INTERACTIONS MAY–JUNE 2025 VOLUME XXXII.3

Association for Computing Machinery

Where Is 'Spatial' in Spatial Design?

Re-Creating Sci-Fi Computer User Interfaces in Real Life

A Conversation with Hiroshi Ishii on TeleAbsence

Multilaboratory Experiments Are the Next Big Thing in HCI

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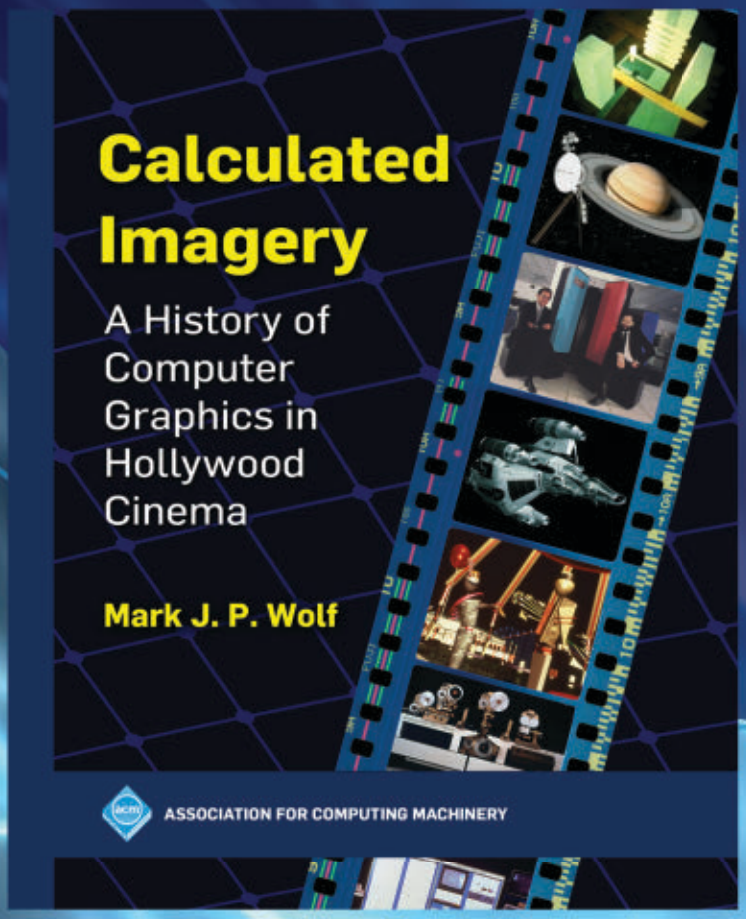

ACM BOOKS
Collection III

Calculated Imagery
A History of Computer Graphics in Hollywood Cinema

By Mark J.P. Wolf

ISBN: 979-8-4007-1266-1
DOI: 10.1145/3694828

This is a comprehensive history of computer graphics in Hollywood cinema. As the first such work of its kind, it is an essential reference for anyone interested in the history of cinema, visual effects, or computer graphics, and the industries of which they are a part. Throughout the book, the histories of individuals, companies, films, and computer graphics techniques are explored in detail, as well as changes in the visual effects (VFX) industry itself over time.

The book begins with a look at the history behind the calculation of images, from weaving to screen imaging, and the faux computer graphics used in movies before real computer graphics were available or affordable. Next, the author examines the rise of computer graphics and computer-animated films, and the gradual introduction of computer-generated imagery into the cinema. The narrative moves chronologically through the development of computer-generated animation and its use both for cartoonlike imagery and for photorealistic imagery. The author discusses behind-the-scenes uses of computer graphics in the film industry, and how these uses have impacted the kinds of imagery made and the technologies by which they are made. The book also looks at how computer animation is combined with approaches such as procedural generation and simulation, and the ways in which computers automate imagery.

Calculated Imagery: A History of Computer Graphics in Hollywood Cinema is for anyone interested in how CG changed the VFX industry, film history, and filmmaking overall, and the people, companies, and techniques that made it happen.

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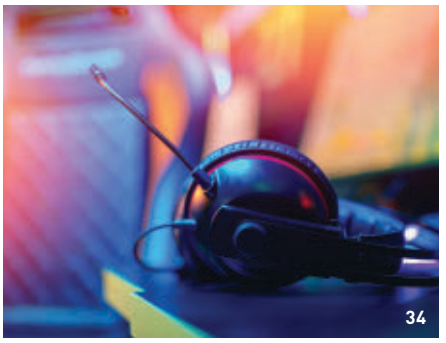
L-TO-R IMAGES BY: ANTON BALAZH / SHUTTERSTOCK.COM; MIRIAM STURDEE; ANDRIJ BORYS ASSOCIATES WITH ASSISTANCE OF SHUTTERSTOCK.AI

HCI has explored embodied, tangible, and ubiquitous computing for many years. The question is: How do we bring those real-world affordances back into "spatial interfaces" at scale?

— P. 22



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On the cover:
Image by Andrij Borys Associates, using art by Master1305 / Shutterstock.com

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Elizabeth F. Churchill

Mikael Wiberg,
Umeå University

Spatiality, Deepfakes, and Life

Welcome to the May–June issue of *Interactions*.

Recently, the idea of spatial computing has seen a thoughtful revision in many texts, including *Spatial Computing: An AI-Driven Business Revolution*, by Cathy Hackl and Irena Cronin. While digital technologies are good for bridging distances, they can also work in the production of space. In this issue's cover story, Davide Zhang addresses interface design issues, asking "where is 'spatial' in spatial design?" He offers a number of provocative "conflicts"—juxtapositions for us to consider—which he illustrates through sketches and imagery. He presents the conflicts of immersion and attention as examples. Zhang also introduces concepts such as "dynamic ensemble," which create interfaces with an "elastic quality" and "ambient continuity." Using these, he leaves us with ideas for exploring different ways of engaging the spatial in 2D, 2.5D, and 3D digital and physical space design.

Deepfakes are manipulated images, videos, and audio recordings that replace one person's likeness with another using artificial intelligence. Many are shockingly compelling. One of the first broadly shared public discussions about the issue appeared on Reddit in late 2017, addressing a set of deepfakes that face-swapped celebrities into existing pornographic videos. From the creation of nonconsensual explicit content to political manipulation and the spread of misinformation, we have seen evidence of the malicious use of deepfakes. Detecting deepfakes has become increasingly important as their potential for personal and societal harm continues to grow. In their article, John Twomey, Cian O'Mahony, Conor Linehan, and Gillian Murphy focus on designing interventions that challenge conspiracy theories rooted in deepfake misinformation. By illustrating how deepfake technologies are used to discredit accurate, fact-based information, we are invited to reflect on how design can counteract these effects.

Despite AI's promise of eternal digital life, physical life remains ephemeral. In her column, Jie Li explores the interplay between absence and presence, loss and mourning, in her conversation with the visionary HCI researcher Hiroshi Ishii. By centering design in the wake of absence, they explore how Ishii's concept of TeleAbsence challenges our understanding of memory and reimagines the role of technology in amplifying humanity.

Inspired by the RepliCHI initiative, which launched as a response to concerns about reproducibility in HCI, Jonas Oppenlaender argues in our Blog@IX section that multilaboratory experiments can push the boundaries of the field. He states that such multisite experiments would create "opportunities to test theories and systems in varied settings, which would be difficult for any single lab to replicate alone." He notes that multilab experiments are common in fields that have historically led the way in scientific rigor. Of course, a shift to such a model would require new funding models, an expansion of open data initiatives, and the development of shared frameworks and procedures. Only with these in place would labs worldwide be able to collaborate effectively on a large scale and conduct cross-context studies. Oppenlaender offers a compelling argument for investing in the expansion of our collaborative networks.

In one of *Interactions'* newest sections, Waves, Victor Cheung shares his love of science fiction, demonstrating how he inspired his students to explore new ways of evaluating and reinventing technologies. Over the course of a semester, undergraduate students were invited to use tools, including 3D printing and Arduino with sensors, to re-create a science fiction UI in "real" life. Cheung introduces us to an example of a completed project, accompanied by illustrations.

In Voices, HCI superstar and SIGCHI volunteer Regan Mandryk talks about why she has been such a dedicated volunteer in the SIGCHI community. She recently started the Salish Sea SIGCHI Chapter, bringing together researchers from the west coast of Canada. As she says, the chapter offers a place for people working across the board in areas related to "understanding humans, computers, and their interaction." More personally, she hopes that HCI and UX scholars and professionals can be "driven by values other than productivity."

As always, we leave you with Exit. In this issue, curators Scott Minneman and Renato Verdugo invite us to step into the future with WhatIFpedia, which "generates foresight provocations for the year 2035 in the form of real-looking Wikipedia pages."

As we close out this Welcome, we invite you to contribute to any section in Interactions. We look forward to working with you!

Elizabeth F. Churchill and Mikael Wiberg
eic@interactions.acm.org

DOI: 10.1145/3729433

The *Interactions* website (interactions.acm.org) hosts a stable of bloggers who share insights and observations on HCI, often challenging current practices. Each issue we'll publish selected posts from some of the leading and emerging voices in the field.

Multilaboratory Experiments Are the Next Big Thing in HCI

Jonas Oppenlaender, University of Oulu

Many scientists assume that public trust in science is a given and stable. Funding institutions, even amid fierce competition in academia, still keep the research engine running. The incentives in academia, however, do not always align with funding priorities. Funding is primarily awarded for innovation and renewal of science. But the prevailing "publish or perish" culture does not just motivate people to produce more research—it also encourages some to take shortcuts, sometimes crossing ethical lines. Paper mills have sprung up to serve those willing to pay for fake data and fraudulent studies [1], and the rise of generative AI makes misconduct easier than ever. At the same time, science denialism continues to grow, making it more important to uphold both rigor and transparency.

We should remind ourselves that public trust in science is not unbreakable; it can crumble. As Marc Edwards and Siddhartha Roy warn, "if a critical mass of scientists become untrustworthy, a tipping point is possible in which the scientific enterprise itself becomes inherently corrupt and public trust is lost, risking a new dark age with devastating consequences to humanity" [2].

We may be far from this tipping point, but it is still pertinent to consider how we can strengthen the current landscape. HCI should be at the forefront of this effort. The field is increasingly centered around how humans interact with AI, a timely focus that has potential to drive meaningful policy recommendations. Yet HCI remains a relatively "soft" discipline. Virginia Braun and Victoria Clarke's

thematic analysis, for instance, is now the most widely used qualitative method in HCI [3]. While valuable, this qualitative emphasis sometimes opens doors for authors to make unsubstantiated claims.

Rigor is lacking in other areas of HCI as well. Literature reviews, for example, often lack transparency. It is not uncommon to encounter a "systematic literature review" being reported in an HCI research article, yet few methodological details are provided. Standards are also missing in emerging areas such as prompt engineering, where practices are still evolving. And with HCI studies, small sample sizes ($N<12$) are common, yet results are frequently generalized to larger populations.

To address these potential risks to public trust in HCI research—or ideally, to prevent them from arising in the first place—the next logical step for HCI are *multilaboratory experiments*. These are studies conducted by multiple independent labs, often spanning different institutions and even countries. By designing experiments with common procedures that can be run and verified across diverse settings, these collaborative studies bring a much higher level of rigor and reproducibility to HCI research. Multilab studies help ensure that findings are not just anomalies or artifacts of one lab's methods, but instead stand up to scrutiny from a broader scientific community.

Multilab experiments have made a significant impact in other disciplines. In psychology, for example, Martin Hagger and colleagues conducted a landmark multilab, preregistered replication of the ego-depletion effect, a theory suggesting that self-control is a finite resource that can be "used up" [4]. Their findings, drawn from contributions across many labs, cast doubt on the robustness of this effect and sparked widespread discussions about reproducibility in psychology. This type of collaborative research has proved invaluable for verifying—or challenging—previous findings.

In physics, large-scale, multilab experiments are even more routine. Projects such as those at CERN require collaborations that span continents, with research teams contributing resources and expertise to answer fundamental questions about the universe. These collaborations also bring transparency, as methodologies and data are often shared across institutions, creating a high level of trust in the findings.

Multilaboratory experiments offer several compelling benefits for HCI. First, by pooling resources across labs, multilab studies can achieve larger sample sizes, which in turn improve statistical power and help detect

IMAGE BY ANTON BALAZH / SHUTTERSTOCK.COM

meaningful effect sizes. With larger, more diverse datasets, findings are not only more robust but also more representative, leading to higher trust in results.

Multilaboratory experiments also have the potential to expand HCI's reach beyond its traditional boundaries. By involving diverse labs, researchers can tailor studies to specific cultural or technological contexts, capturing insights that a single-lab study might miss. This makes findings not only more reliable but also more inclusive, providing a fuller picture of how HCI systems perform across different user groups, devices, and environments.

Moreover, multilab research fosters interdisciplinary work, inviting collaborations with fields such as psychology, data science, machine learning, and engineering. These interactions don't just enrich HCI research—they help create tools and frameworks that can be shared across disciplines, strengthening HCI's role within the broader scientific community.

Multilaboratory studies can also serve as training grounds for early-career researchers, who benefit from exposure to diverse methodologies, collaboration across different academic cultures, and learning about best practices in research transparency. This builds a foundation for the next generation of HCI researchers who are skilled in both collaborative work and rigorous experimentation.

Involving multiple independent parties also reduces incentives to falsify data, as each lab verifies its own findings within the broader study. This shared responsibility adds a layer of accountability, making it more difficult for any one party to manipulate outcomes undetected.

Additionally, multilab experiments align with the growing trend toward collaboration in research. As science becomes more interdisciplinary and collaborative, multilab studies help HCI researchers break down institutional silos and foster open knowledge-sharing across the field. This creates a more resilient research environment, where findings are both stronger and more transparent. In addition, multilaboratory experiments can push the boundaries of HCI, creating opportunities to test theories and systems in varied settings, which would be difficult for any single lab to replicate alone.

HCI already has a foundation to build on when it comes to multilab research. The RepliCHI initiative [5], launched as a response to concerns about reproducibility in HCI, encouraged replication studies within the community. This effort helped emphasize the importance of validating findings across different labs, laying the groundwork for collaborative replication efforts. There are also a few HCI studies that have collaborated across countries to compare studies in different cultural settings. These projects are multilab by nature, involving various institutions. Overall, however, multilab studies are limited in HCI.

In an era where trust in science can no longer be taken for granted and science denialism is growing, the move toward multilaboratory experiments represents an essential step forward for HCI. By embracing this collaborative approach, HCI researchers can address many of the challenges we face today—ensuring transparency, building on rigorous methodologies, and fostering trust in our findings.

Multilaboratory studies offer a way to transcend the limitations of single-lab experiments, such as small sample sizes and narrow contexts, which often weaken the validity of our conclusions. They allow us to test HCI principles and systems across different environments, cultures, and user groups, paving the way for findings that are more generalizable and impactful. This is critical for areas such as human-AI interaction, where broader validation of findings is needed to guide ethical and effective design choices and policies.

This approach also signals a shift in how HCI sees itself. Multilab experiments are common in fields that have historically led the way in scientific rigor, and adopting them gives HCI a chance to contribute to this movement. As we bridge the gap between "soft" and "hard" scientific practices, we can position HCI as a leader in methodological rigor, ultimately enhancing our credibility and influence in the research community.

To realize this vision, HCI will need to make multilab collaborations more accessible. This may involve new funding models, open data initiatives, and development of shared frameworks and procedures that make it easier for labs worldwide to collaborate on large-scale studies. But the rewards—more robust, trustworthy, and impactful research—are well worth it. In the end, multilaboratory experiments are not just a method; they're a statement. They show that HCI is ready to tackle its challenges head-on, setting a standard for transparency and trust that the field can carry into the future.

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Jonas Oppenlaender is a postdoctoral researcher at the University of Oulu in Finland, specializing in meta-research in the field of HCI. With a Ph.D. in creative crowdsourcing, he has explored the creativity of prompt engineering and generative AI.
→ jonas.oppenlaender@oulu.fi

DOI: 10.1145/3725722

In this section, we feature reports from conferences, symposia, workshops, and similar events, focusing on discussions where the boundaries of HCI and UX are being challenged and where debate is lively and ongoing.

Re-Creating Sci-Fi Computer User Interfaces in Real Life

Victor Cheung, Simon Fraser University

The science fiction genre has been the prime platform showcasing some of the most creative and otherworldly computer user interfaces (UIs), particularly in movies, TV shows, and games. With the help of visual effects and computer graphics, these UIs play a crucial role in convincing the audience that the world the story is set in, often a futuristic scene, is plausible. By extension, the stories are believable [1]. One way to achieve this is to incorporate interfaces that only exist in research labs (e.g., gestural UIs from the 2002 movie *Minority Report*).

The incorporation of unseen but promising interfaces and technologies, however, has a more subtle yet practical motive: to reach the general public and affect their perception, thus promoting acceptance and advancements (e.g., artificial heart technology [2]). In fact, much of HCI research (e.g., shape-changing interfaces [3]), as well as the DIY community—for example, the Cortana appliance project [4] based on the *Halo* franchise—has been inspired by the UIs in sci-fi movies and video games (the reverse is also true [5]).

As an educator in computer science and HCI, I believe sci-fi UIs can be more than fun video clips that generate some oohs and aahs in a classroom. They can be used as a powerful vehicle in encouraging CS students to examine the relationship between technologies and humans and to flex their technical knowledge. This belief led to a recent upper-division undergraduate course that I designed and taught in which the term-long project was to re-create a sci-fi UI in real life. (In comparison, MIT's Sci Fab had a different focus on the futuristic artifacts and how they inform today's technologies; https://bit.ly/4gLw59k.)

The objectives of the course were the following:

- To introduce students to a wide range of UIs, novel interaction styles, and their associated technologies
- To be able to read, present, and discuss literature from the HCI community on topics related to the course
- To be able to design, implement, and evaluate a novel computer UI.

To achieve these goals, the project had multiple phases, each presented in a different format to further train the students on illustrating their work:

- A proposal with a sci-fi computer UI selected and a plan on how to implement it (e.g., deciding which hardware and software to use, determining which tasks it supports)
- A low-fidelity prototype that demonstrates progress and elicits feedback/suggestions from the class
- A presentation that provides details about the selected UI, showcases the refined prototype, and reports the evaluation results of the prototype
- A report on the project (using the pictorial format in the HCI community) that includes evaluation of the design, recommendations for improvements, and reflection (lessons learned).

Figure 1 shows an example of a student group project that implements the digital scope of a sniper rifle from the 2015 movie *Hitman: Agent 47* (http://bit.ly/41aMjTI).

Sci-fi UIs can be used as a powerful vehicle in encouraging CS students to examine the relationship between technologies and humans.

The student group used several tools, including 3D printing, Arduino and sensors, Weather and Google Maps API, and React Native software, to re-create a UI that allowed users to zoom in and out via a touch sensor and provided various hints and real-time feedback, such as bullet drop prediction, rifle stability, wind direction, and speed.

Among the pleasantly surprising outcomes from the course were the following:

- Students came back with a variety of UIs. Each of the six groups found a different UI from either a sci-fi game, TV show, or game.
- Students were motivated to apply and learn different technical skills to implement the UIs. For example, they used Unity 3D for heads-up display (HUD), React for multidevice communication, and ARToolKit for volumetric projection, many of which were not part of the current curricula.

COURSE LESSONS

The course was successful in inspiring students to pursue disciplines in related topics (one, for example, decided to take an embedded systems course and later applied for a master's program in computer engineering) and left them with something they can be proud of and show their peers. Nevertheless, I realized a few things that will improve the delivery of the content and the impact of the course.

Offer clear framing and description of the project requirements. Since students could choose from a sci-fi movie, TV show, or game, the UIs were vastly varied, thus making it difficult to evaluate their effort, and for them

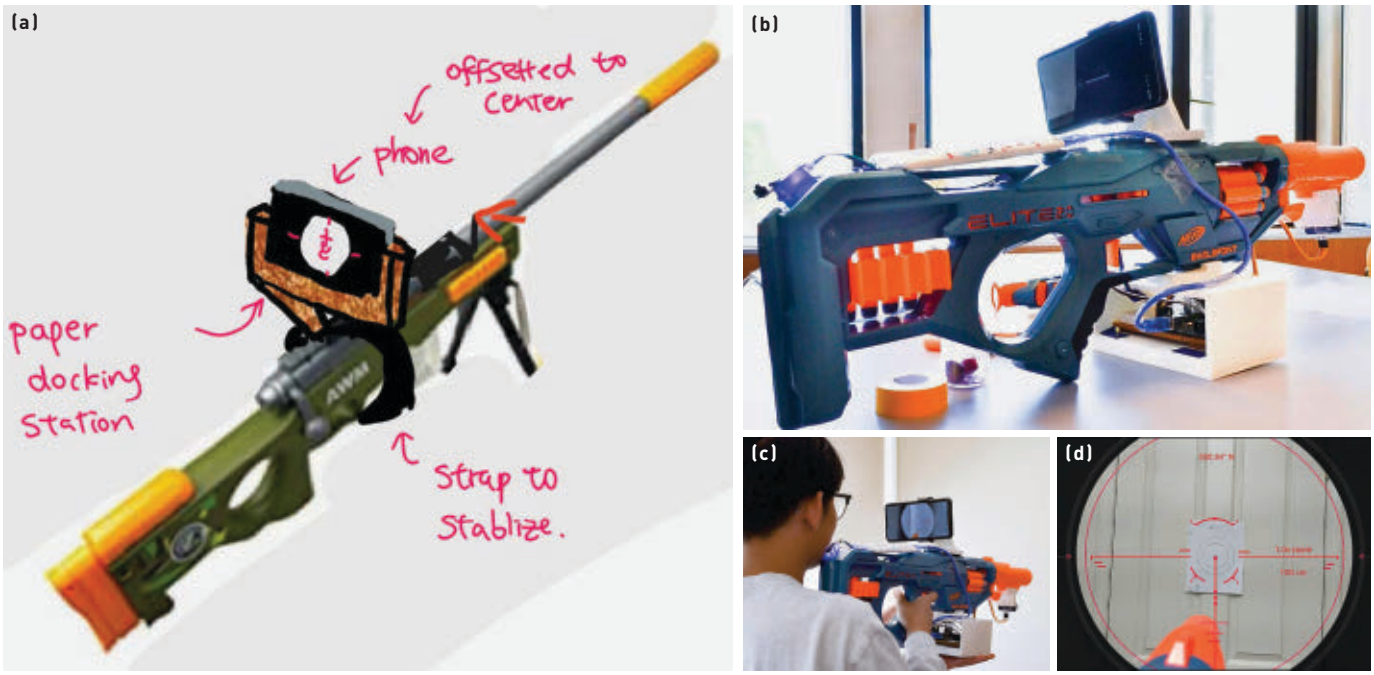

Figure 1. An overview of a project from the course: a) the sketch of the prototype, including the UI of the digital scope taken from the movie *Hitman: Agent 47*; b) the finished prototype; c) a student testing the prototype; and d) the re-creation of the UI.

FIGURE 1 IMAGES COURTESY OF STUDENTS CARMEN L., JOSH C., DEBORAH W., AND JESSICA L.

to evaluate their own progress. Some criteria of what constitutes an acceptable UI—for example, must have a display, must have an input, must support X number of distinct tasks—should be provided, with examples of acceptable and unacceptable UIs. It might also be helpful to choose a theme (e.g., HUDs, large interactive displays) so that there is greater synergy among projects.

Provide stronger support and guidance for the technical aspects of the projects. Due to the open nature of the projects, students might have unrealistic expectations of what they could create (e.g., one group wanted to re-create the object recognition part of the *Iron Man* HUD but realized that required more than they could implement). Help should be provided to the students to narrow their project down to a feasible scope in terms of time and resources, as should pointers and suggestions on where and how to acquire the materials and knowledge to re-create the UIs (e.g., what software libraries they could use, how to build a low-cost volumetric display or mock up a large display).

Encourage students to think beyond just implementing the UI. While the primary deliverable of the course was the UI implementation, students should also be encouraged to reflect on the UI design, especially its impact on the real world. As argued by Daniel Russell and Svetlana Yarosh [6], sci-fi might "provide a good grounding for discussion" but would not be suitable for predicting the future due to "common tropes" and "shortcuts." To train students to be responsible and thoughtful designers of the future, questions that make them reflect on the design can be asked. These could include: *How feasible are the UIs (e.g., space/computational/cognitive requirements)? What are the limitations if they are used in real life (e.g., ergonomics if used for an entire day)?* (For more examples, see Russell and Yarosh's five heuristics for design fiction writers [6]).

To conclude, re-creating a sci-fi computer UI in real life as the underlying theme made this course an appealing opportunity for students to apply their technical knowledge in an engaging way and get a glimpse into some active areas of HCI research. With the described improvements, it is my hope that the course will be more than a technical CS course and that it will equip students with the ability and foresight to design UIs for the future.

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Victor Cheung is a lecturer at Simon Fraser University. He has a Ph.D. degree in systems design engineering from the University of Waterloo. His teaching and research interests involve designing and evaluating technologies that mediate communication between humans and computers, resulting in improved user experience and user empowerment.
→ v_cheung@sfu.ca

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ENTER

"The Politics of Patents project explores gender, technology, and citizenship via clothing inventions from 1820 to 2020. Our sewing social scientists pick patents apart and piece them back together in different ways. It's an archive full of absolutely amazing treasures."

CONVERSATIONS IN SKETCH

MAKE IT, SEW

Kat Jungnickel explores the role of technologies in relation to mobilities, bodies, gender, and DIY cultures, as well as how people radically reinvent and reimagine sociopolitical worlds with ordinary things.

