/Machine Communications. RADC-TR-74-207 Technical Report, University of Utah.

Rheingold, Howard (1991) Virtual Reality. Mandarin: UK.

Roquet, P. (April, 2023) Learning from VR Motion Sickness. Critical Augmented and Virtual Reality Researchers Network (CAVRN).

Researching XR Futures

By Ben Egliston / The University of Sydney

Over the past few years, my research has been focused on exploring the imagined futures of XR technologies. Beyond just trying to understand what kind of future projects industry envisions, I've been particularly interested in studying the values and logics that anchor these visions. There's an essential set of questions that emerges when industry enthusiasts or investors champion their views on XR: who stands to gain, who might be overlooked, or worse, who could be adversely affected?

Studying the future of extended reality (XR) presents a methodological challenge as it involves analysing abstract, forward-looking concepts beyond current existing technology. It's tricky to research due to the speculative nature of future promises and how they're perceived by different audiences. Direct communication with industry insiders is challenging, especially in large tech companies like Meta, where future-related details are closely guarded trade secrets.

An alternative way to study XR futures is by turning to public industry documents. In this CAVRN post I'll explore two forms of documents: patents and financial reporting. I'll provide a brief overview of how researchers doing critical sociotechnical research on XR futures can use these sorts of documents – addressing the valuable insights they can offer (as well as some of their limitations).

Patents

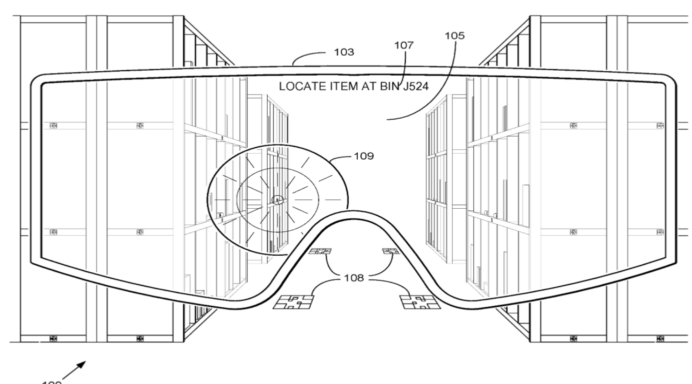
Patents can be a great resource for understanding the underlying logics and values of technological innovation. As media studies scholar Aaron Shapiro writes:

"Patents secure legal exclusion by disclosing an idea or invention. However, the incentive structures behind patents are ambiguous. Patent holders must articulate inventions with enough technical specificity to warrant a property claim while remaining strategically imprecise enough to capture unanticipated future uses" (Shapiro, 2020: 752).

Patents – in effect – are a legal mechanism that allows companies to retain control, and extract value from intellectual property. Because of this, patents are often quite speculative (and often pretty outlandish – so much so, in fact, that The Electronic Frontier Foundation awards a 'Stupid Patent of the Month').

It is all too common to see researchers mistake patents as concrete indicators of a tech company's intent to develop a specific technology. Lee Vinsel (2021) provides a sharp critique of this phenomenon, which he calls 'criti-hype'—the tendency among scholars to form critical stances on technology premised on speculative and sometimes outlandish future visions. Patents are a big culprit in such criti-hype.

Patents should be viewed less as evidence of a company's intent to create specific technologies and more as manifestations of ideology or values. For example, Amazon's patent for AR smartglasses for its warehouse workers may not come to fruition, yet it undeniably reflects the company's interest in tracking and monitoring employee actions to optimize efficiency.



An image from Amazon's patent for smart glasses to be used in its fulfilment centres

In our forthcoming book, Fantasies of Virtual Reality, Marcus Carter and I look at a number of patents when thinking about the kinds of imaginaries surrounding XR in the context of defense and policing. One example comes from Microsoft. Microsoft's patent for military-grade AR smartglasses imagines how wearable AR technologies will enable real time capture and relay of information between soldiers, but also between soldiers and reconnaissance technologies such as drones – rendered within the device's interface, enabling more efficient targeting, tracking and killing.

In the patent, we are presented with an image that encapsulates the United States' imperialist ambitions of conquest in the Middle East and how they are coupled with fantasies of XR as a technological extension of human perception. We see an Arab man being tracked and read as a threat through the device's iris recognition – rendered as such through information stored in databases, transferred to the headset at light speed – a system that feeds into and shapes the anticipatory capacity of the device's user in real-time.