Miriam Sturdee is a lecturer at the University of St Andrews working on intersections of art, design, and computer science. She is a practicing artist and designer and has an MFA in visual communication. Her publications explore areas of futuring, sketching and drawing, alternative research outputs, and psychology.
→ ms535@st-andrews.ac.uk

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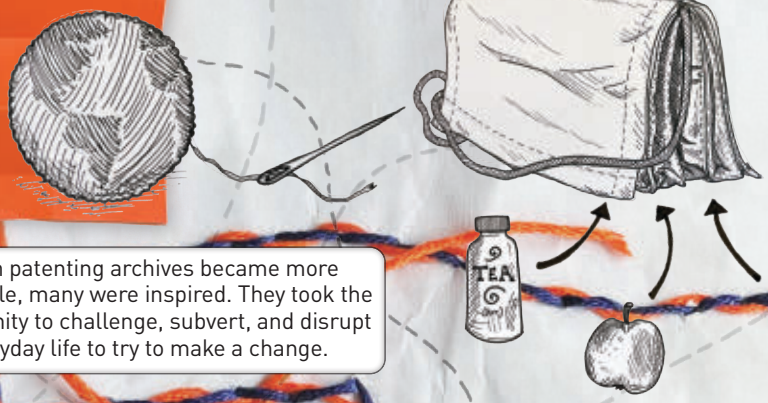
Clothing patents are interesting research objects because they point to lesser-known pasts and reveal alternative possible futures. They are objects with which people have tried to change the world around them—stitch by stitch.

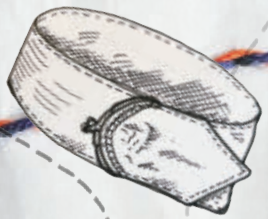


Patents provide glimpses into the sociocultural context of the time in which they were crafted. Many tell stories of marginalized inventors who could not take ordinary rights and privileges for granted. They had to do it themselves.

When patenting archives became more accessible, many were inspired. They took the opportunity to challenge, subvert, and disrupt everyday life to try to make a change.

We've been investigating inventions with combinable, convertible, or invisible features that enabled wearers to do different, surprising, or unexpected things...

...and carve out different kinds of lives.



Wearable tech isn't just about computing; it's also about the evolution of technology, enduring issues, and identity. The patents and inventions I study may not have digital technology built in.

But they have analog technology: pulley systems, weights, wax cords, and stitched channels.

Issues raised by inventors over 100 years ago look remarkably similar to those of today.

A century ago, there were a lot of radically transformative designs.

How might we expand this inspirational thinking? We're making a whole range of clothing patterns inspired by past patents open access!

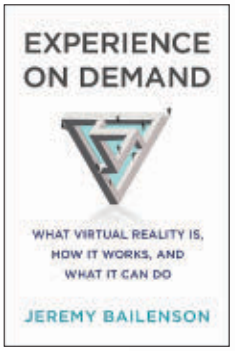
The first collection has been downloaded 75,000 times all over the world by people who have hacked some of the really interesting elements into their contemporary clothes.

Patent archives are full of lesser-known designers, engineers, and inventors, and I find that really exciting.

Find out more at www.politicsofpatents.org

Julie Williamson

As I move through the world, I shape my experiences using technology. Most frequently, I'm changing my reality by using audio as I go through my day. I spend a lot of time listening to books, which allows me to weave my reading experiences into my everyday life. I love physical books and being able to thumb through the chapters and smell the pages. But I live audiobooks, and they become part of my wandering in a way physical books cannot.



As rapidly as immersive technologies change, I find that *Experience on Demand: What Virtual Reality Is, How It Works, and What It Can Do*, by Jeremy Bailenson (narrated by Jeffrey Kafer), still inspires, even six years after publication. I wonder how I would've reacted to it at the time it was released, when I was just beginning my own immersive research, and my thinking around the topic was just developing. Starting from the amazing expression of "experience on demand," which viscerally captures the power and intensity of what immersion can provide, Bailenson discusses how using the infinite possibilities of immersion for mundane or everyday tasks seems like a waste. I believe we're moving toward a future where immersive experience will always be available, meaning some immersive experiences will become routine or mundane. I think immersion can be just as powerful for extraordinary experiences as it can for day-to-day activities. Bailenson also discusses his lab's practices around limiting extended exposure to immersive experiences. In practice, however, immersive cultures have leaned into extended immersion in recent years. For example, I am fascinated by TikTok streamers who spend extended periods immersed, and for my own work I spend extended periods using these technologies. But I did feel my reality start to collapse after spending about 30 hours in a Quest 3 last year!

Brené Brown might not be everyone's cup of tea, but I'm a longtime fan of the self-help section. Her book *Dare to Lead: Brave Work, Tough Conversations, Whole Hearts*, which she also narrates, focuses on vulnerability as a foundational leadership quality. The book doesn't cover just this topic, but how I thought about vulnerability really changed because of it. I'm at a strange moment in my career, where I'm finally realizing that I'm solidly midcareer, and it might be time to grow up and lead my team and myself a little differently. I'm still working on putting these concepts into practice, but this is a book I imagine won't be leaving the first page of my audiobook app any time soon. I have grown as a professional and a person through many hours with my favorite self-help titles (some additional ones I like are *Surrounded by Idiots*, *How to Listen*, and *How to Talk to Anyone*).

I don't spend all my time immersed in nonfiction, but I won't admit how much

IMAGE COURTESY OF JULIE WILLIAMSON

time I spend listening to all kinds of fantasy. I recently finished *One Last Stop*, by Casey McQuiston (narrated by Natalie Naudus), which I heard described as "urban fantasy," a genre I didn't know existed. Now I want more of it. The sapphic romance combines fantastical elements with modern Brooklyn, as two

women solve the mystery of an endless subway ride. It's a story I experienced deeply, because I often listened to the audiobook while walking through urban spaces, hearing the sounds of the city and trains while the story unfolded around me. This kind of everyday immersion is why I love audiobooks.

Dare to Lead focuses on vulnerability as a foundational leadership quality. The book doesn't cover just this topic, but how I thought about vulnerability really changed because of it.

Julie Williamson is a senior lecturer in the School of Computing Science and a co-director of Realities and Immersion Glasgow, the center for research, teaching, and innovation in immersive realities at the University of Glasgow. Her research focuses on understanding what it means to be social in XR.
→ julie.williamson@glasgow.ac.uk

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Gopinaath Kannabiran

Jodi Forlizzi,
Carnegie Mellon University

Compassionate AI and Worker Well-Being

AI technologies play an increasingly important role across various sectors. How might we design AI technologies that can aid compassionate interactions? Why is it necessary to take a compassionate design approach? In this article, I explore how these questions relate to worker well-being in a conversation with Jodi Forlizzi.

WHAT IS COMPASSION?

The Sanskrit word *karuṇā* refers to an important concept in Indian spiritual traditions and is commonly translated in English as compassion. Moving away from an individualistic worldview, *karuṇā* emerges from a worldview that everything is interconnected. It is a profound recognition of our entangled existence that urges us to help alleviate the suffering of others in order to ease our own suffering. The concept of *karuṇā* is echoed in the words of the American voting and women's rights activist Fannie Lou Hamer: "Nobody's free until everybody's free."

Despite being recognized as an important virtue across cultures, a practical definition of compassion is often found wanting. Clara Strauss and colleagues bring together Buddhist and Western psychological perspectives to describe the elements of compassion: recognition of suffering in others, understanding the shared humanity and universality of suffering, feeling emotional resonance (sympathy, empathy, and concern) for those who suffer, tolerating the distress associated with the witnessing of suffering, and motivation to act or acting to alleviate the suffering [1].

DESIGNING FOR AND WITH COMPASSION

Advancing an ecological worldview, a compassionate design approach refutes saviorist attitudes and instead promotes collaboration and cooperation. Exploring designing for resilience in HCI, Dorian Peters and Rafael Calvo point out that "while empathy may lead to an *inward focus* and/or aversive response, as one is absorbed by an experience of vicarious negative emotion, compassion describes an *outward focus* and an active caregiving response" [2]. Peters and Calvo assert that if "design of technologies can encourage the development of compassionate attitudes and elicit compassionate states in the face of social problems, we will not only help to address those problems, but also improve the well-being of all involved" [2]. In a more recent work, Mark Graves and Jane Compson explore compassionate AI for moral decision making, health, and well-being: "By making AI compassionate, the alleviation of suffering becomes explicit, rather than proxied, and potential harms caused by AI automation can be turned into benefits" [3]. The authors suggest that compassionate AI can be deployed "especially into application areas where compassion plays an essential role with high demands on the compassion capacity of caregivers" [3]. Building on existing efforts that advocate for a compassionate approach to the design of AI technologies, here we turn our focus toward worker well-being.

Designing AI technologies for well-being is essential and yet remains elusive.

Gopinaath Kannabiran: Can you tell us a little about your work and how you approach worker well-being?

Jodi Forlizzi: I am currently studying how AI and automation affects workers. I am particularly interested in face-to-face service workers who often confront various systemic sociotechnical challenges that may hinder their ability to work and negatively affect their lives. The focus on how technology affects their work is part of a larger investigation on well-being at work. We have defined worker well-being as feeling agency and self-sufficiency in their roles, having control over their workflow, having positive communication and interaction with other employees and managers in the workplace, and being appropriately trained on the technology systems that they are asked to use in the workplace. This definition is based on themes that were elicited by analyzing interview and observation data collected in several hotels.

GK: Your definition of worker well-being invokes multiple themes that are relevant for HCI and CSCW: agency, participation, power inequity, self-sufficiency, collective empowerment, communication, and upskilling, among others. I have argued for conceptualizing "self as *always-already-relational* and well-being as an ongoing contestation of power" [4] in a conversation with Heather McKinnon about designing for living well. In one of your recent works, you and your coauthors suggested that "focusing on well-being in the hospitality industry may help with retention efforts where solely relying on wage increases would have not sufficed" [5]. This insight

reaffirms my conviction that an individualistic worldview is inadequate while designing technologies for well-being.

What are some challenges and frustrations you encounter while designing for worker well-being? And what keeps you moving forward?

JF: In the aforementioned project, we encountered a lot of bumps and hiccups in studying service workers and their work. While training and digital and AI literacy are part of the problem, there are also issues in how technology is designed, developed, procured, and rolled out. Many approaches to worker well-being do not take the holistic view that is needed. We know that surfacing the voices of workers can positively affect worker well-being. The work is exciting and rewarding, so it helps us move forward, even though finding sites to study can be difficult and time-consuming.

GK: Worker well-being includes complex issues, such as alienation, increasing demands at work, work precarity, unfair labor practices, and digital divide. As you mention, it is vital to design technologies with a holistic perspective that encompasses our embodied, emotional, intellectual, social, and spiritual interactions with others. Suffice to say, designing AI technologies for well-being is essential and yet remains elusive. I am particularly interested in approaches that acknowledge people's vulnerabilities and work toward supporting them as agents of change in their own lives. I agree with you that it is necessary to surface the voices of workers and pay attention to how they face inequities. This kind of approach makes it possible to critically question existing labor practices and can support compassionate exploration of better alternatives for worker well-being.

In a panel discussion with the environmental philosopher Glenn Albrecht, I highlighted that "people who engage with social justice related issues and environmental concerns through their work often experience ecological burnout [and therefore] it is necessary to process our eco-burnout through communal body-based

IMAGE BY ANDRIJ BORYS ASSOCIATES WITH ASSISTANCE OF SHUTTERSTOCK.AI

practices" [6]. You are a martial arts practitioner and yoga teacher. How does this influence your work?

JF: It is critical to enter research collaborations and field sites with as little bias as possible so we can understand the system of study and provide the best future for those we intend to assist in our research. Movement arts, such as martial arts and yoga, have taught me how to feel a deep empathy and understanding for others, whether they are the subjects of research or my academic collaborators. They've also helped me understand any interaction with another human as a dialogue from which one can learn.

COLUMN EPILOGUE

For the past five years, I have been a regular columnist for *Interactions*, exploring a variety of design-related issues. Writing for the flagship magazine of the ACM Special Interest Group on Computer-Human Interaction, which has a global reach with diverse audiences, has been a challenging and rewarding responsibility. I have grown as a public scholar and writer because of this privilege. Writers yearn for meaningful conversations with their readers. Conversing with readers who have reached out to me after reading a piece I wrote has been deeply fulfilling and fueled me to keep writing. After five years, I would like to pass the baton onto others. I am deeply grateful for the critical feedback and unwavering support I have received from readers, friends, colleagues, and the entire *Interactions* editorial team, without whom this would not have been possible. Thank you.

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Gopinaath Kannabiran is an HCI researcher, design educator, sexual rights activist, and tantra yoga teacher. His work explores how the design of technology might aid various dimensions of holistic well-being through interdisciplinary approaches.
→ gopinaath@gmail.com

Jodi Forlizzi is the Herbert A. Simon Professor of Computer Science and Human-Computer Interaction in the School of Computer Science at Carnegie Mellon University. She studies the ethical impacts of human interaction with AI systems in front-line service industries, including healthcare and hospitality. She is an ACM SIGCHI Fellow and recently received its Lifetime Research Award.
→ forlizzi@cs.cmu.edu

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Daria Loi,
Imperfecta


Mark Frischmuth,
DemocracyLab

From Impact to Sustainability: A Tech-for-Good Tale

In the past, I have argued that the high-tech sector prioritizes greed in its decision making and suggested that high-tech companies and those benefiting from and leveraging their output must reconsider their motivations, roles, and responsibilities [1]. This line of thinking is not isolated, as many have made similar arguments in diverse contexts from education [2] to innovation [3]. As Ralph Nader says: "When greed and power are exercised by giant multinational corporations that escape the discipline of the nation-state, the potential for evil becomes infinite in nature. *Enough is never enough* [4]."

In this column, I want to reflect on the experiences of the organizations that made a conscious decision to prioritize public good above greed, learn what can be done to empower them, and ensure that they play key roles in shaping and influencing the high-tech sector. To help achieve this, I interviewed Mark Frischmuth, founder and executive director of DemocracyLab, a U.S.-based nonprofit whose mission is to connect tech-for-good projects with skilled volunteers. (Full disclosure: I serve as secretary on DemocracyLab's board of directors.)

Mark, would you share some examples of what DemocracyLab has uncovered by following through on its mission?

DemocracyLab evolved from an ambitious vision of collaborative policymaking to become a platform connecting public interest technology projects with skilled volunteers. This evolution taught us something fundamental: While traditional capitalist models excel at scaling solutions that demonstrate clear revenue potential, they may undervalue important innovations that have high social impact but uncertain profitability. This creates an opportunity for platforms like DemocracyLab to complement market forces, supporting projects that might otherwise go undeveloped.

The platform's impact has surprised us in unexpected ways. While we designed it to support purpose-driven tech projects, we made a striking discovery about who volunteers and why. We anticipated primarily serving *purpose-seeking professionals*—established tech workers looking to contribute to meaningful causes. Instead, most volunteers were *career advancers*—people who use the platform to build skills and improve their careers.

Our data tells a compelling story: Eighty-five percent of volunteers participate to improve their professional skills, 60 percent of current volunteers are unemployed, and only 13 percent are employed in their desired field. Fifty-four percent of former volunteers have secured employment in their desired field, and only 16 percent remain unemployed. Particularly significant is that 50 percent of our participants self-identify as minorities in the tech industry.

This has revealed our unexpected role in addressing systemic barriers in tech education and employment. Many volunteers come to us after investing in boot camps and community college programs, armed with skills but caught in the classic catch-22: They need experience to get a job, but they need a job to gain experience.

Most volunteers were *career advancers*—people who use the platform to build skills and improve their careers.

What you just described expands your organization's original mission.

Understanding our volunteers' motivations and challenges has reshaped our vision of DemocracyLab's role. We see an opportunity to evolve our platform connecting projects with volunteers into an ecosystem that more deliberately develops tech talent. Our understanding of the value we create has inspired us to expand in key directions.

We're designing features for volunteers to build verifiable portfolios of their contributions, including detailed tracking, skill endorsements, and standardized ways to document outcomes. These tools will help volunteers translate their experience into compelling narratives for potential employers.

Rather than leaving volunteers to find their own way, we are also designing guided experiences to help them progress from entry-level tasks to complex responsibilities. We're matching them with mentors who create skill-based recommendations and develop resources tailored to different experience levels.

We also plan to strengthen our relationships with employers and educational institutions. By understanding their needs and assessment criteria, we can prepare our volunteers' career transitions while maintaining our commitment

to public interest technology. These planned expansions maintain our core mission while acknowledging that our platform can play a vital role in democratizing access to tech careers.

I'm interested in the challenges that you face daily. What keeps you up at night?

Our core challenge is developing a sustainable funding model that matches the value we're creating. While DemocracyLab has demonstrated its ability to generate significant social impact by connecting talented volunteers with meaningful projects, we've struggled to convert this into financial sustainability.

We're exploring and actively pursuing a number of promising paths, from an innovative model to expand our project marketplace to include purpose-driven for-profit start-ups to developing partnerships and grant proposals focused on our demonstrated impact on informal STEM learning and workforce development.

In the past, we've discussed notions of shared power, prosperity, and possibility. What pathways are you exploring?

We're exploring an unconventional pathway, which challenges a fundamental assumption of our capitalist society that money is the optimal store of value. While capitalism has driven remarkable technological advancement and improved living standards globally, its mechanisms have also created significant problems. The system's tendency to concentrate wealth and corrupt political systems, and to externalize costs, threatens both social stability and environmental sustainability.

Money's primary advantages are its fungibility and liquidity: It can be quickly converted into anything, anywhere. Economists generally view high monetary velocity as positive for economic activity. However, this very liquidity may exacerbate capitalism's core problems. When capital can move instantly around the globe seeking maximum returns, it is often allocated to ventures that maximize returns by externalizing costs, creating social and environmental harm. This dynamic creates a cycle

Tech-for-good hackathon hosted by Democracylab.

IMAGES BY MIKE WILSON

where concentrated wealth influences government regulations, further enabling cost externalization and wealth concentration.

Equity, particularly in start-ups, offers compelling alternative characteristics as a store of value. It's inherently tied to long-term value creation rather than short-term profit extraction. Its value is rooted in human relationships and shared purpose, and its relative illiquidity encourages longer-term thinking and commitment. It naturally builds community around solving specific problems, and, importantly, it's harder to use for regulatory capture as value is realized through problem-solving rather than financial engineering.

While these characteristics make equity theoretically superior for storing value sustainably, there are practical challenges that have historically limited its use: illiquidity, high risk due to lack of diversification, and complexity of management. That's why we're developing Equity Forge, an evolution of our platform where individual contributors will build diversified portfolios across multiple ventures. A secondary market will provide liquidity options while preserving the benefits of longer-term thinking, and standardized agreements and automated tracking will make equity ownership more transparent and manageable.

This innovative model could help evolve capitalism by creating more democratic and accessible ways to participate in value creation, while maintaining the advantageous characteristics of equity as a store of value. The platform could fundamentally reshape access to the start-up economy by enabling skilled individuals to contribute to promising ventures, regardless of geographic location or career stage. Early-career professionals can build portfolios of equity while gaining experience. Experts established in their careers can diversify their income streams and take calculated risks. People in regions traditionally excluded from start-up opportunities can participate fully in the innovation economy. While this alone won't solve all of capitalism's challenges, it offers a path toward better alignment of economic incentives and social benefit while democratizing access to start-up ownership.

You've reminded me of the role of adaptability and struggles I often observe: designers' and technologists' stubbornness with maintaining control over irrelevant minutiae and their inability to stay focused on key goals. My final question is twofold. First, can you share one piece of advice for those who want to work in tech for good? Second, what can one do to empower organizations like DemocracyLab?

For those pursuing tech-for-good work, I'll share wisdom that proved critical for DemocracyLab: Be clear about your goal but flexible about your journey. Think of a sailor crossing a bay—they know their destination but rarely travel in a straight line. Instead, they tack back and forth across the wind, moving toward their objective even when not pointed directly at it. Or consider a skier descending a mountain: They don't just point straight downhill, but choose a path that responds to the terrain while maintaining their overall direction. This approach requires maintaining unwavering conviction in your purpose while staying humble and open to new learnings. The wind may shift unexpectedly or an unseen obstacle may appear, requiring quick adaptation without losing sight of the ultimate objective.

As for empowering organizations like DemocracyLab, while financial donations and skilled volunteers are always valuable, I want to highlight a critical need that's often overlooked: partnership opportunities. Emerging social-purpose organizations face a challenging credibility gap—established institutions want proven partners, but organizations can't prove themselves without opportunities to demonstrate their capabilities. Decision makers in larger organizations can play a transformative role by taking calculated risks on partnerships with emerging enterprises, creating innovative programs that achieve multiple objectives—from advancing the established organization's goals to giving the emerging enterprise chances to demonstrate value, and generating insights that benefit the entire sector. When these experiences are documented and shared, they contribute to the evolution and credibility of the grassroots tech-for-good movement as a whole.

This combination—maintaining clear purpose while staying adaptable, and established organizations taking strategic chances on emerging partners—can help us build a more robust ecosystem for technology in the public interest.

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Daria Loi combines design strategy with experience research and innovation to enrich people's lives and humanize technology. She is the founder of imperfecta, an art and design gallery focused on women artists and minority creatives, and Oregon City's arts commissioner. She serves on DemocracyLab's board of directors, and is an honorary professor at the University of Newcastle, Australia.
→ studioloi@darialoi.com

Mark Frischmuth is the founder and executive director of DemocracyLab, a nonprofit organization empowering people who use technology for public good by connecting skilled volunteers with tech-for-good projects. Since launching in 2018, DemocracyLab's platform has facilitated more than 10,000 volunteer placements.
→ mark@democracylab.org

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Jie Li, HAISA

Eternal Life? A Conversation with Hiroshi Ishii on TeleAbsence

I want to always remember you.
I want to always be remembered by you.
— Hiroshi Ishii

One day, after bedtime reading my daughter said, "Mama, I want to hear Grandpa talking." I was initially shocked, as my father had passed away a few years ago. I asked why she wanted to hear Grandpa's voice. My daughter replied, "I miss him, and I find his dialect really funny. So, I want to hear him."

That's when I remembered I still have many voice messages from my father saved on WeChat. I played some of them for her. Instead of feeling sad, we actually started laughing about his dialect. Both of us deeply miss him, but this experience turned into a heartwarming and joyful moment.

Later, I shared this story with Hiroshi Ishii, a professor at MIT, a visionary in HCI, and the creator of the concept of TeleAbsence (https://bit.ly/3Yh8gQ5). His response was thoughtful: "This is precisely why absence is sometimes the highest form of presence. It's the spaces in between, the gaps in memory, that let us feel profound."

Ishii continued: "There's a Portuguese word, *saudade*, that perfectly encapsulates this idea. It's often described as the 'desire for the beloved thing made painful by its absence.' It's that bittersweet longing we feel when we deeply miss someone or something. *Saudade* resonates universally—it's not just about loss but about cherishing the emptiness left behind. This is what TeleAbsence seeks to embrace. Rather than erasing absence or filling it completely, it preserves its authenticity and honors the emotional connections absence evokes."

Intrigued, I asked how TeleAbsence embraces these gaps while other technologies seem to focus on filling them completely, like re-creating the deceased.

Hiroshi Ishii and the author discussed TeleAbsence at the MIT Media Lab.

Ishii leaned forward and smiled. "Let me tell you a story of 'presence of absence.' Imagine a shadow cast on the wall—a silhouette left behind by a loved one who is no longer there. That shadow doesn't pretend to be the person, yet it carries their presence. This is the foundation of TeleAbsence [1,2]. It's not about re-creating the deceased through AI, but about preserving the authenticity of their absence."

BEYOND MOURNING: MEMORY TRACES AS A GENTLE APPROACH TO CONNECTION

Ishii and I discussed how modern technology increasingly pushes the boundaries of re-creating human presence. *Eternal You*, a documentary directed by Hans Block and Moritz Riesewieck, portrays AI systems that simulate deceased individuals through lifelike avatars, voice modulation, and even personalized conversations [3]. Similarly, an episode of the dystopian anthology series *Black Mirror*, "Be Right Back," explores the consequences of creating AI-powered replicas of loved ones. These technologies often aim to replace the void left by the deceased, but they also blur the line between memory and reality.

In contrast, Ishii's concept of TeleAbsence focuses on *memory traces*—subtle, poetic reminders of the past. "It's about tangible and intangible elements that carry emotional weight—like your father's voice messages," he explained. "They don't try to replace him; instead, they allow your daughter to connect with him in her own way."

I nodded, reflecting on how powerful

IMAGE BY ALEXANDRA DIENING

it had been to hear my father's voice without any attempt at re-creating his presence. TeleAbsence isn't about building an illusion, then?

"Exactly," Ishii replied. "It's about designing for absence, not presence. It's why I admire projects like the Wind Phone in Japan. It's a disconnected rotary phone that allows people to 'call' loved ones they've lost [4]. It's not about creating a conversation but offering a space for connection and illusory communication."

Ishii further elaborated that memory traces aren't limited to relationships with others; they also extend to our connection with ourselves. "TeleAbsence helps us reconnect with the past versions of who we were—our younger selves," he explained. "A journal entry, a childhood photograph, or a recording of your teenage voice can act as meaningful memory traces. These aren't about indulging in nostalgia but embracing the journey and growth that brought you to the present. By cherishing these fragments of the past, we foster a deeper understanding of our identity and evolution." In this light, TeleAbsence offers more than just a bridge to lost relationships—it becomes a means of self-reflection and connection, intertwining the narratives of who we've loved and who we've been and embracing both the gaps in our relationships and the spaces within ourselves.

DESIGNING FOR ABSENCE: A CONVERSATION ON PRINCIPLES

I asked Ishii how one can design something like TeleAbsence, which seems so abstract yet deeply personal. He outlined five principles.

Presence of absence. Ishii referenced the Hiroshima shadow memorial to illustrate this concept—a haunting yet poetic representation of absence. In Hiroshima, the preserved shadow on the stone serves as a reminder of the person who perished during the atomic bombing [5]. This shadow doesn't attempt to re-create the individual but symbolizes their existence and the weight of their absence.

In TeleAbsence, this principle can be applied through digital or physical representations that evoke a person without attempting full re-creation. Imagine a dining chair that faintly warms when you sit in it, as if echoing the presence of a loved one who once used it. Or a photograph that subtly alters its color or brightness based on the time of day the photo was taken. Such designs provide a tangible connection to the past while respecting the authenticity of loss and memory.

Illusory communication. Illusory communication focuses on creating moments of connection that evoke shared experiences without falsifying interaction. For instance, a device could replay ambient sounds tied to significant memories—a gentle wave crashing on the shore from a family vacation, birds chirping from a quiet morning walk, or the faint hum of a kitchen alive with conversation during holiday gatherings.

Unlike artificial re-creations of voices or conversations, this method keeps the experience subtle and indirect, allowing the mind to fill in the emotional context. A more advanced example might include a wearable device that gently vibrates in sync with the rhythm of a loved one's recorded heartbeat, offering a soothing, physical reminder of their presence. Another example could involve rediscovering letters or messages you wrote to your future self, enhanced with a mixed-reality interface that projects visuals of what you described in those letters. These sensory cues foster reflection and comfort without crossing into artificial simulation.

Materiality of memory. Objects have always served as anchors for memory, and TeleAbsence builds on this human instinct. Ishii spoke of jewelry or books as examples of material memory, but this idea can extend much further. Imagine a digital locket that stores voice recordings, photos, or even handwritten notes, which you can access by simply touching them.

This principle also embraces tactile experiences. A scarf that emits a familiar scent—such as a favorite perfume or the smell of home—can evoke moments shared with someone who's no longer there. Imagine revisiting your younger self by wearing a glove embedded with tactile sensors that replay the sensation of learning something new, like playing an instrument or molding clay during an art class. This emphasizes the idea that memory lives not just in digital archives but also in objects we can touch, hold, and cherish.

Traces of reflection. Reflection often arises from subtle remnants of a person's life, and this principle leverages those fragments to inspire introspection. Think of handwritten notes, doodles on a calendar, or even a grocery list left behind. These small, seemingly mundane items become deeply personal when preserved. For example, a digital photo album might incorporate scanned pages of a loved one's handwritten recipes or notes in margins of books they read.

Another example could be a desk organizer that emits faint projections of a person's handwriting on its surface, allowing you to revisit their thoughts without overwhelming your space. Alternatively, an interactive map could display the places you frequented at different stages of your life, accompanied by notes or reflections on why they mattered to you. By curating these traces in creative ways, TeleAbsence encourages individuals to contemplate and celebrate the idiosyncrasies of both those they've lost and their younger selves.

Remote time. Remote time focuses on re-creating atmospheres or environments associated with someone. Ishii mentioned the acoustics of Notre-Dame before the fire as an example, but this idea can be expanded in many directions. Imagine a VR headset that allows you to "visit" a home you grew up in, complete with accurate lighting, sounds, and textures.

Similarly, an immersive sound system could replicate the ambience of a place shared with a loved one, such as a café where important conversations occurred or a park where you took walks together. The goal isn't to transport you back in time but to let you experience the emotional tone of those environments. It's about reengaging with spaces that carry meaning, creating a bridge between memory and presence.

I asked Ishii why we should focus on the gaps rather than attempting a full re-creation, as some AI systems do.

"Re-creation often becomes a betrayal of memory," he replied solemnly. "It risks erasing the imperfections and authenticity that make memories meaningful. By embracing absence, we allow people to heal and reflect without becoming trapped in an illusion."

Telepresence versus TeleAbsence.

ETHICAL CONSIDERATIONS: HOW FAR IS TOO FAR?

Our discussion inevitably turned to ethics. I asked Ishii if he thought there's a risk that TeleAbsence could be misused, like turning memory traces into commercialized products.

He paused before answering. "Every technology carries risks," he said. "It depends on the intention behind its use. TeleAbsence must never commodify grief or exploit people's vulnerabilities. Instead, it should serve as a tool for healing, designed with care and empathy."

We explored the ethical boundaries of using technology to navigate loss. Ishii highlighted how a lack of regulation or ethical oversight could blur the lines between helpful tools and harmful exploitation. "If left unchecked, these tools could easily cross into manipulative territory. Imagine a future where a company tempts you to pay for 'premium' memories of a loved one or upgrades to make those memories more 'lifelike.' It's not just unethical; it's dehumanizing," he explained.

We also discussed the psychological implications. Studies show that overly immersive interactions with digital re-creations of loved ones can complicate the grieving process [6]. "It's like being stuck in a loop," Ishii said. "Instead of moving forward, people can become fixated on what they've lost."

Ishii emphasized that TeleAbsence must strike a balance—offering solace without fostering dependency. "The goal is to provide a gentle nudge toward reflection and acceptance, not to trap someone in an endless replay of the past," he said. This balance, however, requires thoughtful design and a commitment to ethical principles.

Drawing from both *Eternal You* and *Black Mirror*, I asked Ishii if he thinks society is ready for technologies like TeleAbsence, or if we're still grappling with what it means to mourn in a digital age.

"Society often adopts technology faster than it can understand its impact," Ishii responded. "Look at social media—it has reshaped how we communicate but also isolated us in unexpected ways. TeleAbsence requires careful integration. It's not about replacing grief but complementing it with tools that respect human emotions."

A PERSONAL REFLECTION

After my conversation with Ishii, I reflected on how his ideas intersected with my own experiences. Playing my father's voice for my daughter was a small act of connection—an embodiment of TeleAbsence, even if I didn't realize it at the time. It reminded me that memory isn't just about holding on; it's about finding ways to let go with grace. More importantly, the ethical considerations of TeleAbsence are as crucial as its technical innovations. Without a framework grounded in empathy, respect, and a deep understanding of human emotion, even the most well-intentioned technologies could cause unintended harm.

TeleAbsence offers a way to preserve and honor those we've lost, and to reconnect with the traces of our younger selves, without undermining the authenticity of grief or self-reflection. In a world where AI promises eternal digital life, Hiroshi Ishii's vision is a vital reminder: The essence of memory lies not in perfection but in imperfection—the gaps, the absences, and the human need to fill them with love, meaning, and a deeper understanding of our own evolving identities.

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Jie Li is an HCI researcher with a background in industrial design engineering. Her research focuses on developing evaluation metrics for immersive experiences. She is chief scientific officer at Human-AI Symbiosis Alliance (HAISA) as well as a creative cake designer and the owner of Cake Researcher, a boutique café.
→ jasminejue@gmail.com

IMAGE BY HIROSHI ISHII

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Where Is 'Spatial' in Spatial Design?: How Design in the Age of Spatial Computing Can Leverage Paradigms from Physical Spatial Design

Davide Zhang, Harvard University

Insights

- "Spatial design" is shifting from traditional architectural disciplines toward digital interfaces.
- Current interfaces on spatial computing hardware underutilize the spatial medium.
- There is an opportunity to integrate HCI research with architectural paradigms to create actionable concepts around embodiment, intimacy gradients, and ambient transitions.

The meaning of *spatial design* is changing, and its implications are far-reaching. Traditionally rooted in architecture, landscape, and urban planning, spatial design has been brought into the limelight with the recent popularity of mixed-reality headsets, augmented-reality platforms, and real-time photorealistic rendering. Apple, for example, has dedicated sessions on the principles of spatial design. If we assume that the way we use language helps shape our culture, then this recent shift in the definition of spatial design will have a profound impact on how we understand space, how we design spaces, and what makes a good space, which touches the foundation of disciplines like architecture. For one, our homes as interfaces have very different dynamics from current headset user interfaces.

But the concept of "spatial" in the context of digital design is not new. It evolved from explorations of text-based virtual places like multiuser dungeons, to the initial hype surrounding VR in the late 1980s, to the emergence of 2D graphical virtual environments, to immersive CAVEs, to collaborative virtual environments (CVEs) and "inhabited information spaces" in the 1990s and early 2000s. Some efforts focused on practical applications for communication and collaboration in virtual spaces and most attempted to

IMAGE BY ANDRIJ BORYS ASSOC., USING ART BY MASTER1305 / SHUTTERSTOCK.COM

re-create the physical world in digital space. Others explored how data might be visualized and digitally rendered to afford spatial investigation of abstract data spaces, building on ideas from architectural environments [1,2]. CVEs and graphical virtual landscapes like *Second Life* (launched in 2003), *World of Warcraft* (launched in 2004), and others laid the groundwork for understanding "spatial" not just as a visual representation involving landscapes and avatars but also as a multifaceted concept encompassing a sense of "place." At the same time, designers of flat screen graphical user interfaces have drawn on physical metaphors—skeuomorphism in the early days of app design and more recently Google's Material Design system, which borrowed motifs like shadows, layers, and "physical" depth to guide interface layouts. The expanding use of this term in the context of spatial computing falls into this lineage.

"Spatial" in the context of technology is not a recent pursuit either. A vast portion of the global population already benefits from spatial computing capabilities: positioning, remote sensing, GIS, and spatial data science. They power ride-sharing, GPS, location-based social media, and even social gaming experiences like Pokémon Go [3]. Computing has thus embraced the spatial dimension, yet physical spaces and digital interfaces each come with decades (or centuries) of accumulated design heritage that must be reconciled.

Recent discussions on architecture in the context of HCI highlight the potential common ground these two fields share. As embodied interaction becomes more central to how we live and work, both architecture and HCI stand to benefit from an ethnographic lens that details how people move within, perceive, and interact with spatial context [4]. This shifts the two disciplines away from purely designer-centric intentions and toward user-driven behaviors unfolding in complex digital-physical hybrids.

Yet, as consumer head-worn spatial computing platforms emerge, we see a

disconnect between the interface and the 3D environments offered by this medium. The interfaces follow the classical deterministic HCI pattern, while the 3D environments approach "spatial" literally as stylized 3D assets and skyboxes. Therefore, there is an opportunity to look carefully at decades of work on virtual environments, immersive interfaces, embodied interaction, human-building interaction [5], and ubiquitous computing to synthesize them into actionable frameworks.

A TALE OF TWO INTERFACES

In a playful nod to a certain 19th-century novel, let us begin by juxtaposing the design ethos of *physical* architectural spaces with *digital* HCI [6]. While this comparison necessarily simplifies a vast body of work, contrasting the two can expose different approaches to "space" and interactivity. It is critical to acknowledge that HCI spans a broad array of approaches—tangible computing, ubiquitous or pervasive computing, gestural interfaces, body-tracking systems, and more—that often break free from the notion of a 2D digital screen. Similarly, not all architecture is about quiet, ambient spaces; environments like Vegas casinos are meticulously designed to capture attention and even employ overstimulation techniques like infinite scrolling to form addiction [7]. Consequently, the comparisons that follow refer to *typical* or mainstream tendencies in each field, rather than universal truths.

Conflict of objectives: Task vs. activity. Many digital interfaces—even consumer software in mixed-reality headsets today—are task oriented, guiding users through discrete actions. Users input commands, the system computes results, and outputs appear on a screen. These looped interactions can feel deterministic: The user is "outside" the system, telling the computer what to do [8].

Architectural interfaces, on the other hand, are often *activity oriented*, concerned with supporting human behavior at many scales, from daily routines in a living room to the flux of travelers through an airport terminal. The interfaces change based on the number of humans, proxemics, social relationships, surfaces, materials, lighting, and objects in space. Notably, humans are part of the interface. People coinhabit physical spaces, and their behaviors dynamically reshape these spaces (Figure 1). Christopher Alexander and colleagues capture this fluidity by describing patterns of intimacy gradients, showing how we partition a house into more private or more public zones that promote or constrain different activities [9]. This resonates with parts of the HCI literature on activity theory, which likewise emphasizes broader, evolving activities rather than isolated tasks. Tangible and embodied interaction, as well as ubiquitous computing in HCI, do also consider how environments and physicality shape the usage of space.

Conflict of immersion: Objectivity vs. subjectivity. We often approach conventional digital interfaces as external objects—screens and devices that we can manipulate at a distance, forming clear mental models of "the phone," "the laptop," or "the headset." Even gestural- or voice-based systems remain, in most cases, physically separate from our bodies.

Architecture, however, tends to envelop us. Spaces are perceived through ever-changing, subject-centered viewpoints, and we can rarely perceive the entire building simultaneously. We are, in effect, "inside" the interface. Yet immersive environments have existed in HCI for decades as VR labs, CAVEs, and collaborative virtual environments [1]. So "being inside the interface" is not new. The point is that consumer spatial computing devices are making these immersive experiences more commonplace and integrated into everyday life, but they are often literal interpretations of spaces as 3D assets, rather than the expanded views developed over the decades. As Muriel Cooper's pioneering "Information Landscapes" first demonstrated, data itself as a 3D navigable environment opens new ways of perceiving and interacting with information [10].

Conflict of mediation: Layers of input. Human-computer interaction is mediated by input devices such as a mouse, joystick, keyboard, touchscreen, and sensors enabling gesture and body tracking. Our intent is translated to the usage of an input device. The input device then sends digital commands that are processed by a computer before an output is returned. Sometimes, the feedback loop is so quick that it creates the illusion of unmediated interaction. For example, real-time camera feeds and natural language interfaces remove the need to operate an input device, but the input device is still present—only the feedback chain is compressed.

In physical environments, the body itself can be an interface—simply walking through a room changes the relationship of occupant to environment. In spatial computing, we see attempts to reduce friction in similar ways: full-body tracking, eye tracking, and environment-aware sensors strive to create experiences that feel "unmediated."

Conflict of attention: Background vs. foreground. Digital interfaces in mainstream consumer markets are often intentionally *attention-seeking*, shaped by business models that rely on capturing as many user interactions (and as much screen time) as possible [11]. This maximalist approach is in contrast with architectural spaces, which can either be quietly ambient (a calming retreat) or intensely engaging (a concert hall). While it is true that some physical spaces, such as Times Square or a flashy retail showroom, are designed explicitly to catch the eye, many others aim for a more subtle, atmospheric role. Human-computer interfaces capture the entirety of one's foreground, whereas the architectural interface recedes to the peripheral vision or background.

If we let the attention-seeking paradigm take over spatial computing, we might arrive at a future where spatially anchored virtual ads and content take over our physical space to a point of overstimulation and desensitization. We have an opportunity to design more ambient, less distracting interfaces that align with how architectural spaces quietly support activities in the background.

Conflict of affordance: Physical vs. minimal. Modern digital interfaces favor minimalist designs with flat icons and minimal shadows, emphasizing simplicity and abstraction. Before the current minimal and flat trend, interfaces did go through a stage of skeuomorphism, where they mimicked physical referents stylistically to create affordance. However, as James Gibson points out in his theory of affordances, affordances are embedded not only in the physicality of the object itself but also in the environment in which it is

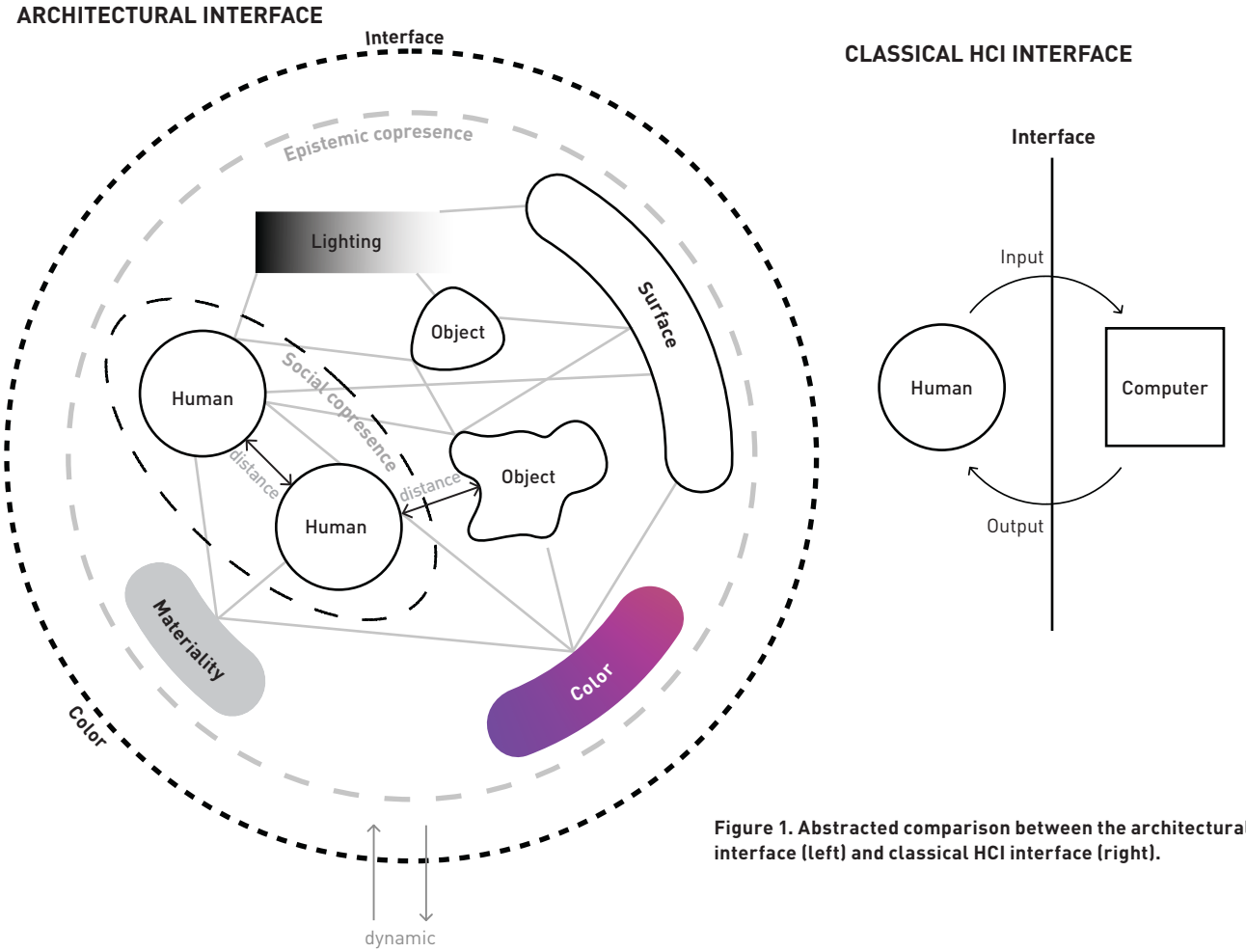

Figure 1. Abstracted comparison between the architectural interface (left) and classical HCI interface (right).

situated—it is an invariant property of an ecological object [12]. Digital icons only *suggested* physical referents, but they lacked the deeper contextual cues that come from an object existing in a place, with surrounding materials, lighting, and constraints.

However, HCI has also explored embodied, tangible, and ubiquitous computing for many years—where physical objects become part of the interface. The question is: How do we bring those real-world affordances back into "spatial interfaces" at scale?

BRINGING 'SPACE' BACK TO 'SPATIAL DESIGN'

Here are some ways we can leverage paradigms from physical spaces to design for spatial computing interfaces.

Concept 1: Situated embodiment. The key idea is to integrate the sense of colocated, embodied interaction with people, objects, and environmental conditions.

In a physical space, a group that is interacting is always colocated within the same space. Through interaction with other humans, we dynamically shape the architectural interface, which in turn shapes the way we engage with it. How can we bring this situated, embodied experience from architecture to human-computer interfaces?

The first aspect is embodiment: interacting with other humans. In the real world, we interact with humans as they are. In the digital realm, collaborative virtual environments explored this decades ago. But we now have consumer headsets that let us place embodied representations of remote humans, or avatars, in the same space. This was the original vision of Microsoft Mesh, where real-time 3D avatars collaborate in the same physical space. Today, the closest implementation to this vision is Apple's Spatial Personas with SharePlay on Vision Pro, where realistic 3D avatars are colocated in the same physical space to engage in the same activity.

But there is a limit to how many embodied digital avatars we can fit in a particular space. This is due partly to the physical dimensions but also to the *intimacy gradient* of spaces, which refers to the relationship between private and public space in a house [5]. A bedroom is usually perceived to be a more private and intimate space than the living room, and we are comfortable with fewer people present. Digital space has an intimacy gradient as well. From one-to-one video calls to mass multiplayer games, we constantly traverse the private-public spectrum in the digital realm. How can we experience colocated embodied experiences across the physical and the virtual private-public spectrums?

The diagram in Figure 2 explores embodiment possibilities across the physical and virtual intimacy gradients. For example, when we are in a digitally private and physically public scenario, such as a work conversation in an airport, spatial computing can create a private virtual boundary for human-scale 3D avatars. In a digitally public and physically private scenario, embodiment can be abstracted to 3D geometries or heatmaps to leverage the qualities of physical space but still be represented in a way that is comfortable to the privateness of space.

The second part of this concept is

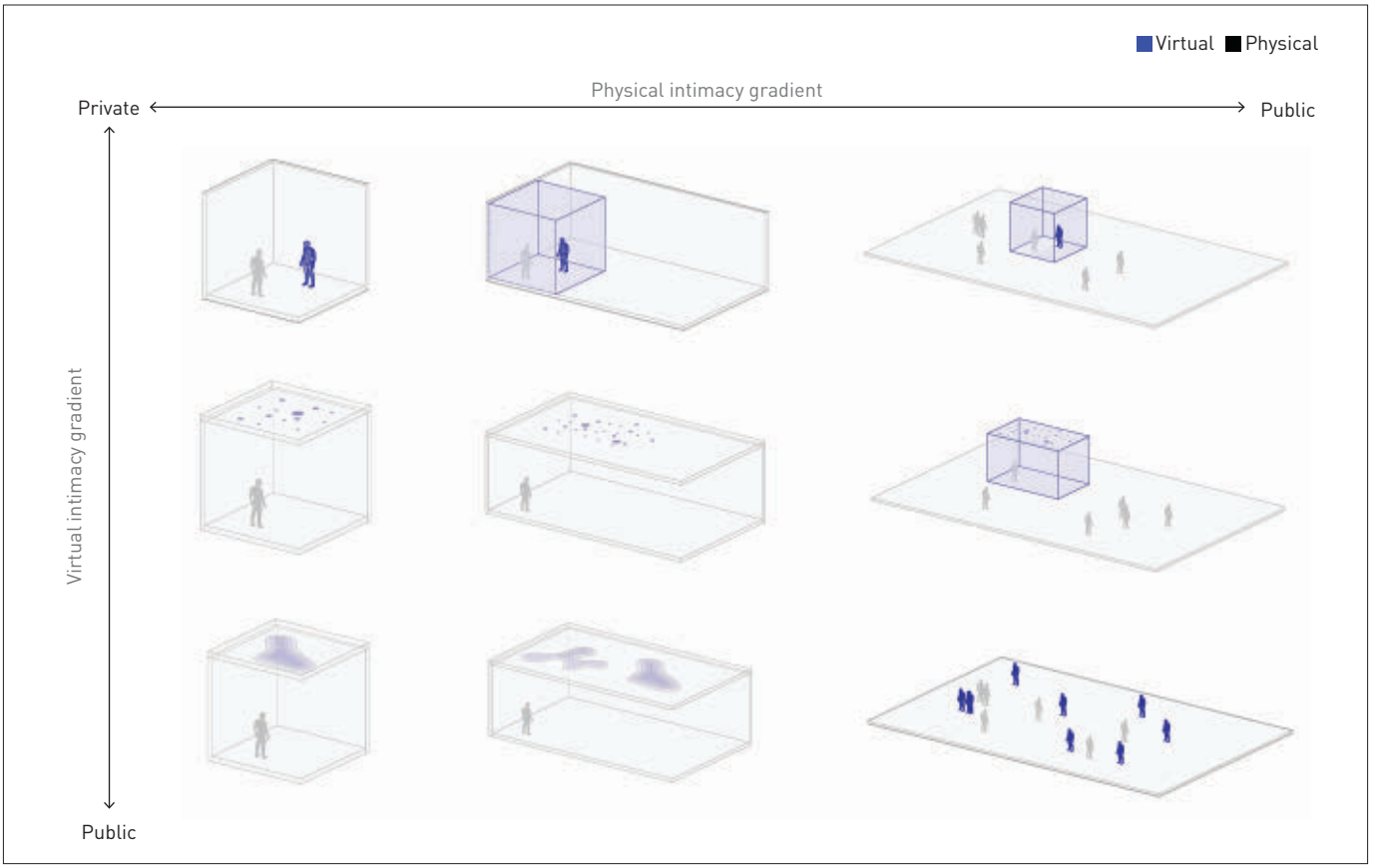

Figure 2. Embodiment diagram based on physical and digital intimacy gradients.

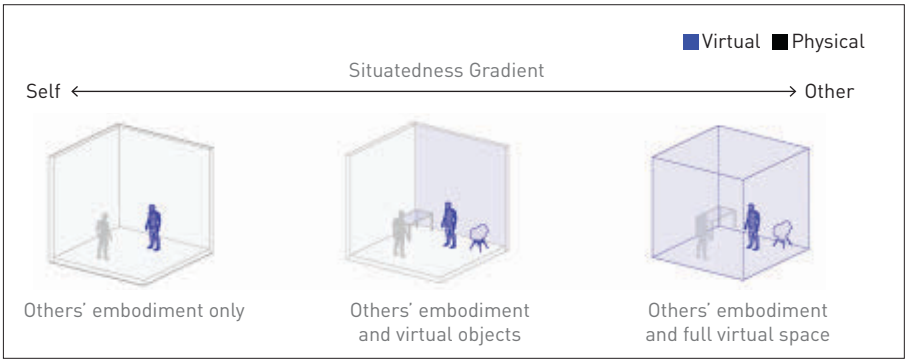

Figure 3. Situatedness diagram.

situatedness. How can spatial interfaces colocate us and other people, objects, and spatial conditions? From the perspective of the user, we can create a situatedness gradient showing how much of another space is situated within our space (Figure 3). For example, a teleported avatar in our space is different from a teleported avatar with half of their space merging with ours. As we move through different levels of digital integration, from simple avatars to fully immersive virtual spaces, we begin to see how these digital experiences can reshape our interaction with both physical and virtual environments. Just as buildings can be seen as a changing medium of data rather than a static object, situatedness is experienced in motion across time. This notion of a large amount of data extending over longtime frames falls into the line of inquiry of HCI [4].