The fantasy here is one of the systematic coordination of soldiers, computer-based systems, and the sensing capacities of the device. How soldiers engage conflict unfolds through AR interfaces which capture information about external environments and the organic and inorganic things in them. These are framed as minimizing the need for soldiers to make split-second decisions in combat. Decisions for using lethal force are distributed between the soldier and the data centres feeding information into the AR device's head up display.

Elsewhere, we looked at how the carceral industry sees new opportunities for profit in VR. One particularly egregious example is Global Tel Link (GTL) – a prison contractor that provides telecommunications systems and payment services to prisons in the US. In 2017, GTL filed a patent for a "system and method for personalized virtual reality experience in a controlled environment". Put plainly, GTL wants to charge prisoners to use its VR software, allowing the incarcerated "for a brief time, imagine himself outside of away from the controlled environment".

While this may never actually come to fruition, it represents a desire to use technology to further extract profits from some of the most vulnerable and oppressed in society.

In these cases, we do not use these patents to anticipate the potential for future harm. Rather, we try to show how innovation in XR is tied to wider violence and oppression.

Corporate financial reports

Securing reliable firsthand information about the business activities of software companies is difficult – much of which is not publicly disclosed and hidden behind NDA-secured trade secrecy.

As such, researchers have come to be reliant upon publicly available secondary data to understand business practices. Corporate financials are a good to get some insight here. Financial statements are official records that detail a company's economic activities and financial health, commonly reviewed for accuracy by auditors for various compliance and business reasons.

If we work with the example of a US-based company – overseen by the Securities and Exchange Commission – there are a number of specific documents that we might draw on. First, are SEC-mandated 10-Q and 10-K forms (these documents are publicly accessible on the SEC's EDGAR database and often on the company's website under the "Investor Relations" section). 10-Q forms are quarterly reports that publicly traded companies must file with the SEC. They provide a detailed account of a company's financial performance, including income, cash flow, and company operations over the past quarter.

10-K Forms are annual reports required by the SEC that give a comprehensive summary of a company's financial performance for the entire year. They are more detailed than quarterly reports and include information such as company history, organizational structure, equity, holdings, earnings per share, subsidiaries, etc. While much of the 10-K and 10-Q are dedicated to overviewing quarterly and yearly financial performance, there is room for firms to address future issues, concerns, and ambitions. In principle, SEC-mandated filings should provide accurate information about a firm's activities for investors (10-K forms include signed statements from a firm's executives attesting to its accuracy).

Other financial documents include shareholder letters and earnings call transcripts. Shareholder letters are communications sent by a company to its shareholders to discuss financial performance, company strategy, market position, future outlook, and other topics of importance to investors. These letters often accompany financial reports and may be released on a quarterly basis. Earnings calls on the other hand are where company executives discuss financial results, answer analyst questions, and may provide guidance on future performance. The transcripts of these calls are valuable for understanding management's perspective and strategy. Unlike 10-Q/10-K forms – which are a very specific genre of writing and language, these other documents allow for more rhetorical flourish.

In my work, particularly in trying to get to grips with the political economy of the XR industry, financial data has been a useful resource (see e.g., Egliston and Carter, 2022). Much of my work in this space has focused on the corporate activities of Meta and its Reality Labs division. Financial data provides insight into the size and scope of the division, as well as its cost. Financial data speaks to the logic of expansion and consolidation characterising much of Meta's business activity in the XR space. Put differently, financial data tells a story about Meta's corporate ambitions that you probably wouldn't get from hearing Mark Zuckerberg speak at an industry event like Meta Connect.

Conclusion

Financial reports and patents offer valuable insights into the emerging field of XR, allowing for an analysis of the underlying values and ideologies driving innovation. But as these technologies have yet to be socialised, it is crucial to avoid perpetuating the industry's linear and deterministic narratives of XR in our critical assessments, steering clear of contributing to 'criti-hype.'

References

Egliston, B., and Carter, M. (2022). 'The metaverse and how we'll build it': The political economy of Meta's Reality Labs. New Media and Society. Epub ahead of print. Doi: 10.1177/14614448221119785

Shapiro, A. (2020). 'Embodiments of the invention': Patents and urban diagrammatics in the smart city. Convergence, 26(4): 751-774.

Vinsel, L. (2021). You're Doing It Wrong: Notes on Criticism and Technology Hype. https://sts-news.medium.com/youre-doing-it-wrong-notes-on-criticism-and-technology-hype-18b08b4307e5

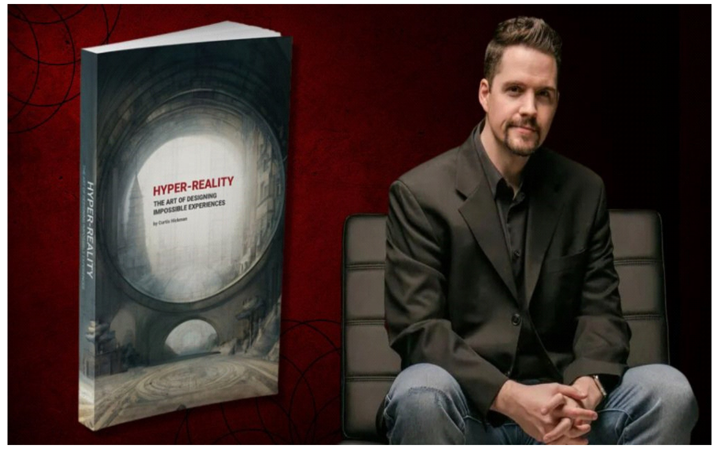
Beyond Boundaries

Navigating the Art and Ethics of Hyper-Reality Design

By Aurelia O'Neil / Texas A&M University

If you've just lost ability to differentiate between simulated reality and the authentic one, you've attained hyperreality, as defined by Jean Baudrillard, and described more recently in Curtis Hickman's Hyper-Reality: The Art of Designing Impossible Experiences. Hickman, a renowned experience designer and co-founder of The Void, introduces a design framework for the creation of immersive hyper-reality experiences in his recently published work. Drawing inspiration from postmodernist, Jean Baudrillard's concepts of simulacra and simulation, and inspiration from his experiences as a magician, Hickman develops a design framework that deconstructs the technical procedures involved in materializing imaginative concepts into multisensory experiences. These virtual simulations create the illusion of attainability for experiences that would otherwise be unachievable.

Hyper-Reality presents its content uniquely. Artwork of geometrical shapes designed by Zebra Creative beautifully builds a spatial theme with red headings in contrast to black backdrops in pages that offer spatially unbound illusion. Hickman's writing creatively meets his audience as if the reader was in the room with him, with anecdotes and footnotes creating an informal conversation between the author and reader. Hyper-Reality also provides numerous case studies created by The Void demonstrating how their audience traverses from reality to believing the setting of their simulations by engaging the senses, by establishing a feeling of presence, and by forgetting the technology that deployed the simulation. Hickman recommends the book should be read by sequence, which is divided into five primary parts.

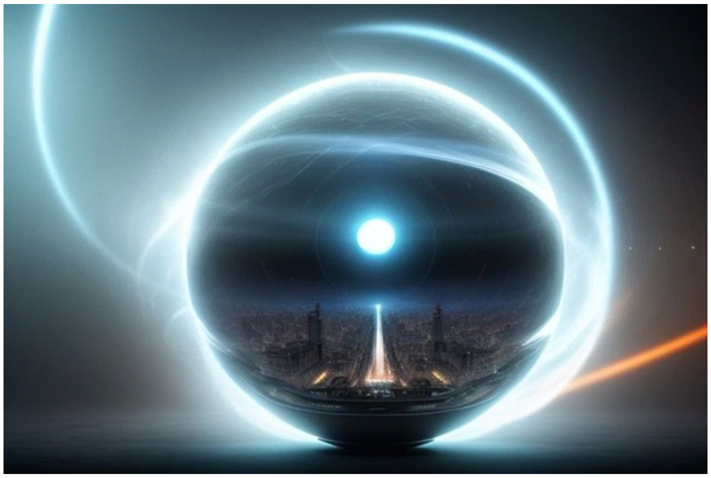


Part I: Hyper-Reality

A central approach for Hickman to craft his experiential design of immersive experiences, is evolving postmodernist Baudrillard's theory of simulation and simulacra with the capabilities of extended reality technologies. Baudrillard believes society has become dominated by simulations that have made the distinction between reality and simulations of reality ambiguous (Baudrillard, 1994). Aspiring to craft Baudrillard's hyperreality concept into fruition and expand from it, Hickman (2023) begins his book by defining hyper-reality as, "the practical illusion of an impossible reality so convincing the mind accepts it as reality itself," (p. 35). According to Hickman, well-designed illusions serve as simulacra that make the imaginary seem plausible.