Due to recent leaps in computer graphics, we can prototype the spectrum of situatedness with space-time Gaussian splats today [13]. Using advanced real-time engines and application programming interfaces, we can now situate anything from small objects to partial spaces and even full environments across time, creating a more integrated and immersive spatial experience.

Concept 2: Dynamic ensemble. The key idea is to give interfaces an *elastic* quality, such that adding or removing elements changes functionality in flexible, context-aware ways.

Physical rooms can accommodate a surprising amount of rearrangement (e.g., removing a coffee table, relocating chairs) before they lose their essential identity. If you swap out a couch for a large dining table, the function of the room might pivot from "living room" to "dining area." In other words, architectural interfaces can change their functionality dynamically. Can human-computer interfaces leverage the built-in elasticity in architectural interfaces?

Responsive UI today partially achieves this by shifting and rearranging UI components based on the dimensions of the canvas. By following the hierarchical zones dictated by the UI's information architecture, the interface can maintain its functionality across different canvas sizes, such as laptop screen, tablet, and smartphone, but they don't have the ability to change functionality on the fly.

Three-dimensional interfaces can not only extend this elasticity but also embrace dynamic functionalities. As UI elements are positioned near certain objects, new functions might become available, such as a note-taking widget

appearing near a desk, or a cooking assistant appearing near a stove (Figure 4). Beyond a certain point—like switching from a "living room layout" to a "kitchen layout"—the interface might reorganize or highlight different features, similar to how a room's identity shifts with certain furniture.

This aligns with the notion in spatial computing to move beyond static overlays or discrete apps, and instead use flexible, location-aware systems that adapt to user context. Like the user-facing front, the backend data layer can fluidly join or leave an integrated 3D interface [3].

Concept 3: Ambient continuity. The key idea is to create a flexible interface that morphs from peripersonal to extrapersonal, foreground to background, attention-seeking to ambient, object-centered to subject-centered, flat to immersive, point-of-view to god's eye.

Architectural spaces are immersive, subjective, and ambient. Imagine an interface that is unbounded by the attention-seeking, 2D rectangle we always hold in our hands. It seamlessly bridges from being within arm's reach to being in the environment, being perceived as an object to being perceived from a POV, and being *outside* of an interface to being *inside* of it. It foregrounds itself when needed and blends into the background when not.

How can spatial interfaces bridge this duality?

One way is to literally break apart the 2D interface we are familiar with and make it architectural (Figure 5). For example, we could expand the interface along a third axis according to its information hierarchy. Actionable UIs, such as buttons and calls to action, are closer (less z-depth). They fade away as the UI becomes more ambient. And content, like text and images, is expanded farther (more z-depth).

The content that is far away blends with the surfaces and architectural conditions, such as walls, windows, ceiling, edge, corner, and floor (Figure 6). The wall is naturally a display canvas for content, as is the window, which favors the image more. The ceiling and floor are often overlooked and are great for subtle background activities or notifications. The edge and the corner are often leveraged by architects but underutilized by the rest of us. The meeting of multiple planes creates a visual tension that lends

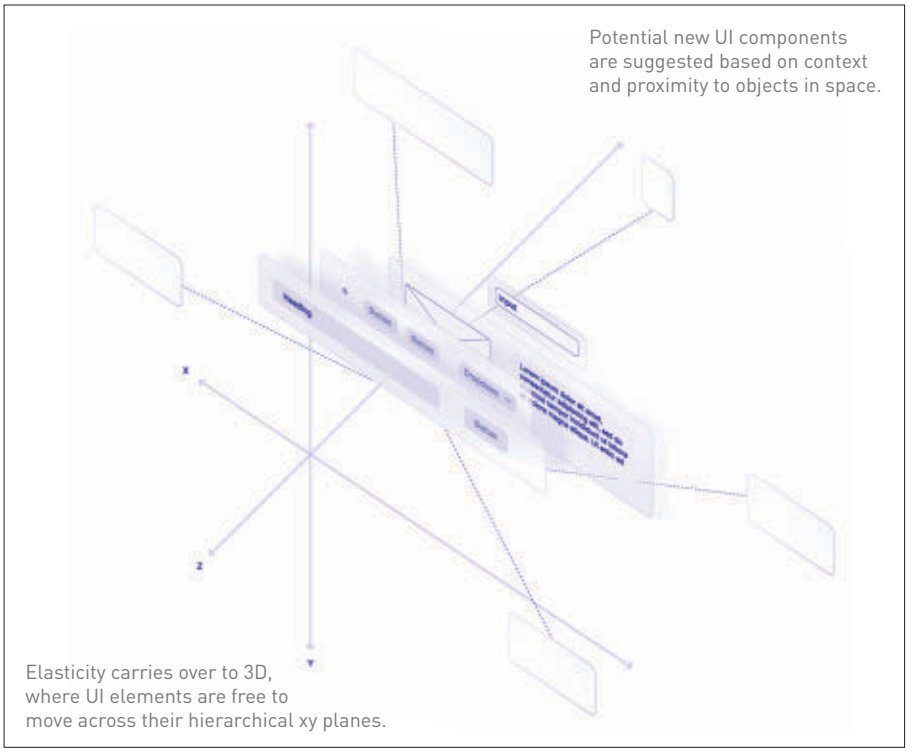

Figure 4. Diagram for expanding UI from 2D to 3D while preserving hierarchical relationships and introducing dynamic functionalities.

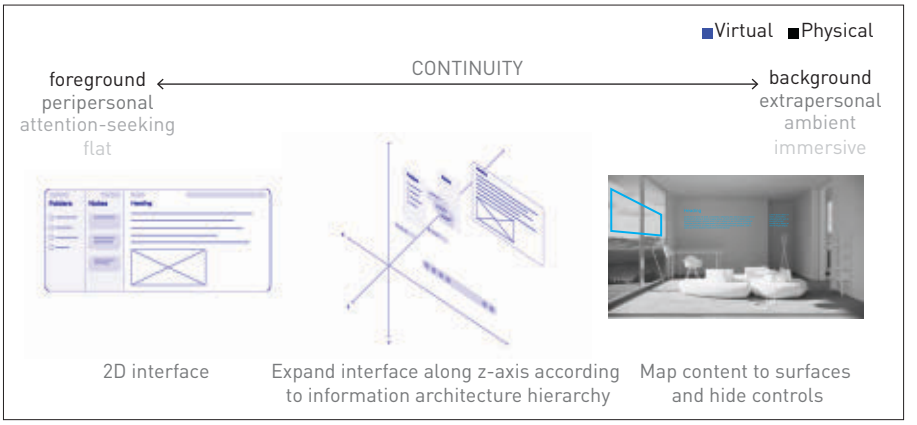

Figure 5. Continuity diagram: mapping UI to architectural conditions.

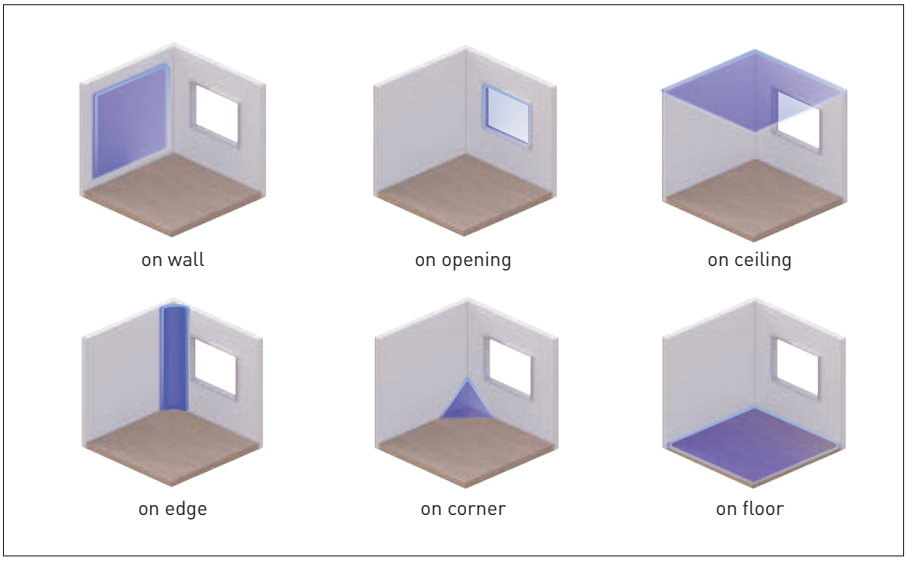

Figure 6. Options for mapping UI to architectural conditions.

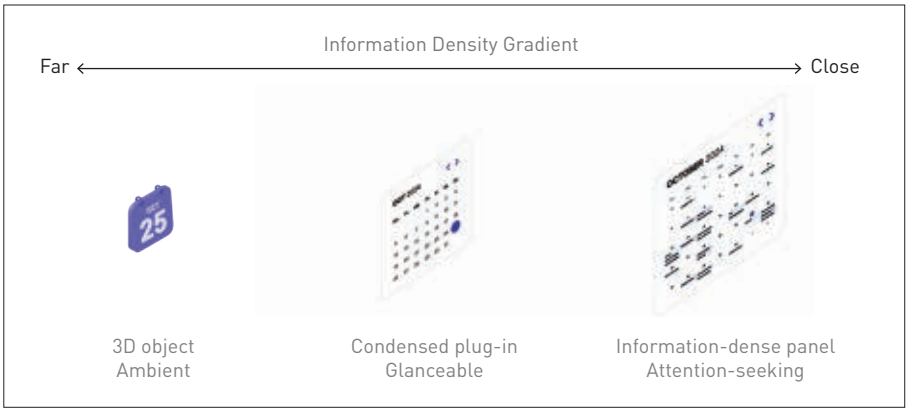

Figure 7. Information density diagram—variation in info density with distance.

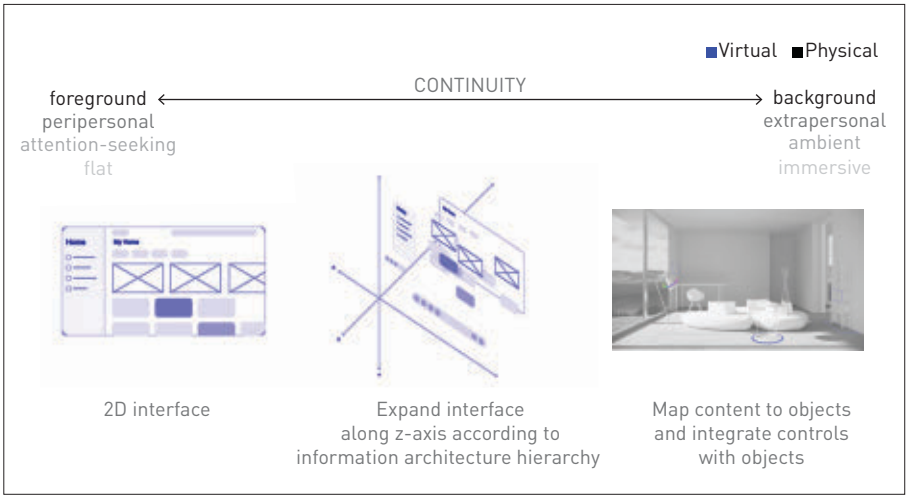

Figure 8. Continuity diagram—mapping UI to architectural objects.

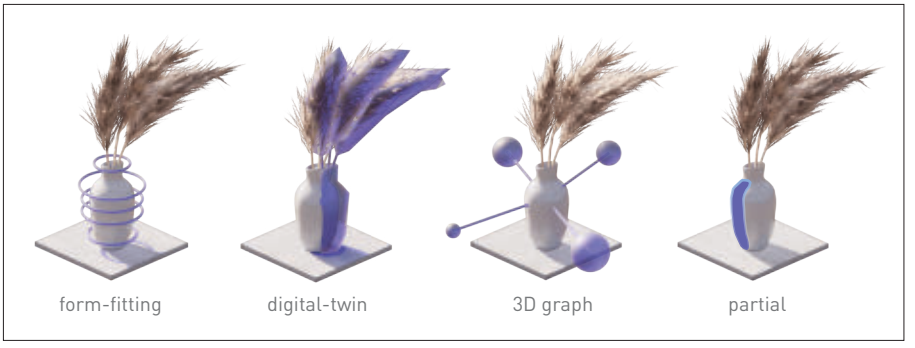

Figure 9. Options for mapping UI to objects.

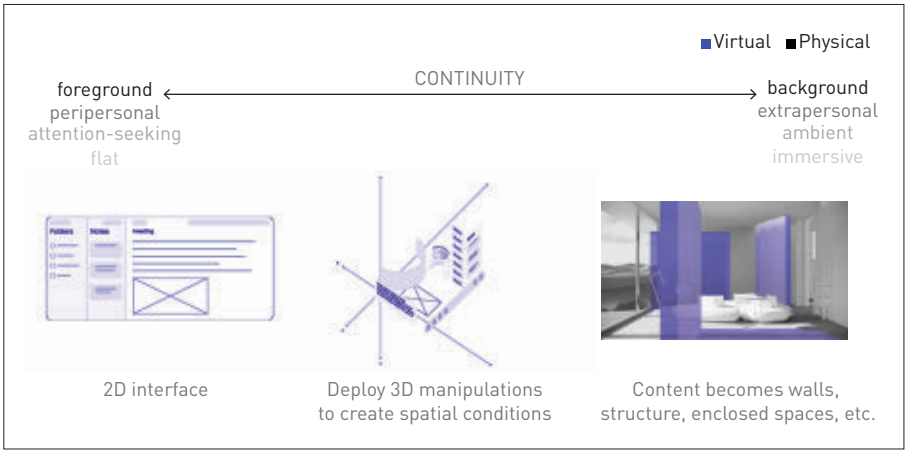

Figure 10. Continuity diagram: UIs becoming architectural conditions themselves.

itself to decor or widgets on display. Architectural conditions are sometimes associated with latent meaning that affords the interaction modality. A door invites and activates upon proximity; the floor traces our movement and reflects it back to us; and walls have been drawn on and carved into. We don't need to look far to envision ways of interacting with an interface that adheres to ambient continuity.

Central to this concept of ambient continuity is three-dimensionalizing a 2D interface. It's as simple as adding z-depth to UI elements, but how do we decide the amount of z-depth for each component? In a two-axis world of 2D UIs up until now, design systems have all followed an implied order from up to down and left to right. This order itself is a function of how we perceive time and structure our language, which is a fascinating topic beyond the scope of this article. For example, in both Apple's Human Interface Guidelines and Google's Material Design system, headers are at the top of the page, and going up one level is implied at the left of the interface.

The introduction of a third axis brings an immense new opportunity for a new hierarchical order, one that is based on *space*, or more specifically, the concept of ambient continuity (Figure 7). As interfaces become closer to us, the information density increases, resulting in the attention-seeking layouts we are familiar with today. As they go farther away, the information density decreases and they morph into condensed widgets, ultimately blending into the environment as architectural elements, 3D objects, or animated phenomena.

Another way of achieving ambient continuity is to make the interface form-fitting and map UI to architectural objects (Figure 8). This strategy suits not only the interfaces of smart appliances but also real-world counterparts of digital tools, like a clock, a calendar, and other gadgets that become features in our smartphone.

Figure 9 shows several ways, depending on the nature of the interface, to map it to objects. Form-fitting is self-explanatory and establishes a strong connection between object and information. A digital twin allows us to track and customize physical objects digitally. A 3D graph treats the object as a node and connects spatially to other objects or UI components. In a way, this

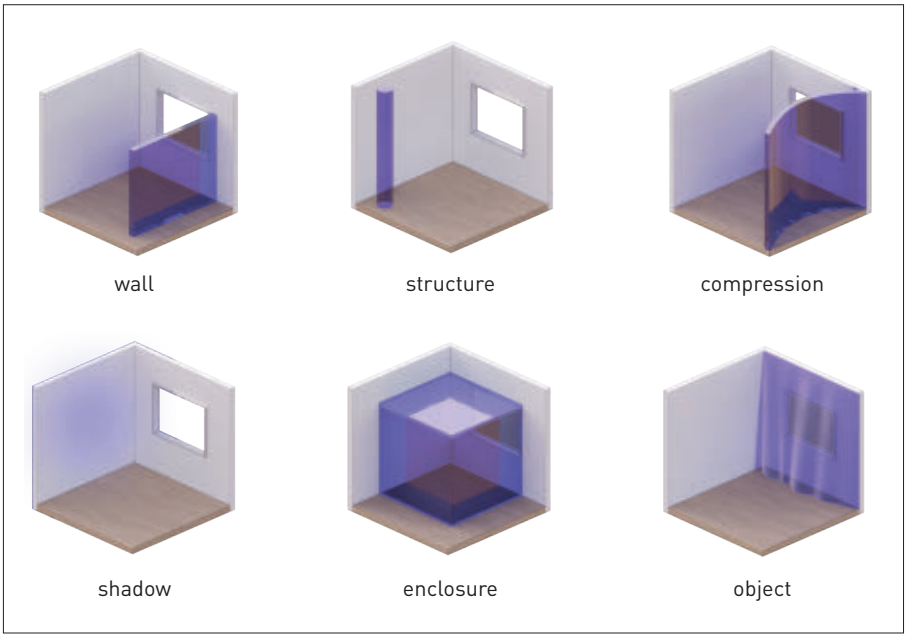

Figure 11. Options for UIs becoming architectural conditions.

surfaces the latent connections between objects in our space and equips them with a digital layer. Lastly, the interface can also be partially occluding or embedded into the object to highlight parts of the object itself.

The third way of achieving ambient continuity is for interfaces to create architectural conditions on their own, continuing the lineage of Muriel Cooper's information as landscapes (Figure 10). Just as data intrinsically exhibit qualities of a field, user interface patterns possess similar qualities to those of physical space.

Concepts like partition, column, hierarchy, compression, shadow, enclosure, and object can be applied to both 2D UI and interior spaces (Figure 11). Instead of adding z-depth to UI components, we can apply 3D transformations to create spatial conditions. Vertical navigation bars can wrap around to create a column; elements on top of one another can project real shadows; callouts can be curved to compress and thereby emphasize the space; subsections can be enclosed three-dimensionally; illustrations and animations can morph into physical objects that embody the same quality, like a rippling curtain.

CONCLUSION: TOWARD A 'SPATIAL INTERFACE DESIGN'

"Spatial design" has historically referred to the expertise of architects, urban planners, and interior designers, but it is increasingly being adopted by the spatial computing industry for interface design. Behind this shift in language is a rich lineage of spatial approaches in digital design and computing, spanning everything from inhabited information spaces to location-based social networks. Recent explorations hint at a potential convergence of architecture and HCI, viewed through an ethnographic lens. What if, instead, we articulate a more specific notion of *spatial interface design*—one that explicitly merges design research on immersive HCI, collaborative virtual environments, human-building interaction, and architecture's long heritage of shaping human activities and experiences?

By drawing insights from decades of research, recognizing that architecture and HCI are not monoliths, and leveraging architectural paradigms, we shed light on actionable concepts around presence, embodiment, intimacy gradients, elasticity of function, ambient transitions, and activity-centered design. They invite us to see the entire environment as an interface and embrace the human capacity to inhabit spaces physically *and* digitally.

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Davide Zhang is a technical product designer at Microsoft, currently working on Windows Volumetric Apps. Previously, he prototyped haptic wearables at MIT Media Lab and studied computer science, architecture, and design technology at Harvard University and Columbia University. He is passionate about mixed-reality experiences and interactions.
→ davidezhangdesign@gmail.com

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Do No Harm:

Designing Interventions for Deepfake-Fueled Conspiracy Theories

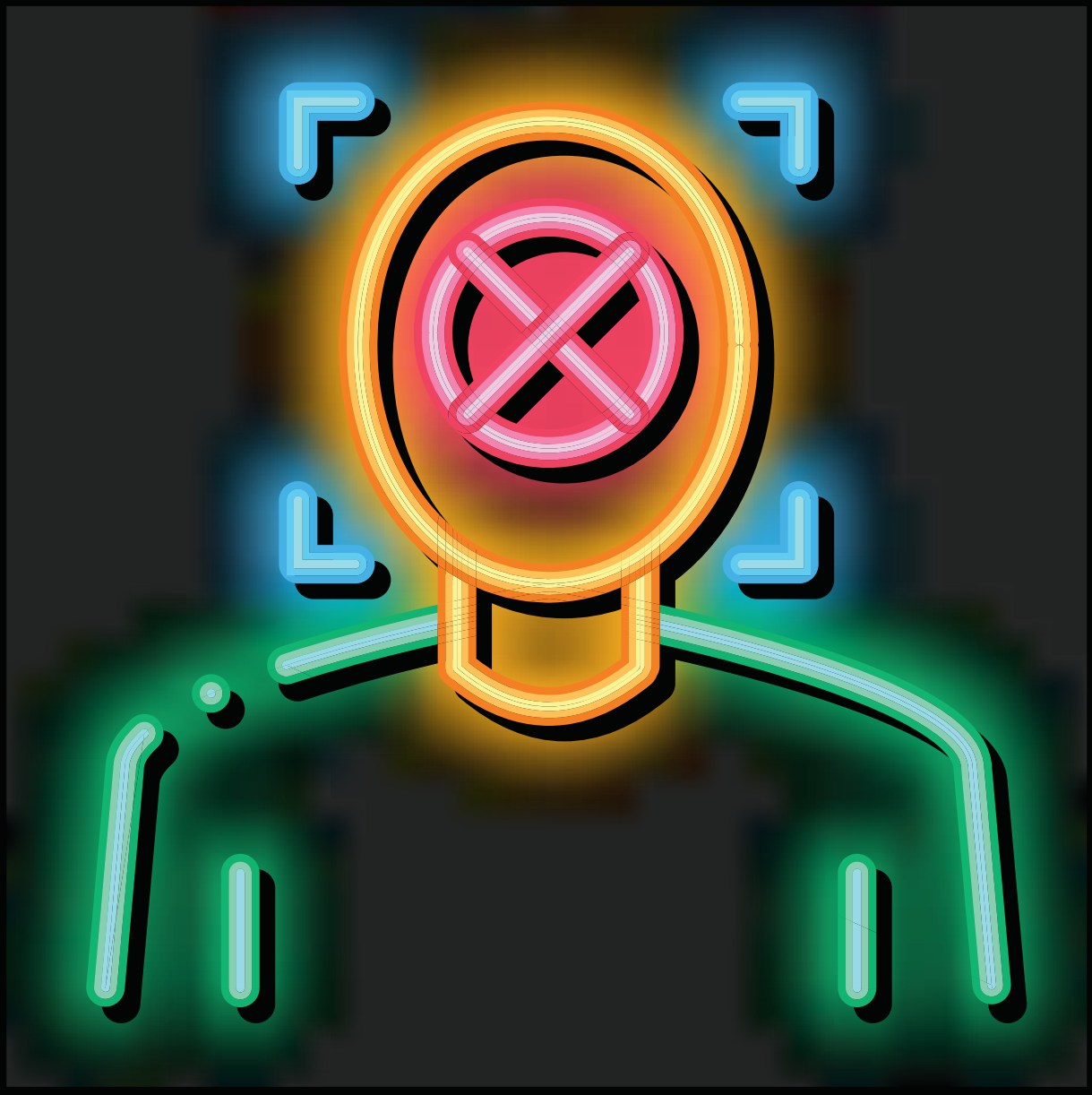
John Twomey, Cian O'Mahony, Conor Linehan, and **Gillian Murphy,**
University College Cork and Lero, the Research Ireland Centre for Software

Insights

- Novel media-editing tools, such as deepfake technology, are used to create misinformation and disinformation.
- Designing interventions to challenge deepfake conspiracy theories is crucial.
- Well-intentioned deepfake interventions may counterintuitively cause more harm than good by undermining trust in media.

Conspiracy theories are a set of explanations about the world where significant (and often negative) events are believed to be orchestrated by clandestine groups. Frequently emerging during periods of tragedy or ambiguity (e.g., the Covid-19 pandemic, the September 11 attacks) conspiracy theories are typically an attempt by individuals to find closure and meaning in these circumstances. This belief system operates as a framework through which individuals seek clear answers, providing them with a structured understanding of how the world functions. The content of conspiracy theories is influenced by advancements in media editing and production technologies. As far back as the first moon landing, conspiracies referenced Hollywood's visual effects advancements of the time (e.g., Stanley Kubrick's *2001: A Space Odyssey*).

More recently, conspiracy theories claimed that the Sandy Hook school shooting and the murder of George Floyd were carried out by paid actors and faked by using video production tools. There are also popular conspiracy theories that similarly argue professional body doubles and actors have replaced individuals such as Melania Trump and Avril Lavigne. The advent of deepfake videos gives agitators engaged in these types of conspiracies a new weapon to



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undermine people's ability to trust the veracity of video evidence.