The foundation of constructing implausible scenarios is rooted in Hickman's 52 principles of design, which are organized into four distinct categories: Guest Laws, Story Laws, World Laws, and Magic Laws. Each category contains thirteen laws. Hickman organized his laws similarly to a deck of cards. The analogy he employs, likening the organization of these principles to a deck of cards, offers a profound insight into his methodology. Much like a well-structured deck, these laws are systematically arranged and strategically utilized, ensuring that each element plays a specific role in the overall composition. The guests are a priority to Hickman with their safety established as the first law. Thus, the guest laws include considerations related to user comfort, safety, and engagement. The story laws revolve around the narrative elements of the experience and story building. Then, the world laws pertain to the immersive environment itself, encompassing aspects like environment design, spatial considerations, and sensory stimuli.

Last, Hickman's magic laws delve into the technical aspects, encompassing the covert and overt illusions, special effects that make the virtual environment magical and the impossible plausible.



Prior to beginning the book, Hickman defines two key terms used interchangeably when explaining various applications of design methods: inner and outer reality. Hickman (2023) introduces the concepts of inner and outer reality earlier in the book to scaffold the reader to the magic applications he presents in the second half of his book. He states, "During a magic effect there are two perceptions of what's going on. One reality is what the magician knows to be true, the other is the false reality the spectators are witnessing," (p. 12).

Inner reality is the individual's perspective of events from inside the experience, while outer reality is the true perspective from outside the experience (Hickman, 2023, p. 13).

Part II: Living a story

A key concept in Hickman's framework is the interplay between diegesis and mimesis in story crafting for hyper-real experiences. He presents diegesis as the explicit telling of a story, while mimesis involves the experiential representation of a story world. As Hickman explains, "Diegesis is how a story is told and mimesis is how a story is represented. In other words, if diegesis is the book that tells you the story, mimesis is the illustration that shows it to you. Mimesis mimics the story" (p. 53). He defines mimetic storybuilding as "the art of crafting experiences through the imitation of a reality that results in the creation of story" (p. 59). Unlike traditional storytelling which relies on controlling the narrative, Hickman notes that virtual reality is an inherently mimetic medium due to its nature of offering participants agency. His emphasis on granting participants the freedom to co-author their journey enables deeper investment in the imagined reality. Hickman explains, "Focalization is the perspective through which a story is seen. In our case it's the perspective of our guests. We can influence it, but we can't control it... What we do control is the way that a guest interacts with the story and how the story interacts with them," (p. 73). In essence, the story is not told, but built by the audience's engagement with the story.

Part III: Magic and covert illusions

Hickman applies principles of magic theory to the framework of his experiential design for hyper-reality experiences. He defines magic as "the art of creating an illusion of an impossible reality" (p.141), drawing parallels to the goals of immersive experience design. Magicians use techniques like misdirection to, "... direct the audience towards the effect and away from the method," (p. 148). Misdirection is a significant method in immersive experience design because it essentially influences the guest's perception of the experience and leads the guest to the conviction of believing the simulation.

After establishing the fundamentals of magic theory, Hickman begins to explain the meaning and application of covert illusions. Covert illusions are deceptive experiences that work without the participant realizing they are being deceived. To further explain how magic is used in hyper-reality, Hickman classifies seven core perceptions that can be covertly manipulated: presence, space, time, motion, matter, force, and life. Manipulating presence, or the feeling of inhabiting a place, is essential for creating acceptance of the impossible reality. For instance, the perception of presence can be manipulated in a hyper-reality experience by sensory concordance, "Do your senses agree with each other?" (p.182). In order to manipulate the perception of presence the guest cannot experience sensory conflict. Hickman provides an anecdote of encountering a Tyrannosaurus rex in a simulation. The dinosaur stopped directly in front of him and let out a roar. "He looked fantastic. The headset and the graphics were state of the art," Hickman describes, "...What pulled me out [of presence] was the lack of vibration beneath my feet as the Tyrannosaurus advanced and the absence of hot breath from his roar," (p. 178).

"Meticulous attention to sensory details in simulations manipulates the guest's feelings of presence in the environment and convinces them to believe the reality."

Meticulous attention to sensory details in simulations manipulates the guest's feelings of presence in the environment and convinces them to believe the reality. Hickman reminds his readers, "What a person perceives through the senses is actually less vital than what they think about what they perceive," (p. 151). An effective illusion not only immerses the guest but convinces them of their presence in the setting. Hickman emphasizes its vital to consider how guests engage with their senses to interpret the experience.

Part IV: Magic and overt illusions

Building upon the foundational principles of covert illusions, Hickman delves into the realm of overt illusions. He introduces a taxonomy of overt illusions known as "Hickman's Twelve Conjuring Classes." Overt illusions, as defined by Hickman, are "effects that are understood to be impossible within their own given reality" (p.173). Hickman begins the overt illusions by elucidating vanishing and distancing techniques.

The method of overt illusions is expertly crafted using these techniques in the Nicodemus: Demon of Evanishment experience. The vanishing technique involves the use of dummy avatars that mimic the movements of real participants, creating the illusion of their disappearance as these avatars are pulled away from view. Meanwhile, the distance technique introduces physical and temporal separation between the virtual and physical aspects of the experience. Participants' virtual avatars move away from their physical selves, or vice versa, creating a profound disconnect between perception and reality. Synchronization of audio enhances the realism, ensuring that all participants feel fear and shock simultaneously, even though their experiences are distinct. In essence, to effectively deploy overt illusions, the boundary between the inner reality and outer reality needs to overlap. It's in this defining moment of time in which the experience becomes magical.

While Hyper-Reality presents an intriguing design framework for constructing impossible experiences, Hickman's first design law on safety could be expanded in a follow-up edition. Though he rightly lists safety as the foremost priority in design, there is opportunity to provide greater guidance on safeguarding users across physical, psychological, moral and societal domains (Steele et al., 2020).

In terms of physical considerations, safety should extend to health and well-being concerns, including issues like dizziness, falls, elevated heart rates, or tripping within simulated environments (Steele et al., 2020). It is crucial to acknowledge that virtual reality simulations can induce physiological responses, such as fluctuations in heart rate, blood pressure, and stress levels (Lavoie et al., 2021). When considering user well-being, it is critical for the designer to take into account the level of tension that the simulations impose on the user. Hickman may enhance the user-centric design approach in Hyper-reality through a more comprehensive examination of the diverse degrees of tension induced in users throughout particular experiences, as well as by discerning user constraints.

Psychological considerations encompass post-traumatic stress disorder, desensitization to violent stimuli, and diminished empathic responsiveness (Steele et al., 2020). Depending on content of the experience and the background of the user, immersive simulations can cause some users to experience emotional harm (Lavoie et al., 2021). In addition, extended reality technologies can increase an individual's presence proximity which could induce them to feel traumatized by an experience or trigger a past traumatic emotional response (McIntosh, 2022). Addressing psychological considerations in hyper-reality design practices is essential to safeguard users from potential emotional harm and ensure that the experiences provided offer support for users.

Moreover, moral considerations should be addressed, including the ethical implications of personal data collection and the potential exploitation of vulnerable populations (Steele et al., 2020). Currently, extended reality technologies collect sensitive data from the users that could be used to study and influence users (Abraham et al., 2022). Notably, in the Future section of his book, Hickman expresses an interest in the convergence of artificial intelligence with hyper-reality. As hyper-reality technologies continue to advance, it is crucial for designers to prioritize user privacy and the underlying motivations behind data collection. Ethical assessments of participants' behavior within simulations are also pertinent (Francis et al., 2016). When users have agency, they sometimes will commit morally egregious acts that differ from their behavior in reality. Considering the heightened sense of realism offered by virtual reality, it is imperative for developers to possess a clear understanding of the boundaries that should be established in VR experiences (Lavoie et al., 2021). Moreover, they should also be cognizant of the potential adverse effects that may arise from the inclusion of morally contentious content (Lavoie et al., 2021).

Social problems encompass the lack of interaction and challenges in forming interpersonal connections in reality, as opposed to the user's involvement in simulated environments (Steele et al., 2020). Furthermore, designers should examine how age and cognitive differences impact susceptibility to believing simulations are real when crafting age-appropriate experiences (Liao et al., 2019). Thus, multisensory manipulations and the belief of presence in simulations is important to consider in regards of the user's age. Numerous presumably advantageous features of virtual reality simulation inherently harbor the possibility of adverse consequences (McIntosh, 2022).