Deepfake videos use deep learning to insert someone's image into a video, often saying things they never said. Deepfakes have the potential to be used in disinformation and misinformation campaigns—for example, spreading a deepfake video defaming a politician the night before an election—as well as more broadly to undermine trust in video evidence (e.g., voters disregarding real and credible evidence of a politician engaged in something nefarious and rejecting the video as a deepfake). Novel media-editing technologies, such as deepfake technology, may provide a valuable tool for conspiracy theorists who seek to discredit factual video evidence. The first notable incident of a deepfake conspiracy involved former Gabonese President Ali Bongo. Many people believed that he died after being hospitalized for a stroke in 2018. While official sources released videos that proved the president was alive and well, conspiracy theorists discredited the videos as being deepfaked or using body doubles. The conspiracies created political instability in the country and lead to a failed coup d'état.

Our past research on the use of deepfakes during the Russian invasion of Ukraine highlighted the harms of deepfake conspiracies [1]. Specifically, we found that some users questioned the validity of all war-related media after being exposed to deepfake and CGI educational content about the war. A wide range of deepfake-related conspiracies emerged during the conflict, with many claiming that world leaders were using deepfakes for various reasons. One such conspiracy theory, which was picked up by tabloids, said Russia's president, Vladimir Putin, was desperately ill and using deepfakes to hide his condition. The supposed evidence for this theory—a video of Putin's hand passing through a microphone at a meeting—was debunked as an artifact of Twitter compression.

Such theories will only become more

popular as deepfake technology becomes more prevalent. In the time since we carried out that research, a video of former U.S. President Joe Biden has also been falsely labeled a deepfake. The supposed evidence for the accusation was that the Biden "deepfake" did not blink (17 seconds between blinking is not impossible and there was also a cut within the video). The conventional wisdom around identifying deepfakes is undermining real information, and this needs to be considered in deepfake research.

CONSPIRACY INTERVENTIONS: AVOIDING A BACKFIRE

Our research team reviewed 25 studies that analyzed the efficacy of conspiracy theory interventions and found the majority were not successful [2]. Some interventions, however, did produce medium to large effects in reducing belief in conspiracy theories. These interventions mainly focused on preventative measures, such as priming participants to engage conspiracies with an analytical mindset or debunking conspiracy theories preemptively, before participants were exposed to them.

One intervention was effective in reducing a wide range of counterfactual beliefs by enrolling participants in a pseudoscience university class. Students were encouraged to both make arguments for various counterfactual beliefs and to actively evaluate those beliefs with the skills they learned in class. This group was compared to a standard research methods class. At the end of three months students in the pseudoscience class believed in significantly fewer conspiracy theories than those in the research methods class [3].

These findings highlight the importance of teaching explicit skills to analyze misinformation that people can put into practice, in contrast with peripheral knowledge that is passively consumed. Furthermore, previous interventions addressing misinformation have highlighted the importance of active interventions, as they motivate participants to be more inclined in the future to apply what they have learned. Importantly, the review also highlighted the many ways in which conspiracy interventions may actually increase belief in conspiracies, as several of the interventions identified in the review resulted in a backfire effect. Evidence of this effect has also been found in a handful of previous misinformation interventions, though some researchers argue the results are inconclusive.

DEEPFAKE MISINFORMATION INTERVENTIONS

Current attempts to design interventions for deepfake misinformation have focused primarily on improving the ability of individuals to identify deepfake videos. As the quality of deepfake videos improves and other novel AI-generated media becomes more prevalent, however, the type of knowledge needed to recognize them will also change. There is already a so-called arms race between the technology that identifies deepfakes and one that generates them. As illustrated by the Biden and Putin examples, a layperson's understanding of deepfake features (e.g., the absence of eye blinks) can be incorrect or outdated, and it can be used to discredit real media.

The erosion of trust in media is fundamental in predicting deepfake harms. Indeed, "the liar's dividend" theorizes that, as fake videos become more prevalent, individuals will use public skepticism to cast doubt on real media. The awareness of deepfakes alone may be enough for people to lose trust in real media and for the political process to become destabilized. Thus, counterintuitively, education around the harms of deepfakes may actually increase belief in misinformation.

It is important that interventions for deepfake conspiracies reduce people's susceptibility to fabricated media without making them overtly skeptical of real media.

Similarly, when people who are highly concerned about deepfakes accidentally share a video that includes them, they tend to become highly skeptical of all news media. The public's decreasing trust in the validity of real media may be as harmful as people believing deepfake media.

Research has shown that exposure to false labeling of real videos as deepfakes may undermine authentic political speech [4]. A similar phenomenon was observed when researchers tested fake news interventions. Such interventions attempted to reduce participants' susceptibility to misinformation, but they resulted in participants rejecting both factual information and misinformation. As a result, we argue it is important that interventions for deepfake conspiracies reduce people's susceptibility to fabricated media without making them overtly skeptical of real media.

Many deepfake interventions have focused on teaching people how to identify fake videos and not how the interventions may damage the veracity of real videos. Rashid Tahir and colleagues conducted research [5], showing one real video and three deepfakes to two groups of participants. One group was given a specialized training that walked them through specific examples of deepfakes and highlighted the features used by detection algorithms. Tahir and his colleagues found that, while the training increased the treatment group's ability to detect deepfakes significantly, it also reduced their ability to correctly identify real media by 9 percent.

Further evidence comes from research carried out by the MIT Media Lab, which found that, by the end of a deepfake detection test, participants were both 18 percent better at detecting deepfakes and 18 percent worse at identifying real videos [6]. In a test where half the media is fake and the other half is real, an increase in both identifying and misidentifying deepfakes does not affect overall measures of accuracy. In real-life information environments, however, where deepfake videos are not as prevalent as real media, increasing the amount of people who do not trust real media is disproportionately dangerous. Importantly, both pieces of research measured the false positives (people accusing real media of being fake),

which is a good practice in misinformation research and needs to be more common when evaluating the efficacy of deepfake interventions.

WHAT SHOULD A DEEPFAKE CONSPIRACY INTERVENTION LOOK LIKE?

We have already shown how the current interventions for deepfakes and conspiracies have significant limitations. The harms of deepfakes increase with the awareness of technology. The use of strategies such as inoculations and priming to deal with conspiracy theories may, counterintuitively, increase skepticism of real videos. To avoid this, we recommend that interventions for deepfake conspiracies be designed with the following principles in mind.

Consider the disproportionate impact of false positives and/or negatives. Interventions should consider the social impact of false positives and negatives. If a deepfake intervention causes some individuals to be overly skeptical of real media, then it is a poor intervention (assuming there is more real information in the media ecosystem than fake).

Focus on decision making over identification. Interventions should avoid treating deepfake susceptibility dichotomously, overly focusing on getting people to make snap judgments about whether something is a deepfake. The goal of deepfake interventions should not be to turn people into machines that can easily identify media as deepfake or real. Rather, interventions should encourage healthy suspicion of media and focus on how people treat suspected mis/disinformation.

Consider the effects of deepfake prevalence. Future interventions need to question the extent to which they carry information about prevalence. It is important to consider whether it is wise to train people on deepfake interventions using an equal number of deepfake and non-deepfake videos. This does not reflect the current media environment.

Design for implementation. Interventions should be designed with practical, real-world implementation in mind. Previous research has highlighted that many effective conspiracy interventions could not be realistically applied to settings outside a laboratory environment.

Measure effects over time. Interventions should assess whether the effects they induce persist over time. It is important to establish whether both positive and negative effects will last longer than a few minutes—something that is lacking in current deepfake and conspiracy theory research.

Encourage motivation to apply learned skills. Interventions should aim to motivate participants to sustain the use of the skills and tools acquired during the intervention. As such, future experiments should measure this motivation as an indicator of the participants' likelihood to persist in applying these skills and tools to potential deepfake content.

CONCLUSION

Deepfakes pose a threat to trust in the veracity of video information. Deepfake conspiracies provide a unique use case of the AI technology in misinformation, and we believe they require unique solutions. Existing deepfake interventions have counterintuitively increased the likelihood of participants misidentifying real media as deepfake. It is imperative to not only teach how to identify deepfakes but also how *not* to misidentify real videos as fake. As deepfake technology develops and becomes more accessible and prevalent, and many well-intended interventions and educational initiatives are launched, researchers must remember our guiding principle: Do no harm.

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John Twomey is an HCI researcher in the School of Applied Psychology at University College Cork. His current work, which is funded by Lero, the Research Ireland Centre for Software, focuses on the use of deepfakes and their impact on individuals and society.
→ john.twomey@ucc.ie

Cian O'Mahony is a post-doctoral researcher in the School of Applied Psychology at University College Cork, where he is studying the psychology of conspiracy beliefs and how games can be used to teach critical thinking skills. This work is funded by Lero, the Research Ireland Centre for Software.
→ cianomahony@ucc.ie

Conor Linehan is a senior lecturer in the School of Applied Psychology at University College Cork, where he is a member of the People and Technology research group. His research expertise lies in human-computer interaction, focusing on the design and evaluation of technology that supports education and health behaviors. He has a strong interest in how games and gamification can be useful in these contexts.
→ conor.linehan@ucc.ie

Gillian Murphy is a senior lecturer in the School of Applied Psychology at University College Cork. Her research explores cognitive processes in applied settings, in particular misinformation, memory distortion, and attention failures.
→ gillian.murphy@ucc.ie

Ethical Challenges in Video Game Research:

Experiences and Reflections

Arianna Boldi, University of Turin
Selina Cho, University of Oxford
Yubo Kou, Pennsylvania State University
Amon Rapp, University of Turin
Max V. Birk, Eindhoven University of Technology

Insights

- Gaining access and trust in closed gaming communities requires insider knowledge and authentic engagement.
- Researchers in video game studies face unique challenges, including harassment, skepticism, and personal attacks.
- Addressing these challenges requires institutional support, ethical guidelines, and collaboration with the gaming industry and digital platforms.

Imagine stepping into the digital battlegrounds of *League of Legends* to study teamwork. As you join a match, declare your research interest, and ask your teammates about their team behavior, they mock the legitimacy of your research, forcing you to mute them just to finish the game. Or picture this: You are embarking on your first Ph.D. study on gaming technologies. During participant recruitment, an anonymous male individual harshly criticizes your survey, escalating into personal accusations of attempting to steal data. If that were not enough, while researching *Counter-Strike: Global Offensive* cheating communities, one of your recruitment accounts meant to present your research objectives transparently is compromised and filled with explicit pornographic content.

These are real stories shared by researchers working in the field of video game research who have faced hostility and skepticism from the gaming community. The challenges not only risk disrupting their research initiatives but also pose threats at a personal level. How many similar stories remain untold? What effects do these experiences have on researchers, as well as on the quality and the nature

of the research produced in the gaming domain? And who are the most vulnerable researchers?

THE ETHICAL LANDSCAPE

Research ethics is traditionally focused on the safety of participants, but the increase in hostility when researching digital environments suggests that we should reflect on how we can improve the safety of scholars as well. Although digital environments offer valuable insights into human behavior, they also expose researchers to stigma, harassment, abuse, and even threats to physical safety [1,2,3]. This phenomenon is well known in "risky" real-world ethnographies [4], which involve research conducted in sensitive or hazardous environments. Unlike real-world ethnographies, however, where physical threats are more visible, online spaces obscure these dangers. Social actors are shielded by anonymity and the cues present in the physical environment are lacking, making it much easier to stumble into unexpected threatening situations. Female researchers, in particular, have highlighted the perils within male-dominated communities, known for their "toxic techno cultures" and gatekeeping behaviors that hinder access to data. These threats call more pressingly for a situated ethics, as well as careful navigation before, during, and after fieldwork.

Our reflections and firsthand experiences, alongside discussions of the problem in academic literature, set the stage for a workshop at CHI PLAY in 2023 in Stratford, Ontario. The workshop aimed to create awareness around the ethical issues researchers encounter when conducting field research within online gaming spaces. We explored how these issues are shaped by the professional settings, methodologies, and dynamics arising when collecting data. It became evident that the risks of doing video game research depend on various factors, such as the researcher's characteristics, position, experience, and familiarity with the game. The approach—whether ethnographic, requiring deep interaction with people, or involving secondary data—and the studied topic play a significant role in increasing potential risk (e.g., direct interactions with young male players of first-person shooter games pose a different risk from that of an online study with predominantly middle-aged people playing the puzzle game Bejeweled). Solutions must consider these factors to ensure safe, ethical, and effective research in online gaming communities.

The risks of doing video game research depend on various factors, such as the researcher's characteristics, position, experience, and familiarity with the game.

CHALLENGES IN QUALITATIVE RESEARCH

Here, we present some of the insights discussed during the workshop, before outlining possible solutions to the challenges posed by game research.

Access and trust. A key theme in the workshop discussions was the relevance of the methodological approach adopted by researchers. When researchers move from controlled experimental settings to real-world online gaming environments, they find it increasingly difficult to gain access, which is crucial for interacting with potential participants and collecting data.

Online gaming communities often appear closed to outsiders. Researchers need preliminary insider knowledge of the community's norms, values, and language, and they have to work diligently to earn the trust and favor of its members. The challenge, however, does not end with initial access. Once accepted by a community, researchers must continue to immerse themselves in it over extended periods to deepen their understanding, which requires a continued, authentic engagement with the community's dynamics and rules. Such an approach is particularly crucial in ethnographic research, where sustained interaction is essential for gaining meaningful insights.

Downsides of immersion. While often seen as a beneficial approach in ethnographic research, immersion also poses risks. The presence of researchers can feel intrusive, exacerbating stigma and provoking defensive reactions. For example, in studies on problematic gaming and addiction, a workshop participant

IMAGE BY CASSIANO CORREIA / SHUTTERSTOCK.COM

recounted how gamers resisted being involved because they did not want to be treated as experimental subjects. Therefore, while some researchers suggested integrating more deeply into gaming communities by adopting a more informal stance, others expressed concerns about the ethical implications of this approach.

On the one hand, setting aside formal roles might ensure that researchers are more accepted in the community and not perceived as patronizing or intrusive. Researchers can try to remain accessible to potential participants, avoiding excessive detachment. This is both a strategic choice and an ethical mandate to ensure participants' well-being. On the other hand, researchers' openness may in turn expose them to unpleasant situations. As several participants in the workshop recounted, it is not uncommon to encounter ridicule toward the research focus.

This situation highlights a broader issue of hostility and dismissal that scholars face when engaging with online communities. Workshop participants expressed discomfort with revealing their identities as academics, balancing the need for transparency with the desire to protect their personal and professional integrity. The difficulty of differentiating their personal identities from their professional roles also emerged, especially when the people they studied sought to find out details about their personal lives.

Researcher-participant relationship. Workshop participants also acknowledged the complex and ambiguous relationship between participants and researchers. Ethical guidelines prompt researchers to consider benefits for participants to be part of a study, leading to a deeper reflection on what researchers can offer in return (not necessarily in monetary form). In qualitative research, interviews and participatory methods can provide value to participants by allowing them to reflect, share their stories, and feel heard. When hostility or skepticism is expressed, however, this dynamic may become strained. Participants may offer socially desirable responses out of a sense of obligation, or, conversely, they may be resistant to engaging, interpreting the researcher's attempts to offer something in return as an effort to "buy" their cooperation.

The risks of using secondary data. The use of secondary data, such as social media posts or forum discussions, may potentially simplify the research process and shield researchers from the risks associated with the fieldwork, but it can also have unwanted consequences. As individuals become more aware that researchers might be monitoring public spaces, like Reddit or gaming forums, they may perceive these environments as no longer private. The awareness that their conversations or behaviors may be analyzed without their consent can foster mistrust of or resentment toward researchers. This shift in perception may lead to prejudices against researchers, who are increasingly seen as outsiders or intruders. As a result, players may become less inclined to collaborate, which not only complicates data collection, but also strains the already delicate researcher-participant relationship.

Furthermore, giving visibility to harmful behavior encountered in online posts through research poses another dilemma. Highlighting such behaviors in gaming communities risks reinforcing negative stereotypes about players, which can stigmatize participants and create a one-dimensional portrayal of the gaming community. This, in turn, may negatively influence public opinion, policymaking, and parental attitudes toward gaming. A narrow focus on gaming technologies often overlooks the benefits that gaming can offer, promoting a partial perspective and preventing broader recognition of its value.

LEGITIMIZATION OF THE DISCIPLINE AND INTERDISCIPLINARITY

Beyond the challenges already highlighted in other research domains, such as difficulties in gaining participants' trust and engagement, the obstacles faced by gaming researchers have deeper roots. These stem from a broader stigma surrounding the legitimacy of game research, with skepticism arising not only from the general public but also, surprisingly, from within the academic community itself, where scholars approach the study of games from different disciplinary perspectives. One illustrative case, presented by a workshop participant, highlighted the position of game AI research within the broader context of game studies, sparking a debate over whether it truly constitutes part of "game research." This conversation exposed interdisciplinary tensions and underscored the broader issue of acceptance and recognition of gaming research as a legitimate academic discipline where multiple and diverse perspectives may coexist.

These doubts and debates can be particularly damaging to young researchers, who are often at the forefront of fieldwork. Early-career researchers, struggling to navigate these interdisciplinary tensions and defend the legitimacy of their work, may have their confidence undermined, hindering their ability to establish a strong academic identity. In response, workshop participants stressed the importance of ethical considerations in how researchers engage with one another, advocating for a culture of respect and integrity across academic discourses, including speaker-audience interactions and peer review processes. The interdisciplinary nature of game research thus brings to light a common identity problem faced by researchers, one that calls for innovative solutions.

ADDRESSING THE CHALLENGES AND LOOKING FOR SUPPORT

The final discussions of the workshop highlighted a common understanding that researchers often face these challenges alone, navigating hostile environments with limited support. This isolation can be detrimental to both their well-being and the quality of their research, especially for junior researchers who encounter such situations at the start of their academic careers. Therefore, it is crucial to move beyond merely addressing the consequences and instead focus on proactive solutions to mitigate such issues. In the following section, we discuss some measures to address these problems, which may be used by virtual ethnographers in gaming environments.

One key aspect involves personal protection strategies, as already recommended by Alice Marwick and

colleagues [2], who emphasized the importance of researchers taking proactive steps to protect their personal information and manage their online presence. For example, practical measures that can reduce exposure to harassment include using public email aliases and securing social media accounts. Establishing clear boundaries between personal and professional identities is also crucial for safeguarding against potential harm. Another personal aspect relates to the in-game competence of the ethnographer. Online gaming environments are often highly competitive, whereby "competence" represents the main value driving the communities. For an ethnographer, being good at play—that is, showing skills only experienced players possess—may be a means to gain respect, avoid harassment, and prevent toxic behavior. Preliminary understanding of the field is essential in the real-world ethnographies, and in gaming environments an in-depth understanding of the game and well-developed in-game abilities may be essential prerequisites to face the challenges that the ethnography poses.

Institutions play a pivotal role in supporting researchers in adopting protective practices. They can offer mental health resources, training on how to handle online harassment, and clear protocols for reporting and addressing incidents. Such support, as highlighted by Marwick et al., would include proactive communication plans and dedicated personnel to assist researchers in managing online threats. It could take the form of safety advisory councils that offer specialized advice and support to researchers who encounter online risks [5].

Beyond individual and institutional efforts, building communities of practice is crucial for fostering a supportive research environment. Organizations like AnyKey, founded by Morgan Romine and T.L. Taylor [5], provide platforms where researchers can exchange experiences, seek support, and offer mutual assistance. Other online spaces can be found in the Rutgers Digital Ethnography Working Group (https://bit.ly/4cmiB3g) and the Ethnographic Café (https://bit.ly/4jirvkw). These networks may help mitigate the isolation that many researchers experience, creating a more resilient and connected research community. A problem communities of this kind face is that young game researchers may not be familiar with them. Publicizing such initiatives more widely and building new ones specifically targeted to the game domain can ensure that even researchers who have just begun their research journey can find a place where they feel heard.

Grassroots approaches, including distributed moderation systems and community-led initiatives, such as those suggested by Taylor [5], can also play a vital role in enhancing safety and legitimacy within online communities. For example, live Q&A sessions where researchers transparently engage with the community can build trust and reduce hostility. In the gaming community, informal networks such as Slack channels for early-career researchers in HCI or Discord communities for CHI PLAY can be formalized into more-consistent support networks. A dedicated mentoring system, paired with access to mental health services and guidance on ethical best practices, would significantly reduce the isolation many researchers in this field feel.

Additionally, involving participants directly in the research process by offering them a stake in the outcomes, such as an explicit mention in the research publications in exchange for their support, can foster a more cooperative relationship. This broader community engagement mitigates hostility and also reduces the risk of self-selection bias, which can lead to skewed data and compromised research integrity.

Collaboration with the gaming industry further strengthens these efforts. Digital gaming platforms like Discord and Twitch are particularly important in this context, as they shape the environment in which research is conducted. They present unique challenges, however, such as fast-paced interactions in Twitch chat rooms and stringent moderation policies that can complicate data collection. To effectively collect data on these platforms, researchers must become familiar with the specific cultures and rules of each platform. By partnering with game developers, publishers, and community managers, researchers can promote positive behavioral norms and reduce toxicity within gaming spaces. Institutions and platform providers can support researchers by offering guidelines and tools for ethical research practices, ensuring that data collection respects user privacy and complies with platform policies.

Addressing ethical challenges in online game research requires a multifaceted approach that includes institutional support, collaboration with the gaming industry, conversation with scholars from other fields, and cooperation from digital platforms. This supportive and collaborative environment can help researchers share experiences and leverage resources that would not only alleviate their individual burden but also foster innovation and progress.

CONCLUSION

Despite years of discussions, the challenges faced by researchers in the gaming community remain persistent and troubling, potentially compromising scholars' work and well-being. These challenges include hostility from the gaming community expressed in the form of questioning researchers' credibility, personal attacks, and harassment. In this article, we have delved into personal stories shared by researchers in video game research, explored the effects of problematic experiences, and discussed the steps needed to address

Broader community engagement mitigates hostility and also reduces the risk of self-selection bias, which can lead to skewed data and compromised research integrity.

these issues. The stories shared during our workshop highlight a spectrum of toxic behaviors, including harassment, gatekeeping, and ridicule—issues that continue to affect the research process. While these behaviors are not new, they might be underestimated in online gaming research, where the environment is believed to be "lighter" and more "fun" than serious. The prevalence of such issues even in online games, however, underscores the urgent need for more concrete and proactive solutions. Different sources of harm significantly affect the research process, from participant recruitment to the integrity and acceptance of game research within and outside academic circles. It appears that researchers are particularly at risk during the recruitment phase, when they are exposed to personal attacks and privacy breaches, especially in situations that require them to disclose their identities. The situation becomes even more complex when we consider the academic stigma surrounding the study of games. The interdisciplinarity of game research, while often a strength, presents significant challenges for researchers attempting to find their footing. It is not only the members of the gaming community; academics in different fields question the legitimacy and value of academic interdisciplinary research on gaming. This may eventually lead to increased self-doubt among researchers, especially those early in their careers.

Moving forward, it is clear that steps need to be taken to address these issues, starting with the need to engage hostile audiences more effectively and explain the importance and potential of gaming research. This could include gaining players' respect by developing the ethnographer's in-game skills and creating clearer communication strategies to emphasize how gaming studies contribute to education, therapy, and social engagement, as well as involving gaming communities more directly in the research process. Additionally, establishing networks and forums can provide valuable support to early-career researchers, who may be unaware of the potential risks of their research and unprepared to face the challenges ahead. Researchers could exchange experiences and strategies and provide support to one another to address the complexities of their work. It is important for researchers to have a safe space to share personal stories, seek peer advice, and engage in broader conversations about adapting research methodologies to keep pace with evolving trends in the gaming field and its communities.

Finally, strengthening institutional support is crucial for protecting young researchers. Existing training programs, like the Collaborative Institutional Training Initiative Program, often used at the start of Ph.D. programs [6], can be expanded to emphasize researcher protection and prevent researchers from feeling isolated. Training modules on handling harassment, online safety, and navigating hostile communities could be incorporated into graduate programs across different disciplines. Such comprehensive training frameworks would not only equip early-career researchers to face future challenges but also offer practical solutions for maintaining mental well-being. Additionally, institutions can offer more hands-on support, such as providing access to university cybersecurity teams to prevent trolls or hacks during online data collection, thereby safeguarding researchers' personal and professional identities.

By taking these steps, we can reduce the challenges researchers face and enhance the legitimacy, acceptance, and societal impact of game research.

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Arianna Boldi is a research fellow in the Computer Science Department at the University of Turin, where she obtained her Ph.D. in psychology. Her research focuses on the intersection of HCI and psychology. She explores various topics, including the potential of video games for understanding human behavior and enhancing mental health, as well as emotional experiences of esports players.
→ arianna.boldi@unito.it

Selina Cho obtained her Ph.D. from the Human Centred Computing group at the University of Oxford, where she investigated online game cheating communities. Her research interests lie at the intersection of game cheating, cybersecurity, and computer-supported cooperative work.
→ selina.cho@cs.ox.ac.uk

Yubo Kou is an assistant professor in the College of Information Sciences and Technology at Pennsylvania State University. His research includes HCI, computer-supported cooperative work, and video games, with a focus on the intersection of governance and play.
→ yubokou@psu.edu

Amon Rapp is an associate professor in the Computer Science Department at the University of Turin. His main research areas are self-tracking and behavior change technologies, video games, and intelligent agents. He has organized several workshops at prestigious conferences, including UbiComp/ISWC, CHI Play, Hypertext, and UMAP. He is an associate editor of the *International Journal of Human-Computer Studies* and *Human-Computer Interaction*.
→ amon.rapp@unito.it

Max V. Birk is an assistant professor in the Human-Technology Interaction group at Eindhoven University of Technology. Drawing from psychology, data science, and game design, his research focuses on motivation in games, game-based digital biomarkers of stress, and behavioral design strategies in commercial games. His work aims to contribute to a healthy society, improve entertainment experiences, and develop tools and methods for researching interactive experiences.
→ m.v.birk@tue.nl

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Rebuilding the Digital Town Square:

Designing Social Media for Meaningful Connection (Again)

Duncan P. Brumby, University College London

Insights

- Social media platforms, originally designed for connection, often foster disconnection through design choices that prioritize engagement over meaningful interaction.
- Algorithm-driven feeds optimize for attention capture, disrupting spontaneity and reducing the depth of relationships.
- Human-centered design principles can help rebuild digital spaces, with smaller, intentional networks offering a more sustainable model for valuable connection.