The true magic lies not only in the illusions crafted but in the ethical parameters that safeguard the essence of what it means to be human. Hickman's imaginative vision sets the stage for innovation, but true ethical design means coupling boundless creativity with moral responsibility for humanity. While Hyper-reality offers innovative methods for creating immersive experiences, there is a need for a more comprehensive exploration of the ethical implications associated with design. ▬

References

Abraham, M., Saeghe, P., Mcgill, M., & Khamis, M. (2022). Implications of xr on privacy, security and behaviour: Insights from experts. In Nordic Human-Computer Interaction Conference (pp. 1-12).

Francis, K. B., Howard, C., Howard, I. S., Gummerum, M., Ganis, G., Anderson, G., & Terbeck, S. (2016). Virtual morality: Transitioning from moral judgment to moral action? PloS One, 11(10), e0164374-e0164374. https://doi.org/10.1371/journal.pone.0164374

Hickman, C. (2023). Hyper-Reality: The Art of Designing Impossible Experiences. Independently Published.

Baudrillard, J. (1994). Simulacra and simulation. University of Michigan Press.

Lavoie, R., Main, K., King, C., & King, D. (2021). Virtual experience, real consequences: The potential negative emotional consequences of virtual reality gameplay. Virtual Reality: The Journal of the Virtual Reality Society, 25(1), 69-81. https://doi.org/10.1007/s10055-020-00440-y

Liao, T., Jennings, N. A., Dell, L., & Collins, C. (2019). Could the virtual dinosaur see you? understanding Children's perceptions of presence and reality distinction in virtual reality environments. Journal of Virtual Worlds Research, 12(2)https://doi.org/10.4101/jvwr.v12i2.7361

McIntosh, V. (2022). Dialing up the danger: Virtual reality for the simulation of risk. Frontiers in Virtual Reality, 3https://doi.org/10.3389/frvir.2022.909984

Steele, P., Burleigh, C., Kroposki, M., Magabo, M., & Bailey, L. (2020). Ethical considerations in designing virtual and augmented reality Products—Virtual and augmented reality design with students in mind: Designers' perceptions. Journal of Educational Technology Systems, 49(2), 219-238. https://doi.org/10.1177/0047239520933858

Dis/Unity

Why game engines are central to the metaverse

By Maxwell Foxman / University of Oregon

In September 2023, Unity had to eat its words as the game production community "united" against the platform (Parrish, 2023b). Developers vociferously proclaimed boycotts and that the company was greedy, adding that titles made from its software of the same name would be removed from distribution store shelves (Parrish, 2023a). Their angst, directed at the pricing of game downloads, may seem obscure to those outside of studios. However, the ongoing battle highlights some troubling issues surrounding the construction of the metaverse.

That is the thrust of this article. Underlying debates over Unity's pricing model reflect significant stakes surrounding the production, distribution, and monetization of these future virtual spaces. I will first briefly relay the core concerns in the Unity controversy and then discuss how the application can reinforce power imbalances and ideologies inherent to the game industry.

A Unitary Decision

Unity's importance to the metaverse stems from its longstanding tendency to expand into novel markets. In previous work, I wrote about how, since its 2009 founding, the company distinguished itself from other "game engines"—software frameworks that include physics, lighting, and control integration for building content (Foxman, 2019). Unity capitalized on the popularity of computer "modding" and the rise of mobile media to buck traditional pricing schemes and only charge producers grossing around US$100,000 or more in revenue from products made with its app. As a result, their engine became the de facto tool for many would-be design students and makers—while competitors like Epic's Unreal and the open-source Godot scrambled to catch up. As of 2022, 70% of mobile games were created with Unity, with thousands of projects generated daily; the tool is particularly lauded for creating VR apps (Dealessandri & Calvin, 2020).

Furthermore, Unity prides its platform on being integral to all parts of game-making. It permits users to take an idea into production by supporting—and providing a store for—a variety of objects, backgrounds, and code. Evangelists go as far as to suggest that a game can be developed without almost any programming required (Dealessandri & Calvin, 2020). The engine is also a valuable part of implementation and distribution, with hardware providers building software packages of essential components to integrate standard controllers and interfaces; additionally, Unity's "build and run" function enables the same content to be deployed on dozens of systems and consoles. Figure 1 showcases this process.