IMAGE BY ANTON VIERIETIN / SHUTTERSTOCK.COM

For decades, digital platforms have served as our town squares—spaces where ideas, dialogue, and connections flourished. As we enter 2025, however, many of these once-thriving spaces feel fractured, their roles either diminished or entirely repurposed. For those of us in the CHI community—researchers, practitioners, and readers of *Interactions* magazine—the question arises: Where do we gather now? How have the platforms that shaped our professional and social lives evolved, and what does that mean for how we communicate?

This search for connection is not new. Long before today's social media giants emerged, early Internet pioneers built communities on platforms like the WELL and Usenet newsgroups. Howard Rheingold, in *The Virtual Community: Homesteading on the Electronic Frontier* [1], described these early digital town squares as spaces where people could share ideas, debate, and build relationships. But just as those pioneering platforms evolved, fragmented, or faded, today's dominant social networks face their own moment of transition. Once again, we find ourselves asking: Where do we gather now?

Twitter—now X (our *ex*)—once served as the virtual town hall for online dialogue within the CHI community but now lies mostly silent. Attendees of CHI may remember @_CHINOSAUR, a mystery T. rex

account known for its witty commentary that added a playful dynamic to CHI Twitter's vibrant discussions. Sadly, it made its last roaring appearance in July 2024 before retreating to digital extinction—a foretelling of things to come. Since Elon Musk's $44 billion acquisition, drastic layoffs, erratic policies, and alienated advertisers have turned Twitter into a digital graveyard, a stark reminder of how fragile communal spaces become when leadership misaligns with user needs, fueling a more polarized environment (https://bit.ly/41tUcoj). Yet, for all its decline, Twitter still shapes mainstream narratives (https://bit.ly/3DTaWN0). Some users remain, keeping a foothold while exploring alternatives; others have moved entirely to platforms like Bluesky, where many in the CHI community are rebuilding the digital town square. The migration is ongoing, but can any platform truly replace what Twitter once was?

LinkedIn remains the default platform for professional networking, offering a polished, career-focused space. This polish, however, can feel overly curated and boastful—a showcase for achievements where humility and self-deprecation are rare. Even Microsoft, LinkedIn's parent company, acknowledges the platform's limitations, calling it "too boring for kids" due to its emphasis on careers over genuine social exchange (https://bit.ly/4l7bShg). While LinkedIn excels at professional visibility, its risk-averse atmosphere often dampens the warmth and authenticity that make interactions feel truly meaningful. Ironically, despite positioning itself as the premier job-seeking platform, LinkedIn has faced growing criticism for employer "ghosting"—leaving candidates without responses after a lengthy application process. In response, the platform has introduced new tools aimed at improving employer engagement, though frustrations remain widespread (https://bit.ly/4l7kuoh).

Facebook remains the largest social platform, with around 3 billion monthly active users as of 2025 (https://bit.ly/4l7MGaE). It still provides a space to reconnect with old friends, keep up with colleagues' updates, and sustain long-term relationships—at least for those who remain active on the platform. But relentless commercialization, driven by ads and engagement algorithms, has pushed many away. In January 2025, Meta compounded this by shifting to a Community Notes model, a move widely criticized for potentially amplifying disinformation and eroding trust on the platform (https://bit.ly/41F2dHr). It's no surprise, then, that many friends, family, and colleagues seem to have started the year with a resolution to leave Facebook for good.

TikTok's user-driven content has captivated younger generations, offering a dynamic, refreshing alternative to Facebook's ad-driven algorithms. Its powerful recommendation system and culturally relevant, user-generated content have made it a global phenomenon—but its future remains uncertain. In January 2025, U.S. President Donald Trump delayed a nationwide ban, giving ByteDance, TikTok's China-based owner, more time to negotiate a sale or deal (https://bit.ly/43cuUwi). This precarious status underscores how global platforms are increasingly entangled in geopolitical tensions, a trend echoed in recent debates over China's DeepSeek AI (https://bbc.in/3FLfzcq).

Instagram remains a thriving visual-first platform, perfect for sharing snapshots of a holiday on the beach, a festival in the woods, or fleeting moments of beauty amid the rush of daily life. But for those seeking in-depth discourse or idea sharing—particularly within communities like CHI—it often feels limited. While Instagram fosters creativity and self-expression, its format prioritizes visual storytelling over extended discussion. By contrast, long-form platforms like Substack and Medium cater to audiences seeking deeper engagement, allowing ideas to unfold through essays, newsletters, and podcasts.

As larger platforms face growing challenges, many users are turning to smaller, private networks. Group chats on platforms like WhatsApp and Telegram offer intimacy and focus, making them ideal for close-knit discussions—whether brainstorming a CHI paper with colleagues or planning a party with friends. However, they lack the scale and spontaneity of broader social platforms. Niche tools like Discord, favored by gamers and hobbyists, and Mastodon, a decentralized and privacy-focused alternative, provide tailored interactions but struggle to re-create the broad connectivity and serendipity of traditional public forums.

The fragmentation of digital spaces raises fundamental questions about what we truly seek from these platforms—questions I find myself asking more and more. Do I want casual humor, deeper personal connections, or professional growth? Can a single platform meet all these needs, or am I, like so many others, scattering across multiple tools, each fulfilling only a fraction of what I once found in the digital town square? As I navigate shifting platforms, attempt to reconnect with old friends, and watch once-thriving spaces fade, I keep coming back to the same question: What does a better online world look like, and how do we build it?

COMMUNICATION TOOLS: FROM IN-PERSON CHATS TO DIGITAL MESSAGING

This article was sparked by a conversation with Kate McCusker of *The Guardian* about Gen Z's shift from phone calls to texting (https://bit.ly/4ifqmtA). The way we connect has always evolved with technology—walking together, picking up the phone, or messaging online. Each new tool has expanded our reach, enabling instant global communication but also introducing new complexities. The real question isn't just where we gather now, but what we can learn from how these

By triggering reactive decision making, social media pushes users into reflexive rather than deliberate engagement, prioritizing habits over substance.

tools have shaped our interactions—and where they might take us next.

Walk with me. Walking and talking is one of the oldest and simplest forms of communication. The rhythm of movement mirrors the natural flow of dialogue, with participants taking turns sharing stories and observations. Walking also engages both body and mind—movement helps ideas flow, and the shared experience of a changing environment shapes conversation in ways digital interactions struggle to replicate.

But walking together isn't always possible. As our social circles stretch across cities and continents, physical colocation becomes rare. Health and mobility issues can make walking inaccessible for some, while larger groups add complexity—conversations splinter, turn taking becomes difficult, and worthwhile exchange is harder to sustain. Communication is shaped not just by the tools we use but also by the spaces we inhabit and the constraints we navigate.

Call me. The telephone transformed communication by enabling real-time conversation across distance, but it also introduced new expectations. Shared household phones carried unspoken rules: scheduled catch-ups and etiquette around when it was too early or too late to call. The arrival of answering machines, and later mobile voicemail, subtly shifted these norms. Initially seen as impersonal, these tools soon became essential, allowing people to leave messages when someone wasn't available. This marked the first major step away from the expectation of an immediate response.

Ironically, the telephone itself accelerated this shift to asynchronous communication. The second major step came from a simple design choice: Early telephones lacked an off switch. As Barry Brown and Mark Perry note, this design embedded the habit that when a phone rings, you answer it [2]. Now, we carry cell phones everywhere, always on and available, creating the illusion of perpetual reachability. In reality, though, no one is constantly available—our days are busy, fragmented, and filled with competing demands, including meetings, deadlines, family responsibilities, or just decompression periods needed after a long day.

Always on, yet harder to reach. Mobile phones have created a paradox: Despite being constantly available, meaningful conversations are harder than ever. The expectation of availability conflicts with the reality of fragmented schedules and competing priorities. Asynchronous tools let us message at any time, but they also introduce ambiguity: When should we expect a reply, and how long is too long to wait? Managing availability now requires planning, but vague or overly optimistic plans often result in unfulfilled tasks or missed goals [3]. Even small adjustments—like rethinking when and how we connect—can create space for focus and ease the pressures of constant connectivity.

However, many of our digital tools are designed for reflexive engagement rather than intentional interaction. Notification cues alert users to every new message the moment it arrives, creating a sense of urgency and encouraging instant responses, often at the expense of more important but less time-sensitive messages [4]. Frequent task switching further erodes focus, as Gloria Mark explores in *Attention Span: A Groundbreaking Way to Restore Balance, Happiness, and Productivity* [5]. Even brief breaks can help: In another study, Gloria Mark, Stephen Voida, and Armand Cardello found that stepping away from digital work communication tools for just a week improved focus by reducing reactive engagement and stress [6]. Social media platforms amplify this pressure, subtly instilling a sense of guilt for being "unreliable" or unresponsive, even when delayed replies are necessary for maintaining focus. This reactive engagement cycle fuels stress, contributes to burnout, and reinforces an always-on mentality, making it harder to disconnect.

Social media platforms reinforce asynchronous communication by design. We share updates—publicly or privately—at our convenience, while recipients engage at their own pace, either through direct replies or passive scrolling. This dynamic makes real-time, in-depth conversations feel less necessary: Why schedule a call when major life updates have already been broadcast through posts and messages? We've reduced important conversations with friends and family to fleeting scrolls, filling idle moments while waiting for the elevator to arrive. It's a quiet erosion of connection—one we barely notice but deeply feel. Worse, these platforms are deliberately engineered to capture and hold our attention, maximizing engagement at the expense of genuine interaction.

SOCIAL MEDIA: DESIGNED TO KEEP YOU HOOKED

Platforms like Facebook and Instagram rely on neural networks to personalize content and encourage use. Meta's AI-driven systems process billions of pieces in real time, adapting to user preferences and refining recommendations based on feedback from nearly 3 billion monthly active users (https://bit.ly/4icHpfB). While these systems create highly personalized experiences, they also raise concerns about oversight, accountability, and user autonomy. Human-centered responsible AI emphasizes balancing innovation with ethical responsibility, ensuring AI prioritizes well-being. Without safeguards, platforms risk fostering engagement strategies that encourage fixation rather than meaningful connection.

This tension becomes clear in how platforms personalize content. When you first join, they offer a broad mix of interests, supplying variety, novelty, and diversity. Over time, they learn from your behavior: What do you linger on? What grabs your attention? These systems build a detailed understanding of your preferences, reinforcing certain patterns and profoundly shaping your experience. The more you engage, the more refined the recommendations become, narrowing exposure and shaping consumption. Why? Because your attention is the product. These "free" platforms monetize engagement by selling targeted access to advertisers. The more time you spend on the platforms, the more data you provide—and the more valuable you become to the company.

This process creates a pattern of fixation, like being stuck in a hamster wheel. The vastness of the Internet—its knowledge, creativity, and potential—is reduced to a curated subset of interests. Whether it's cats, cars, celebrities, or interior design, the result is the same: a narrowing of what we see and engage with. And this narrowing isn't incidental—it's deliberate. Platforms maximize

engagement by continuously serving similar content to keep users scrolling. But here's the rub: Even as content becomes less interesting—even monotonous—the habit persists. By triggering reactive decision making, social media pushes users into reflexive rather than deliberate engagement, prioritizing habits over substance. This cycle keeps users scrolling, increasing time on the platform—and, ultimately, maximizing monetization. So why isn't there a reset button?

THE FAILURE OF CURATION: WHY SOCIAL MEDIA NEEDS A REDESIGN

Social media platforms promised curated experiences—tailored feeds, relevant updates, and valuable connections—but the reality falls far short. Users have little real control over what they see, constrained by business incentives, rigid infrastructure, and limited customization tools. Platforms like Facebook and Instagram don't allow users to reset their algorithms, instead reinforcing engagement loops that leave many frustrated and disconnected. What was once a way to stay connected with friends, colleagues, and even childhood acquaintances has become dull and draining. Feeds are cluttered with repetitive, low-effort content designed to keep users scrolling, while passive consumption fuels social comparison, anxiety, and dissatisfaction. Instead of fostering connection, these platforms have become digital holding spaces—places we turn to out of habit rather than intent. While some remain hooked, many are disengaging, seeking alternative platforms that offer more-authentic experiences.

At its core, the failure of curation stems from three interrelated issues. First, engagement-driven business models prioritize time spent on-platform over user control—keeping people scrolling is simply more profitable than empowering them to shape their own experience. Second, many platforms still rely on aging recommendation engines that reinforce familiar patterns rather than broadening perspectives, optimizing for engagement over content quality. Third, while platforms offer tools to mute content or refine recommendations, these adjustments remain surface level, offering little real agency. Users lack meaningful control over their digital environments, making it harder to curate feeds in ways that truly serve their interests.

Reconnecting with old friends has become harder. Fewer people post or share, and even direct messaging feels more fragmented. The very platforms designed to bring us together are making it more difficult to sustain important relationships. To reverse this trend, social media must move beyond passive engagement and embrace systemic change—offering tools to reset, redefine, and curate experiences that prioritize depth over distraction.

RETHINKING SOCIAL MEDIA: DESIGNING FOR MEANINGFUL CONNECTION

To address these problems, platforms need to fundamentally rethink how they shape user experiences. Currently, they offer only limited ways to influence what appears in our feeds—often reducing control to simple "more like this" and "less like this" buttons. These tweaks do little to break entrenched algorithmic patterns. A better approach would be tools that let users periodically reset their content preferences, refresh their networks, or reconnect with meaningful past connections. Without ways to step outside automated feedback loops, social media risks further fragmenting communities rather than bringing people together.

Another approach might prioritize depth over breadth—encouraging fewer but more meaningful interactions. Platforms could support long-form posts, personal reflections, and shared experiences to help rebuild the authentic connections social media initially promised. This trend is already visible on platforms like Substack and Medium, where writers cultivate dedicated audiences through deeper content. Similarly, Discord and Telegram offer ad-free spaces for focused, interest-driven communities, while Mastodon and BeReal reflect a growing desire for autonomy, privacy, and intentional networking, breaking from algorithm-driven engagement.

To reclaim their original promise, social media platforms must prioritize user autonomy and worthwhile engagement over maximizing time spent on the platform. Currently, time on-platform is treated as a proxy for profit, with engagement metrics driving advertising revenue. Shifting focus toward genuine connection rather than passive consumption isn't just desirable—it's essential for creating digital spaces that enrich and empower their users.

THE SHIFT TO SMALLER, CLOSED NETWORKS

As mainstream platforms struggle to foster meaningful engagement, many users are turning to smaller, closed networks. This shift has fueled the rise of platforms like WhatsApp and Telegram, where communication is more focused and purposeful. Unlike algorithm-driven feeds, these spaces allow users to connect directly, knowing exactly who they are reaching. End-to-end encryption ensures privacy, enabling candid discussion without fear of outside scrutiny.

But this closed nature is a double-edged sword. While these groups strengthen personal connections, they also limit interaction to a small circle, reducing the serendipity of public social media platforms. Privacy protections, while crucial, can also enable the unchecked spread of misinformation, harmful content, or illegal activity. Unlike public platforms with moderation policies, these spaces rely on communities to self-regulate—sometimes effectively, but not always. The result is a paradox: greater control over who we talk to, but also a higher risk of echo chambers where no one outside the group can be heard.

Whether through private WhatsApp groups, focused Discord communities, or long-form platforms like Substack, people are reshaping their digital environments.

These networks solve some frustrations of algorithm-driven platforms but don't fully replace the digital town square—an open space for reconnecting with friends, fostering broader communities, and maintaining weak ties. As social media fragments, we gain privacy but lose the spontaneous, wide-reaching interactions that once defined digital connection.

CONCLUSION

From the early days of the WELL and Usenet newsgroups to the rise of Facebook, Twitter, and LinkedIn, social media has promised connection—effortless ways to stay in touch with colleagues, friends, and loved ones, even across vast distances. These platforms reshaped communication, offering unprecedented speed and scale, connecting billions of people every day. But in their relentless pursuit of engagement, they have shifted, overwhelming users, isolating relationships, and trapping us in cycles of shallow content consumption.

This paradox—the lure of connection versus the experience that drives disconnection—defines a central challenge of our digital age. Social media platforms promise seamless communication, yet their design imposes hidden costs. Prioritizing engagement metrics has eroded spontaneity and depth, replacing organic interactions with algorithmically filtered feeds, relentless ads, and content designed to capture attention rather than foster connection. Reaching out to an old friend—once a simple, unmediated act—now means navigating an interface shaped by commercial incentives. For many, the rising costs, whether in attention, privacy, or misaligned platform values, have become too great. As a result, people are drifting away from once-thriving digital town squares, seeking spaces that feel more genuine, intentional, and human.

Rebuilding the digital town square is possible. The rise of smaller, purpose-driven networks reflects a clear demand for meaningful interaction. Whether through private WhatsApp groups, focused Discord communities, or long-form platforms like Substack, people are reshaping their digital environments—seeking connection free from the noise of infinite scrolling and algorithmic pressure.

To reclaim the promise of social media, both individual action and systemic change are necessary. As users, we must be deliberate about how and where we engage. As designers, researchers, and advocates, we must champion platforms that prioritize depth over distraction and community over commodification.

But valuable change requires rethinking the business model. As long as engagement-driven advertising dictates platform design, user well-being will always come second to retention. In their relentless drive for ever-greater profits, platforms have tightened their grip—only to see users slip through their fingers, seeking spaces that feel less extractive and more human.

While writing this article, I found myself reflecting on my summer internship at Microsoft Research in 2005. As a special perk, interns were invited to a gathering at Bill Gates's home. I was running an eye-tracking study on how people search computer displays, and I distinctly recall Gates remarking that tech companies would soon be paying people for what they look at on a screen. At the time, I didn't fully grasp the weight of his words: Facebook had yet to emerge, and social media was still in its infancy. Yet Gates saw where things were headed.

Our attention became the product, and we gave it away. If we want better platforms, we need to pay in ways that align incentives with user experience rather than exploitation. Subscription models, decentralized networks, and cooperative ownership could provide more-sustainable alternatives, ensuring that technology serves us—not the other way around.

HCI has long taught us that great design begins with understanding people—how they think, what they need, and how they interact with technology. As researchers, designers, and educators, we have the expertise—and the responsibility—to shape platforms that foster genuine, lasting relationships rather than extractive engagement. The challenge ahead is clear: We must move beyond fragmented, attention-driven systems and reclaim what social media was meant to be. By applying human-centered design, we can create digital spaces that enrich, rather than exploit, our connections.

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Duncan P. Brumby is a professor of HCI at University College London and editor in chief of the *International Journal of Human-Computer Studies*. His research examines how digital tools shape human behavior, influencing how we work, connect, and find meaning in an increasingly digitized world. His recent work explores the role of generative AI in education and the limitations of voice user interfaces for assisting with everyday domestic tasks—research that earned a CHI 2024 Best Paper Award.

→ d.brumby@ucl.ac.uk

Post-Growth HCI:

Some Reflections and a Call to Action

Vishal Sharma, Georgia Institute of Technology
Bonnie Nardi, University of California, Irvine
Neha Kumar, Georgia Institute of Technology

Insights

- Moving away from endless growth is our only shot at surviving climate catastrophe.
- Post-growth ideas are already seeding a global shift from overconsumption to a more sustainable, equitable, and pleasurable living.
- HCI needs to move beyond incremental change to a paradigm shift via critical deliberation and action aligned with post-growth.

HCI researchers have begun to question the ideology of economic growth that is ingrained in our economy and in our field. This growth has placed immense burdens on Earth's resources and climate, leading to a global metacrisis, the breakdown of multiple, interconnected global systems arising from inattention to planetary limits. In seeking alternatives, we turn to a post-growth philosophy that provides ways to chart a path to a postcapitalist world. In our recent *Transactions on Computer-Human Interaction* paper, "Post-growth Human-Computer Interaction" [1], we discuss ways to identify hidden assumptions of growth and examine how HCI can orient to post-growth futures. The paper was an attempt to lay down the foundation to critically reflect on how to liberate HCI and the larger computing discipline from the growth paradigm. It took four years of rejected papers at three consecutive CHI conferences for us to make a compelling case for post-growth and its relevance to HCI. Some specific critiques repeatedly came up during the reviews. In this article, we provide responses to doubts, misunderstandings, and reservations that we could not include in the *TOCHI* paper. We conclude with a call to action for the HCI community to embrace post-growth philosophy and collectively

IMAGE BY VISHAL SHARMA

Go Native, a farm-to-table café and shop in Bangalore, India, that provides alternatives to mass-produced items.

LET'S RETURN TO OUR ROOTS
AND REBUILD OUR LOCAL COMMUNITIES,
START A GLOBAL MOVEMENT
THAT EMPOWERS ARTISANS AND FARMERS,
DO BETTER FOR THE EARTH,
FOR EACH OTHER, FOR OURSELVES

work toward realizing futures where technologies promote well-being for all.

ENGAGING WITH CRITIQUES

Post-growth is "too radical."

The steering arms of society including embedded financial, legal, political, and governance systems must be radically realigned and recognize the connectivity among social, ecological, and technological domains of urban systems to deliver more just, equitable, sustainable, and resilient future.
— Timon McPhearson et al.

Post-growth asks for a radical civilizational shift. It suggests altering the growth economy by moving from production to redistribution, from acquisition to sharing and community, and from industrialized development to development appropriate to local circumstances. For example, post-growth proposes limiting consumption by defining legally allowable minimum and maximum standards of consumption. Minimum standards could be implemented through a universal basic income and services such as healthcare, ensuring that everyone's basic needs are met. While trickier, maximum standards of consumption could be achieved by limiting maximum wealth, through taxation and other mechanisms to reduce consumption, especially in affluent societies.

Proponents of growth or those who have not yet questioned the depth of the metacrisis may disagree with the radical changes post-growth demands. They may suggest more-moderate changes: *decoupling* the economy from environmental destruction—that is, achieving economic growth without a corresponding *increase* in environmental damage—and *decarbonizing* (i.e., reducing or eliminating emissions of greenhouse gases associated with economic activity). Historical records, however, show that decoupling environmental impacts from economic growth is extremely rare, and decarbonizing is not enough. In an analysis of 835 empirical studies of decoupling GDP, resource use, and GHG emissions, Helmut Haberl et al. [2] noted that "large rapid absolute reductions of resource use and GHG emissions cannot be achieved," concluding that "decoupling needs to be complemented by sufficiency-oriented strategies and strict enforcement of absolute reduction targets." Carbon dioxide emissions are just one among many environmental pressures, including ocean acidification, biodiversity loss, air and water pollution, loss of fresh water, erosion, and deforestation. Post-growth emphasizes the imperative to move beyond piecemeal "solutions" and holistically embrace the social, economic, political, and cultural transformation crucial for addressing the metacrisis.

The Covid-19 pandemic demonstrated that we *can* affect radical transformation, instigating changes previously considered impossible. New regulations were rapidly implemented. We shifted to remote work. The state intervened in the market and placed restrictions on economic activities. The reduction of economic activity gave nature a chance to recover. We enjoyed cleaner air and improved water quality. More-than-human life-forms enjoyed less noise pollution and human disturbance. Although the pandemic forced these changes upon us, it showed that we can, if needed, alter business as usual.

Such changes could be implemented in a planned and proactive way to enable a transition to more sustainable and just futures. If we are determined enough, we can act with the care and agency necessary to alter our modus operandi radically. Post-growth offers a road map for transitioning voluntarily to a future in which we live in harmony with other life-forms on this beautiful planet all of us call home. Some suggestions from post-growth philosophy to reduce growth include universal basic income, greater wealth and inheritance taxes, decommodification of public goods, reduced work hours, granting rights to natural resources, supporting care work, building worker cooperatives, and reducing consumption.

Post-growth is "too idealistic."

[Post-]growth is utopian only because it contradicts one of the common senses of our time: the imperative for endless economic growth.... Call it a concrete utopia, a subversive concept to educate our desire for a future we didn't know was possible even though it actually is.
— Timothée Parrique

Post-growth ideas may seem unrealistic and unattainable to some, but organizations across the globe have already implemented some of the ideas. In 2010, Bolivia passed the Mother Earth Law, establishing legal rights for nature, including the right to exist and thrive and to maintain natural cycles and processes free from human alteration, as well as plants' and animals' right to access clean air and water. In 2017, New Zealand granted legal personhood to the Whanganui River, which allows it to act as a person in a court of law. For example, if the river changes the course of its flow, interrupting it would be a violation of its rights. Over the past several decades, many ecovillages have been established globally, such as Findhorn in Scotland, Earthaven Ecovillage in the U.S., Ökodorf Sieben Linden in Germany, Auroville in India, and transition towns in the U.K. Ecovillages support small-scale, sustainable living with community-based governance, participatory democracy, community economics, cohousing, and localized agriculture and energy production.

Scholars from diverse disciplines, backgrounds, and identities have assisted in the development of post-growth philosophy. For example, Latin American anthropologist Arturo Escobar rejects economic growth masked as "development" in which the Global North exploits resources in the Global South, originally through

Post-growth is about creating a "world of less" by reducing resource and energy consumption and a "world of more" through equality, democracy, health, and well-being.

colonization, and now through imperialism. Escobar calls for post-development in the Global South: decentralized and localized production, distribution, and consumption. Post-growth ideas have been influenced by many others, including philosophers André Gorz, M.K. Gandhi, Rabindranath Tagore, and Vandana Shiva. Among the economists who have written about post-growth are Herman Daly, Serge Latouche, and J.C. Kumarappa, and the theorists include Ivan Illich and Murray Bookchin. Tagore, for example, argued that the accumulation of capital and resources will never end poverty. We would need to shift our attention from money and possessions to fulfilling basic needs, such as food, clothing, and shelter for everyone.

Post-growth inherited many of its ideas from traditional wisdom that has guided humanity for centuries. *Ubuntu* from Africa, *buen vivir* from South America, Indigenous sovereignty from North America, and *ahimsa*, *swaraj*, and *dharma* from South Asia all inform post-growth philosophy. These approaches suggest localized development and sovereignty in order to live in harmony with the human and more-than-human world. These philosophies are still practiced across the globe, even after their countries of origin have suffered from colonialism. For example, the belief that all living and nonliving forms are animated beings with agency and free will is still part of African practice. *Vasudhaiva kutumbakam*, the belief that the world is one family, with an emphasis on the interconnectedness of all life-forms and the importance of global unity, is part of contemporary Indian society. It was the theme and the logo for the 2023 G20 summit held in India. These philosophies are not idealistic; they stimulate practical, everyday activity and have the potential to guide us away from capitalist logic as we prioritize providing care to all, including the planet that gives us a home.

The interdisciplinary field of ecological economics is another influence. It considers the economy as part of the finite planetary ecosystem, with ideas consistent with post-growth thought. Beyond academia, post-growth has entered mainstream conversations, with articles in *The New Yorker*, *The New York Times*, *Harvard Business Review*, *The Guardian*, and *Vogue*. There is a growing consensus on post-growth [3]. Seventy-three percent of 800 climate policy researchers surveyed worldwide supported post-growth. Seventy-seven percent of 500 sustainability scholars favored post-growth. Sixty-one percent of the European population favored post-growth. Fifty-six percent of the global population criticized capitalism. Even in the highly capitalist U.S., 70 percent of the population believes that "environmental protection is more important than economic growth" [3].

These developments suggest that post-growth values are not unattainable. Such values have existed in many traditional cultures and are now finding a wider audience, flourishing in the cracks of capitalism. We can see glimmers of the beginning of a transition to post-growth. The transition is yet to be labeled post-growth, just as changes in the Enlightenment and the Industrial Revolution had no name until after they were well underway.

Post-growth is "regressive."

A [post-]growth economy would be the inversion of austerity. For the majority, it would mean a more abundant, more convivial, more fulfilling lifestyle. For the wealthy few, it would mean the end of private abundance, excess emissions and concentrated power. For humanity, it would be our only shot at a future worth living in.
— Matthias Schmelzer and Aaron Vansintjan

Post-growth is about creating a "world of less" by reducing resource and energy consumption and a "world of more" through equality, democracy, health, and well-being. Downscaling economic activity is not regressive in the sense of a return to a primitive past, implementation of austerity, or voluntary poverty. Knowing the limits of our planet yet continuing to organize limitless production and consumption within an economic system devised in the 16th century is backward. Capitalism only seeks opportunities to accumulate more. Rampant wildfires? A chance to sell insurance. A plague of locusts? A reason to sell more fertilizer. Decreasing natural resources on Earth? An occasion to sell shares in plots on celestial bodies. Failing to question this growth ideology and failing to innovate a sustainable and just economy is regressive.

Post-growth is progressive. It challenges the centuries-old economic growth model that is taken for granted and entirely normalized and accepted without critical assessment. In 2017, Nancy Pelosi, then Speaker of the U.S. House of Representatives, was asked if the Democrats, the more progressive of the two parties, support an alternative economy. Pelosi replied, "I thank you for your question, but I have to say we're capitalist, and that's just the way it is." The normalization of capitalism prompted an unreflective reply from an incredibly savvy politician who occupied an important leadership position yet did not think we should even consider another economic system.

ENGINEERING A SHIFT

We can change voluntarily, smoothing the transition through civilized redistribution, or it will happen, probably with dire consequences, involuntarily. Rather than letting circumstances become intolerable for billions, we should take heart and listen to those telling us to slow down, to organize our lives around caring and conviviality, to intervene in processes of capital accumulation. Thoughtful people [post-growth proponents] have offered sound, reasonable alternatives, and, in my view, responsible design practice should act on them.
— Bonnie Nardi

Critical reflection. What can we do to embrace post-growth philosophy? First, we need to acknowledge that our planet cannot produce resources at the rate we currently consume them. It cannot dispose of waste at the rate we produce it. Planetary limits need to become a default consideration in all our doings. Second, we need to utilize our tool of imagination. At any point have we said that we have now achieved technologies that will never be surpassed? So why have we stopped imagining and realizing social innovation? Why have we stopped at capitalism, an economic system devised in the 16th century? We cannot keep following *après moi, le déluge*, an expression of indifference to events after one has gone. *Le déluge* is already here in the form of wildfires,

floods, droughts, biodiversity loss, and other calamities. We need to ask why we have created an entire social, political, and economic infrastructure to support the imperatives of growth. Why do we have stock markets, GDP, credit scores, limited liability, shareholder value, and corporations as persons? Why don't we open ourselves up to a new political vision? Asking these critical questions is crucial. The questions, however, cannot be addressed through immediate "solutions." We need to sit with them, pause, and reflect.

We need to center our work around the fact that if the planet fails, it is game over for us: *There is no plan(et) B*. The gravity of our current situation—an impending "biological annihilation" and a "frightening assault on human civilization" [4]—requires us to ask thought-provoking, thoroughgoing, and soul-stirring questions. Instead of avoiding conversations about the political economy, we should reflect on HCI's fundamentals, which are rooted in economic growth, and question them. Why is sustainability an add-on, an afterthought, or simply neglected in most HCI work? Why are CHI submissions that focus on critical and progressive accounts restricted to the critical computing, sustainability, and social justice subcommittees? Why cannot all subcommittees make such accounts fundamental to their call? We are approaching tipping points, after which there is no turning back—our questions should reflect this urgency. It is important that we do not act just because we need to "do something." We have to take careful and calculated steps to head in the right direction. Post-growth provides a path.

Critical action. HCI has always provided a space for radical, subversive thinking where change *can* happen. It offers a space where scholars from diverse disciplines—sociology, anthropology, engineering, computing, policy, and many more—can come together to discuss alternative possibilities. HCI scholars Christine Wolf, Mariam Asad, and Lynn Dombrowski [5] call for "designing within capitalism," saying that "we can, through our projects and design praxis, wrestle with and struggle against the institutions that we ourselves live and work under, at the same time we try to create alternatives that are more equitable and make possible anti-capitalist futures." We can think about mediating socioeconomic innovations beyond capitalist logic to restore Earth with a better life for all, human and more than human. We can work toward transforming the computing discipline, rippling outward to the larger academic community. Considering that digital technologies underlie the infrastructure of our global society, HCI can work to enable real-world social change and postcapitalist futures.

Many HCI researchers have initiated such critical conversations. They have, however, encountered challenges. Nardi [6] shared: "When I talk to people about ecological and social devastation, they often say they feel overwhelmed to the point of paralysis. Sustainability is 'too hard,' in the words of one of my colleagues. Because the issues are overwhelming, we often approach them with dread, denial, or resignation. We give up and give in to soothing but preposterous stories (e.g., coming technological miracles)." We, in HCI, can build a community to support one another, stand in solidarity, and continue to ask critical questions. We can use questioning as a constructive process to instigate critical reflection and action to take the community forward. Increasingly, HCI work is centered on care: for the self, one another, and the planet. HCI professionals can join efforts for the cause of planetary care subsuming humans, computers, and the natural ecosystem.

Shifting a paradigm—in our case, that of economic growth—will be a laborious process. Introducing a new way of thinking that challenges long-held beliefs requires significant effort and time. But there is hope: A growing HCI community dedicated to cultivating postcapitalist ideas offers a fertile ground for raising HCI's collective critical consciousness toward post-growth. We encourage those with creative ideas and analyses across the Global North and South to reach out to us and join the growing Post-growth HCI Collective. We need to work together, as sustainability predicaments are, after all, global. We can support one another in challenging unjust and unsustainable narratives in HCI. We need to remember that we are not just passengers. Rather, we are a crew on a collective journey; it is our shared responsibility to nurture better futures in and through HCI. A better HCI is possible; it is *necessary*. Let's join forces to translate post-growth ideals into tangible design solutions that benefit all. We can make this happen.

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Vishal Sharma is a human-centered computing Ph.D. candidate in the School of Interactive Computing at the Georgia Institute of Technology. His research focuses on the responsible—ethical, sustainable, and human-centered—design of computing technologies to nurture socioecologically just futures for all.
→ visharma@gatech.edu

Bonnie Nardi is a professor emeritus in the Department of Informatics at the University of California, Irvine. Her research investigates digital technology's role in transitioning to sustainable environmental and socioeconomic practices.
→ nardi@ics.uci.edu

Neha Kumar is an associate professor at the Georgia Institute of Technology. Her research lies at the intersection of human-centered computing and sustainable development, focusing on values of care, solidarity, and postdevelopment, among others.
→ neha.kumar@gatech.edu

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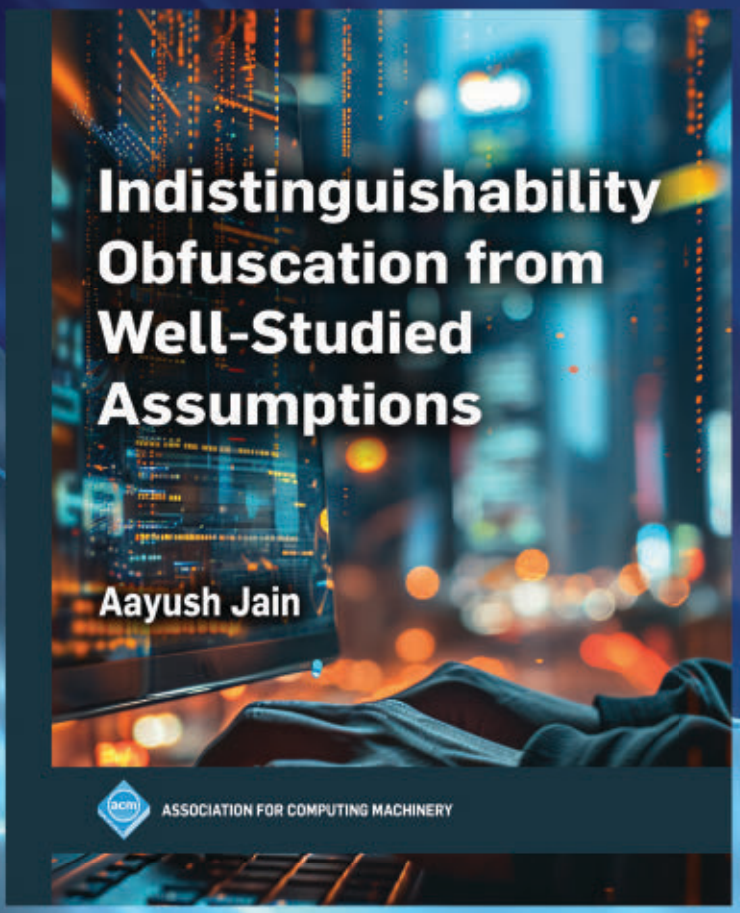

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Indistinguishability Obfuscation from Well-Studied Assumptions

By Aayush Jain

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Software obfuscation is used in cryptography to transform source code to make it unintelligible without altering what it computes. As a software security mechanism, it is essential that software obfuscation has a firm mathematical foundation.

The research described in this book, for which the author won the ACM Dissertation Award, establishes the feasibility of mathematically rigorous software obfuscation from well-studied hardness conjectures.The mathematical object that the author constructs, indistinguishability obfuscation, is considered a theoretical “master tool” in the context of cryptography: not only in helping to achieve long-desired cryptographic goals such as functional encryption, but also in expanding the scope of the field of cryptography itself. For example, indistinguishability obfuscation aids in goals related to software security that were previously entirely in the domain of software engineering.

http://books.acm.org

In this forum we explore different perspectives for how to apply intersectionality as a critical framework for design across multiple contexts. — **Yolanda A. Rankin and Jakita O. Thomas, Editors**

My Only Weapon Is My Pen:

Black Women Speaking Truth to Power

Jakita O. Thomas, Auburn University, **Yolanda A. Rankin,** Emory University

In this issue, we focus on the U.S., relying on our lived experiences as Black feminist scholars in HCI. While engaging in a political discussion may be perceived as being outside the scope of HCI, the actions of the current administration have unforeseen consequences that affect the HCI community and the work we do. For example, as Black women scholars, we apply *intersectionality* as a critical framework in our research and a tool for resistance. Intersectionality is a critical social theory that examines how overlapping social constructs, such as race, gender, class, sexuality, nationality, ableism, and religion, become converging systems of power that oppress nondominant populations living at these intersections [1]. As of this moment, our research has been classified as a diversity, equity, and inclusion (DEI) activity and will no longer be supported by federal grants due to executive orders that have banned such activities and initiatives across the nation with threats of prosecution. The two of us have a choice to make: Do we continue to do this work that draws attention to an understudied and underserved population in the field of HCI, one that has been marginalized for years in the HCI community? Do we tuck our tails and run, abandoning the very community that we vowed to serve? Do we censor or silence ourselves out of fear, no longer engaging Black women as equal partners in our work, and stop disseminating the results of our research? Do Black women simply fade back into silence and nonexistence? To be a critically conscious Black woman in this country is to be political. We do not get to sit this one out.

In full transparency, when this article was reviewed, we were asked how it was specifically relevant to HCI. We wrote this article so that the HCI community continues to strive to be a safe space for all people, including those who exercise their agency and epistemic power to forge new directions in HCI and challenge the status quo. We realize that what seems obvious to us is not so obvious to others. This piece is about telling a different narrative than the one offered by mainstream media or press conferences. Patricia Hill Collins posits, "What sense does it make for a group that is oppressed by intersecting identity categories of race and gender to refuse to organize its political responses using the very categories that oppress it?" [1]. She argues that identity politics provides a democratic space for political analysis that invites critical examination of power dynamics along social constructs often taken for granted by dominant groups. Scholars who apply intersectionality as a critical theory have consistently argued that identity politics is at play for everyone, including dominant groups who do not explicitly call out their race, gender, class, or nationality. The notion of objectivity in HCI research (and scientific research, more broadly) is false. The point of intersectionality in HCI research is that the methodologies rooted in nondominant groups' knowledge validation processes, experiences, and culture are valid methodologies that stand on their own.

This brings us to the current state of affairs. We see democracy under attack, a country on fire, and subordinated populations, such as women, immigrants, Indigenous people, Black and Brown people, people with disabilities, the elderly, being dehumanized yet again. From a historical perspective, this is nothing new, as we have seen similar behavior during the Jim Crow era when Black people were terrorized, murdered, and lynched, had our land taken from us, and were denied civil rights in America. This is not the first time we have criticized the HCI community [2]. However, this is a call to arms as academic freedom is also at stake. The work we do is a matter of life and death, not just for us but for the communities that we build, reside in, and serve. We share an excerpt of our conversation below, providing insights into why some Black women scholars are sounding the alarm concerning the dire straits of a federal government that openly embraces white supremacy, patriarchy, racism, classism, homophobia, and xenophobia in the context of "making America great again." We cannot sit quietly

Insights

- → The anti-DEI movement has devalued ways of knowing that center nondominant populations.
- → Scholars have worked hard to democratize the field of HCI so that we design with marginalized populations rather than for them.
- → This is a call to arms for the HCI community to protect scholars' academic freedom.

and do nothing. Instead, this forum is a conscious decision to exercise our agency, privilege, and power while using our platform to speak truth to power.

Yolanda A. Rankin: In *Black Feminist Thought*, Patricia Hill Collins writes, "Two political criteria influence knowledge validation processes. First, knowledge claims are evaluated by a group of experts whose members bring with them a host of sedimented experiences that reflect their group location in intersecting oppressions" [3]. Black feminist thought connects Eurocentric knowledge validation processes—those that uplift European and white culture and viewpoints as superior to others—to power structures that oppress nondominant populations. For example, we find ourselves dealing with the politicization of what is called the anti-DEI movement, led by the current administration. White supremacy is front and center as those who uphold whiteness dismiss the need for DEI, arguing that it represents reverse discrimination against white people, who are still the majority in the U.S. and control the institutions and agencies that define policy and law that affect all Americans. In tech, white men are the CEOs who define the culture, make the rules, and determine who has a seat at the table. In the academy, white heterosexual men have largely been the majority and have created and enforced the rules as to what constitutes a valid knowledge claim. White people, as the dominant population, do not share the same reference point as racialized groups in this country [4]. White people have not been denied the right to vote, housing, access to education, or decent healthcare. White people have not been gunned down in front of their families just because they dared to stand up for the humanity of Black people (e.g., Medgar Evers). They were not asked to guess the number of jelly beans in a jar to qualify to vote, nor have they had their businesses or homes firebombed because of a false accusation of raping a white woman (e.g., the Tulsa Race Massacre).

People want to talk about what is fair. Yet nothing has ever been fair for Black people in this country. America is a country that was built on white supremacy through the hands of enslaved Black people. Look at the current administration's attempt to blame every bad thing on DEI, telling the false narrative that DEI stands for promoting unqualified people. Some Black people also criticize DEI as being an ineffective failure, but that is not unexpected given that the community is not a monolith. However, it is vital to know the history and the facts. We find ourselves at a crossroads where any work or person that blatantly calls out racism, sexism, classism, nationalism, ableism, and xenophobia could be labeled unpatriotic, un-American, and now, potentially criminal [5]. This is the work of white supremacy.

IMAGE BY RIDO / SHUTTERSTOCK.COM

Now think about the tech industry and how companies such as Meta, Amazon, and others have walked back their DEI initiatives and policies [6]. DEI has become anathema and is considered to be illegal, given the president's recent executive orders. The pushback to DEI initiatives in the workplace makes it easier to overlook the repercussions of deploying technologies that "fail to see Blackness, while others render Black people hypervisible," exposing them to racial surveillance [7]. In HCI, we are constantly grappling with questions like *Who gets to design technology? For whom is technology designed or accessible? Who has a seat at the table and why are they there in the first place?* We, as a diverse community of scholars who come from academia and the private sector, must continue to wrestle with the implications of who has agency, who is empowered, and who is disenfranchised in the tech sector. Yet we see a government actively seeking to disenfranchise women, Black and Brown people, and other marginalized populations while tech companies renounce their DEI initiatives. The goal is to undo any gains in addressing social inequalities that have been made in the past four years. These are serious implications for the field of HCI.

Jakita O. Thomas: There are a couple of things that come to the fore in this present moment. One of the things

I find very intriguing about the reaction of the people to what is currently happening with this entire so-called anti-DEI or anti-woke movement is that many people who identified DEI as a synonym for Black are now discovering that they, too, are in fact a part of the legislation that was created under the DEI umbrella. Black people have pushed the country since the end of the Civil War, through the civil rights and larger human rights movements, to create an infrastructure of policies and legislation that protects all citizens. The majority of people, because of the way that this infrastructure had been talked about culturally, assumed it meant Black people. And so now they are, as the young people would say, "crashing out," because they are discovering that the work Black people did and continue to do has actually benefited many other groups, including white people [8]. The other groups who benefited include those you mentioned—women, the differently abled, and other minorities. There are so many people who fall under the DEI umbrella who did not understand the political moment that we were and currently are in. Consequently, they voted against their best interests, their own security, their own support systems and infrastructures. That's one thing.

The second thing is that we have to understand historically what is happening. When you look at some of the things that are getting called into question by this current administration, it goes all the way back to the 14th Amendment and birthright citizenship. During a recent panel conversation that took place in New Orleans, Kimberlé Crenshaw said they are "coming for the infrastructure." She was referring to the *Brown v. Board of Education* decision and the strides that were made in the 1950s, the Civil Rights Movement, and other movements. Political and economic changes that benefited Black people were made during Reconstruction and subsequently rolled back during the era of Jim Crow. I think we have to look not only at current events and the dismantling of the infrastructure but also at the history. What are they dismantling, and why are they dismantling it? This is not arbitrary. This effort aims to undo the work that has been done by Black people and other historically marginalized people to make this country live up to the ideals and creeds that are set forth in the Constitution, the Bill of Rights, and other documents, which were written without us in mind.

YR: This attempt to rewrite history is another attempt to misrepresent Black people. If we are going to talk about Black or African American history, which is America's history, then we have to talk about the history of our people being enslaved. This notion that we were happy slaves or immigrants who learned necessary skills to survive is absolutely ridiculous. If you don't know your history, then you will simply dismiss what is playing out right in front of us as an attempt to responsibly manage the government budget and reduce the country's debt. Project 2025 is being executed [9]. Dismantling DEI is the first priority, because Black people must not have the same human rights, opportunities, or power in any form. To talk about the history of how Black people were brought to this country in chains and treated horribly—that truth is dividing the nation? In reality, it is about being honest about what happened. It requires atonement, and that is not what the people in power want to even think about, consider, or deem necessary. It's why the conversation around reparations has been one muted by white people with the idea that "we don't owe you anything." Those were our ancestors. Racism and even enslavement have continued in this country in different guises (e.g., the school-to-prison pipeline).

JT: As you were talking, it made me think about a couple of things. First, out of all the places in the world that the Portuguese, the Spanish, the Dutch, and the British could have gone to, why did they go to West Africa? This speaks to the point you were making earlier about the false narrative of Black people developing skills to survive and have better lives. But the reality is that, by enslaving people, the Europeans gained a free labor force. They already knew that people from West Africa had the skill sets they needed to survive in the New World. They already knew that we were experts in cultivating rice. They already knew that we understood sustainable agricultural practices. They already knew that we were blacksmiths and artisans and had the skills that were going to be required to build an economy. Again, history is a crucial factor in understanding what African people were doing and building. We had dynasties and empires prior to the Europeans coming to Africa. We were chosen *because* of the knowledge and skills we already had. Collins talks about this as cultural or hegemonic power—there was an entirely false narrative that was told about African people to explain why we had to be taken. And it was this notion that we were savages. We didn't have a better life where we were. We had to be brought over here to get a better life. We were not able to take care of ourselves and sustain ourselves, so we needed these European masters, colonizers, and oppressors to help us take care of ourselves. Not even acknowledging that some of the first empires that existed on Earth, such as Ghana, Mali, and Songhai, were in Africa. Mansa Musa went around Africa handing out bars of gold and almost disrupted the global economy because he was so wealthy.

Then there is this trope of the happy Negro. For example, in Florida, they are trying to push a narrative that we were happy as enslaved people [10]. We were immigrants. We learned skills. That's actually a reemergence of a very old trope—the singing, whistling, dancing minstrel Negro, or even the magical Negro who is always subservient and in service to whiteness, even if it requires the giving up of one's own life—that came up during slavery, Reconstruction, and Jim Crow. So again, these cultural narratives are repurposing themselves in this modern time. The only way for us to get past it is precisely what you said: It is through atonement. It is not enough to acknowledge that atonement has to happen, because even today

We wrote this article so that the HCI community continues to strive to be a safe space for all people.

some groups are benefiting and some are experiencing harm because of that infrastructure of white supremacy that was built into the founding of the country. Now they're trying to tear down any infrastructure that was built to provide equity. History is repeating itself. Those who do not know their history are doomed to repeat it. We're either going to learn the lessons this time and move in a different direction, or we won't.

I actually see this time as a time of opportunity, because now there are more people who understand that the infrastructure Black people and others fought so hard to build benefited not just Black people but many other groups. The structural and hegemonic domains of power want to dismantle the things that are helping Black people, women, immigrants, children, the elderly, and any vulnerable or marginalized community. We are now in a place where there's a huge opportunity for us to really come together and think strategically about what kind of society, especially here in the U.S., we really want to have. Now we're at a place where we can actually build an infrastructure that benefits everyone. Fred Hampton used to say, "All power to the people." That's real. We really do have the power. The question is: Are we going to step into this moment and wield it?

YR: This is indeed the question that we pose to the HCI community. For those of us who have power and privilege in the HCI community, what are we willing to do? When we think about the user studies we conduct, the technologies that we design, the systems that we build, and the decisions to work with historically excluded populations as knowledge agents and equal partners, our actions become acts of resistance. Thank you, Jakita, for challenging us to take up our weapons and fight.

The views expressed by the authors are their own and not necessarily held by Interactions or the Association for Computing Machinery.

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Jakita O. Thomas is an associate professor of computer science and software engineering in the Ginn College of Engineering at Auburn University. She is also director of the CUltuRally and SOcially Relevant (CURSOR) Computing Lab. She is a recipient of the National Science Foundation CAREER Award and the Presidential Early Career Award for Scientists and Engineers.
→ jnt0020@auburn.edu

Yolanda A. Rankin is an associate professor in the Department of Computer Science at Emory University and director of the DEsigning TechnOlogies for the UndeRserved (DETOUR) Research Lab. She is a recipient of the National Science Foundation CAREER Award and an ACM senior member.
→ yrankin@emory.edu

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This forum showcases emerging approaches, new ideas, and promising pathways that draw attention to the diverse, interdisciplinary, and impactful work of global scholars to advance dialogue in the field on how we can best contribute to climate action. **— Robert Soden, Vishal Sharma, Matthew Louis Mauriello, and Nicola J. Bidwell, Editors**

Reworlding: Creating the Climate to Change Climate Change

Maurizio Teli, Aalborg University, **Liesbeth Huybrechts,** Hasselt University, **Ann Light,** University of Sussex

Reworlding is a European doctoral network funded by the Marie Skłodowska-Curie Actions. It is designed to challenge conventional interpretations of interaction design (IxD) research, supporting just and sustainable futures in a historical period defined by, and contributing to, climate change. Global warming is threatening many of the current life-forms inhabiting Earth and requires design practices to shift quickly to build networks for exchange, solidarity, inspiration, and collaboration. Composed of scholars who care about participatory design (PD), our Reworlding network aims to update the practice and offer what is needed for contemporary PD researchers to shift, strengthen, and redirect their collaborative efforts to responsibly inhabit a climate change–ridden world. We must consider together what that means for research practices. The network includes organizations in Belgium, Croatia, Denmark, Ireland, Italy, Sweden, and Switzerland, along with scholars in PD, architecture, the philosophy of technology, and sociology.