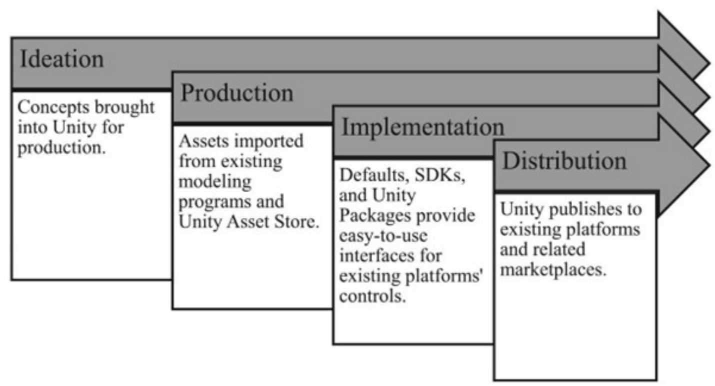


Figure 1: Unity's use in the game production pipeline; from Foxman 2019

This may explain developers' consternation when the company proposed a drastic change to its business model in 2023, charging 20 cents per game installed for those earning $200,000 in revenue. That the fee was based on a per-download basis was particularly vexing, with someone who owned a single game installed on multiple computers incurring extra fees for the studio producing the content (Parrish, 2023a). Unity appeared to be capitalizing on its engine's ease of distribution and implementation.

At the same time, developers felt locked into the platform: "[We] have no option to say no, since we are close to release and this change is 4 months out. You can't simply remake an entire game in another engine when you've been working on it for 4+ years" (Parrish, 2023a). Their frustration speaks not just to unexpected costs suddenly leveraged for an individual sale but was complicated by how ingrained the program is in the gaming economy.

Now to the Metaverse

Given this background, game engines may particularly interest VR scholars because they provocatively sit at the nexus of many components of the proposed metaverse. In a sweeping early effort to articulate its infrastructure during the peak of the concept's recent hype cycle, Lee et al. (2021) note the metaverse's multiple layers of infrastructural innovation, ranging from artificial intelligence to computer vision, extended reality (XR), and robotics. Above these are ecosystems comprising avatars, content creation, virtual economy, social acceptability, security and privacy, and trust and accountability. In theory, ecosystem components would be interoperable, with, for instance, a single avatar passing through metaverse, digital, and physical spaces.

Unity acts as a bridge between the technological and ecosystem levels. The "production pipeline" depicted above allows digital content to be configured and distributed efficiently. Not only does the company do this well, but they already have the edge over other entrants. For instance, Amazon quickly abandoned attempts to make a comparable free-to-use engine (Halfacree, 2021) after a $50 million acquisition (Schreier, 2015). By contrast, Unity has established significant partnerships with Apple to provide tools for creating the first set of their "Vision Pro" headset's programs (Heater, 2023).

Accompanying this centrality, however, are particular ideologies and expectations about what it means to make content. In a separate paper (Foxman, 2022), I point to a "playbor production system," which is already standardizing in VR production and based on normative gaming expectations. "Playbour" (Kücklich, 2005) refers to the (often) uncompensated labor expected from fans, who provide excess content based on their passion for gaming (e.g., Bulut, 2020). This relationship haphazardly consolidates power in hardware providers, game engines like Unity, and distribution platforms, with each taking full advantage of avid users to extend the life of and get feedback about their products (see Figure 2). Microcosms of the system already exist in platforms like Roblox, which even contains its own "Unity"-like game engine. Roblox (as expected) produces mostly game-related content, keeping a percentage of all profits (Peters, 2023), while only a small percentage (300) of the thousands of developers on the platform make a significant living from their labor (Levy, 2021).

This is only one example: ideologies from user labor to body representation in avatars and content monetization have the potential to "calcify" (Foxman, 2022) when gaming tools become widely used in novel contexts.

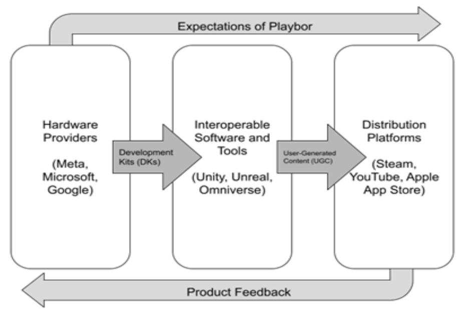


Figure 3: The "Playbor Production System"; from Foxman, 2022

A swathe of research has emerged linking game production and the metaverse (e.g., Bay, 2023; Chia, 2022; Freedman, 2022; Jungherr & Schlarb, 2022; Thorhauge, 2023) and emphasizes not only how engines are instrumental in plans for financial gain (Jungherr & Schlarb, 2022) and production (Chia, 2022; Jungherr & Schlarb, 2022), but also ultimately will impact perceptions of the self, memory and even, at its extreme, reality (Bay, 2023). Aleena Chia (2022) poignantly lays out the stakes of this state: "As we anticipate the arrival of the metaverse, we risk overlooking its infrastructure that is currently being laid and the alternative configurations it can still take." In sum, such debates over Unity's payment modifications deserve closer attention because game developers' seemingly isolated battles may foreshadow the future of how we consume and produce content.

References

Bay, M. (2023). Arendt in the Metaverse: Four properties of eXtended Reality that imperil factual truth and democracy. Convergence, 29(6), c 1698–1712.

Bulut, E. (2020). A Precarious Game: The Illusion of

Dream Jobs in the Video Game Industry. Cornell University Press.

Chia, A. (2022). The metaverse, but not the way you think: game engines and automation beyond game development. Critical Studies in Media Communication, 39(3), 191–200.

Dealessandri, M., & Calvin, A. (2020, January 16). What is the best game engine: is Unity right for you? GamesIndustry.biz. https://www.gamesindustry.biz/what-is-the-best-game-engine-is-unity-the-right-game-engine-for-you

Foxman, M. (2019). United We Stand: Platforms, Tools and Innovation With the Unity Game Engine. Social Media + Society, 5(4), 2056305119880177.

Foxman, M. (2022). Gaming the system: Playbour, production, promotion, and the metaverse. Baltic Screen Media Review, 10(2), 224–233.

Freedman, E. (2022). Artificial Intelligence and Playable Media. Taylor & Francis.

Halfacree, G. (2021, July 7). Amazon Lumberyard is dead, long live the permissively licensed Open 3D Engine. The Register. https://www.theregister.com/2021/07/07/open_3d_engine/

Heater, B. (2023, July 19). Unity's Apple Vision Pro game development tool opens in beta. TechCrunch. https://techcrunch.com/2023/07/19/unitys-apple-vision-pro-game-development-tool-opens-in-beta/

Jungherr, A., & Schlarb, D. B. (2022). The Extended Reach of Game Engine Companies: How Companies Like Epic Games and Unity Technologies Provide Platforms for Extended Reality Applications and the Metaverse. Social Media + Society, 8(2), 20563051221107641.

Kücklich, J. (2005). Precarious playbour: Modders and the digital games industry. Fibreculture, 5(1). http://five.fibreculturejournal.org/fcj-025-precarious-playbour-modders-and-the-digital-games-industry/

Lee, L.-H., Braud, T., Zhou, P., Wang, L., Xu, D., Lin, Z., Kumar, A., Bermejo, C., & Hui, P. (2021). All One Needs to Know about Metaverse: A Complete Survey on Technological Singularity, Virtual Ecosystem, and Research Agenda. In arXiv [cs.CY]. arXiv. http://arxiv.org/abs/2110.05352

Levy, A. (2021). How indie game makers turned Roblox into a $30 billion company. CNBC. https://www.cnbc.com/2021/03/09/roblox-ipo-how-game-developers-built-a-30-billion-platform.html

Parrish, A. (2023a, September 12). Unity has changed its pricing model, and game developers are pissed off. The Verge https://www.theverge.com/2023/9/12/23870547/unit-price-change-game-development

Parrish, A. (2023b, September 14). Unity unites the indie game industry against its new pricing model. https://www.theverge.com/23873852/unity-new-pricing-model-news-updates

Peters, J. (2023, September 8). Roblox is going to let creators that make assets and tools keep nearly all of their sales. The Verge https://www.theverge.com/2023/9/8/23864027/roblox-marketplace-creators-keep-sales-revenue-share-subscriptions-rdc-2023

Schreier, J. (2015, April 6). Sources: Amazon Spent Big Bucks On Crytek's Engine. Kotaku. https://kotaku.com/sources-amazon-spent-big-bucks-on-cryteks-engine-1696008878

Thorhauge, A. M. (2023). Games in the Platform Economy. Bristol University Press.