Reworlding is heavily inspired by the work of the late Bruno Latour. He pointed to the need to find new ways of relating to Earth when discussing ecology and how human activities like research are part of it. Following Latour, the proponents of Reworlding— including the three of us—stress the importance of being "down to earth" [1,2], that theory should follow empirical realities and not be imposed on them. Therefore, the Latourian premise of Reworlding pushes us, among other things, to question what we call "climate change."

We propose three ways of questioning the expression "climate change": the relationship between IxD and the causes of climate change, IxD's contribution in dealing with the consequences of climate change, and how IxD practices change when we take into account the causes and consequences of climate change.

• The first item points directly to research in IxD on sustainable practices supported by computing and on the reduced ecological impacts of hardware and software [1]. The focus is on computer-related human actions that contribute to the ecological processes changing the climate.

• The second item refers to research addressing the consequences of changes in climate. These include more frequent natural disasters, migration driven by reduced economic opportunities, armed conflict, and negative impact on the more-than-human elements (e.g., water, food, minerals).

• The third way of questioning starts with the acknowledgment that the climate has already changed and is changing life on Earth as a result of human actions (and, consequently, IxD research is also changing). When any research deals with a changed climate that affects life conditions, there is a need to conceptualize and investigate the set of situated relations between the changes that have already happened and those happening at the moment. Therefore, we suggest not only thinking about *climate* as referring to the meteorological conditions but also thinking about how it is used and understood in the expression "creating a climate." This would be to consider *climate* as a set of eco-social relations [3] that favors certain actions rather than others, leading us to rethink what it is to be human and how we share our substance with other living beings.

Questioning the expression "climate change" opens up a new set of questions for the IxD community, such as *What kind of actions are favored by the eco-social climate in relation to the technologies we research and design? Can IxD research support the transformation from climate-changing practices to creating a climate promoting eco-social justice while decreasing the role of humans in global warming?* Refined and alternative research methods and practices are needed to answer the latter question, which we explore in Reworlding through four capabilities (Figure 1) that PD and IxD researchers should develop to actually get "down to

Insights

- We refer to "climate" as a set of eco-social relations, and research as a means to favor a climate that decreases the role of humans in global warming.
- The Reworlding doctoral network focuses on deepening, shifting, and creating methods and practices for more-than-human participation by attending to four capabilities: retracing, reconnecting, reimagining, and reinstitutioning.

earth" [2] and to create the climate to change climate change.

Retracing focuses on situated research, emphasizing the importance of tracing eco-social challenges through direct and caring engagements with case studies. This approach aims to rethink and advance traditional methods of observation and data collection, adapting them to eco-social issues to support a more careful, situated, and pluralistic engagement. The goal is to surface knowledge about human and more-than-human practices of care for eco-social challenges. To do so, members of the network trace and map the practices, strategies, and capabilities used by different actors to address eco-social challenges, with the goal of articulating marginalized perspectives and Reworlding ambitions.

The doctoral researchers following this theme in the network focus on four different empirical domains through which retracing capabilities can be strengthened: neurodiversity inclusion strategies, social housing transitions, platform cooperative models, and precarious self-employment. For example, by engaging with international residents in Aalborg, Denmark, to investigate the possibility for a platform cooperative that provides food, one doctoral researcher found herself working in agriculture, job services, and immigration law, observing daily practices and cultural differences in these domains.

Reconnecting aims to develop capabilities that bring diverse actors together and make their design concerns matters of public discussion while fostering solidarity with marginalized world experiences. It focuses on how design capabilities can support connecting actors and building alliances over shared concerns to act upon eco-social urgencies. The core idea is to bridge the gaps between different sectors, disciplines, and actors, enabling them to reframe their ideas and practices of eco-social transformation. This involves understanding diverse perspectives and facilitating negotiations to achieve common goals.

To do so, practical and conceptual tools can help us grasp the diverse possible understandings of eco-social transformation: The researchers will create translation objects to help connect actors around transformation goals [4]. Three doctoral projects are related to reconnecting; their focus is on urban social renewal, urban cultural heritage, and sustainable work platforms. For instance, one student working with Malmö University and in Italy researches cocreated festivals that have an eco-social theme, looking to what extent their focus and rhythms (i.e., their transience and recurrence) work to change people's engagement with environmental and social issues around them. The festivals and the futures they work toward are instances of micro- and macro-reworlding.

The Reworlding network is designed to challenge conventional interpretations of interaction design research.

Reimagining critically examines how the material environment has been designed in ways that foster unsustainable practices and exclude less powerful human and more-than-human actors. The capability seeks to redefine design as world-making, helping us rethink past models and propose alternatives where different—multiple and pluralist—worlds can fit. The focus is on creating novel spatial and organizational conditions to share knowledge and foster solidarity. Empirically, the doctoral researchers are working on reimagining regenerative urban practices, community-driven transformations of the built environment, the repurposing of industrial sites, and spaces of collective learning. These projects, such as the two focusing on socially just neighborhood energy transitions, will analyze and interpret learning and imaginative practices, resulting in workshops, tools, and prototypes (e.g., public installations) for different contexts.

Finally, all researchers in the *Reworlding* network are engaging with the "reinstitutioning" capability. *Reinstitutioning* aims to ensure that the outcomes of the research are not just academic but also contribute to transforming eco-social relations beyond academia. This capability focuses on building and reshaping institutions and their connections,

WP2 RETRACING	WP3 RECONNECTING	WP4 REIMAGINING	WP5 REINSTITUTIONING (transversal)
Key research methods: careful observation, more-than-human PAR, cartography, and multi-stakeholder roles analysis.	*Key research methods*: design workshops, translation objects, and more-than-human PD.	*Key research methods*: boundary objects, collective imagining, and prototyping.	*Key research methods*: infrastructuring, commoning, public and open science.
Tasks: Trace challenges, practices, and perspectives in the contexts of inclusivity, work, and social housing.	*Tasks*: Identify and redefine design capabilities in the context of transformation initiatives, work cooperatives, and heritage.	*Tasks*: Cocreate reworlding tools and environments in the contexts of spatial design, urban regeneration, and landscape futures.	*Tasks*: Identifying and delineating strategies and tools for institutioning project findings across cross-sectoral networks, institutions, and EU mission programs.

Figure 1. The four Reworlding capabilities in connection with the key methods adopted.

noting how they connect different social and ecological worlds and what beneficial changes might be possible. This reveals how design capabilities can tackle eco-social challenges at strategic and institutional levels [5], and it includes explorations on how to integrate project-specific outputs into long-term networks and programs for eco-social transition. The goal is to integrate IxD and PD research into long-term networks, institutions, and programs, leading to practical and lasting eco-social outcomes. This involves both building new institutions and engaging with existing ones, thereby creating new arenas for collective action—from privileging the cooperative organization of economic activities to urban social renewal oriented toward different water policies and practices codeveloped by policy, design, and farmer communities.

The activities connected to reinstitutioning are the following: translating different capabilities into frameworks and policies across different scales, organizing webinars and establishing online training modules, and continually engaging with the programs that leave space for eco-social sensibilities in the European context, such as the EU's Green Deal and the New European Bauhaus. In describing these ambitions, we not only describe activities for our students and our research but also lay out a different approach to thinking about sustainable futures. This approach does not look to preserve what we have: a largely livable physical climate but with rampant social and environmental injustice. Instead it imagines something better: a cultural climate of progressive change, hope, and care that may be the only route to a physical climate within which all life can flourish. To this end, we identify questions for ourselves and anyone else similarly motivated:

- Can IxD research support the transformation from climate-changing practices to creating a climate promoting eco-social justice while decreasing the role of humans in global warming?
- How can the technologies we research and design support, enhance, and lead to the creation of this climate?

The Reworlding network is engaging with both questions—one as a premise, one as an object of investigation. Reworlding assumes that, unfortunately, most research in computing is embedded in an eco-social climate that pushes toward actions and social configurations that are mostly unsustainable and fuel global warming. Therefore, Reworlding engages with "creating a climate" as a necessity, as something needed in research and beyond to face the contradictions and negative trajectories of current eco-social configurations. As a network, we think that the role of technology in creating this climate can come from the deepening of the four Reworlding capabilities discussed here. These capabilities are not proposed as final answers but rather contributions to the much-needed collective conversation this forum aims to advance.

To open the discussion on what creating this climate can mean for the IxD community, we share a few questions that readers of this forum can ask themselves. First, what type of "climate" is your research part of and (re)creating today? Is it engaging with the processes and the actors changing the climate, the consequences of a changing climate for humans and more-than-human entities, or the transformation of IxD research in the face of climate change? Next, what are the situated empirical domains from which your IxD research can learn the most, and how can those empirical domains be approached to be better understood? How can IxD research contribute to the construction of the capabilities necessary to create a climate for eco-social justice? Lastly, how can we turn research results into long-lasting outcomes that exist beyond the academic domain?

Reworlding engages with "creating a climate" as a necessity, as something needed in research and beyond.

ACKNOWLEDGMENTS

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Maurizio Teli is an associate professor in the Techno-Anthropology and Participation research group at Aalborg University in Denmark. His participatory design work focuses on the political dimensions of computing. His interests include design practices aimed at promoting eco-social justice, with a particular attention to the organization of social cooperation in a sustainable way.
→ maurizio@plan.aau.dk

Liesbeth Huybrechts is a professor with the ArcK research group at Hasselt University in Belgium. Her work focuses on participatory design, design anthropology, and environmental transformation processes, with research interests that include designing for/with participatory exchanges and capacity-building processes between humans and the material/natural environment.
→ liesbeth.huybrechts@uhasselt.be

Ann Light is an interaction theorist and professor of design at the University of Sussex in the U.K. and at Malmö University in Sweden. She specializes in participatory practice, human-technology relations, and collaborative future-making. Her U.K.-based fellowship examines the role of immersive participatory techniques in eco-social change.
→ ann.light@sussex.ac.uk

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This section of the magazine features SIGCHI Chapters volunteers who are having an impact on the ground for HCI globally. — **Jeni Paay and Elizabeth F. Churchill, Editors**

Regan Mandryk

What are you working on right now?

I'm a professor of computer science at the University of Victoria in British Columbia and a Canada Research Chair in Digital Gaming and Immersive Social Technologies. My focus is mainly on designing, developing, and evaluating digital games that provide social and emotional benefits to players, as well as on developing models and systems to combat the types of things that undermine those benefits, such as toxicity and obsessive play.

What inspired you to forge a career in HCI?

I have an interdisciplinary background. My bachelor's degree is in mathematics and physics, my master's is in kinesiology, and my Ph.D. is in computer science. I'm very much a person who enjoys computational, statistical, and technical work, but I always wanted to apply these skills to benefit humanity. If we are not asking for technology innovation to benefit people or the planet, why are we even considering it? Humans are complex, and there are many unique challenges in working at the intersection of technology and people that can fuel a lifelong career.

Have you had any pivots in your career?

Although it seems that I've pivoted multiple times, my work has actually been much more linear. In my Ph.D. work in the early 2000s, I built mathematical models of emotions, based on physiological sensors gathered from people interacting with computer games, which brought my skills in math, kinesiology, and computer science to the fore.

Which volunteering roles are you taking on right now?

I've been really involved with SIGCHI over the years, cobuilding a conference community from scratch—CHI PLAY—and holding most roles on that committee multiple times. I was the general cochair for the CHI conference in 2018, and I chaired the Steering Committee from 2019 to 2022. I have led several groups working on the format, finances, and review process for the conference, and I also served on the SIGCHI Executive Committee and other SIGCHI committees (e.g., publications, lifetime awards). I recently started a local SIGCHI chapter, the Salish Sea SIGCHI Chapter, that brings together researchers from the west coast of Canada.

How long have you been in this role?

I moved to the University of Victoria in May 2023 and immediately started looking at ways to contribute to building up our local HCI networks. Everyone seemed keen on forming a SIGCHI chapter.

What drew you to take on this role?

We have so many great professors in HCI in the region at multiple universities—the University of Victoria, Simon Fraser University, the University of British Columbia—who supervise amazing students and work with a thriving local tech industry. We are also in close proximity to the Puget Sound SIGCHI Chapter but operating in a different country and different context. I wanted to help build stronger ties and contribute to

If we are not asking for technology innovation to benefit people or the planet, why are we even considering it?

regional community-building events, such as seminar series, summer schools, pre-CHI events, and writing retreats. As we aim to reduce our travel, it is important to build strong regional communities. That's hard in a place like Canada with large geographical distances between cities and a lack of high-speed trains connecting them.

What are you working on right now?

We just created the chapter, so our goal for this year is to do one summer school writing event and a pre- or post-CHI event. Next year, we also hope to get our seminar series underway and conduct more student exchanges and hackathons.

What is one thing you'd like to see happening in the HCI community?

I would love for us to find ways to highlight important innovation and scientific discovery. The pace of publication in our field is intense, and it's hard to find the important contributions when so much work is being produced. I would also like us to be more proactive in designing the future rather than responding to what's out there.

Ten years from now, what issues do you imagine the HCI community may be confronting?

This is a challenging question, because there is so much flux and generative AI development at the moment. At the current scale of publication, HCI is in a peer review crisis. One of my roles is coleading a working group in which we are reimagining peer review for the CHI conference. If we don't intervene and accept current growth in scale, I can't imagine a manageable peer review system in three years, let alone 10.

What excites you about the future of the HCI field?

We are pretty unique in understanding humans, computers, and their interaction. We have wicked societal problems globally in health, education, well-being, climate change, democracy, and social connection, and HCI researchers have a unique set of skills to design innovative solutions that benefit people and the planet.

What advice would you give a young colleague at the start of their professional career?

I always like the idea of maintaining a high-risk and high-reward line of work that may or may not pay off, alongside a more bread-and-butter line of work. This allows researchers to ensure career progression, while also opening opportunities for true innovation and radical progress. I've had some of these blue-sky projects that succeeded and failed, but they helped me grow as a researcher and consider the potential impact of my work.

What is one thing you have gotten wrong about tech?

Democratization of access to technology has had a drastic knock-on effect, eroding the importance of expertise. I don't think I was prepared in the early days of the Internet for the future we live in today.

Is there a vision of the future that you had as a child that still persists?

We can be driven by values other than productivity. I have devoted my entire career to a domain that many would consider frivolous (digital gaming), but by trying to understand emotions, experiences, social connections, and well-being, I'm driven to innovate toward a future that isn't defined by how we are contributing to capitalism. This is a vision I have held for my whole life, and it only gets stronger with age.

Regan Mandryk is a professor of computer science at the University of Victoria. Her research explores the potential of digital games for social connection, emotion regulation, and mental health. She pioneered the area of affective physiological evaluation for computer games in her Ph.D. research from Simon Fraser University, with support from Electronic Arts.
→ regan@acm.org

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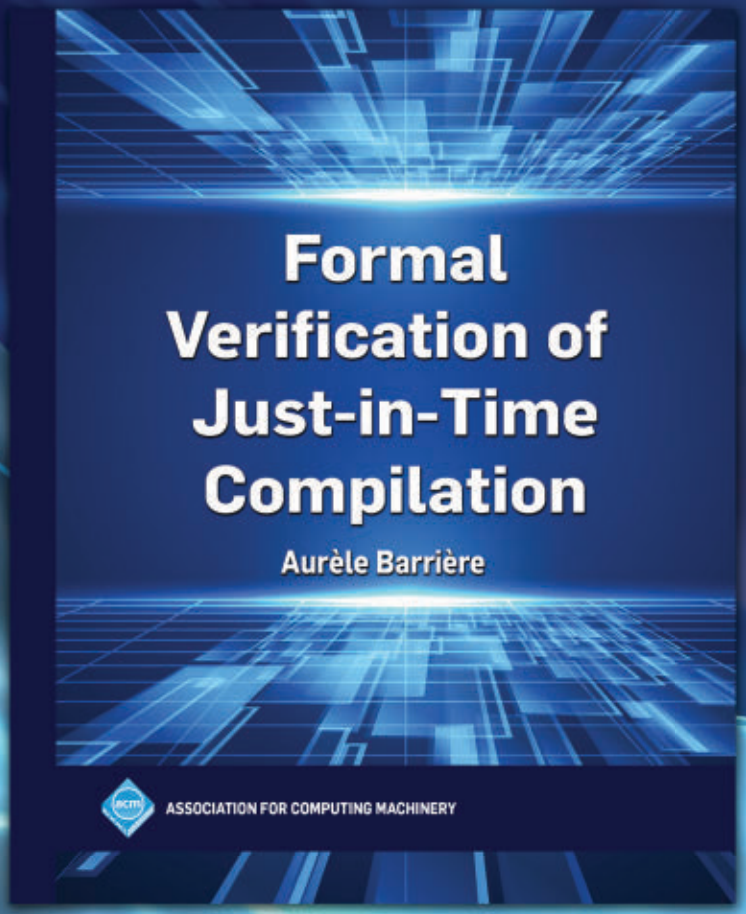

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Formal Verification of Just-in-Time Compilation

Aurèle Barrière

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DOI: 10.1145/3705593

This book outlines a methodology to develop formally verified Just-in-Time compilers. Just-in-Time compilation is a technique to execute programs, where execution is interleaved with optimizations of the program itself. These compilers often produce fast executions, so much so that their use has grown greatly for dynamic programming languages. Most modern web browsers today use Just-in-Time compilation to speed up the execution of the JavaScript programs they execute.

However, the techniques used in Just-in-Time compilers can be particularly complex. This complexity can be a source of bugs and vulnerabilities. How can you make sure that your Just-in-Time compiler is bug-free? For traditional ahead-of-time compilers, many techniques have been developed to prevent compilation bugs. One such technique is formally verified compilation, where the compiler itself comes with proof that the semantics of the compiled program correspond to the semantics of the source program. But Just-in-Time compilers are more recent, less understood, and have been the target of far fewer verification efforts. To bring formal verification to Just-in-Time compilation, the book identifies a set of specific verification challenges and presents novel solutions for each of them. Such challenges include dynamic optimizations, speculative optimizations, deoptimizations, and the interleaving of interpretation and machine code generation. The author repurposes proof techniques from formally verified ahead-of-time compilers like CompCert. Following this methodology, readers can develop Just-in-Time compilers and formally prove that they behave as prescribed by the semantics of the program they execute. All proofs within the book have been mechanized in the Coq proof assistant.

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May – August 2025

May

EKSIG '25: Data as Experiential Knowledge and Embodied Processes (Budapest, Hungary)
May 12–13, 2025
→ https://eksig2025.mome.hu/

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May 28–30, 2025
→ https://sigmis.org/cpr/

June

IMX '25: ACM International Conference on Interactive Media Experiences (Rio de Janeiro, Brazil)
June 3–6, 2025
→ https://imx.acm.org/2025/

UMAP '25: 33rd ACM International Conference on User Modeling, Adaptation and Personalization (New York, USA)
June 16–19, 2025
→ https://www.um.org/umap2025/

IDC '25: 24th ACM Interaction Design and Children Conference (Reykjavík, Iceland)
June 23–26, 2025
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C&C '25: ACM Creativity and Cognition Conference (Online)
June 23–25, 2025
→ https://cc.acm.org/2025/

EICS '25: 17th ACM SIGCHI Symposium on Engineering Interactive Computing Systems (Trier, Germany)
June 24–28, 2025
→ https://eics.acm.org/2025/

July

DIS '25: ACM Designing Interactive Systems Conference (Funchal, Madeira)
July 5–9, 2025
→ https://dis.acm.org/2025/

COMPASS '25 (Toronto, Canada)
July 22–25, 2025
→ https://compass.acm.org/

August

CI '25: ACM Collective Intelligence (La Jolla, CA, USA)
Aug 4–6, 2025
→ https://ci.acm.org/2025

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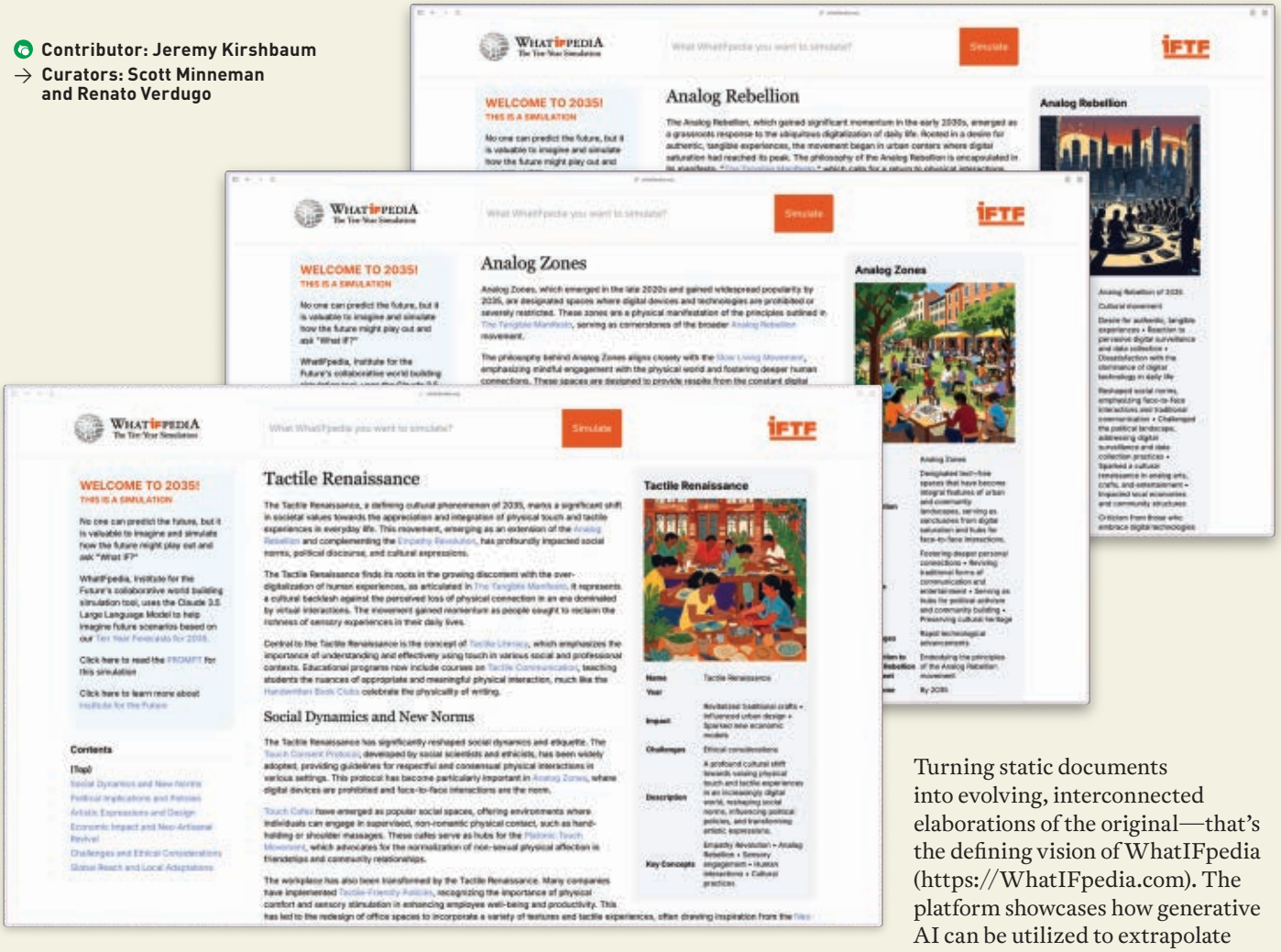
EXIT

AI Hallucinations—Bug or Superpower?

Contributor: Jeremy Kirshbaum
→ Curators: Scott Minneman and Renato Verdugo



Turning static documents into evolving, interconnected elaborations of the original—that's the defining vision of WhatIFpedia (https://WhatIFpedia.com). The platform showcases how generative AI can be utilized to extrapolate from provided content and take it in directions that readers express interest in, while remaining loyal to the original content's topics and tone (not unlike fan fiction). Specifically, WhatIFpedia generates foresight provocations for the year 2035 in the form of real-looking Wikipedia pages, complete with convincing forecast descriptions, genre-appropriate headings, and working links to additional content. Powered by Anthropic's Claude 3.5 and utilizing proprietary mechanisms to feed just the right amount of existing content into subsequent results, the platform produces novel but consistent visions of 2035 that are mixed with a concise forecast from the skilled forecasting team at the Institute for the Future. Using the familiar online encyclopedia format, WhatIFpedia morphs the current single-user large language model consumption pattern into a collaborative experience, with an ever-growing body of intriguing, fun, and sometimes silly forecasts. The WhatIFpedia simulation database had already swollen to more than 1,300 entries when this column was written, but the results still felt fresh and didn't reek of AI. This project is just the beginning of utilizing AI's tendency to "hallucinate" as a creative feature, extending static document corpora in new directions.

This project was produced by Oakland, California–based Handshake, contracted by the Institute for the Future (IFTF), and inspired by Sawyer Hood's Wonkypedia. The core text that seeds WhatIFpedia content encapsulates IFTF's recent Ten-Year Forecast research. The project team recognized and demonstrated a new way to utilize generative AI: not to answer queries for individuals but to collectively imagine and develop new possibilities. **Jeremy Kirshbaum**, founder and CEO of Handshake, has worked as both a research director and an affiliate researcher at IFTF (where he and Scott first met). Find out more about Handshake's work at https://handshake.fyi.

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